DEPARTMENT OF COMMERCE

National Oceanic and Atmospheric Administration

50 CFR Part 216

[Docket No. 080519680–8684–01]

RIN 0648–AW86

Taking and Importing Marine Mammals; U.S. Navy Training in the Hawaii 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 within the Hawaii Range Complex (HRC) for the period of December 2008 through December 2013. 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 July 23, 2008.

ADDRESSES: You may submit comments, identified by 0648-AW86, 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.

Comments regarding the burden-hour estimates or other aspects of the collection-of-information requirements contained in this proposed rule should be submitted in writing to Michael Payne at the address above and to David Rostker, OMB, by e-mail at *David_Rostker@omb.eop.gov* or by fax to 202–395–7285.

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 Final Environmental Impact Statement (FEIS) for the Hawaii Range Complex was published on May 9, 2008, and may be viewed at *http://www.govsupport.us/hrc*. NMFS participated in the development of the Navy's FEIS as a cooperating agency under NEPA. Last, NMFS is preparing a Draft Environmental Assessment (EA) that analyzes the environmental effects of several different mitigation alternatives for the potential issuance of the proposed rule. The Draft EA will be posted on the following Web site as soon as it is complete: *http://www.nmfs.noaa.gov/pr/permits/incidental.htm*.

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) (Public Law 108–136) removed 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

(ii) Any act that disturbs or is likely to disturb a marine mammal or marine mammal stock in the wild by causing disruption of natural behavioral patterns, including, but not limited to, migration, surfacing, nursing, breeding, feeding, or sheltering, to a point where such behavioral patterns are abandoned or significantly altered [Level B Harassment].

Summary of Request

On June 25, 2007, NMFS received an application from the Navy requesting authorization for the take of 24 species of marine mammals incidental to upcoming Navy training activities to be conducted within the HRC, which covers 235,000 nm^2 around the Main Hawaiian Islands (see map on page 17 of the application), over the course of 5 years. These training activities are classified as military readiness activities. The Navy states that these training activities may incidentally take marine mammals present within the HRC by exposing them to sound from mid-frequency or high frequency active sonar (MFAS/HFAS) or to underwater detonations at levels that NMFS associates with the take of marine mammals. The Navy requests authorization to take individuals of 24 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 individuals each of 10 species over the course of the 5-year period (bottlenose dolphin, *Kogia spp.*, melon-headed whale, pantropical spotted dolphin, pygmy killer whale, short-finned pilot whale, striped dolphin, and Cuvier's, Longman's, and Blainville's beaked whale).

Background of Navy 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.) section 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, test, and evaluation (RDT&E) of naval weapons systems.

The HRC, where the Navy has, for more than 40 years, routinely conducted training and major exercises in the waters around the Hawaiian Islands, is a critical part of the Navy's mission, especially as it relates to training, for several reasons. Centrally located in the Pacific Ocean between the west coast of the United States and the naval stations in the western Pacific, and surrounding the most isolated islands in the world, the HRC has the infrastructure (i.e., extensive existing range assets and training capabilities) to support a large number of forces in a location both remote and under U.S. control. The range surrounds the major homeport of Naval Station Pearl Harbor, enabling re-supply and repairs to submarines and surface ships alike. The isolation of the range offers an invaluable facility on which to conduct missile testing and training. Able to link with the U.S. Army's Pohakuloa Training Area, as well as U.S. Air Force and U.S. Marine Corps bases where aircraft basing and amphibious training may occur, the HRC provides a superior joint training environment for all the U.S. armed services and advanced missile testing capability. Among the important assets of the HRC is the Pacific Missile Range Facility (PMRF), which is the world's largest instrumented, multi-environment, military test range capable of supporting subsurface, surface, air, and space training, and RDT&E. It consists of instrumented underwater ranges, controlled airspace, and a temporary operating area covering 2.1 million square nautical miles (nm^2) of ocean area. The Navy must have the flexibility and capacity to quickly surge required combat power in the event of a national crisis or contingency operation. Because of its location, training for sustained deployment at the HRC, rather than at ranges on the west coast, saves 10 transit days to the western Pacific from the west coast of the United States.

The HRC complex consists of targets and instrumented areas, airspace, surface OPAREAS, and land range facilities. The Navy's proposed action includes conducting current and emerging training in the HRC. Although the Navy plans to conduct many different types of RDT&E on the land, in the air, and in the water, as well as implement infrastructure improvements (addressed comprehensively in the Navy's FEIS), this document specifically analyzes those activities in the HRC for which the Navy seeks MMPA incidental take authorization, i.e., those training activities that the Navy predicts would result in the generation of levels of sound in the water that NMFS has indicated are likely to result in the take of marine mammals (not counting SURTASS LFA sonar, for which the Navy has already obtained an MMPA authorization), either through the use of sonar (mid-frequency active sonar (MFAS) or high frequency active sonar (HFAS)) or from the use of live ordnance, including the detonation of explosives in the water. Table 1–1 in the Navy's application presents a summary of the training and RDT&E activities that will occur in the HRC and indicates the exercise types that the Navy's modeling indicated would likely result in the take of marine mammals.

Description of the Specified Activities

As mentioned above, the Navy has requested MMPA authorization to take marine mammals incidental to training activities in the HRC that would result in the generation of sound 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.

Activities Utilizing Active Tactical Sonar Sources

For this operating area (HRC), 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 the active acoustic devices used in ASW exercises, as well as the exercise types in which these acoustic sources are used.

Acoustic Sources Used for ASW Exercises in the HRC

Tactical military sonars are designed to search for, detect, localize, classify, and track submarines. There are two types of sonars, passive and active:

- Passive sonars only listen to incoming sounds and, since they do not emit sound energy in the water, lack the potential to acoustically affect the environment.
- Active sonars generate and emit acoustic energy specifically for the purpose of obtaining information concerning a distant object from the received and processed reflected sound energy.

Modern sonar technology includes 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 sonars transmit multiple preformed beams, listening to echoes from several directions simultaneously and providing efficient detection of both direction and range.

The tactical military sonars to be deployed during testing and training in the HRC are designed to detect submarines in tactical training scenarios. This task requires the use of the sonar mid-frequency range (1 kilohertz [kHz] to 10 kHz) predominantly, as well as one source in the high frequency range (above 10 kHz) that operates at a level high enough to be considered in the modeling. The high frequency source will contribute a comparatively very small amount to the total amount of active sonar that marine mammals will be exposed to during the Navy's proposed activities, however, for this document we will refer to the collective high and mid-frequency sonar sources as MFAS/HFAS. A narrative description of the types of acoustic sources used in ASW training exercises is included below. Table 1 (below) summarizes the nominal characteristics of the acoustic sources used in the modeling to predict take of marine mammals.

Sonar Type	Description of Sonar	Source Depth (m)	Center Freq (kHz)	Source Level (dB)	Spacing (m)*	Vertical Directivitiy	Horizontal Directivity	Units per Hour
MK-48	Torpedo	27	> 10	classified	144	Omni	Omni	one torpedo run
AN/SQS-53	Surface Ship	7	3.5	235	154	Omni	240° Forward	120 pings
AN/SQS-56	Surface Ship	7	7.5	225	154	Omni	30° Forward	120 pings
AN/SSQ-62	Sonobuoy	27	8	201	450	Omni	Omni	8 sonobuoys
AN/AQS-22	Helo Dipping	27	4.1	217	15	Omni	Omni	2 dips
AN/BQQ-10	Submarine	91	classified	classified	n/a	Omni	Omni	2 pings

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

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. Within Navy ASW exercises in the HRC, two types of hull-mounted sonar sources account for the majority of the estimated impacts to marine mammals. The AN/SQS–53 hull-mounted sonar, which has a nominal source level of 235 decibels (dB) re 1 μPa and transmits at center frequencies of 2.6 kHz and 3.3 kHz, is the Navy's most powerful sonar source used in ASW exercises in the HRC. The AN/SQS–56 hull-mounted sonar has a nominal source level of 225 dB re 1 μPa and transmits at a center frequency of 7.5 kHz. Sonar ping transmission durations were modeled as lasting 1 second per ping and omni-directional, which is a conservative assumption that may overestimate potential effects. Actual ping durations will be less than 1 second. 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. The AN/SQS–53 and the AN/SQS–56 were modeled using the number of hours of predicted use (typically at two pings per minute; meaning an hour of sonar operation results in approximately 120 one-second pings). Based on modeling results, the Navy anticipates that the operation of these two sources will likely result in take of marine mammals (see Estimated Take of Marine Mammals Section).

Hull-mounted 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. All Kingfisher use in the HRC (approximately 27 hours/year) was modeled as AN/SQS–53, though the less powerful AN/SQS–56 likely accounts for part of the total Kingfisher use as well.

Submarine Sonars—Submarine sonars (AN/BQQ–10, AN/BQQ–5, or AN/BSY–1) are used to detect and target enemy submarines and surface ships. Because they are trying to avoid being detected, a submarine's use of MFAS is generally rare, very brief, using minimal power, and may be narrowly focused. Modeling for the AN/BQQ–10 (all three submarine types were modeled as AN/BQQ–10, the most powerful submarine sonar source) assumes sonar use of two pings an hour (which is higher than typical), for one second each, at 235 dB re 1 μPa, and using an omni-directional transmission. The AN/BQQ–10 was modeled using the number of hours of predicted use (at two pings per hour). Based on modeling results, the Navy anticipates that the operation of this source may result in some take of marine mammals (see Estimated Take of Marine Mammals Section).

Aircraft Sonar Systems—Aircraft sonar systems that would operate in the HRC include sonobuoys (SSQ–62) and dipping sonar (AN/AQS–22). A sonobuoy is an expendable device, which may be deployed by maritime patrol aircraft or helicopters, used for the detection of underwater acoustic energy and for conducting vertical water column temperature measurements. Most sonobuoys are passive, but some, like the SSQ–62, can also generate active acoustic signals. The SSQ–62 has a nominal source level of 201 dB re 1 μPa and transmits at a center frequency of 8 kHz. Dipping sonar is an active or passive sonar device lowered on cable 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. The AN/AQS–22 has a nominal source level of 217 dB re 1 μPa and transmits at a center frequency of 4.1 kHz. Based on modeling results, the Navy anticipates that the operation of these two sources may result in some take of marine mammals (see Estimated Take of Marine Mammals Section).

Torpedoes—Torpedoes are the primary ASW weapon used by surface ships, aircraft, and submarines. The guidance systems of these weapons can be autonomous (acoustically based) or electronically controlled from the launching platform through an attached wire. They operate either passively, exploiting the emitted sound energy by the target, or actively, ensonifying the target and using the received echoes for guidance. We know that the MK–48 operates in the high frequency range (>10 kHZ), however, the nominal source level and the center frequency are classified. Based on modeling results, the Navy anticipates that the operation of this source may result in some take of marine mammals (see Estimated Take of Marine Mammals Section). In addition to the HFA sonar source used to guide the torpedo, the MK–48 is discussed in the ''Activities Utilizing Underwater Detonations'' Section.

Other Acoustic Sources—The Navy uses other acoustic sources 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)—submarine simulators that make sound to act as decoys to avert localization and/or torpedo attacks.

• Training Targets—ASW training targets consisting of MK–30 and/or MK–39 Expendable Mobile ASW Training

Target (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 pingers are active acoustic devices that allow inwater platforms on the range (e.g., submarines, target simulators, and exercise torpedoes) to be tracked by hydrophones on the seafloor such as those at the underwater instrumented range at PMRF. The range hydrophones are also tied in with transducer nodes that are capable of transmitting acoustic signals for a limited set of functions, including 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 HRC

ASW training conducted within the HRC involves the use of surface ships, submarines, aircraft, non-explosive and explosive exercise weapons, and other training-related devices. ASW training involves the use of active and passive acoustic devices with training activities occurring in both offshore (<12 nm (22 km) from shore) and open ocean (>12 nm (22 km) from shore) areas. A description of the different exercise types is provided below. Table 2 lists the types of ASW exercises and indicates the areas they are conducted in, the average duration of an exercise, the average number of exercises/per year, and the time of year they are conducted. Table 3, at the end of this section, indicates the total number of hours for each source type anticipated for each year for each exercise type.

Training Operation	Location Where Exercise May Be Conducted	Time of Year Conducted	Number of Training Events per/year	Average Length of Exercise (hrs)
Other ASW (TRACKEX/TORPEX)	Hawaii OpArea	Any time	32	13.5
RIMPAC	Hawaii OpArea	Summer Only	1 every other year	1 month (44 individual ASW ops from 2-24 hours long)
USWEX	Hawaii OpArea	Any time	5	3-4 days, including several 16-hr ASW ops
Multi Strike Group	Hawaii OpArea	Any time	0*	5 to 10 days including multiple 12-hr ASW ops

Table 2. Summary of locations, durations, and times of year of ASW exercises.
* If a Multiple Strike Group Exercise were planned for any given year, either other exercises (of a different type) would be cancelled to ensure that authorized take of marine mammals was not exceeded, or the Navy would seek separate MMPA authorization.

Anti-Submarine Warfare Tracking Exercise (ASW TRACKEX)—An ASW TRACKEX trains aircraft, ship, and submarine crews in tactics, techniques, and procedures for search, detection, and tracking of submarines. No torpedoes are fired during a TRACKEX. ASW TRACKEX includes ships, fixed wing aircraft, helicopters, torpedo targets, submarines, and weapons recovery boats and/or helicopters. As a unit-level exercise, an aircraft, ship, or submarine is typically used versus one target submarine or simulated target. TRACKEXs can include the use of hull-mounted sonar, submarines, or sonobuoys. No explosive ordnance is used in TRACKEX exercises.

The target may be non-evading while operating on a specified track or it may be fully evasive, depending on the state of training of the ASW unit. Duration of a TRACKEX is highly dependent on the tracking platform and its available on-station time. A maritime patrol aircraft can remain on station for eight hours, and typically conducts tracking exercises that last three to six hours. An ASW helicopter has a much shorter on-station time, and conducts a typical TRACKEX in one to two hours. Surface ships and submarines, which measure their on-station time in days, conduct tracking exercises exceeding eight hours and averaging up to 18 hours. For modeling purposes, TRACKEX and TORPEX (explained in next section) sonar hours are averaged, resulting in a sonar time of 13.5 hours.

ASW TRACKEX events are conducted on ranges within PMRF Warning Area W–188, the Hawaii Offshore Areas and/or the open ocean. Whenever aircraft use the ranges for ASW training, range clearance procedures include a detailed visual range search for marine mammals and unauthorized boats and planes by the aircraft releasing the inert torpedoes, range safety boats/aircraft, and range controllers. TRACKEXs can include the use of hull-mounted sonar, submarines, or sonobuoys, which can result in the take of marine mammals.

Anti-Submarine Warfare Torpedo Exercises (ASW TORPEX)—Anti-Submarine Warfare Torpedo Exercises (ASW TORPEX) train crews in tracking and attack of submerged targets, firing one or more Recoverable Exercise Torpedoes. TORPEX targets used in the Offshore Areas include submarines, MK–30 ASW training targets, and MK–39 Expendable Mobile ASW Training Targets. The target may be non-evading while operating on a specified track, or it may be fully evasive, depending on the training requirements. Submarines periodically conduct torpedo firing training exercises within the Hawaii Offshore OPAREA. Typical duration of a submarine TORPEX event is 22.7 hours, while air and surface ASW platform TORPEX events are considerably shorter. For modeling purposes, TRACKEX and TORPEX sonar hours are averaged resulting in a sonar time of 13.5 hours. TORPEXs can include the use of hull-mounted sonar, submarines, sonobuoys, or MK–48 torpedoes (inert), which can result in the take of marine mammals.

Rim of the Pacific (RIMPAC)—RIMPAC is a multi-threat maritime exercise where submarines, surface ships, and aircraft from the U.S. and other countries conduct many different exercise events, including ASW against opposition submarine targets to improve coordination and interoperability of combined, bilateral and joint forces of participating nations. RIMPAC occurs during the summer over a 1-month period every other year (currently in even numbered years). Submarine targets include real submarines, targets that simulate the operations of an actual submarine including those described previously under TORPEX, and virtual submarines interjected into the training events by exercise controllers. ASW training events are complex and highly variable. For RIMPAC, the primary event involves a Surface Action Group (SAG), consisting of one to five surface ships equipped with sonar, with one or more helicopters, and a P–3 aircraft searching for one or more submarines. There will be approximately four to eight SAGs for a typical RIMPAC. For the purposes of analysis, each SAG event is counted as an ASW training activity. One or more ASW events may occur simultaneously within the HRC. There will be approximately 44 ASW training events during a typical RIMPAC, with an average event length of approximately 12 hours (ranging from 2–24 hours).

In addition to including potential training with of all of the acoustic sources mentioned previously, RIMPAC includes training events that involve underwater detonations (described in the next section: Activities Utilizing Underwater Detonations), including Sinking Exercise, Air-to-Surface Gunnery Exercise, Surface-to-Surface Gunnery Exercise, Naval Surface Fire Support, Air-to-Surface Missile Exercise, Surface-to-Surface Missile Exercise, Bombing Exercise, Mine Neutralization Exercise, and IEER/EER Exercise. Both the use of the acoustic sources as well as the underwater detonations could result in the take of marine mammals. These exercises involving underwater detonations do not overlap in space and time with sonar exercises. Explosives from RIMPAC have been included in the training events described in the next Section.

Undersea Warfare Exercise (USWEX)—Carrier Strike Groups (CSGs) and Expeditionary Strike Groups (ESGs) that deploy from the west coast of the United States will experience realistic submarine combat conditions and assess submarine warfare training capabilities postures in the HRC prior to their deployment to real world operations elsewhere. As a combined force, submarines, surface ships, and aircraft will conduct ASW against opposition submarine targets, which include real submarines, targets that simulate the operations of an actual submarine, and virtual submarines interjected into the training events by exercise controllers. USWEX training events are complex and highly variable. The primary event involves from one to five surface ships equipped with sonar, with one or more helicopters, and a P–3 aircraft searching for one or more submarines. A total of five exercises using MFAS/HFAS, lasting three to four days each, could occur throughout the year for USWEX.

In addition to the use of hull-mounted sonar (AN/SQS–53 and AN/SQS–56), submarine sonar, helicopter dipping sonar, and sonobuoys, USWEX includes training events that involve underwater detonations as described in the next section (Activities Utilizing Underwater Detonations), including Air-to-Surface Gunnery Exercise, Air-to-Surface Missile Exercise, and Bombing Exercise. Both the use of the acoustic sources as well as the underwater detonations could result in the take of marine mammals. These exercises utilizing underwater detonations do not overlap in space and time with sonar exercises. Explosives from USWEX have been included in the training events described in the next section.

Multiple Strike Group Exercise—A Multiple Strike Group Exercise consists of events that involve Navy assets engaging in a schedule of events battle scenario, with U.S. forces (blue forces) pitted against a notional opposition force (red force). Participants use and build upon previously gained training skill sets to maintain and improve the proficiency needed for a mission-capable, deployment-ready unit. The exercise would occur over a 5-day to 10-day period at any time during the year. As described above for USWEX, as a combined force, submarines, surface ships, and aircraft will conduct ASW against opposition submarine targets.

In addition to the use of hull-mounted sonar (AN/SQS–53 and AN/SQS–56), submarine sonar, helicopter dipping sonar, and sonobuoys , the Multiple Strike Group Exercise includes training events that involve underwater detonations as described in the next Section (Activities Utilizing Underwater Detonations), including Sinking Exercise, Air-to-Surface Missile Exercise, Mine Neutralization Exercise, and EER/IEER Exercise. Both the use of the acoustic sources as well as the underwater detonations could result in the take of marine mammals. These exercises utilizing underwater detonations do not overlap in space and time with sonar exercises. Explosives from the Multiple Strike Group Exercise have been included in the events described in the next Section.

	Hull-mounted AN/SQS-53 (hours)	Hull-mounted AN/SQS-56 (hours)	Dipping Sonar AN/AQS-22 (dips)	Sonobuoy AN/SSQ-62 (# buoys)	Torpedo MK-48 (runs)	Submarine AN/BQQ-10 (hours)
Other ASW (TRACKEX/TORPEX)	360 (~43200 pings)	75 (~9000 pings)	110	1278	309	200 (~400 pings)
RIMPAC	399	133	400	497	4	near zero*
USWEX	525	175	500	648	0	near zero*
Multi Strike Group	**	**	**	**	**	**
Total	**1284*** **	**383**	**1010**	**2423**	**313**	**200 (400 pings)**

Table 3. Total estimated use of sonar sources per year.

* Any submarine hours are few and would be included in the 200 hours under TORPEX/TRACKEX

** If a Multiple Strike Group Exercise were planned for any given year, either other exercises (of a different type) would be cancelled to ensure that the authorized take of marine mammals was not exceeded, or the Navy would seek separate MMPA authorization.

*** 27 of these hours are in kingfisher mode

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, 76mm 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 4. 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 5 at the end of this section.

Ordnance	Net Explosive Weight for Modeling	Detonation Depth for Modeling
5" Naval gunfire	9.54 lbs	1 ft
76 mm Rounds	1.6 lbs	1 ft
Maverick	78.5 lbs	2 m
Harpoon	448 lbs	2 m
MK-82	238 lbs	2 m
MK-83	574 lbs	2 m
MK-84	945 lbs	2 m
MK-48	851 lbs	50 ft
Demolition Charges	20 lbs	Bottom
EER/IEER	5 lbs	20m

Table 4. Ordnance utilized in HRC Explosive exercises

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 submarine and aircraft crews in delivering both live and inert ordnance on a real target. These target vessels are remediated to standards set by the Environmental Protection Agency. 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 four to eight hours over one to two days. SINKEXs typically occur only once or twice a year in the HRC.

