DEPARTMENT OF COMMERCE

National Oceanic and Atmospheric Administration

50 CFR Part 216

[Docket No. 0808061069–81171–01]

RIN 0648–AW91

Taking and Importing Marine Mammals; U.S. Navy Training in the Southern California Range Complex

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

ACTION: Proposed rule; request for comments.

SUMMARY: NMFS has received a request from the U.S. Navy (Navy) for authorization to take marine mammals incidental to training activities conducted in the Southern California Range Complex (SOCAL), which extends south and southwest off the southern California coast, for the period of January 2009 through January 2014. Pursuant to the Marine Mammal Protection Act (MMPA), NMFS is proposing regulations to govern that take and requesting information, suggestions, and comments on these proposed regulations.

DATES: Comments and information must be received no later than November 13, 2008.

ADDRESSES: You may submit comments, identified by 0648–AW91, by any one 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 Michael Payne, Chief, Permits, Conservation and Education 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. Attachments to electronic comments will be accepted in Microsoft Word, Excel, WordPerfect, or Adobe PDF file formats only.

FOR FURTHER INFORMATION CONTACT: Jolie Harrison, Office of Protected Resources, NMFS, (301) 713–2289, ext. 166.

SUPPLEMENTARY INFORMATION:

Availability

A copy of the Navy's application may be obtained by writing to the address specified above (see **ADDRESSES**), telephoning the contact listed above (see **FOR FURTHER INFORMATION CONTACT**), or visiting the internet at: *http://www.nmfs.noaa.gov/pr/permits/incidental.htm*. The Navy's Draft Environmental Impact Statement (DEIS) for SOCAL was published on April 4, 2008, and may be viewed at *http://www.nmfs.noaa.gov/pr/permits/incidental.htm.* NMFS is participating in the development of the Navy's EIS as a cooperating agency under NEPA.

Background

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

Authorization 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, and if the permissible methods of taking and requirements pertaining to the mitigation, monitoring and reporting of such taking 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) modified the MMPA by removing the ''small numbers'' and ''specified geographical region'' limitations and amended the definition of ''harassment'' as it applies to a ''military readiness activity'' to read as follows (Section 3(18)(B) of the MMPA):

> (i) any act that injures or has the significant potential to injure a marine mammal or marine mammal stock in the wild [Level A Harassment]; or
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> (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 1, 2008, NMFS received an application from the Navy requesting authorization for the take of individuals of 37 species of marine mammals incidental to upcoming Navy training activities, maintenance, and research, development, testing, and evaluation (RDT&E) activities to be conducted within SOCAL, which extends southwest approximately 600 nm in the general shape of a 200-nm wide rectangle (see the Navy's application), over the course of 5 years. These training activities are military readiness activities under the provisions of the NDAA. The Navy states, and NMFS concurs, that these military readiness activities may incidentally take marine mammals present within SOCAL by exposing them to sound from mid-frequency or high frequency active sonar (MFAS/HFAS) or underwater detonations. The Navy requests authorization to take individuals of 37 species of marine mammals by Level B Harassment. Further, though they do not anticipate it to occur, the Navy requests authorization to take, by injury or mortality, up to 10 beaked whales over the course of the 5-yr regulations.

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. Title 10, U.S. Code (U.S.C.) 5062 directs the Chief of Naval Operations to train all naval 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 weapons systems.

The Navy proposes to implement actions within the SOCAL Range Complex to:

- Increase training and RDT&E operations from current levels as necessary to support the Navy-wide training plan, known as the Fleet Readiness Training Plan (FRTP);

• Accommodate mission requirements associated with force structure changes and introduction of new weapons and systems to the Fleet; and

• Implement enhanced range complex capabilities.

The Proposed Action would result in selectively focused but critical increases in training, and range enhancements (including the establishment and use of a shallow-water minefield and construction of a shallow-water training range) to address testing and training resource shortfalls, as necessary to ensure the SOCAL Range Complex supports Navy and Marine Corps training and readiness objectives. The proposed action would result in approximately a 12-percent increase in the amount of MFAS/HFAS currently used.

Overview of SOCAL Range Complex

The U.S. Navy has been training and operating in the area now defined as the SOCAL Range Complex for over 70 years. The SOCAL Range Complex has three primary components: Ocean Operating Areas (SOCAL OPAREAs), Special Use Airspace (SUA), and San Clemente Island (SCI). The Range Complex is situated between Dana Point and San Diego, and extends more than 600 nautical miles (nm) (1,111 kilometers (km)) southwest into the Pacific Ocean (See the Navy's application). The components of the SOCAL Range Complex encompass 120,000 square nm (nm^2) (411,600 square km (km^2)) of sea space, 113,000 nm^2 (387,500 km^2) of SUA, and over 42 nm^2 (144 km^2) of land (SCI). To facilitate range management and scheduling, the SOCAL Range Complex is divided into numerous sub-component ranges and training areas, which are described below.

SOCAL OPAREAS

The ocean areas of the SOCAL Range Complex include surface and subsurface OPAREAs extending generally southwest from the coastline of southern California between Dana Point and San Diego for approximately 600 nm into international waters to the west of Baja California, Mexico. Most of the SOCAL OPAREAS are located under the Warning Area 291 Airspace mentioned below. Several SOCAL OPAREAs do not lie under W–291. These OPAREAS are used for ocean surface and subsurface training. Military aviation activities may be conducted in airspace that is not designated as SUA, however, these aviation activities do not include use of live or inert ordnance.

Special Use Airspace (SUA)

The SOCAL Range Complex includes military airspace designated as Warning Area 291 (W–291). W–291 comprises 113,000 nm^2 (209,276 km^2) of SUA that generally overlies the SOCAL OPAREAs and SCI, extending to the southwest from approximately 12 nm (22 km) off the coast to approximately 600 nm (1,111 km). W–291 is the largest component of SUA in the Navy's range inventory.

San Clemente Island (SCI)

SCI, a component part of the SOCAL Range Complex, is comprised of existing land ranges and training areas that are integral to training of Pacific Fleet air, surface, and subsurface units; First Marine Expeditionary Force (I MEF) units; Naval Special Warfare (NSW) units; and selected formal schools. SCI provides instrumented ranges, operating areas, and associated facilities to conduct and evaluate a wide range of exercises within the scope of naval warfare. SCI also provides ranges and services for RDT&E activities. Over 20 Navy and Marine Corps commands conduct training and testing activities on SCI. Due to its unique capabilities to support multiple training operations, SCI training activities encompass every Navy primary mission area (PMAR), and SCI provides critical training resources for Expeditionary Strike Group (ESG), Carrier Strike Group (CSG), and Marine Expeditionary Unit (MEU) certification exercises.

SCI provides an extensive suite of range capabilities for tactical training. SCI includes a Shore Bombardment Area (SHOBA), landing beaches, several live-fire training areas and ranges (TARs) for small arms, maneuver areas, and other dedicated ranges for the conduct of training in all Primary Mission Areas (PMARs). SCI includes extensive instrumentation, and provides robust opposing force simulation and targets for use in land, sea-based, and air live-fire training. SCI also contains an airfield and other infrastructure for training and logistical support.

Overlap With Point Mugu Sea Range for Certain Anti-Submarine Warfare Training (ASW)

The Point Mugu Sea Range is a Navy ocean range area north of and generally adjacent to the SOCAL Range Complex. ASW training conducted in the course of major exercises occurs across the boundaries of the SOCAL Range Complex into the Point Mugu Sea Range. These cross-boundary events are addressed in this authorization request.

Description of Specified Activities

As mentioned above, the Navy has requested MMPA authorization to take marine mammals incidental to training activities in the SOCAL Range Complex that would result in the generation of sound or pressure waves in the water at or above levels that NMFS has determined will likely result in take (see Acoustic Take Criteria Section), either through the use of MFAS/HFAS or the detonation of explosives in the water. These activities are discussed below.

Activities Utilizing Active Sonar Sources

For the SOCAL Range Complex, the training activities that utilize active tactical sonar sources fall into the category of Anti-submarine Warfare (ASW) exercises. This section includes a description of ASW, the active acoustic devices used in ASW exercises, as well as the exercise types in which these acoustic sources are used.

ASW Training and Active Sonar

ASW involves helicopter and sea control aircraft, ships, and submarines, operating alone or in combination, in operations to locate, track, and neutralize submarines. Controlling the undersea battlespace is a unique naval capability and a vital aspect of sea control. Undersea battlespace dominance requires proficiency in ASW. Every deploying strike group and individual ASW-capable combatant must possess this capability.

Various types of active and passive sonars are used by the Navy to determine water depth, locate mines, and identify, track, and target submarines. Passive sonar "listens" for sound waves by using underwater microphones, called hydrophones, which receive, amplify and process underwater sounds. No sound is introduced into the water when using passive sonar. Passive sonar can indicate the presence, character and movement of submarines. Passive sonar, alternatively, provides only a bearing (direction) to a sound-emitting source; it does not provide an accurate range (distance) to the source. Active sonar is needed to locate objects because active sonar provides both bearing and range to the detected contact (such as an enemy submarine).

Active sonar transmits pulses of sound that travel through the water, reflect off objects and return to a receiver. By knowing the speed of sound in water and the time taken for the sound wave to travel to the object and back, active sonar systems can quickly calculate direction and distance from the sonar platform to the underwater object. There are three types of active sonar: Low-frequency, mid-frequency, and high-frequency.

Low-frequency sonar operates below 1 kilohertz (kHz) and is designed to detect extremely quiet diesel-electric submarines at ranges far beyond the capabilities of mid-frequency active sonars. There are only two ships in use by the U.S. Navy that are equipped with low-frequency sonar; both are ocean surveillance vessels operated by Military Sealift Command. Low-frequency active sonar is not presently utilized in the SOCAL Range Complex, and use of low-frequency active sonar is not contemplated in the Proposed Action.

High-frequency active sonar (HFAS), operates at frequencies greater than 10 kilohertz (kHz). At higher acoustic frequencies, sound rapidly dissipates in the ocean environment, resulting in short detection ranges, typically less than five nm. High-frequency sonar is used primarily for determining water depth, hunting mines and guiding torpedoes.

Mid-frequency active sonar (MFAS) operates between 1 and 10 kHz, with detection ranges up to 10 nautical miles (nm). Because of this detection ranging capability, MFAS is the Navy's primary tool for conducting ASW. Many ASW experiments and exercises have demonstrated that this improved capability for long range detection of adversary submarines before they are able to conduct an attack is essential to U.S. ship survivability. Today, ASW is the Navy's #1 war-fighting priority. Navies across the world utilize modern, quiet, diesel-electric submarines which pose the primary threat to the U.S. Navy's ability to perform a number of critically necessary missions. Extensive training is necessary of sailors, ASW-capable units, and strike groups are to gain proficiency in using MFAS. If a strike group does not demonstrate MFAS proficiency, it cannot be certified as combat ready.

Acoustic Sources Used for ASW Exercises in SOCAL

Modern sonar technology has developed a multitude of sonar sensor and processing systems. In concept, the simplest active sonars emit omni-directional pulses (''pings'') and time the arrival of the reflected echoes from the target object to determine range. More sophisticated active sonar emits an omni-directional ping and then rapidly scans a steered receiving beam to provide directional, as well as range, information. More advanced active sonars transmit multiple preformed beams, listening to echoes from several directions simultaneously and providing efficient detection of both direction and range. The types of active sonar sources employed during ASW active sonar training exercises in the SOCAL Range Complex are identified in Table 1.

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Sonar Sources	Freq- uency (kHz)	Source Level (dB) re 1 µPa @ 1 m	Emission Spacing (m)*	Vertical Direct-ivity	Horizon-tal Direct-ivity	Associated Platform	System Description
AN/SQS-53C	3.5	235	154	Omni	240° forward-looking	Cruiser (CG) and Destroyer (DDG) hull mounted sonar	ASW search, detection, & localization (approximately 2 pings per minute)
AN/SQS-53C Kingfisher Mode	3.5	236	4.6	20° width 42° D/E	120° forward	Same as above	Mine object detection (approximately 2 pings per minute)
AN/SQS-56C	7.5	225	129	13°	30°	Frigate (FFG) hullmounted sonar	ASW search, detection, & localization (approximately 2 pings per minute)
AN/AQS-22 (or AN/AQS-13F**)	4.1	217	15	Omni	Omni	Helicopter (SH-60, MH-60R) dipping sonar	ASW sonar lowered from hovering helicopter (approximately 10 pings/dip, 30 seconds between pings)
AN/BQQ-10	Classifed (MF)	Classified	n/a	Omni	Omni	Submarine (SSN) hullmounted sonar	ASW search and attack (approximately two pings per hour when in use)
AN/BQQ-15	Classifed (MF)	Classified				Submarine (SSN) hullmounted sonar	Submarine navigational sonar
AN/SSQ-62 DICASS (sonobuoy, tonal)	8	201	450	Omni	Omni	Helicopter and maritime patrol aircraft (P3 and P8 MPA) dropped sonobuoy	Remotely commanded expendable sonar-equipped buoy (approximately 12 pings per use, 30 secs between pings)
MK-48 torpedo sonar	Classified (>10)	Classified	144	Omni	Omni	Submarine (SSN) launched torpedo	Recoverable and non-explosive exercise torpedo; sonar is active approximately 15 min per torpedo run
***MK-46 or 54 torpedo sonar	Classified (HF)	Classified				Surface ship and aircraft fired exercise torpedo (lightweight)	Recoverable and non-explosive exercise torpedo
AN/SSQ-110A (IEER)	Classified (impulsive, broadband)	Classified	n/a	Omni	Omni	MPA deployed	ASW system consists of explosive acoustic source buoy (contains two 4.1 lb charges) and expendable passive receiver sonobuoy
AN/SLQ-25A (NIXIE)	Classified (MF)	Classified				DDG, CG, FFG and certain other surface ship towed array (torpedo countermeasure)	Towed countermeasure to avert localization and torpedo attacks (approximately 20 mins per use)

Table 1. Parameters used for modeling the six sonar sources Many of the actual parameters and capabilities of these sonars are classified. Parameters used for modeling were derived to be as representative as possible. When, however, there were a wide range of potential modeling values, a nominal parameter likely to result in the most impact was used so that the model would err towards overestimation.

*Spacing means distance between pings at the nominal speed

**AN/AQS-22 used as surogote for AN/AQS-13F, AQS-22 source level is higher than AQS-13F

*** MK-48 used as surogote for MK-46/54 in modeling; MK-48 source level is higher than MK-46

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ASW sonar systems are deployed from certain classes of surface ships, submarines, helicopters, and fixed wing maritime patrol aircraft (Table 1). The surface ships used are typically equipped with hull-mounted sonars (active and passive) and towed-array passive sonar for the detection of submarines. Helicopters equipped with dipping sonar or sonobuoys are utilized to locate submarines or submarine targets within the training area. In addition, fixed wing marine patrol aircraft (MPA) are used to deploy both active and passive sonobuoys to assist in locating and tracking submarines during the duration of the exercise. Submarines are equipped with hull-mounted sonars sometimes used to locate and prosecute other submarines and/or surface ships during the exercise. The platforms used in ASW exercises are identified below.

Surface Ship Sonars—A variety of surface ships participate in testing and training events. Some ships (e.g., aircraft carriers, amphibious assault ships) do not have any onboard active sonar systems, other than fathometers. Others, like guided missile cruisers, are equipped with active as well as passive tactical sonars for mine avoidance and submarine detection and tracking. For purposes of the analysis, the SQS–53 was modeled as having a nominal source level of 235 decibels (dB) re 1 μPa @ 1 m, and the SQS–56 was modeled as having a nominal source level of 225 decibels (dB) re 1 μPa @ 1 m. Sonar ping transmission durations were modeled as lasting 1 second per ping and omni-directional, which is a conservative assumption that will overestimate potential effects. Actual ping durations will be less than 1 second. The SQS–53 hull-mounted sonar transmits at center frequencies of 2.6 kHz and 3.5 kHz. The SQS–56 sonar transmits at a center frequency of 7.5 kHz. Details concerning the tactical use of specific frequencies and the repetition rate for the sonar pings is classified but was modeled based on the required tactical training setting.

Hull-mounted active sonars occasionally operate in a mode called ''Kingfisher,'' which is designed to better detect smaller objects. The Kingfisher mode uses the same source level and frequency as normal search modes, however, it uses a different waveform (designed for small objects), a shorter pulse length (< 1 sec), a higher pulse repetition rate (due to the short ranges), and the ping is not omnidirectional, but directed forward.

Submarine Sonars—Submarine active and passive sonars are used to detect and target enemy submarines and surface ships. Because submarine MF active sonar (AN/BQQ–10) use is very rare and in those rare instances, very brief (only approximately 2 pings per hour), it is extremely unlikely that use of active sonar by submarines would have any measurable effect on marine mammals. However, submarine sonar was included in the modeling for estimating exposures of marine mammals to sonar sounds. Estimates of exposure are also included for the HF AN/BQQ–15 which is used for navigation.

Aircraft Sonar Systems—Aircraft sonar systems that would operate in the SOCAL Range Complex include DICASS sonobuoys (AN/SSQ–62; source level of 201 dB) and dipping sonar (AN/AQS–22). Sonobuoys may be deployed by maritime patrol aircraft or helicopters; dipping sonars are used by carrier-based helicopters. A sonobuoy is an expendable device used by aircraft for the detection of underwater acoustic energy and for conducting vertical water column temperature measurements. Most sonobuoys are passive, but some can generate active acoustic signals, as well as listen passively. Dipping sonar is an active or passive sonar device lowered on cable by helicopters to detect or maintain contact with underwater targets. During ASW training, these systems active modes are only used briefly for localization of contacts and are not used in primary search capacity. Because active mode dipping sonar use is very brief and has a lower normal source level than hull-mounted active sonars, it is extremely unlikely its use would have any effect on marine mammals. However, the AN/AQS–22 dipping sonar was modeled based on estimated use during major training exercises within the SOCAL Range Complex.

Extended Echo Ranging and Improved Extended Echo Ranging (EER/IEER) Systems—EER/IEER are airborne ASW systems used in conducting large area searches for submarines. These systems are made up of airborne avionics, ASW acoustic processing and sonobuoy types that are deployed in pairs. The IEER System's active sonobuoy component, the AN/SSQ–110A Sonobuoy, would generate a sonar ''ping'' (actually small explosive detonation) and the passive AN/SSQ–101A ADAR Sonobuoy would ''listen'' for the return echo of the sonar ping that has been bounced off the surface of a submarine. These sonobuoys are designed to provide underwater acoustic data necessary for naval aircrews to quickly and accurately detect submerged submarines. The sonobuoy pairs are dropped from a fixed-wing aircraft into the ocean in a predetermined pattern with a few buoys covering a very large area. The AN/SSQ–110A Sonobuoy Series is an expendable and commandable sonobuoy. Upon command from the aircraft, the bottom payload is released to sink to a designated operating depth. A second command is required from the aircraft to cause the second payload to release and detonate generating a ''ping''. There is only one detonation in the pattern of buoys at a time. The AN/SSQ–110A is listed in this table because it functions like a sonar ping, however, the source creates an explosive detonation and its effects are considered in the underwater explosive section.

Torpedoes—Torpedoes are the primary ASW weapon used by surface ships, aircraft, and submarines. The guidance systems of these weapons can be autonomous or electronically controlled from the launching platform through an attached wire. The autonomous guidance systems are acoustically based. They operate either passively, exploiting the emitted sound energy by the target, or actively, by reflecting a sonar signal off the target and using the received echoes for guidance. The MK–48 torpedo was modeled for active sonar transmissions during specified training operations within the SOCAL Range Complex. The MK–48 sonar with a higher source level was also conservatively used to account for MK–46 torpedo exercises.

Other Acoustic Sources—The Navy also utilizes the sources listed below in ASW exercises. However, based on operational characteristics (such as frequency and source level), the Navy determined that use of the following acoustic sources would not likely result in the take of marine mammals:

• Acoustic Device Countermeasures (ADC)—Several types of acoustic counter measure devices could be deployed during Fleet training exercises, including the free-floating submarine launched Acoustic Device Countermeasure (MK–1, MK–2, MK–3, MK–4), the free-floating submarine launched Noise Acoustic Emitter (NAE), and the surface ship towed AN/SLQ–25A (NIXIE). Countermeasure devices are submarine simulators and act as decoys to avert localization and torpedo attacks.

• Training Targets—ASW training targets consisting of MK–30 and/or MK–39 EMATT are used to simulate opposition submarines. They are equipped with one or a combination of the following devices: (1) Acoustic projectors emanating sounds to simulate submarine acoustic signatures; (2) echo repeaters to simulate the characteristics of the echo of a particular sonar signal reflected from a specific type of submarine; and (3) magnetic sources to trigger magnetic detectors.

• Range Sources. Range pingers are active acoustic devices that allow each of the in-water platforms on the range (e.g., ships, submarines, target simulators, and exercise torpedoes) to be tracked by the instrumented range hydrophones on the Southern California ASW Range (SOAR) west of San Clemente Island. In addition to passively tracking the pinger signal from each range participant, the range transducer nodes also are capable of transmitting acoustic signals for a limited set of functions. These functions include submarine warning signals, acoustic commands to submarine target simulators (acoustic command link), and occasional voice or data communications (received by participating ships and submarines on range).

Types of ASW Exercises in the SOCAL

The Navy's ASW training plan, including the use of active sonar in at-sea training scenarios, includes multiple levels of training. Independent Unit-level ASW training (such as TRACKEX and TORPEX exercises) addresses basic skills such as detection and classification of contacts, distinguishing discrete acoustic signatures including those of ships, submarines, and marine life, and identifying the characteristics, functions, and effects of controlled jamming and evasion devices.

The Navy must execute training involving ships, aircraft, submarines, and Marine Corps forces operating in multiple dimensions (at sea, undersea, in the air, and on land) in order to ensure the readiness of naval forces. Unit training proceeds on a continuum, ranging from events involving a small number of ships, submarines, or aircraft engaged in training tailored to specific tasks, to large-scale pre-deployment or readiness exercises involving Strike Groups. Exercises involving an entire Strike Group are referred to as major range events (JTFEX and COMPTUEX). Smaller, integrated unit-level exercises are complex events (SHAREM, IAC2, or sustainment exercise), but of lesser scope than major range events, which pursue tailored training objectives for components of a Strike Group. It is useful to view larger exercises as being composed of individual training events conducted in a coordinated fashion. For example, the ASW portions of a major range event might include multiple TRACKEX and TORPEX events, conducted simultaneously with aviation or amphibious training. Table 2, at the end of this section, summarizes the exercise types (both sonar and explosive) and they are further described below. Note that the names and exact composition of these exercises may change, however, the basic components are described here and the total hours of sonar sound source and explosive use will not exceed those described in this document.

Antisubmarine Warfare Tracking Exercise (TRACKEX)

A TRACKEX, which is an independent unit-level exercise, tests the Naval Strike Group's (NSG) ability to locate and track an unknown or hostile submarine over a predetermined time. This operation tests the NSG's ability to coordinate the positioning of assets including surface, air, and subsurface, and the effective communication and turnover of responsibility for maintaining coverage of the unknown submarine.

The TRACKEX-surface involves a surface ship employing hull mounted and/or towed array sonar against a target which may be an Expendable Mobile Anti-submarine Warfare Training Target (EMATT) or live submarine. The target may be either non-evading and assigned to a specified track or fully evasive depending on the state of training of the ship and crew. Passive and active sonar may be employed depending on the type of threat submarine, the tactical situation, and water conditions that may affect sonar effectiveness. Active sonar transmits at varying power levels, pulse types, and intervals, while passive sonar listens for noise emitted by the threat submarine. Passive sonar is typically employed first for tactical reasons, followed by active sonar to determine an exact target location; however, active sonar may be employed during the initial search phase against an extremely quiet submarine or in situations where the water conditions do not support acceptable passive reception. There is no ordnance expended in this exercise. An ASW TRACKEX-Surface usually lasts two to four hours.

This exercise may involve a single ship, or may be undertaken in the context of a coordinated larger exercise involving multiple aircraft and/or ships, including a major range event.

The Navy also conducts Submarine TRACKEX exercises. However, during this event, passive sonar is used almost exclusively; active sonar use is tactically proscribed because it would reveal the tracking submarine's presence to the target submarine.

Torpedo Exercise (TORPEX)

Anti-submarine Warfare Torpedo Exercises (ASW TORPEX) operations, which are independent unit-level exercises, train crews in tracking and attack of submerged targets, firing one or two exercise torpedoes (EXTORPs) or recoverable exercise torpedoes (REXTORPs). TORPEX targets used in the Offshore Areas include live submarines, MK 48 torpedoes, MK–30 ASW training targets, and MK–39 Expendable Mobile ASW Training Targets (EMATT). The target may be non-evading while operating on a specified track, or it may be fully evasive, depending on the training requirements of the operation.

The ASW TORPEX-Surface involves a surface ship using hull-mounted and towed sonar arrays to search for, detect, classify, localize, and track a simulated threat submarine. Submarines periodically conduct TORPEXs within the SOCAL Range Complex. Typical duration of a submarine TORPEX exercise is 10 hours, while air and surface ASW platform TORPEX operations are considerably shorter.

Ship ASW Readiness and Evaluation Measuring (SHAREM)

SHAREM is a Chief of Naval Operations (CNO) chartered program with the overall objective to collect and analyze high-quality data to quantitatively ''assess'' surface ship ASW readiness and effectiveness. The SHAREM is an integrated unit-level event and will typically involve multiple ships, submarines, and aircraft in several coordinated events over a period of a week or less. A SHAREM may take place once per year in SOCAL.

Sustainment Exercise

Included in the FRTP is a requirement to conduct post-deployment sustainment, training, and maintenance. The sustainment exercise, which is an integrated unit-level exercise, ensures that the components of a Strike Group maintain an acceptable level of readiness after returning from deployment. A sustainment exercise is an exercise designed to challenge the strike group in all warfare areas. This exercise is similar to a COMPTUEX but of shorter duration. One to two sustainment exercises may occur each year in SOCAL.

Integrated ASW Course Phase II (IAC2)

IAC2 exercises are combined aircraft and surface ship events. The IAC2 consists of two 12-hour events conducted primarily on SOAR over a 2–3 day period. SOAR is an undersea warfare range providing instrumented three dimensional tracking over a 670 sq nm area within the large Southern California Offshore Range (SCORE). The typical participants include four helicopters, two P–3 aircraft, two adversary submarines, and two Mk 30 or Mk 39 targets. Frequently, IAC2s include the introduction of an off-range Mk 30 target. Four IAC2 exercises may occur per year.

Major Range Events

The Navy conducts large-scale exercises, or major ranges events, in the SOCAL Range Complex. These exercises are required for pre-deployment certification of naval formations. The composition of the force to be trained, and the nature of its mission upon deployment, determines the scope of the exercise. The Navy currently conducts up to eight major range events per year. Major range events bring together the component elements of a Strike Group or Strike Force (that is, all of the various ships, submarines, aircraft, and Marine Corps forces) to train in complex command, control, operational coordination, and logistics functions. Major range events require vast areas of sea space and airspace for the exercise of realistic training, as well as land areas for conducting land attack training events. The training space required for these events is a function of naval warfighting doctrine, which favors widely dispersed units capable of projecting forces and firepower at high speeds across distances of up to several hundred miles in a coordinated fashion, to concentrate on an objective. The three-dimensional space required to conduct a major range event involving a carrier strike group (CSG) or expeditionary strike group (ESG) is a complicated polygon covering an area as large as 50,000 nm^2.

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

Major range events include:

• Composite Training Unit Exercise (COMPTUEX). The COMPTUEX is an Integration Phase, at-sea, major range event. For the CSG, this exercise integrates the aircraft carrier and carrier air wing with surface and submarine units in a challenging operational environment. For the ESG, this exercise integrates amphibious ships with their associated air wing, surface ships, submarines, and Marine Expeditionary Unit. Live-fire operations that may take place during COMPTUEX include long-range air strikes, Naval Surface Fire Support (NSFS), and surface-to-air, surface-to-surface, and air-to-surface missile exercises. The MEU also conducts realistic training based on anticipated operational requirements and to further develop the required coordination between Navy and Marine Corps forces. Special Operations training may also be integrated with the exercise scenario. The COMPTUEX is typically 21 days in length. The exercise is conducted in accordance with a schedule of events, which may include two 1-day, scenario-driven, ''mini'' battle problems, culminating with a scenario-driven free play (as opposed to scripted) 3-day Final Battle Problem where the strike group is required to respond to dynamic maneuvers.'' COMPTUEX occurs three to four times per year.

• Joint Task Force Exercise (JTFEX). The JTFEX is a dynamic and complex major range event that is the culminating exercise in the Sustainment Phase training and certification event for the CSGs and ESGs. For an ESG, the exercise incorporates an Amphibious Ready Group (ARG) Certification Exercise (ARG CERT) for the amphibious ships and a Special Operations Capable Certification (SOCCERT) for the MEU. When schedules align, the JTFEX may be conducted concurrently for an ESG and CSG. JTFEX emphasizes mission planning and effective execution by all primary and support warfare commanders, including command and control, surveillance, intelligence, logistics support, and the integration of tactical fires. JTFEX is mostly a free-play (as opposed to scripted) event. JTFEX is normally 10 days long, not including a 3-day in-port Force Protection Exercise, and is the final at-sea exercise for the CSG or ESG prior to deployment. JTFEX occurs three to four times per year.

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	Independent Unit-Level Exercises							Integrated / Coordinated / Major Exercises				
Exercise Type	**S-S GUNEX / NSFS**	**A-S MISSILEX**	**A-S BOMBEX**	**SINKEX**	**ASW TRACKEX including IAC [1]**	**ASW TORPEX including IAC [1]**	**EER/ IEER**	**IAC**	**Sus- tain- Ment**	**SHAREM**	**JTFEX**	**COMP- TUEX**
Sources/ Weapons/ Rounds	5" rounds	HELLFIRE Harpoon	MK82, MK83, MK84 bombs	Bombs, MK48 5" rounds	53C AQS-22 sonobuoys	53C, MK48, AQS22 sonobuoys	SSQ-110A	All sources possible	All sources possible	All sources possible	All sources possible	All sources possible
Length of Exercise	2.5 - 9 hrs	3 hrs	1 hr	16 hrs	2 hrs	2	6 hrs	2 days	>21 days	7 days	10 days	21 days
Detonations/ Rounds per exercise	6 to 11	3	MK82 - 9 MK83 - 5 MK84 - 2	5" - 120 MK82 - 2 MK83 - 1 MK48 - 1	N/A	N/A	36	N/A	N/A	N/A	N/A	N/A
Number Exercises per Year	402	50	40	2	53C – 1.600 buoys – 3,864 AQS22-2,453	53C - 28 buoys - 150 MK48 - 84 AQS22 - 112	3	2	1	2	4	4
Possible Areas Conducted	SOAR SHOBA W-291	LTR-1/2	W-291	W-291	SOAR W-291	SOAR	W-291	SOCAL	Primarily SOAR	SOCAL	SOCAL	SOCAL
Months of Year conducted	Year Round	Year Round	Year Round	Year Round	Year Round	Year Round	Year Round	Year Round	Year Round	Year Round	Year Round	Year Round

Table 2. Summary of Exercise Types with sonar or explosive use anticipate in take of marine mammals.

1. IAC activities are accounted for in ASW TRACKEX and ASW TORPEX

2. For ASW TRACKEX and ASW TORPEX: 53C number equates to annual hours of use; buoys number equates to annual number of sonobuoys used; AQS22 number equates to annual number of dips; MK48 number equates to annual number of MK48 or 46 torpedoes used.

Activities Utilizing Underwater Detonations

Underwater detonation activities can occur at various depths depending on the activity (sinking exercise [SINKEX] and mine neutralization), but may also include activities which may have detonations at or just below the surface (SINKEX, gunnery exercise [GUNEX], or missile exercise [MISSILEX]). When the weapons hit the target, except for live torpedo shot, there is no explosion in the water, and so a ''hit'' is not modeled (i.e., the energy (either acoustic or pressure) from the hit is not expected to reach levels that would result in take of marine mammals). When a live weapon misses, it is modeled as exploding below the water surface at 1 ft (5-inch naval gunfire, 76-mm rounds), 2 meters (Maverick, Harpoon, MK–82, MK–83, MK–84), or 50 ft (MK–48 torpedo) as shown in Appendix A of the Navy's application, Table A–7 (the depth is chosen to represent the worst case of the possible scenarios as related to potential marine mammals impacts). Exercises may utilize either live or inert ordnance of the types listed in Table 3. Additionally, successful hit rates are known to the Navy and are utilized in the effects modeling. Training events that involve explosives and underwater detonations occur throughout the year and are described below and summarized in Table 2.

		TTS		Injury		Mortality	Exclusion
	lbs	182 SEL	23 psi	205 SEL	13 psi-ms	31 psi-ms	Zone Used
5" Naval gunfire	9.5	260	273	18	43	23	548
76mm rounds	1.6	133	151	7	24	12	548
Maverick	78.5	1051	562	70	193	107	1852 (SINKEX), 1645 (MISSILEX)
Harpoon	448	1959	821	134	273	159	1852 (SINKEX), 1645 (MISSILEX)
MK-82	238	1854	800	127	264	154	1852 (SINKEX), 914 (BOMBEX)
MK-83	574	2898	1073	198	333	197	1852 (SINKEX), 914 (BOMBEX)
MK-84	990	3828	1301	260	379	228	1852 (SINKEX), 914 (BOMBEX)
MK-48	851	3514	1232	248	738	437	1852 (SINKEX), 914 (BOMBEX)
AN/SSQ-110A (IEER)	5	336	288	72	158	75	914

Table 3. Ordnance used in SOCAL Explosive Exercises for which take of marine mammals is anticipated
Table indicates range to indicated threshold and size of Navy exclusion zone used in mitigation.

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Sinking Exercise (SINKEX)

In a SINKEX, a specially prepared, deactivated vessel is deliberately sunk using multiple weapons systems. The exercise provides training to ship and aircraft crews in delivering both live and inert ordnance on a real target. These target vessels are empty, cleaned, and environmentally remediated ship hulk (i.e., a hulk that has been stripped of all hazardous materials and potential marine water contaminants in accordance with the requirements of 40 CFR 229.2 [Transport of target vessels]). A SINKEX target is towed to sea and set adrift at the SINKEX location. The duration of a SINKEX is unpredictable since it ends when the target sinks, sometimes immediately after the first weapon impact and sometimes only after multiple impacts by a variety of weapons. Typically, the exercise lasts for 4 to 8 hours over 1 to 2 days. SINKEXs occur only occasionally during SOCAL Range Complex exercises.

Some or all of the following weapons may be employed in a SINKEX:

- Three HARPOON surface-to-surface and air-to-surface missiles.
- Two to eight air-to-surface Maverick missiles.
- Two to four MK–82 General Purpose Bombs.
- Two Hellfire air-to-surface missiles.
- One SLAM–ER air-to-surface missile.
- Two-hundred and fifty rounds for a 5-inch gun.
- One MK–48 heavyweight submarine-launched torpedo.

Air-to-Surface Gunnery Exercise (A–S GUNEX)

Air-to-Surface GUNEX operations, which may be conducted in W291, are conducted by fixed or rotary-wing aircraft against stationary targets (Floating at-sea Target [FAST] and smoke buoy). Rotary-wing aircraft involved in this operation would include a single SH–60 using either 7.62-mm or .50-caliber door-mounted machine guns. A typical A–S GUNEX will last approximately one hour and involve the expenditure of approximately 400 rounds of 0.50-caliber or 7.62-mm ammunition. Due to the inert nature of the ammunition and the small size of the rounds, they are not considered to have an underwater detonation impact.

Surface-to-Surface Gunnery Exercise (S–S GUNEX)

Surface gunnery exercises (GUNEX) take place in the open ocean (W291 and SOAR) to provide gunnery practice for Navy and Coast Guard ship crews. This exercise may involve a single firing ship, or be undertaken in the context of a coordinated larger exercise involving multiple ships, including a major range event. GUNEX training operations conducted in the Offshore OPAREA involve stationary targets such as a MK–42 FAST or a MK–58 marker (smoke) buoy. The gun systems employed against surface targets include the 5-inch, 76 millimeter (mm), 57-mm, 25-mm chain gun, 20-mm Close-in Weapon System (CIWS), and .50 caliber machine gun. Typical ordnance expenditure for a single GUNEX is 21–70 rounds of 5-inch, 76-mm, or 57-mm ammunition, and approximately 150 rounds of 25-mm or .50-caliber ammunition. Both live and inert training rounds are used. After impacting the water, the rounds and fragments sink to the bottom of the ocean. A GUNEX lasts up to 2.5 hours, depending on target services and weather conditions. The live 5-inch, 57-mm and 76-mm rounds are considered in the underwater detonation modeling.

Naval Surface Fire Support exercises (NSFS), in which crews train in naval gunnery against shore targets using the same ammunition as a GUNEX, are included with GUNEX both in Table 2 and further discussion (though separate mitigation is described in the Mitigation section). NSFS may be conducted in SOAR, MIR, or SHOBA.

Air-to-Surface Missile Exercise (A–S MISSILEX)

The air-to-surface missile exercise (MISSILEX [A–S]) consists of the attacking platform releasing a forward-fired, guided weapon at the designated towed target. The exercise involves locating the target, then designating the target, usually with a laser. MISSILEX (A–S) training that does not involve the release of a live weapon can take place if the attacking platform is carrying a captive air training missile (CATM) simulating the weapon involved in the training. The CATM MISSILEX is identical to a live-fire exercise in every aspect except that a weapon is not released. The operation requires a laser-safe range as the target is designated just as in a live-fire exercise.