Underwater detonation of several different explosive types could result in the take of marine mammals. 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; and one MK–48 heavyweight submarine-launched torpedo.

Surface-to-Surface Gunnery Exercise (S-S GUNEX)—Surface gunnery exercises (GUNEX) take place in the open ocean to provide gunnery practice for Navy and Coast Guard ship crews. GUNEX training events 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), 25-mm chain gun, 20-mm Close-in Weapon System (CIWS), and .50 caliber machine gun. Typical ordnance expenditure for a single GUNEX is a minimum of 21 rounds of 5-inch or 76-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 S-S GUNEX lasts approximately two to four hours, depending on target services and weather conditions. Detonation of the live 5-inch and 76-mm rounds could result in the take of marine mammals.

Naval Surface Fire Support Exercise—Navy surface combatants conduct fire support exercise (FIREX) training events at PMRF on a virtual range against ''Fake Island'', located on Barking Sands Tactical Underwater Range (BARSTUR). Fake Island is unique in that it is a virtual landmass simulated in three dimensions. Ships conducting FIREX training against targets on the island are given the coordinates and elevation of targets. PMRF is capable of tracking fired rounds to an accuracy of 30 feet (9.1 m). Detonation of the live 5-inch and 76-mm rounds fired into ocean during this exercise could result in the take of marine mammals.

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

A–S MISSILEX training can take place without the release of a live weapon 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, nor does it contain any explosives or propellant. The event 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. A–S MISSILEX assets include helicopters and/or one 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 decommissioned ship hulks. Detonation of live ordnance could result in the take of marine mammals.

Surface-to-Surface Missile Exercise (S–S MISSILEX)—Surface-to-surface missile exercise (S–S MISSILEX) 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. S–S MISSILEX training is routinely conducted on individual ships with embedded training devices. A S–S MISSILEX could include four 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. S–S MISSILEX activities are conducted within PMRF Warning area W–188. Each exercise typically lasts five hours, though future S–S MISSILEXs could range from four to 35 hours. Missile detonation could result in the take of marine mammals.

Bombing Exercise (BOMBEX)—Fixed-wing aircraft conduct BOMBEX events 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. At PMRF, a range boat might be used to deploy the target for an aircraft to attack. A BOMBEX may involve either live or inert ordnance. Underwater detonation of live ordnance could result in the take of marine mammals.

Mine Neutralization—Mine Neutralization events 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 subsurface assets. Tactics for neutralization of ground or bottom mines involve a 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. Inert dummy mines are used in the exercises. The total net explosive weight used against each mine ranges from less than one pound to 20 pounds (0.5 to 9.1 kg). Mine neutralization training takes place offshore in Puuloa Underwater Range, Lima Landing, Naval Inactive Ship Maintenance Facility, MCBH, MCTAB, Barters Point Range, Ewa Training Minefield; and in open-ocean areas. Detonation of live ordnance could result in the take of marine mammals.

All demolition activities are conducted in accordance with current Navy directives and approved standard operating procedures. Before any explosive is detonated, divers are transported a safe distance away from the explosive. Standard practices for tethered mines in Hawaiian waters require ground mine explosive charges to be suspended 10 feet (3.0 m) below the surface of the water.

EER/IEER AN/SSQ–110A—The Extended Echo Ranging and Improved Extended Echo Ranging (EER/IEER) Systems are air-launched 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 ''ping'' (small detonation) and the passive AN/SSQ–101 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 expendable and commandable sonobuoy pairs are dropped from a fixed-wing aircraft into the ocean in a predetermined pattern (array) with a few buoys covering a very large area. 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. Detonation of the buoys could result in the take of marine mammals.

Air-to-Surface Gunnery Exercise (A–S GUNEX)—Air-to-Surface GUNEX events are conducted by rotary-wing aircraft against stationary targets (Floating at-sea Target [FAST] and smoke buoy). Rotary-wing aircraft involved in this training activity 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 50-caliber or 7.62-mm ammunition. Due to the use of small, inert rounds, A–S GUNEXs are not expected to result in the take of marine mammals.

Training Operation	Explosive Sources	Locations Where Exercises May be Conducted	Time of Year Conducted	Number of Training Events per/year	Average Length of Exercise (hrs)	Number of Rounds per/year
Mine Neutralization	1 to 20-lb Demolition charge	Puuloa Underwater Range, Lima Landing, Naval Inactive Ship Maintenance Facility, MCBH, MCTAB, Barbers Point Range, Ewa Training Minefield	Any time	62	6	62
A-S MISSILEX	Penguin Maverick	Pacific Missile Range Facility (W-188)	Any time	36	5.5	36
S-S MISSILEX	Harpoon	Pacific Missile Range Facility (W-188)	Any time	7	5	7
BOMBEX	Mk82, Mk83, Mk84, Mk48	Hawaii OpArea	Any time	35	6	35
SINKEX	Multiple sources as described in narrative	Hawaii OpArea	Any time	6	14.5	3
S-S GUNNEX	5 inch round, 76-mm round	Warning Areas W-191, 192, 193, 194, 196, and Mela South	Any time	69	2 to 4	355
Naval Surface Fire Support	5 inch round, 76-mm round	Warning Area W-188	Any time	22	8.1	97
IEER	SSQ-110A Sonobuoy	Hawaii OpArea	Summer only	4	4 to 8	960

Table 5. Summary of the location, duration, time of year, and nature of the exercises involving underwater detonations

Additional information on the Navy's proposed activities may be found in the LOA Application and the FEIS (Section 2 and Appendices D, E, and J).

Description of Marine Mammals in the Area of the Specified Activities

There are 27 marine mammal species with possible or confirmed occurrence in the HRC. As indicated in Table 6, there are 25 cetacean species (7 mysticetes and 18 odontocetes) and two pinnipeds. Table 6 also includes the estimated abundance, estimated group size, and estimated probability of detection (based on Barlow 2006) of the species that occur in the HRC. Seven marine mammal species listed as federally endangered under the Endangered Species Act (ESA) occur in the HRC: the humpback whale, North Pacific right whale, sei whale, fin whale, blue whale, sperm whale, and Hawaiian monk seal. The most abundant marine mammals appear to be dwarf sperm whales, striped dolphins, and Fraser's dolphins. The most abundant large whales are sperm whales.

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Common Name	Scientific Name	Status	Occurs	Group Size*	Detection Probability[3]		Estimated Abundance in Hawaii
					Group 1-20	Group >20	
MYSTICETES (baleen whales)							
Family Balaenidae (right whales)							
North Pacific right whale	*Eubalaena japonica*	E	Rare				unknown
Family Balaenopteridae (rorquals)							
Humpback whale	*Megaptera novaeangliae*	E	Regular	1.7			4,491
Minke whale	*Balaenoptera acutorostrata*		Regular				unknown
Sei whale	*Balaenoptera borealis*	E	Rare	3.4	0.9	0.9	236
Fin whale	*Balaenoptera physalus*	E	Rare	2.6	0.9	0.9	236
Blue whale	*Balaenoptera musculus*	E	Rare				unknown
Bryde's whale	*Balaenoptera edeni/brydei*		Regular	1.5	0.9	0.9	469
ODONTOCETES (toothed whales)							
Family Physeteridae (sperm whale)							
Sperm whale	*Physeter macrocephalus*	E	Regular	7.3	0.87	0.87	6,919
Family Kogiidae (pygmy sperm whales)							
Pygmy sperm whale	*Kogia breviceps*		Regular	1	0.35	0.35	7,138
Dwarf sperm whale	*Kogia sima*		Regular	2.3	0.35	0.35	17,519
Family Ziphiidae (beaked whales)							
Cuvier's beaked whale	*Ziphius cavirostris*		Regular	2	0.23	0.23	15,242
Blainville's beaked whale	*Mesoplodon densirostris*		Regular	2.3	0.45	0.45	2,872
Longman's beaked whale	*Indopacetus pacificus*		Regular	17.8	0.76	1	1,007
Family Delphinidae (dolphins)							
Rough-toothed dolphin	*Steno bredanensis*		Regular	14.8	0.76	1	8,709
Bottlenose dolphin	*Tursiops truncatus*		Regular	9	0.76	1	3,215
Pantropical spotted dolphin	*Stenella attenuata*		Regular	60	0.76	1	8,978
Spinner dolphin	*Stenella longirostris*		Regular	31.7	0.76	1	3,351
Striped dolphin	*Stenella coeruleoalba*		Regular	37.3	0.76	1	13,143
Risso's dolphin	*Grampus griseus*		Regular	15.4	0.76	1	2,372
Melon-headed whale	*Peponocephala electra*		Regular	89.2	0.76	1	2,950
Fraser's dolphin	*Lagenodelphis hosei*		Rare	286.3	0.76	1	10,226
Pygmy killer whale	*Feresa attenuata*		Regular	14.4	0.76	1	956
False killer whale	*Pseudorca crassidens*		Regular	10.3	0.76	1	236
Killer whale	*Orcinus orca*		Regular	6.5	0.9	0.9	349
Short-finned pilot whale	*Globicephala macrorhynchus*		Regular	22.5	0.76	1	8,870
Total Number of Delphinids in Hawaiian Waters (from Barlow 2006)							63,354
Total Number of Beaked Whales in Hawaiian Waters (from Barlow 2006)							19,492
PINNIPEDS (seals, sea lions, walruses)							
Family Phocidae (true seals)							
Hawaiian monk seal	*Monachus schauinslandi*	E	Regular				1252****
Northern elephant seal	*Mirounga angustirostris*		Rare				

Table 6. Species of marine mammals known to occur in the HRC (E means endangered under the ESA).

Source: U.S. Department of the Navy, 2005a; Barlow, 2003; Mobley, 2004; Barlow, 2006; Carretta et al., 2006

*Mean group sizes are the geometric mean of best estimates from multiple observers and have not been corrected for bias.

**Estimated from Barlow 2006

***For analysis purposes (and in the absence of specific data), abundance and density for fin and sei whales were estimated to be the same as for false killer whales, which have similarly small numbers in the area.

****Estimated abundance in the Main Hawaiian Islands is 77 animals

The Navy has compiled information on the abundance, behavior, status and distribution, and vocalizations of marine mammal species in the Hawaiian waters from peer reviewed literature, the Navy Marine Resource Assessment, 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 FEIS for the HRC (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.*

Based on their rare occurrence in the HRC, the Navy and NMFS do not anticipate any effects to Blue whales, North Pacific right whales, or Northern elephant seals and, therefore, they are not addressed further in this document.

Important Reproductive Areas

Because the consideration of areas where marine mammals are known to selectively breed or calve are important to both the negligible impact finding necessary for the issuance of an MMPA authorization and the need for NMFS to put forth the means of effecting the least practicable adverse impact paying particular attention to rookeries, mating grounds, and other areas of similar significance, we are emphasizing important reproductive areas within this section. Little is known about the breeding and calving behaviors of many of the marine mammals that occur in the HRC. Some delphinid species have calving peaks once or twice a year, but give birth throughout their ranges. The mysticete species that may occur in the HRC are generally thought to migrate from higher to lower latitudes to breed and calve in the winter. With one notable exception, no breeding or calving areas have been identified in the HRC for the species that occur there. However, the main Hawaiian Islands constitute one of the world's most important habitats for the endangered humpback whale. Nearly two-thirds of the entire North Pacific population of humpback whales migrates to Hawaii each winter to engage in breeding, calving and nursing activities important for the survival of their species. The available sighting information and the known preferred breeding habitat (shallow water) indicates that humpback whale densities are much higher (up to almost four whales/square mile) in certain areas and that humpback mothers and calves are concentrated within the 200-m isobath. The Hawaiian Humpback Whale National Marine Sanctuary worked with Dr. Joe Mobley to compile a figure that generally illustrates humpback whale survey data collected between 1993 and 2003 and indicates areas of high and low density (Mobley 2004, Figure 1).

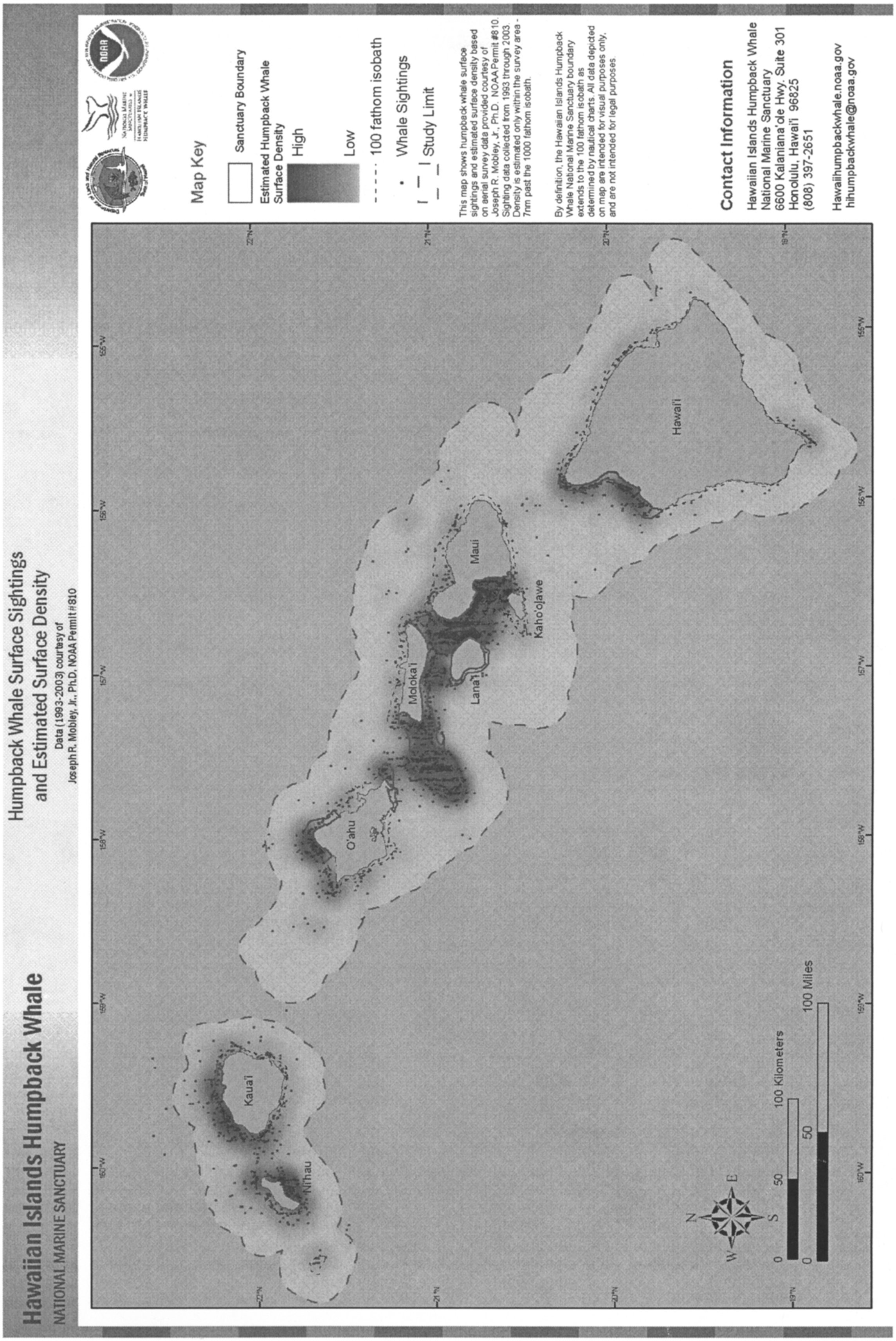

Figure 1. General illustration of areas of high humpback whale density based on survey data collected between 1993 and 2003 (Mobley 2004)

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A 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 sonar 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 sound level, or a 10 dB decrease in noise as a halving of sound level. 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: 1 μPa) 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 and ultrasonic 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''; airguns are an example of a broadband sound source and 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, anatomical modeling, and other data, Southall *et al.* (2007) designate ''functional hearing groups'' 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. More specific data is available for certain species (Table 17). The functional groups and the associated frequencies are indicated below:

- 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.
- Pinnipeds in Air: Functional hearing is estimated to occur between approximately 75 Hz and 30 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. As a result, it is important not to confuse source levels and received levels when discussing the loudness of sound in the ocean.

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 sonar operations, crews will measure oceanic conditions, such as sea water temperature and depth, to calibrate models that determine the path the sonar signal will take as it travels through the ocean and how strong the sound signal will be at a given range along a particular transmission path). As sound travels through the ocean, the intensity associated with the wavefront diminishes, or attenuates. This decrease in intensity is referred to as propagation loss, also commonly called transmission loss.

Metrics Used in This Document

This section includes a brief explanation of the two sound measurements (sound pressure level (SPL) and sound exposure level (SEL)) frequently used 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 $\mu Pa^2 s$.

SEL = SPL + 10log(duration in seconds)

As applied to tactical sonar, the SEL includes both the SPL of a sonar ping and the total duration. Longer duration pings and/or pings with higher SPLs will have a higher SEL. If an animal is exposed to multiple pings, the SEL in each individual ping is summed to calculate the 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 HRC utilizing MFAS/HFAS or underwater explosives. The Navy has analyzed other Navy activities in the HRC, both ongoing and proposed, and in consultation with NMFS as a cooperating agency for the HRC EIS, has determined that take of marine mammals incidental to other Navy activities is unlikely and, therefore, has not requested authorization for take of marine mammals that might occur incidental to any other activities. Therefore, NMFS will analyze the potential effects on marine mammals from MFAS/HFAS and underwater detonations, but not from other activities.

For the purposes of MMPA authorizations, NMFS's effects assessments have 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 HRC, so this determination is inapplicable for the HRC).

More specifically, for activities involving active tactical sonar or underwater detonations, NMFS's 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 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 April 14, 2008, Biological Opinion of the U.S. Navy's proposal to conduct four training exercises in the Cherry Point, Virginia Capes, and Jacksonville, Range Complexes NMFS presented a conceptual model of the potential responses of endangered and threatened species upon being exposed to active sonar 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 this document for reference (Figure 2).

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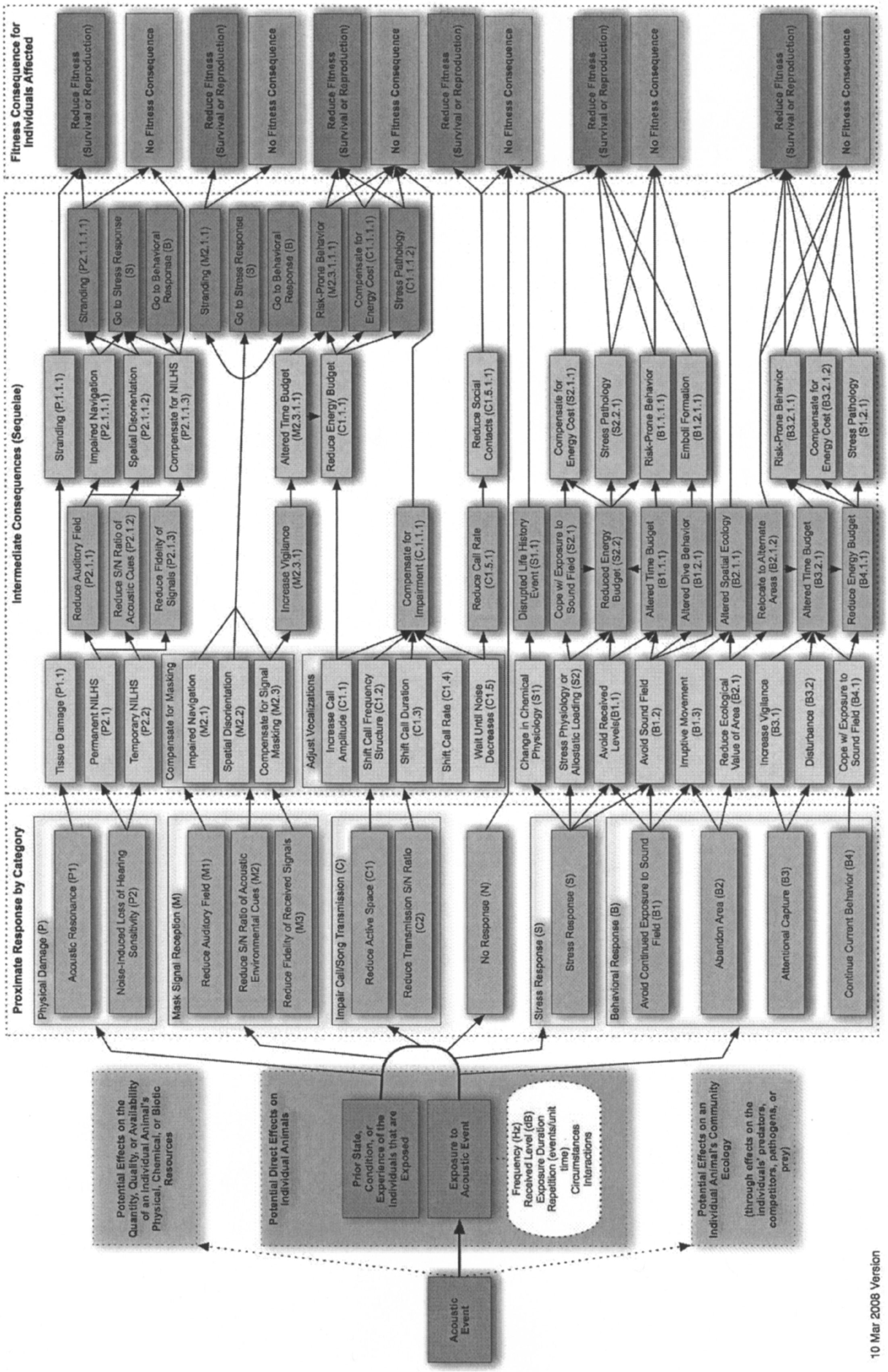

Figure 2. Conceptual model of the potential responses of endangered and threatened species upon being exposed to active sonar and the pathways by which those responses might affect the fitness of individual animals that have been exposed.

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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.

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. 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 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 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 is 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 interpreting environmental cues for purposes such as predator avoidance and prey capture. Depending on the degree (dB), duration, 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 long term 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 sonar pings would be long enough to drive bubble growth to any substantial size, if such a phenomenon occurs. Recent work conducted by Crum *et al.* (2005) demonstrated the possibility of rectified diffusion for short duration signals, but at sound exposure levels and tissue saturations levels that are improbable to occur in a diving marine mammal. 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 sonar exposures. Further investigation is needed to further assess the potential validity of these hypotheses. More information regarding hypotheses that attempt to explain how behavioral responses to 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 communication (Zaitseva *et al.,* 1980).

As mentioned previously, the functional hearing ranges of mysticetes, odontocetes, and pinnipeds all encompass the frequencies of the sonar sources used in the Navy's training exercises. Additionally, almost all species vocal repertoires span across the frequencies of the sonar sources used by the Navy. The closer the characteristics of the masking signal to the signal of interest, the more likely masking is to occur. However, due to the pulse length and duty cycle of the MFAS/HFAS signal, masking is unlikely to occur as a result of exposure to MFAS/HFAS during the training exercises in the HRC.

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 are more important than detecting a vocalization (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 vocal adjustments to their vocalizations to increase the signal-to-noise ratio, active space, and recognizability of their vocalizations in the face of temporary changes in background noise (Brumm *et al.*, 2004; Patricelli *et al.*, 2006). Vocalizing animals will 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 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 hypothalmus-pituitary-adrenal system (also known as the HPA axis in mammals or the hypothalamus-pituitary-interrenal axis in fish and some reptiles). Unlike stress responses associated with the autonomic nervous system, virtually all neuro-endocrine functions that are affected by stress—including immune competence, reproduction, metabolism, and behavior—are regulated by pituitary hormones. Stress-induced changes in the secretion of pituitary hormones have been implicated in failed reproduction (Moberg, 1987; Rivier, 1995) 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 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 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 cetaceans 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 cetaceans remains limited, it seems reasonable to assume that reducing an animal's ability to gather information about its environment and to communicate with other members of its species would be stressful for animals that use hearing as their primary sensory mechanism. Therefore, we assume that acoustic exposures sufficient to trigger onset PTS or TTS would be accompanied by physiological stress responses because terrestrial animals exhibit those responses under similar conditions (NRC, 2003). More importantly, marine mammals might experience stress responses at received levels lower than those necessary to trigger onset TTS. Based on empirical studies of the time required to recover from stress responses (Moberg, 2000), we also assume that stress responses are likely to persist beyond the time interval required for animals to recover from TTS and might result in pathological and pre-pathological states that would be as significant as behavioral responses to TTS.

Behavioral Disturbance

Behavioral responses to sound are highly variable and context-specific. 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).

Many different variables can influence an animals perception of and response to (nature and magnitude) an acoustic event. An animals prior experience with a sound type 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.

There are few empirical studies of avoidance responses of free-living cetaceans to mid-frequency sonars. Much more information is available on the avoidance responses of free-living cetaceans to other acoustic sources, like seismic airguns and low frequency sonar, than mid-frequency active sonar. Richardson *et al.*, (1995) noted that avoidance reactions are the most obvious manifestations of disturbance in marine mammals.

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 man-made sound with the goal of proposing exposure criteria for certain effects. This compilation of literature is very valuable, though Southall *et al.* note that not all data is 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.

In the Southall *et al.,* (2007) report, for the purposes of analyzing responses of marine mammals to anthropogenic sound and developing critieria, the authors differentiate between single pulse sounds, multiple pulse sounds, and non-pulse sounds. MFAS/HFAS sonar is considered a non-pulse sound. Southall *et al.,* (2007) summarize the reports associated with low and mid-frequency cetacean and pinniped responses to non-pulse sounds (there are no high frequency cetaceans in Hawaii) in Appendix C of their report (incorporated by reference and summarized in the three paragraphs below).

The reports 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, low frequency active sonar playback, drill ships, Acoustic Thermometry of Ocean Climate (ATOC) source, and non-pulse playbacks. These reports generally indicate no (or very limited) responses to received levels in the 90 to 120 dB re: 1 Pa range and an increasing likelihood of avoidance and other behavioral effects in the 120 to 160 dB range. As mentioned earlier, though, contextual variables play a very important role in the reported responses and the severity of effects are not linear when compared to received level. Also, though, few of the laboratory or field datasets had common conditions, behavioral contexts or sound sources, so it is not surprising that responses differ.

The reports 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.* were unable to come to a clear conclusion regarding these reports. 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 responded at lower levels in the field).

The reports 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 and 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 of 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 7 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.

	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		L	L/P	L/M	L/M	L	L		M	M		
5					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/P	L/P	L/M	L/M/P	L/M/P	L	M				M	M

Table 7. Data compiled from three tables from Southall et al. (2007) indicating when marine mammals (low-frequency cetaceans = L, mid-frequency cetaceans = M, 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 (see Figure 2). 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 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 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. 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 × 103kJ/min), and spent energy fleeing or acting aggressively toward hikers (White *et al.* 1999).

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 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 stranding 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 the 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 sonar (Hildebrand, 2004; IWC, 2005; Taylor *et al.*, 2004). For example, based on a review of stranding records between 1960 and 1995, the International Whaling Commission (2005) identified ten mass stranding events of Cuvier's beaked whales had been reported and one mass stranding of four Baird's beaked 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 associated with the use of mid-frequency sonar, one of those seven had been associated with the use of low-frequency sonar, and the remaining stranding event had been associated with the use of seismic airguns.

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

Between 1960 and 2006, 48 strandings (68 percent) involved beaked whales, 3 (4 percent) involved dolphins, and 14 (20 percent) involved other 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 sonar use that are believed to most likely have been caused by exposure to the sonar: Greece (1996); the Bahamas (2000); Madeira (2000); Canary Islands (2002); and Spain (2006). In 2004, during the RIMPAC exercises, between 150–200 usually pelagic melon-headed whales occupied the shallow waters of the Hanalei Bay, Kaua'i, Hawaii for over 28 hours. NMFS determined that the mid-frequency sonar was a plausible, if not likely, contributing factor in what may have been a confluence of events that led to the Hanalei Bay stranding. A number of other stranding events coincident with the operation of mid-frequency sonar and resulting in 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 sonar tests with signals of 600 Hz and 3 kHz and rms SPL of 228 and 226 dB re: 1 μPa, 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 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 was compiled, and many potential causes were examined including major pollution events, important 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 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 not consistent 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 (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 sonar training activities and beaked whale strandings (Cox *et al.*, 2006).

Bahamas (2000)

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

Necropsies were performed on five 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 mid-frequency sonar 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 mid-frequency sonars aboard U.S. Navy ships that were in use during the sonar exercise in question were the most plausible source of this acoustic or impulse trauma. 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 sonars. The investigation team concluded that the cause of this stranding event was the confluence of the Navy mid-frequency sonar and these contributory factors working together, and further recommended that the Navy avoid operating mid-frequency sonar 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 presence of surface ducts, steep bathymetry, and/or constricted channels added to the operation of mid-frequency sonar in the presence of cetaceans (especially beaked whales and, potentially, deep divers) may increase the likelihood of producing a sound field with the potential to cause cetaceans to strand, and therefore, suggests the need for increased vigilance while operating MFAS/HFAS.

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 and 80 warships took place in Portugal during May 2–15, 2000.

The bodies of the three stranded whales were examined post mortem (Woods Hole Oceanographic Institution, 2005), though only one of the stranded whales was fresh enough (24 hours after stranding) to be necropsied (Cox *et al.*, 2006). Results from the necropsy revealed evidence of hemorrhage and congestion in the right lung and both kidneys (Cox *et al.*, 2006). There was also evidence of intercochlear and intracranial hemorrhage similar to that which was observed in the whales that stranded in the Bahamas event (Cox *et al.*, 2006). There were no signs of blunt trauma, and no major fractures (Woods Hole Oceanographic Institution, 2005). The cranial sinuses and airways were found to be quite 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 (1000 m) depth near a shoreline where there is a rapid change in bathymetry on the order of 547 to 3,281 fathoms (1000–6000 m) occurring across a relatively short horizontal distance (Freitas, 2004); multiple ships were operating around Madeira, though it is not known if MFA sonar 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 MFA 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 (1000 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 MFA sonar 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 MFA sonar use close in space and time to the beaked whale strandings, and the similarity between this stranding event and previous beaked whale mass strandings coincident with sonar use, suggests that a similar scenario and causative mechanism of stranding may be shared between the events. Beaked whales stranded in this event demonstrated brain and auditory system injuries, hemorrhages, and congestion in multiple organs, similar to the pathological findings of the Bahamas and Madeira stranding events. In addition, the necropsy results of the Canary Islands stranding event lead to the hypothesis that the presence of disseminated and widespread gas bubbles and fat emboli were indicative of nitrogen bubble formation, similar to what might be expected in decompression sickness (Jepson *et al.,* 2003; 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 May 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 (1000 m) depth near a shoreline where there is a rapid change in bathymetry on the order of 547 to 3,281 fathoms (1000–6000 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 MFA sonar 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).

Hanalei Bay (2004)

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

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

Environmental factors, abiotic and biotic, were analyzed for any anomalous occurrences that would have contributed to the animals entering and remaining in Hanalei Bay. The Bay's bathymetry is similar to many other sites within the Hawaiian Island chain and dissimilar to sites that have been associated with mass strandings in other parts of the United States. The weather conditions appeared to be normal for that time of year with no fronts or other significant features noted. There was no evidence of unusual distribution or occurrence of predator or prey species, or unusual harmful algal blooms. Weather patterns and bathymetry that have been associated with mass strandings elsewhere were not found to occur in this instance.

A separate event involving melon-headed whales and rough-toothed dolphins took place over the same period of time in the Northern Mariana Islands (Jefferson *et al.,* 2006), which is several thousand miles from Hawaii. Some 500–700 melon-headed whales came into Sasanhaya Bay on 4 July 2004 on the island of Rota and then left of their own accord after 5.5 hours; no known active sonar transmissions occurred in the vicinity of that event. Global reports of these types of events or sightings are of great interest to the scientific community and continuing efforts to enhance reporting in island nations will contribute to our increased understanding of animal behavior and potential causes of stranding events. Exactly what, if any, relationship this event has to the simultaneous events in Hawai'i and whether they might be related to some common factor (e.g., there was a full moon on July 2, 2004) is and will likely remain unknown. However, these two synchronous, nearshore events involving a rarely-sighted species are curious and may point to the range of potential contributing factors for which we lack detailed understanding and which the authors acknowledged might have played some role in the ''confluence of events'' in Hanalei Bay.

The Hanalei event was spatially and temporally correlated with RIMPAC. Official sonar training and tracking exercises in the Pacific Missile Range Facility (PMRF) warning area did not commence until approximately 8 a.m. on July 3 and were thus ruled out as a possible trigger for the initial movement into the Bay.

However, six naval surface vessels transiting to the operational area on July 2 intermittently transmitted active sonar (for approximately 9 hours total from 1:15 p.m. to 12:30 a.m.) as they approached from the south. The potential for these transmissions to have triggered the whales' movement into Hanalei Bay was investigated. Analyses with the information available indicated that animals to the south and east of Kaua'i could have detected active sonar transmissions on July 2, and reached Hanalei Bay on or before 7 a.m. on July 3, 2004. However, data limitations regarding the position of the whales prior to their arrival in the Bay, the magnitude of sonar exposure, behavioral responses of melon-headed whales to acoustic stimuli, and other possible relevant factors preclude a conclusive finding regarding the role of sonar in triggering this event. Propagation modeling suggest that transmissions from sonar use during the July 3 exercise in the PMRF warning area may have been detectable at the mouth of the Bay. If the animals responded negatively to these signals, it may have contributed to their continued presence in the Bay. The U.S. Navy ceased all active sonar transmissions during exercises in this range on the afternoon of July 3, 2004. Subsequent to the cessation of sonar use, the animals were herded out of the Bay.

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

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 mid-frequency sonar (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 and see Figure 3), 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 mid-frequency active sonar than other cetaceans (for reasons that remain unknown). Because the association between active sonar exposures and marine mammals mass stranding events is not consistent—some marine mammals strand without being exposed to sonar and some sonar transmissions are not associated with marine mammal stranding events despite their co-occurrence—other risk factors or a groupings of risk factors probably contribute to these stranding events.

Behaviorally Mediated Responses to MFAS/HFAS That May Lead to Stranding

Although the confluence of Navy mid-frequency active tactical sonar 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 be injured and strand.

Although causal relationships between beaked whale stranding events and active sonar remain unknown, several authors have hypothesized that stranding events involving these species in the Bahamas and Canary Islands may have been triggered when the whales changed their dive behavior in a startled response to exposure to active sonar or to further avoid exposure (Cox *et al.,* 2006, Rommel *et al.*, 2006). These authors proposed two 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 sonar. These two behavioral mechanisms may be necessary to purge excessive dissolved nitrogen concentrated in their tissues during their frequent long dives (Baird *et al.*, 2005). Baird *et al.* (2005) further suggests that abnormally rapid ascents or premature dives in response to high-intensity sonar could indirectly result in physical harm to the beaked whales, through the mechanisms described above (gas bubble formation or non-elimination of excess nitrogen).

Because many species of marine mammals make repetitive and prolonged dives to great depths, it has long been assumed that marine mammals have evolved physiological mechanisms to protect against the effects of rapid and repeated decompressions. Although several investigators have identified physiological adaptations that may protect marine mammals against nitrogen gas supersaturation (alveolar collapse and elective circulation; Kooyman *et al.*, 1972; Ridgway and Howard, 1979), Ridgway and Howard (1979) reported that bottlenose dolphins (*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 as deep as 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 sonar sound, could pose a risk for decompression sickness and that this risk should increase with the duration of the response. Their models also suggested that unrealistically rapid ascent rates of ascent from normal dive behaviors are unlikely to result in supersaturation to the extent that bubble formation would be expected. Tyack *et al.* (2006) suggested that emboli observed in animals exposed to mid-frequency range sonar (Jepson *et al.*, 2003; Fernandez *et al.*, 2005) could stem from a behavioral response that involves repeated dives shallower than the depth of lung collapse. Given that nitrogen gas accumulation is a passive process (i.e. nitrogen is metabolically inert), a bottlenose dolphin was trained to repetitively dive a profile predicted to elevate nitrogen saturation to the point that nitrogen bubble formation was predicted to occur. However, inspection of the vascular system of the dolphin via ultrasound did not demonstrate the formation of asymptomatic nitrogen gas bubbles (Houser *et al.*, 2007).

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 scientific agreement or complete lack of information exists regarding 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 the HRC training exercises there will be use of multiple sonar units in an area where three species of beaked whale species may be present. A surface duct may be present in a limited area for a limited period of time. Although most of the ASW training events will take place in the deep ocean, some will occur in areas of high bathymetric relief. However, none of the training events will take place in a location having a constricted channel with limited egress similar to the Bahamas (because none exist in the HRC). Consequently, not all five of the environmental factors believed to contribute to the Bahamas stranding (mid-frequency sonar, beaked whale presence, surface ducts, steep bathymetry, and constricted channels with limited egress) will be present during HRC ASW exercises. However, as mentioned previously, NMFS recommends caution when steep bathymetry, surface ducting conditions, or a constricted channel is present in addition to the operation of mid-frequency tactical sonar and the presence of cetaceans (especially beaked whales).

Exposure 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 damage 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 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 National Defense Authorization Act (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 HRC LOA application are considered military readiness activities.

NMFS reviewed the proposed HRC activities and the proposed HRC mitigation measures (which the Navy refers to as Protective 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: (1) Humpback whales congregating in the winter in the shallow areas of the HRC in high densities to calve and breed; and (2) 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''.

NMFS and the Navy developed two additional mitigation measures that address the concerns mentioned above, including a humpback whale cautionary area and a 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 additional measures that NMFS and the Navy developed (see ''Additional Measures 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 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 sonar and will take the actions necessary to ensure that sonar is powered down or shut down when detected animals are within the specified distance (for example, by initiating shut-down when animals are approaching, but not quite 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).

Navy's Protective Measures for MFAS/HFAS

Current protective measures employed by the Navy include applicable training of personnel and implementation of activity specific procedures resulting in minimization and/or avoidance of interactions with protected resources.

Navy shipboard lookout(s) are highly qualified and experienced observers of the marine environment. Their duties require that they report all objects sighted in the water to the Officer of the Deck (e.g., trash, a periscope, a marine mammal) 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.

Navy lookouts undergo extensive training in order to qualify as a watchstander. This training includes on-the-job instruction under the supervision of an experienced watchstander, followed by completion of the Personal Qualification Standard program, certifying that they have demonstrated the necessary skills (such as detection and reporting of partially submerged objects and night observation techniques). In addition to these requirements, many Fleet lookouts periodically undergo a 2-day refresher training course.

The Navy includes marine species awareness as part of its training for its bridge lookout personnel on ships and submarines. Marine Species Awareness Training (MSAT) was updated in 2005, and the additional training materials are now included as required training for Navy lookouts. 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. Marine species awareness and training is reemphasized by the following means:

- Bridge personnel on ships and submarines—Personnel utilize marine species awareness training techniques as standard operating procedure, they have available a marine species visual identification aid when marine mammals are sighted, and they receive updates to the current marine species awareness training as appropriate.
- Aviation units—Pilots and air crew personnel whose airborne duties during Anti-Submarine Warfare (ASW) training activities include searching for submarine periscopes would be trained in marine mammal spotting. These personnel would also be trained on the details of the mitigation measures specific to both their platform and that of the surface combatants with which they are associated.
- Sonar personnel on ships, submarines, and ASW aircraft—Both passive and active sonar operators on ships, submarines, and aircraft utilize protective measures relative to their platform. The Navy issues a Letter of Instruction for each Major Exercise which mandates specific actions to be taken if a marine mammal is detected, and these actions are standard operating procedure throughout the exercise.

Implementation of these protective measures is required of all units. The activities undertaken on a Navy vessel or aircraft are highly controlled. The chain of command supervises these activities. Failure to follow orders can result in disciplinary action.

Personnel Training

(a) All lookouts onboard platforms involved in ASW training events will review the NMFS-approved Marine Species Awareness Training (MSAT) material prior to use of midfrequency active sonar.

(b) All Commanding Officers, Executive Officers, and officers standing watch on the Bridge will have reviewed the MSAT material prior to a training event employing the use of mid-frequency active sonar.

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

(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.

(e) 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

(a) 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.

(b) All surface ships participating in ASW exercises 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 lookouts.

(c) 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.

(d) On surface vessels equipped with mid-frequency active sonar, pedestal mounted ''Big Eye'' (20x110) binoculars will 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 will employ visual search procedures employing a scanning methodology in accordance with the Lookout Training Handbook (NAVEDTRA 12968–B).

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

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

(b) Commanding Officers 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.

(c) 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.

(d) During mid-frequency active sonar training activities, personnel will 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 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.

(f) Aircraft with deployed sonobuoys will use only the passive capability of sonobuoys when marine mammals are detected within 200 yards of the sonobuoy.

(g) 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.

(h) Safety Zones—When marine mammals are detected by any means (aircraft, shipboard lookout, or acoustically) the Navy will ensure that MFAS transmission levels are limited to at least 6 dB below normal operating levels if any detected marine mammals are within 1,000 yards (914 m) of the sonar dome (the bow).

(i) Ships and submarines will continue to limit maximum MFAS transmission levels by this 6-dB factor until the marine mammal has been seen to leave the area, has not been detected for 30 minutes, or the vessel has transited more than 2,000 yards (1828 m) beyond the location of the last detection.

(ii) The Navy will ensure that MFAS transmissions will be limited to at least 10 dB below the equipment's normal operating level if any detected animals are within 500 yards (457 m) of the sonar dome. Ships and submarines will continue to limit maximum ping levels by this 10-dB factor until the marine mammal has been seen to leave the area, has not been detected for 30 minutes, or the vessel has transited more than 2,000 yards (1828 m) beyond the location of the last detection.

(iii) The Navy will ensure that MFAS transmissions are ceased if any detected marine mammals are within 200 yards (183 m) of the sonar dome. MFAS will not resume until the marine mammal has been seen to leave the area, has not been detected for 30 minutes, or the vessel has transited more than 2,000 yards (1828 m) beyond the location of the last detection.

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

(v) If the need for power-down should arise as detailed in "Safety Zones" above, 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 sonar was being operated).

(i) 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.

(j) 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.

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

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

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

Navy's Protective Measures for IEER

The following are protective measures for use with Extended Echo Ranging/ Improved Extended Echo Ranging (EER/ IEER) given an explosive source generates the acoustic wave used in this sonobuoy.

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

(b) Crews shall conduct a minimum of 30 minutes of visual and acoustic 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 1,000 yards (914 m) of observed marine mammal activity, deploy the receiver ONLY and monitor while conducting a visual search. When marine mammals are no longer detected within 1,000 yards (914 m) of the intended post position, co-locate the explosive source sonobuoy (AN/SSQ–110A) (source) with the receiver.