From 1 to 16 aircraft, carrying live, inert, or CATMs, or flying without ordnance (dry runs) are used during the exercise. At sea, seaborne powered targets (SEPTARs), Improved Surface Towed Targets (ISTTs), and decommissioned hulks are used as targets. MISSILEX (A–S) assets include helicopters and/or 1 to 16 fixed wing aircraft with air-to-surface missiles and anti-radiation missiles (electromagnetic radiation source seeking missiles). When a high-speed anti-radiation missile (HARM) is used, the exercise is called a HARMEX. Targets include SEPTARs, ISTTs, and excess ship hulks.

Surface-to-Surface Missile Exercise (S–S MISSILEX)

Surface-to-surface missile exercise (MISSILEX [S–S]) involves the attack of surface targets at sea by use of cruise missiles or other missile systems, usually by a single ship conducting training in the detection, classification, tracking and engagement of a surface target. Engagement is usually with Harpoon missiles or Standard missiles in the surface-to-surface mode. Targets could include virtual targets or the SEPTAR or ship deployed surface target. MISSILEX (S–S) training is routinely conducted on individual ships with embedded training devices.

A MISSILEX (S–S) could include 4 to 20 surface-to-surface missiles, SEPTARs, a weapons recovery boat, and a helicopter for environmental and photo evaluation. All missiles are equipped with instrumentation packages or a warhead. Surface-to-air missiles can also be used in a surface-to-surface mode. MISSILEX (S–S) activities are conducted withinW–291. Each exercise typically lasts five hours. Future MISSILEX S–S could range from 4 to 35 hours.

S–S MISSILEX exercises only occur during SINKEX exercises, and the hours of S–S MISSILEX are included in the total hours of SINKEX indicated in Table 2.

Bombing Exercise (BOMBEX)

Fixed-wing aircraft conduct bombing exercise (BOMBEX [Sea]) operations against stationary targets (MK–42 FAST or MK–58 smoke buoy) at sea. An aircraft will clear the area, deploy a smoke buoy or other floating target, and then set up a racetrack pattern, dropping on the target with each pass. A BOMBEX may involve either live or inert ordnance.

Mine Warfare (MIW)/ Mine Countermeasures (MCM)

MIW is the naval warfare area involving the detection, avoidance, and neutralization of mines to protect Navy ships and submarines, and offensive mine laying in naval operations. A naval mine is a self-contained explosive device placed in water to destroy ships or submarines. Naval mines are deposited and left in place until triggered by the approach of or a contact with an enemy ship, or are destroyed or removed. Naval mines can be laid by purpose-built minelayers, other ships, submarines, or airplanes. MIW training includes Mine Countermeasures (MCM) Exercises and Mine Laying Exercises (MINEX). MCM training is currently conducted on the Kingfisher Range and offshore areas in the Tanner and Cortes Banks. MCM training engages ships' crews in the use of sonar for mine detection and avoidance, and minefield navigation and reporting. The proposed extension of the SOAR is intended for use in such training. MINEX events involve aircraft dropping inert training shapes, and less frequently submarine mine laying. MINEX events are conducted on the MINEX Training Ranges in the Castle Rock, Eel Point, China Point, and Pyramid Head areas offshore of SCI.

Mine Neutralization operations involve the detection, identification, evaluation, rendering safe, and disposal of mines and unexploded ordnance (UXO) that constitutes a threat to ships or personnel. Mine neutralization training can be conducted by a variety of air, surface and sub-surface assets. Potential harassment would be from underwater detonation.

Tactics for neutralization of ground or bottom mines involve the diver placing a specific amount of explosives, which when detonated underwater at a specific distance from a mine results in neutralization of the mine. Floating, or moored, mines involve the diver placing a specific amount of explosives directly on the mine. Floating mines encountered by Fleet ships in open-ocean areas will be detonated at the surface. In support of an expeditionary assault, divers and Navy marine mammal assets deploy in very shallow water depths (10 to 40 feet) to locate mines and obstructions. Divers are transported to the mines by boat or helicopter. Inert dummy mines are used in the exercises. The total net explosive weight used against each mine ranges from less than 1 pound to 20 pounds.

Various types of surveying equipment may be used during mine detection. Examples include the Canadian Route Survey System that hydrographically maps the ocean floor using multi-beam side scan sonar and the Bottom Object Inspection Vehicle used for object identification. These units can help in supporting mine detection prior to Special Warfare Operations (SPECWAROPS) and amphibious exercises.

All demolition activities are conducted in accordance with established Navy guidelines and procedures for disposal of explosives at sea. Before any explosive is detonated, divers are transported a safe distance away from the explosive.

Standard practices for tethered mines in the SOCAL Range Complex require ground mine explosive charges to be suspended 10 feet below the surface of the water.

Mine neutralization exercises would involve training using Organic Airborne Mine Countermeasures (OAMCM) systems employed by helicopters in simulated threat minefields with the goal of clearing a safe channel through the minefield for the passage of friendly ships. Once a mine shape is located, mine neutralization is simulated. Helicopters engaged in MCM training would be configured with one or more of the following systems:

- AN/AQS–20 Mine Hunting System: The AQS–20 is an active high resolution, side-looking, multibeam sonar system used for mine hunting of deeper mine threats along the ocean bottom. It is towed by a helicopter. A small diameter electromechanical cable is used to tow the rapidly-deployable system that provides real-time sonar images to operators in the helicopter.
- AN/AES–1 Airborne Laser Mine Detection System (ALMDS): ALMDS is a helicopter-mounted system that uses Light Detection and Ranging (LIDAR) blue-green laser technology to detect, classify, and localize floating and near-surface moored mines in shallow water.
- AN/ALQ–220 Organic Airborne Surface Influence Sweep (OASIS). OASIS is a helicopter deployed, towed-body, 10 ft long and 20 inches in diameter that is self-contained, allowing for the emulation of magnetic and acoustic signatures of the ships.
- Airborne Mine Neutralization System (AMNS): AMNS is a helicopter-deployed underwater vehicle that searches for, locates, and destroys mines. This vehicle is a self-propelled, unmanned, wire-guided munition with

homing capability that expends itself during the mine destruction process.

• AN/AWS–2 Rapid Airborne Mine Clearance System (RAMCIS): RAMICS is a helicopter-borne weapon system that fires a 30mm projectile from a gun or cannon to neutralize surface and near-surface mines. RAMICS uses LIDAR technology to detect mines.

Mine neutralization exercises also would involve shipboard MCM systems, including the Remote Minehunting System (RMS). The RMS is an unmanned, semi-submersible vehicle that tows a variable-depth sensor to detect, localize, classify and identify mines. The RMS includes a shipboard launch and recovery system.

Mine neutralization exercises also would involve submarine-deployed MCM systems, the Long-term Mine Reconnaissance System (LMRS). The LMRS employs a self-propelled underwater vehicle equipped with forward-looking search sonar and side-looking classification sonar.

Locations proposed for mine neutralization training are: Pyramid Cove; Northwest Harbor; Kingfisher Training Range; MTR–1, MTR–2, and Advanced Research Project Agency (ARPA).

The unusual physical bathymetries, the low numbers of protected species and the training routines at the sites where these exercises are conducted combine with the unusual pressure-wave propagation characteristics of the Northwest Harbor, where multiple charges are used, to allow exceptionally reliable and effective mitigation procedures. The exceptional reliability of visual detection of protected species at these sites allows for complete mitigation within a radius that extends out to the distance at which only the lowest degree of temporary auditory threshold shift (onset-TTS) would be expected to occur (if mitigation were not so effective at the site). Therefore, the Navy and NMFS do not expect mine neutralization exercises to result in the take of marine mammals and no take authorization pursuant to this activity type has been proposed.

Shallow Water Minefield

Currently, the Navy conducts mine countermeasures (MCM) training on two existing ranges in the SOCAL Range Complex: the Kingfisher Range off SCI and the ARPA Training Minefield off La Jolla. The ARPA has historically been used for shallow water submarine and MCM training, and is the desired location for expanding MCM training. ARPA currently supports the submarine training requirement for a shallow water minefield to train in small object avoidance. Use of the ARPA shallow water minefield would be expanded from its current use by submarines to include surface ships and helicopters.

On the ARPA, 35 mine shapes approximately 30–35 inches in diameter, constructed of cylinders weighted with cement, are placed approximately 500–700 yards apart, either moored (no drilling is required) or simply set on the sea floor. Mine shapes are recoverable and replaceable, and typically need maintenance or cleaning every two years.

In addition to expanded use of the ARPA, the Navy proposes to establish an offshore shallow water minefield on Tanner Banks. The training area would be approximately 2 by 3 nm in size. Mine shapes like those used at ARPA would be placed on the ocean floor, with a total of 15 mine shapes in three rows of five. This offshore MCM range would be utilized by surface ships training to detect, classify and localize underwater mines.

MCM training involving ships or helicopters typically employ mid-to high-frequency navigation and mine detecting sonar systems. Once a mine shape is located, mine neutralization is simulated. Surface ships engaged in MCM training at ARPA and Tanner Banks MCM ranges would utilize the Remote Mine Hunting System (RMS). The RMS is an unmanned, semi-submersible vehicle that will be deployed from both the DDG–51 Class destroyer and the LCS. The RMS is launched and recovered by the host ship using a davit system. After deployment, the RMS enters the target zone to perform reconnaissance for bottom-laid mines. An area search is conducted following an operator-programmed search pattern. The RMS searches using low-power (< 85dB) acoustic sonar. Upon detecting a mine, the RMS unit will localize and photograph the object for classification, and then continue on its programmed search. When the search portion of the mission is completed, the RMS will proceed to a programmed location for recovery.

The exercises that will be conducted on these minefields have been described in previous sections and any expected take of marine mammals will be included when those exercise types are analyzed in later sections. NMFS does not expect the actual expansion and formation of the minefields to result in any take of marine mammals.

Shallow Water Training Range (SWTR) Extension

The SWTR component of the Proposed Action would provide underwater instrumentation for two additional areas of the current SOAR, one 250nm^2 (463-km^2) area to the west of the already instrumented (deep water) section, in the area of Tanner/Cortes Banks, and one 250 nm^2 (463-km^2) area between the deep water section and the southern section of SCI (See Figure 2–3). Once in place, the new instrumentation in the SWTR would expand the areas of the Navy's existing program on SOAR to enhance the ability to use passive hydrophones to detect and track marine mammals. If installed in these areas, use of the SWTR would increase the use of these areas for ASW training involving MFAS.

The proposed instrumentation would be in the form of undersea cables and sensor nodes. The cables and sensors would be similar to those that instrument the current deep water range at (SOAR). The new areas would form an integral SWTR capability for SOAR. The combination of deep water and shallow water instrumentation would support a seamless tracking interface from deep to shallow water, which is an essential element of effective ASW training. The instrumented area would be connected to shore via multiple trunk cables.

The SWTR instrumentation would be an undersea cables system integrated with hydrophone and underwater telephone sensors, called nodes, connected to each other and then connected by up to eight trunk cable(s) to a land-based facility where the collected range data are used to evaluate the performance of participants in shallow water (120'-600'deep) training exercises. The basic proposed features of the instrumentation and construction follow.

The transducer nodes are capable of both transmitting and receiving acoustic signals from ships operating within the instrumented areas of SOAR (a transducer is an instrument that converts one form of energy into another [in this case, underwater sound into an electrical signal or vice-versa]). Some nodes are configured to only support receiving signals, some can both transmit and receive, and others are transmit-only versions. The acoustic signals that are sent from the exercise participants (e.g., submarines, torpedoes, ships) to the receive-capable range nodes allow the position of the participants to be determined and stored electronically for both real-time and future evaluation. The transmit-capable nodes allow communication from the range to ships or other devices that are being tracked. More specifically:

• The SWTR extension would consist of no more than 500 sensor nodes spread on the ocean floor over a 500-nm area. The distance between nodes would vary between 0.5nm and 3nm, depending on water depth. Each sensor node would be similar on construction to the existing SOAR instrumentation. The sensor nodes are small spherical shapes of less than 6 inches in diameter. The sensors would be either suspended up to 15 feet in the water column or lie flat on the seafloor. Sensor nodes located in shallow water with a presence of commercial fishing activity would have an additional protective device surrounding or overlaying a sensor. These mechanical protective devices would be 3–4 feet round or rectangular with a shallow height. The final physical characteristics of the sensor nodes would be determined based upon local geographic conditions and to accommodate man-made threats such as fishing activity. Sensor nodes would be connected to each other by interconnect cable (standard submarine telecommunications cable with diameters less than 1 inch). Approximately 900nm of interconnect cable would be deployed.

• A series of sensor nodes would be connected via the interconnect cable to an underwater junction box(es) located in diver-accessible water depths. A junction box is rectangular in shape with dimensions of 10–15 feet on each side. The junction box(es) would connect to a shore-based facility via trunk cable(s) (submarine cables up to 2 inch diameter with additional data capacity). The trunk cable(s) eliminate the need to have numerous interconnect cables running to shore. Up to 8 trunk cables with a combined length of 375nm would be employed. Trunk cables would be protected in the sea-shore area by horizontally directionally drilled pipes running beneath the shoreline.

• The interconnect and trunk cables would be deployed using a ship with a length overall up to 300 feet. The trunk cable paths would be routed through the deep water as much as is possible. Trunk cable deployed in shallow water may require cable burial. Burial equipment would cut (hard bottom) or plow (soft sediment) a furrow 4 inches (10 cm) wide by up to 36 inches deep. Burial equipment (tracked vehicle or towed plow) would be deployed from a ship. The trunk cable, which passes through the sea-shore area, would terminate in SOAR's current cable termination facility (CTF) at West Cove. From there, information gathered on the SWTR would be transmitted via an existing microwave datalink to the Southern California Offshore Range (SCORE) Range Operations Center (ROC) on Naval Air Station North Island. The adjacent SOAR has a single junction box located outside the nearshore area and places the trunk cable in a horizontally directionally drilled bore that terminates on shore. The size of the SWTR may require up to 8 junction boxes and 8 trunk cables. Multiple horizontal bores are in the SOAR. Every effort would be made to take advantage of any excess bore capacity available in the SOAR.

• The in-water instrumentation system would be structured to achieve a long operating life, with a goal of 20 years and with a minimum of maintenance and repair throughout the life-cycle. This is due to the high cost of performing at-sea repairs on transducer nodes and cables, the inherently long lead-time to plan, permit, fund and conduct such repairs (6–18 months) and the loss of range capability while awaiting completion. The long life performance would be achieved by using high quality components, proven designs, and multiple levels of redundancy in the system design. This includes back-up capacity for key electronic components and fault tolerance to the loss of individual sensors or even an entire sensor string. The use of materials capable of withstanding long term exposure to high water pressure and salt water-induced corrosion is also important. Periodic inspection and maintenance in accessible areas also extends system life.

The Navy would submit cable area coordinates to the National Geospatial Intelligence Agency (NGA) and request that the combined SWTR/SOAR area be noted on charts within the appropriate warning area. This area would be noted in the U.S. Coast Pilot as a Military Operating Area (MOA), as are other areas on the West Coast. The Navy may promulgate a Notice to Mariners (NOTMAR) and a Notice to Airmen (NOTAM) within 72 hours of the training activities, as appropriate.

Installation of the SWTR instrumentation array may be done in phases. For example, the Tanner Bank area could be installed first, followed by the eastern area. The decision as to whether or not to proceed in phases, how many phases, and the order in which the phases are executed is based on multiple factors, including weather, ship availability and capacity, production schedules for nodes and cable, installation time, total environmental impact of installation, funding availability, and efficiency.

RDT&E

Space and Naval Warfare Systems Center (SPAWARSYSCEN) conducts research, development, testing, and evaluation (RDT&E), engineering, and fleet support for command, control, and communications systems and ocean surveillance in the SOCAL Range Complex, primarily in the vicinity of SCI. Specific events include ship tracking and torpedo tests, unmanned underwater vehicle (UUV) tests; and sonobuoy quality assurance/quality control.

The San Diego Division of the Naval Undersea Warfare Center (NUWC) is a Naval Sea Systems Command (NAVSEA) organization supporting the Pacific Fleet. NUWC operates and maintains the SCI Underwater Range (SCIUR). NUWC conducts tests, analysis, and evaluation of submarine USW exercises and test programs. NUWC also provides engineering and technical support for Undersea Warfare (USW) programs and exercises, design cognizance of underwater weapons acoustic and tracking ranges and associated range equipment, and provides proof testing and evaluation for underwater weapons, weapons systems, and components.

Additional information on the Navy's proposed activities may be found in the LOA Application and Appendix A of the Navy's SOCAL DEIS.

Description of Marine Mammals in the Area of the Specified Activities

The California Current passes through the SOCAL Range Complex, creating a mixing of temperate and tropical waters, and making this area one of the most productive ocean systems in the world (Hickey 1979, Hickey 1992, Daily *et al.* 1993, DoN 2002a). Because of this productive environment, there is a rich marine mammal fauna, as evidenced in abundance and species diversity (Leatherwood *et al.*, 1988; Bonnell and Dailey, 1993). In addition to many marine mammal species that live in the area year-round and use the region's coasts and islands for breeding and hauling out, there is a community of seasonal residents and migrants. The narrow continental shelf along the Pacific coast and the presence of the cold California Current sweeping down from Alaska allows cold-water marine mammal species to reach nearshore waters as far south as Baja California. The Southern California Bight (SCB) is the major geological region occurring within the SOCAL Range Complex and can be described as a complex combination of islands, ridges, and basins that exhibit wide ranges in water temperature. San Diego Bay, a naturally formed, crescent-shaped embayment is located along the southern end of the SCB (Largier, 1995; DoN, 2000); the bay provides habitat for a number of oceanic and estuarine species as the ebb and flood of tides within the Bay circulate and mix ocean and Bay waters, creating for distinct circulation zones within San Diego Bay (*see* Chapter 2 of the application for further detail regarding these zones) (Largier *et al.*, 1996; DoN, 2000).

Populations/stocks of forty-one marine mammal species have been confirmed or may possibly occur in the study area off southern California (see Table 4), including 34 cetacean (whales, dolphins, and porpoises), six pinniped (seals, sea lions, and fur seals), and one fissiped species (the sea otter, which is managed by the U.S. Fish and Wildlife Service and will not be addressed further here). Information on marine mammal occurrence at the Point Mugu Sea Range (just to the north of the SOCAL Range Complex) is analyzed in Koski *et al.* (1998). Temperate and warm-water toothed whales often change their distribution and abundance as oceanographic conditions vary both seasonally (Forney and Barlow, 1998) and interannually (Forney 2000). Forney and Barlow (1998) noted significant north/south shifts in distribution for Dall's porpoises, common dolphins, and Pacific white-sided dolphins, and they identified significant inshore/offshore differences for northern right whale dolphins and humpback whales. Several authors have noted the impact of the El Niño events of 1982/1983 and 1997/1998 on marine mammal occurrence patterns and population dynamics in the waters off California (Wells *et al.*, 1990; Forney and Barlow, 1998; Benson *et al.*, 2002).

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Common Name	Species Name	Stock	Occurrence	Warm Season May-Oct	Cold Season Nov-Apr
Mysticetes					
Blue whale	*Balaenoptera musculus*	Eastern North Pacific	Seasonal, Arrive Apr-May, more common late summer to fall	YES	NO
Fin whale	*Balaenoptera physalus*	California, Oregon, & Washington	Year round species, small population	YES more	YES less
Humpback whale	*Megaptera novaeangliae*	California, Oregon, & Washington	Seasonal, More sightings around the northern Channel Islands	YES	NO
North Pacific right whale	*Eubalaena japonica*	Eastern North Pacific	Very rare Rare throughout the Pacific; only 12 sightings in California since 1900	RARE	RARE
Sei whale	*Balaenoptera borealis*	Eastern North Pacific	Rare, Less than three sightings within the last 30 years	UNK	UNK
Bryde's whale	*Balaenoptera edeni*	Eastern Tropical Pacific	Rare, Only one confirmed sighting in California	UNK	UNK
Gray whale	*Eschrichtius robustus*	Eastern North Pacific	Transient during seasonal migrations		
Minke whale	*Balaenoptera acutorostrata*	California, Oregon, & Washington	Less common in summer, small numbers around northern Channel Islands	NO	YES
Odontocetes					
Sperm whale	*Physeter macrocephalus*	California, Oregon, & Washington	Common year round, More likely in waters > 1000 m, most often > 2000 m	YES more	YES less
Bottlenose dolphin coastal	*Tursiops truncatus*	California Coastal	Limited, small population within one km of shore	YES	YES
Bottlenose dolphin offshore	*Tursiops truncatus*	California Offshore	Common	YES	YES
Long-beaked common dolphin	*Delphinus capensis*	California	Common, more inshore distribution	YES	YES
Northern right whale dolphin	*Lissodelphis borealis*	California, Oregon, & Washington	Common, cool water species, more abundant Nov-Apr		
Pacific white-sided dolphin	*Lagenorhynchus obliguidens*	California, Oregon, & Washington	Common, year round cool water species, more abundant Nov-Apr	YES less	YES more
Pantropical spotted dolphin	*Stenella attenuate*	Eastern Tropical Pacific	Rare	UNK	UNK
Risso's Dolphin	*Grampus griseus*	California, Oregon, & Washington	Common, present in summer, but higher densities Nov-Apr	YES less	YES more
Rough-toothed dolphin	*Steno bredanensis*	no stock designated on Pacific Coast	Rare, more tropical offshore species	RARE	RARE
Short-beaked common dolphin	*Delphinus delphis*	California, Oregon, & Washington	Common, one of the most abundant SOCAL dolphins, higher summer densities	YES more	YES less
Spinner dolphin	*Stenella longirostris*	no stock designated on Pacific Coast	Rare	RARE	RARE
Striped dolphin	*Stenella coeruleoalba*	California, Oregon, & Washington	Occasional visitor, cool water oceanic species	NO	RARE
Dall's porpoise	*Phocoenoides dalli*	California, Oregon, & Washington	Common, year round cool water species; more abundant Nov-Apr	NO	YES
False killer whale	*Pseudorca crassidens*	Eastern Tropical Pacific	Uncommon, warm water species, although stranding records from the Channel Islands	UNK	UNK
Killer whale offshore	*Orcinus orca*	Eastern North Pacific	Uncommon, occurs infrequently, more likely in winter	NO	YES
Killer whale transient	*Orcinus orca*	Eastern North Pacific	Uncommon, occurs infrequently, more likely in winter	NO	YES
Melon-headed whale	*Peponocephala electra*	no stock designated on Pacific Coast		RARE	RARE
Pygmy killer whale	*Feresa attenuata*	no stock designated on Pacific Coast		RARE	RARE
Short-finned pilot whale	*Globicephala macrorhynchus*	California, Oregon, & Washington	Uncommon, more common before 1982	UNK	UNK
Pygmy sperm whale	*Kogia breviceps*	California, Oregon, & Washington	Rare, seaward of 500-1000 m, limited sightings over entire SCB	UNK	UNK
Dwarf sperm whale	*Kogia sima*	California, Oregon, & Washington	Possible visitor, seaward of 500-1000 m, limited sightings over entire SCB	UNK	YES
Baird's beaked whale	*Berardius bairdii*	California, Oregon, & Washington	Rare	UNK	UNK
Cuvier's beaked whale	*Ziphius cavirostris*	California, Oregon, & Washington	Uncommon, seaward of 1000 m, only limited sightings in winter	YES	UNK
Mesoplodont beaked whales (including Blainville's, Hubb's, Perrin's, pygmy, and ginkgo-toothed beaked whales)	*Mesoplodon* spp	California, Oregon, & Washington	Rare, seaward of 500-1000 m, limited sightings	UNK	UNK
Pinniped					
Guadalupe fur seal	*Arctocephalus townsendi*	Mexico	Rare, Occasional visitor to northern Channel Islands, mainly breeds on Guadalupe Is . Mexico, May-Ju	UNK	UNK
Steller sea lion	*Eumetopias jubatus*	California, Oregon, & Washington	Very rare, Summer distribution north of 38N, last seen in northern Channel Islands in 1998	NO	NO
Northern elephant seal	*Mirounga angustirostris*	California Breeding	Common, Channel Island haul-outs of different age classes, including SCI Dec-Mar and Apr-Aug, spend 8-	YES	YES
Pacific Harbor seal	*Phoca vitulina*	California	Common, Channel Islands haul-outs including SCI	YES	YES
California sea lion	*Zalophus californianus*	U S Stock	Common, most common pinniped, Channel Islands breeding sites in summer	YES	YES
Northern fur seal	*Callorhinus ursinus*	San Miguel Island	Common, small population that breeds on San Miguel Is May-Oct	YES more	YES less

Table 4 Marine Mammals with known or suspected occurrence in the Southern California Range Complex

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The Navy has compiled information on the abundance, behavior, status and distribution, and vocalizations of marine mammal species in SOCAL Range Complex waters from peer reviewed literature, the Navy Marine Resource Assessment for the SOCAL Operating Area, NMFS Stock Assessment Reports, and marine mammal surveys using acoustics or visual observations from aircraft or ships. This information may be viewed in the Navy's LOA application and/or the Navy's DEIS for SOCAL (see Availability). Additional information is available in NMFS Stock Assessment Reports, which may be viewed at:

http://www.nmfs.noaa.gov/pr/sars/species.htm.

Species Not Considered Further

Killer whale, Southern Resident Stock—The Southern Resident stock of killer whale is not likely to be present within Southern California. This stock is most commonly seen in the inland waters of Washington state and southern Vancouver Island; however, individuals from this stock have been observed in Monterey Bay, California in January, 2000 and March, 2003, near the Farallon Islands in February 2005 and off Point Reyes in January 2006 (Pacific Fishery Management Council (PFMC) and NMFS 2006). Based on the above known information, there is a very low likelihood of Southern Resident killer whales being present in the action area, so this species will not be considered in greater detail.

North Pacific right whale—The likelihood of a North Pacific right whale being present in the action area is extremely low. It may be the most endangered of the large whale species (Perry *et al.* 1999) and currently there is no reliable population estimate, although the population in the eastern North Pacific Ocean is considered to be very small, perhaps in the tens to low hundreds of animals. Despite many years of systematic aerial and ship-based surveys for marine mammals off the western coast of the U.S., only seven documented sightings of right whales were made from 1990 through 2000 (Waite *et al.*, 2003). Based on this information, it is highly unlikely for this species to be present in the action area. Consequently, this species will not be considered in greater detail.

Steller sea lion (Eumetopias jubatus) Eastern Distinct Population Segment—Steller sea lions are also not expected to be present in the action area. Steller sea lions range along the North Pacific Rim from northern Japan to California (Loughlin *et al.*, 1984), with centers of abundance and distribution in the Gulf of Alaska and Aleutian Islands, respectively. In U.S. waters, there are two separate stocks of Steller sea lions: an eastern U.S. stock, which includes animals east of Cape Suckling, Alaska (144° W longitude), and a western U.S. stock, which includes animals at and west of Cape Suckling (Loughlin 1997). The closest rookery to the action area is Año Nuevo Island, which declined by 85% between 1970 and 1987 (LeBoeuf *et al.*, 1991). Steller sea lions are rarely sighted in Southern California waters and have not been documented interacting with southern California fisheries in over a decade. The last documented interaction with California-based fisheries was in northern California, in 1994, with the California/Oregon drift gillnet fishery (NMFS, 2000). The last sighting of a Steller sea lion in Southern California was that of a subadult male that was briefly on San Miguel Island in 1998 (Thorson *et al.*, 1998). For the reasons listed above, Steller sea lions are not likely to be present in the action area, and will not be considered in greater detail.

Marine Mammal Density Estimates

The southern California region has been systematically surveyed for several years (1991–1993, 1996, 2001, 2005) by the National Marine Fisheries Service (NMFS), both via aircraft (e.g., Carretta and Forney, 1993) and vessel (e.g., Ferguson and Barlow, 2003; Barlow, 2003; Forney, 2007). The most recent vessel survey was conducted in the U.S. Exclusive Economic Zone (EEZ) out to 300 nm offshore of California, Oregon and Washington by NMFS in summer and fall 2005 (Barlow, 2007; Forney, 2007). There has also been regional survey effort in the area of the proposed action, particularly around San Clemente Island and in extreme near shore areas (e.g., Carretta *et al.*, 2000; Carretta, 2003). Consequently there are several density estimates available for most cetacean species in southern California.

For this LOA, NMFS Southwest Fisheries Science Center calculated marine mammal density estimates based on compiled densities from vessel surveys conducted from 1986 to 2005, and provided it to the Navy as Government Furnished Information (GFI). A new multiple-covariate, line-transect approach (Marques and Buckland, 2003) was used to account for multiple factors that affect the distance at which cetaceans can be seen in different conditions. Other computational procedures were as described in Barlow (2007) and Forney (2007).

These density compilations prorate densities of ''unidentified'' species groups (such as unidentified dolphins, small whales, rorquals, large whales, etc.) with densities of identified species, so likely represent the most conservative densities at this time for the southern California region. Densities are presented for warm (May–October) and cold water (November–April) seasons north of 30° N, which is the southern extent of NMFS marine mammal survey cruises. Gray whale densities were taken from Carretta *et al.* (2000), and are applicable for January–April only. The geographic distributions of cetacean species for which densities are available off southern California overlap completely with all eight sonar areas (shown in Figure 3–1 of the application), so further refinement of densities to sonar areas was not necessary. Area 8 includes all areas outside the previous seven areas that are within the quasi-rectangular region bounded in latitude by 29° N and 34° N, and in longitude by 120°30′ W and 116°30′ W but is not indicated in Figure 3–1 of the application.

Pinniped at-sea density is not often known because pinniped abundance is obtained via shore counts of animals at known rookeries and haulouts. Therefore, densities of pinnipeds were derived quite differently from those of cetaceans. Several parameters were identified from the literature, including area of stock occurrence, number of animals (which may vary seasonally) and season, and those parameters were then used to calculate density. Once density per ''pinniped season'' was determined, those values were prorated to fit the warm water (May–October) and cold water (November–April) seasons. Pinniped geographic distributions do not overlap all sonar areas, so density was further refined as the percentage of each sonar area actually overlapped by the species distribution. Determining density in this manner is risky as the parameters used usually contain error (e.g., geographic range is not exactly known and needs to be estimated, abundance estimates usually have large variances) and, as is true of all density estimates, it assumes that animals are always distributed evenly within an area which is likely never true. However, this remains one of the few means available to determine at-sea density for pinnipeds.

The detailed density estimate methods and results may be viewed in Section 3.5 of the Navy's LOA application. Density and abundance are summarized in Table 13.

Depth Distribution of Marine Mammals

There are limited depth distribution data for most marine mammals. This is especially true for cetaceans, as they must be tagged at-sea and by using a tag that either must be implanted in the skin/blubber in some manner or adhere to the skin. There is slightly more data for some pinnipeds, as they can be tagged while on shore during breeding or molting seasons and the tags can be glued to the pelage rather than implanted. There are a few different methodologies/techniques that can be used to determine depth distribution percentages, but by far the most widely used technique currently is the time-depth recorder. These instruments are attached to the animal for a fairly short period of time (several hours to a few days) via a suction cup or glue, and then retrieved immediately after detachment or when the animal returns to the beach. Depth information can also be collected via satellite tags, sonic tags, digital tags, and, for sperm whales, via acoustic tracking of sounds produced by the animal itself.

There are somewhat suitable depth distribution data for a few marine mammal species. Sample sizes are usually extremely small, nearly always fewer than 10 animals total and often only one or two animals. Depth distribution information often must be interpreted from other dive and/or preferred prey characteristics. Depth distributions for species for which no data are available can be extrapolated from similar species.

Density is nearly always reported for an area, e.g., animals/km^2. Analyses of survey results using Distance Sampling techniques include correction factors for animals at the surface but not seen as well as animals below the surface and not seen. Therefore, although the area (e.g., km^2) appears to represent only the surface of the water (two-dimensional), density actually implicitly includes animals anywhere within the water column under that surface area. Density assumes that animals are uniformly distributed within the prescribed area, even though this is likely rarely true. Marine mammals are usually clumped in areas of greater importance, for example, areas of high productivity, lower predation, safe calving, etc. Density estimates are typically derived for large areas by NMFS, for instance the All California and Point Conception south stratas presented in Forney and Barlow, 2007. Often scientific information on smaller scale distribution and density within discrete areas such as the SOCAL modeling areas used in the acoustic impact analysis is lacking and larger scale densities have to be used as an approximate. The available NMFS derived density estimates are therefore used in lieu of small scale density estimates. In addition, as a further conservative approach, these densities are evenly distributed across a given model area since the degree of daily, seasonal, and yearly presence/absence or spatial clumping is currently not well known for many species.

Assuming that marine mammals are distributed evenly within the water column is not accurate. The ever-expanding database of marine mammal behavioral and physiological parameters obtained through tagging and other technologies has demonstrated that marine mammals use the water column in various ways, with some species capable of regular deep dives (<800 m) and others regularly diving to <200 m, regardless of the bottom depth. Assuming that all species are evenly distributed from surface to bottom is almost never appropriate and can present a distorted view of marine mammal distribution in any region.

By combining marine mammal density with depth distribution information, as is done for the SOCAL Range Complex, a more accurate three-dimensional density estimate is possible. These 3–D estimates allow more accurate modeling of potential marine mammal exposures from specific noise sources. Complete details on species biological parameters used in sonar and explosives modeling are provided in Appendix F to the SOCAL DEIS.

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 (for the MFAS/HFAS considered in this proposed rule, the medium is marine 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, it is derived 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 power (e.g., 20 dB is a 100-fold increase, 30 dB is a 1,000-fold increase). Humans perceive a 10-dB increase in noise as a doubling of loudness, or a 10 dB decrease in noise 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 decibels underwater and decibels in air are not the same and cannot be directly compared. To estimate a comparison between sound in air and underwater, because of the different densities of air and water and the different decibel standards (i.e., reference pressures) in water and air, a sound with the same intensity (i.e., power) in air and in water would be approximately 63 dB quieter in air. Thus a sound that is 160 dB loud underwater would have the same approximate effective intensity as a sound that is 97 dB loud 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 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 developed for each 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 (13 species of mysticetes): functional hearing is estimated to occur between approximately 7 Hz and 22 kHz;

• Mid-frequency cetaceans (32 species of dolphins, six species of larger toothed whales, and 19 species of beaked and bottlenose whales): functional hearing is estimated to occur between approximately 150 Hz and 160 kHz;

• High frequency cetaceans (eight species of true porpoises, six species of river dolphins, Kogia, the franciscana, and four species of cephalorhynchids): 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, with the greatest sensitivity between approximately 700 Hz and 20 kHz.

Because ears adapted to function underwater are physiologically different from human ears, comparisons using decibel measurements in air would still not be adequate to describe the effects of a sound on a whale. When sound travels away from its source, its loudness decreases as the distance traveled (propagates) by the sound increases. Thus, the loudness of a sound at its source is higher than the loudness of that same sound a kilometer distant. Acousticians often refer to the loudness of a sound at its source (typically measured one meter from the source) as the source level and the loudness of sound elsewhere as the received level. For example, a humpback whale three kilometers from an airgun that has a source level of 230 dB may only be exposed to sound that is 160 dB loud, depending on how the sound propagates (in this example, it is spherical spreading). As a result, it is important not to confuse 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 MFAS/HFAS 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 in the discussions of acoustic effects in this document.

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. The commonly used reference pressure level in underwater acoustics is 1 μPa, and the units for SPLs are dB re: 1 μPa.

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

SPL is an instantaneous measurement and can be expressed as the peak, the peak-peak, or the root mean square (rms). Root mean square, 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 a sound 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).

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.

SEL = SPL + 10 log (duration in seconds).

As applied to MFAS/HFAS, 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 total SEL. The total 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 in SEL.

Potential Effects of Specified Activities on Marine Mammals

Exposure to MFAS/HFAS

The Navy has requested authorization for the take of marine mammals that may occur incidental to training activities in the SOCAL Range Complex utilizing MFAS/HFAS or underwater detonations. The Navy has analyzed the potential impacts to marine mammals from training activities in the SOCAL Range Complex, including ship strike, entanglement in or direct strike by expended materials, ship noise, and others, and in consultation with NMFS as a cooperating agency for the SOCAL EIS, has determined that take of marine mammals incidental to these non-acoustic components of SOCAL is unlikely and, therefore, has not requested authorization for take of marine mammals that might occur incidental to these non-acoustic components. In this document, NMFS analyzes the potential effects on marine mammals from exposure to MFAS/HFAS and underwater detonations from the IEER.

For the purpose of MMPA authorizations, NMFS' effects assessments serve three primary purposes: (1) to put forth the permissible methods of taking within the context of MMPA Level B Harassment (behavioral harassment), Level A Harassment (injury), and mortality (i.e., identify the number and types of take that will occur); (2) to determine whether the specified activity will have a negligible impact on the affected species or stocks of marine mammals (based on the likelihood that the activity will adversely affect the species or stock through effects on annual rates of recruitment or survival); and (3) to determine whether the specified activity will have an unmitigable adverse impact on the availability of the species or stock(s) for subsistence uses (however, there are no subsistence communities that would be affected in the SOCAL Range Complex, so this determination is inapplicable for SOCAL).

More specifically, for activities involving sonar or underwater detonations, 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 that would be classified as behavioral harassment or injury and/or would be likely to adversely affect the species or stock through effects on annual rates of recruitment or survival. In this section, we will focus qualitatively on the different ways that MFAS/HFAS and underwater explosive detonations (IEER) may affect marine mammals (some of which NMFS would not classify as harassment). Then, in the Estimated Take of Marine Mammals Section, NMFS 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 those effects.

In its June 21, 2008, Biological Opinion of the U.S. Navy's proposal to conduct MFAS in the Hawaii Range Complex, NMFS presented a conceptual model of the potential responses of endangered and threatened species upon being exposed to MFAS/HFAS and the pathways by which those responses might affect the fitness of individual animals that have been exposed, which may then affect the reproduction and/or survival of those individuals. Literature supporting the framework, with examples drawn from many taxa (both aquatic and terrestrial) was included in the ''Application of this Approach'' and ''Response Analyses'' sections of that document (available at: *http://www.nmfs.noaa.gov/pr/permits/incidental.htm*). This conceptual framework may also be used to describe the responses and pathways for non-endangered and non-threatened species and is included in Biological Opinion of the U.S. Navy's proposal to conduct MFAS in the Hawaii Range Complex.

Direct Physiological Effects

Based on the literature, there are two basic ways that MFAS/HFAS 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 recognize them) following exposure to a sufficiently intense sound, 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 recovery), occurs 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 by only 6 dB or reduced by 30 dB). PTS is permanent (i.e., there is no recovery), but also occurs 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 TSs: 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 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 continuous sounds, exposures of equal energy (the same SEL) will lead to approximately equal effects. For intermittent sounds, less TS will occur than from a continuous exposure with the same energy (some recovery will occur between intermittent exposures) (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, very prolonged exposure to sound strong enough to elicit TTS, or shorter-term exposure to sound levels well above the TTS threshold, can cause PTS, at least in terrestrial mammals (Kryter, 1985) (although in the case of 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 cetaceans, published data on the onset of TTS are limited to the captive bottlenose dolphin and beluga (Finneran *et al.*, 2000, 2002b, 2005a; Schlundt *et al.*, 2000; Nachtigall *et al.*, 2003, 2004). For pinnipeds in water, data are limited to Kastak *et al.*'s measurement of TTS in one harbor seal, one elephant seal, and one California sea lion.

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 takes place during a time when the animal is traveling through the open ocean, where ambient noise is lower and there are not as many competing sounds present. Alternatively, a larger amount and longer duration of TTS sustained during 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 development and 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. There is no empirical evidence that exposure to MFAS/HFAS can cause PTS in any marine mammals; instead the probability of PTS has been inferred from studies of TTS (see Richardson *et al.*, 1995).

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

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. 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 MFAS/HFAS 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 MFAS/HFAS can lead to strandings is included in the Behaviorally Mediated Bubble Growth Section, after the summary of strandings.

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.

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As mentioned previously, the functional hearing ranges of mysticetes, odontocetes, and pinnipeds underwater all encompass the frequencies of the MFAS/HFAS sources used in the Navy's MFAS/HFAS training exercises. Additionally, in almost all species, vocal repertoires span across the frequencies of these MFAS/HFAS 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 MFAS/HFAS—which accounts for the largest part of the takes of marine mammals (because of the source strength and number of hours it's conducted), the pulse length and duty cycle of the MFAS/HFAS signal (~ 1 second pulse twice a minute) makes it less likely that masking will 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 one or more of the following adjustments to their vocalizations: Adjust the frequency structure; adjust the amplitude; adjust temporal structure; or adjust temporal delivery (see Biological Opinion).

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 response.

In the case of many stressors, an animal's first and 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 or sympathetic nervous systems; the system that has received the most study has been the hypothalamus-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) and 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.

Relationships between these physiological mechanisms, animal behavior, and the costs of stress responses have also been documented fairly well through controlled experiment; 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). Although no information has been collected on the physiological responses of marine mammals to exposure to anthropogenic sounds, studies of other marine animals and terrestrial animals would 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) 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), NMFS also assumes that stress responses could 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 effect 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 (but is not limited to) the following observable responses: Increased alertness; orientation or attraction to a sound source; vocal modifications; cessation of feeding; cessation of social interaction; alteration of movement or diving behavior; habitat abandonment (temporary or permanent); and, in severe cases, panic, flight, stampede, or stranding, potentially resulting in death (Southall *et al.*, 2007). A review of marine mammal responses to anthropogenic sound was first conducted by Richardson (1995). 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 MFAS 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.

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 MFAS 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).

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 level at the animals was 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 United States have been observed to increase the duration of primary calls once a threshold in observing vessel density (e.g., whale watching) was reached, which has been suggested as a response to increased masking noise produced by the vessels (Foote *et al.*, 2004). 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).

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 mid-frequency active sonars. Much more information is available on the avoidance responses of free-living cetaceans to other acoustic sources, such as seismic airguns and low frequency active sonar, than mid-frequency active sonar.

Behavioral Responses (Southall et al. (2007))

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 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: 1μPa 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 the 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 (~90–120 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. The Pacific harbor porpoise, however, does not normally occur within Southern California south of Point Conception, and would therefore, not be exposed to Navy activities covered by this proposed rule. 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 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)

In Table 5 we have summarized the scores that Southall *et al.* (2007) assigned to the papers that reported behavioral responses of low-frequency cetaceans, mid-frequency cetaceans, and pinnipeds in water to non-pulse sounds. This table is included simply to summarize the findings of the studies and opportunistic observations (all of which were capable of estimating received level) that Southall *et al.* (2007) compiled in the effort to develop acoustic criteria.

	Received RMS Sound Pressure Level (dB re: 1 μPa)											
Response Score	80 to < 90	90 to < 100	100 to < 110	110 to < 120	120 to < 130	130 to < 140	140 to < 150	150 to < 160	160 to < 170	170 to < 180	180 to < 190	190 to <200
9												
8		M	M		M		M				M	M
7						L	L					
6	H	L/H	L/P/H	L/M/H	L/M/H	L	L/H	H	M/H	M		
5			H	H	M							
4				L/M	L/M/P	P	L					
3		M	L/M	L/M	M/P	P						
2			L	L/M	L	L	L					
1			M	M	M							
0	L/H/P	L/H/P	L/M/H	L/M/H/P	L/M/H/P	L	M				M	M

Table 5. Data compiled from three tables from Southall et al. (2007) indicating when marine mammals (low-frequency cetaceans = L, mid-frequency cetaceans = M, high frequency cetaceans = H, and pinnipeds = P) were reported as having a behavioral response of the indicated severity to a non-pulse sound of the indicated received level. As discussed in the text, responses are highly variable and context specific.

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 unconsciously (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 a 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 to 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 (*Anser brachyrhynchus*) in undisturbed habitat gained body mass and had about a 46-percent reproductive success rate compared with geese in disturbed habitat (being consistently scared off the fields on which they were foraging) which did not gain mass and has a 17-percent reproductive success rate. Similar reductions in reproductive success have been reported for mule deer (*Odocoileus hemionus*) disturbed by all-terrain vehicles (Yarmoloy *et al.*, 1988), caribou 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 (*Cervus elaphus*) that were disturbed experimentally by pedestrians concluded that the ratio of young to mothers was inversely related to disturbance rate (Phillips and Alldredge, 2000).

The primary mechanism by which increased vigilance and disturbance appear to affect the fitness of individual animals is by disrupting an animal's time budget and, as a result, reducing the time they might spend foraging and resting (which increases an animal's activity rate and energy demand). For example, a study of grizzly bears (*Ursus horribilis*) reported that bears disturbed by hikers reduced their energy intake by an average of 12 kcal/min (50.2×10^3kJ/min), 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 five 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-hr 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 one day and not recurring on subsequent days is not considered particularly severe unless it could directly affect reproduction or survival (Southall *et al.*, 2007).

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; National Marine Fisheries Service, 2007p). The legal definition for a stranding within the United States is that (A) ''a marine mammal is dead and is (i) on a beach or shore of the United States; or (ii) in waters under the jurisdiction of the United States (including any navigable waters); or (B) a marine mammal is alive and is (i) on a beach or shore of the United States and is unable to return to the water; (ii) on a beach or shore of the United States and, although able to return to the water, is in need of apparent medical attention; or (iii) in the waters under the jurisdiction of the United States (including any navigable waters), but is unable to return to its natural habitat under its own power or without assistance.'' (16 U.S.C. 1421h).

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

Several sources have published lists of mass stranding events of cetaceans during attempts to identify relationships between those stranding events and military active sonar (Hildebrand, 2004; IWC, 2005; Taylor *et al.*, 2004). For example, based on a review of stranding records between 1960 and 1995, the International Whaling Commission (2005) identified ten mass stranding events of Cuvier's beaked whales that had been reported and one mass stranding of four Baird's beaked whales (*Berardius bairdii*). 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 MFAS, 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 (Franzis, 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 MFAS.

Between 1960 and 2006, 48 strandings (68 percent) involved beaked whales, 3 (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 (7 or 10 percent), and Blainville's and Gervais' beaked whales (4 each or 6 percent). Naval activities that might have involved active sonar are reported to have coincided with 9 (13 percent) or 10 (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 7 were coincident with naval exercises that were using mid-frequency sonar.

Strandings Associated With MFAS

Over the past 12 years, there have been five stranding events coincident with military mid-frequency active sonar use in which exposure to sonar is believed to have been a contributing factor: Greece (1996); the Bahamas (2000); Madeira (2000); Canary Islands (2002); and Spain (2006). A number of other stranding events coincident with the operation of MFAS including the death of beaked whales or other species (minke whales, dwarf sperm whales, pilot whales) have been reported, however, the majority have not been investigated to the degree necessary to determine the cause of the stranding.

Greece (1996)

Twelve Cuvier's beaked whales stranded atypically (in both time and space) along a 38.2-kilometer strand of the coast of the Kyparissiakos Gulf on May 12 and 13, 1996 (Frantzis, 1998). From May 11 through May 15, the NATO research vessel Alliance was conducting active 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 the location of the testing encompassed the time and location of the whale 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 (Frantzis, 2004). 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 (Frantzis, 2004). 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).

It was determined that 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 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). The analysis of this stranding event provided support for, but no clear evidence for, the cause-and-effect relationship of active 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 MFAS 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 (5 Cuvier's beaked whales, 1 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 (1,000–6,000 m) fathoms 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); 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 3 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 active 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; Fernandez *et al.*, 2005).

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 fourth animal was found dead on the afternoon of January 27, a few kilometers north of the first three animals. From January 25–26, 2006, Standing North Atlantic Treaty Organization (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—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; 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 active 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 (acoustically mediated bubble growth, addressed above) prior to stranding or whether a behavioral response to sound occurred that ultimately caused the beaked whales to be injured and to 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: 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 MFAS. 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 active 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 (*Tursiops truncatus*) 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 of up to 2 kilometers) and long (as long as 90 minutes) foraging dives with (2) relatively slow, controlled ascents, followed by (3) a series of ‘‘bounce’’ dives between 100 and 400 meters 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.

Recently, 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 active 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 MFAS (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 (Baird *et al.* 2008). 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.

During SOCAL exercises there will be use of multiple sonar units in areas where seven species of beaked whale species may be present. A surface duct may be seasonally present in a limited area for a limited period of time. Some exercises will occur in areas of high bathymetric relief. However, none of the training events will take place in a location having a constricted channel less than 35 miles wide or with limited egress similar to the Bahamas (because none exist in the SOCAL Range Complex). Consequently, not all five of the environmental factors believed to contribute to the Bahamas stranding (mid-frequency active sonar, beaked whale presence, surface ducts, steep bathymetry, and constricted channels with limited egress) will be present during SOCAL exercises. However, as mentioned previously, NMFS recommends caution when steep bathymetry, surface ducting conditions, or a constricted channel is present when mid-frequency active sonar is employed and cetaceans (especially beaked whales) are present.

Exposure to Underwater Detonation of Explosives

Some of the Navy's training exercises include the underwater detonation of explosives. For many of the exercises discussed, inert ordnance is used for a subset of the exercises. For exercises that involve ''shooting'' at a target that is above the surface of the water, underwater explosions only occur when the target is missed, which is the minority of the time (the Navy has historical hit/miss ratios and uses them in their exposure estimates). The underwater explosion from a weapon would send a shock wave and blast noise through the water, release gaseous by-products, create an oscillating bubble, and cause a plume of water to shoot up from the water surface. The shock wave and blast 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 worse impacts to an individual animal.

Injuries resulting from a shock wave take place at boundaries between tissues of different density. 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 trauma associated with blast noise can be theoretically distinct from injury from the shock wave, particularly farther from the explosion. If an animal is able to hear a noise, at some level it can fatigue or damage its hearing by causing decreased sensitivity (Ketten, 1995) (See Noise-induced Threshold Shift Section above). 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 than MFAS/HFAS. However, though the nature of the sound waves emitted from an explosion is different (in shape and rise time) from MFAS/HFAS, we still anticipate the same sorts of behavioral responses (see Exposure to MFAS/HFAS:Behavioral Disturbance Section) to result from repeated explosive detonations (a smaller range of likely less severe responses would be expected to occur as a result of exposure to a single explosive detonation).

Mitigation

In order to issue an incidental take authorization (ITA) 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 incidental take authorization 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 activities described in the SOCAL application are considered military readiness activities.

NMFS reviewed the proposed SOCAL activities and the proposed SOCAL mitigation measures presented in the Navy's application to determine whether the activities and mitigation measures were capable of achieving the least practicable adverse effect on marine mammals. NMFS determined that further discussion was necessary regarding the potential relationship between the operation of MFAS/HFAS and marine mammal strandings. NMFS worked with the Navy to identify additional practicable and effective mitigation measures, which included 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 ''military-readiness activity''.

To address the concern above, NMFS and the Navy developed a comprehensive Stranding Response Plan. Included below are the mitigation measures the Navy initially proposed (see ''Mitigation Measures Proposed in the Navy's LOA Application'') and the Stranding Response Plan that NMFS and the Navy developed (see ''Additional Measure Developed by NMFS and the Navy'' below).

Separately, NMFS has previously received comments from the public expressing concerns regarding potential delays between when marine mammals are visually detected by watchstanders and when the active sonar is actually powered or shut down. NMFS and the Navy have discussed this issue and determined the following: Naval operators and lookouts are aware of the potential for a very small delay (up to about 4 seconds) between detecting a marine mammal and powering down or shutting down the tactical sonar and will take the actions necessary to ensure that MFAS is powered down or shut down when detected animals are within the specified powerdown or shutdown zone (for example, by preparing to shut-down when animals are approaching, so as to implement shut-down when they are within the designated distance).

Mitigation Measures Proposed in the Navy's LOA Application

This section includes the protective measures proposed by the Navy and is taken directly from their application (with the exception of headings, which have been modified for increased clarity within the context of this proposed rule). In their proposed mitigation, the Navy has included measures to protect sea turtles—those measures are included here as part of the Navy's proposed action. Although measures to protect sea turtles are important, they are not required by the MMPA, and therefore, will not be codified through this regulation or required in any subsequent MMPA LOA. Measures to protect sea turtles will, however, be addressed in the Endangered Species Act section 7 consultation.

General Maritime Measures for All Training at Sea

Personnel Training (for All Training Types)

The use of shipboard lookouts is a critical component of all Navy protective measures. Lookout 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 serving as lookouts on station at all times (day and night) when a ship or surfaced submarine is moving through the water.

• All commanding officers (COs), executive officers (XOs), lookouts, officers of the deck (OODs), junior OODs (JOODs), maritime patrol aircraft aircrews, and Anti-submarine Warfare (ASW)/Mine Warfare (MIW) helicopter crews will complete the NMFS-approved Marine Species Awareness Training (MSAT) by viewing the U.S. Navy MSAT digital versatile disk (DVD). All bridge lookouts will complete both parts one and two of the MSAT; part two is optional for other personnel. This training addresses the lookout's role in environmental protection, laws governing the protection of marine species, Navy stewardship commitments and general observation information to aid in avoiding interactions with marine species.

• Navy lookouts will undertake extensive training in order to qualify as a watchstander in accordance with the Lookout Training Handbook (Naval Education and Training Command [NAVEDTRA] 12968–D).

• Lookout training will include on-the-job instruction under the supervision of a qualified, experienced lookout. Following successful completion of this supervised training period, lookouts will complete the Personal Qualification Standard Program, certifying that they have demonstrated the necessary skills (such as detection and reporting of partially submerged objects). Personnel being trained as lookouts can be counted among those listed below as long as supervisors monitor their progress and performance.

• Lookouts will be trained in the most effective means to ensure quick and effective communication within the command structure in order to facilitate implementation of protective measures if marine species are spotted.

Operating Procedures & Collision Avoidance

• Prior to major exercises, a Letter of Instruction, Mitigation Measures Message or Environmental Annex to the Operational Order will be issued to further disseminate the personnel training requirement and general marine species protective measures.

• COs will make use of marine species detection cues and information to limit interaction with marine species to the maximum extent possible consistent with safety of the ship.

• While underway, surface vessels will have at least two lookouts with binoculars; surfaced submarines will have at least one lookout with binoculars. Lookouts already posted for safety of navigation and man-overboard precautions may be used to fill this requirement. As part of their regular duties, lookouts will watch for and report to the OOD the presence of marine mammals and sea turtles.

• On surface vessels equipped with a multi-function active sensor, pedestal mounted ''Big Eye'' (20 x 10) binoculars will be properly installed and in good working order to assist in the detection of marine mammals and sea turtles in the vicinity of the vessel.

• Personnel on lookout will employ visual search procedures employing a scanning methodology in accordance with the Lookout Training Handbook (NAVEDTRA 12968–D).

• After sunset and prior to sunrise, lookouts will employ Night Lookouts Techniques in accordance with the Lookout Training Handbook (NAVEDTRA 12968–D).

• While in transit, naval vessels will be alert at all times, use extreme caution, and proceed at a ''safe speed'' so that the vessel can take proper and effective action to avoid a collision with any marine animal and can be stopped within a distance appropriate to the prevailing circumstances and conditions.

• When whales have been sighted in the area, Navy vessels will increase vigilance and take reasonable and practicable actions to avoid collisions and activities that might result in close interaction of naval assets and marine mammals. Actions may include changing speed and/or direction and would be dictated by environmental and other conditions (e.g., safety, weather).

• Floating weeds and kelp, algal mats, clusters of seabirds, and jellyfish are good indicators of sea turtles and marine mammals. Therefore, increased vigilance in watching for sea turtles and marine mammals will be taken where these are present.

• Navy aircraft participating in exercises at sea will conduct and maintain, when operationally feasible and safe, surveillance for marine species of concern as long as it does not violate safety constraints or interfere with the accomplishment of primary operational duties. Marine mammal detections will be immediately reported to assigned Aircraft Control Unit for further dissemination to ships in the vicinity of the marine species as appropriate where it is reasonable to conclude that the course of the ship will likely result in a closing of the distance to the detected marine mammal.

• All vessels will maintain logs and records documenting training operations should they be required for event reconstruction purposes. Logs and records will be kept for a period of 30 days following completion of a major training exercise.

Measures for MFAS Operations

Personnel Training (for MFAS Operations)

• All lookouts onboard platforms involved in ASW training events will review the NMFS-approved Marine Species Awareness Training material prior to use of mid-frequency active sonar.

• All COs, XOs, and officers standing watch on the bridge will have reviewed the Marine Species Awareness Training material prior to a training event employing the use of mid-frequency active sonar.

• Navy lookouts will undertake extensive training in order to qualify as a watchstander in accordance with the Lookout Training Handbook (Naval Educational Training [NAVEDTRA], 12968–D).

• Lookout training will include on-the-job instruction under the supervision of a qualified, experienced watchstander. Following successful completion of this supervised training period, lookouts will complete the Personal Qualification Standard program, certifying that they have demonstrated the necessary skills (such as detection and reporting of partially submerged objects). This does not forbid personnel being trained as lookouts from being counted as those listed in previous measures so long as supervisors monitor their progress and performance.

• Lookouts will be trained in the most effective means to ensure quick and effective communication within the command structure in order to facilitate implementation of mitigation measures if marine species are spotted.

Lookout and Watchstander Responsibilities

• On the bridge of surface ships, there will always be at least three people on watch whose duties include observing the water surface around the vessel.

• All surface ships participating in ASW training events will, in addition to the three personnel on watch noted previously, have at all times during the exercise at least two additional personnel on watch as marine mammal lookouts.

• Personnel on lookout and officers on watch on the bridge will have at least one set of binoculars available for each person to aid in the detection of marine mammals.

• On surface vessels equipped with mid-frequency active sonar, pedestal mounted ''Big Eye'' (20 x 110) binoculars will be present and in good working order to assist in the detection of marine mammals in the vicinity of the vessel.

• Personnel on lookout will employ visual search procedures employing a scanning methodology in accordance with the Lookout Training Handbook (NAVEDTRA 12968–D).

• After sunset and prior to sunrise, lookouts will employ Night Lookouts Techniques in accordance with the Lookout Training Handbook.

• Personnel on lookout will be responsible for reporting all objects or anomalies sighted in the water (regardless of the distance from the vessel) to the Officer of the Deck, since any object or disturbance (e.g., trash, periscope, surface disturbance, discoloration) in the water may be indicative of a threat to the vessel and its crew or indicative of a marine species that may need to be avoided as warranted.

Operating Procedures

• A Letter of Instruction, Mitigation Measures Message, or Environmental Annex to the Operational Order will be issued prior to major exercises to further disseminate the personnel training requirement and general marine mammal mitigation measures.

• COs will make use of marine species detection cues and information to limit interaction with marine species to the maximum extent possible consistent with safety of the ship.

• All personnel engaged in passive acoustic sonar operation (including aircraft, surface ships, or submarines) will monitor for marine mammal vocalizations and report the detection of any marine mammal to the appropriate watch station for dissemination and appropriate action.

• During mid-frequency active sonar operations, personnel will utilize all available sensor and optical systems (such as night vision goggles) to aid in the detection of marine mammals.

• Navy aircraft participating in exercises at sea will conduct and maintain, when operationally feasible and safe, surveillance for marine species of concern as long as it does not violate safety constraints or interfere with the accomplishment of primary operational duties.

• Aircraft with deployed sonobuoys will use only the passive capability of sonobuoys when marine mammals are detected within 200 yds (183 m) of the sonobuoy.

• Marine mammal detections will be immediately reported to assigned Aircraft Control Unit for further dissemination to ships in the vicinity of the marine species as appropriate where it is reasonable to conclude that the course of the ship will likely result in a closing of the distance to the detected marine mammal.

• Safety Zones—When marine mammals are detected by any means (aircraft, shipboard lookout, or acoustically) within or closing to inside 1,000 yds (914 m) of the sonar dome (the bow), the ship or submarine will limit active transmission levels to at least 6 decibels (dB) below normal operating levels. (A 6 dB reduction equates to a 75 percent power reduction. The reason is that decibel levels are on a logarithmic scale, not a linear scale. Thus, a 6 dB reduction results in a power level only 25 percent of the original power.)

• Ships and submarines will continue to limit maximum transmission levels by this 6-dB factor until the animal has been seen to leave the area, has not been detected for 30 minutes, or the vessel has transited more than 2,000 yds (1,829 m) beyond the location of the last detection.

• Should a marine mammal be detected within or closing to inside 500 yds (457 m) of the sonar dome, active sonar transmissions will be limited to at least 10 dB below the equipment's normal operating level. (A 10 dB reduction equates to a 90 percent power reduction from normal operating levels.) Ships and submarines will continue to limit maximum ping levels by this 10-dB factor until the animal has been seen to leave the area, has not been detected for 30 minutes, or the vessel has transited more than 2,000 yds (1,829 m) beyond the location of the last detection.

• Should the marine mammal be detected within or closing to inside 200 yds (183 m) of the sonar dome, active sonar transmissions will cease. Active sonar will not resume until the animal has been seen to leave the area, has not been detected for 30 minutes, or the vessel has transited more than 2,000 yds (457 m) beyond the location of the last detection.

• Special conditions applicable for dolphin and porpoise only: If, after conducting an initial maneuver to avoid close quarters with dolphin or porpoise, the OOD concludes that dolphin or porpoise are deliberately closing to ride the vessel's bow wave, no further mitigation actions would be necessary while the dolphin or porpoise continue to exhibit bow wave riding behavior.

• If the need for power-down should arise as detailed in ''Safety Zones'' above, the Navy shall follow the requirements as though they were operating at 235 dB—the normal operating level (i.e., the first power-down will be to 229 dB, regardless of at what level above 235 dB active sonar was being operated).

• Prior to start up or restart of active sonar, operators will check that the Safety Zone radius around the sound source is clear of marine mammals.

• Active sonar levels (generally)—Navy will operate sonar at the lowest practicable level, not to exceed 235 dB, except as required to meet tactical training objectives.

• Helicopters shall observe/survey the vicinity of an ASW training event for 10 minutes before the first deployment of active (dipping) sonar in the water.

• Helicopters shall not dip their active sonar within 200 yds (183 m) of a marine mammal and shall cease pinging if a marine mammal closes within 200 yds (183 m) of the sonar source after pinging has begun.

• Submarine sonar operators will review detection indicators of close-aboard marine mammals prior to the commencement of ASW training events involving MFAS.

Measures for Underwater Detonations

Surface-to-Surface Gunnery (5-inch, 76 mm, 20 mm, 25 mm and 30 mm Explosive Rounds)

• Lookouts will visually survey for floating weeds and kelp, and algal mats which may be inhabited by immature sea turtles in the target area. Intended impact shall not be within 600 yds (585 m) of known or observed floating weeds and kelp, and algal mats.

• For exercises using targets towed by a vessel or aircraft, target-towing vessels/aircraft shall maintain a trained lookout for marine mammals and sea turtles. If a marine mammal or sea turtle is sighted in the vicinity, the tow aircraft/vessel will immediately notify the firing vessel, which will suspend the exercise until the area is clear.

• A 600-yard radius buffer zone will be established around the intended target.

• From the intended firing position, trained lookouts will survey the buffer zone for marine mammals and sea turtles prior to commencement and during the exercise as long as practicable. Due to the distance between the firing position and the buffer zone, lookouts are only expected to visually detect breaching whales, whale blows, and large pods of dolphins and porpoises.

• The exercise will be conducted only when the buffer zone is visible and marine mammals and sea turtles are not detected within it.

Surface-to-Surface Gunnery (Non-Explosive Rounds)

• Lookouts will visually survey for floating weeds and kelp, and algal mats which may be inhabited by immature sea turtles in the target area. Intended impact will not be within 200 yds (183 m) of known or observed floating weeds and kelp, and algal mats.

• A 200-yd (183 m) radius buffer zone will be established around the intended target.

• From the intended firing position, trained lookouts will survey the buffer zone for marine mammals and sea turtles prior to commencement and during the exercise as long as practicable. Due to the distance between the firing position and the buffer zone, lookouts are only expected to visually detect breaching whales, whale blows, and large pods of dolphins and porpoises.

• If applicable, target towing vessels will maintain a lookout. If a marine mammal or sea turtle is sighted in the vicinity of the exercise, the tow vessel will immediately notify the firing vessel in order to secure gunnery firing until the area is clear.

• The exercise will be conducted only when the buffer zone is visible and marine mammals and sea turtles are not detected within the target area and the buffer zone.

Surface-to-Air Gunnery (Explosive and Non-Explosive Rounds)

• Vessels will orient the geometry of gunnery exercises in order to prevent debris from falling in the area of sighted marine mammals, sea turtles, algal mats, and floating kelp.

• Vessels will expedite the recovery of any parachute deploying aerial targets to reduce the potential for entanglement of marine mammals and sea turtles.

• Target towing aircraft shall maintain a lookout. If a marine mammal or sea turtle is sighted in the vicinity of the exercise, the tow aircraft will immediately notify the firing vessel in order to secure gunnery firing until the area is clear.

Air-to-Surface Gunnery (Explosive and Non-Explosive Rounds)

• If surface vessels are involved, lookouts will visually survey for floating kelp, which may be inhabited by immature sea turtles, in the target area. Impact shall not occur within 200 yds (183 m) of known or observed floating weeds and kelp or algal mats.

• A 200-yd (183 m) radius buffer zone will be established around the intended target.

• If surface vessels are involved, lookout(s) will visually survey the buffer zone for marine mammals and sea turtles prior to and during the exercise.

• Aerial surveillance of the buffer zone for marine mammals and sea turtles will be conducted prior to commencement of the exercise. Aerial surveillance altitude of 500 feet to 1,500 feet (ft) (152–456 m) is optimum. Aircraft crew/pilot will maintain visual watch during exercises. Release of ordnance through cloud cover is prohibited: Aircraft must be able to actually see ordnance impact areas.

• The exercise will be conducted only if marine mammals and sea turtles are not visible within the buffer zone.

Small Arms Training—(Grenades, Explosive and Non-Explosive Rounds)

• Weapons will not be fired in the direction of known or observed floating weeds or kelp, algal mats, marine mammals, sea turtles.

Air-to-Surface At-Sea Bombing Exercises (Explosive and Non-Explosive)

• If surface vessels are involved, trained lookouts will survey for floating kelp, which may be inhabited by immature sea turtles, and marine mammals. Ordnance shall not be targeted to impact within 1,000 yds (914 m) of known or observed floating kelp, sea turtles, or marine mammals.

• A 1,000 yd (914 m) radius buffer zone will be established around the intended target.

• Aircraft will visually survey the target and buffer zone for marine mammals and sea turtles prior to and during the exercise. The survey of the impact area will be made by flying at 1,500 ft (152 m) or lower, if safe to do so, and at the slowest safe speed. Release of ordnance through cloud cover is prohibited: Aircraft must be able to actually see ordnance impact areas. Survey aircraft should employ most effective search tactics and capabilities.

• The exercise will be conducted only if marine mammals and sea turtles are not visible within the buffer zone.

Air-to-Surface Missile Exercises (Explosive and Non-Explosive)

• Ordnance shall not be targeted to impact within 1,800 yds (1,646 m) of known or observed floating kelp, which may be inhabited by immature sea turtles, or coral reefs.

• Aircraft will visually survey the target area for marine mammals and sea turtles. Visual inspection of the target area will be made by flying at 1,500 (457 m) feet or lower, if safe to do so, and at slowest safe speed. Firing or range clearance aircraft must be able to actually see ordnance impact areas. Explosive ordnance shall not be targeted to impact within 1,800 yds (1,646 m) of sighted marine mammals and sea turtles.

Demolitions, Mine Warfare, and Mine Countermeasures (up to a 20-lb Charge)

Exclusion Zones—All Mine Warfare and Mine Countermeasures Operations involving the use of explosive charges must include exclusion zones for marine mammals and sea turtles to prevent physical and/or acoustic effects to those species. These exclusion zones shall extend in a 700-yard arc (640 yd) radius around the detonation site.

Pre-Exercise Surveys—For Demolition and Ship Mine Countermeasures Operations, pre-exercise survey shall be conducted within 30 minutes prior to the commencement of the scheduled explosive event. The survey may be conducted from the surface, by divers, and/or from the air, and personnel shall be alert to the presence of any marine mammal or sea turtle. Should such an animal be present within the survey area, the exercise shall be paused until the animal voluntarily leaves the area. The Navy will suspend detonation exercises and ensure the area is clear for a full 30 minutes prior to detonation. Personnel will record any protected species marine mammal and sea turtle observations during the exercise as well as measures taken if species are detected within the exclusion zone.

Post-Exercise Surveys—Surveys within the same radius shall also be conducted within 30 minutes after the completion of the explosive event.

Reporting—If there is evidence that a marine mammal or sea turtle may have been stranded, injured or killed by the action, Navy training activities will be immediately suspended and the situation immediately reported by the participating unit to the Officer in Charge of the Exercise (OCE), who will follow Navy procedures for reporting the incident to Commander, Pacific Fleet, Commander, Navy Region Southwest, Environmental Director, and the chain-of-command. The situation will also be reported to NMFS (see Stranding Plan for details).

Mining Operations

Mining Operations involve aerial drops of inert training shapes on target points. Aircrews are scored for their ability to accurately hit the target points. This operation does not involve live ordnance. The probability of a marine species being in the exact spot in the ocean where an inert object is dropped is remote. However, as a conservative measure, initial target points will be briefly surveyed prior to inert ordnance release from an aircraft to ensure the intended drop area is clear of marine mammals and sea turtles. To the extent feasible, the Navy shall retrieve inert mine shapes dropped during Mining Operations.

Sink Exercise

The selection of sites suitable for Sink Exercises (SINKEXs) involves a balance of operational suitability, requirements established under the Marine Protection, Research and Sanctuaries Act (MPRSA) permit granted to the Navy (40 Code of Federal Regulations § 229.2), and the identification of areas with a low likelihood of encountering Endangered Species Act (ESA) listed species. To meet operational suitability criteria, locations must be within a reasonable distance of the target vessels' originating location. The locations should also be close to active military bases to allow participating assets access to shore facilities. For safety purposes, these locations should also be in areas that are not generally used by non-military air or watercraft. The MPRSA permit requires vessels to be sunk in waters which are at least 6,000 ft (1,829 m) deep and at least 50 nm from land. In general, most listed species prefer areas with strong bathymetric gradients and oceanographic fronts for significant biological activity such as feeding and reproduction. Typical locations include the continental shelf and shelf-edge.

The Navy has developed range clearance procedures to maximize the probability of sighting any ships or protected species in the vicinity of an exercise, which are as follows:

• All weapons firing would be conducted during the period 1 hour after official sunrise to 30 minutes before official sunset.

• A marine mammal exclusion zone with a radius of 1.0 nm will be established around the target. An additional safety zone with radius of 2.0 nm surrounding the target will be monitored. If marine mammals or sea turtles enter this 2.0 nm radius, they shall be monitored to the extent practicable and no weapons release is authorized until they are clear of the area

• A series of surveillance overflights shall be conducted prior to the event to ensure that no marine mammals or sea turtles are present in the exclusion zone. Survey protocol will be as follows:

• Overflights within the exclusion zone would be conducted in a manner that optimizes the surface area of the water observed. This may be accomplished through the use of the Navy's Search and Rescue Tactical Aid, which provides the best search altitude, ground speed, and track spacing for the discovery of small, possibly dark objects in the water based on the environmental conditions of the day. These environmental conditions include the angle of sun inclination, amount of daylight, cloud cover, visibility, and sea state.

• All visual surveillance activities would be conducted by Navy personnel trained in visual surveillance. At least one member of the mitigation team would have completed the Navy's marine mammal training program for lookouts.

• In addition to the overflights, the exclusion zone would be monitored by passive acoustic means, when assets are available. This passive acoustic monitoring would be maintained throughout the exercise. Potential assets include sonobuoys, which can be utilized to detect any vocalizing marine mammals (particularly sperm whales) in the vicinity of the exercise. The sonobuoys would be re-seeded as necessary throughout the exercise. Additionally, passive sonar onboard submarines may be utilized to detect any vocalizing marine mammals in the area. The OCE would be informed of any aural detection of marine mammals and would include this information in the determination of when it is safe to commence the exercise.

- On each day of the exercise, aerial surveillance of the exclusion and safety zones would commence 2 hours prior to the first firing.
- The results of all visual, aerial, and acoustic searches would be reported immediately to the OCE. No weapons launches or firing would commence until the OCE declares the safety and exclusion zones free of marine mammals and threatened and endangered species.
- If a protected species observed within the exclusion zone is diving, firing would be delayed until the animal is re-sighted outside the exclusion zone, or 30 minutes have elapsed. After 30 minutes, if the animal has not been re-sighted it would be assumed to have left the exclusion zone. The OCE would determine if the listed species is in danger of being adversely affected by commencement of the exercise.
- During breaks in the exercise of 30 minutes or more, the exclusion zone would again be surveyed for any protected species. If protected species are sighted within the exclusion zone, the OCE would be notified, and the procedure described above would be followed.
- Upon sinking of the vessel, a final surveillance of the exclusion zone would be monitored for 2 hours, or until sunset, to verify that no listed species were harmed.
- Aerial surveillance would be conducted using helicopters or other aircraft based on necessity and availability. The Navy has several types of aircraft capable of performing this task; however, not all types are available for every exercise. For each exercise, the available asset best suited for identifying objects on and near the surface of the ocean would be used. These aircraft would be capable of flying at the slow safe speeds necessary to enable viewing of marine vertebrates with unobstructed, or minimally obstructed, downward and outward visibility. The exclusion and safety zone surveys may be cancelled in the event that a mechanical problem, emergency search and rescue, or other similar and unexpected event preempts the use of one of the aircraft onsite for the exercise.
- Every attempt would be made to conduct the exercise in sea states that are ideal for marine mammal sighting, Beaufort Sea State 3 or less. In the event of a 4 or above, survey efforts would be increased within the zones. This would be accomplished through the use of an additional aircraft, if available, and conducting tight search patterns.
- The exercise would not be conducted unless the exclusion zone could be adequately monitored visually.
- In the unlikely event that any listed species are observed to be harmed in the area, a detailed description of the animal would be taken, the location noted, and if possible, photos taken. This information would be provided to NMFS via the Navy's regional environmental coordinator for purposes of identification (see the Stranding Plan for detail).
- An after action report detailing the exercise's time line, the time the surveys commenced and terminated, amount, and types of all ordnance expended, and the results of survey efforts for each event would be submitted to NMFS.