(d) 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 communication range of these sensors.

(e) 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.

(f) Visual Detection:

(i) If marine mammals are visually detected within 1,000 yards (914 m) 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 1,000 yards (914 m) safety buffer.

(ii) Aircrews may shift their multi-static active search to another post, where marine mammals are outside the 1,000 yards (914 m) 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 1,000 yards (914 m) 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) 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.

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

Navy's Protective Measures for Underwater Detonations

To ensure protection of marine mammals during underwater detonation training and Mining Laying Training, the operating area must be determined to be clear of marine mammals prior to detonation. Implementation of the following mitigation measures continue to ensure that marine mammals would not be exposed to temporary threshold shift (TTS), PTS or injury from physical contact with training mine shapes during Major Exercises.

Demolitions (DEMOs) and Mine Countermeasure (MCM) Training (Up to 20 lb)

Exclusion Zones—All mine warfare and mine countermeasure (MCM) training activities 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 (640 m) arc radius around the detonation site.

Pre-Exercise Surveys—For MCM training activities, 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.

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

Reporting—Any evidence of a marine mammal that may have been injured or killed by the action shall be reported immediately to NMFS and Commander, Pacific Fleet and Commander, Navy Region Southwest, Environmental Director.

Mine Laying Training—Mine Laying Training involves aerial drops of inert training shapes on floating targets. Aircrews are scored for their ability to accurately hit the target although this operation does not involve live ordnance, marine mammals have the potential to be injured if they are in the immediate vicinity of a floating target; therefore, the safety zone shall be clear of marine mammals and sea turtles around the target location. Pre- and post-surveys and reporting requirements outlined for underwater detonations shall be implemented during Mine Laying Training. To the maximum extent feasible, the Navy shall retrieve inert mine shapes dropped during Mine Laying Training.

SINKEX, GUNEX, MISSILEX, and BOMBEX

The selection of sites suitable for sinking exercises (SINKEXs) involves a balance of operational suitability, requirements established under the MPRSA permit granted to the Navy (40 CFR 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 1000 fathoms (3000 m) deep and at least 50 nm (92 km) 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.

Although the siting of the location for the exercise is not regulated by a permit, the range clearance procedures used for gunnery exercise (GUNEX), missile exercise (MISSILEX), and bombing exercise (BOMBEX) are the same as those described immediately below for a SINKEX.

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:

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

(b) Extensive range clearance training activities would be conducted in the hours prior to commencement of the exercise, ensuring that no shipping is located within the hazard range of the longest-range weapon being fired for that event.

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

(d) An exclusion zone with a radius of 1.0 nm (1.8 km) would be established around each target. This exclusion zone is based on calculations using a 449 kg (990 lb) H6 NEW high explosive source detonated 5 feet (1.5 m) below the surface of the water, which yields a distance of 0.85 nm (1.57 km) (cold season) and 0.89 nm (1.65 km) (warm season) beyond which the received level is below the 182 dB re: 1 Pa sec2 threshold established for the WINSTON S. CHURCHILL (DDG 81) shock trials. An additional buffer of 0.5 nm (0.9 km) would 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 (1.8 km) out an additional 0.5 nm (0.9 km), would be surveyed. Together, the zones extend out 2 nm (3.6 km) from the target.

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

(i) 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 (SAR) Tactical Aid (TACAID). The SAR TACAID 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.

(ii) 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.

(iii) 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.

(iv) On each day of the exercise, aerial surveillance of the exclusion and safety zones would commence two hours prior to the first firing.

(v) The results of all visual, aerial, and acoustic searches would be reported immediately to the OCE (Officer Conducting the Exercise). No weapons launches or firing would commence until the OCE declares the safety and exclusion zones free of marine mammals.

(vi) If a marine mammal observed within the exclusion zone is diving, firing would be delayed until the animal is re-sighted outside the exclusion zone, or 30 minutes has elapsed. After 30 minutes, if the animal has not been re-sighted it would be assumed to have left the exclusion zone. This is based on a typical dive time of 30 minutes for traveling marine mammals. The OCE would determine if the marine mammal is in danger of being adversely affected by commencement of the exercise.

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

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

(f) 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 mammals 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.

(g) 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.

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

(i) In the unlikely event that any marine mammals are observed to be harmed in the area, a detailed description of the animal would be documented, 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.

Additional Mitigation Measures 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 following two issues of concern: (1) Humpback whales congregating in the winter in the shallow areas of the HRC in high densities to calve and breed; and (2) the potential relationship between the operation of MFAS/HFAS and marine mammal strandings. Any mitigation measure prescribed by NMFS should be known 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, in which we explored several mitigation options and their respective practicability (these alternatives and their practicability are analyzed in NMFS' Draft Environmental Assessment of the Mitigation Measures to be used in the Issuance of the HRC LOA). Ultimately, NMFS and the Navy developed two additional measures (below), a humpback whale cautionary area and a Stranding Response Plan, which we believe support (or contribute to) the goals mentioned in a–e above. These measures are described below.

Humpback Whale Cautionary Area

Humpback whales migrate to the Hawaiian Islands each winter to rear their calves and mate. Data indicate that, historically, humpbacks have clearly concentrated in high densities in certain areas around the Hawaiian Islands. NMFS has reviewed the Navy's data on MFA sonar training in these dense humpback areas since June 2006 and found it to be rare and infrequent. While past data is no guarantee of future activity, it documents a history of low level MFA sonar activity in dense humpback areas. In order to be successful at operational missions and against the threat of quiet, diesel-electric submarines, the Navy has, for more than 40 years, routinely conducted anti-submarine warfare (ASW) training in major exercises in the waters off the Hawaiian Islands, including the Humpback Whale National Marine Sanctuary. During this period, no reported cases of harmful effects to humpback whales attributed to MFA sonar use have occurred. Coincident with this use of MFA sonar, abundance estimates reflect an annual increase in the humpback whales migrating to Hawaii (Mobely, 2001, 2004).

NMFS and the Navy explored ways of affecting the least practicable impact (which includes a consideration of practicality of implementation and impacts to training fidelity) to humpbacks from exposure to MFA sonar. Proficiency in ASW requires that sailors gain and maintain expert skills and experience in operating MFA sonar in myriad marine environments. Exclusion zones or restricted areas are impracticable and adversely impact MFA sonar training fidelity. The Hawaiian Islands, including areas in which humpback whales concentrate, contain unique bathymetric features the Navy needs to ensure sailors gain critical skills and experience by training in littoral waters. Sound propagates differently in shallow water. No two shallow water areas are the same. Each shallow water area provides a unique training experience that could be critical to address specific future training and assessment requirements. Given the finite littoral areas in the Hawaiian Islands area, maintaining the possibility of using all shallow water training areas is required to ensure sailors receive the necessary training to develop and maintain critical MFA sonar skills. In real world events, crew members will be working in these types of areas and these are the types of areas where the adversary's quiet diesel-electric submarines will be operating. Without the critical ASW training in a variety of different near-shore environments, crews will not have the skills and varied experience needed to successfully operate MFA sonar in these types of waters, negatively affecting vital military readiness.

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

Stranding Response Plan for Major Navy Training Exercises in the HRC

NMFS and the Navy have developed a draft Stranding Response Plan for Major Exercises in the HRC (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 indicates the conditions under which the Navy is authorized to take marine mammals pursuant to training activities involving MFAS or explosives in the Hawaii Range Complex (HRC). 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 Hawaii Range Complex (HRC) 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 in the HRC are related to, or caused by, Navy training activities, absent a determination made in a Phase 2 Investigation as outlined in Paragraph 7 of this plan, indicating that MFAS or explosive detonation in the HRC 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 or explosive 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 HRC, 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 (14 nm) (26 km) is the distance at which sound from the sonar source is anticipated to attenuate to approximately 140–145 dB (SPL). The risk function predicts that less than 1 percent of the animals exposed to 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 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 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 intends to investigate any strandings that occur during major training exercises in the HRC.

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 MFAS/HFAS 6 dB when a marine mammal is detected within 1000 yd (.914 km), powerdown 4 more dB (or 10 dB total) when a marine mammal is detected within 500 yd (.457 km), and cease MFAS/HFAS transmissions when a marine mammal is detected within 200 yd (.183 km).

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 source at which an animal would receive a level of 215 dB SEL (threshold for PTS/injury/Level A Harassment) is approximately 10 m (10.9 yd).

• NMFS believes that the probability that a marine mammal would approach within 10 m (10.9 yd) 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 the model did not predict any animals (see Table 15) would be exposed to a 215 dB SEL of MFAS/HFAS and animals would likely avoid approaching a source transmitting at that level at that distance.

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 distances from the source at which an animal would receive 195 dB SEL (the TTS threshold) is from 110–165 m (120–180 yd) from the source.

• 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, and social pelagic species (pilot whales, melon-headed whales, etc.) at some point within the 1000 yd (.914 km) 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 levels associated with TTS.

• However, more cryptic, deep-diving species (beaked whales and *Kogia* sp.) are less likely to be visually detected and could potentially be exposed to levels of MFAS/HFAS expected to cause TTS. 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.

Underwater Explosives

The Navy utilizes exclusion zones (wherein explosive detonation will not begin/continue if animals are within the zone) for explosive exercises. Table 8 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 (3704 m) from the source.

• Animals would need to be within less than 1023 m (1118 yd) (large explosives) or 305 m (334 yd) (smaller charges) from the source to be injured.

• Unlike for 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 3 animals would be exposed to levels associated with injury (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:

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

• Additionally, for two of the explosive types (MK–84 and MK–48), though the distance to the presuure threshold is within the exclusion zone, the distance at which an animal would be expected to receive SEL levels associated with TTS (182 dB SEL) is larger than the exclusion zone, which means that for those two explosive types, any species could potentially be exposed to levels associated with TTS if it was detected in the limited area outside of the exclusion zone, but inside the distance to 182 dB SEL.

		TTS		Injury		Mortality	Exclusion
	lbs	182 SEL	23 psi	205 SEL	13 psi-ms	31 psi-ms	Zone Used
5" Naval gunfire	9.5	249	254	12	91	18	1852 m (1 nm)
76mm rounds	1.6	74	114	8	17	13	1852 m (1 nm)
Maverick	78.5	652	532	18	550	268	1852 m (1 nm)
Harpoon	448	1020	785	39	852	472	1852 m (1 nm)
MK-82	238	982	759	65	824	452	1852 m (1 nm)
MK-83	574	1322	992	113	1023	639	1852 m (1 nm)
MK-84	945	3834	1236	234	723	384	1852 m (1 nm)
MK-48	851	3495	1178	228	759	442	1852 m (1 nm)
Demolition Charges	20 (max)	643 (703 yd)	532	115	305	148	700 yd
EER/IEER	5	460	270	17	154	75	1000 yd

Table 8. Estimated maximum distances to indicated Criteria from source (meters unless otherwise noted)

The Stranding Response Plan will minimize the probability of distressed live-stranded animals responding to the proximity of sonar in a manner that further stresses them or increases the potential likelihood of mortality. The Humpback Whale Cautionary Area is intended to reduce the number and intensity of potential humpback exposures to MFAS/HFAS.

NMFS has preliminarily determined that the Navy's proposed mitigation measures (from the LOA application), along with the Humpback Whale Cautionary Area and 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 and Conservation Measures for Marine Mammals

The Navy is working towards a better understanding of marine mammals and sound in ways that are not directly related to the MMPA process. The Navy highlights some of those ways in the section below. Further, NMFS is working on a long-term stranding study that will be supported by the Navy by way of a funding and information sharing component (see below).

Navy's Conservation Measures

The Navy will continue to fund ongoing marine mammal research in the Hawaiian Islands. Results of conservation efforts by the Navy in other locations will also be used to support efforts in the Hawaiian Islands. The Navy is coordinating both short and long term monitoring/studies of marine mammals on various established ranges and operating areas to determine the response of marine mammals to Navy sound sources and the effectiveness of mitigation measures:

• Coordinating with NMFS to conduct surveys within the selected Hawaiian Islands Operating Area as part of a baseline monitoring program.

• Implementing a long-term monitoring program of marine mammal populations in the Hawaiian Islands Operating Area, including evaluation of trends.

• Implementing a marine mammal monitoring program in the HRC during training exercises.

• Continuing Navy research and Navy contribution to university/external research to improve the state of the science regarding marine species biology and acoustic effects.

• Sharing data with NMFS and via the literature for research and development efforts.

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., sonar, seismic, weather). The study will not be a true "cohort" study, because we will be unable to quantify or estimate specific sonar or other sound exposures for individual animals that strand. However, a cross-sectional or correlational analyses, 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 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 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 CFR 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 (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 (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 compared to observations in the absence of sonar (need to be able to accurately predict received level and report bathymetric conditions, distance from source, and other pertinent information.
- Physiological measurements in the presence of MFAS compared to observations in the absence of sonar (need to be able to accurately predict received level and report bathymetric conditions, distance from source, and other pertinent information), and/or
- Pre-planned and thorough investigation of stranding events that occur coincident to naval activities.
- Distribution and/or abundance comparisons in times or areas with concentrated MFAS versus times or areas without MFAS.

(d) An increased knowledge of the effected species.

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

Proposed Monitoring Plan for the HRC

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

(a) Are marine mammals exposed to mid-frequency active sonar (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 HRC, 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) What are the behavioral responses of marine mammals that are exposed to explosives at specific levels?

(e) Is the Navy's suite of mitigation measures for MFAS and explosives (e.g., PMAP, major exercise 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:

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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	SCC OPS, or TRE or Unit Level - 60 hours of active sonar Three nearshore underwater detonation events	SCC OPS or TRE or Unit Level - 60 hours of active sonar Three nearshore underwater detonation events 1-2 SINKEX events	SCC OPS or TRE or Unit Level - 60 hours of active sonar Three nearshore underwater detonation events	(Only if not enough data to complete study) SCC OPS or TRE or Unit Level - 60 hours of active sonar Three nearshore underwater detonation events 1-2 SINKEX events	(Only if not enough data to complete study) SCC OPS or TRE or Unit Level - 60 hours of active sonar
Marine Mammal Observers	Opportunistic as staff and SOP developed	SCC OPS or TRE or Unit Level - 60 hours	SCC OPS or TRE or Unit Level - 60 hours	SCC OPS or TRE or Unit Level - 60 hours	(Only if not enough data to complete study) SCC OPS or TRE or Unit Level - 60 hours	(Only if not enough data to complete study) SCC OPS or TRE or Unit Level - 60 hours if study not completed
Tagging before during and after training events	NOAA project in conjunction with RIMPAC 08 (partial Navy funding) Award monitoring contract	Order tags and secure tagging permit	SCC OPS August and February – 5 animals Unit level - 5 animals	SCC OPS August and February – 5 animals Unit level – 5 animals	SCC OPS August and February – 5 animals Unit level – 5 animals	(Only if not enough data to complete study) SCC OPS August and February – 5 animals Unit level – 5 animals
Vessel surveys (study 3 and 4 only)	NOAA project in conjunction with RIMPAC 08 (partial Navy funding) Award monitoring contract, develop SOP	USWEX – 40 hours Unit level – 100 hours Three nearshore underwater detonation events	USWEX – 40 hours Unit level – 100 hours Three nearshore underwater detonation events	USWEX – 40 hours Unit level – 100 hours Three nearshore underwater detonation events	(Only if not enough data to complete study) USWEX – 40 hours Unit level – 100 hours Three nearshore underwater detonation	(Only if not enough data to complete study) USWEX – 40 hours Unit level – 100 hours Three nearshore underwater detonation
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	(Only if not enough data to complete study) Nearshore underwater detonation events near appropriate coastal topography	(Only if not enough data to complete study) 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	USWEX – 60 hours RIMPAC – 40 hours	Unit level – 40 hours	Unit level – 40 hours	Unit level – 40 hours	(Only if not enough data to complete study) Unit Level - 40 hours	(Only if not enough data to complete study) Unit Level - 40 hours
Passive Acoustics	Award monitoring contract	Order devices and determine best location	Installation of 10 autonomous devices in the HRC Begin recording	Continue recording from 10 devices Begin data analysis	Continue recording from 10 devices and data analysis	Data Analysis and continue recording from 10 devices only if not enough data to complete study
Study 5 (mitigation effectiveness)	**FY08**	**FY09**	**FY10**	**FY11**	**FY12**	**FY13**
Marine mammal observers/lookout comparison	Training Events – 40 hours	Unit level – 100 hours Training events – 40 hours	Unit level – 100 hours Training Events– 40 hours	Unit level – 100 hours Training Events – 40 hours	(Only if not enough data to complete study) Unit level – 100 hours Training Events – 40 hours	(Only if not enough data to complete study) Unit level – 100 hours Training Events – 40 hours
Aerial surveys before and after training events, exercise area and coastlines	USWEX – 60 hours RIMPAC – 40 hours	Unit level – 40 hours	Unit level – 40 hours	Unit level – 40 hours	(Only if not enough data to complete study) Unit level – 40 hours	(Only if not enough data to complete study) Unit level – 40 hours

Table 9. Summary of monitoring effort proposed in Monitoring Plan for the Hawaii Range Complex

In addition to the Monitoring Plan for the HRC, 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 HRC, the Atlantic Fleet Active Sonar Training Range (AFAST), or 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 mid-frequency sonar and underwater detonations, for compliance with the terms and conditions of ESA Section 7 consultations or MMPA authorizations;
- To collect data to support estimating the number of individuals exposed to sound levels above current regulatory thresholds;
- To assess the efficacy of the Navy's current marine species mitigation;
- To add to the knowledgebase on potential behavioral and physiological effects to marine species from mid-frequency active sonar and underwater detonations; and,
- To 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 the HRC.

Past Monitoring in the HRC

Since RIMPAC 2006, which was the first Navy training activity utilizing MFAS to receive an MMPA authorization and an incidental take statement pursuant to the ESA, NMFS has received four monitoring reports (one covering two exercises) addressing MFAS use in the HRC, including the RIMPAC after action report (AAR). The Navy's AARs may be viewed at: *http://www.nmfs.noaa.gov/pr/permits/incidental.htm*. For three of the exercises, the reports describe observations by the watchstanders (who are involved in the training exercise) only. For two of the exercises (RIMPAC and the most recent USWEX), independent marine mammal observers were used to collect data before, during, and after the exercises. NMFS has reviewed these reports and has summarized the results, as related to marine mammal observations, below.

RIMPAC 2006

During the RIMPAC exercises in July 2006, the Navy operated MFAS hull-mounted sonar for 472 hours. They operated active sonobuoys for 115 hours and helicopter dipping sonar for 110 hours, however, these sources do not ping continuously and put far less sound in the water per hour than hull-mounted sonar. A map in the AAR showing the locations of the marine mammal sightings indicates that the exercises covered a very large area, both to the north and south of the islands, with the majority of the sightings of marine mammals occurring in the open ocean (not near shore).

Observations by Exercise Participants—Table 10 summarizes the marine mammals sighted by exercise participants and whether or not sonar was shut down. The Navy indicates in its report that no evidence of behavioral effects was observed.

MFAS active	Navy implemented shutdown (or unable to turn on sonar source)	Distance from MFAS source	Number of animals sighted	Species (if identified)	Detection Method
Yes	Yes	> 3000 yd		marine mammal	heli
Yes	Yes			marine mammal	heli
Yes	Yes	< 1000 yd	pod	dolphins	surface ship
Yes	Yes	< 200 yd		whale	
No	not applicable	500 yd		dolphin	surface ship
No	not applicable	300 yd	pod	whales	surface ship
No	not applicable	200 yd		whale	surface ship
Yes	Yes			marine mammal	
Yes	Yes	< 4000 yd		marine mammal	passive acoustic
Yes	No	> 1000 yd		whale	surface ship
Yes	No	> 1000 yd		marine mammal	surface ship
No	not applicable			dolphin	surface ship
Yes	Yes		2	whales	P-3 aircraft
Yes	Yes		2 pods of 10	pilot whales	surface ship
Yes	Yes	200 yd	pod of 3	pilot whales	surface ship
Yes	Yes	1000 yd		whales	surface ship
Yes	Yes		pod	whales	surface ship
Yes	Yes			marine mammals	surface ship
No	not applicable	off bow	pod	dolphins	surface ship
Yes	Yes		8	whales	P-3 aircraft
No	not applicable		5	dolphins	surface ship
No	not applicable		20	dolphins	surface ship
No	not applicable	1-2 miles		porpoises	surface ship
No	not applicable			pilot whales	surface ship
Yes	Yes		20	whales	surface ship
No	not applicable			whale	surface ship

Table 10. Summary of marine mammal sightings by RIMPAC 2006 participants.

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Observations by Marine Mammal Observers—The Navy contracted marine mammal observers to conduct aerial surveys, and their summary and conclusions of the monitoring are described here. A total of six aerial surveys of marine mammals were performed on dates corresponding with scheduled dates for ''choke point'' maneuvers of the RIMPAC exercises. Three surveys were performed in the vicinity of the Kaulakahi Channel (between Kauai and Niihau) (July 16, 17 and 20) and three were performed in the Alenuihaha Channel (between Hawaii and Maui) (July 24–26). The mission of the surveys was to detect, locate and identify all marine mammal species in the target areas using methods consistent with modern distance sampling theory. Marine mammals were sighted on four of the six surveys, comprising a total of 13 groups. All sightings consisted of small- to medium-sized odontocetes (toothed cetaceans), including one sighting each of bottlenose dolphins, spotted dolphins, Cuvier's beaked whale, false killer whale, unidentified beaked whale and eight sightings of unidentified delphinid species. Encounter rates of odontocete sightings (sightings/km surveyed) in this series were identical to those seen during earlier survey series (1993–03), though at different times of the year. No unusual observations (*e.g.*, sightings of unusual behavior or aggregations, near strandings, or stranded or dead animals) were noted during the total of approximately 18 hrs. of survey effort.