Explosive Source Sonobuoys Used in EER/IEER (AN/SSQ–110A)

- Crews will conduct visual reconnaissance of the drop area prior to laying their intended sonobuoy pattern. This search should be conducted below 457 m (500 yd) at a slow speed, if operationally feasible and weather conditions permit. In dual aircraft operations, crews are allowed to conduct coordinated area clearances.
- Crews shall conduct a minimum of 30 minutes of visual and aural monitoring of the search area prior to commanding the first post detonation. This 30-minute observation period may include pattern deployment time.
- For any part of the briefed pattern where a post (source/receiver sonobuoy pair) will be deployed within 914 m (1,000 yd) of observed marine mammal activity, deploy the receiver ONLY and monitor while conducting a visual search. When marine mammals are no longer detected within 914 m (1,000 yd) of the intended post position, co-locate the explosive source sonobuoy (AN/SSQ–110A) (source) with the receiver.
- When able, crews will conduct continuous visual and aural monitoring of marine mammal activity. This is to include monitoring of own-aircraft sensors from first sensor placement to checking off station and out of RF range of these sensors.
- Aural Detection—If the presence of marine mammals is detected aurally, then that should cue the aircrew to increase the diligence of their visual surveillance. Subsequently, if no marine mammals are visually detected, then the crew may continue multi-static active search.
- Visual Detection—If marine mammals are visually detected within 914 m (1,000 yd) of the explosive source sonobuoy (AN/SSQ–110A) intended for use, then that payload shall not be detonated. Aircrews may utilize this post once the marine mammals have not been re-sighted for 30 minutes, or are observed to have moved outside the 914 m (1,000 yd) safety buffer. Aircrews may shift their multi-static active search to another post, where marine mammals are outside the 914 m (1,000 yd) safety buffer.
- Aircrews shall make every attempt to manually detonate the unexploded charges at each post in the pattern prior to departing the operations area by using the ''Payload 1 Release'' command followed by the ''Payload 2 Release'' command. Aircrews shall refrain from using the ''Scuttle'' command when two payloads remain at a given post. Aircrews will ensure that a 914 m (1,000 yd) safety buffer, visually clear of marine mammals, is maintained around each post as is done during active search operations.
- Aircrews shall only leave posts with unexploded charges in the event of a sonobuoy malfunction, an aircraft system malfunction, or when an aircraft must immediately depart the area due to issues such as fuel constraints, inclement weather, and in-flight emergencies. In these cases, the sonobuoy will self-scuttle using the secondary or tertiary method.
- Ensure all payloads are accounted for. Explosive source sonobuoys (AN/SSQ–110A) that cannot be scuttled shall be reported as unexploded ordnance via voice communications while airborne, then upon landing via naval message.
- Mammal monitoring shall continue until out of own-aircraft sensor range.

Additional Mitigation Measure Developed by NMFS and the Navy

As mentioned above, NMFS worked with the Navy to identify additional practicable and effective mitigation measures to address the potential relationship between the operation of MFAS/HFAS and marine mammal strandings. 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) A reduction in 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.).

NMFS and the Navy had extensive discussions regarding mitigation and potential strandings. Ultimately, NMFS and the Navy developed the proposed draft SOCAL Stranding Plan (summarized below), which we believe supports (or contributes) to the goals mentioned in (a)–(e) above.

Stranding Response Plan for Major Navy Training Exercises in the SOCAL Range Complex

NMFS and the Navy have developed a draft Stranding Response Plan for Major Exercises in the SOCAL Range Complex (available at: *http://www.nmfs.noaa.gov/pr/permits/incidental.htm*). Pursuant to 50 CFR Section 216.105, the plan will be included as part of (attached to) the Navy's MMPA Letter of Authorization (LOA), which contains the conditions under which the Navy is authorized to take marine mammals pursuant to training activities involving MFAS/HFAS or explosives in the SOCAL Range Complex. The Stranding Response plan is specifically intended to outline the applicable requirements the authorization is conditioned upon in the event that a marine mammal stranding is reported in the SOCAL Range Complex during a major training exercise (MTE) (see glossary below). As mentioned above, NMFS considers all plausible causes within the course of a stranding investigation and this plan in no way presumes that any strandings that could occur in the SOCAL Range Complex are related to, or caused by, Navy training activities, absent a determination made in a Phase 2 Investigation as outlined in the plan, indicating that MFAS or explosive detonation in the SOCAL Range Complex were a cause of the stranding. This plan is designed to address the following three issues:

• Mitigation—When marine mammals are in a situation that can be defined as a stranding (see glossary of plan), they are experiencing physiological stress. When animals are stranded, and alive, NMFS believes that exposing these compromised animals to additional known stressors would likely exacerbate the animal's distress and could potentially cause its death. Regardless of the factor(s) that may have initially contributed to the stranding, it is NMFS' goal to avoid exposing these animals to further stressors. Therefore, when live stranded cetaceans are in the water and engaged in what is classified as an Uncommon Stranding Event (USE) (see glossary of plan), the shutdown component of this plan is intended to minimize the exposure of those animals to MFAS and explosive detonations, regardless of whether or not these activities may have initially played a role in the event.

• Monitoring—This plan will enhance the understanding of how MFAS/HFAS or underwater detonations (as well as other environmental conditions) may, or may not, be associated with marine mammal injury or strandings. Additionally, information gained from the investigations associated with this plan may be used in the adaptive management of mitigation or monitoring measures in subsequent LOAs, if appropriate.

• Compliance—The information gathered pursuant to this protocol will inform NMFS' decisions regarding compliance with Sections 101(a)(5)(B and C) of the MMPA.

The Stranding Response Plan has several components:

Shutdown Procedures—When an uncommon stranding event (USE—defined in the plan) occurs during a major exercise in the SOCAL Range Complex, and a live cetacean(s) is in the water exhibiting indicators of distress (defined in the plan), NMFS will advise the Navy that they should cease MFAS/HFAS operation and explosive detonations within 14 nm (26 km) of the live animal involved in the USE (NMFS and Navy will maintain a dialogue, as needed, regarding the identification of the USE and the potential need to implement shutdown procedures). This distance is the approximate distance at which sound from the active sonar sources is anticipated to attenuate to 145 dB (SPL). The risk function predicts that less than 1 percent of the animals exposed to active sonar at this level (mysticete or odontocete) would respond in a manner that NMFS considers Level B Harassment.

Memorandum of Agreement (MOA)—The Navy and NMFS will develop a MOA, or other mechanism consistent with federal fiscal law requirements (and all other applicable laws), that allows the Navy to assist NMFS with the Phase 1 and 2 Investigations of USEs through the provision of in-kind services, such as (but not limited to) the use of plane/boat/truck for transport of stranding responders or animals, use of Navy property for necropsies or burial, or assistance with aerial surveys to discern the extent of a USE. The Navy may assist NMFS with the Investigations by providing one or more of the in-kind services outlined in the MOA, when available and logistically feasible and when the provision does not negatively affect Fleet operational commitments.

Communication Protocol—Effective communication is critical to the successful implementation of this Stranding Response Plan. Very specific protocols for communication, including identification of the Navy personnel authorized to implement a shutdown and the NMFS personnel authorized to advise the Navy of the need to implement shutdown procedures (NMFS Protected Resources HQ—senior administrators) and the associated phone trees, etc. are currently in development and will be refined and finalized for the Stranding Response Plan prior to the issuance of a final rule (and updated yearly).

Stranding Investigation—The Stranding Response Plan also outlines the way that NMFS plans to investigate any strandings (providing staff and resources are available) that occur during major training exercises in the SOCAL Range Complex.

Mitigation Conclusions

NMFS believes that the range clearance procedures and shutdown/safety zone/exclusion zone measures the Navy has proposed will enable the Navy to avoid injuring any marine mammals and will enable them to minimize the numbers of marine mammals exposed to levels associated with TTS for the following reasons:

MFAS/HFAS

The Navy's standard protective measures indicate that they will ensure powerdown of MFAS/HFAS by 6 dB when a marine mammal is detected within 1,000 yd (914 m), powerdown of 4 more dB (or 10 dB total) when a marine mammal is detected within 500 yd (457 m), and will cease MFAS/HFAS transmissions when a marine mammal is detected within 200 yd (183 m).

PTS/Injury—NMFS believes that the proposed mitigation measures will allow the Navy to avoid exposing marine mammals to received levels of MFAS/HFAS sound that would result in injury for the following reasons:

• The estimated distance from the most powerful source at which cetaceans and all pinnipeds except harbor seals would receive a level of 215 dB SEL (threshold for PTS/injury/Level A Harassment) is approximately 10 m (10.9 yd). The PTS threshold for harbor seals is 203 dB SEL, which has an associated distance of approximately 50 m.

• NMFS believes that the probability that a marine mammal would approach within the above distances of the sonar dome (to the sides or below) without being seen by the watchstanders (who would then activate a shutdown if the animal was within 200 yd (183 m)) is very low, especially considering that animals would likely avoid approaching a source transmitting at that level at that distance.

• The model predicted that some animals would be exposed to levels associated with injury, however, the model does not consider the mitigation or likely avoidance behaviors and NMFS believes that injury is unlikely when those factors are considered.

TTS—NMFS believes that the proposed mitigation measures will allow the Navy to minimize exposure of marine mammals to received levels of MFAS/HFAS sound associated with TTS for the following reasons:

• The estimated range of maximum distances from the most powerful source at which an animal would receive 195 dB SEL (the TTS threshold) is from approximately 140 m from the source in most operating environments (except for harbor seals for which the distance is approximately 1,700 m).

• Based on the size of the animals, average group size, behavior, and average dive time, NMFS believes that the probability that Navy watchstanders will visually detect mysticetes or sperm whales, dolphins, social pelagic species (pilot whales, melon-headed whales, etc.), and sea lions at some point within the 1,000 yd (914 m) safety zone before they are exposed to the TTS threshold levels is high, which means that the Navy would be able to shutdown or powerdown to avoid exposing these species to sound levels associated with TTS.

• However, seals and more cryptic (animals that are difficult to detect and observe), deep-diving cetaceans (beaked whales and *Kogia* spp.) are less likely to be visually detected and could potentially be exposed to levels of MFAS/HFAS expected to cause TTS. Animals at depth in one location would not be expected to be continuously exposed to repeated sonar signals, though, given the typical 5–10+ knot speed of Navy surface ships during ASW event. During a typical one-hour subsurface dive by a beaked whale, the ship will have moved over 5 to 10 nm from the original location.

• Additionally, the Navy's bow-riding mitigation exception for dolphins may sometimes allow dolphins to be exposed to levels of MFAS/HFAS likely to result in TTS. However, there are combinations of factors that reduce the acoustic energy received by dolphins approaching ships to ride in bow waves. Dolphins riding ship's bow wave are outside of the main beam of the MFAS vertical beam pattern. Source levels drop quickly outside of the main beam. Sidelobes of the radiate beam pattern that point to the surface are significantly lower in power. Together with spherical spreading losses, received levels in the ship's bow wave can be more than 42 dB less than typical source level (i.e., 235 dB − 42 dB = 193 dB). Finally, bow wave riding dolphins are frequently in and out of a bubble layer generated by the breaking bow waves. This bubble layer is an excellent scatterer of acoustic energy and can further reduce received energy.

Underwater Explosives

The Navy utilizes exclusion zones (wherein explosive detonation will not begin/continue if animals are within the zone) for explosive exercises. Table 3 indicates the various explosives, the estimated distance at which animals will receive levels associated with take (see Acoustic Take Criteria Section), and the exclusion zone associated with the explosive types.

Mortality and Injury—NMFS believes that the mitigation measures will allow the Navy to avoid exposing marine mammals to underwater detonations that would result in injury or mortality for the following reasons:

• Surveillance for large charges (which includes aerial and passive acoustic detection methods, when available, to ensure clearance) begins two hours before the exercise and extends to 2 nm (3,704 m) from the source. Surveillance for all charges extends out 2–12 times the farthest distance from the source at which injury would be anticipated to occur (see Table 3).

• Animals would need to be within less than 193–723 m (211–790 yd) (large explosives) or 24–158 m (26–173 yd) (smaller charges) from the source to be injured.

• Unlike for active sonar, an animal would need to be present at the exact moment of the explosion(s) (except for the short series of gunfire example in GUNEX) to be taken.

• The model predicted only 34 and 7 animals would be exposed to levels associated with injury and death, respectively (though for the reasons above, NMFS does not believe they will be exposed to those levels).

• When the implementation of the exclusion zones (i.e., not starting or continuing to detonate explosives if an animal is detected within the exclusion zone) is combined with the above bullets, NMFS believes that the Navy's mitigation will be effective for avoiding injury and mortality to marine mammals from explosives.

TTS—NMFS believes that the proposed mitigation measures will allow the Navy to minimize the exposure of marine mammals to underwater detonations that would result in TTS for the following reasons:

• A number of animals were predicted to be exposed to explosive levels that would result in TTS—and for the reasons above, NMFS believes that most modeled TTS takes can be avoided, especially dolphins, mysticetes and sperm whales, and social pelagic species.

• However, pinnipeds and more cryptic, deep-diving species (beaked whales and *Kogia* spp.) are less likely to be visually detected and could potentially be exposed to explosive levels expected to cause TTS.

• Additionally, for two of the exercise types (SINKEX and BOMBEX), the distance at which an animal would be expected to receive sound or pressure levels associated with TTS (182 dB SEL or 23 psi) is sometimes larger than the exclusion zone, which means that for those two exercise types, some individuals will likely be exposed to levels associated with TTS outside of the exclusion zone.

The Stranding Response Plan, another important component of the mitigation measures for SOCAL, will minimize the probability of distressed live-stranded animals responding to the proximity of active sonar in a manner that further stresses them or increases the potential likelihood of mortality.

NMFS has preliminarily determined that the Navy's proposed mitigation measures (from the LOA application), along with the Stranding Response Plan (and when the Adaptive Management (see Adaptive Management below) component is taken into consideration) 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.

These mitigation measures may be refined, modified, removed, or added to prior to the issuance of the final rule based on the comments and information received during the public comment period.

Research

The Navy provides a significant amount of funding and support to marine research. In the past five years the agency funded over $100 million ($26 million in FY08 alone) to universities, research institutions, federal laboratories, private companies, and independent researchers around the world to study marine mammals. The U.S. Navy sponsors seventy 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 research 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,
- Understanding the effects of sound on marine mammals, sea turtles, fish, and birds, and
- Developing tools to model and estimate potential effects of sound.

This research is directly applicable to Fleet training activities, particularly with respect to the investigations of the potential effects of underwater noise sources on marine mammals and other protected species. Proposed training activities employ active sonar and underwater explosives, which introduce sound into the marine environment.

The Marine Life Sciences Division of the Office of Naval Research currently coordinates six programs that examine the marine environment and are devoted solely to studying the effects of noise and/or the implementation of technology tools that will assist the Navy in studying and tracking marine mammals. The six programs are as follows:

- Environmental Consequences of Underwater Sound,
- Non-Auditory Biological Effects of Sound on Marine Mammals,
- Effects of Sound on the Marine Environment,
- Sensors and Models for Marine Environmental Monitoring,
- Effects of Sound on Hearing of Marine Animals, and
- Passive Acoustic Detection, Classification, and Tracking of Marine Mammals.

The Navy has also developed the technical reports referenced within this document, which include the Marine Resource Assessments and the Navy OPAREA Density Estimates (NODE) reports. Furthermore, research cruises by the National Marine Fisheries Service (NMFS) and by academic institutions have received funding from the U.S. Navy.

The Navy has sponsored several workshops to evaluate the current state of knowledge and potential for future acoustic monitoring of marine mammals. The workshops brought together acoustic experts and marine biologists from the Navy and other research organizations to present data and information on current acoustic monitoring research efforts and to evaluate the potential for incorporating similar technology and methods on instrumented ranges. However, acoustic detection, identification, localization, and tracking of individual animals still requires a significant amount of research effort to be considered a reliable method for marine mammal monitoring. The Navy supports research efforts on acoustic monitoring and will continue to investigate the feasibility of passive acoustics as a potential mitigation and monitoring tool.

Overall, the Navy will continue to fund ongoing marine mammal research, and is planning to coordinate long term monitoring/studies of marine mammals on various established ranges and operating areas. The Navy will continue to research and contribute to university/external research to improve the state of the science regarding marine species biology and acoustic effects. These efforts include mitigation and monitoring programs; data sharing with NMFS and via the literature for research and development efforts; and future research as described previously.

Long-Term Prospective Study

Apart from this proposed rule, NMFS, with input and assistance from the Navy and several other agencies and entities, will perform a longitudinal observational study of marine mammal strandings to systematically observe for and record the types of pathologies and diseases and investigate the relationship with potential causal factors (e.g., active sonar, seismic, weather). The study will not be a true ''cohort'' study, because we will be unable to quantify or estimate specific active sonar or other sound exposures for individual animals that strand. However, a cross-sectional or correlational analysis, a method of descriptive rather than analytical epidemiology, can be conducted to compare population characteristics, e.g., frequency of strandings and types of specific pathologies between general periods of various anthropogenic activities and non-activities within a prescribed geographic space. In the long-term study, we will more fully and consistently collect and analyze data on the demographics of strandings in specific locations and consider anthropogenic activities and physical, chemical, and biological environmental parameters. This approach in conjunction with true cohort studies (tagging animals, measuring received sounds, and evaluating behavior or injuries) in the presence of activities and non-activities will provide critical information needed to further define the impacts of MTEs and other anthropogenic and non-anthropogenic stressors. In coordination with the Navy and other Federal and non-federal partners, the comparative study will be designed and conducted for specific sites during intervals of the presence of anthropogenic activities such as active sonar transmission or other sound exposures and absence to evaluate demographics of morbidity and mortality, lesions found, and cause of death or stranding. Additional data that will be collected and analyzed in an effort to control potential confounding factors include variables such as average sea temperature (or just season), meteorological or other environmental variables (e.g., seismic activity), fishing activities, etc. All efforts will be made to include appropriate controls (i.e., no active sonar or no seismic);

environmental variables may complicate the interpretation of ''control'' measurements. The Navy and NMFS along with other partners are evaluating mechanisms for funding this study.

Monitoring

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''. The MMPA implementing regulations at 50 Section 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:

(a) 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.

(b) 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.

(c) 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 active 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 active sonar (need to be able to accurately predict received level and report bathymetric conditions, distance from source, and other pertinent information).
- Pre-planned (i.e., well designed protocols in place) 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.

(d) An increased knowledge of the affected species.

(e) An increase in our understanding of the effectiveness of certain mitigation and monitoring measures

Proposed Monitoring Plan for the SOCAL Range Complex

The Navy has submitted a draft Monitoring Plan for the SOCAL Range Complex, which may be viewed at NMFS' Web site: *http://www.nmfs.noaa.gov/pr/permits/incidental.htm*. NMFS and the Navy have worked together on the development of this plan in the months preceding the publication of this proposed rule; however, we are still refining the plan and anticipate that it will contain more details by the time it is finalized in advance of the issuance of the final rule. Additionally, the plan may be modified or supplemented based on comments or new information received from the public during the public comment period. A summary of the primary components of the plan follows.

The draft Monitoring Plan for SOCAL has been designed as a collection of focused ''studies'' (described fully in the SOCAL draft Monitoring Plan) to gather data that will allow the Navy to address the following questions:

(a) Are marine mammals exposed to MFAS, especially at levels associated with adverse effects (i.e., based on NMFS' criteria for behavioral harassment, TTS, or PTS)? If so, at what levels are they exposed?

(b) If marine mammals are exposed to MFAS in the SOCAL Range Complex, do they redistribute geographically as a result of continued exposure? If so, how long does the redistribution last?

(c) If marine mammals are exposed to MFAS, what are their behavioral responses to various levels?

(d) Is the Navy's suite of mitigation measures for MFAS (e.g., measures agreed to by the Navy through permitting) effective at avoiding TTS, injury, and mortality of marine mammals?

Data gathered in these studies will be collected by qualified, professional marine mammal biologists that are experts in their field. They will use a combination of the following methods to collect data:

- Contracted vessel and aerial surveys.
- Passive acoustics.
- Marine mammal observers on Navy ships.

In the five proposed study designs (all of which cover multiple years), the above methods will be used separately or in combination to monitor marine mammals in different combinations before, during, and after training activities utilizing MFAS/HFAS. Table 6 contains a summary of the Monitoring effort that is planned for each study in each year.

This monitoring plan has been designed to gather data on all species of marine mammals that are observed in the SOCAL. The Plan recognizes that deep-diving and cryptic species of marine mammals such as beaked whales have a low probability of detection (Barlow and Gisiner, 2006). Therefore, methods will be utilized to attempt to address this issue (e.g., passive acoustic monitoring).

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STUDY 1,3, 4 (exposures and behavioral responses)						
	FY08	FY09	FY10	FY11	FY12	FY13
Aerial surveys	Award monitoring contract, develop SOP, obtain permits	Portions of COMPTUEX/JTFEX, IACs, and ULT- 48 hours Includes 3 nearshore underwater detonation events	Portions of COMPTUEX/JTFEX, IACs, and ULT- 48 hours Includes 3 nearshore underwater detonation events	Portions of COMPTUEX/JTFEX, IACs, and ULT- 48 hours Includes 3 nearshore underwater detonation events	Portions of COMPTUEX/JTFEX, IACs, and ULT- 48 hours Includes 3 nearshore underwater detonation events	Portions of COMPTUEX/JTFEX, IACs, and ULT- 48 hours Includes 3 nearshore underwater detonation events
Marine Mammal Observers	Opportunistic as staff and SOP developed	IAC or ULT - 40 hours	IAC or ULT - 40 hours	IAC or ULT - 40 hours	IAC or ULT - 40 hours	IAC or ULT - 40 hours
Vessel surveys (study 3 and 4 only)	Award monitoring contract, develop SOP	Portions of COMPTUEX/JTFEX, IACs, and ULT- 60 hours Includes 3 nearshore underwater detonation events	Portions of COMPTUEX/JTFEX, IACs, and ULT- 60 hours Includes 3 nearshore underwater detonation events	Portions of COMPTUEX/JTFEX, IACs, and ULT- 60 hours Includes 3 nearshore underwater detonation events	Portions of COMPTUEX/JTFEX, IACs, and ULT- 60 hours Includes 3 nearshore underwater detonation events	Portions of COMPTUEX/JTFEX, IACs, and ULT- 60 hours Includes 3 nearshore underwater detonation events
Shore based surveys (study 4 only)		Nearshore underwater detonation events near appropriate coastal topography	Nearshore underwater detonation events near appropriate coastal topography	Nearshore underwater detonation events near appropriate coastal topography	Nearshore underwater detonation events near appropriate coastal topography	Nearshore underwater detonation events near appropriate coastal topography
STUDY 2 (geographic redistribution)						
	FY08	FY09	FY10	FY11	FY12	FY13
Aerial surveys before and after training events	Portions of COMPTUEX and/or JTFEX, IACs, or ULT- 50 hours	Portions of COMPTUEX and/or JTFEX, IACs, or ULT- 50 hours	Portions of COMPTUEX and/or JTFEX, IACs, or ULT- 50 hours	Portions of COMPTUEX and/or JTFEX, IACs, or ULT- 50 hours	Portions of COMPTUEX and/or JTFEX, IACs, or ULT- 50 hours	Portions of COMPTUEX and/or JTFEX, IACs, or ULT- 50 hours
Passive Acoustics	Award monitoring contract	Order devices and determine best location, integrate SOAR M3R classification data (beaked whales	Installation of up to 5 autonomous devices in the SOCAL study area and begin recording, integrate SOAR M3R classification data (beaked whales	Continue recording from devices Begin data analysis, integrate SOAR M3R classification data (beaked whales	Continue recording from devices and data analysis, integrate SOAR M3R classification data (beaked whales	Data Analysis and continue recording from devices and data analysis, integrate SOAR M3R classification data (beaked whales
STUDY 5 (mitigation effectiveness)						
	FY08	FY09	FY10	FY11	FY12	FY13
Marine mammal observers/lookout comparison	Opportunistic as staff and SOP developed	IAC or ULT- 40 hours	IAC or ULT- 40 hours	IAC or ULT- 40 hours	IAC or ULT- 40 hours	SEASWITI or ULT- 40 hours
Aerial surveys before and after training events	Portions of COMPTUEX and/or JTFEX - 50 hours	Portions of COMPTUEX and/or JTFEX - 50 hours	Portions of COMPTUEX and/or JTFEX - 50 hours	Portions of COMPTUEX and/or JTFEX - 50 hours	Portions of COMPTUEX and/or JTFEX - 50 hours	Portions of COMPTUEX and/or JTFEX - 50 hours

Table 6. Summary of monitoring effort proposed in draft Monitoring Plan for SOCAL

In addition to the Monitoring Plan for SOCAL, by the end of 2009, the Navy will have completed an Integrated Comprehensive Monitoring Program (ICMP). The ICMP will provide the overarching structure and coordination that will, over time, compile data from both range specific monitoring plans (such as AFAST, the Hawaii Range complex, and the Southern California Range Complex) as well as Navy funded research and development (R&D) studies. The primary objectives of the ICMP are to:

• Monitor Navy training events, particularly those involving MFAS and underwater detonations, for compliance with the terms and conditions of ESA Section 7 consultations or MMPA authorizations;

• Collect data to support estimating the number of individuals exposed to sound levels above current regulatory thresholds;

• Assess the efficacy of the Navy's current marine species mitigation;

• Add to the knowledge base on potential behavioral and physiological effects to marine species from mid-frequency active sonar and underwater detonations; and,

• Assess the practicality and effectiveness of a number of mitigation tools and techniques (some not yet in use).

More information about the ICMP may be found in the draft Monitoring Plan for SOCAL.

Past Monitoring in the SOCAL Range Complex

NMFS has received ten total after action reports (AARs) addressing 12 MFAS exercises in the SOCAL Range Complex since 2006 (the Navy has only been required to submit reports to NMFS since 2006 pursuant to the terms and conditions of the associated biological opinions). NMFS has reviewed these reports and has summarized the results, as related to marine mammal observations, in Table 7. The data contained in the After Action Reports (AAR) have been considered in developing mitigation and monitoring measures for the proposed activities contained in this rule. The Navy's AARs may be viewed at: *http://www.nmfs.noaa.gov/pr/permits/incidental.htm*.

Exercise	Dates	Year	No. of surface vessels equipped with 53C or 56C Sonar in exercise	Sonar Sources used in this exercise	Known hours of observation by individuals (hours)	Hours of total MFAS use (not continuous)	No. of separate marine mammal sightings	No. of total marine mammals sighted	No. of Dolphins of total animals	Minimum No. of Large whales	No. of Times Sonar was shut or Powered Down: NDE Measures: Within 200 m	NDE Measures: 200 - 500 m	NDE Measures: 500 - 1000 m	Court-Imposed (2008): 1000 - 2000 m	TOTAL (including outside of safety zones or unknown range)	Reports of Unusual behavior
COMPTUEX 08-3 USS Ronald Reagan CSG	March 17 - April 7	2008	5	Hull-mounted, Helicopter Dipping Sonar, sonobuoys	> 2840	490	133	623	426	82	7	11	6	18	42	No
COMPTUEX 08-3 USS Peleliu ESG	March 20 - 27	2008	3	Hull-mounted, Helicopter Dipping Sonar, sonobuoys	> 504	65	71	182	90	1	1	2	3	0	9	No
JTFEX 08-04	August 10 - 17	2008	4	Hull-mounted, Helicopter Dipping Sonar, Sonobuoys, Submarine			11	230	221	9	0	0	0	0	0	No
COMPTUEX 07-01 USS Nimitz CSG	November 19 - December 19	2006		Hull-mounted, Submarine			48	376	305	1	1	1	0	1	10	No
JTFEX 08-05 USS Ronald Reagan CSG	April 11 - 17	2008	9	Hull-mounted, Helicopter Dipping, sonobuoys	> 1512	218	59	936	879	21	1	2	4	3	10	No
COMPTUEX 07-07 USS Tarawa ESG	September 7 - 21	2007	3	Hull-mounted, Helicopter Dipping, sonobuoys		134	57	299	223	18	2	0	0	0	4	No
COMPTUEX 08-04 USS Stennis CSG	September 20 - October 12	2008	10	Hull-mounted, Helicopter Dipping Sonar, Submarine		310	73	1225	1091	43	2	1	1	0	5	No
JTFEX 07-01 USS Stennis CSG	November 7 - 16	2007	6	Hull-mounted and Submarines			18	140	95	1	1	1	0	0	3	No
COMPTUEX 08-01 USS Lincoln CSG	October 25 - November 14	2007	6	Hull-mounted, Helicopter Dipping Sonar	4032	345	105	1410	1255	70	3	1	2	0	6	No
COMPTUEX 07-02 ESG	February 14 - March 2	2007	3	Hull-mounted and helicopter dipping		170	26	404	355	0	1	1	1	0	5	No
JTFEX 07-03 CSG	February 23 - March 3	2007	5	Hull-mounted and helicopter dipping		100	42	881	858	1	0	0	0	0	0	No
JTFEX 07 - 05 ESG	March 14 - 24	2007	3	Hull-mounted and helicopter dipping		48	61	729	607	29	1	3	1	3	11	No
					totals	1880	704	7435	6405	276	20	23	18	25	105	

Table 7. Summary of SOCAL After Action Reports

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General Conclusions Drawn From Review of Monitoring Reports

The data included in the after action reports provided by the Navy thus far comes from Navy watchstander observations, not independent aerial or vessel-based observers (though they would be required by these regulations and any accompanying LOA (see Monitoring)), and therefore it is difficult to draw biological conclusions. However, NMFS can draw some general conclusions from the content of the monitoring reports:

(a) Data from watchstanders is generally useful to indicate the presence or absence of marine mammals within the safety zones (and sometimes without) and to document the implementation of mitigation measures, but does not provide useful species' specific information or behavioral data. Though a few observations identified pilot or gray whales specifically, the vast majority of the observations identified marine mammals as dolphins, whales, large whales, small whales, sea lions, pinnipeds, or unknown. Data gathered by independent observers can provide very valuable information at a level of detail not possible with watchstanders (such as data gathered by independent, biologist monitors in Hawaii and submitted to NMFS in a monitoring report, which indicated the presence of sub-adult sei whales in the Hawaiian Islands in fall, potentially indicating the use of the area for breeding).

(b) Though it is by no means conclusory, it is worth noting that no instances of obvious behavioral disturbance were reported by the Navy watchstanders in their 704 marine mammal sightings totaling 7435 animals. Though of course, these observations only cover the animals that were at the surface (or slightly below in the case of aerial surveys) and within the distance that the observers can see with the big-eye binoculars or from the aircraft.

(c) NMFS and the Navy need to more carefully designate what information should be gathered during monitoring, as some reports contain different information, making cross-report comparisons difficult. NMFS and Navy will work on this issue prior to the issuance of the final rule for the SOCAL activities.

Adaptive Management

Adaptive Management was addressed above in the context of the Stranding Response Plan because that Section will be a stand-alone document. More specifically, the final regulations governing the take of marine mammals incidental to Navy training exercises in the SOCAL Range Complex will contain an adaptive management component. Our understanding of the effects of MFAS/HFAS and explosives on marine mammals is still in its relative infancy, 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 (though not the SOCAL Range Complex in the Navy's over 70 years of use of the area for testing and training). The use of adaptive management will give NMFS the ability to consider new data from different sources to determine (in coordination with the Navy), on an annual basis if new or modified mitigation or monitoring measures are appropriate for subsequent annual LOAs. Following are some of the possible sources of applicable data:

- Results from the Navy's monitoring from the previous year (either from the SOCAL Range Complex or other locations).
- Results from specific stranding investigations (either from the SOCAL Range Complex or other locations, and involving coincident MFAS/HFAS or explosives training or not involving coincident use).
- Results from the Long Term Prospective Study described below.
- Results from general marine mammal and sound research (funded by the Navy (described below) or otherwise).

Mitigation measures could be modified or added 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. NMFS could also coordinate with the Navy to modify or add to the existing monitoring requirements if the new data suggest that the addition of a particular measure would likely fill in a specifically important data gap.

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 rule may contain additional details not contained in the proposed rule. Additionally, proposed reporting requirements may be modified, removed, or added based on information or comments received during the public comment period. Currently, there are several different reporting requirements pursuant to these proposed regulations:

General Notification of Injured or Dead Marine Mammals

Navy personnel will ensure that NMFS (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 will provide NMFS with species or description of the animal(s), the condition of the animal(s) (including carcass condition if the animal is dead), location, time of first discovery, observed behaviors (if alive), and photo or video (if available). The SOCAL Stranding Response Plan contains more specific reporting requirements for specific circumstances.

SINKEX, GUNEX, MISSILEX, BOMBEX, Mine Warfare/Countermeasures, and NSFS

A yearly report detailing the exercise's timeline, the time the surveys commenced and terminated, amount, and types of all ordnance expended, and the results of marine mammal survey efforts for each event will be submitted to NMFS.

IEER

A yearly report detailing the number of exercises along with the hours of associated marine mammal survey and associated marine mammal sightings, number of times employment was delayed by marine mammal sightings, and the number of total detonated charges and self-scuttled charges will be submitted to NMFS.

MFAS/HFAS Mitigation/Navy Watchstanders

The Navy will submit an After Action Report to the Office of Protected Resources, NMFS, within 120 days of the completion of a Major or Coordinated Training Exercise (Sustainment, IAC2, SHAREM, COMPTUEX, or JTFEX). For other ASW exercises the Navy will submit a yearly summary report. These reports will, at a minimum, include the following information:

- The estimated total number of hours of active sonar operation and the types of sonar used in the exercise.
- If possible, the total number of hours of observation effort (including observation time when active sonar was not operating).
- A report of all marine mammal sightings (at any distance—not just within a particular distance) to include, when possible and to the best of their ability, and if not classified:
  - ■ Species or animal type.
  - ■ Number of animals sighted.
  - ■ Location of marine mammal sighting (where not classified).
  - ■ Distance of animal from any operating active sonar sources.
  - ■ Whether animal is fore, aft, port, starboard.
  - ■ Direction animal is moving in relation to source (away, towards, parallel).

■ Any observed behaviors of marine mammals.

• The status of any active sonar sources (what sources were in use) and whether or not they were powered down or shut down as a result of the marine mammal observation.

• The platform type that the marine mammals were sighted from.

Monitoring Report From Monitoring Plan

Although the draft Monitoring Plan for SOCAL contains a general description of the monitoring that the Navy plans to conduct (and that NMFS has analyzed) in the SOCAL Range Complex, the detailed analysis and reporting protocols that will be used for the SOCAL monitoring plan are still being refined at this time. The draft SOCAL Monitoring plan may be viewed at: *http://www.nmfs.noaa.gov/pr/permits/incidental.htm.* Navy will standardize data collection methods across ranges to allow for comparison in different geographic locations. Reports of the required monitoring will be submitted to NMFS on an annual basis as well as in the form of a multi-year report that compiles all five years worth of monitoring data (reported at end of fourth year of rule—in future rules will include the last year of the prior rule).

SOCAL Comprehensive Report

The Navy will 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 individual reports are required. This report will be submitted at the end of the fourth year of the rule (December 2012), covering activities that have occurred through June 1, 2012. 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 comment by then. The activities authorized by this LOA that are not covered in this report (i.e., those that occur between June 2012 and January 2014) will be covered in the comprehensive report of the next 5-yr regulations for SOCAL, if issued.

Comprehensive National ASW Report

The Navy will submit a draft Comprehensive National ASW Report that analyzes, compares, and summarizes the data gathered from the watchstanders and pursuant to the implementation of the Monitoring Plans for AFAST, the Hawaii Range Complex, the Southern California (SOCAL) Range Complex, the Northwest Training Range Complex (NWTRC) and the Marianas range Complex. This report will be submitted by June 2014, covering activities that have occurred in these four ranges through June 1, 2013. 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 comment by then.

Estimated Take of Marine Mammals

As mentioned previously, for the purposes of MMPA authorizations, NMFS' effects assessments have two primary purposes (in the context of the SOCAL rulemaking and LOA process, where subsistence communities are not present): (1) To set forth the permissible methods of taking within the context of MMPA Level B Harassment (behavioral harassment), Level A Harassment (injury), and mortality (i.e., identify the number and types of take that will occur); and (2) to determine whether the specified activity will have a negligible impact on the affected species or stocks of marine mammals (based on the likelihood that the activity will adversely affect the species or stock through effects on annual rates of recruitment or survival).

In the Potential Effects of Exposure of Marine Mammal to MFAS/HFAS and Underwater Detonations section, NMFS' analysis identified the lethal responses, physical trauma, sensory impairment (permanent and temporary threshold shifts 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 statutory definitions of Level A and Level B Harassment and attempt to quantify the effects that might occur from the specific training activities that the Navy is proposing in the SOCAL Range Complex.

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 in the Potential Effects of Exposure of Marine Mammal to MFAS/HFAS and Underwater Detonations Section, 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 MFAS/HFAS or underwater detonations, is considered Level B Harassment. Some of the lower level physiological stress responses discussed in the Potential Effects of Exposure of Marine Mammal to MFAS/HFAS and Underwater Detonations Section: Stress Section will 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.

In the effects section above, 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 categories. 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.

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 either MFAS/HFAS or underwater detonations) as Level B Harassment, not Level A Harassment (injury).

Level A Harassment

Of the potential effects that were described in the Potential Effects of Exposure of Marine Mammals to MFAS/HFAS and Underwater Detonations Section, following are the types of effects that fall into the Level A Harassment category:

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 active 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 in a manner (unusually rapid ascent, unusually long series of surface dives, etc.) that might result in unusual bubble formation or growth ultimately resulting in tissue damage (emboli, etc.) 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.

Acoustic Take Criteria

For the purposes of an MMPA incidental take 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 MFAS/HFAS and underwater detonations cannot be detected or measured (not all responses visible external to animal, portion of exposed animals underwater (so not visible), many animals located many miles from observers and covering very large area, etc.) 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 MFAS/HFAS or explosive detonations) Level B Harassment, Level A Harassment, and mortality (for explosives) of marine mammals would occur. The acoustic criteria for MFAS/HFAS and Underwater Detonations (IEER) are discussed below.

MFAS/HFAS Acoustic Criteria

Because relatively few applicable data exist to support acoustic criteria specifically for HFAS and because such a small percentage of the active sonar pings that marine mammals will likely be exposed to incidental to this activity come from a HFAS source (the vast majority come from MFAS sources), NMFS will apply the criteria developed for the MFAS to the HFAS as well.

NMFS utilizes three acoustic criteria for MFAS/HFAS: PTS (injury—Level A Harassment), TTS (Level B Harassment), and behavioral harassment (Level B Harassment). Because the TTS and PTS criteria are derived similarly and the PTS criteria was extrapolated from the TTS data, the TTS and PTS acoustic criteria will be presented first, before the behavioral criteria.

For more information regarding these criteria, please see the Navy's DEIS for SOCAL.

Level B Harassment Threshold (TTS)

As mentioned above, 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 at what received levels 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.

A number of investigators have measured TTS in marine mammals. These studies measured hearing thresholds in trained marine mammals before and after exposure to intense sounds. The existing cetacean TTS data are summarized in the following bullets.

- Schlundt *et al.* (2000) reported the results of TTS experiments conducted with 5 bottlenose dolphins and 2 belugas exposed to 1-second tones. This paper also includes a reanalysis of preliminary TTS data released in a technical report by Ridgway *et al.* (1997). At frequencies of 3, 10, and 20 kHz, sound pressure levels (SPLs) necessary to induce measurable amounts (6 dB or more) of TTS were between 192 and 201 dB re 1 μPa (EL = 192 to 201 dB re 1 μPa^2-s). The mean exposure SPL and EL for onset-TTS were 195 dB re 1 μPa and 195 dB re 1 μPa^2-s, respectively.
- Finneran *et al.* (2001, 2003, 2005) described TTS experiments conducted with bottlenose dolphins exposed to 3-kHz tones with durations of 1, 2, 4, and 8 seconds. Small amounts of TTS (3 to 6 dB) were observed in one dolphin after exposure to ELs between 190 and 204 dB re 1 uPa2-s. These results were consistent with the data of Schlundt *et al.* (2000) and showed that the Schlundt *et al.* (2000) data were not significantly affected by the masking sound used. These results also confirmed that, for tones with different durations, the amount of TTS is best correlated with the exposure EL rather than the exposure SPL.
- Nachtigall *et al.* (2003) measured TTS in a bottlenose dolphin exposed to octave-band sound centered at 7.5 kHz. Nachtigall *et al.* (2003a) reported TTSs of about 11 dB measured 10 to 15 minutes after exposure to 30 to 50 minutes of sound with SPL 179 dB re 1 μPa (EL about 213 dB re μPa^2-s). No TTS was observed after exposure to the same sound at 165 and 171 dB re 1 μPa. Nachtigall *et al.* (2004) reported TTSs of around 4 to 8 dB 5 minutes after exposure to 30 to 50 minutes of sound with SPL 160 dB re 1 μPa (EL about 193 to 195 dB re 1 μPa^2-s). The difference in results was attributed to faster post-exposure threshold measurement—TTS may have recovered before being detected by Nachtigall *et al.* (2003). These studies showed that, for long-duration exposures, lower sound pressures are required to induce TTS than are required for short-duration tones.
- Finneran *et al.* (2000, 2002) conducted TTS experiments with dolphins and belugas exposed to impulsive sounds similar to those produced by distant underwater explosions and seismic waterguns. These studies showed that, for very short-duration impulsive sounds, higher sound pressures were required to induce TTS than for longer-duration tones.
- Finneran *et al.* (2007) conducted TTS experiments with bottlenose dolphins exposed to intense 20 kHz fatiguing tone. Behavioral and auditory evoked potentials (using sinusoidal amplitude modulated tones creating auditory steady state response [AASR]) were used to measure TTS. The fatiguing tone was either 16 (mean = 193 re 1uPa, SD = 0.8) or 64 seconds (185–186 re 1uPa) in duration. TTS ranged from 19–33db from behavioral measurements and 40–45dB from ASSR measurements.
- Kastak *et al.* (1999a, 2005) conducted TTS experiments with three species of pinnipeds, California sea lion, northern elephant seal and a Pacific harbor seal, exposed to continuous underwater sounds at levels of 80 and 95 dB sensation level at 2.5 and 3.5 kHz for up to 50 minutes. Mean TTS shifts of up to 12.2 dB occurred with the harbor seals showing the largest shift of 28.1 dB. Increasing the sound duration had a greater effect on TTS than increasing the sound level from 80 to 95 dB.

Some of the more important data obtained from these studies are onset-TTS levels (exposure levels sufficient to cause a just-measurable amount of TTS) often defined as 6 dB of TTS (for example, Schlundt *et al.*, 2000) and the fact that energy metrics (sound exposure levels (SEL), which include a duration component) better predict when an animal will sustain TTS than pressure (SPL) alone. NMFS' TTS criteria (which indicate the received level at which onset TTS (>6dB) is induced) for MFAS/HFAS are as follows:

- Cetaceans—195 dB re 1 μPa^2-s (based on mid-frequency cetaceans—no published data exist on auditory effects of noise in low- or high-frequency cetaceans (Southall *et al.* (2007)).
- Harbor Seals (and closely related species)—183 dB re 1 μPa^2-s
- Northern Elephant Seals (and closely related species)—204 dB re 1 μPa^2-s
- California Sea Lions (and closely related species)—206 dB re 1 μPa^2-s.

A detailed description of how TTS criteria were derived from the results of the above studies may be found in Chapter 3 of Southall *et al.* (2007), as well as the Navy's SOCAL LOA application. Because they are both otariids, the California sea lion criteria is used to estimate take of northern fur seals for this authorization.

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 the 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 discovered through study of terrestrial mammals. NMFS uses the following acoustic criteria for injury:

- Cetaceans—215 dB re 1 μPa^2-s (based on mid-frequency cetaceans—no published data exist on auditory effects of noise in low-or high-frequency cetaceans (Southall *et al.* (2007))
- Harbor Seals (and closely related species)—203 dB re 1 μPa^2-s
- Northern Elephant Seals (and closely related species)—224 dB re 1 μPa^2-s
- California Sea Lions (and closely related species)—226 dB re 1 μPa^2-s

These criteria are based on a 20 dB increase in SEL over that required for onset-TTS. Extrapolations from terrestrial mammal data indicate that PTS occurs at 40 dB or more of TS, and that TS growth occurs at a rate of approximately 1.6 dB TS per dB increase in EL. There is a 34-dB TS difference between onset-TTS (6 dB) and onset-PTS (40 dB). Therefore, an animal would require approximately 20 dB of additional exposure (34 dB divided by 1.6 dB) above onset-TTS to reach PTS. A detailed description of how TTS criteria were derived from the results of the above studies may be found in Chapter 3 of Southall *et al.*

(2007), as well as the Navy's SOCAL LOA application. Southall *et al.* (2007) recommend a precautionary dual criteria for TTS (230 dB re 1 μPa (SPL peak pressure) in addition to 215 dB re 1 μPa^2-s (SEL)) to account for the potentially damaging transients embedded within non-pulse exposures. However, in the case of MFAS/HFAS, the distance at which an animal would receive 215 dB (SEL) is farther from the source (*i.e.*, more conservative) than the distance at which they would receive 230 dB (SPL peak pressure) and therefore, it is not necessary to consider 230 dB peak.

We note here that behaviorally mediated injuries (such as those that have been hypothesized as the cause of some beaked whale strandings) could potentially occur in response to received levels lower than those believed to directly result in tissue damage. As mentioned previously, data to support a quantitative estimate of these potential effects (for which the exact mechanism is not known and in which factors other than received level may play a significant role) do not exist. However, based on the number of years (more than 40) 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.

Level B Harassment Risk Function (Behavioral Harassment)

In 2006, NMFS issued the only MMPA authorization that has, as yet, authorized the take of marine mammals incidental to MFAS (to the Navy for the Rim of the Pacific Exercises (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,’’ ‘‘dose-response functions,’’ or ‘‘stress-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 3a). 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), the Supplemental EIS for SURTASS LFA sonar (U.S. Department of the Navy, 2007d) and the FEIS for the Navy's Hawaii Range Complex (U.S. Department of the Navy, 2008). As discussed in the Effects section, factors other than received level (such as distance from or bearing to the sound source) 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.

The particular acoustic risk functions developed by NMFS and the Navy (see Figures 2a and 2b) 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)

In order to use this function to estimate the percentage of an exposed population that would respond in a manner that NMFS classifies as Level B Harassment, based on a given received level, the values for B, K and A need to be identified.

B Parameter (Basement)—The B parameter is the estimated received level below which the probability of 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 approaches zero for the MFAS/HFAS risk assessment. At this received level, the curve would predict that the percentage of the exposed population that would be taken by Level B Harassment approaches zero. For MFAS/HFAS, NMFS has determined that B = 120 dB. This level is based on a broad overview of the levels at which many species have been reported responding to a variety of sound sources.

K Parameter (representing the 50 percent Risk Point)—The K parameter is based on the received level that corresponds to 50 percent risk, or the received level at which we believe 50 percent of the animals exposed to the designated received level will respond in a manner that NMFS classifies as Level B Harassment. The K parameter (K = 45 dB) is based on three data sets in which marine mammals exposed to mid-frequency sound sources were reported to respond in a manner that NMFS would classify as Level B Harassment. There is widespread consensus that marine mammal responses to MFA sound signals need to be better defined using controlled exposure experiments (Cox *et al.*, 2006; Southall *et al.*, 2007). The Navy is contributing to an ongoing behavioral response study in the Bahamas that is expected to provide some initial information on beaked whales, the species identified as the most sensitive to MFAS. NMFS is leading this international effort with scientists from various academic institutions and research organizations to conduct studies on how marine mammals respond to underwater sound exposures. Additionally, the Navy recently tagged whales in conjunction with the 2008 RIMPAC exercises. Until additional data are available, however, NMFS and the Navy have determined that the following three data sets are most applicable for the direct use in establishing the K parameter for the MFAS/HFAS risk function. These data sets, summarized below, represent the only known data that specifically relate altered behavioral responses (that NMFS would consider Level B Harassment) to exposure—at specific received levels—to MFAS and sources within or having components within the range of MFAS (1–10 kHz).

Even though these data are considered the most representative of the proposed specified activities, and therefore the most appropriate on which to base the K parameter (which basically determines the midpoint) of the risk function, these data have limitations, which are discussed in Appendix F of the Navy's DEIS for SOCAL.

1. Controlled Laboratory Experiments with Odontocetes (SSC Data set)—Most of the observations of the behavioral responses of toothed whales resulted from a series of controlled experiments on bottlenose dolphins and beluga whales conducted by researchers at SSC's facility in San Diego, California (Finneran *et al*., 2001, 2003, 2005; Finneran and Schlundt, 2004; Schlundt *et al*., 2000). In experimental trials (designed to measure TTS) with marine mammals trained to perform tasks when prompted, scientists evaluated whether the marine mammals still performed these tasks when exposed to mid-frequency tones. Altered behavior during experimental trials usually involved refusal of animals to return to the site of the sound stimulus, but also included attempts to avoid an exposure in progress, aggressive behavior, or refusal to further participate in tests.

Finneran and Schlundt (2004) examined behavioral observations recorded by the trainers or test coordinators during the Schlundt *et al.* (2000) and Finneran *et al.* (2001, 2003, 2005) experiments. These included observations from 193 exposure sessions (fatiguing stimulus level > 141 dB re 1 μPa) conducted by Schlundt *et al.* (2000) and 21 exposure sessions conducted by Finneran *et al.* (2001, 2003, 2005). The TTS experiments that supported Finneran and Schlundt (2004) are further explained below:

• Schlundt *et al.* (2000) provided a detailed summary of the behavioral responses of trained marine mammals during TTS tests conducted at SSC San Diego with 1-sec tones and exposure frequencies of 0.4 kHz, 3 kHz, 10 kHz, 20 kHz and 75 kHz. Schlundt *et al.* (2000) reported eight individual TTS experiments. The experiments were conducted in San Diego Bay. Because of the variable ambient noise in the bay, low-level broadband masking noise was used to keep hearing thresholds consistent despite fluctuations in the ambient noise. Schlundt *et al.* (2000) reported that ''behavioral alterations,'' or deviations from the behaviors the animals being tested had been trained to exhibit, occurred as the animals were exposed to increasing fatiguing stimulus levels.

• Finneran *et al.* (2001, 2003, 2005) conducted 2 separate TTS experiments using 1-sec tones at 3 kHz. The test methods were similar to that of Schlundt *et al.* (2000) except the tests were conducted in a pool with very low ambient noise level (below 50 dB re 1 μPa^2/hertz [Hz]), and no masking noise was used. In the first, fatiguing sound levels were increased from 160 to 201 dB SPL. In the second experiment, fatiguing sound levels between 180 and 200 dB SPL were randomly presented.

Bottlenose dolphins exposed to 1-second (sec) intense tones exhibited short-term changes in behavior above received sound levels of 178 to 193 dB re 1 μPa (rms), and beluga whales did so at received levels of 180 to 196 dB and above.

2. Mysticete Field Study (Nowacek *et al*., 2004)—The only available and applicable data relating mysticete responses to exposure to mid-frequency sound sources is from Nowacek *et al.* (2004). Nowacek *et al.* (2004) documented observations of the behavioral response of North Atlantic right whales exposed to alert stimuli containing mid-frequency components in the Bay of Fundy. Investigators used archival digital acoustic recording tags (DTAG) to record the behavior (by measuring pitch, roll, heading, and depth) of right whales in the presence of an alert signal, and to calibrate received sound levels. The alert signal was 18 minutes of exposure consisting of three 2-minute signals played sequentially three times over. The three signals had a 60 percent duty cycle and consisted of: (1) Alternating 1-sec pure tones at 500 Hz and 850 Hz; (2) a 2-sec logarithmic down-sweep from 4,500 Hz to 500 Hz; and (3) a pair of low (1,500 Hz)-high (2,000 Hz) sine wave tones amplitude modulated at 120 Hz and each 1-sec long. The purposes of the alert signal were (a) to pique the mammalian auditory system with disharmonic signals that cover the whales' estimated hearing range; (b) to maximize the signal to noise ratio (obtain the largest difference between background noise) and (c) to provide localization cues for the whale. The maximum source level used was 173 dB SPL.

Nowacek *et al.* (2004) reported that five out of six whales exposed to the alert signal with maximum received levels ranging from 133 to 148 dB re 1 μPa significantly altered their regular behavior and did so in identical fashion. Each of these five whales: (i) Abandoned their current foraging dive prematurely as evidenced by curtailing their ''bottom time''; (ii) executed a shallow-angled, high power (*i.e.* significantly increased fluke stroke rate) ascent; (iii) remained at or near the surface for the duration of the exposure, an abnormally long surface interval; and (iv) spent significantly more time at subsurface depths (1–10 m) compared with normal surfacing periods when whales normally stay within 1 m (1.1 yd) of the surface.

3. Odontocete Field Data (Haro Strait—USS SHOUP)—In May 2003, killer whales (Orcinus orca) were observed exhibiting behavioral responses generally described as avoidance behavior while the U.S. Ship (USS) SHOUP was engaged in MFAS in the Haro Strait in the vicinity of Puget Sound, Washington. Those observations have been documented in three reports developed by Navy and NMFS (NMFS, 2005; Fromm, 2004a, 2004b; DON, 2003). Although these observations were made in an uncontrolled environment, the sound field that may have been associated with the active sonar operations was estimated using standard acoustic propagation models that were verified (for some but not all signals) based on calibrated in situ measurements from an independent researcher who recorded the sounds during the event. Behavioral observations were reported for the group of whales during the event by an experienced marine mammal biologist who happened to be on the water studying them at the time. The observations associated with the USS SHOUP provide the only data set available of the behavioral responses of wild, non-captive animals upon actual exposure to AN/SQS–53 sonar.

U.S. Department of Commerce (National Marine Fisheries, 2005a); U.S. Department of the Navy (2004b); Fromm (2004a, 2004b) documented reconstruction of sound fields produced by USS SHOUP associated with the behavioral response of killer whales observed in Haro Strait. Observations from this reconstruction included an approximate closest approach time which was correlated to a reconstructed estimate of received level. Observations from this reconstruction included an estimate of 169.3 dB SPL which represents the mean level at a point of closest approach within a 500 m wide area which the animals were exposed. Within that area, the estimated received levels varied from approximately 150 to 180 dB SPL.

Calculation of K Parameter—NMFS and the Navy used the mean of the following values to define the midpoint of the function: (1) The mean of the lowest received levels (185.3 dB) at which individuals responded with altered behavior to 3 kHz tones in the SSC data set; (2) the estimated mean received level value of 169.3 dB produced by the reconstruction of the USS SHOUP incident in which killer whales exposed to MFAS (range modeled possible received levels: 150 to 180 dB); and (3) the mean of the 5 maximum received levels at which Nowacek *et al.* (2004) observed significantly altered responses of right whales to the alert stimuli than to the control (no input signal) is 139.2 dB SPL. The arithmetic mean of these three mean values is 165 dB SPL. The value of K is the difference between the value of B (120 dB SPL) and the 50 percent value of 165 dB SPL; therefore, K = 45.

A Parameter (Steepness)—NMFS determined that a steepness parameter (A) = 10 is appropriate for odontocetes (except harbor porpoises) and pinnipeds and A = 8 is appropriate for mysticetes.

The use of a steepness parameter of A = 10 for odontocetes for the MFAS/HFAS risk function was based on the use of the same value for the SURTASS LFA risk continuum, which was supported by a sensitivity analysis of the parameter presented in Appendix D of the SURTASS/LFA FEIS (U.S. Department of the Navy, 2001c). As concluded in the SURTASS FEIS/EIS, the value of A = 10 produces a curve that has a more gradual transition than the curves developed by the analyses of migratory gray whale studies (Malme *et al.*, 1984; Buck and Tyack, 2000; and SURTASS LFA Sonar EIS, Subchapters 1.43, 4.2.4.3 and Appendix D, and National Marine Fisheries Service, 2008).

NMFS determined that a lower steepness parameter (A = 8), resulting in a shallower curve, was appropriate for use with mysticetes and MFAS/HFAS. The Nowacek *et al.* (2004) dataset contains the only data illustrating mysticete behavioral responses to a sound source that encompasses frequencies in the mid-frequency sound spectrum. A shallower curve (achieved by using A = 8) better reflects the risk of behavioral response at the relatively low received levels at which behavioral responses of right whales were reported in the Nowacek *et al.* (2004) data. Compared to the odontocete curve, this adjustment results in an increase in the proportion of the exposed population of mysticetes being classified as behaviorally harassed at lower RLs, such as those reported in and is supported by the only dataset currently available.

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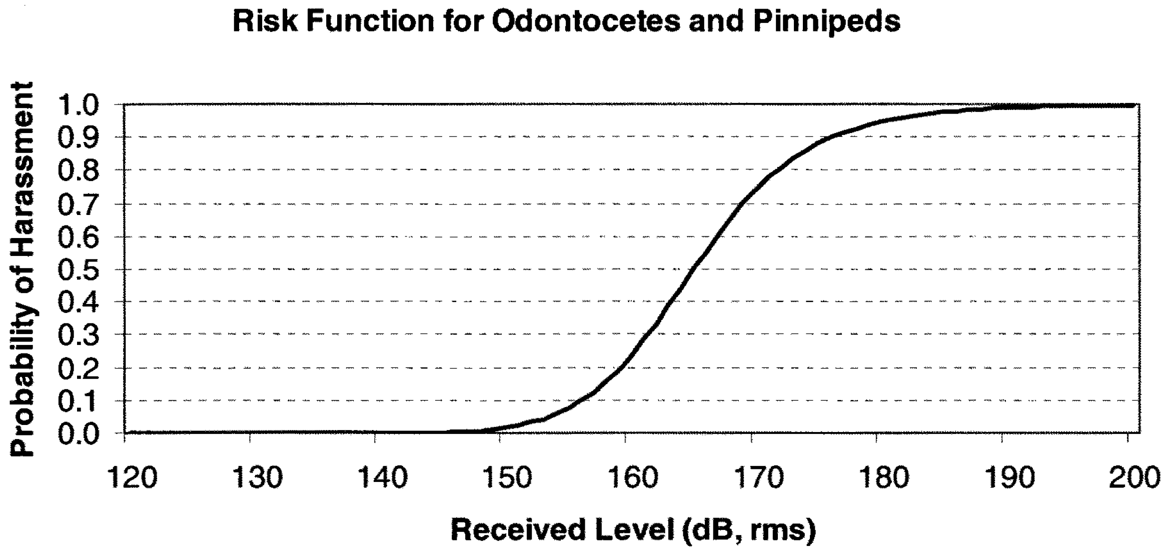

Figure 3a. Risk function for odontocetes and pinnipeds. B=120 dB, K=45 dB, A=10

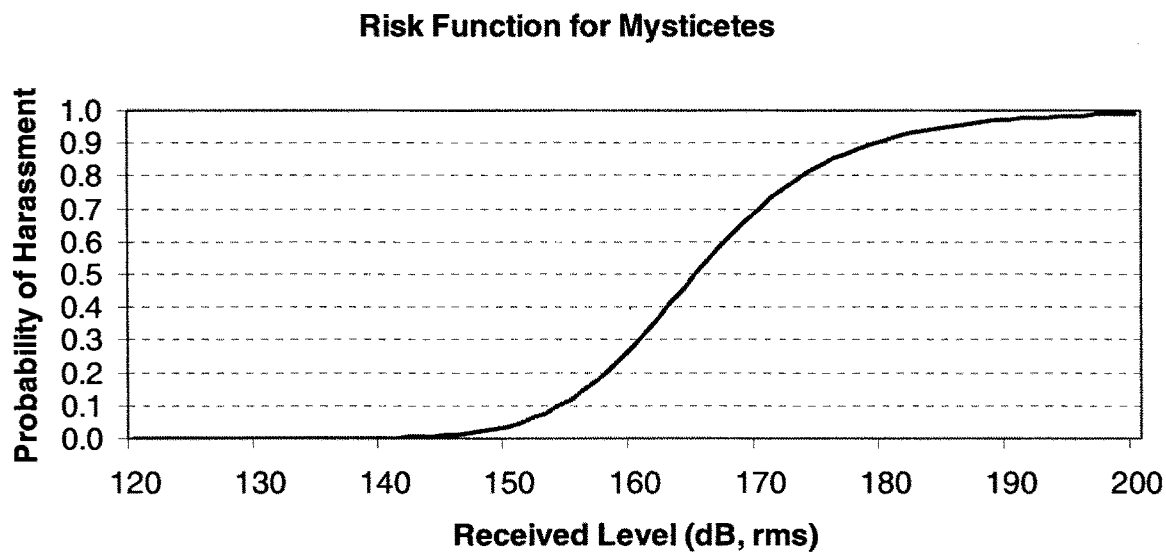

Figure 3b. Risk function for mysticetes. B=120 dB, K=45 dB, A=8.

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Basic Application of the Risk Function—The risk function is used to estimate the percentage of an exposed population that is likely to exhibit behaviors that would qualify as harassment (as that term is defined by the MMPA applicable to military readiness activities, such as the Navy's testing and training with MFAS) at a given received level of sound. For example, at 165 dB SPL (dB re: 1 μPa rms), the risk (or probability) of harassment is defined according to this function as 50 percent, and Navy/NMFS applies that by estimating that 50 percent of the individuals exposed at that received level are likely to respond by exhibiting behavior that NMFS would classify as behavioral harassment. The risk function is not applied to individual animals, only to exposed populations.

The data primarily used to produce the risk function (the K parameter) were compiled from four species that had been exposed to sound sources in a variety of different circumstances. As a result, the risk function represents a general relationship between acoustic exposures and behavioral responses that is then applied to specific circumstances. That is, the risk function represents a relationship that is deemed to be generally true, based on the limited, best-available science, but may not be true in specific circumstances. In particular, the risk function, as currently derived, treats the received level as the only variable that is relevant to a marine mammal's behavioral response. However, we know that many other variables—the marine mammal's gender, age, and prior experience; the activity it is engaged in during an exposure event, its distance from a sound source, the number of sound sources, and whether the sound sources are approaching or moving away from the animal—can be critically important in determining whether and how a marine mammal will respond to a sound source (Southall *et al.*, 2007). The data that are currently available do not allow for incorporation of these other variables in the current risk functions; however, the risk function represents the best use of the data that are available.

As more specific and applicable data become available for MFAS/HFAS sources, NMFS can use these data to modify the outputs generated by the risk function to make them more realistic. Ultimately, data may exist to justify the use of additional, alternate, or multi-variate functions. For example, as mentioned previously, the distance from the sound source and whether it is perceived as approaching or moving away can affect the way an animal responds to a sound (Wartzok *et al.*, 2003). In the SOCAL example, animals exposed to received levels between 120 and 130 dB may be 22–65 nm (41–120 km) from a sound source depending on seasonal variations; those distances could influence whether those animals perceive the sound source as a potential threat, and their behavioral responses to that threat. Though there are data showing response of certain marine mammal species to mid-frequency sound sources at that received level, NMFS does not currently have any data that describe the response of marine mammals to mid-frequency sounds at that distance, much less data that compare responses to similar sound levels at varying distances (much less for MFAS/HFAS). However, if data were to become available, NMFS would re-evaluate the risk function and to incorporate any additional variables into the "take" estimates.

Harbor Porpoise Behavioral Harassment Criteria

The information currently available regarding these inshore species that inhabit shallow and coastal waters suggests a very low threshold level of response for both captive and wild animals. Threshold levels at which both captive (e.g. Kastelein *et al.*, 2000; Kastelein *et al.*, 2005; Kastelein *et al.*, 2006; Kastelein *et al.*, 2008) and wild harbor porpoises (e.g. Johnston, 2002) responded to sound (e.g. acoustic harassment devices (ADHs), acoustic deterrent devices (ADDs), or other non-pulsed sound sources) is very low (e.g. ~120 dB SPL), although the biological significance of the disturbance is uncertain. Therefore, a step function threshold of 120 dB SPL was used to estimate take of harbor porpoises instead of the risk functions used for other species (i.e., we assume for the purpose of estimating take that all harbor porpoises exposed to 120 dB or higher MFAS/HFAS will be taken by Level B behavioral harassment).

Explosive Detonation Criteria (for IEER)

The criteria for mortality, Level A Harassment, and Level B Harassment resulting from explosive detonations were initially developed for the Navy's Seawolf and Churchill ship-shock trials and have not changed since other MMPA authorizations issued for explosive detonations. The criteria, which are applied to cetaceans and pinnipeds, are summarized in Table 8. Additional information regarding the derivation of these criteria is available in the Navy's DEIS for the SOCAL and in the Navy's CHURCHILL FEIS (U.S. Department of the Navy, 2001c).

Criterion	Criterion Definition	Threshold
Mortality	onset of severe lung injury (1% probability of mortality)	31 psi-ms (positive impulse)
Level A Harassment (Injury)	Slight lung injury; or	13 psi-ms (positive impulse)
	50% of animals exposed would experience ear drum rupture; and 30% exposed sustain PTS	205 dB re 1 microPa^2-s (full spectrum energy)
Level B Harassment	TTS (dual criteria); or	23 psi (peak pressure) (explosives < 2,000 lbs.); or
		182 dB re 1 microPa^2-s (peak 1/3 octve band)

Table 8. Summary of Criteria for Explosive Detonations applicable to IEER

Estimates of Potential Marine Mammal Exposure

Estimating the take that will result from the proposed activities entails the following four general steps: (1) Propagation model estimates animals exposed to sources at different levels; (2) further modeling determines number of exposures to levels indicated in criteria above (i.e., number of takes); (3) post-modeling corrections refine estimates to make them more accurate; and, (4) mitigation is taken into consideration. More information regarding the models used, the assumptions used in the models, and the process of estimating take is available in Appendix F of the Navy's DEIS for SOCAL.

(1) In order to quantify the types of take described in previous sections that are predicted to result from the Navy's specified activities, the Navy first uses a sound propagation model that predicts the number of animals that will be exposed to a range of levels of pressure and energy (of the metrics used in the

criteria) from MFAS/HFAS and explosive detonations based on several important pieces of information, including:

- Characteristics of the sound sources.
  - ■ Active sonar source characteristics include: Source level (with horizontal and vertical directivity corrections), source depth, center frequency, source directivity (horizontal/vertical beam width and horizontal/vertical steer direction), and ping spacing.
  - ■ Explosive source characteristics include: The weight of an explosive, the type of explosive, the detonation depth, number of successive explosions.
- Transmission loss (in 13 representative environmental provinces across 8 sonar modeling areas in two seasons) based on: Water depth; sound speed variability throughout the water column (warm season exhibits a weak surface duct, cold season exhibits a relatively strong surface duct); bottom geo-acoustic properties (bathymetry); and wind speed.
- The estimated density of each marine mammal species in the SOCAL (see Table 13), horizontally distributed uniformly and vertically distributed according to dive profiles based on field data.

(2) Next, the criteria discussed in the previous section are applied to the estimated exposures to predict the number of exposures that exceed the criteria, i.e., the number of takes by Level B Harassment, Level A Harassment, and mortality.

(3) During the development of the EIS for SOCAL, NMFS and the Navy determined that the output of the model could be made more realistic by applying post-modeling corrections to account for the following:

- Acoustic footprints for active sonar sources must account for land masses (by subtracting them out).
- Acoustic footprints for active sonar sources should not be added independently, rather, the degree to which the footprints from multiple ships participating in the same exercise would typically overlap needs to be taken into consideration.
- Acoustic modeling should account for the maximum number of individuals of a species that could potentially be exposed to active sonar within the course of 1 day or a discreet continuous sonar event if less than 24 hours.

(4) Mitigation measures are taken into consideration by NMFS and adjustments may be applied to the numbers produced by the Navy's modeled estimates. For example, in some cases the raw modeled numbers of exposures to levels predicted to result in Level A Harassment from exposure to MFAS/HFAS might indicate that 1 fin whale would be exposed to levels of active sonar anticipated to result in PTS—However, a fin whale would need to be within approximately 10 m of the source vessel in order to be exposed to these levels. Because of the mitigation measures (watchstanders and shutdown zone), size of fin whales, and nature of fin whale behavior, it is highly unlikely that a fin whale would be exposed to those levels, and therefore the Navy would not request authorization for Level A Harassment of 1 fin whale. Table 9 contains the Navy's estimated take estimates.

(5) Last, the Navy's specified activities have been described based on best estimates of the number of MFAS/HFAS hours that the Navy will conduct. The exact number of hours may vary from year to year, but will not exceed the 5-year total indicated in Table 10 (by multiplying the yearly estimate by 5) by more than 10 percent. NMFS estimates that a 10-percent increase in active sonar hours would result in approximately a 10-percent increase in the number of takes, and we have considered this possibility in our analysis.

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Species	Navy's Estimated Sonar Exposures at Indicated Threshold			Navy's Estimated Explosive Exposures at Indicated Thresholds				NMFS Proposed Take Authorization		
	Level B Take		Level A Take	Level B Take		Level A Take	Mortality	Level B	Level A	Mortality
	behavioral	TTS	PTS	sub-TTS	TTS					
Mysticetes										
Blue whale	538	67	1	2	2	0	0	609 (0-1)	0	0
Fin whale	152	12	0	2	1	0	0	167 (0-1)	0	0
Humpback whale	13	2	0	0	0	0	0	15	0	0
Sei whale	0	0	0	0	0	0	0	0	0	0
Bryde's whale	0	0	0	0	0	0	0	0	0	0
Gray whale	4,903	544	1	6	7	0	0	5460 (0-4)	0	0
Minke whale	110	16	0	0	0	0	0	126 (0-16)	0	0
Odontocetes										
Sperm whale	137	8	0	2	1	0	0	148 (0-9)	0	0
Bottlenose dolphin	1,291	194	0	14	10	0	0	1509 (0-101)	0	0
Long beaked common dolphin	4,083	435	1	61	41	1	0	4622 (0-236)	0	0
Northern right whale dolphin	1,340	169	0	19	12	0	0	1540	0	0
Pacific white-sided dolphin	1,184	192	0	12	9	0	0	1397 (0-100)	0	0
Pantropical spotted dolphin	N/A	N/A	N/A	N/A	N/A	N/A	N/A	20*	0	0
Risso's dolphin	3,157	343	0	57	34	1	0	3592 (0-187)	0	0
Rough-toothed dolphin	N/A	N/A	N/A	N/A	N/A	N/A	N/A	20*	0	0
Short beaked common dolphin	34,829	3,730	6	528	354	12	4	39441 (0-1940)	0	0
Spinner dolphin	N/A	N/A	N/A	N/A	N/A	N/A	N/A	20*	0	0
Striped dolphin	1,569	249	1	6	6	0	0	1830 (0-128)	0	0
Dall's porpoise	530	88	0	2	2	0	0	622	0	0
False killer whale	N/A	N/A	N/A	N/A	N/A	N/A	N/A	20*	0	0
Killer whale	6	1	0	0	0	0	0	7	0	0
Melon-headed whale	N/A	N/A	N/A	N/A	N/A	N/A	N/A	20*	0	0
Pygmy killer whale	N/A	N/A	N/A	N/A	N/A	N/A	N/A	20*	0	0
Short-finned pilot whale	39	6	0	0	0	0	0	45	0	0
Dwarf sperm whale	N/A	N/A	N/A	N/A	N/A	N/A	N/A	20*	0	0
Pygmy sperm whale	141	16	0	1	1	0	0	159 (8-17)	0	0
Baird's beaked whale	12	1	0	0	0	0	0	13 (0-1)	0	10 (over 5 years)
Cuvier's beaked whale	383	37	0	5	3	0	0	428 (18-40)	0	
Mesoplodon spp	115	13	0	2	1	0	0	131(6-14)	0	
Ziphiid whales	86	8	0	2	1	0	0	97 (4-9)	0	
Pinnipeds										
Guadalupe fur seal	870	190	0	2	2	0	0	1064 (0-1)	0	0
Northern elephant seal	833	5	0	76	41	0	0	955 (30-44)	0	0
Pacific harbor seal	1,048	4,562	9	26	26	1	0	5672 (2863-4559)	0	0
California sea lion	54,380	6	0	584	510	16	6	55502 (0-255)	0	0
Northern fur seal	1,072	3	0	90	64	3	1	1229 (0-32)	0	0
Total	**112,821**	**10,897**	**19**	**1,499**	**1,128**	**34**	**11**	126049	0	10

Table 9. Density and Navy's estimated exposures to indicated criteria and NMFS proposed take authorization Though exposures are predicted by the model, NMFS does not anticipate any injury/PTS to occur because of the mitigation measures (as related to certain characteristics of animals, such as size, gregariousness, or group size) and likely avoidance behavior of marine mammals As discussed in the Estimated Take of Marine Mammals Section, NMFS also anticipates fewer takes by TTS will actually occur than were modeled Anticipated TTS occurences are indicated in parentheses in the last column (and are already counted within the broad Level B harassment number that NMFS proposes to authorize)

Event	SQS-53C Sonar Hours	SQS-56C Sonar Hours	BQQ-10 Sonar Hours	BQQ-15 Sonar Hours	Total Sonar Hours	AQS-22 Number of Dips	SSQ-62 Number of Sonobuoys	MK-48 Number of Torpedo Events	MK-46 Number of Torpedo Events	AN/SLQ-25A NIXIE Number of Hours
Major Exercise (8/yr)	1,045	261	98	41	1,445	337	2,255	11	28	76
Integrated Exercises (7/yr)	403	101	138	41	683	690	845	15	28	76
ULT & Maintenance	529	132	579	41	1,281	1,692	1,156	61	28	76
Total Annual Hours	**1,977**	**494**	**815**	**122**	**3,408**	**2,719**	**4,256**	**87**	**84**	**227**

Table 10. Estimated Annual use of each sonar source Note that values may vary slightly between years but will not exceed 5 times the annual estimate for any source (+/- 10%) over the course of the 5-yr regulations.

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Mortality

Evidence from five beaked whale strandings, all of which have taken place outside the SOCAL Range Complex, and have occurred over approximately a decade, suggests that the exposure of beaked whales to MFAS in the presence of certain conditions (e.g., multiple units using active sonar, steep bathymetry, constricted channels, strong surface ducts, etc.) may result in strandings, potentially leading to mortality. Although these physical factors believed to have contributed to the likelihood of beaked whale strandings are not present, in their aggregate, in the SOCAL Study Area, scientific uncertainty exists regarding what other factors, or combination of factors, may contribute to beaked whale strandings. Accordingly, to account for scientific uncertainty regarding contributing causes of beaked whale strandings and the exact behavioral or physiological mechanisms that can lead to the ultimate physical effects (stranding and/or death), the Navy has requested authorization for take, by serious injury or mortality of 10 beaked whales over the course of the 5-yr regulations. Neither NMFS nor the Navy anticipates that marine mammal strandings or mortality will result from the operation of MFAS during Navy exercises within the SOCAL Range Complex.

Effects on Marine Mammal Habitat

The Navy's proposed training exercises 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 SOCAL DEIS 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 Navy's DEIS, NMFS has preliminarily determined that the SOCAL training activities will not have adverse or long-term impacts on marine mammal habitat. A summary of the conclusions is included in subsequent sections.