USWEX 06–04

During this three-day exercise, which was conducted from September 19–21, 2006 and in which the hours of sonar use were not reported, no marine mammals were sighted by the exercise participants.

USWEX 07–02

This exercise was conducted from April 10–11, 2007 and involved 5 MFAS-equipped ships, one non-MFAS equipped ship, and 8–12 helicopters. Other participating units representing support and opposition forces, which did not utilize sonar, included 2 submarines and 3 MFA-equipped ships. During the exercise, 265.5 hours of sonar use were reported.

No marine mammals were sighted by the participants during the exercise.

USWEX 07–03

This exercise was conducted from April 17–18, 2007, and involved 3 MFAS-equipped ships, 3 non-MFAS equipped ships, and 6 helicopters. Other participating units representing support and opposition forces, which did not utilize sonar, included 2 submarines and 2 MFA-equipped ships. During this exercise 50.1 hours of sonar use were reported.

One large whale was sighted by Navy watchstanders at a distance of approximately 300 yds when MFAS was not operating.

USWEX 08–1

USWEX 08–1 was conducted from November 13–15, 2007, and involved 3 MFAS-equipped ships, several other non-MFAS-equipped ships, and 2–4 helicopters with dipping sonar. During the exercise, a total of 77 hours of MFAS time was reported from all sources, including hull-mounted, helicopter dipping, and DICASS sonobuoys. The exercise was primarily conducted to the Northeast (extending far out to sea) of Oahu (a map is available in the AAR).

Observations by Exercise Participants

There were no sightings of marine mammals within 2000 yds by Navy personnel engaged in the training during USWEX 08–01. Sea states were high during some of the exercise period, which may have limited sightings of smaller marine mammals.

Observations of Marine Mammal Observers

Aerial Survey

A pre- and post-exercise aerial survey was conducted by a civilian science crew from 1 to 12 November and 15 to 17 November. The purpose of these surveys was to detect, locate, and identify all marine mammals and sea turtles observed within a 2384 mi^2 (6175 km^2) grid (to the east and northeast of Oahu); and during circumnavigation of the islands of Oahu and Molokai. Over 17 hours of survey time was conducted, involving a linear distance of approximately 1,701 nm (3150 km). There were 26 marine mammal sightings (six at sea with the remaining 20 observed nearshore), including short-finned pilot whales, Hawaiian spinner dolphins, bottlenose dolphins, Hawaiian monk seals, and three unidentified species (*Stenella* sp., dolphin and baleen whale) (see Table 11). Time was spent characterizing behavior at the time of the sightings and no indications of distressed or unusual behavior were documented. Additionally, there were no observations of any stranded or floating dead marine mammals. More information regarding the findings of these aerial surveys may be found in Appendix B of the USWEX 08–01 Monitoring report, which is posted on the NMFS Web site, at: *http://www.nmfs.noaa.gov/pr/permits/incidental.htm.*

Species	No. Sightings	No. Individuals
Short-finned pilot whale	2	31
Hawaiian spinner dolphin	2	84
Bottlenose dolphin	1	5
Stenella sp.	1	31
Hawaiian monk seal	2	3
Unidentified dolphin	1	1
Unidentified whale	1	1

Table 11. Summary of sightings by species during aerial surveys of USWEX 08-01

Vessel Survey

A civilian science-based research vessel conducted a visual monitoring survey for cetaceans and sea turtles from November 11–17, 2007. The purpose of these surveys was to monitor, identify, and report surface behavior of marine mammals observed before, during, and after the scheduled training exercise; particularly any injured or harmed marine mammals and/or unusual behavior or changes in behavior, distribution and numbers of animals. Another goal was to attempt to remain within view of any opportunistically encountered Navy vessels while conducting surveys and focal follows sessions. The effort was focused in the same designated survey box as the aerial survey team, to the east and northeast of Oahu. A total of 66 hours and approximately 911 km (492 nm) were visually surveyed over seven days with a total of eight cetacean groups sighted. Line surveys were conducted over 817 km (441 nm) (with 105 km (57 nm) while Navy vessels were within view) and animals were focally followed for a total of approximately 63 km (34 nm). None of the whales followed during the focal sessions exhibited any notable evasive or disturbance behavior related to the observation vessel or as defined under the MMPA. No injured or dead whales were detected.

A summary of the marine mammals sighted and their associated behaviors (including those that occurred during four focal follows) is presented in Table 12. The observers documented the first occurrence of Bryde's whale near the main Hawaiian islands, previous verified sightings have only occurred in the leeward Northwestern chain of the Hawaiian Islands. A Navy vessel was operating MFAS at approximately the same time as the Bryde's whale focal follow, at approximately 50 nm (93 km) away. Post exercise modeling predicted that the Bryde's whale may have been exposed to received levels of up to 141dB (SPL), though, as mentioned previously, no unusual behaviors were observed.

The vessel survey report, which is included in Appendix C of the Navy's AAR, and available at: *http://www.nmfs.noaa.gov/pr/permits/incidental.htm*, draws some conclusions regarding the efficacy of certain monitoring techniques and makes recommendations for future monitoring plans. The Navy has taken this information into consideration in developing the monitoring plan for the HRC that is proposed here.

						Results from Animals that were specifically focally followed					
Date	Species	Initial Sighting Distance (km)	Beaufort Sea State	Group Size/ Composition	Summary of Observed Behavior	Total time with animals (mins)	Depth (m)	Behavioral State	Individual Non-blow behavior	Focal Follow Comments
12-Nov	**UnID'd small whale (possibly *Ziphius cavirostris*)**	4	3	1/unknown	Unable to resight, probable beaked whale					
12-Nov	**Sei whale**	3.2	2 to 3	1/adult	26 resights of 1 sei whale in 2.25 h. Repeatedly approached boat; blew every 6-12 minutes.	145	2500	Slow travel	No blow rise	Maintained slow travel throughout observations, often logging just below surface.
13-Nov	**Bryde's whale**	<1.6	3	1/adult	11 resights of Bryde's whale. Whale approached boat to within ~65 m.	50	4500	Slow travel	No blow rise, underwater blow	Maintained slow travel speed throughout observations; Navy vessel in view over horizon during encounter
14-Nov	**Risso's dolphin**	0.5	6	5/adult	Sighting made near bow in proximity to previous location of yellowfin tuna school					
15-Nov	**Spinner dolphins**	0.32	4	10/adult	3 subgroups totalling ~10 swam close and parallel to shore as headed to mouth of bay at dusk; crossed bow.					
16-Nov	**UnID'd medium delphinid**	0.8	6	5/unknown	Unable to resight. Probable pygmy killer whales					
16-Nov	**Sei whale**	2.9	4	3/sudadults	Looked like 1-2 yr-old whales	64	5000	logging, slow travel	No blow rise	Repeatedly followed vessel, crossed bow and "surfed" bow wave and swells. Whale movement appeared to be propelled by swells
17-Nov	**Humpback whale**	1.6	3	3, 1subadult/ 2 adults	May have been up to 5 individuals, seen 1-2 at a time. Other blows seen near horizon on Penguin Bank	70	40	fast and medium travel, surface active travel	peduncle slap, pectoral fin slap, tail swish, fluke up, peducle arch no blow rise	Frequently changed travel direction in apparent response to other nearby humpbacks; appeared to be a disaffiliation then and affiliation of humpbacks associated with sruface-active behaviors

Table 12. Summary of results from vessel surveys conducted 11-17 November. Additional results of animals that were focally followed presented on right side of table.

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General Conclusions Drawn From Review of Monitoring Reports

Because NMFS has received relatively few monitoring reports from sonar training in the HRC, and even fewer that have utilized independent aerial or vessel-based observers, it is too early to draw any biological conclusions. However, NFMS can draw some general conclusions from the content of the monitoring reports:

(a) The data gathered by independent observers contains far more detail than the data gathered by watchstanders. 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. Data gathered by independent observers can provide very valuable information at a level of detail not possible with watchstanders, such as the presence of sub-adult sei whales in the Hawaiian islands in fall, potentially indicating the use of the area for breeding.

(b) More marine mammal sightings per hour of effort were reported by independent observers than by Navy watchstanders. Out of approximately 1100 hours of sonar operation, the Navy watchstanders reported 30 sightings of marine mammals. Out of approximately 100 hours of observation, the independent observers reported 47 sightings of marine mammals (if the observations and hours that were specifically near shore or in channels are removed (likely higher density of marine mammals), the independent observers had 14 sightings in 80 hours of effort: 6 sightings in 14 hours of aerial and 8 sightings in 66 hours of vessel-based). There are a couple of possible explanations for this:

(i) MFAS was likely operating in much closer proximity to and for a significantly larger percentage of the time when watchstanders were reporting marine mammal sightings as compared to when independent observers were reporting them. Marine mammals may have been avoiding the sonar source and therefore been present in lower numbers immediately around the watchstanders (usually on the same platform as the sonar source itself), or within the distance that the watchstanders could easily detect them. Alternatively, MFAS was not necessarily operating in the immediate vicinity of the independent observers, and even when so, the source was at least a few miles away.

(ii) Because of their experience and training, independent vessel-based marine mammal observers may see a higher percentage of the animals at the surface than the Navy watchstanders (0.12 sightings/hour versus 0.03 sightings/hour, respectively).

(c) Though it is by no means conclusory, it is worth noting that no instances of obvious behavioral disturbance were observed either by the Navy watchstanders or the independent observers (and a portion of the independent observations were reported within the vicinity of operating MFAS) in the 1200+ hours of effort in which 77 sightings of marine mammals were made. 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.

(d) 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. For example, some reports indicate marine mammals seen within the safety zones, while others indicate marine mammals detected within any distance.

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 HRC will contain an adaptive management component. Our understanding of the effects of MFAS/HFAS 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 HRC). 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 HRC or other locations).
- Results from specific stranding investigations (either from the HRC or other locations, and involving coincident MFAS 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 were 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 Stranding Response Plan contains more specific reporting requirements for specific circumstances.

SINKEX, GUNEX, MISSILEX, BOMBEX, and IEER

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 survey efforts for each event will be submitted to NMFS.

MFAS 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 Training Exercise (RIMPAC, USWEX, and Multi Strike Group). For other ASW exercises (TRACKEX and TORPEX), the Navy will submit a yearly summary report. These reports will, at a minimum, include the following information:

- The estimated number of hours of sonar operation, broken down by source type.
- If possible, the total number of hours of observation effort (including observation time when 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.
  - Number of animals sighted.
  - Location of marine mammal sighting.
  - Distance of animal from any operating 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 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 that the marine mammals were sighted from.

Monitoring Report

Although the draft Monitoring Plan for the HRC contains a general description of the monitoring that the Navy plans to conduct (and that NMFS has analyzed) in the HRC, the detailed analysis and reporting protocols that will be used for the Hawaii monitoring plan are still being refined at this time. The draft HRC Monitoring plan may be viewed at: *http://www.nmfs.noaa.gov/pr/permits/incidental.htm*. Standard marine species sighting forms will be used by Navy lookouts and biologists to standardize data collection and data collection methods will be standardized 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).

HRC 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 in § 216.175 (d–f). This report will be submitted at the end of the fourth year of the rule (November 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.

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 the HRC, the Atlantic Fleet active Sonar Training (AFAST), and the Southern California (SOCAL) Range Complex. 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 HRC LOA, where subsistence communities are not present): (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); 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 regulatory 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 HRC.

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, 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 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 effect 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 Mammal 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.

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. 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. Tissue damage from either of these processes would be considered an injury.

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.)

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 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 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 FEIS for the HRC.

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 is likely to occur are 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). TTS is a physiological effect that has been studied and quantified in laboratory conditions. Because data that support an estimate of at what received levels marine mammals will TTS exist, NMFS also uses an acoustic criteria to estimate the number of marine mammals that might sustain TTS incidental to a specific activity (in addition to the behavioral criteria).

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 μPa2-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 μPa^2-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.
- 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 SPL 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 μPa²-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)).
- Pinnipeds (monk seals)—204 dB re 1 μPa²-s (based on data from elephant seals, which are the most closely related to the monk seal).

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 HRC LOA application.

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 μPa²-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)).
- Pinnipeds (monk seals)—224 dB re 1 μPa²-s (based on data from elephant seals, which are the most closely related to the monk seal).

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 20dB 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 HRC LOA application. Southall *et al.* (2007) recommend a precautionary dual criteria for TTS (230 dB re 1 μPa (SPL) in addition to 215 re 1 μPa²-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 (SEL) is farther from the source than the distance at which they would receive 230 (SPL) and therefore, it is not necessary to consider 230 dB.

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. For that authorization, NMFS used 173 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 SEL would be predicted to be taken by Level B Harassment and all animals exposed to less than 173 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), and the Supplemental EIS for SURTASS LFA sonar (U.S. Department of the Navy, 2007d). 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 becomes available.

The particular acoustic risk functions developed by NMFS and the Navy (see Figures 3a and b) 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 MFA sonar. 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) 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 datasets 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 plans to tag whales in conjunction with the 2008 RIMPAC exercises. Until additional data is 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 to MFAS sources.

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 J of the Navy's FEIS for the HRC.

1. Controlled Laboratory Experiments with Odontocetes (SSC Dataset)—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 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 1Pa) 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 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 animal 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 (which ranged from 150 to 180 dB) at an approximate whale location with a mean value of 169.3 dB SPL.

Calculation of K Paramenter—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 MFA sonar (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 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 mid-frequency sound source. 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 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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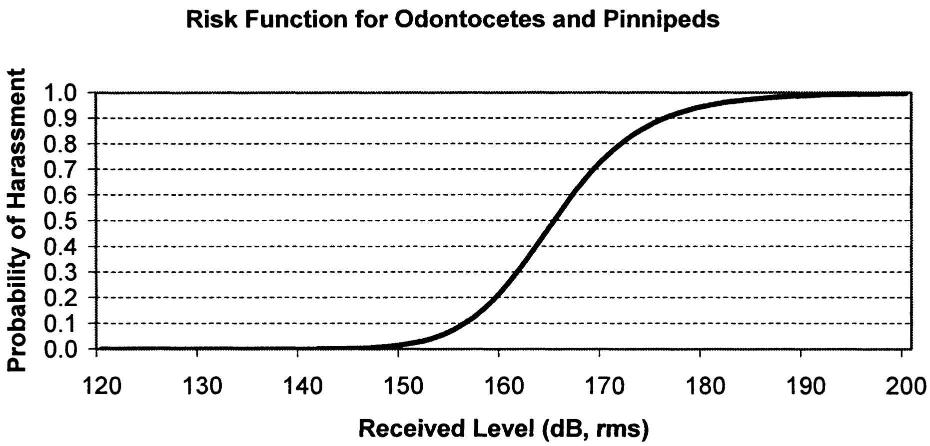

Figure 3a. Risk function for odontocetes and pinnipeds. B=120 dB, K=45 dB, A=10.

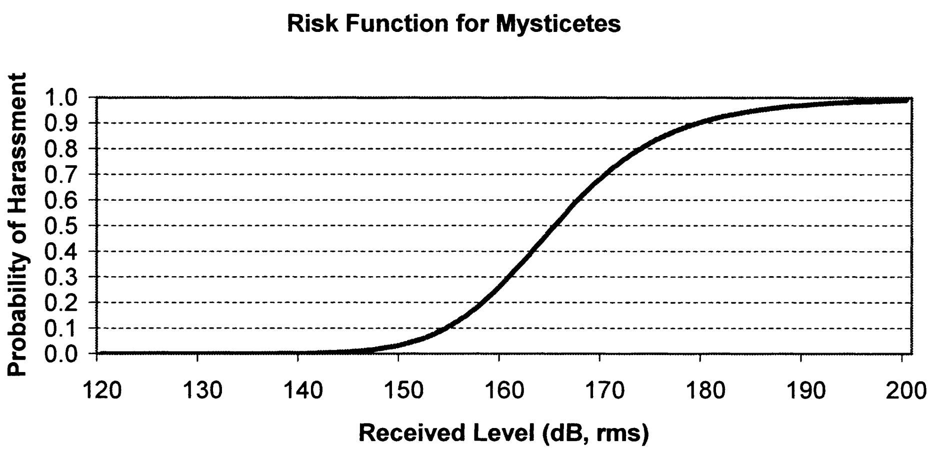

Figure 3b. Risk function for mysticetes. B=120 dB, K=45 dB, A=8.

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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 MFA sonar) 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 HRC example, animals exposed to received levels between 120 and 130 dB may be more than 65 nautical miles (131,651 yards (120,381 m)) from a sound source (Table 16); 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 marine mammal responses to sound sources at that received level, NMFS does not currently have any data that describe the response of marine mammals to 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.

Explosive Detonation Criteria

The criteria for mortality, Level A Harassment, and Level B Harassment resulting from explosive detonations were initially developed for the Navy's Sea Wolf 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 13. Additional information regarding the derivation of these criteria is available in the Navy's FEIS for the HRC 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)
	Sub-TTS behavioral disruption (for multiple detonations only, not applicable for single detonations)	177 dB re 1 microPa^2-s, (1/3 octave band)

Table 13. Summary of Criteria for Explosive Detonations

Take Calculations

Estimating the take that will result from the proposed activities entails the following four steps: Propagation model estimates animals exposed to sources at different levels; further modeling determines number of exposures to levels indicated in criteria above (*i.e.*, number of takes); post-modeling corrections refine estimates to make them more accurate; 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 J of the Navy's FEIS for the HRC.

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Species Name	Abundance	Density (#/km^2)	CV	Area in which densities are applied for Modeling Purposes	Seasons in which densities are applied for Modeling Purposes	Reference
Bryde's whale	469	0.0002	0.45	75-200 nm offshore	Year-round	Barlow 2006
Minke whale*	469	0.0002		0-200 nm offshore	Year-round	*
Humpback whale	4,491	0.2186	0.15	0-25 nm offshore	Dec-Mar	Mobley et al. 2001
Fin whale**	236	0.0001		0-200 nm offshore	Year-round	**
Sei whale**	236	0.0001		0-200 nm offshore	Year-round	**
Sperm whale	6,919	0.0028	0.81	0-200 nm offshore	Year-round	Barlow 2006
Dwarf sperm whale	17,519	0.0071	0.74	0-200 nm offshore	Year-round	Barlow 2006
Pygmy sperm whale	7,138	0.0029	1.12	0-200 nm offshore	Year-round	Barlow 2006
Cuvier's beaked whale	15,242	0.0062	1.43	0-200 nm offshore	Year-round	Barlow 2006
Longman's beaked whale	1,007	0.0004	1.26	75-200 nm offshore	Year-round	Barlow 2006
Blainville's beaked whale	2,872	0.0012	1.25	0-200 nm offshore	Year-round	Barlow 2006
Unidentified beaked whale	371	0.0002	1.17	0-200 nm offshore	Year-round	Barlow 2006
Bottlenose dolphin	3,215	0.0013	0.59	0-200 nm offshore	Year-round	Barlow 2006
False killer whale	236	0.0001	1.13	0-200 nm offshore	Year-round	Barlow 2006
Killer whale	349	0.0001	0.98	0-200 nm offshore	Year-round	Barlow 2006
Pygmy killer whale	956	0.0004	0.83	0-200 nm offshore	Year-round	Barlow 2006
Short-finned pilot whale	8,870	0.0036	0.38	0-200 nm offshore	Year-round	Barlow 2006
Risso's dolphin	2,372	0.001	0.65	0-200 nm offshore	Year-round	Barlow 2006
Melon-headed whale	2,950	0.0012	1.17	0-200 nm offshore	Year-round	Barlow 2006
Rough-toothed dolphin	8,709	0.0036	0.45	0-200 nm offshore	Year-round	Barlow 2006
Fraser's dolphin	10,226	0.0042	1.16	75-200 nm offshore	Year-round	Barlow 2006
Offshore pantropical spotted dolphin	8,978	0.0037	0.48	0-200 nm offshore	Year-round	Barlow 2006
Spinner dolphin	3,351	0.0014	0.74	0-200 nm offshore	Year-round	Barlow 2006
Striped dolphin	13,143	0.0054	0.46	0-200 nm offshore	Year-round	Barlow 2006
Hawaiian monk seal	1,252	0.0035	N/A	Offshore HI Island Archipelago	Year-round	Carretta et al. 2006

Table 14. Estimated densities of marine mammals in HRC.

*No density information is avaialable for Minke whales, estimate is based on density estimates for Bryde's whale

**No density information is available for fin or sei whales, estimate is based on false killer whale estimate

(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.
  - 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 20 representative environmental provinces across 8 sonar modeling areas) based on: Water depth; sound speed variability throughout the water column (presume surface duct is present in HRC); bottom geo-acoustic properties (bathymetry); and wind speed.
- The density of each marine mammal species in the HRC (see Table 14), 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 the HRC, 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 sonar sources must account for land masses (by subtracting them out).
- Acoustic footprints for 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 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. For example, in some cases the raw modeled numbers of exposures to levels predicted to result in Level A Harassment from exposure to sonar might indicate that 1 fin whale would be exposed to levels of 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 15 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 3 (by multiplying the yearly estimate by 5) by more than 10 percent. NMFS estimates that a 10-percent increase in sonar hours would result in approximately a 10 percent increase in the number of takes, and we have considered this possibility in our analysis.

	Total Estimated Exposures to Indicated Levels of Energy/Pressure from Explosive Detonations				Total Estimated Exposures to Indicated Levels of Sound from MFAS/HFAS		
	Level B Harassment		Level A Harassment	Mortality	Level B Harassment		Level A Harassment
	177 dB re 1 μPa^2-s	23 psi or 182 dB re 1 μPa^2-s	13 psi-ms / 205 dB re 1 μPa^2-s	31 psi-ms	Risk Function	195 dB re 1 μPa^2-s	215 dB re 1 μPa^2-s
Species	Behavioral Harassment	TTS (mitigation considered)	Slight Lung / TM Injury	Onset Massive Lung Injury	Behavioral Harassment	TTS (mitigation considered)	PTS
Bryde's whale	0	0	0	0	64	0	0
Fin whale	0	0	0	0	46	0	0
Sei whale	0	0	0	0	46	0	0
Minke whale	0	0	0	0	64	0	0
Humpback whale	5	12 (4)***	1 (0)	0	9,677	199 (0)*	0
Sperm whale	9	5 (4)***	0	0	758	9 (0)*	0
Dwarf sperm whale	13	13	0	0	2,061	35	0
Pygmy sperm whale	4	5	0	0	842	14	0
Cuvier's beaked whale	15	8	0	0	1,121	5	0
Longman's beaked whale	0	0	0	0	104	1	0
Blainville's beaked whale	2	2	0	0	347	6	0
Unidentified beaked whale	0	0	0	0	36	0	0
Bottlenose dolphin	0	1 (0)***	0	0	716	17 (9)*	0
False killer whale	0	0	0	0	46	0	0
Killer whale	0	0	0	0	46	0	0
Pygmy killer whale	0	0	0	0	192	4 (0)*	0
Short-finned pilot whale	2	5 (1)***	0	0	1,751	40 (0)*	0
Risso's dolphin	0	1 (0)***	0	0	486	10 (5)**	0
Melon-headed whale	0	1 (0)***	0	0	583	13 (0)*	0
Rough-toothed dolphin	2	4 (2)***	0	0	1,053	18 (9)**	0
Fraser's dolphin	6	6 (3)***	0	0	1,216	19 (10)**	0
Pantropical spotted dolphin	0	5 (0)***	1 (0)	0	2,144	49 (25)**	0
Spinner dolphin	2	2 (1)***	0	0	410	7 (4)**	0
Striped dolphin	2	7 (2)***	1 (0)	0	3,126	73 (37)**	0
Monk seal	0	3 (0)***	0	0	104	3 (0)*	0
Total	62	80 (45)	0	0	26,963	522 (160)	0

Table 15. Estimated exposures of marine mammals to indicated criteria (parenthetical numbers corrected for mitigation). Numbers indicate the number NMFS is proposing to authorize in the LOAs (not including the mortality authorization discussed in Mortality Section)

*Due to the animal size, average group size, or behavior of these species, watchstanders will very likely detect these animals and cease MFAS/HFAS operations before they are within the distance of the source that would put them at risk of TTS (120 m)

**Individuals of these species travel in group sizes that will allow for detection and shutdown prior to TTS exposure, however, they may also bow-ride and MFAS/HFAS sonar may operate if vessel attempted to change course but the animals stayed with the vessel, therefore, some TTS could occur

***As mentioned above, these animals are likely to be seen by watchstanders, and mitigation implemented, however the exclusion zone for the two largest explosive charges is not large enough to avoid all TTS, so estimated TTS takes potentially associated with those charges remain

NOTE: if calculated TTS takes are assumed not to occur because of mitigation, they are still included as a Level B behavioral harassment

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Mortality

Evidence from five beaked whale strandings, all of which have taken place outside the HRC, and have occurred over approximately a decade, suggests that the exposure of beaked whales to mid-frequency sonar in the presence of certain conditions (e.g., multiple units using tactical sonar, steep bathymetry, constricted channels, strong surface ducts, etc.) may result in strandings, potentially leading to mortality. Although these physical factors believed to contribute to the likelihood of beaked whale strandings are not present, in their aggregate, in the Hawaiian Islands, scientific uncertainty exists regarding what other factors, or combination of factors, may contribute to beaked whale strandings. Accordingly, to allow 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 individuals of each of the following species over the course of the five-year rule: bottlenose dolphin, *Kogia* spp., melon-headed whale, pantropical spotted dolphin, pygmy killer whale, short-finned pilot whale, striped dolphin, Cuvier's, Longman's, and Blainville's beaked whales. Neither NMFS nor the Navy anticipates that marine mammal strandings or mortality will result from the operation of mid-frequency sonar during Navy exercises within the HRC.

''Take'' Interpretation

For explosive detonations, a ''take'' (as reported in the take table and proposed to be authorized), is very simply, an instance of exposure of a marine mammal to levels above those indicated in the criteria. Every separate take does necessarily represent effects to a separate animal, some of the takes may be takes that occur to the same animal, either within one day and one exercise, or on different days from different exercise types.

For MFAS/HFAS, TTS and PTS takes can be described the same as the explosive detonation takes described above. Alternately, for behavioral harassment a take is slightly different from that described above. Within the context of exposure to continuous ASW within exercises that last less than 24 hrs (they typically last less than 16 hrs), one behavioral harassment take might include more than one exposure to MFAS/HFAS levels above those identified on the risk continuum within the 11–16-hr. Then, however, the estimated numbers of take (in the take table) represent instances of take. Again, every separate take does necessarily represent effects to a separate animal, some animals may be taken (which, as mentioned above, may include multiple exposures within one day) more than one time on different days as a result of exposure to different exercises.

Effects on Marine Mammal Habitat

There are no areas within the HRC that are specifically considered as important physical habitat for marine mammals. The nearshore areas in and around the Hawaiian Humpback Whale National Marine Sanctuary contain very important breeding and calving habitat for the humpback whale, however effects in this area have been analyzed previously in this document in the context of the whales themselves. Additionally, in 2007, the Navy only conducted sonar training in the areas where humpback whales are known to be densest for a total of approximately 30–40 hours.

The prey of marine mammals are considered part of their habitat. The Navy's FEIS for the HRC contains a detailed discussion of the potential effects to fish from MFAS/HFAS and explosive detonations. Below is a summary of conclusions regarding those effects.

Effects on Fish From MFAS/HFAS

The extent of data, and particularly scientifically peer-reviewed data, on the effects of high intensity sounds on fish is limited. In considering the available literature, the vast majority of fish species studied to date are hearing generalists and cannot hear sounds above 500 to 1,500 Hz (depending upon the species), and, therefore, behavioral effects on these species from higher frequency sounds are not likely. Moreover, even those fish 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. Therefore, even among the species that have hearing ranges that overlap with some mid- and high-frequency sounds, it is likely that the fish will only actually hear the sounds if the fish and source are very 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 mask detection of lower frequency biologically relevant sounds. Based on the above information, there will likely be few, if any, behavioral impacts on fish.

Alternatively, it is possible that very intense mid- and high-frequency signals, and particularly explosives, could have a physical impact on fish, resulting in damage to the swim bladder and other organ systems. However, even these kinds of effects have only been shown in a few cases in response to explosives, and only when the fish has been very close to the source. Such effects have never been indicated in response to any Navy sonar. Moreover, at greater distances (the distance clearly would depend on the intensity of the signal from the source) there appears to be little or no impact on fish, and particularly no impact on fish that do not have a swim bladder or other air bubble that would be affected by rapid pressure changes.

Effects on Fish From Explosive Detonations

Underwater detonations are possible during SINKEX, EER/IEER, A–S MISSILEX, S–S MISSILEX, BOMBEX, S–S GUNEX, and NSFS. The weapons used in most missile and Live Fire Exercises pose little risk to fish unless the fish were near the surface at the point of impact. Machine guns (50 caliber) and close-in weapons systems (anti-missile systems) fire exclusively non-explosive ammunition. The same applies to larger weapons firing inert ordnance for training (e.g., 5-inch guns and 76-mm guns). The rounds pose an extremely low risk of a direct hit and potential to directly affect a marine species. Target area clearance procedures will again reduce this risk. A SINKEX uses a variety of live fire weapons. These rounds pose a risk only at the point of impact.

Several factors determine a fish's susceptibility to harm from underwater detonations. Most injuries in fish involve damage to air-or gas-containing organs (i.e., the swim bladder). Fish with swim bladders are vulnerable to effects of explosives, while fish without swim bladders are much more resistant (Yelverton, 1981; Young, 1991). Research has focused on the effects on the swim bladder from underwater detonations but not the ears of fish (Edds-Walton and Finneran, 2006).

For underwater demolition training, the effects on fish from a given amount of explosive depend on location, season, and many other factors. O'Keeffe (1984) provides charts that allow estimation of the potential effect on swim-bladder fish using a damage prediction method developed by Goertner (1982). O'Keeffe's parameters include the size of the fish and its location relative to the explosive source, but are independent of environmental conditions (e.g., depth of fish, explosive shot, frequency content).

Based on O'Keeffe's parameters, potential impacts on fish from underwater demolition detonations would be negligible. A small number of fish are expected to be injured by detonation of explosive, and some fish located in proximity to the initial detonations can be expected to die. However, the overall impacts on water column habitat would be localized and transient. As training begins, the natural reaction of fish in the vicinity would be to leave the area. When training events are completed, the fish stock would be expected to return to the area.

Essential Fish Habitat (EFH) Determination

EFH is defined as ''those waters and substrates necessary to fish for spawning, breeding, feeding or growth to maturity.'' Adverse effects on EFH are defined further as ''any impact that reduces the quality and/or quantity of EFH'' and may include ''site specific or habitat-wide impacts, including individual, cumulative or synergistic consequences of actions'', as well as direct or indirect physical, chemical, or biological alterations of the waters or substrate and loss of, or injury to, benthic organisms, prey species and their habitat, and other ecosystem components, if such modifications reduce the quality and/or quantity of EFH. The HRC is located in an area that has been identified as essential fish habitat under the following Western Pacific Regional Fishery Management Council (WPRFMC) Fishery Management Plans (FMPs): Pelagics (eggs, larvae, juveniles, and adults), Bottomfish (eggs, larvae, juveniles, and adults), Crustaceans (eggs, larvae, juveniles, and adults), Coral Reef Ecosystem (eggs, larvae, juveniles, and adults) and Precious Corals.

The Navy does not anticipate permanent, adverse impacts on EFH components since training activities are conducted to avoid potential impacts; however, there are temporary unavoidable impacts associated with several training activities that may result in temporary and localized impacts. In addition, a single operation may potentially have multiple effects on EFH. The current and proposed training activities in the HRC have the potential to result in the following impacts:

- Physical disruption of open ocean habitat.
- Physical destruction or adverse modification of benthic habitats.
- Alteration of water or sediment quality from debris or discharge.
- Cumulative impacts.

Each impact and operation associated with those impacts are discussed in a separate document, Essential Fish Habitat and Coral Reef Assessment for the Hawaii Range Complex EIS/OEIS (U.S. Department of the Navy, 2007b) and a summary for each proposed activity is provided. Potential impacts on FMP species include direct and indirect effects from sonar and shock waves (see discussion above and EFH document, U.S. Department of the Navy, 2007a). Numerous training activities may affect benthic habitats from debris, and there may also be temporary impacts on water quality from increased turbidity or release of materials. However, due to the mitigation measures implemented to protect sensitive habitats, and the localized and temporary impacts of the Proposed Action, the Navy concluded that the potential impact of the Proposed Action and alternatives on EFH for the five major FMPs and their associated management units would be minimal. Additional detail is provided in the Navy's FEIS on effects on EFH.

NMFS reviewed the Navy's Essential Fish Habitat and Coral Reef Assessment for the Hawaii Range Complex EIS/OEIS (2007) in accordance with the Fish and Wildlife Coordination Act (16 U.S.C. Section 662(a)), the Magnuson-Stevens Fishery Conservation and Management Act (MSA) (16 U.S.C. Section 1855(b)(2)), the Coral Reef Executive Order 13089, and NMFS'' essential fish habitat (EFH) regulations (50 CFR 600.905–930).

The Navy proposed the following mitigation measures to minimize impacts to EFH: conducting training activities in open ocean away from sensitive EFH, avoiding areas of live coral during inshore training activities, and restricting amphibious landing to specific areas of designated beaches. NMFS concurred that it is unlikely that the proposed project would have adverse impacts to EFH for the various WPRFMC FMPs, provided the proposed mitigation measures were implemented to protect EFH in the area of operation.

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 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 may vary from year to year, but will not exceed the 5-year total indicated in Table 3 (by multiplying the yearly estimate by 5) by more than 10 percent. NMFS estimates that a 10 percent increase in sonar hours would result in approximately a 10 percent increase in the number of takes, and we have considered this possibility in our analysis.

Taking the above into account, and considering the sections discussed below, 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 HRC.

Behavioral Harassment

As discussed in the Potential Effects of Exposure of Marine Mammals to MFAS/HFAS and Underwater Detonations Section and illustrated in the conceptual framework (Figure 2), 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 the source to one extent or another. Although an animal that avoids the sound source might 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 16) estimating what percentage of the total takes 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. As mentioned above, an animal's exposure to a higher received level is more likely to result in a behavioral response that is more likely to adversely affect the health of the animal.

Received Level (SPL)	Approximate Distance at which Levels Occur in HRC	Percent of Total Harassment Takes Estimated to Occur at Indicated Level
Below 140 dB	36 km – 125 km	<1%
140 < Level < 150 dB	15 km – 36 km	2%
150 < Level < 160 dB	5 km – 15 km	20%
160 < Level < 170 dB	2 km – 5 km	40%
170 < Level < 180 dB	0.6 – 2 km	24%
180 < Level < 190 dB	180 – 560 meters	9%
Above 190 dB	0 – 180 meters	2%
TTS (195 dB EFDL)	0 - 110 meters	2%
PTS (215 dB EFDL)	0 - 10	<1%

Table 16. Approximate percent of estimated takes that occur in the indicated 10-dB bins

Because the Navy has only been monitoring specifically to discern the effects of MFAS/HFAS on marine mammals since 2006, and because of the overall datagap regarding the effects MFAS/HFAS on marine mammals, not a lot is known regarding, specifically, how marine mammals in the Hawaiian Islands will respond to MFAS/HFAS. For the five MTEs for which NMFS has received a monitoring report, no instances of obvious behavioral disturbance were observed either by the Navy watchstanders or the independent observers (and a portion of the independent observations were reported within the vicinity of operating MFAS) in the 1,200+ hours of effort in which 77 sightings of marine mammals were made. One cannot conclude from these results that marine mammals were not harassed from MFAS/HFAS, as certainly 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 sp.) 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, which in the case of the watchstanders observations were the ones closest to the source and likely exposed to the highest levels, 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 this LOA, 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.

Diel Cycle

As noted previously, many animals perform vital functions, such as feeding, resting, traveling, and socializing, 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, which is not expected. Because of the need to train in a large variety of situations, the Navy does not typically conduct successive MTEs or other ASW exercises in the same locations (with the exception of the Navy's permanent instrumented ranges, such as PMRF located off Kaui). Within one multi-day exercise, the participants could potentially stay in one general area for multiple days, but the area would typically cover something like 5000 mi^2. Separately, the average length of ASW exercises (times of continuous sonar use) is approximately 12–16 hours and the vessels involved are typically moving at a speed of 10–12 knots. When this is combined with the fact that the majority of the cetaceans in the HRC would not likely remain in an area for successive days (especially an area in waters deeper than 2000 m, which is where the majority of the exercises take place), it is unlikely that animal would be exposed to MFAS/HFAS at levels 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 individuals of a few species of marine mammals may sustain some level of TTS (from MFAS or explosives). As mentioned previously, TTS can last from a few minutes to days, be of varying degree, and occur across various frequency bandwidths. Table 15 indicates the estimated number of animals that might sustain TTS from exposure to MFAS or explosives (fewer are likely to have TTS from explosives). TTS 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 of the source up to one octave higher than the source (with the maximum at ½ octave above). The two hull-mounted MFAS sources (from which the TTS was modeled) have center frequencies of 3.5 and 7.5 kHz, which suggests that TTS induced by either of these sources would be in a frequency band somewhere between approximately 2 and 20 kHz. Tables 17a and b 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 (SEL), which might be received at distances of up to 120 m from the MFAS source. 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 a sonar vessel (15 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 only pings 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 in 1 day (or less, often in minutes), though in one study (Finneran *et al.*, (2007)), recovery took 4 days.

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	Signal Type	Frequency Range (kHz)	Frequency Near Max energy (kHz)	Source Level (dB re 1 μPa)
Bryde's Whale	moans	0.07 - 0.245	0.124 - 0.132	152-174
	pulsed moans	0.1 - 0.93	0.165 - 0.9	
	discrete pulses	0.7 - 0.95	0.7 - 0.9	
Fin whale	moans	0.016 - 0.75	0.02	160-190
	pulses	0.04 - 0.075 / 0.018 - 0.025	~ / 0.020	
	ragged pulse	< 0.030		
	rumbles	~ / 0.010 - 0.030	< 0.030 / ~	
	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		
	clicks	16 - 28		
	vocal sequence, ♂ only	0.015 - 0.03		
Sei whale	FM sweeps	1.5 - 3.5		
	growls and whooshes	0.433		156
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	0.850 - 6	0.85	
	thump trains	0.1 - 2	0.1 - 0.2	
	speed up pulse train	0.2 - 0.4		
	slow down pulse train	0.25 - 0.35		
	Star Wars vocalization	0.05 - 9.4		150-165
	Breeding Boings (pulse then amp-mod. call)	1.3 - 1.4		
Humpback Whale	songs	0.03 - 8	0.1 - 4	144-186
	social	0.05 - 10	< 3	
	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	175-192
Humpback Calf	simple vocalization	0.14 - 4	0.22 (mean)	

Table 17a. Summary of mysticete vocalization information compiled from The Biology of Marine Mammals (Reynolds and Rommel (eds), 1999) and the Navy's FEIS - see those documents for specific references

	Signal Type	Frequency Range (kHz)	Frequency Near Max energy (kHz)	Source Level (dB re 1 μPa)
Sperm Whale	clicks	0.1 - 30	2 - 4, 10 - 16	160-180
	clicks in coda	16- 30		
Sperm whale calf			0.3 - 1.7	140-162
False killer whale	whistles		4 - 9.5	
	click		25 -30, 95 - 130	220-228
Pygmy killer whale	clicks	45 - 117	70 - 85	197-223
Short-finned pilot w.	whistles	0.5 - > 20	2 to 14	180
	click		30 - 60	180
Melon-headed w.	whistles	8 to 12		155
	clicks	20 - 40		165
Blainville' beaked w.	whistles, chirps	< 1 - 6		
	whistles	2.6 - 10.7		
	echolocation clicks	20 - 40		
Cuvier's beaked w.	echolocation clicks	20 - 70		
Longman's beaked w.				
Pygmy sperm whale	clicks	60 - 200	120	
Dwarf sperm whale				
Rough-toothed d.	whistles		4 to 7	
	echolocation clicks	0.1 - 200	25	
	whistles	0.3 - 24		
Risso's dolphin	whistles		3.5 - 4.5	
	rasp / pulse burst	0.1 - > 8	2 to 5	
	click		65	~120
	whistles	4 to 22		
	broadband clicks	6 - > 22		
	narrowband grunts	0.4 - 0.8		
	echolocation clicks	30 -50, 80 -100		up to 216
Risso's d. infant				
Bottlenose Dolphin	whistles	0.8 - 24	3.5 - 14.5	125-173
	whistle	4 to 20		
	click	0.2 - 150	30 -60	
	click		110 - 130	218-228
	bark	0.2 - 16		
Pantrop spotted d.	whistles	3.1 - 21.4	6.7 - 17.8	
	pulse	up to 150		
	clicks	40 -140		197-220
Spinner dolphin	whistles	1 to 20	8 to 12	
	echolocation clicks	up to 65		
	click	1 - 160	60	
Striped dolphin	whistles	1 - 22.5	6.8 - 16.9	109-125
	whistles	6 to 24	8 - 125	
	pulse bursts		May-60	108-115
Fraser's dolphin	whistles	7.6 - 13.4		
Killer whale	whistles	1.5 - 18	6 to 12	
	clicks	0.1 - 35 / 0.25 - 0.5	12 to 25 / ~	0.18 / ~
	scream	2		
	pulsed calls	0.5 - 25	1 to 6	160

Table 17b. Summary of odontocete vocalization information compiled from The Biology of Marine Mammals (Reynolds and Rommel (eds), 1999) the Navy's FEIS - see those documents for specific references

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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). Additionally (see Tables 17a and 17b), though the frequency range of TTS that marine mammals might sustain would overlap with some of their vocalization types, this frequency range of TTS would not usually span the entire frequency range of one vocalization type, much less span all types of vocalizations. It is worth noting that TTS from MFAS could potentially result in reduced sensitivity to the vocalizations of killer whales (potential predators). However, if impaired, marine mammals would typically be aware of their impairment and implement behaviors to compensate for it (see Communication Impairment Section).

Acoustic Masking or Communication Impairment

Table 17 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). 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. MFAS/HFAS pings last for about one second and occur about once every 24–30 seconds for hull-mounted sources. 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. 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 of the pulse length and duty cycle of the MFAS signal.