There is no marine mammal critical habitat (designated under the ESA) or known specific breeding areas within the SOCAL Range Complex with the exception of pinnipeds (e.g., seals and sea lions). 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 study area 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.

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. Marine mammals may be temporarily displaced from areas where Navy training is occurring, but the area will be utilized again after the activities have ceased.

Effects on Food Resources

Fish

The Navy's DEIS includes a detailed discussion of the effects of active sonar on marine fish. In summary, studies have indicated that acoustic communication and orientation of fish may be restricted by anthropogenic sound in their environment. However, the vast majority of fish species studied to date are hearing generalists and cannot hear sounds above 500 to 1,500 Hz (0.5 to 1.5 kHz) (depending upon the species), and therefore, there are not likely to be behavioral effects on these species from higher frequency sounds such as MFAS/HFAS. Moreover, even those marine species that may hear above 1.5 kHz, such as a few sciaenids and the clupeids (and relatives), have relatively poor hearing above 1.5 kHz as compared to their hearing sensitivity at lower frequencies, so it is likely that the fish will only actually hear the sounds if the fish and source were fairly close to one another. And, finally, since the vast majority of sounds that are of biological relevance to fish are below 1 kHz (e.g., Zelick *et al.*, 1999; Ladich and Popper, 2004), even if a fish detects a mid- or high-frequency sound, these sounds will not likely mask detection of lower frequency biologically relevant sounds. Thus, a reasonable conclusion, even without more data, is that there will be few, and more likely no, impacts on the behavior of fish from active sonar.

Though mortality has been shown to occur in one species, a hearing specialist, as a result of exposure to non-impulsive sources, the available evidence does not suggest that exposures such as those anticipated from MFAS/HFAS would result in significant fish mortality on a population level. The mortality that was observed was considered insignificant in light of natural daily mortality rates. Experiments have shown that exposure to loud sound can result in significant threshold shifts in certain fish that are classified as hearing specialists (but not those classified as hearing generalists). Threshold shifts are temporary, and considering the best available data, no data exist that demonstrate any long-term negative effects on marine fish from underwater sound associated with active sonar activities. Further, while fish may respond behaviorally to mid-frequency sources, this behavioral modification is only expected to be brief and not biologically significant.

There are currently no well-established thresholds for estimating effects to fish from explosives other than mortality models. Fish that are located in the water column, in proximity to the source of detonation could be injured, killed, or disturbed by the impulsive sound and possibly temporarily leave the area. Continental Shelf Inc. (2004) summarized a few studies conducted to determine effects associated with removal of offshore structures (e.g., oil rigs) in the Gulf of Mexico. Their findings revealed that at very close range, underwater explosions are lethal to most fish species regardless of size, shape, or internal anatomy. For most situations, cause of death in fishes has been massive organ and tissue damage and internal bleeding. At longer range, species with gas-filled swimbladders (e.g., snapper, cod, and striped bass) are more susceptible than those without swimbladders (e.g., flounders, eels). Studies also suggest that larger fishes are generally less susceptible to death or injury than small fishes. Moreover, elongated forms that are round in cross section are less at risk than deep-bodied forms; and orientation of fish relative to the shock wave may affect the extent of injury. Open water pelagic fish (e.g., mackerel) also seem to be less affected than reef fishes. The results of most studies are dependent upon specific biological, environmental, explosive, and data recording factors.

The huge variations in the fish population, including numbers, species, sizes, and orientation and range from the detonation point, make it very difficult to accurately predict mortalities at any specific site of detonation. However, most fish species experience a large number of natural mortalities, especially during early life-stages, and any small level of mortality caused by the SOCAL training exercises involving explosives will likely be insignificant to the population as a whole.

Invertebrates

Oceanographic features and bottom topography south of Point Conception produce localized turbulence, mixing, and increased surface nutrients which in turn support aggregations of primary and secondary production such as krill (Euphausiids) (Fiedler *et al.*, 1998). Off the California coast, zooplankton biomass tends to reach its maximum abundance in the summer months and main prey species for marine mammals found within Southern California include *Euphausia pacifica* and *Thysanoessa spinifera* both of which are relatively cold water species, produced locally along the southern California coast (Brinton, 1976; Brinton, 1981).

Swarms of *E. pacifica* are most abundant off Channel Island shelf edges between 150–200 m during daylight, with vertical migration to the surface at night (Fiedler *et al.*, 1998). T. spinifera is a more coastal species, highly favored by blue whales (Balaenoptera musculus), and found during daylight from 50–150 m particularly on shelf areas northwest of San Miguel Island, and north of Santa Rosa Island (Fiedler *et al.*, 1998).

Very little is known about sound detection and use of sound by invertebrates (see Budelmann, 1992a, b; Popper *et al.*, 2001 for reviews). The limited data shows that some crabs are able to detect sound, and there has been the suggestion that some other groups of invertebrates are also able to detect sounds. In addition, cephalopods (octopus and squid) and decapods (lobster, shrimp, and crab) are thought to sense low-frequency sound (Budelmann, 1992b). Packard *et al.*, (1990) reported sensitivity to sound vibrations between 1–100 Hz for three species of cephalopods. McCauley *et al.*, (2000) found evidence that squid exposed to seismic airguns show a behavioral response including inking. However, these were caged animals, and it is not clear how unconfined animals may have responded to the same signal and at the same distances used. In another study, Wilson *et al.*, (2007) played back echolocation clicks of killer whales to two groups of squid (Loligo pealeii) in a tank. The investigators observed no apparent behavioral effects or any acoustic debilitation from playback of signals up to 199 to 226 dB re 1 μPa. It should be noted, however, that the lack of behavioral response by the squid may have been because the animals were in a tank rather than being in the wild. In another report on squid, Guerra *et al.* (2004) claimed that dead giant squid turned up around the time of seismic airgun operations off of Spain. The authors suggested, based on analysis of carcasses, that the damage to the squid was unusual when compared to other dead squid found at other times. However, the report presents conclusions based on a correlation to the time of finding of the carcasses and seismic testing, but the evidence in support of an effect of airgun activity was totally circumstantial. Moreover, the data presented showing damage to tissue is highly questionable since there was no way to differentiate between damage due to some external cause (e.g., the seismic airgun) and normal tissue degradation that takes place after death, or due to poor fixation and preparation of tissue. To date, this work has not been published in peer reviewed literature, and detailed images of the reportedly damaged tissue are also not available.

In summary, baleen whales feed on the aggregations of krill and small schooling fish within Southern California, while toothed whales feed on epipelagic, mesoplegic, and bathypelagic fish and squid. As summarized above and in the SOCAL Range Complex DEIS in more detail, potential impacts to marine mammal food resources within the SOCAL Range Complex is negligible given both lack of hearing sensitivity to MFAS, the very geographic and spatially limited scope of most Navy at sea activities including underwater detonations, and the high biological productivity of these resources. No short or long term effects to marine mammal food resources from Navy activities are anticipated within the SOCAL Range Complex.

Bottom Disturbance

The current Shallow Water Training Range (SWTR) instrumentation is to be extended out from SOAR, to include one 250-nm² (463-km²) area to the west in the area of the Tanner/Cortes Banks, and one 250-nm² (463-km²) area between SOAR and the southern section of SCI. The SWTR instrumentation is a system of underwater acoustic transducer devices, called nodes, connected by cable to each other and to a land-based facility where the collected range data are used to evaluate the performance of participants in shallow water training exercises. The transducer nodes are capable of both transmitting and receiving acoustic signals from ships operating within the SWTR Extension.

Since the exact cable route has not been decided, it is not possible to determine if sensitive habitat will be affected by the SWTR Extension. The marine biological resource that could be most affected is the white abalone, and anywhere the cable crosses between 65 to 196 ft (20 to 60 m) and there is rocky substrate, there is the possibility of affecting white abalone or disrupting abalone habitat. Assuming that rocky substrate is avoided throughout the cable corridor, the activities that could affect marine biological resources are associated with the construction of the SWTR Extension. Direct impact and mortality of marine invertebrates at each node and from burial of the trunk cable would occur. Assuming that 300 transducer nodes will be used, approximately 65,400 ft2 (6,075 m²) of soft bottom habitat would be affected, and also assuming that 14 nm (25.9 km) of the trunk cable will be buried (assuming a width of 7.8 inches [20 cm], which is twice the wide of the trench to account for sidecasted material), approximately 55,757 ft2 (5,180 m²) of soft bottom habitat would be affected. Soft bottom habitats are not considered sensitive habitats and generally support lower biological diversity than hard substrate habitats. Soft bottom organisms are also generally opportunistic and would be expected to rapidly re-colonize the disturbed areas. Localized turbidity during installation may also temporarily impact suspension feeding invertebrates in the vicinity of the cable corridor and nodes. Therefore, assuming that rocky substrate is avoided, impacts to marine biological resources from the SWTR Extension are anticipated to be minimal.

Water Quality

The SOCAL Range Complex EIS analyzed the potential effects to water quality from sonobuoy, Acoustic Device Countermeasures (ADC), and Expendable Mobile Acoustic Training Target (EMATT) batteries; explosive packages associated with the explosive source sonobuoy (AN/SSQ–110A), and Otto Fuel (OF) II combustion byproducts associated with torpedoes. Expendable Bathythermographs do not have batteries and were not included in the analysis. In addition, sonobuoys were not analyzed since, once scuttled, their electrodes are largely exhausted during operations and residual constituent dissolution occurs more slowly than the releases from activated seawater batteries. As such, only the potential effects of batteries and explosions on marine water quality in and surrounding the sonobuoy operation area were completed. It was determined that there would be no significant effect to water quality from seawater batteries, lithium batteries, and thermal batteries associated with scuttled sonobuoys. ADCs and EMATTs use lithium sulfur dioxide batteries. The constituents in the battery react to form soluble hydrogen gas and lithium dithionite. The hydrogen gas eventually enters the atmosphere and the lithium hydroxide dissociates, forming lithium ions and hydroxide ions. The hydroxide is neutralized by the hydronium formed from hydrolysis of the acidic sulfur dioxide, ultimately forming water. Sulfur dioxide, a gas that is highly soluble in water, is the major reactive component in the battery. The sulfur dioxide ionizes in the water, forming bisulfite (HSO3) that is easily oxidized to sulfate in the slightly alkaline environment of the ocean. Sulfur is present as sulfate in large quantities (i.e., 885 milligrams per liter [mg/L]) in the ocean. Thus, it was determined that there would be no significant effect to water quality from lithium sulfur batteries associated with scuttled ADCs and EMATTs.

Only a very small percentage of the available hydrogen fluoride explosive product in the explosive source sonobuoy (AN/SSQ–110A) is expected to become solubilized prior to reaching the surface and the rapid dilution would occur upon mixing with the ambient water. As such, it was determined that there would be no significant effect to water quality from the explosive product associated with the explosive source sonobuoy (AN/SSQ–110A).

OF II is combusted in the torpedo engine and the combustion byproducts are exhausted into the torpedo wake, which is extremely turbulent and causes rapid mixing and diffusion. Combustion byproducts include carbon dioxide, carbon monoxide, water, hydrogen gas, nitrogen gas, ammonia, hydrogen cyanide, and nitrogen oxides. All of the byproducts, with the exception of hydrogen cyanide, are below the United States Environmental Protection Agency (EPA) water quality criteria. Hydrogen cyanide is highly soluble in seawater and dilutes below the USEPA criterion within 6.3 m (20.7 ft) of the torpedo. Therefore, it was determined there would be no significant effect to water quality as a result of OF II.

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 (for example: 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 has 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.), or any of the other variables mentioned in the first paragraph (if known), as well as the number and nature of estimated Level A 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 number of MFAS/HFAS hours that the Navy will conduct. The exact number of hours (or torpedoes, or pings, whatever unit the source is estimated in) may vary from year to year, but will not exceed the 5-year total indicated in Table 10 (by multiplying the yearly estimate by 5) by more than 10 percent. NMFS estimates that a 10 percent increase in active sonar hours (torpedoes, pings, etc.) would result in approximately a 10 percent increase in the number of takes, and we have considered this possibility and the effect of the additional active sonar use in our analysis.

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 training exercises utilizing MFAS/HFAS and underwater detonations will have a negligible impact on the marine mammal species and stocks present in the SOCAL Range Complex.

Behavioral Harassment

As discussed in the Potential Effects of Exposure of Marine Mammals to MFAS/HFAS and illustrated in the conceptual framework, marine mammals can respond to MFAS/HFAS in many different ways, a subset of which qualify 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 11) estimating what percentage of the total takes that will occur within the 10-dB bins (without considering mitigation or avoidance) that are within the received levels considered in the risk continuum and for TTS and PTS. This table applies specifically to 53C hull-mounted active sonar (the most powerful source), with less powerful sources the percentages would increase slightly in the lower received levels and correspondingly decrease in the higher received levels. 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 animals.

Received Level (SPL)	Distance At Which Levels Occur in SOCAL (warm season / cold season)	Percent of Total Harassment Takes Estimated to Occur at Indicated Level (warm season/ cold season)
Below 140 dB	8.3 km - 40 km / 44 km - 140 km	< 1%
140 < Level < 150 dB	3.4 km - 8.3 km / 19 km - 44 km	2%
150 < Level < 160 dB	1.3 km - 3.4 km / 6.7 km - 19 km	16% / 19%
160 < Level < 170 dB	0.5 km - 1.3 km / 2.2 km - 6.7 km	36% / 42%
170 < Level < 180 dB	200 m - 500 m / 680 m - 2200 m	27% / 26%
180 < Level < 190 dB	100 m - 200 m / 210 m - 680 m	12% / 10%
Above 190 dB	within 100 m / 210 m	< 3% / < 1%

Table 11. Approximate percent of estimated takes that occur in the indicated 10-dB bins for AN/SQS-53 (the most powerful source). For smaller sources, a higher % of the takes occur at lower levels, and a lower % at higher levels.

Because the Navy has only been monitoring specifically to discern the effects of MFAS/HFAS on marine mammals since approximately 2006, and because of the overall data gap regarding the effects of MFAS/HFAS on marine mammals, not a lot is known regarding how marine mammals in the SOCAL Range Complex will respond to MFAS/HFAS. For the 12 MTEs for which NMFS has received a monitoring report, no instances of obvious behavioral disturbance were observed by the Navy watchstanders in the 704 marine mammal sightings of 7435 animals (9000+ hours of effort, though only 4 of the 12 reports reported the total number of hours of observation). 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.) 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.

In addition to the monitoring that will be required pursuant to these regulations and any corresponding LOAs, which is specifically designed to help us better understand how marine mammals respond to sound, the Navy and NMFS have developed, funded, and begun conducting a controlled exposure experiment with beaked whales in the Bahamas. Separately, the Navy and NMFS conducted an opportunistic tagging experiment with beaked whales in the area of the 2008 Rim of the Pacific training exercises in the HRC.

Diel Cycle

As noted previously, many animals perform vital functions, such as feeding, resting, traveling, and socializing on a diel cycle (24-hr 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 one day and not recurring on subsequent days is not considered particularly severe unless it could directly affect reproduction or survival (Southall *et al.*, 2007).

In the previous section, we discussed the fact that potential behavioral responses to MFAS/HFAS that fall into the category of harassment could range in severity. By definition, the takes by behavioral harassment involve the 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 hours or be repeated in subsequent days. For hull-mounted active sonar (the highest power source), approximately 27 percent of the hours of source use are comprised of Unit Level Training or maintenance activities that occur in events of 4 hours or less. Integrated Unit Level Training or Major Training events typically last more than one day, however, active sonar use is not continuous and the exercises take place over very large areas, up to 50,000 nm^2). Additionally, during times of continuous sonar use (parts of some ASW exercises), vessels with hull-mounted active sonar are typically moving at speeds of 10–12 knots. NMFS believes that it is unlikely that animals would be exposed to MFAS/HFAS at levels or for a duration likely to result in a substantive response that would then be carried on for more than one day or on successive days.

TTS

NMFS and the Navy have estimated that some individuals of some species of marine mammals may sustain some level of TTS from MFAS/HFAS. As mentioned previously, TTS can last from a few minutes to days, be of varying degree, and occur across various frequency bandwidths. Table 9 indicates the estimated number of animals that might sustain TTS from exposure to MFAS/HFAS. The TTS sustained by an animal is primarily classified by three characteristics:

• Frequency—Available data (of mid-frequency hearing specialists exposed to mid to 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 two hull-mounted MFAS sources, the DICASS sonobuoys, and the helicopter dipping sonar 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 far fewer hours of HF source use and the sounds would attenuate more quickly, 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. Tables 12a and 12b summarize the vocalization data for each species.

• 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 (> 6 dB) is 195 dB (SEL), which might be received at distances of up to 140 m from the most powerful MFAS source, the AN/SQS–53 (the maximum ranges to TTS from other sources would be less, as modeled for SOCAL). 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 watchstanders and the nominal speed of an active sonar vessel (10–12 knots). Of all 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-sec exposure to a 20 kHz source (MFAS emits a 1-s ping 2 times/minute).

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

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Species	Signal Type	Frequency Range (kHz)	Frequency Near Max energy (kHz)	Source Level (dB re 1 μPa)	Duration / Other
Blue whale	moans, long duration songs	0 012 - .4	.012 - .025	188	up to 36 s, repeated every 1 - 2 min
	FM sweeps	0.858 ± 0 148			< 5 s
	vocalizations	0.012 - 4	.012 - 025		
Fin whale	vocalizations	- / .015 - .028	- / -	159-184 / 185-192	
	moans	0 016 - 0.75	0 02	160-190	
	pulses	0 04 - 0.075 / 0 018 - 0 025	- / 0 02		
	ragged pulse	< 0.03			
	rumbles	- / 0.01 - 0.03	< 0 03 / -		
	moans, downsweeps	0.014 - 0.118	0.02	160-186	
	constant call	0.02 - 0.04			
	moans, tones, upsweeps	0 03 - 0.75		155-165	
	whistles, chirps	1 5 - 5	1 5 - 2 5		
	clicks	16 - 28			
	vocal sequence, ♂ only	0.015 - 0.03			
	FM sweeps	0.018 - .23		184 - 186	1 s
Humpback whale	social	020 - 10 / 0 05 -10	<3 / 0.1 - 4		
	songs	0 03 - 8 / -	0 12 - 4 / -	144 - 186 / 151-173	
	shrieks		0.75 - 1 8	179-181	
	horn blasts		0 41 - 0.42	181-185	
	moans	0 02 - 1.8	0 035 - 0 36	175	
	grunts	0.025 - 1 9		190	
	pulse trains	0 025 - 1.25	0.025 - 0 080	179-181	
	slap	0.03 - 1 2		183-192	
	feeding calls	0 02 - 2	0.5	162 -192	< 1 s
Humpback whale, Calf	simple vocalization	0 14 - 4	0 22 (mean)		
Sei whale	FM sweeps	1.5 - 3.5			7 to 20 sweeps lasting 4 ms
	growls, whooshes, tonal calls	0 433		156	.45 s
	growls and whooshes	0 241 - 0.625		152.4 - 159.6	
Bryde's whale	moans	0.07 - 0 245	0.124 - 0.132	152-174	0 25 to several s
	pulsed moans	0.1 - 0 93	0 165 - 0 9		
	discrete pulses call	0.7 - 0.95 < 0.06	0.7 - 0.9		0.25 to several s
Gray whale	broadband signals	0.1 - 12			
	call	0.2 - 2.5	1 - 1 5		
	moans	0.02 - 1 2 / -	0.2 - 0 2 / 0.7 - 1 2	185 / -	
	modulated pulse	0 08 - 1 8	0 225 - 0.6		
	FM sweeps	0.10 - 0 35	0 3		
	pulses	0 1 - 2	0 3 - 0 825		
Gray whale, Calf	clicks	0.1 - 20	3 4 - 4		
Minke whale	sweeps, moans	0.06 - 0.14		151-175	
	down sweeps	0.06 - 0 13		165	
	moans, grunts	0 06 - 0 14	0 06 - 0.14	151-175	
	ratchet	0.85 - 6	0 85		
	thump trains	0 1 - 2	0.1 - 0.2		
	speed up pulse train	0.2 - 0.4			40 to 60 ms
	slow down pulse train	0.25 - 0 35			70 to 140 ms
	Star Wars vocalization	0 05 - 9.4		150-165	
	Breeding Boings (pulse then amp-mod. call)	1.3 - 1 4			2 5 s with slight frequency modulation
	vocalizations	0 06 - 12			

Table 12a. Summary of mysticete vocalization information compiled from The Biology of Marine Mammals (Reynolds and Rommel (eds), 1999) and the Navy's SOCAL, AFAST, and HRC EISs - see those documents for specific information.

Species	Signal Type	Frequency Range (kHz)	Frequency Near Max energy (kHz)	Source Level (dB re 1 µPa)	Duration / Other
Sperm whale	clicks	0 1 - 30	2 - 4, 10 - 16	160 - 180	< 30 ms
	short clicks			236	< 1 µs, highly directional
	trumpets			172	
Sperm whale, Neonate	clicks		0 5	140 - 162	< 2 to 12 ms, low directionality
Bottlenose dolphin	whistles	0 8 - 24	3 5 - 14 5	125-173	
	whistle	4 - 20			
	click	0 2 - 150	30 - 60		
	click		110 - 130	218 - 228	
	clicks and burst-pulses	110 - 130		218 - 228	
	bark	0 2 - 16			
Long-beaked common dolphin	clicks	23 - 67			
	whistles	0 5 - 18			
Northern right whale dolphin	clicks high repetition		170		
	echolocation clicks	23 - 41			
	whistles, tones	16-Jan	1 8, 3		
Pacific white-sided dolphin	whistles	002 - 02	12-Apr		
	pulse trains for echolocation	- / -	50 - 80 / 60 -80	170 / 180	
Pantropical spotted Dolpin	whistles	3 1 - 21 4	6 7 - 17 8		
	pulse	up to 150			
	clicks	40 -140		up to 220	
Risso's dolphin	whistles		3 5 - 4 5		
	rasp / pulse burst	0 1 - > 8	2 - 5		
	click		65	~120	
	whistle / burst	4 - 22			< 1 sec to several s
	broadband clicks	6 - > 22			
	narrowband grunts	0 4 - 0 8			
	echolocation clicks	30 - 50, 80 - 100		up to 216	
	echolocation clicks		50 -65	up to 222	< 40 - 70 µs
Rough-toothed dolphin	whistles	0 3 - 24			< 1 s
	whistles		4 - 7		
	clicks	0 1 - 200	25		< 250 µsec
	clicks		5 - 32		
Common dolphin	whistles, chirps		0 5 - 18		
	whistles	4 - 16			
	click	0 2 - 150	30 - 60	170	
	clicks		23 - 67		
	chips and barks	0 5 - 14			
	whistles	2 - 18		180	
Spinner dolphin	pulse	1 - 160	5 - 60		
	whistles	1 - 20 / 1 - 22 5	8 - 12 / 6 8 - 17 9		
	echolocation clicks	up to 65			
	click	1 - 160	60	195 - 222	
Striped dolphin	whistles	1 - 22 5	6 8 - 16 9	109-125	
	whistles	6 - 24	8 - 12 5		
	pulse bursts	wideband	5 - 60	108-115	
Dall's porpoise	clicks		120 - 160		50 to 1,500 µsec
	clicks	0 04 - 12 / -	- / 135 - 149	120 - 148 / 165-175	
False killer whale	whistles		4 - 9 5		
	clicks		25 -30, 95 - 130	220-228	
	echolocation clicks	20 - 130	40	201 - 225	
Killer whale	whistles	1 5 - 18	6 - 12		
	clicks	0 1 - 35 / 0 25 - 0 5	12 - 25	180	
	scream	2			
	pulsed calls	0 5 - 25	1 - 6	160	
Canadian killer whale	echolocation clicks		45 - 80	195 - 224	< 80 - 120 µs
Norwegian killer whale	echolocation clicks		22 - 49	173 - 202	< 31 - 203 µs
Melon-headed whale	whistles	8 to 12		155	
	clicks	20 - 40		165	
Pygmy killer whale	clicks	45 - 117	70 - 85	197-223	
Short-finned pilot whale	whistles	0 5 - > 20	2 to 14	180	
	click		30 - 60	180	
Dwarf sperm whale	clicks	13-33			0 3 - 0 5 s
Pygmy sperm whale	clicks	60 - 200	120		
	narrowband pulses		129	175	119 µs, interclk intervals 40-70 ms
	echolocation clicks	60 - 200	120 - 130		
Baird's beaked whale	echolocation	3 - 129			
	social	0 002 - 0 016			
Cuvier's beaked whale	echolocation clicks	20 - 40, 20 - 70		214	< 200 to 250 µs, depths > 200 m
	whistles	8 - 12			upsweep lasts 1 s
	pulses	13 - 17			15 to 44 s
Blainville's beaked whale	whistles, chirps	< 1 - 6			
	whistles	2 6 - 10 7			
	echolocation clicks	20 - 40		200 - 220	< 175 µs, depths > 200 m
Hubb's beaked whale	pulses	0 3 - 80	0 3 - 2		
Perrin's beaked whale					
Pygmy beaked whale					
Ginkgo-toothed beaked whale					
Guadalupe fur seal					
Northern elephant seal					
Pacific harbor seal	communication	100 - 1			
	clicks	8 - 150	12 - 40		
	roar	0 4 - 4	0 4 - 0 8		
	growl, grunt, groan	< 0 1 - 0 4	< 0 1 - 0 25		
	creak	0 7 - 4	0 7 - 2		
California sea lion	barks	< 8	< 3 5		
	whinny	< 1 - 3			
	clicks		0 5 - 4		
	buzzing	< 1 - 4	< 1		
Northern fur seal	clicks, bleats				

Table 12b Summary of odontocete and pinniped vocalization information compiled from The Biology of Marine Mammals (Reynolds and Rommel (eds), 1999) and the Navy's SOCAL, AFAST and HRC EISs - see those documents for specific information

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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, it is unlikely that marine mammals would sustain a TTS from MFAS that alters their sensitivity by more than 20 dB for more than a few days (and the majority would be far less severe). 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 were impeded. Additionally (see Tables 12a and 12b), 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 more likely be sustained because the higher source level and slower attenuation make it more likely that an animal would be exposed to a higher 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 for it (see Communication Impairment Section), though these compensations may incur energetic costs.

Acoustic Masking or Communication Impairment

Table 12 is also informative regarding the nature of the masking or communication impairment that could potentially occur from MFAS (again, center frequencies are 3.5 and 7.5 kHz for the two types of hull-mounted active sonar). However, masking only occurs during the time of the signal (and potential secondary arrivals of indirect rays), versus TTS, which occurs continuously for its duration. Standard MFAS pings last on average one second and occur about once every 24–30 seconds for hull-mounted sources. When hull-mounted active sonar is used in the Kingfisher mode, pulse length is shorter, but pings are much closer together (both in time and space, since the vessel goes slower when operating in this mode). 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 10s of micro seconds. 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 24 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 pulse 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

The Navy's model estimated that the following numbers of individuals of the indicated species would be exposed to levels of MFAS/HFAS associated with the likelihood of resulting in PTS: bottlenose dolphin-47; blue whale—1; gray whale—1: Long-beaked common dolphin—1; short-beaked common dolphin—6; striped dolphin—1; and Pacific harbor seal—9. However, these estimates do not take into consideration either the mitigation measures or the likely avoidance behaviors of some of the animals exposed. NMFS believes that many marine mammals would deliberately avoid exposing themselves to the received levels of active sonar necessary to induce injury (i.e., approaching to within approximately 10 m (10.9 yd) of the source) 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) further 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 and indicated that they are capable of effectively monitoring a 1000-meter (1093-yd) safety zone at night using night vision goggles, infrared cameras, and passive acoustic monitoring. When these two points are considered, NMFS does not believe that any marine mammals will incur PTS from exposure to MFAS/HFAS.

The Navy's model estimated that 34 total animals (dolphins and pinnipeds) would be exposed to explosive detonations at levels that could result in injury and that 4 dolphins and 7 pinnipeds would be exposed to levels that could result in death—however, those estimates do not consider mitigation measures. Because of the surveillance conducted prior to and during the exercises, the associated exclusion zones (see table 3 and the Mitigation section), and the distance within which the animal would have to be from the explosive, NMFS does not think that any animals will be exposed to levels of sound or pressure from explosives that will result in injury or death.

As discussed previously, marine mammals 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 mechanisms of this potential response, behavioral or physiological, are not known. However, 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 suggest that the probability is small that this will occur. Additionally, 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.

Though NMFS does not expect it to occur, because of the uncertainty surrounding the mechanisms that link exposure to MFAS to stranding (especially in beaked whales), NMFS is proposing to authorize the injury or mortality of 10 beaked whales over the course of the 5-yr regulations.

40 Years of Navy Training Exercises Using MFAS/HFAS in the SOCAL Range Complex

The Navy has been conducting MFAS/HFAS training exercises in the SOCAL Range Complex for over forty years. Although monitoring specifically in conjunction with training exercises to determine the effects of active sonar on marine mammals was not being conducted by the Navy prior to 2006 and the symptoms indicative of potential acoustic trauma were not as well recognized prior to the mid-nineties, people have been collecting stranding data in the SOCAL Range Complex for approximately 25 years. Though not all dead or injured animals are expected to end up on the shore (some may be eaten or float out to sea), one might expect that if marine mammals were being harmed by active sonar with any regularity, more evidence would have been detected over the 40-yr period.

Species-Specific Analysis

In the discussions below, the ''acoustic analysis'' refers to the Navy's analysis, which includes the use of several models and other applicable calculations as described in the

Estimates of Potential Marine Mammal Exposure section. The numbers predicted by the ''acoustic analysis'' are based on a uniform and stationary distribution of marine mammals and do not take into consideration the implementation of mitigation measures or potential avoidance behaviors of marine mammals, and therefore, are likely overestimates of potential exposures to the indicated thresholds (PTS, TTS, behavioral harassments). Consequently, NMFS has factored in the mitigation measures and avoidance to make both quantitative and qualitative adjustments to the take estimates predicted by the Navy's ''acoustic analysis''. The revised take estimates (and proposed take authorization) depict a more realistic scenario than those adopted directly from the Navy's acoustic analysis.

Although NMFS is not required to identify the number of animals that will be taken specifically by TTS versus behavioral harassment (Level B Harassment takes include both), we have attempted to make more realistic estimates by quantitatively refining the Navy's TTS estimates by modifying the estimate produced by the acoustic analysis by a specific amount if certain circumstances are present as described below:

For MFAS/HFAS, some animals are likely to avoid the source to some degree (which could decrease the number exposed to TTS levels). Adding to that, in the following circumstances (discussed in more detail in the individual sections below) the indicated multipliers were applied to the TTS estimates predicted by the acoustic analysis:

- When animals are highly visible (such as melon-headed whales, humpback whales), we assume that lookouts will see them in time to cease sonar operation before the animals are exposed to levels associated with TTS, which reach to about 140 m from the sonar source. In this case we estimate 0 animals will incur TTS.
- When animals are deep divers and very cryptic at the surface (such as beaked whales), though some may avoid the source, we assume that most will not be sighted, and therefore we estimated that 50–100 percent of the number predicted by the Navy's acoustic analysis might actually incur TTS.
- When animals are more likely to be visually detected than beaked whales, but less likely than the highly visible species, we estimate that 0–100 percent of the number of these species (sperm whales, some pinnipeds) predicted by the Navy's acoustic analysis might actually incur TTS.
- Though dolphins are highly visible, because the mitigation includes a provision to allow bow-riding, not all TTS take of dolphins will necessarily be avoided. Therefore, we estimated that 0–50 percent of the number of dolphins predicted by the Navy's acoustic analysis might actually incur TTS.

For explosives, all TTS will likely not be avoided for any species because for a couple of the larger explosives, the distance at which an animal could incur TTS is somewhat greater than the Navy's exclusion zone for a couple of the exercise types (see Table 3). Adding to that, in the following circumstances (discussed in more detail in the individual sections below) the indicated multipliers were applied to the TTS estimates predicted by the acoustic analysis:

- When marine mammals are highly detectable, NMFS estimated that 0–50 percent of the number of those species predicted by the Navy's acoustic analysis might actually incur TTS.
- When marine mammals are less than highly detectable, NMFS estimated that 50–100 percent of the number of those species predicted by the Navy's acoustic analysis might actually incur TTS.

Humpback Whale

Acoustic analysis indicates that up to 15 exposures of humpback whales to sound levels likely to result in Level B harassment may occur from MFAS/HFAS and explosives. This estimate represents the total number of takes and not necessarily the number of individuals taken, as a single individual may be taken multiple times over the course of a year. These Level B takes are anticipated to be in the form of behavioral disturbance as described in the Definition of Harassment: Level B Harassment section section. Although 2 of the modeled Level B Harassment takes were predicted to be in the form of TTS from MFAS/HFAS, NMFS believes it is unlikely that any humpback whales will incur TTS because of the distance within which they would have to approach the active sonar source (depending on conditions, within a range of 140 m for the most powerful source), the fact that many animals will likely avoid active sonar sources to some degree, and the high likelihood that Navy monitors would detect these animals (due to their large size, surface behavior, and pronounced blow) prior to an approach within this distance and implement active sonar powerdown or shutdown. Acoustic analysis estimates that no humpback whales will be exposed to MFAS/HFAS sound levels likely to result in Level A harassment.

Modeling of the explosive sources predicts that no take of humpback whales will result from the detonation of underwater explosives.

Humpback whales in southern California are primarily from the Eastern North Pacific Stock. The current best estimate of population size for this stock is 1,391 (Caretta *et al.*, 2007). No areas of specific importance for reproduction or feeding for humpback whales have been identified in the SOCAL Range Complex.

Sei Whales and Bryde's Whales

Both Sei whales and Bryde's whales are considered rare in SOCAL (less than 3 sightings in last 30 years, only one confirmed sighting in California, respectively). Because of their very low density in the area, the Navy's acoustic analysis indicates that no sei whales or Bryde's whales will be exposed to sound levels or explosive detonations likely to result in take and the Navy has not requested authorization to take any individuals of these species.

Fin Whales

Acoustic analysis indicates that up to 167 exposures of fin whales to sound levels likely to result in Level B harassment may result from MFAS/HFAS and explosives. This estimate represents the total number of takes and not necessarily the number of individuals taken, as a single individual may be taken multiple times over the course of a year. These Level B takes are anticipated to primarily be in the form of behavioral harassment as described in the Definition of Harassment: Level B Harassment section. Although 12 of the modeled Level B Harassment takes were predicted to be in the form of TTS from MFAS/HFAS, NMFS believes it is unlikely that any fin whales will incur TTS because of the distance within which they would have to approach the MFAS source (approximately 140 m for the most powerful source for TTS), the fact that many animals will likely avoid active sonar sources to some degree, and the likelihood that Navy monitors would detect these animals prior to an approach within this distance and implement active sonar powerdown or shutdown. Navy lookouts will likely detect a group of fin whales because of their large size, mean group size (3), and pronounced blow.

Acoustic analysis also predicted that 1 TTS take of fin whales from explosives would occur. For the same reasons listed above, NMFS anticipates that the Navy watchstanders would likely detect these species and implement the mitigation to avoid exposure. However, the range to TTS for a few of the larger explosives is larger than the associated exclusion zones for BOMBEX, MISSILEX, or SINKEX (see Table 3), and therefore NMFS anticipates that TTS might not be entirely avoided during those exercises, so NMFS estimates that up to 1 TTS take of a fin whale might result from explosive detonations.

Acoustic analysis estimates that no fin whales will be exposed to MFAS/HFAS sound levels or explosives expected to result in injury or death. Further, NMFS believes that many marine mammals would avoid exposing themselves to the received levels necessary to induce injury (and avoid getting as close to the vessel as they would need to: within approximately 10 m (10.9 yd)) by moving away from or at least modifying their path to avoid a close approach. Also, NMFS believes that the mitigation measures would be effective at avoiding injurious exposures to animal that approached within the explosive safety zone, especially in the case of these large animals.

Fin whales in the Southern California Range Complex belong to the California/Oregon/Washington stock. The best population estimate for this stock is 2,099. No areas of specific importance for reproduction or feeding for fin whales have been identified in the SOCAL Range Complex.

Blue Whales

Acoustic analysis indicates that up to 609 exposures of blue whales to MFAS/HFAS or explosive detonations at sound or pressure levels likely to result in Level B harassment may occur. This estimate represents the total number of takes and not necessarily the number of individuals taken, as a single individual may be taken multiple times over the course of a year. These Level B takes are anticipated to be primarily in the form of behavioral disturbance as described in the Definition of Harassment: Level B Harassment section. Although 67 of the modeled Level B Harassment takes were predicted to be in the form of TTS from MFAS/HFAS exposure, NMFS believes it is unlikely that any blue whales will incur TTS because of the distance within which they would have to approach the MFAS source (approximately 140 m for the most powerful source for TTS), the fact that many animals will likely avoid active sonar sources to some degree, and the likelihood that Navy monitors would detect these animals prior to an approach within this distance and implement active sonar powerdown or shutdown. Navy lookouts will likely detect a group of blue whales given their large size, average group size (2–3), and pronounced vertical blow. The acoustic analysis also predicted that 1 animal would be exposed to MFAS/HFAS sound levels that would result in Level A Harassment (PTS—injury). However, for the same reasons listed above for TTS (and because animals would need to approach within 10 m of the sonar dome), NMFS does not believe that any animals will incur PTS or be otherwise injured by MFAS/HFAS.