PTS, Injury, or Mortality

No animals were predicted (through modeling) to be exposed to levels of MFAS/HFAS that would result in direct physical injury. Further, NMFS believes that many marine mammals would deliberately avoid exposing themselves to the received necessary to induce injury levels (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. Last, 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/HFA) further ensure that animals would be not be exposed to injurious levels of sound. The Navy has 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.

The Navy's model estimated that 3 animals (one humpback whale, one spotted dolphin, and one striped dolphin) would be exposed to explosive detonations at levels that would result in injury—however, those estimates do not consider mitigation measures. Surveillance during the exercises for which injury was estimated (which includes aerial and passive acoustic detection methods, when available, to ensure clearance) begins two hours before the exercise and extends to 2 nm (3704 m) from the source. Because of the behavior and visibility of these species and the two hours of monitoring that occurs prior to detonation, NMFS does not think that any animals will be exposed to levels of sound or pressure that will result in injury from explosive detonations.

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, behavioral or physiological are not known. However, based on the number of occurrences where strandings have been definitively associated with military sonar versus the number of hours of sonar that have been conducted, we suggest that the probability is small that this will occur. Additionally, proposed monitoring of shorelines before and after major exercises combined with a shutdown protocol for live, in water, strandings minimize the chances that live milling 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 total individuals of each of these species each over the course of the 5-yr rule: bottlenose dolphin, *Kogia* spp., melon-headed whale, pantropical spotted dolphin, pygmy killer whale, short-finned pilot whale, striped dolphin, and Cuvier's, Longman's, and Blainville's beaked whale.

Resident Populations/Additional Management Units

Studies of several odontocete species within the HRC suggest demographically isolated populations might exist within the EEZ and that some species show site-fidelity. Though only one stock is designated for the HRC, both genetic testing and analysis of movement suggest that a demographically isolated inshore population of false killer whales exists within the Hawaiian EEZ and that individuals from the offshore (genetically separate) Eastern North Pacific population are also seen regularly within the Hawaii EEZ. Results from Baird *et al.'s*, (in press) analysis of interisland movements of bottlenose dolphins suggest that within the main Hawaiian Islands there are as many as four discrete populations corresponding to the four main island groupings (Nihau/Kaui, Oahu, 4-island:Molokai/Lanai/Maui/Kaho'olawe, Hawaii). McSweeney *et al.* (2007) analyzed a 21-yr photographic record of Cuvier's and Blainville's beaked whales and found evidence of long-term (15-yr), multi-season site-fidelity on the west side of Hawaii.

If the nature of the Navy's training exercises was such that they were disproportionately conducting sonar in a certain fairly large area that largely overlapped with a particular demographically isolated population, stock, or resident population, additional analysis might be needed to determine what additional impacts might occur. However, due to the Navy's need to train in a variety of bathymetric conditions and in the vicinity of a variety of other resources throughout the Main Hawaiian Islands, the location of the Navy's training exercises are highly variable, with the exception of the Navy's ranges (PMRF, etc.).

40 Years of Navy Training Exercises Using MFAS/HFAS in the HRC

The Navy has been conducting MFAS/HFAS training exercises in the HRC for over 40 years. During this time, NMFS found that sonar was a plausible, if not likely, contributor to one milling/stranding event that occurred in Hanalei Bay (see Stranding section: Hanalei), though the cause of the event was not definitively determined. Though monitoring specifically to determine the effects of sonar on marine mammals was not being conducted 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 Hawaii for 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 sonar with any regularity, more evidence would have been detected over the 40-yr period. Similarly, though population trends are not available for the vast majority of the cetacean stocks in the HRC, data indicate that humpback whale numbers are generally increasing both in Hawaii (7 percent rate of increase between 1993 and 2007: Mobley, 2004) and in Southeast Alaska (Caretta *et al.*, 2007), where the majority of the Hawaii humpback whales feed over the summer.

Species Conclusions

Mysticetes (Except Humpback Whale)

Bryde's whales, fin whales, sei whales, and Minke whales are not expected to be encountered very often in the HRC. 64 instances each of behavioral harassment of Bryde's and Minke whales, and 46 instances each of behavioral harassment of fin and sei whales are estimated to result from exposure to MFAS/HFAS (though this number does not take the potential avoidance of the sound source into consideration). When the numbers of behavioral takes are compared to the estimated abundance and if one assumes that each ''take'' happens to a separate animal, less than 20 percent of each of these Hawaiian stocks would be behaviorally harassed during the course of a year (each animal one time per year). No areas of specific importance for reproduction or feeding for these species have been identified in the HRC.

The modeling indicates that these species will not be exposed to levels associated with TTS or any type of injury as a result of the Navy's action. Further, NMFS believes that many marine mammals would avoid exposing themselves to the received levels necessary to induce injury (i.e., avoid getting as close to the vessel as they would need to: within approximately 10 m) by moving away from or at least modifying their path to avoid a close approach. Last, NMFS believes that the mitigation measures, including range clearance procedures for explosives and shutdown/exclusion zones for MFAS/HFAS and explosives would be effective at avoiding injurious exposures to animals that approach the safety zone, especially in the case of these large animals.

Sperm Whales

The modeling estimates that 767 instances of sperm whale behavioral harassment will occur as a result of MFAS/HFAS training (758—though this number does not take the potential avoidance of the sound source into consideration) or underwater detonations (9). When the numbers of behavioral takes are compared to the estimated abundance and if one assumes that each ''take'' happens to a separate animal (and each animal one time per year), less than 11 percent of the sperm whale stock would be behaviorally harassed during the course of a year. More likely, slightly fewer animals are harassed and a subset are taken more than one time per year. No areas of specific importance for reproduction or feeding for sperm whales have been identified in the HRC.

The Navy's model predicted that 9 sperm whales might be exposed to received levels of MFAS expected to cause TTS. However, due to the large size of an individual, large average group size, and pronounced blow of the sperm whale and the distance within which TTS levels are expected to occur, watchstanders will very likely detect these whales in time to shut down and prevent their exposures to levels of MFAS associated with TTS.

The model also predicted that some animals might experience TTS as a result of exposure to explosive detonations. For the same reasons listed above, NMFS anticipates that the Navy watchstanders would detect these species and implement the mitigation to avoid exposure. However, two of the largest explosives (MK–84s and MK–48s) used in the training exercises have a range to TTS that is larger than the exclusion zone (see Table 8), which means that in the types of exercises that utilize these explosives, it is possible that animals could experience TTS as a result of being exposed beyond 1 nm (1.9 km) from the explosion. Therefore, we estimate TTS could still occur incidental to exercise types that utilize the two largest explosive types these explosives (the Navy provided NMFS with take estimates broken down to the exercise level), which results in an estimate of 4 sperm whales taken by TTS from explosive detonations.

The modeling indicates that sperm whales will not be exposed to levels associated with any type of injury or death as a result of the Navy's action. Further, NMFS believes that many marine mammals would deliberately avoid exposing themselves to MFAS/HFAS at 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. Last, NMFS believes that the mitigation measures would be effective at avoiding injurious exposures to animal that approached within the safety zone, especially in the case of these large animals.

Cryptic, Deep Diving Species

The modeling predicts that the following numbers of behavioral harassments (Level B Harassment) of the associated species will occur: 2074 (dwarf sperm whales), 846 (pygmy sperm whales), 1136 (Cuvier's beaked whales), 104 (Longmans's beaked whales), and 349 (Blainvilles beaked whales). When the numbers of behavioral takes are compared to the estimated abundance and if one assumes that each ''take'' happens to a separate animal (one time per year), less than 13 percent of each of these stocks would be behaviorally harassed during the course of a year. More likely, fewer individuals would be taken, but a subset would be taken more than one time per year. No areas of specific importance for reproduction or feeding for these species have been identified in the HRC.

The Navy's model predicted that the following number of each of the species would sustain TTS (Level B Harassment) from exposure to MFAS: 35 (dwarf sperm whales), 14 (pygmy sperm whales), 5 (Cuvier's beaked whales), 1 (Longmans's beaked whales), and 6 (Blainvilles beaked whales). Though some of these predicted takes might be avoided if the animals avoided the source or if they were sighted by the watchstanders, because the species are all deep divers that are cryptic at the surface, we will assume that they actually sustain the TTS takes that are modeled. As mentioned above, some beaked whale vocalizations might overlap with the MFAS/HFAS TTS frequency range (2–20 kHz), but the limited information for *Kogia* sp. indicates that their echolocation clicks are at a much higher frequency and that their maximum hearing sensitivity is between 90 and 150 kHz. It is worth noting that TTS in the range induced by MFAS would reduce sensitivity in the band that killer whales click and echolocate in. 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 model also predicted TTS takes from explosive detonations: 13 (dwarf sperm whales), 5 (pygmy sperm whales), 8 (Cuvier's beaked whales), and 2 (Blainvilles beaked whales).

The modeling indicates that none of these species would be injured as a result of the Navy's action. Further, NMFS believes that many marine mammals would deliberately avoid exposing themselves to the received MFAS/HFAS 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. Last, NMFS believes that the mitigation measures would be effective at avoiding injurious exposures (which would only occur within approximately 10 m (10.9 yd) of the vessel) if an animal did happen to approach that closely.

Although NMFS does not expect mortality of any of these five species to occur as a result of the MFAS/HFAS training exercises (see Mortality paragraph above), because we intend to authorize mortality, we consider the 10 potential mortalities of each of these species over the course of 5 years in our negligible impact determination.

Social Pelagic Species

The modeling predicts that the following numbers of behavioral harassments of the associated species will occur: 46 (false killer whales), 46 (killer whales), 192 (Pygmy killer whales), 1753 (short-finned pilot whales), and 583 (melon-headed whales). When the numbers of behavioral takes are compared to the estimated abundance and if one assumes that each ''take'' happens to a separate animal, less than 22 percent of each of these stocks would be behaviorally harassed during the course of a year (one time per animal). More likely, fewer individuals would be taken and a small subset would be harassed more than one time per year. No areas of specific importance for reproduction or feeding for these species have been identified in the HRC.

The Navy's model predicted that these species might be exposed to received levels of MFAS expected to cause TTS. However, because of the average group size, large animal size, and the distance from the vessel in which TTS levels are expected to occur (120–160m), watchstanders will very likely detect these whales in time to shut down and prevent their exposures to levels of MFAS associated with TTS. The model also predicted that melon-headed whales and short-finned pilot whales might experience TTS as a result of explosive detonations. For the same reasons listed above, NMFS anticipates that the Navy watchstanders would detect these species and implement the mitigation to avoid exposure. However, two of the largest explosives (MK–84s and MK–48s) used in the training exercises have a range to TTS that is larger than the exclusion zone (see Table 8), which means that in the types of exercises that utilize these explosives, it is possible that animals could experience TTS as a result of being exposed beyond 1 nm from the explosion. Therefore, we estimate TTS takes could still occur incidental to exercise types that utilize two largest explosive types (the Navy provided NMFS with take estimates broken down to the exercise level), which results in the following estimates of take from explosive detonations: 1 short-finned pilot whale.

As mentioned previously, TTS from MFAS is anticipated to occur primarily in the 2–20 kHz range. If any individuals of these species were to experience TTS from MFAS/HFAS, the information in Table 7 indicates that the TTS would likely overlap with some of the vocalizations of conspecifics, and not with others. 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 modeling indicates that none of these species would be injured as a result of the Navy's action. Further, NMFS believes that many marine mammals would deliberately 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. Last, NMFS believes that the mitigation measures would be effective at avoiding injurious exposures (which would only occur within approximately 10 m (10.9 yd) of the vessel) if an animal did happen to approach that closely.

Although NMFS does not expect mortality of any of these three species to occur as a result of the MFAS/HFAS training exercises (see Mortality paragraph above), because we intend to authorize mortality, we consider the 10 total potential mortalities (over the course of 5 years) of melon-headed whales, pygmy killer whales, and short-finned pilot whales in our negligible impact determination.

Dolphins

The modeling predicts that the following numbers of behavioral harassments of the associated species will occur: 716 (bottlenose dolphins), 486 (Risso's dolphins), 1055 (rough-toothed dolphin), 1222 (Fraser's dolphin), and 2144 (pantropical spotted dolphin), 412 (spinner dolphin), and 3128 (striped dolphin). When the numbers of behavioral takes are compared to the estimated abundance and if one assumes that each ''take'' happens to a separate animal (one time per year), 12–24 percent of each of these stocks would be behaviorally harassed during the course of a year. More likely, slightly fewer individuals are harassed, but a subset are harassed more than one time during the course of the year. No areas of specific importance for reproduction or feeding for these species have been identified in the HRC, though several bays have been identified as important resting areas for spinner dolphins (the Navy conducts the majority of exercises in water deeper than 2000 m).

The Navy's model predicted that a certain number of individuals of these dolphin species would sustain TTS as a result of exposure to MFAS. Though the group size and behavior of these species makes it likely that watchstanders would detect them and implement shutdown if appropriate, the proposed mitigation has a provision that allows them 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 they would be close enough to sustain TTS, we estimate that half of the number of animals modeled for MFAS/HFAS TTS might actually sustain TTS: 9 (bottlenose dolphins), 5 (Risso's dolphins), 9 (rough-toothed dolphin), 10 (Fraser's dolphin), and 25 (pantropical spotted dolphin), 4 (spinner dolphin), and 37 (striped dolphin). As mentioned above, many of the recorded dolphin vocalizations overlap with the MFAS/HFAS TTS frequency range (2–20kHz), however, as noted above, NMFS does not anticipate TTS of a serious degree or extended duration to occur. It is worth noting that TTS is in the range induced by MFAS would reduce sensitivity in the band that killer whales click and echolocate in.

The model also predicted that individuals of this species would experience TTS from explosives. For the same reasons listed above, NMFS anticipates that the Navy watchstanders would detect these species and implement the mitigation to avoid exposure. However, as mentioned in the Social Pelagic Section, the range to TTS for the two largest explosives is larger than the exclusion zone (see Table 8), and therefore NMFS anticipates that TTS might not be entirely avoided during those exercises, which results in the following predicted TTS takes from explosives: 2 (rough-toothed dolphin), 3 (Fraser's dolphin), 1 (spinner dolphin), and 2 (striped dolphin).

The modeling indicates that none of these species would be injured as a result of exposure to MFAS/HFAS. Further, NMFS believes that many marine mammals would deliberately 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. Last, NMFS believes that the mitigation measures would be effective at avoiding injurious exposures (which would only occur within approximately 10 m (10.9 yd) of the vessel) if an animal did happen to approach that closely.

The model predicted that one pantropical spotted dolphin and one striped dolphin would be exposed to injurious levels of energy or pressure from an explosive detonation. However, as stated previously, the relatively small area in which an animal would have to be to be injured (12–1023 m) and the visibility of these species, coupled with the 1862-m (2036-yd) exclusion zone (no explosives detonated if animals are in there), which is surveyed up to 2 hours in advance of the exercise by vessel-based observers, as well as aerial and passive acoustic means (when available), support the determination that individuals of these species will not likely be injured by explosive detonations.

Although NMFS does not expect mortality of any of these species to occur as a result of the MFAS/HFAS training exercises (see Mortality paragraph above), because we intend to authorize mortality, we must consider the 10 total potential mortalities (over the course of 5 years) of bottlenose dolphin, pantropical spotted dolphins, and striped dolphins in our negligible impact determination.

Monk Seals

The modeling predicts 104 instances of behavioral harassments of monk seals. When the number of behavioral takes is compared to the estimated abundance and if one assumes that each ''take'' happens to a separate animal, approximately 8.3 percent of the stock would be behaviorally harassed during the course of a year. More likely, a smaller number of individuals would be harassed, and a subset would be harassed more than one time. More than likely, also, the 77 animals that reside in the main Hawaiian Islands would be the animals harassed. No areas of specific importance for reproduction or feeding for these species have been identified in waters of the HRC.

The Navy's model predicted that monk seals might be exposed to received levels of MFAS expected to cause TTS 3 times. Monk seals generally forage at depths of less than 100 m (109 yd), but occasionally dive to depths of over 500 m (546 yd). The majority of ASW training in the HRC, however, takes place in waters 4 to 8 times deeper than even this known (500-m (546-yd)) maximum and it is very rare for ASW training to take place in waters as shallow as 100 m (109 yd) in depth. So, generally, monk seals are less likely to be in the vicinity of ASW activities, and we believe that watchstanders are likely to spot the seals before they could close within the distance necessary to sustain TTS, which would be less than 100 m (109 yd). For these reasons we do not believe that any monk seals will experience TTS.

The Navy's model also predicted that 3 monk seals might be exposed to explosive levels that would result in the TTS. However, because of the likelihood of spotting these animals within the distance necessary to avoid TTS and implementing the exclusion zone (i.e., not detonating explosives) and the fact that the TTS takes that were modeled were not incidental to exercises using the two largest explosives, NMFS does not anticipate that any monk seals will experience TTS.

The model-estimates that individuals of this species would not be injured as a result of the Navy's action. Further, NMFS believes that monk seals would deliberately 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. Last, NMFS believes that the mitigation measures would be effective at avoiding injurious exposures (which would only occur within approximately 10 m (10.9 yd) of the vessel) if an animal did happen to approach that closely.

Humpback Whales

The modeling estimates that 9,682 instances of humpback whale behavioral harassment would occur as a result of Navy training. This may be an overestimate. The Hawaiian Humpback Whale National Marine Sanctuary worked with Dr. Joe Mobley to compile a figure that illustrates 10 years worth of humpback density data (Figure 2). This map generally shows the distribution of humpbacks throughout the Main Hawaiian Islands over 10 years and clearly depicts several ''hot spots'' where the density (on average—over 4 surveys) far exceeds the density elsewhere in the HRC (high density areas are up to 3.8 animals/square mile (Mobley, pers. comm)). However, the Navy applied a uniform distribution of humpback whales within 25 km (46.3 nm) of shore to estimate take in their model. Additionally, the Navy has indicated that, historically, they have conducted a very small amount of MFAS/HFAS transmissions in the dense humpback areas (they estimate approximately 30 hours of hull-mounted sonar were conducted in these areas in 2007), although they cannot commit to any particular levels of MFAS/HFAS use in the areas in the future because of the need for flexibility in training (every area has different characteristics and exercise participants need to be exposed to a large variety of training scenarios).

As described in the monk seal section, the Navy has indicated that the majority of ASW training in the HRC takes place in waters 2000–4000 m (2187–4374 yd) deep and it is very rare for ASW training to take place in waters as shallow as 100 m (109 yd) in depth. Based on the bathymetry of the islands and the map of the densest areas of humpbacks, this means that the majority of the exercises are 2–15 km (1–8 nm), or farther, out from the densest areas of humpbacks, which would suggest, based on table 16, that the majority of behavioral takes of humpbacks would occur at received levels less than 150–160 dB. This suggests that the overall potential severity of the effects is likely less than one would anticipate if humpbacks were not selectively using the shallower, inshore areas and the Navy were not conducting the majority of their exercises in deeper areas. Additionally, the Navy has designated a cautionary area in the Maui Basin (see Mitigation) which the Navy recognizes as an area of importance to humpback whales. As noted above, the Navy has agreed that training exercises in the humpback whale cautionary area will require a much higher level of clearance than is normal practice in planning and conducting MFA sonar training. Any determination by the Commander, Pacific Fleet, to conduct training exercises in the cautionary area will be based on the unique characteristics of the area from a military readiness perspective, taking into account the importance of the area for humpback whales. The model results suggest that each humpback whale in the HRC may be harassed somewhere between approximately 1 and 3 times per year, though more than likely some will not be harassed at all and a subset will be harassed more than 3 times/year. However, as mentioned previously, the estimated takes do not factor in the fact that a portion of the animals will likely avoid the sound to some degree.

The Navy's model predicted that 199 humpback whales might be exposed to received levels of MFAS expected to cause TTS. However, due to the large size and social behavior of humpback whales and the distance within which TTS levels are expected to occur, watchstanders will very likely detect these whales in time to shut down and prevent their exposures to levels of MFAS associated with TTS. If TTS were to occur in some humpbacks, desensitization at the frequencies of humpback vocalizations could occur due to the MFAS/HFAS TTS frequency range (2–20 kHz), however, as noted above, NMFS does not anticipate TTS of serious degree or extended duration to occur. Additionally of note, recent measurements of humpback whale calf calls, which were measured at frequencies of 140Hz to 4 kHz, with a mean frequency of 220 Hz, suggest that if a humpback did have TTS from MFAS exposure, it would not overlap with the majority of the range of the call that a calf might make, suggesting that the temporary impairment would not increase the risk of cow/calf separation.

The model also predicted that TTS takes from explosives that might occur. For the same reasons listed above, NMFS anticipates that the Navy watchstanders would detect these species and implement the mitigation to avoid exposure. However, as mentioned in the Social Pelagic Section, the range to TTS for the two largest explosives is larger than the exclusion zone (see Table 8), and therefore NMFS anticipates that TTS might not be entirely avoided during those exercises, which results in 4 predicted TTS takes of humpbacks from explosive detonations.

The modeling indicates that humpback whales will not be exposed to levels associated with any type of injury as a result of exposure to MFAS/HFAS. 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 safety zone, especially in the case of these large animals.

The model predicts that 1 humpback would be injured by an explosive detonation. However, as stated previously, the relatively small area within which an animal would have to be present at a particular moment to be injured (12 to 1023 m (13 to 1119 yd)) and the visibility of these species, coupled with the 1862-m (2036-yd) exclusion zone (no explosives detonated if animals are in there), which is surveyed up to 2 hours in advance of the exercise by vessel-based observers, as well as aerial and passive acoustic means (when available), support the determination that no humpback whales will be injured by explosive detonations.