Acoustic analysis also predicted that 2 blue whales would be exposed to sound or pressure from explosives at levels expected to result in TTS. For the same reasons listed above, NMFS anticipates that the Navy watchstanders would likely detect these species and implement the mitigation to avoid exposure. However, the range to TTS for a few of the larger explosives is larger than the associated exclusion zones for BOMBEX, MISSILEX, or SINKEX (see Table 3), therefore NMFS anticipates that TTS might not be entirely avoided during those exercises, so NMFS estimates that up to 1 TTS take of a blue whale might result from explosive detonations. Acoustic analysis estimates that no blue whales will be exposed to explosive levels likely to result in PTS or mortality.

Blue whales in the Southern California Range Complex belong to the Eastern North Pacific stock. The best population estimate for this stock is 1,744 (Caretta *et al.*, 2007). No areas of specific importance for reproduction or feeding for blue whales have been identified in the SOCAL Range Complex.

Gray Whales

Acoustic analysis indicates that up to 5,460 exposures of gray whales to MFAS/HFAS or explosive detonations at sound or pressure levels likely to result in Level B harassment may occur. This estimate represents the total number of takes and not necessarily the number of individuals taken, as a single individual may be taken multiple times over the course of a year. These Level B takes are anticipated to primarily be in the form of behavioral disturbance as described in the Definition of Harassment: Level B Harassment section section. Although 544 of the modeled Level B Harassment takes were predicted to be in the form of TTS from MFAS/HFAS exposure, NMFS believes it is unlikely that any gray whales will incur TTS because of the distance within which they would have to approach the MFAS source (approximately 140 m for the most powerful source for TTS, 10 m for injury), the fact that many animals will likely avoid active sonar sources to some degree, and the likelihood that Navy monitors would detect these animals prior to an approach within this distance and implement active sonar powerdown or shutdown. Navy lookouts will likely detect a group of gray whales given their large size, pronounced blow and mean group size of about 3 animals. The acoustic analysis also predicted that 1 animal would be exposed to MFAS/HFAS sound levels that would result in Level A Harassment (PTS—injury). However, for the same reasons listed above for TTS (and because animals would need to approach within 10 m of the sonar dome), NMFS does not believe that any animals will incur PTS or be otherwise injured by MFAS/HFAS.

Acoustic analysis also predicted that 7 gray whales would be exposed to sound or pressure from explosives at levels expected to result in TTS. For the same reasons listed above, NMFS anticipates that the Navy watchstanders would likely detect these species and implement the mitigation to avoid exposure. However, the range to TTS for a few of the larger explosives is larger than the associated exclusion zones for BOMBEX, MISSILEX, or SINKEX (see Table 3), and therefore NMFS anticipates that TTS might not be entirely avoided during those exercises, so NMFS estimates that up to 4 TTS take of a gray whale might result from explosive detonations. Acoustic analysis predicts that no gray whales will be exposed to explosive levels likely to result either in Level A harassment or mortality.

Gray whales in the Southern California Range Complex belong to the Eastern North Pacific stock, for which the best population estimate is 26,635 (Angliss and Outlaw, 2007). No areas of specific importance for reproduction or feeding for gray whales have been identified in the SOCAL Range Complex.

Minke Whales

Acoustic analysis indicates that up to 126 exposures of minke whales to MFAS/HFAS or explosive detonations at sound or pressure levels likely to result in Level B harassment may occur. This estimate represents the total number of Level B takes and not necessarily the number of individuals taken, as a single individual may be taken multiple times over the course of a year. These Level B takes are anticipated to be in the form of behavioral disturbance as described in the Definition of Harassment: Level B

Harassment section. Although 16 of the modeled Level B Harassment takes were predicted to be in the form of TTS from MFAS/HFAS exposure, NMFS believes it is unlikely that all 16 whales will incur TTS because of the distance within which they would have to approach the active sonar source (approximately 140 m for the most powerful source), the fact that many animals will likely avoid active sonar sources to some degree, and the likelihood that Navy monitors would detect some of these animals prior to an approach within this distance and implement active sonar powerdown or shutdown. However, because of their cryptic behavior/profile at the surface, NMFS believes that some animals may approach undetected within the distance in which TTS would likely be incurred (although, they can be detected well using passive acoustic monitoring). Therefore, NMFS estimates that 0–16 Minke whales may incur TTS from exposure to MFAS/HFAS.

As indicated in Table 12, known minke whale vocalizations are largely below 1 kHz and would not likely overlap with MFAS/HFAS TTS, which would be in the range of 2–20 kHz. As noted previously, NMFS does not anticipate TTS of a long duration or severe degree to occur as a result of exposure to MFA/HFAS.

Acoustic analysis predicts that no minke whales will be exposed to MFAS/HFAS sound levels likely to result either in Level A harassment or mortality. Additionally, acoustic analysis predicts that no take of minke whales will result form exposure to explosive detonations. No areas of specific importance for reproduction or feeding for minke whales have been identified in the SOCAL Range Complex.

Minke whales in the Southern California Range Complex belong to the California/Oregon/Washington stock, for which the best population estimate is 823 (Barlow and Forney, 2007).

Sperm Whales

Acoustic analysis indicates that up to 148 exposures of sperm whales to MFAS/HFAS or explosive detonations at sound or pressure levels likely to result in Level B harassment may occur. This estimate represents the total number of Level B takes and not necessarily the number of individuals taken, as a single individual may be taken multiple times over the course of a year. These Level B takes are anticipated to primarily be in the form of behavioral disturbance as described in the Definition of Harassment: Level B Harassment section. Although 8 of the modeled Level B Harassment takes were predicted to be in the form of TTS from MFAS/HFAS exposure, NMFS believes it is unlikely that all eight whales will incur TTS because of the distance within which they would have to approach the MFAS source (approximately 140 m for the most powerful source), the fact that many animals will likely avoid active sonar sources to some degree, and the likelihood that Navy monitors would detect some of these animals at the surface prior to an approach within this distance and implement active sonar powerdown or shutdown. However, because of their long, deep diving behavior (up to 2-hour dives), NMFS believes that some animals may approach undetected within the distance in which TTS would likely be incurred. Therefore, NMFS estimates that 0–8 sperm whales may incur some degree of TTS from exposure to MFAS/HFAS.

As indicated in Table 12, some (but not all) sperm 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, as noted previously, NMFS does not anticipate TTS of a long duration or severe degree to occur as a result of exposure to MFA/HFAS. No sperm whales are predicted to be exposed to MFAS/HFAS sound levels associated with PTS or injury.

Acoustic analysis also predicted that one sperm whale would be exposed to sound or pressure from explosives at levels expected to result in TTS. For the same reasons listed above, NMFS anticipates that the Navy watchstanders would likely detect these species in most instances and implement the mitigation to avoid exposure. However, the range to TTS for a few of the larger explosives is larger than the associated exclusion zones for BOMBEX, MISSILEX, or SINKEX (see Table 3), and therefore NMFS anticipates that TTS might not be entirely avoided during those exercises, so NMFS estimates that up to one TTS take of a sperm whale might result from explosive detonations. Acoustic analysis predicts that no sperm whales will be exposed to explosive levels likely to result either in Level A harassment or mortality.

No areas of specific importance for reproduction or feeding for sperm whales have been identified in the SOCAL Range Complex. Sperm whales in the Southern California Range Complex belong to the California/Oregon/Washington stock, for which the best population estimate is 1,233 (Caretta *et al.*, 2007).

Pygmy and Dwarf Sperm Whales

Acoustic analysis indicates that up to 159 exposures of pygmy sperm whales to MFAS/HFAS or explosive detonations at sound or pressure levels likely to result in Level B harassment may occur. This estimate represents the total number of Level B takes and not necessarily the number of individuals taken, as a single individual may be taken multiple times over the course of a year. These Level B takes are anticipated to primarily be in the form of behavioral disturbance as described in the Definition of Harassment: Level B Harassment section. Sixteen of the modeled Level B Harassment takes were predicted to be in the form of TTS from MFAS/HFAS exposure. NMFS believes it is unlikely that all 16 whales will incur TTS because of the distance within which they would have to approach the MFAS source (approximately 140 m for the most powerful source) and the fact that many animals will likely avoid active sonar sources to some degree. However, the likelihood that Navy monitors would detect most of these animals at the surface prior to an approach within this distance is low because of their small size, non-gregarious nature, and cryptic behavior and profile. Therefore, NMFS estimates that 8–16 pygmy sperm whales may incur some degree of TTS from exposure to MFAS/HFAS.

As indicated in Table 12, some *Kogia* spp. vocalizations might overlap with the MFAS/HFAS TTS frequency range (2–20 kHz), but the limited information for Kogia sp. indicates that the majority of their clicks are at a much higher frequency and that their maximum hearing sensitivity is between 90 and 150 kHz. However, as noted previously, NMFS does not anticipate TTS of a long duration or severe degree to occur as a result of exposure to MFA/HFAS. No pygmy sperm whales are predicted to be exposed to MFAS/HFAS sound levels associated with PTS or injury.

Acoustic analysis also predicted that one pygmy sperm whale would be exposed to sound or pressure from explosives at levels expected to result in TTS. For the same reasons listed above, NMFS anticipates that the Navy watchstanders would not always detect these species to implement the mitigation to avoid exposure. Additionally, the range to TTS for a few of the larger explosives is larger than the associated exclusion zones for BOMBEX, MISSILEX, or SINKEX (see Table 3), and therefore NMFS anticipates that TTS might not be entirely avoided during those exercises, so NMFS estimates that one TTS take of a pygmy sperm whale would result from explosive detonations. Acoustic analysis predicts that no sperm whales will be exposed to explosive levels likely to result either in Level A harassment or mortality.

Dwarf sperm whales are considered rare in the SOCAL Range Complex and no information is available to estimate the population size of dwarf sperm whales off the U.S. West Coast (Caretta *et al.*, 2007). NMFS and the Navy do not anticipate take of this species occurring, but NMFS is proposing to authorize 20 Level B Harassment takes for this species annually to ensure MMPA compliance should the Navy unexpectedly encounter an individual of this species while operating active sonar.

No areas of specific importance for reproduction or feeding for pygmy or dwarf sperm whales have been identified in the SOCAL Range Complex. Pygmy sperm whales in the Southern California Range Complex belong to the California/Oregon/Washington stock, for which the most recent population estimate is 247 (Caretta *et al.*, 2007).

Beaked Whales

Due to the difficulty in differentiating Mesoplodon species from each other, the management unit (California/Oregon/Washington stock of Mesoplodont beaked whales) is defined to include all the mesoplodon populations (Blainville's, Hubb's, Perrin's, pygmy, and ginkgo-toothed beaked whales) and anticipated take of these 5 species is combined in Table 9. Acoustic analysis indicates that 13 Baird's beaked whales, 428 Cuvier's beaked whales, and 131 Mesoplodon species will likely be exposed to MFAS/HFAS or explosives at pressure or sound levels likely to result in Level B harassment. The analysis also further estimates that 97 unidentified beaked whales may be taken by Level B Harassment. These estimates represent the total number of exposures and not necessarily the number of individuals exposed, as a single individual may be exposed multiple times over the course of a year.

One (Baird's), 37 (Cuvier's), and 13 (Mesoplodon) of the modeled Level B Harassment takes were predicted to be in the form of TTS from MFAS/HFAS exposure. NMFS believes it is unlikely that all 51 beaked whales will incur TTS because of the distance within which they would have to approach the active sonar source (approximately 140 m for the most powerful source) and the fact that many animals will likely avoid active sonar sources to some degree. However, the likelihood that Navy monitors would detect most of these animals at the surface prior to an approach within this distance is low because of their non-gregarious nature, cryptic behavior and profile, and the fact that they often dive for up to an hour. Therefore, NMFS estimates that 1 Baird's, 19–37 Cuvier's, and 7–13 Mesoplodon beaked whales may incur some degree of TTS from exposure to MFAS/HFAS.

As indicated in Table 12, 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, as noted previously, NMFS does not anticipate TTS of a long duration or severe degree to occur as a result of exposure to MFA/HFAS. No beaked whales are predicted to be exposed to MFAS/HFAS sound levels associated with PTS or injury.

Acoustic analysis also predicted that 3 Cuvier's and 1 Mesoplodon beaked whale would be exposed to sound or pressure from explosives at levels expected to result in TTS. For the same reasons listed above, NMFS anticipates that the Navy watchstanders would not likely always detect these species and implement the mitigation to avoid exposure. Additionally, the range to TTS for a few of the larger explosives is larger than the associated exclusion zones for BOMBEX, MISSILEX, or SINKEX (see Table 3), therefore NMFS anticipates that TTS might not be entirely avoided during those exercises. NMFS estimates that up to 1 TTS take of a Mesoplodon species and up to 3 TTS takes of a Cuvier's beaked whale would result from explosive detonations. Acoustic analysis predicts that no beaked whales will be exposed to explosive levels likely to result either in Level A harassment or mortality.

No areas of specific importance for reproduction or feeding for beaked whales have been identified in the SOCAL Range Complex. The California/Oregon/Washington stock of Mesoplodon whales has estimated population of 1,777 (Barlow and Forney, 2007). The population size of the California/Oregon/Washington stock of Cuvier's beaked whale is estimated at 4,342 (Barlow and Forney, 2007). The population size of the California/Oregon/Washington stock of Baird's beaked whale is estimated at 1,005 (Barlow and Forney, 2007).

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 seven species to occur as a result of the MFAS/HFAS training exercises (see Mortality paragraph above), 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).

Social Pelagic Species (killer whales, short-finned pilot whales, false killer whales, pygmy killer whales, and melon-headed whales)

Acoustic analysis indicates that 7 killer whales and 45 short-finned pilot whales will be exposed to MFAS/HFAS or explosive detonations at sound or pressure levels likely to result in Level B harassment. This estimate represents the total number of Level B takes and not necessarily the number of individuals taken, as a single individual may be taken multiple times over the course of a year. These Level B takes are anticipated to be in the form of behavioral disturbance as described in the Definition of Harassment: Level B harassment section. Acoustic analysis predicts that neither of these species will be exposed to levels of MFAS/HFAS associated with PTS or injury.

Although 1 and 6 (killer whale and pilot whale, respectively) of the modeled Level B Harassment takes were predicted to be in the form of TTS from MFAS/HFAS exposure, NMFS believes it is unlikely that any killer whales or short-finned pilot whales will incur TTS because of the distance within which they would have to approach the active sonar source (approximately 140 m for the most powerful source for TTS), the fact that many animals will likely avoid active sonar sources to some degree, and the likelihood that Navy monitors would detect these animals prior to an approach within this distance and implement active sonar powerdown or shutdown. Navy lookouts will likely detect a group of killer whales or short-finned pilot whales given their large individual size and mean large group size (6.5 and 22.5, respectively).

Acoustic analysis predicts that neither of these species will be exposed to levels of sound or pressure from explosives that would be expected to result in any form of take. No areas of specific importance for reproduction or feeding for beaked whales have been identified in the SOCAL Range Complex.

The low density of killer whales in California consists primarily of individuals from the Offshore Eastern North Pacific stock and the Transient stock (as mentioned previously, individuals from the eastern north Pacific southern resident stock are not expected to be encountered in SOCAL). The combined population of these three stocks is estimated at 1,340 (Caretta *et al.*, 2007). Population size of the California/Oregon/Washington stock of the short-finned pilot whale is estimated at 350 (Barlow and Forney 2007).

Pygmy killer, false killer, and melon-headed whales are considered rare in the SOCAL Range Complex and no stocks have been designated for these species on the west coast of the U.S. NMFS and the Navy do not anticipate take of this species occurring, but NMFS is proposing to authorize 20 Level B Harassment takes for each of these species annually to ensure MMPA compliance should the Navy unexpectedly encounter an individual of this species while operating MFAS/HFAS.

Dolphins and Dall's Porpoise

The acoustic analysis predicts that the following numbers of Level B behavioral harassments of the associated species will occur: 1472 (bottlenose dolphins), 4583 (long-beaked common dolphin), 39404 (short-beaked common dolphin), 1503 (northern right whale dolphin), 1360 (Pacific white-sided dolphin), 1830 (striped dolphin), 622 (Dall's porpoise). This estimate represents the total number of exposures and not necessarily the number of individuals exposed, as a single individual may be exposed multiple times over the course of a year.

Although a portion (191 (bottlenose dolphins), 432 (long-beaked common dolphin), 3727 (short-beaked common dolphin), 166 (northern right whale dolphin), 189 (Pacific white-sided dolphin), 249 (striped dolphin), 88 (Dall's porpoise)) of the modeled Level B Harassment takes for all of these species were predicted to be in the form of TTS, NMFS believes it is unlikely that all of the individuals estimated will incur TTS because of the distance within which they would have to approach the active sonar source (approximately 140 m for the most powerful source), the fact that many animals will likely avoid active sonar sources to some degree, and the likelihood that Navy monitors would detect these animals prior to an approach within this distance and implement active sonar powerdown or shutdown. Navy lookouts will likely detect a group of dolphins given their relatively short dives, gregarious behavior, and large average group size. 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 and could potentially be exposed to levels associated with TTS as they approach or depart from bow-riding, we estimate that half or less of the number of animals modeled for MFAS/HFAS TTS would sustain TTS (see table 9). As mentioned above and indicated in Table 12, 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, as noted previously, NMFS does not anticipate TTS of a long duration or severe degree to occur as a result of exposure to MFA/HFAS.

The acoustic analysis also predicted that 1 long-beaked common dolphin, 6 short-beaked common dolphins, and 1 striped dolphin would be exposed to MFAS/HFAS sound levels that would result in Level A Harassment (PTS—injury). However, for the same reasons listed above for TTS (and because animals would need to approach within 10 m of the sonar dome), NMFS does not believe that any animals will incur PTS or be otherwise injured by MFAS/HFAS. Of note, the directionality of the sonar dome is such that dolphins would not likely be exposed to injurious levels of sound while bow-riding.

Acoustic analysis also predicted that 10 bottlenose dolphins, 41 long-beaked common dolphins, 354 short-beaked common dolphins, 12 northern right whale dolphins, 9 Pacific white-sided dolphins, 6 striped dolphins, and 2 Dall's porpoises would be exposed to sound or pressure from explosives at levels expected to result in TTS. For the same reasons listed above, NMFS anticipates that the Navy watchstanders would likely detect these species and implement the mitigation to avoid exposure. However, the range to TTS for a few of the larger explosives is larger than the associated exclusion zones for BOMBEX, MISSILEX, or SINKEX (see Table 3), and therefore NMFS anticipates that TTS might not be entirely avoided during those exercises, so NMFS estimates that up to half of the estimated explosive detonation TTS takes of dolphins might occur.

Acoustic analysis also predicted that 1 long-beaked dolphin, 1 Risso's dolphin, and 12 short-beaked common dolphins might be exposed to sound or pressure from explosive detonations that would result in PTS or injury, and that 4 short-beaked common dolphins would be exposed to levels that would result in mortality. For the same reasons listed above (group size, dive and social behavior), NMFS anticipates that the Navy watchstanders would detect these species and implement the mitigation measures to avoid exposure. In the case of all explosive exercises, the exclusion zones are 2–12 times larger than the estimated distance at which an animal would be exposed to injurious sounds or pressure waves. Therefore, no takes by injury or death are anticipated or authorized.

No areas of specific importance for reproduction or feeding for dolphins have been identified in the SOCAL Range Complex. Table 13 shows the estimated abundance of the affected stocks of dolphins and Dall's porpoise.

Pantropical spotted, rough-toothed, and spinner dolphins are considered rare in the SOCAL Range Complex and no stocks have been designated for these species on the west coast of the U.S. NMFS and the Navy do not anticipate take of this species occurring, but NMFS is proposing to authorize 20 Level B Harassment takes for each of these species annually to ensure MMPA compliance should the Navy unexpectedly encounter an individual of this species while operating MFAS/HFAS.

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Species Name	Warm Season density/km^2	Cold Season density/km^2	Estimated Abundance
MYSTICETES			
Blue whale	0.0041222	0.0041222	1,744
Fin whale	0.0024267	0.0008008	2,099
Humpback whale	0.0001613	0.0000984	1,391
Sei whale	0.0000081	0.000005	56
Bryde's whale	0.0000081	0.0000081	12
Gray whale	0	0.051	26,635
Minke whale	0.0010313	0.0010313	823
ODONTOCETES			
Sperm whale	0.0014313	0.0008731	1,934
Baird's beaked whale	0.0001434	0.0001434	1,005
Bottlenose dolphin	0.0123205	0.0184808	323 onshore/2026 offshore
Cuvier's beaked whale	0.0036883	0.0036883	4,342
Dall's porpoise	0.0016877	0.0081008	85,955
Killer whale	0.0000812	0.0000812	1340 offshore/ 346 transient
Long-beaked common dolphin	0.0965747	0.0366984	21,902
Mesoplodonts	0.0011125	0.0011125	1,177
Northern right whale dolphin	0.0056284	0.0270163	11,097
Pacific white-sided dolphin	0.0160748	0.0160748	23,817
Pygmy sperm whale	0.0013785	0.0013785	247
Short-finned pilot whale	0.0003315	0.0003315	350
Risso's dolphin	0.0180045	0.0540134	11,910
Short-beaked common dolphin	0.8299606	0.315385	352,069
Striped dolphin	0.0175442	0.0107019	18,976
Ziphiid whales	0.0008214	0.0008214	
PINNIPEDS			
Guadalupe fur seal	0.007	0.007	7,408
Northern elephant seal	0.042	0.025	101,000
Harbor seal	0.19	0.19	34,233
California sea lion	0.605	0.87	237,000
Northern fur seal	0.027	0.027	9,424

Table 13. Estimated density and abundance of marine mammals (see Navy application for sources)

BILLING CODE 3510–22–C

Pinnipeds (Guadalupe fur seal, Northern fur seal, California sea lion, Northern elephant seal, and Pacific harbor seal).

The Navy's acoustic analysis predicts that the following numbers of Level B behavioral harassments of the associated species will occur: 1064 (Guadalupe fur seal), 1229 (Northern fur seal), 55443 (California sea lion), 955 (northern elephant seal), and 5625 (Pacific harbor seal). This estimate represents the total number of exposures and not necessarily the number of individuals exposed, as a single individual may be exposed multiple times over the course of a year.

A portion (190 Guadalupe fur seal, 3 Northern fur seal, 3 California sea lion, 5 northern elephant seal, and 4559 Pacific harbor seal) of the modeled Level B Harassment takes for all of these species were predicted to be in the form of TTS. For Guadalupe fur seals, Northern fur seals, and California sea lions, for which the TTS threshold is 206 dB SEL, NMFS believes it is unlikely that any of these pinnipeds will incur TTS because of the distance within which they would have to approach the MFAS source (approximately 40 m for the most powerful source for), the fact that many animals will likely avoid active sonar sources to some degree, and the likelihood that Navy monitors would detect these pinnipeds (because of the relatively short duration of their dives and their tendency to rest near the surface) prior to an approach within this distance and implement active sonar powerdown or shutdown. Because elephant seals typically dive for longer periods (20–30 minutes) and only spend about 10 percent of their time at the surface, some animals will likely not be detected by Navy monitors and will likely incur TTS. Also of note though, elephant seals make extensive foraging migrations to the North Pacific and Gulf of Alaska outside of SOCAL returning two times a year California haul-out sites for breeding and molting. Northern elephant seals would not be exposed during the times they are foraging outside of SOCAL (Stewart and DeLong 1995, Le Boeuf *et al.*, 2000, Crocker *et al.*, 2006, Bearzi *et al.*, 2008). NMFS estimates that less than half of the estimated elephant seal TTS takes may occur (0–3). Though harbor seals have generally short dive times, they are smaller (harder to see) and the TTS threshold for this species is substantively lower (183 dB SEL), which means that they can be exposed to levels expected to result in TTS at a substantially larger distance from the source (approximately 1650 m). Therefore, though some TTS takes will likely be avoided through mitigation implementation, NMFS estimates that more than half of the estimated TTS takes will still actually occur (2280–4559). As mentioned above and indicated in Table 12, some pinniped 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, 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 acoustic analysis also predicted that 9 Pacific harbor seals animal would be exposed to MFAS/HFAS sound levels that would result in Level A Harassment (PTS—injury). However, because of the distance within which they would have to approach the MFAS source (approximately 50 m for the most powerful source for) and the fact that animals will likely avoid active sonar sources to some degree, NMFS does not believe that any animals will incur PTS or be otherwise injured by MFAS/HFAS.

Acoustic analysis also predicted that 2 Guadalupe fur seals, 64 Northern fur seals, 510 California sea lions, 41 northern elephant seals, and 26 Pacific harbor seals would be exposed to sound or pressure from explosives at levels expected to result in TTS. For the same reasons listed above, NMFS anticipates that the Navy watchstanders would likely detect the majority of the individual Guadalupe fur seals, northern fur seals, and California sea lions and implement the mitigation measures to avoid exposure. However, the range to TTS for a few of the larger explosives is larger than the associated exclusion zones for BOMBEX, MISSILEX, or SINKEX (see Table 3), therefore NMFS anticipates that TTS might not be entirely avoided during those exercises, so NMFS estimates that up to half of the TTS takes predicted by the acoustic analysis might actually be incurred (0–1 Guadalupe fur seals, 0–32 northern fur seals, and 0–255 California sea lions). NMFS estimates that of all of the pinnipeds, fewer elephant seals and harbor seals would likely be detected, and therefore we estimate that a larger portion of predicted exposures of elephant seals and harbor seals might be in the form of TTS (20–41 elephant seals, 13–26 harbor seals).

Acoustic analysis also predicted that 20 pinnipeds might be exposed to levels of sound or pressure from explosives that would result in PTS or other injury and that 7 pinnipeds mortalities would result from explosive detonations. NMFS anticipates that the Navy watchstanders would likely detect these species and implement the mitigation measures to avoid exposure. In the case of all explosive exercises, the exclusion zones are 2–12 times larger than the estimated distance at which an animal would be exposed to injurious sounds or pressure waves. Therefore, no takes by injury or death are anticipated or authorized. Table 13 shows the estimated abundance of the affected stocks of dolphins and Dall's porpoise.

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 exercises utilizing MFAS/HFAS and underwater explosives in the SOCAL Range Complex will have a negligible impact on the affected species or stocks. NMFS has proposed regulations for these exercises that prescribe the means of affecting 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 exercises in the SOCAL Range Complex 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 six marine mammal species and six sea turtle species that are listed as endangered under the ESA with confirmed or possible occurrence in the study area: humpback whale, sei whale, fin whale, blue whale, sperm whale, Guadalupe fur seal, loggerhead sea turtle, the green sea turtle, leatherback sea turtle, and the olive ridley sea turtle. The Navy has begun consultation with NMFS pursuant to section 7 of the ESA, and NMFS will also consult internally on the issuance of an LOA under section 101(a)(5)(A) of the MMPA for SOCAL activities. Consultation will be concluded prior to a determination on the issuance of the final rule and an LOA.

NEPA

NMFS has participated as a cooperating agency on the Navy's Draft Environmental Impact Statement (DEIS) for SOCAL, which was published on April 4, 2008. The Navy's DEIS is posted on NMFS' Web site: *http://www.nmfs.noaa.gov/pr/permits/incidental.htm.* NMFS intends to adopt the Navy's Final EIS (FEIS), if adequate and appropriate. Currently, we believe that the adoption of the Navy's FEIS will allow NMFS to meet its responsibilities under NEPA for the issuance of an LOA for SOCAL. If the Navy's FEIS is deemed not to be adequate, NMFS would supplement the existing analysis to ensure that we comply with NEPA prior to the issuance of the final rule or LOA.

Classification

This action does not contain any collection of information requirements for purposes of the Paperwork Reduction Act.

The Office of Management and Budget has determined that this proposed rule is significant for purposes of Executive Order 12866.

Pursuant to the Regulatory Flexibility Act, 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 rule, if adopted, would not have a significant economic impact on a substantial number of small entities. The Regulatory Flexibility Act 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. section 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 will be affected by this rulemaking, not a small governmental jurisdiction, small organization or small business, as defined by the Regulatory Flexibility Act (RFA). Any requirements imposed by a Letter of Authorization issued pursuant to these regulations, and any monitoring or reporting requirements imposed by these regulations, will 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.

Dated: September 25, 2008.

James Balsiger,

Acting Assistant Administrator for Fisheries, National Marine Fisheries Service.

For reasons set forth in the preamble, 50 CFR part 216 is proposed to be amended as follows:

PART 216—REGULATIONS GOVERNING THE TAKING AND IMPORTING OF MARINE MAMMALS

1. The authority citation for part 216 continues to read as follows:

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

2. Subpart X is added to part 216 to read as follows:

Subpart X—Taking and Importing Marine Mammals; U.S. Navy's Southern California Range Complex (SOCAL)

Sec.

Subpart X—Taking and Importing Marine Mammals; U.S. Navy's Southern California Range Complex (SOCAL)

§ 216.270 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 occur 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 SOCAL Range Complex (as depicted in Figure ES–1 in the Navy's Draft Environmental Impact Statement for SOCAL), which extends southwest from southern California in an approximately 700 by 200 nm rectangle with the seaward corners at 27°30′00″ N. lat.; 127°10′04″ W. long. and 24°00′01″ N. lat.; 125°00′03″ W. long.

(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) The use of the following mid-frequency active sonar (MFAS) sources, high frequency active sonar (HFAS) sources for U.S. Navy anti-submarine warfare (ASW), mine warfare (MIW) training, maintenance, or research, development, testing, and evaluation (RDT&E) in the amounts indicated below (±10 percent):

(i) AN/SQS–53 (hull-mounted active sonar)—up to 9,885 hours over the course of 5 years (an average of 1,977 hours per year).

(ii) AN/SQS–56 (hull-mounted active sonar)—up to 2,470 hours over the course of 5 years (an average of 494 hours per year).

(iii) AN/BQQ–10 (submarine active sonar)—up to 4,075 hours over the course of 5 years (an average of 815 hours per year) (an average of 2 pings per hour during training events, 60 pings per hour for maintenance).

(iv) AN/AQS–22 or 13 (active helicopter dipping sonar)—up to 13,595 dips over the course of 5 years (an average of 2,719 dips per year—10 pings per dip).

(v) SSQ–62 (Directional Command Activated Sonobuoy System (DICASS) sonobuoys)—up to 21,275 sonobuoys over the course of 5 years (an average of 4,255 sonobuoys per year).

(vi) MK–48 (heavyweight torpedoes)—up to 435 torpedoes over the course of 5 years (an average of 87 torpedoes per year).

(vii) AN/BQQ–15 (submarine navigational sonar)—up to 610 hours over the course of 5 years (an average of 122 hours per year).

(viii) MK–46 (lightweight torpedoes)—up to 420 torpedoes over the course of 5 years (an average of 84 torpedoes per year).

(ix) AN/SLQ–25A NIXIE—up to 1,135 hours over the course of 5 years (an average of 227 hours per year).

(2) The detonation of the underwater explosives indicated in this paragraph (c)(2)(i) conducted as part of the training exercises indicated in this paragraph (c)(2)(ii):

(i) Underwater Explosives:

(A) 5″; Naval Gunfire (9.5 lbs).

(B) 76 mm rounds (1.6 lbs).

(C) Maverick (78.5 lbs).

(D) Harpoon (448 lbs).

(E) MK–82 (238 lbs).

(F) MK–83 (574 lbs).

(G) MK–84 (945 lbs).

(H) MK–48 (851 lbs).

(I) Demolition Charges (20 lbs).

(J) AN/SSQ–110A (IEER explosive sonobuoy—5 lbs).

(ii) Training Events:

(A) Surface-to-surface Gunnery Exercises (S–S GUNEX)—up to 2,010 exercises over the course of 5 years (an average of 402 per year).

(B) Air-to-surface Missile Exercises (A–S MISSILEX)—up to 250 exercises over the course of 5 years (an average of 50 per year).

(C) Bombing Exercises (BOMBEX)—up to 200 exercises over the course of 5 years (an average of 40 per year).

(D) Sinking Exercises (SINKEX)—up to 10 exercises over the course of 5 years (an average of 2 per year).

(E) Extended Echo Ranging and Improved Extended Echo Ranging (EER/IEER) Systems—up to 15 exercises over the course of 5 years (an average of 3 per year).

§ 216.271 Definitions.

(a) 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 § 216.271(b)(1)(ii) found dead or live on shore within a two-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, dwarf or pygmy sperm whales, short-finned pilot whales, humpback whales, sperm whales, blue whales, fin whales, or sei whales.

(iii) A group of 2 or more cetaceans of any species exhibiting indicators of distress as defined in § 216.271(b)(3).

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

(3) *Exhibiting Indicators of Distress*—Animals exhibiting an uncommon combination of behavioral and physiological indicators typically associated with distressed or stranded animals. This situation would be identified by a qualified individual and typically includes, but is not limited to, some combination of the following characteristics:

(i) Marine mammals continually circling or moving haphazardly in a tightly packed group—with or without a member occasionally breaking away and swimming towards the beach.

(ii) Abnormal respirations including increased or decreased rate or volume of breathing, abnormal content or odor.

(iii) Presence of an individual or group of a species that has not historically been seen in a particular habitat, for example a pelagic species in a shallow bay when historic records indicate that it is a rare event.

(iv) Abnormal behavior for that species, such as abnormal surfacing or swimming pattern, listing, and abnormal appearance.

(4) *Major Training Exercise*—MTEs, within the context of the SOCAL Stranding Plan, include:

(i) Composite Training Unit Exercise (COMPTUEX)—3–4 events annually, 21 days per entire event.

(ii) Joint Task Force Exercise (JTFEX)—3–4 events annually, 10 days per entire event.

(iii) Ship Anti-submarine warfare (ASW) Readiness and Evaluation Measuring (SHAREM)—1 event annually, less than a week long.

(iv) Sustainment Exercise—2 events annually, shorter than COMPTUEX.

(v) Integrated ASW Course (IAC2)—4 events annually, 2 12-hour exercises over 2 days.

(b) [Reserved]

§ 216.272 Permissible methods of taking.

(a) Under Letters of Authorization issued pursuant to §§ 216.106 and 216.277, the Holder of the Letter of Authorization (hereinafter ''Navy'') may incidentally, but not intentionally, take marine mammals within the area described in § 216.270(b), provided the activity is in compliance with all terms, conditions, and requirements of these regulations and the appropriate Letter of Authorization.

(b) The activities identified in § 216.270(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 § 216.270(c) is limited to the following species, by the indicated method of take and the indicated number of times (estimated based on the authorized amounts of sound source operation):

(1) Level B Harassment (+/−10 percent of the take estimate indicated below):

(i) Mysticetes:

(A) Humpback whale (*Megaptera novaeangliae*)—15.

(B) Fin whale (*Balaenoptera physalus*)—167.

(C) Blue whale (*Balaenoptera musculus*)—609.

(D) Minke whale (*Balaenoptera acutorostrata*)—126.

(E) Gray whale (*Eschrichtius robustus*)—5460.

(ii) Odontocetes:

(A) Sperm whales (*Physeter macrocephalus*)—148.

(B) Pygmy sperm whales (*Kogia breviceps*)—159.

(C) Dwarf sperm whale (*Kogia sima*)—20.

(D) Mesoplodont beaked whales (Blainville's, Hubb's, Perrin's, pygmy, and ginkgo-toothed) (*Mesoplodon densirostris, M. carlhubbsi, M. perrini, M. peruvianus, M. ginkgodens*)—131.

(E) Cuvier's beaked whales (*Ziphius cavirostris*)—428.

(F) Baird's beaked whales (*Berardius bairdii*)—13.

(G) Unidentified beaked whales—97.

(H) Rough-toothed dolphin (*Steno bredanensis*)—20.

(I) Bottlenose dolphin (*Tursiops truncatus*)—1,509.

(J) Pan-tropical spotted dolphin (*Stenella attenuata*)—20.

(K) Spinner dolphin (*Stenella longirostris*)—20.

(L) Striped dolphin (*Stenella coeruleoalba*)—1,830.

(M) Long-beaked common dolphin (*Delphinus capensis*)—4,622.

(N) Risso's dolphin (*Grampus griseus*)—3,592.

(O) Northern right whale dolphin (*Lissodelphis borealis*)—1,540.

(P) Pacific white-sided dolphin (*Lagenorhynchus obliquidens*)—1,397.

(Q) Short-beaked common dolphin (*Delphinus delphis*)—39,441.

(R) Melon-headed whale (*Peponocephala electra*)—20.

(S) Pygmy killer whale (*Feresa attenuata*)—20.

(T) False killer whale (*Pseudorca crassidens*)—20.

(U) Killer whale (*Orcinus orca*)—7.

(V) Short-finned pilot whale (*Globicephala macrorynchus*)—45.

(W) Dall's porpoise (*Phocoenoides dalli*)—622.

(ii) Pinnipeds:

(A) Northern elephant seal (*Mirounga angustirostris*)—955.

(B) Pacific harbor seal (*Phoca vitulina*)—5,672.

(C) California sea lion (*Zalophus californianus*)—55,502.

(D) Northern fur seal (*Callorhinus ursinus*)—1,229.

(E) Guadelupe fur seal (*Arctocephalus townsendi*)—1,064.

(2) Level A Harassment and/or mortality of no more than 10 beaked whales (total), of any of the species listed in § 216.272(c)(1)(ii)(D–F) over the course of the 5-year regulations.

§ 216.273 Prohibitions.

No person in connection with the activities described in § 216.270 may:

(a) Take any marine mammal not specified in § 216.272(c);

(b) Take any marine mammal specified in § 216.272(c) other than by incidental take as specified in § 216.272(c)(1) and (c)(2);

(c) Take a marine mammal specified in § 216.272(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 a Letter of Authorization issued under §§ 216.106 and 216.277.

§ 216.274 Mitigation.

(a) The activities identified in § 216.270(c) must be conducted in a manner that minimizes, to the greatest extent practicable, adverse impacts on marine mammals and their habitats.

(b) When conducting training, maintenance, or RDT&E activities and utilizing the sound sources or explosives identified in § 216.270(c), the mitigation measures contained in the Letter of Authorization issued under §§ 216.106 and 216.277 must be implemented. These mitigation measures include, but are not limited to:

(1) Navy's General Maritime Measures for All Training at Sea:

(i) Personnel Training (for all Training Types):

(A) All commanding officers (COs), executive officers (XOs), lookouts, Officers of the Deck (OODs), junior OODs (JOODs), maritime patrol aircraft aircrews, and Anti-submarine Warfare (ASW)/Mine Warfare (MIW) helicopter crews shall complete the NMFS-approved Marine Species Awareness Training (MSAT) by viewing the U.S. Navy MSAT digital versatile disk (DVD). All bridge lookouts shall complete both parts one and two of the MSAT; part two is optional for other personnel.

(B) Navy lookouts shall undertake extensive training in order to qualify as a watchstander in accordance with the Lookout Training Handbook (Naval Education and Training Command [NAVEDTRA] 12968–D).

(C) Lookout training shall include on-the-job instruction under the supervision of a qualified, experienced lookout. Following successful completion of this supervised training period, lookouts shall complete the Personal Qualification Standard Program, certifying that they have demonstrated the necessary skills (such as detection and reporting of partially submerged objects). Personnel being trained as lookouts can be counted among required lookouts as long as supervisors monitor their progress and performance.

(D) Lookouts shall be trained in the most effective means to ensure quick and effective communication within the command structure in order to facilitate implementation of protective measures if marine species are spotted.

(ii) Operating Procedures and Collision Avoidance:

(A) Prior to major exercises, a Letter of Instruction, Mitigation Measures Message or Environmental Annex to the Operational Order shall be issued to further disseminate the personnel training requirement and general marine species protective measures.

(B) COs shall make use of marine species detection cues and information to limit interaction with marine species to the maximum extent possible consistent with safety of the ship.

(C) While underway, surface vessels shall have at least two lookouts with binoculars; surfaced submarines shall have at least one lookout with binoculars. Lookouts already posted for safety of navigation and man-overboard precautions may be used to fill this requirement. As part of their regular duties, lookouts will watch for and report to the OOD the presence of marine mammals.

(D) On surface vessels equipped with a multi-function active sensor, pedestal mounted ''Big Eye'' (20x10) binoculars shall be properly installed and in good working order to assist in the detection of marine mammals in the vicinity of the vessel.

(E) Personnel on lookout shall employ visual search procedures employing a scanning methodology in accordance with the Lookout Training Handbook (NAVEDTRA 12968–D).

(F) After sunset and prior to sunrise, lookouts shall employ Night Lookouts Techniques in accordance with the Lookout Training Handbook. (NAVEDTRA 12968–D).

(G) While in transit, naval vessels shall be alert at all times, use extreme caution, and proceed at a ''safe speed'' so that the vessel can take proper and effective action to avoid a collision with any marine animal and can be stopped within a distance appropriate to the prevailing circumstances and conditions.

(H) When marine mammals have been sighted in the area, Navy vessels shall increase vigilance and take reasonable and practicable actions to avoid collisions and activities that might result in close interaction of naval assets and marine mammals. Actions may include changing speed and/or direction and are dictated by environmental and other conditions (e.g., safety, weather).

(I) Floating weeds and kelp, algal mats, clusters of seabirds, and jellyfish are good indicators of marine mammals. Therefore, where these circumstances are present, the Navy shall exercise increased vigilance in watching for marine mammals.

(J) Navy aircraft participating in exercises at sea shal conduct and maintain, when operationally feasible and safe, surveillance for marine mammals as long as it does not violate safety constraints or interfere with the accomplishment of primary operational duties. Marine mammal detections shall be immediately reported to assigned Aircraft Control Unit for further dissemination to ships in the vicinity of the marine species as appropriate when it is reasonable to conclude that the course of the ship will likely result in a closing of the distance to the detected marine mammal.

(K) All vessels shall maintain logs and records documenting training operations should they be required for event reconstruction purposes. Logs and records will be kept for a period of 30 days following completion of a major training exercise.

(2) Navy's Measures for MFAS Operations.

(i) Personnel Training (for MFAS Operations):

(A) All lookouts onboard platforms involved in ASW training events shall review the NMFS-approved Marine Species Awareness Training material prior to use of mid-frequency active sonar.

(B) All COs, XOs, and officers standing watch on the bridge shall have reviewed the Marine Species Awareness Training material prior to a training event employing the use of mid-frequency active sonar.

(C) Navy lookouts shall undertake extensive training in order to qualify as a watchstander in accordance with the Lookout Training Handbook (Naval Educational Training [NAVEDTRA], 12968–D).

(D) Lookout training shall include on-the-job instruction under the supervision of a qualified, experienced watchstander. Following successful completion of this supervised training period, lookouts shall complete the Personal Qualification Standard program, certifying that they have demonstrated the necessary skills (such as detection and reporting of partially submerged objects). This does not forbid personnel being trained as lookouts from being counted as those listed in previous measures so long as supervisors monitor their progress and performance.

(E) Lookouts shall be trained in the most effective means to ensure quick and effective communication within the command structure in order to facilitate implementation of mitigation measures if marine species are spotted.

(ii) Lookout and Watchstander Responsibilities:

(A) On the bridge of surface ships, there shall always be at least three people on watch whose duties include observing the water surface around the vessel.

(B) All surface ships participating in ASW training events shall, in addition to the three personnel on watch noted previously, have at all times during the exercise at least two additional personnel on watch as marine mammal lookouts.

(C) Personnel on lookout and officers on watch on the bridge shall have at least one set of binoculars available for each person to aid in the detection of marine mammals.

(D) On surface vessels equipped with mid-frequency active sonar, pedestal mounted ''Big Eye'' (20x110) binoculars shall be present and in good working order to assist in the detection of marine mammals in the vicinity of the vessel.

(E) Personnel on lookout shall employ visual search procedures employing a scanning methodology in accordance with the Lookout Training Handbook (NAVEDTRA 12968–D).

(F) After sunset and prior to sunrise, lookouts shall employ Night Lookouts Techniques in accordance with the Lookout Training Handbook.

(G) Personnel on lookout shall be responsible for reporting all objects or anomalies sighted in the water (regardless of the distance from the vessel) to the Officer of the Deck, since any object or disturbance (e.g., trash, periscope, surface disturbance, discoloration) in the water may be indicative of a threat to the vessel and its crew or indicative of a marine species that may need to be avoided as warranted.

(iii) Operating Procedures:

(A) A Letter of Instruction, Mitigation Measures Message, or Environmental Annex to the Operational Order shall be issued prior to the exercise to further disseminate the personnel training requirement and general marine mammal mitigation measures.

(B) COs shall make use of marine species detection cues and information to limit interaction with marine species to the maximum extent possible consistent with safety of the ship.

(C) All personnel engaged in passive acoustic sonar operation (including aircraft, surface ships, or submarines) shall monitor for marine mammal vocalizations and report the detection of any marine mammal to the appropriate watch station for dissemination and appropriate action.

(D) During mid-frequency active sonar operations, personnel shall utilize all available sensor and optical systems (such as night vision goggles) to aid in the detection of marine mammals.

(E) Navy aircraft participating in exercises at sea shall conduct and maintain, when operationally feasible and safe, surveillance for marine species of concern as long as it does not violate safety constraints or interfere with the accomplishment of primary operational duties.

(F) Aircraft with deployed sonobuoys shall use only the passive capability of sonobuoys when marine mammals are detected within 200 yds (183 m) of the sonobuoy.

(G) Marine mammal detections shall be immediately reported to assigned Aircraft Control Unit for further dissemination to ships in the vicinity of the marine species as appropriate where it is reasonable to conclude that the course of the ship will likely result in a closing of the distance to the detected marine mammal.

(H) Safety Zones—When marine mammals are detected by any means (aircraft, shipboard lookout, or acoustically) within or closing to inside 1,000 yds (914 m) of the sonar dome (the bow), the ship or submarine shall limit active transmission levels to at least 6 decibels (dB) below normal operating levels.

(*1*) Ships and submarines shall continue to limit maximum transmission levels by this 6-dB factor until the animal has been seen to leave the area, has not been detected for 30 minutes, or the vessel has transited more than 2,000 yds (1829 m) beyond the location of the last detection.

(*2*) Should a marine mammal be detected within or closing to inside 500 yds (457 m) of the sonar dome, active sonar transmissions shall be limited to at least 10-dB below the equipment's normal operating level. Ships and submarines shall continue to limit maximum ping levels by this 10-dB factor until the animal has been seen to leave the area, has not been detected for 30 minutes, or the vessel has transited more than 2,000 yds (1829 m) beyond the location of the last detection.

(*3*) Should the marine mammal be detected within or closing to inside 200 yds (183 m) of the sonar dome, active sonar transmissions shall cease. Sonar shall not resume until the animal has been seen to leave the area, has not been detected for 30 minutes, or the vessel has transited more than 2,000 yds (1829 m) beyond the location of the last detection.

(*4*) Special conditions applicable for dolphins and porpoises only: If, after conducting an initial maneuver to avoid close quarters with dolphins or porpoises, the OOD 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.

(*5*) If the need for power-down should arise as detailed in ''Safety Zones'' above, the Navy shall follow the requirements as though they were operating at 235 dB—the normal operating level (i.e., the first power-down will be to 229 dB, regardless of at what level above 235 dB active sonar was being operated).

(I) Prior to startup or restart of active sonar, operators will check that the Safety Zone radius around the sound source is clear of marine mammals.

(J) Active sonar levels (generally)—Navy shall operate active sonar at the lowest practicable level, not to exceed 235 dB, except as required to meet tactical training objectives.

(K) Helicopters shall observe/survey the vicinity of an ASW training event for 10 minutes before the first deployment of active (dipping) sonar in the water.

(L) Helicopters shall not dip their active sonar within 200 yds (183 m) of a marine mammal and shall cease pinging if a marine mammal closes within 200 yds (183 m) after pinging has begun.

(M) Submarine sonar operators shall review detection indicators of close-aboard marine mammals prior to the commencement of ASW training events involving active mid-frequency sonar.

(3) Navy's Measures for Underwater Detonations

(i) Surface-to-Surface Gunnery (5-inch, 76 mm, 57 mm, 20 mm, 25 mm and 30 mm explosive rounds)

(A) Lookouts shall visually survey for floating weeds and kelp. Intended impact shall not be within 600 yds (585 m) of known or observed floating weeds and kelp, and algal mats.

(B) For exercises using targets towed by a vessel or aircraft, target-towing vessels/aircraft shall maintain a trained lookout for marine mammals. If a marine mammal is sighted in the vicinity, the tow aircraft/vessel shall immediately notify the firing vessel, which shall suspend the exercise until the area is clear.

(C) A 600-yard radius buffer zone shall be established around the intended target.

(D) From the intended firing position, trained lookouts shall survey the buffer zone for marine mammals prior to commencement and during the exercise as long as practicable.

(E) The exercise shall be conducted only when the buffer zone is visible and marine mammals are not detected within it.

(ii) Surface-to-Surface Gunnery (non-explosive rounds)

(A) Lookouts shall visually survey for floating weeds and kelp, and algal mats. Intended impact will not be within 200 yds (183 m) of known or observed floating weeds and kelp, and algal mats.

(B) A 200-yd (183 m) radius buffer zone shall be established around the intended target.

(C) From the intended firing position, trained lookouts shall survey the buffer zone for marine mammals prior to commencement and during the exercise as long as practicable.

(D) If applicable, target towing vessels shall maintain a lookout. If a marine mammal is sighted in the vicinity of the exercise, the tow vessel shall immediately notify the firing vessel in order to secure gunnery firing until the area is clear.

(E) The exercise shall be conducted only when the buffer zone is visible and marine mammals are not detected within the target area and the buffer zone.

(iii) Surface-to-Air Gunnery (explosive and non-explosive rounds)

(A) Vessels shall orient the geometry of gunnery exercises in order to prevent debris from falling in the area of sighted marine mammals.

(B) Vessels will expedite the recovery of any parachute deploying aerial targets to reduce the potential for entanglement of marine mammals.

(C) Target towing aircraft shall maintain a lookout. If a marine mammal is sighted in the vicinity of the exercise, the tow aircraft shall immediately notify the firing vessel in order to secure gunnery firing until the area is clear.

(iv) Air-to-Surface Gunnery (explosive and non-explosive rounds)

(A) If surface vessels are involved, lookouts will visually survey for floating kelp in the target area. Impact shall not occur within 200 yds (183 m) of known or observed floating weeds and kelp or algal mats.

(B) A 200 yd (183 m) radius buffer zone shall be established around the intended target.

(C) If surface vessels are involved, lookout(s) shall visually survey the buffer zone for marine mammals prior to and during the exercise.

(D) Aerial surveillance of the buffer zone for marine mammals shall be conducted prior to commencement of the exercise. Aerial surveillance altitude of 500 feet to 1,500 feet (ft) (152—456 m) is optimum. Aircraft crew/pilot shall maintain visual watch during exercises. Release of ordnance through cloud cover is prohibited: Aircraft must be able to actually see ordnance impact areas.

(E) The exercise shall be conducted only if marine mammals and are not visible within the buffer zone.

(v) Small Arms Training (grenades, explosive and non-explosive rounds)—Lookouts will visually survey for floating weeds or kelp, algal mats, and marine mammals. Weapons shall not be fired in the direction of known or observed floating weeds or kelp, algal mats, or marine mammals.

(vi) Air-to-Surface At-sea Bombing Exercises (explosive and non-explosive):

(A) If surface vessels are involved, trained lookouts shall survey for floating kelp and marine mammals. Ordnance shall not be targeted to impact within 1,000 yds (914 m) of known or observed floating kelp or marine mammals.

(B) A 1,000 yd (914 m) radius buffer zone shall be established around the intended target.

(C) Aircraft shall visually survey the target and buffer zone for marine mammals prior to and during the exercise. The survey of the impact area shall be made by flying at 1,500 ft (152 m) or lower, if safe to do so, and at the slowest safe speed. Release of ordnance through cloud cover is prohibited: Aircraft must be able to actually see ordnance impact areas. Survey aircraft should employ most effective search tactics and capabilities.

(D) The exercise will be conducted only if marine mammals are not visible within the buffer zone.

(vii) Air-to-Surface Missile Exercises (explosive and non-explosive):

(A) Ordnance shall not be targeted to impact within 1,800 yds (1646 m) of known or observed floating kelp.

(B) Aircraft shall visually survey the target area for marine mammals. Visual inspection of the target area shall be made by flying at 1,500 (457 m) feet or lower, if safe to do so, and at slowest safe speed. Firing or range clearance aircraft must be able to actually see ordnance impact areas. Explosive ordnance shall not be targeted to impact within 1,800 yds (1646 m) of sighted marine mammals.

(viii) Demolitions, Mine Warfare, and Mine Countermeasures (up to a 20-lb charge):

(A) Exclusion Zones—All Mine Warfare and Mine Countermeasures Operations involving the use of explosive charges must include exclusion zones for marine mammals to prevent physical and/or acoustic effects to those species. These exclusion zones shall extend in a 700-yard arc radius around the detonation site.

(B) Pre-Exercise Surveys—For Demolition and Ship Mine Countermeasures Operations, pre-exercise survey shall be conducted within 30 minutes prior to the commencement of the scheduled explosive event. The survey may be conducted from the surface, by divers, and/or from the air, and personnel shall be alert to the presence of any marine mammal. Should such an animal be present within the survey area, the exercise shall be paused until the animal voluntarily leaves the area. The Navy shall suspend detonation exercises and ensure the area is clear for a full 30 minutes prior to detonation. Personnel shall record any marine mammal observations during the exercise.

(C) Post-Exercise Surveys—Surveys within the same radius shall also be conducted within 30 minutes after the completion of the explosive event.

(D) Reporting—If there is evidence that a marine mammal may have been stranded, injured or killed by the action, Navy training activities shall be immediately suspended and the situation immediately reported by the participating unit to the Officer in Charge of the Exercise (OCE), who will follow Navy procedures for reporting the incident to Commander, Pacific Fleet, Commander, Navy Region Southwest, Environmental Director, and the chain-of-command. The situation shall also be reported to NMFS (see Stranding Plan for details).

(ix) Mining Operations—initial target points shall be briefly surveyed prior to inert ordnance (no live ordnance used) release from an aircraft to ensure the intended drop area is clear of marine mammals. To the extent feasible, the Navy shall retrieve inert mine shapes dropped during Mining Operations.

(x) Sink Exercise:

(A) All weapons firing shall be conducted during the period 1 hour after official sunrise to 30 minutes before official sunset.

(B) Prior to conducting the exercise, remotely sensed sea surface temperature maps shall be reviewed. SINKEX shall not be conducted within areas where strong temperature discontinuities are present, thereby indicating the existence of oceanographic fronts. These areas shall be avoided because concentrations of some listed species, or their prey, are known to be associated with these oceanographic features.

(C) An exclusion zone with a radius of 1.0 nm shall be established around each target. An additional buffer of 0.5 nm shall be added to account for errors, target drift, and animal movements. Additionally, a safety zone, which extends from the exclusion zone at 1.0 nm out an additional 0.5 nm, shall be surveyed. Together, the zones extend out 2 nm from the target.

(D) A series of surveillance over-flights shall be conducted within the exclusion and the safety zones, prior to and during the exercise, when feasible. Survey protocol shall be as follows:

(*1*) Overflights within the exclusion zone shall be conducted in a manner that optimizes the surface area of the water observed. This may be accomplished through the use of the Navy's Search and Rescue Tactical Aid, which provides the best search altitude, ground speed, and track spacing for the discovery of small, possibly dark objects in the water based on the environmental conditions of the day. These environmental conditions include the angle of sun inclination, amount of daylight, cloud cover, visibility, and sea state.

(*2*) All visual surveillance activities shall be conducted by Navy personnel trained in visual surveillance. At least one member of the mitigation team would have completed the Navy's marine mammal training program for lookouts.

(*3*) In addition to the overflights, the exclusion zone shall be monitored by passive acoustic means, when assets are available. This passive acoustic monitoring would be maintained throughout the exercise. Potential assets include sonobuoys, which can be utilized to detect any vocalizing marine mammals (particularly sperm whales) in the vicinity of the exercise. The sonobuoys shall be re-seeded as necessary throughout the exercise. Additionally, passive sonar onboard submarines may be utilized to detect any vocalizing marine mammals in the area. The OCE would be informed of any aural detection of marine mammals and would include this information in the determination of when it is safe to commence the exercise.

(*4*) On each day of the exercise, aerial surveillance of the exclusion and safety zones shall commence 2 hours prior to the first firing.

(*5*) The results of all visual, aerial, and acoustic searches shall be reported immediately to the OCE. No weapons launches or firing may commence until the OCE declares the safety and exclusion zones free of marine mammals.

(*6*) If a protected species observed within the exclusion zone is diving, firing shall be delayed until the animal is re-sighted outside the exclusion zone, or 30 minutes have elapsed. After 30 minutes, if the animal has not been re-sighted it would be assumed to have left the exclusion zone.

(*7*) During breaks in the exercise of 30 minutes or more, the exclusion zone shall again be surveyed for any protected species. If marine mammals are sighted within the exclusion zone, the OCE shall be notified, and the procedure described above would be followed.

(*8*) Upon sinking of the vessel, a final surveillance of the exclusion zone shall be monitored for 2 hours, or until sunset, to verify that no marine mammals were harmed.

(E) Aerial surveillance shall be conducted using helicopters or other aircraft based on necessity and availability. The Navy has several types of aircraft capable of performing this task; however, not all types are available for every exercise. For each exercise, the available asset best suited for identifying objects on and near the surface of the ocean would be used. These aircraft would be capable of flying at the slow safe speeds necessary to enable viewing of marine vertebrates with unobstructed, or minimally obstructed, downward and outward visibility. The exclusion and safety zone surveys may be cancelled in the event that a mechanical problem, emergency search and rescue, or other similar and unexpected event preempts the use of one of the aircraft onsite for the exercise.

(F) Every attempt would be made to conduct the exercise in sea states that are ideal for marine mammal sighting, Beaufort Sea State 3 or less. In the event of a 4 or above, survey efforts shall be increased within the zones. This shall be accomplished through the use of an additional aircraft, if available, and conducting tight search patterns.

(G) The exercise shall not be conducted unless the exclusion zone could be adequately monitored visually.

(H) In the event that any marine mammals are observed to be harmed in the area, a detailed description of the animal shall be taken, the location noted, and if possible, photos taken. This information shall be provided to NMFS via the Navy's regional environmental coordinator for purposes of identification (see the Stranding Plan for detail).

(I) An after action report detailing the exercise's time line, the time the surveys commenced and terminated, amount, and types of all ordnance expended, and the results of survey efforts for each event shall be submitted to NMFS.

(xi) Extended Echo Ranging/Improved Extended Echo Ranging (EER/IEER):

(A) Crews shall conduct visual reconnaissance of the drop area prior to laying their intended sonobuoy pattern. This search shall be conducted at an altitude below 457 m (500 yd) at a slow speed, if operationally feasible and weather conditions permit. In dual aircraft operations, crews are allowed to conduct coordinated area clearances.

(B) Crews shall conduct a minimum of 30 minutes of visual and aural monitoring of the search area prior to commanding the first post detonation. This 30-minute observation period may include pattern deployment time.

(C) For any part of the briefed pattern where a post (source/receiver sonobuoy pair) will be deployed within 914 m (1,000 yd) of observed marine mammal activity, the Navy shall deploy the receiver ONLY and monitor while conducting a visual search. When marine mammals are no longer detected within 914 m (1,000 yd) of the intended post position, the Navy shall co-locate the explosive source sonobuoy (AN/SSQ–110A) (source) with the receiver.

(D) When able, Navy crews shall conduct continuous visual and aural monitoring of marine mammal activity. This is to include monitoring of own-aircraft sensors from first sensor placement to checking off station and out of RF range of these sensors.

(E) Aural Detection—If the presence of marine mammals is detected aurally, then that shall cue the Navy aircrew to increase the diligence of their visual surveillance. Subsequently, if no marine mammals are visually detected, then the crew may continue multi-static active search.

(F) Visual Detection—If marine mammals are visually detected within 914 m (1,000 yd) of the explosive source sonobuoy (AN/SSQ–110A) intended for use, then that payload shall not be detonated. Aircrews may utilize this post once the marine mammals have not been re-sighted for 30 minutes, or are observed to have moved outside the 914 m (1,000 yd) safety buffer. Aircrews may shift their multi-static active search to another post, where marine mammals are outside the 914 m (1,000 yd) safety buffer.

(G) Aircrews shall make every attempt to manually detonate the unexploded charges at each post in the pattern prior to departing the operations area by using the ''Payload 1 Release'' command followed by the ''Payload 2 Release'' command. Aircrews shall refrain from using the ''Scuttle'' command when two payloads remain at a given post. Aircrews will ensure that a 914 m (1,000 yd) safety buffer, visually clear of marine mammals, is maintained around each post as is done during active search operations.

(H) Aircrews shall only leave posts with unexploded charges in the event of a sonobuoy malfunction, an aircraft system malfunction, or when an aircraft must immediately depart the area due to issues such as fuel constraints, inclement weather, and in-flight emergencies. In these cases, the sonobuoy will self-scuttle using the secondary or tertiary method.

(I) The Navy shall ensure all payloads are accounted for. Explosive source sonobuoys (AN/SSQ–110A) that can not be scuttled shall be reported as unexploded ordnance via voice communications while airborne, then upon landing via naval message.

(J) Mammal monitoring shall continue until out of own-aircraft sensor range.

(4) The Navy shall abide by the letter of the ''Stranding Response Plan for Major Navy Training Exercises in the SOCAL Range Complex'' (available at: *http://www.nmfs.noaa.gov/pr/permits/incidental.htm*), to include the following measures:

(i) Shutdown Procedures—When an Uncommon Stranding Event (USE—defined in § 216.271) occurs during a Major Training Exercise (MTE) (as defined in the Stranding Plan, meaning including Sustainment, SHAREM, IAC2, JTFEX, or COMPTUEX) in the SOCAL Range Complex, the Navy shall implement the procedures described below.

(A) The Navy shall implement a Shutdown (as defined § 216.271) when advised by a NMFS Office of Protected Resources Headquarters Senior Official designated in the SOCAL 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 shall communicate, as needed, regarding the identification of the USE and the potential need to implement shutdown procedures.

(B) 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).

(C) If the Navy finds an injured or dead marine mammal 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 behaviors (if alive), and photo or video (if available). Based on the information provided, NMFS shall determine if, and advise the Navy whether a modified shutdown is appropriate on a case-by-case basis.

(D) In the event, following a USE, that: (a) qualified individuals are attempting to herd animals back out to the open ocean and animals are not willing to leave, or (b) 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 MFAS/HFAS training activities or explosive detonations, though farther than 14 nm from the distressed animal(s), is likely decreasing the likelihood that the animals return to the open water. If so, NMFS and the Navy shall further coordinate to determine what measures are necessary to further minimize that likelihood and implement those measures as appropriate.

(ii) Within 72 hours of NMFS notifying the Navy of the presence of a USE, the Navy shall provide available information to NMFS (per the SOCAL Communication Protocol) regarding the location, number and types of acoustic/explosive sources, direction and speed of units using MFAS/HFAS, and marine mammal sightings information associated with training activities occurring within 80 nm (148 km) and 72 hours prior to the USE event. Information not initially available regarding the 80 nm (148 km), 72 hours, period prior to the event shall be provided as soon as it becomes available. The Navy shall provide NMFS investigative teams with additional relevant unclassified information as requested, if available.

(iii) Memorandum of Agreement (MOA)—The Navy and NMFS shall develop an MOA, or other mechanism consistent with federal fiscal law requirements (and all other applicable laws), that allows the Navy to assist NMFS with the Phase 1 and 2 Investigations of USEs through the provision of in-kind services, such as (but not limited to) the use of plane/boat/truck for transport of personnel involved in the stranding response or investigation or animals, use of Navy property for necropsies or burial, or assistance with aerial surveys to discern the extent of a USE. The Navy may assist NMFS with the Investigations by providing one or more of the in-kind services outlined in the MOA, when available and logistically feasible and when the assistance does not negatively affect Fleet operational commitments.

§ 216.275 Requirements for monitoring and reporting.

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

(b) As outlined in the SOCAL Stranding Communication Plan, the Navy must notify NMFS immediately (or as soon as clearance procedures allow) if the specified activity identified in § 216.270(b) is thought to have resulted in the mortality or injury of any marine mammals, or in any take of marine mammals not identified in § 216.270(c).

(c) The Navy must conduct all monitoring and/or research required under the Letter of Authorization including abiding by the letter of the SOCAL Monitoring Plan, which requires the Navy to implement, at a minimum, the monitoring activities summarized in Table 1 below (and described in more detail in the SOCAL Monitoring Plan, which may be viewed at: *http://www.nmfs.noaa.gov/pr/permits/incidental.htm*).

(d) Report on Monitoring required in sub-paragraph (c) of this section—The Navy shall submit a report annually on September 1 describing the implementation and results (through June 1 of the same year) of the monitoring required in paragraph c, above. Navy will standardize data collection methods across ranges to allow for comparison in different geographic locations.

(e) SINKEX, GUNEX, MISSILEX, BOMBEX, Mine Warfare/Countermeasures, and Naval Surface Fire Support—A yearly report detailing the exercise's timelines, the time the surveys commenced and terminated, amount, and types of all ordnance expended, and the results of marine mammal survey efforts for each event will be submitted to NMFS.

(f) IEER exercises—A yearly report detailing the number of exercises along with the hours of associated marine mammal survey and associated marine mammal sightings, number of times employment was delayed by marine mammal sightings, and the number of total detonated charges and self-scuttled charges shall be submitted to NMFS.

(g) MFAS/HFAS exercises—The Navy shall submit an After Action Report to the Office of Protected Resources, NMFS, within 120 days of the completion of any Major Training or Integrated Unit-Level Exercise (Sustainment Exercise, IAC2, SHAREM, COMPTUEX, JTFEX). For other ASW exercises, the Navy shall submit a yearly summary report. These reports (the AARs and the annual reports) shall, at a minimum, include the following information:

(1) The estimated total number of hours of active sonar operation and the types of sonar utilized in the exercise;

(2) The total number of hours of observation effort (including observation time when active sonar was not operating), if obtainable; and;

(3) All marine mammal sightings (at any distance—not just within a particular distance) to include, when possible, and if not classified:

(i) Species,

(ii) Number of animals sighted,

(iii) Geographic location of marine mammal sighting,

(iv) Distance of animal from any ship with observers,

(v) Whether animal is fore, aft, port, or starboard,

(vi) Direction of animal movement in relation to boat (towards, away, parallel),

(vii) Any observed behaviors of marine mammals.

(4) The status of any active sonar sources (what sources were in use) and whether or not they were powered down or shut down as a result of the marine mammal observation; and

(5) The platform that the marine mammals were initially sighted from.

(h) SOCAL 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 all training for which individual reports are required in § 216.175 (d through f). This report shall be submitted at the end of the fourth year of the rule (November 2012), covering activities that have occurred through June 1, 2012.

(i) The Navy shall respond to NMFS comments on the draft SOCAL comprehensive report if NMFS provides the Navy with comments on the draft report within 3 months of receipt. The report shall be considered final after the Navy has addressed NMFS' comments, or 3 months after the submittal of the draft if NMFS does not comment by then.

(j) Comprehensive National Sonar Report—By June 2014, the Navy shall submit a draft National Report that analyzes, compares, and summarizes the active sonar data gathered (through November 2013) from the watchstanders and pursuant to the implementation of the Monitoring Plans for SOCAL, the Hawaii Range Complex (HRC), the Southern California (SOCAL) Range Complex, the Marianas Range Complex, and the Northwest Training Range.

(k) The Navy shall respond to NMFS comments on the draft comprehensive

National Sonar report if NMFS provides the Navy with comments on the draft report within 3 months of receipt. The report will be considered final after the Navy has addressed NMFS' comments, or 3 months after the submittal of the draft if NMFS does not comment by then.

§ 216.276 Applications for Letters of Authorization.

To incidentally take marine mammals pursuant to these regulations, the U.S. Citizen (as defined by § 216.103) conducting the activity identified in § 216.270(c) (i.e., the Navy) must apply for and obtain either an initial Letter of Authorization in accordance with § 216.277 or a renewal under § 216.278.

§ 216.277 Letter of Authorization.

(a) A Letter of Authorization, unless suspended or revoked, will be valid for a period of time not to exceed the period of validity of this subpart, but must be renewed annually subject to annual renewal conditions in § 216.278.

(b) Each Letter of Authorization shall 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 Letter of Authorization shall 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).

§ 216.278 Renewal of Letters of Authorization and adaptive management.

(a) A Letter of Authorization issued under § 216.106 and § 216.177 for the activity identified in § 216.170(c) will be renewed annually upon:

(1) Notification to NMFS that the activity described in the application submitted under § 216.246 will be undertaken and that there will not be a substantial modification to the described work, mitigation or monitoring undertaken during the upcoming 12 months;

(2) Receipt of the monitoring reports and notifications within the indicated timeframes required under § 216.275(b through j); and

(3) A determination by the NMFS that the mitigation, monitoring and reporting measures required under § 216.274 and the Letter of Authorization issued under §§ 216.106 and 216.277, were undertaken and will be undertaken during the upcoming annual period of validity of a renewed Letter of Authorization.

(b) Adaptive Management—Based on new information, NMFS may modify or augment the existing mitigation measures 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. Similarly, NMFS may coordinate with the Navy to modify or augment the existing monitoring requirements if the new data suggest that the addition of a particular measure would likely fill in a specifically important data gap. The following are some possible sources of new and applicable data:

(1) Results from the Navy's monitoring from the previous year (either from the SOCAL Range Complex or other locations);

(2) Results from specific stranding investigations (either from the SOCAL Range Complex or other locations, and involving coincident MFAS/HFAS training or not involving coincident use) or NMFS' long term prospective stranding investigation discussed in the preamble to this proposed rule;

(3) Results from general marine mammal and sound research (funded by the Navy or otherwise).

(c) If a request for a renewal of a Letter of Authorization issued under §§ 216.106 and 216.278 indicates that a substantial modification to the described work, mitigation or monitoring undertaken during the upcoming season will occur, or if NMFS utilizes the adaptive management mechanism addressed in paragraph (b) of this section to modify or augment the mitigation or monitoring measures, the NMFS shall provide the public a period of 30 days for review and comment on the request. Review and comment on renewals of Letters of Authorization would be 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 Letter of Authorization.

(d) A notice of issuance or denial of a renewal of a Letter of Authorization will be published in the **Federal Register**.

§ 216.279 Modifications to Letters of Authorization.

(a) Except as provided in paragraph (b) of this section, no substantive modification (including withdrawal or suspension) to the Letter of Authorization by NMFS, issued pursuant to §§ 216.106 and 216.277 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 a Letter of Authorization under § 216.278, 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 § 216.270(b), a Letter of Authorization issued pursuant to §§ 216.106 and 216.277 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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STUDY 1,3, 4 (exposures and behavioral responses)						
	FY08	**FY09**	**FY10**	**FY11**	**FY12**	**FY13**
Aerial surveys	Award monitoring contract, develop SOP, obtain permits	Portions of COMPTUEX/JTFEX, IACs, and ULT- 48 hours Includes 3 nearshore underwater detonation events	Portions of COMPTUEX/JTFEX, IACs, and ULT- 48 hours Includes 3 nearshore underwater detonation events	Portions of COMPTUEX/JTFEX, IACs, and ULT- 48 hours Includes 3 nearshore underwater detonation events	Portions of COMPTUEX/JTFEX, IACs, and ULT- 48 hours Includes 3 nearshore underwater detonation events	Portions of COMPTUEX/JTFEX, IACs, and ULT- 48 hours Includes 3 nearshore underwater detonation events
Marine Mammal Observers	Opportunistic as staff and SOP developed	IAC or ULT - 40 hours	IAC or ULT - 40 hours	IAC or ULT - 40 hours	IAC or ULT - 40 hours	IAC or ULT - 40 hours
Vessel surveys (study 3 and 4 only)	Award monitoring contract, develop SOP	Portions of COMPTUEX/JTFEX, IACs, and ULT- 60 hours Includes 3 nearshore underwater detonation events	Portions of COMPTUEX/JTFEX, IACs, and ULT- 60 hours Includes 3 nearshore underwater detonation events	Portions of COMPTUEX/JTFEX, IACs, and ULT- 60 hours Includes 3 nearshore underwater detonation events	Portions of COMPTUEX/JTFEX, IACs, and ULT- 60 hours Includes 3 nearshore underwater detonation events	Portions of COMPTUEX/JTFEX, IACs, and ULT- 60 hours Includes 3 nearshore underwater detonation events
Shore based surveys (study 4 only)		Nearshore underwater detonation events near appropriate coastal topography	Nearshore underwater detonation events near appropriate coastal topography	Nearshore underwater detonation events near appropriate coastal topography	Nearshore underwater detonation events near appropriate coastal topography	Nearshore underwater detonation events near appropriate coastal topography
STUDY 2 (geographic redistribution)						
	FY08	**FY09**	**FY10**	**FY11**	**FY12**	**FY13**
Aerial surveys before and after training events	Portions of COMPTUEX and/or JTFEX, IACs, or ULT- 50 hours	Portions of COMPTUEX and/or JTFEX, IACs, or ULT- 50 hours	Portions of COMPTUEX and/or JTFEX, IACs, or ULT- 50 hours	Portions of COMPTUEX and/or JTFEX, IACs, or ULT- 50 hours	Portions of COMPTUEX and/or JTFEX, IACs, or ULT- 50 hours	Portions of COMPTUEX and/or JTFEX, IACs, or ULT- 50 hours
Passive Acoustics	Award monitoring contract	Order devices and determine best location; integrate SOAR M3R classification data (beaked whales	Installation of up to 5 autonomous devices in the SOCAL study area and begin recording; integrate SOAR M3R classification data (beaked whales	Continue recording from devices Begin data analysis; integrate SOAR M3R classification data (beaked whales	Continue recording from devices and data analysis, integrate SOAR M3R classification data (beaked whales	Data Analysis and continue recording from devices and data analysis, integrate SOAR M3R classification data (beaked whales
STUDY 5 (mitigation effectiveness)						
	FY08	**FY09**	**FY10**	**FY11**	**FY12**	**FY13**
Marine mammal observers/lookout comparison	Opportunistic as staff and SOP developed	IAC or ULT- 40 hours	IAC or ULT- 40 hours	IAC or ULT- 40 hours	IAC or ULT- 40 hours	SEASWITI or ULT- 40 hours
Aerial surveys before and after training events	Portions of COMPTUEX and/or JTFEX - 50 hours	Portions of COMPTUEX and/or JTFEX - 50 hours	Portions of COMPTUEX and/or JTFEX - 50 hours	Portions of COMPTUEX and/or JTFEX - 50 hours	Portions of COMPTUEX and/or JTFEX - 50 hours	Portions of COMPTUEX and/or JTFEX - 50 hours

Table 1 of Subpart X. Summary of monitoring effort proposed in draft Monitoring Plan for SOCAL

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