Last, as mentioned above, humpback whale numbers are reported to be increasing both in Hawaii and in Alaska, where the majority of the Hawaii humpback whales feed in the summer.

Subsistence Harvest of Marine Mammals

NMFS has preliminarily determined that the issuance of an LOA for Navy training exercises in the HRC 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 seven marine mammal species and five sea turtle species that are listed as endangered under the ESA with confirmed or possible occurrence in the study area: humpback whale, North Pacific right whale, sei whale, fin whale, blue whale, sperm whale, and Hawaiian monk seal, loggerhead sea turtle, the green sea turtle, hawksbill sea turtle, leatherback sea turtle, and 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 training exercises in the HRC. 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 Final Environmental Impact Statement (FEIS) for the Hawaii Range Complex, which was published on May 9th, 2008. Additionally, NMFS is preparing a Draft Environmental Assessment (EA) tiered off the Navy's FEIS that analyzes the environmental effects of several different mitigation alternatives for the potential issuance of the HRC proposed rule and LOA. The Draft EA will be posted on NMFS' Web site as soon as it is complete: *http://www.nmfs.noaa.gov/pr/permits/incidental.htm*. The Navy's FEIS is also posted on NMFS website.

NMFS intends to adopt the Navy's FEIS, if adequate and appropriate, and we believe that the Navy's FEIS and NMFS' final EA will allow NMFS to meet its responsibilities under NEPA for the issuance of an LOA for training activities in the HRC. If the Navy's FEIS were not adequate, NMFS would supplement the existing analysis and documents to ensure that we comply with NEPA prior to the issuance of the final rule or LOA.

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 measures, NMFS preliminarily finds that the total taking from Navy training exercises utilizing MFAS/HFAS and underwater explosives in the HRC 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.

Classification

This action does not contain a collection of information requirement for purposes of the Paperwork Reduction Act.

Pursuant to the procedures established to implement section 6 of Executive Order 12866, the Office of Management and Budget has determined that this proposed rule is significant.

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 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. 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. Because this action, if adopted, would directly affect the Navy and not a small entity, NMFS concludes the action would not result in a significant economic impact on a substantial number of small entities.

List of Subjects in 50 CFR Part 216

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

Dated: June 13, 2008.

Samuel D. Rauch III

Deputy Assistant Administrator for Regulatory Programs, 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 P is added to part 216 to read as follows:

Subpart P—Taking Marine Mammals Incidental to U.S. Navy Training in the Hawaii Range Complex (HRC)

Subpart P—Taking Marine Mammals Incidental to U.S. Navy Training in the Hawaii Range Complex (HRC)

§ 216.170 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 Hawaii Operational Area, which extends from 16 to 43o N. lat. and from 150–179° degrees 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) and high frequency active sonar (HFAS) sources for U.S. Navy anti-submarine warfare (ASW) training in the amounts indicated below (± 10 percent):

(i) AN/SQS–53 (hull-mounted sonar)—up to 6420 hours over the course of 5 years (an average of 1284 hours per year)

(ii) AN/SQS–56 (hull-mounted sonar)—up to 1915 hours over the course of 5 years (an average of 383 hours per year)

(iii) AN/AQS–22 (helicopter dipping sonar)—up to 5050 dips over the course of 5 years (an average of 1010 dips per year)

(iv) SSQ–62 (sonobuoys)—up to 12115 sonobuoys over the course of 5 years (an average of 2423 sonobuoys per year)

(v) MK–48 (torpedoes)—up to 1565 topedoes over the course of 5 years (an average of 313 torpedoes per year)

(vi) AN/BQQ–10 (submarine mounted sonar)—up to 1,000 hours over the course of 5 years (an average of 200 per year)

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

(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) EER/IEER (5 lbs)

(ii) Training Events:

(A) Mine Neutralization—up to 310 exercises over the course of 5 years (an average of 62 per year).

(B) Air-to-Surface MISSILEX—up to 180 exercises over the course of 5 years (an average of 36 per year).

(C) Surface-to-Surface MISSILEX—up to 35 exercises over the course of 5 years (an average of 7 per year).

(D) BOMBEX—up to 180 exercises over the course of 5 years (an average of 35 per year).

(E) SINKEX—up to 30 exercises over the course of 5 years (an average of 6 per year).

(F) Surface-to-Surface GUNEX—up to 345 exercises over the course of 5 years (an average of 69 per year).

(G) Naval Surface Fire Support—up to 110 exercises over the course of 5 years (an average of 22 per year).

§ 216.171 Effective dates and definitions.

(a) Regulations in this subpart become effective upon issuance of the final rule.

(b) The following definitions are utilized in this subpart:

(1) Uncommon Stranding Event (USE)—A stranding event that takes place during a major training exercise 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 next bullet) found dead or live on shore within a two day period and occurring on same shore lines or facing shorelines of different islands.

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

(iii) A group of 2 or more cetaceans of any species exhibiting indicators of distress.

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

§ 216.172 Permissible methods of taking.

(a) Under Letters of Authorization issued pursuant to §§ 216.106 and 216.177, the Holder of the Letter of Authorization may incidentally, but not intentionally, take marine mammals within the area described in § 216.170(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 § 216.170(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 § 216.170 (c) is limited to the following species, by the indicated method of take the indicated number of times:

(1) Level B Harassment (+/−10 percent):

(i) Mysticetes:

(A) Humpback whale (*Megaptera novaeangliae*)—9893.

(B) Minke whale (*Balaenoptera acutorostrata*)—64.

(C) Sei whale (*Balaenoptera borealis*)—46.

(D) Fin whale (*Balaenoptera physalus*)—46.

(E) Bryde's whale (*Balaenoptera edeni*)—64.

(ii) Odontocetes:

(A) Sperm whales (*Physeter macrocephalus*)—781.

(B) Pygmy sperm whales (*Kogia breviceps*)—865.

(C) Dwarf sperm whale (*Kogia sima*)—2122.

(D) Cuvier's beaked whale (*Ziphius cavirostris*)—1149.

(E) Blainville's beaked whale (*Mesoplodon densirostris*)—357.

(F) Longman's beaked whale (*Indopacetus pacificus*)—105.

(G) Rough-toothed dolphin (*Steno bredanensis*)—1077.

(H) Bottlenose dolphin (*Tursiops truncatus*)—734.

(I) Pan-tropical dolphins (*Stenella attenuata*)—2199.

(J) Spinner dolphins (*Stenella longirostris*)—421.

(K) Striped dolphins (*Stenella coeruleoalba*).—3209.

(L) Risso's dolphin (*Grampus griseus*)—497.

(M) Melon-headed whale (*Peponocephala electra*)—597.

(N) Fraser's dolphin (*Lagenodelphis hosei*)—1247.

(O) Pygmy killer whale (*Feresa attenuata*)—196.

(P) False killer whale (*Pseudorca crassidens*)—46.

(Q) Killer whale (*Orcinus orca*)—46.

(R) Short-finned pilot whale (*Globicephala macrorynchus*)—1,798.

(iii) Pinnipeds: Hawaiian monk seal (*Monachus schauinslandi*)—110.

(2) Level A Harassment and/or mortality of no more than 10 individuals total of each of the species listed below over the course of the 5-year regulations: Bottlenose dolphin (*Tursiops truncatus*), Pygmy and Dwarf sperm whales (*Kogia breviceps* and *sima*), Melon-headed whale (*Peponocephala electra*), Pantropical spotted dolphin (*Stenella attenuata*), Pygmy killer whale (*Feresa attenuata*), Short-finned pilot whale (*Globicephala macrorynchus*), Striped dolphin (*Stenella coeruleoalba*), and Cuvier's beaked whale (*Ziphius cavirostris*), Blainville's beaked whale, (*Mesoplodon densirostris*), Longman's beaked whale (*Indopacetus pacificus*).

§ 216.173 Prohibitions.

Notwithstanding takings contemplated in § 216.172 and authorized by a Letter of Authorization issued under §§ 216.106 and 216.177, no person in connection with the activities described in § 216.170 may:

(a) Take any marine mammal not specified in § 216.172(c);

(b) Take any marine mammal specified in § 216.172(c) other than by incidental take as specified in § 216.172(c)(1) and (2);

(c) Take a marine mammal specified in § 216.172(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 216.177.

§ 216.174 Mitigation.

(a) The activity identified in § 216.170(a) must be conducted in a manner that minimizes, to the greatest extent practicable, adverse impacts on marine mammals and their habitats. When conducting training activities identified in § 216.170(a), the mitigation measures contained in the Letter of Authorization issued under §§ 216.106 and 216.177 must be implemented. These mitigation measures include (but are not limited to):

(1) *Mitigation Measures for ASW training:* (i) All lookouts onboard platforms involved in ASW training events will review the NMFS-approved Marine Species Awareness Training (MSAT) material prior to use of mid-frequency active sonar.

(ii) All Commanding Officers, Executive Officers, and officers standing watch on the Bridge will have reviewed the MSAT material prior to a training event employing the use of mid-frequency active sonar.

(iii) Navy lookouts will undertake extensive training in order to qualify as a watchstander in accordance with the Lookout Training Handbook (NAVEDTRA, 12968–B).

(iv) 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).

(v) 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.

(vi) 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.

(vii) All surface ships participating in ASW exercises 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 lookouts.

(viii) 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.

(ix) On surface vessels equipped with mid-frequency active sonar, pedestal mounted ''Big Eye'' (20x110) binoculars will be present and in good working order.

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

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

(xii) 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.

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

(xiv) Commanding Officers 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.

(xv) 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.

(xvi) During mid-frequency active sonar training activities, personnel will utilize all available sensor and optical systems (such as Night Vision Goggles) to aid in the detection of marine mammals.

(xvii) 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.

(xviii) Aircraft with deployed sonobuoys will use only the passive capability of sonobuoys when marine mammals are detected within 200 yards (182 m) of the sonobuoy.

(xix) 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.

(xx) Safety Zones—When marine mammals are detected by any means (aircraft, shipboard lookout, or acoustically) the Navy will ensure that MFA transmission levels are limited to at least 6 dB below normal operating levels if any detected marine mammals are within 1,000, yards (914 m) of the sonar dome (the bow).

(A) Ships and submarines will continue to limit maximum MFAS transmission levels by this 6-dB factor until the marine mammal has been seen to leave the area, has not been detected for 30 minutes, or the vessel has transited more than 2,000 yards (1828 m) beyond the location of the last detection.

(B) The Navy will ensure that MFAS transmissions will be limited to at least 10 dB below the equipment's normal operating level if any detected animals are within 500 yards (457 m) of the sonar dome. Ships and submarines will continue to limit maximum ping levels by this 10-dB factor until the marine mammal has been seen to leave the area, has not been detected for 30 minutes, or the vessel has transited more than 2,000 yards (1828 m) beyond the location of the last detection.

(C) The Navy will ensure that MFAS transmissions are ceased if any detected marine mammals are within 200 yards of the sonar dome. MFAS transmissions will not resume until the marine mammal has been seen to leave the area, has not been detected for 30 minutes, or the vessel has transited more than 2,000 yards beyond the location of the last detection.

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

(E) If the need for power-down should arise as detailed in ''Safety Zones'' above, 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 sonar was being operated).

(xxi) 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.

(xxii) 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.

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

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

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

(xxvi) Humpback Whale Cautionary Area: An area extending 5 km (2.7 nm) from a line drawn from Kaunakakai on the island of Molokai to Kaena Point on the Island of Lanai; and an area extending 5 km (2.7 nm) from a line drawn from Kaunolu on the Island of Lanai to the most Northeastern point on the Island of Kahoolawe; and within a line drawn from Kanapou Bay on the Island of Kahoolawe to Kanahena Point on the Island of Maui and a line drawn from Cape Halawa on the Island of Molokai to Lipo Point on the Island of Maui, excluding the existing submarine operating area.

(A) Should national security needs require MFA sonar training and testing in the cautionary area between 15 December and 15 April, it must be personally authorized by the Commander, U.S. Pacific Fleet based on his determination that training and testing in that specific area is required for national security purposes. This authorization shall be documented by the CPF in advance of transiting and training in the cautionary area, and the determination shall be based on the unique characteristics of the area from a military readiness perspective, taking into account the importance of the area for humpback whales and the need to minimize adverse impacts on humpback whales from MFA sonar whenever practicable. Further, Commander, U.S. Pacific Fleet will provide specific direction on required mitigation measures prior to operational units transiting to and training in the cautionary area.

(B) The Navy will provide advance notification to NMFS of any such activities (listed in paragraph (a)(1)(xxvi)(A) of this section).

(C) The Navy will include in its periodic reports for compliance with the MMPA whether or not activities occurred in the Humpback Cautionary Area above and any observed effects on humpback whales due to the conduct of these activities.

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

(A) Shutdown Procedures—When an Uncommon Stranding Event (USE—defined in § 216.171) occurs during a Major Training Exercise (MTE, including RIMPAC, USWEX, or Multi-Strike Group Exercise) in the HRC, the Navy will implement the procedures described below.

(*1*) The Navy will implement a Shutdown (as defined in § 216.171) when advised by a NMFS Office of Protected Resources Headquarters Senior Official designated in the HRC 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 Navy will maintain a dialogue, as needed, regarding the identification of the USE and the potential need to implement shutdown procedures.

(*2*) Any shutdown in a given area will remain in effect in that area until NMFS advises the Navy that the subject(s) of the USE at that area die or are euthanized, or that all live animals involved in the USE at that area have left the area (either of their own volition or herded).

(*3*) If the Navy finds an injured or dead animal floating at sea during an MTE, the Navy shall notify NMFS immediately or as soon as operational security considerations allow. The Navy will 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 will determine if, and advise the Navy whether a modified shutdown is appropriate on a case-by-case basis.

(*4*) In the event, following a USE, that: qualified individuals are attempting to herd animals back out to the open ocean and animals are not willing to leave, or animals are seen repeatedly heading for the open ocean but turning back to shore, NMFS and the Navy will coordinate (including an investigation of other potential anthropogenic stressors in the area) to determine if the proximity of MFAS 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 will further coordinate to determine what measures are necessary to further minimize that likelihood and implement those measures as appropriate.

(B) Within 72 hours of NMFS notifying the Navy of the presence of a USE, the Navy will provide available information to NMFS (per the HRC Communication Protocol) regarding the location, number and types of acoustic/explosive sources, direction and speed of units using MFAS, 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 will be provided as soon as it becomes available. The Navy will provide NMFS investigative teams with additional relevant unclassified information as requested, if available.

(C) Memorandum of Agreement (MOA)—The Navy and NMFS will 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 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 assistance does not negatively affect Fleet operational commitments.

(2) *Mitigation for IEER*—The following are protective measures for use with Extended Echo Ranging/Improved Extended Echo Ranging (EER/IEER) given an explosive source generates the acoustic wave used in this sonobuoy.

(i) Crews will conduct visual reconnaissance of the drop area prior to laying their intended sonobuoy pattern. This search should be conducted below 500 yards (457 m) at a slow speed, if operationally feasible and weather conditions permit. In dual aircraft training activities, crews are allowed to conduct coordinated area clearances.

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

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

(iv) 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 communication range of these sensors.

(v) 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.

(vi) Visual Detection:

(A) If marine mammals are visually detected within 1,000 yards (914 m) 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 1,000 yards (914 m) safety buffer.

(B) Aircrews may shift their multi-static active search to another post, where marine mammals are outside the 1,000 yards (914 m) safety buffer.

(vii) 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 1,000 yard (914 m) safety buffer, visually clear of marine mammals, is maintained around each post as is done during active search operations.

(viii) 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.

(ix) 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.

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

(3) *Mitigation for Demolitions (DEMOs) and Mine Countermeasure (MCM) Training (Up to 20 lb).* (i) *Exclusion Zones*—Explosive charges will not be detonated if a marine mammal is detected within 700 yards (640 m) of the detonation site.

(ii) *Pre-Exercise Surveys*—For MCM training activities, the Navy will conduct a pre-exercise survey 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. If a marine mammal is detected within the survey area, the exercise shall be suspended until the animal voluntarily leaves the area.

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

(iv) *Reporting*—Any evidence of a marine mammal that may have been injured or killed by the action shall be reported immediately to NMFS.

(v) *Mine Laying Training*—Though mine laying training operations involve aerial drops of inert training shapes on floating targets, measures 1, 2, and 3 for Demolitions and Mine countermeasures (above) will apply to mine laying training. To the maximum extent feasible, the Navy shall retrieve inert mine shapes dropped during Mine Laying Training.

(4) *Mitigation for SINKEX, GUNEX, MISSILEX, and BOMBEX.* (i) All weapons firing would be conducted during the period 1 hour after official sunrise to 30 minutes before official sunset.

(ii) Extensive range clearance operations would be conducted in the hours prior to commencement of the exercise, ensuring that no shipping is located within the hazard range of the longest-range weapon being fired for that event.

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

(iv) An exclusion zone with a radius of 1.0 nm (1.85 km) would be established around each target. This exclusion zone is based on calculations using a 449 kg H6 NEW high explosive source detonated 5 feet below the surface of the water, which yields a distance of 0.85 nm (1.57 km) (cold season) and 0.89 nm (1.64 km) (warm season) beyond which the received level is below the 182 dB re: 1 Pa sec2 threshold established for the WINSTON S. CHURCHILL (DDG 81) shock trials. An additional buffer of 0.5 nm (0.93 km) would 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 (1.85 km) out an additional 0.5 nm (0.93 km), would be surveyed. Together, the zones extend out 2 nm (3.7 km) from the target.

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

(A) 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 (SAR) Tactical Aid (TACAID). The SAR TACAID 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.

(B) 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.

(C) 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 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.

(D) On each day of the exercise, aerial surveillance of the exclusion and safety zones would commence two hours prior to the first firing.

(E) The results of all visual, aerial, and acoustic searches would be reported immediately to the OCE (Officer Conducting the Exercise). No weapons launches or firing would commence until the OCE declares the safety and exclusion zones free of marine mammals.

(F) If a marine mammal observed within the exclusion zone is diving, firing would be delayed until the animal is re-sighted outside the exclusion zone, or 30 minutes has elapsed. After 30 minutes, if the animal has not been re-sighted it would be assumed to have left the exclusion zone and firing would commence.

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

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

(vi) 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 mammals 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.

(vii) 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.

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

(ix) In the unlikely event that any marine mammals are observed to be harmed in the area, a detailed description of the animal would be documented, the location noted, and if possible, photos taken. This information would be provided to NMFS.

(b) [Reserved]

§ 216.175 Requirements for monitoring and reporting.

(a) The Holder of the Letter of Authorization issued pursuant to §§ 216.106 and 216.177 for activities described in § 216.170(b) 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 HRC Stranding Communication Plan, the Holder of the Authorization must notify NMFS immediately (or as soon as clearance procedures allow) if the specified activity identified in § 216.170(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 § 216.170(c).

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

(d) Report from Monitoring required in paragraph (c) of this section—The

Navy will 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) of this section. Standard marine species sighting forms will be use to standardize data collection and data collection methods will be standardized across ranges to allow for comparison in different geographic locations.

(e) SINKEX, GUNEX, MISSILEX, BOMBEX, and IEER exercises—A report detailing the timelines of the exercises conducted, the time the surveys commenced and terminated, amount and types of all ordnance expended, and the results of survey efforts for each event will be submitted to NMFS yearly.

(f) MFAS/HFAS exercises—The Navy will submit an After Action Report to the Office of Protected Resources, NMFS, within 120 days of the completion of any Major Training Exercise (RIMPAC, USWEX, and Multi Strike Group). For other ASW exercises (TRACKEX and TORPEX), the Navy will submit a yearly summary report. These reports will, at a minimum, include the following information:

(1) The estimated number of hours of sonar operation, broken down by source type

(2) If possible, the total number of hours of observation effort (including observation time when sonar was not operating)

(3) A report of 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 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.

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

(g) HRC 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 in § 216.175 (d) through (f) of this section. This report will be submitted at the end of the fourth year of the rule (November 2012), covering activities that have occurred through June 1, 2012.

(h) 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.

(i) Comprehensive National ASW Report—The Navy will submit a draft National Report that analyzes, compares, and summarizes the data gathered from the watchstanders and pursuant to the implementation of the Monitoring Plans for the HRC, the Atlantic Fleet active Sonar Training (AFAST), and the Southern California (SOCAL) Range Complex.

(j) 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.

§ 216.176 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 § 216.170(a) (the U.S. Navy) must apply for and obtain either an initial Letter of Authorization in accordance with §§ 216.177 or a renewal under § 216.178.

§ 216.177 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 § 216.178.

(b) Each Letter of Authorization will set forth:

(1) Permissible methods of incidental taking;

(2) Means of effecting the least practicable adverse impact on the species, its habitat, and on the availability of the species for subsistence uses (i.e., mitigation); and

(3) Requirements for mitigation, monitoring and reporting.

(c) Issuance and renewal of the Letter of Authorization will be based on a determination that the total number of marine mammals taken by the activity as a whole will have no more than a negligible impact on the affected species or stock of marine mammal(s).

§ 216.178 Renewal of Letters of Authorization.

(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 § 216.176 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) Timely receipt of the monitoring reports required under § 216.175(b); and

(3) A determination by the NMFS that the mitigation, monitoring and reporting measures required under § 216.174 and the Letter of Authorization issued under §§ 216.106 and 216.177, were undertaken and will be undertaken during the upcoming annual period of validity of a renewed Letter of Authorization.

(b) If a request for a renewal of a Letter of Authorization issued under §§ 216.106 and 216.178 indicates that a substantial modification to the described work, mitigation or monitoring undertaken during the upcoming season will occur, the NMFS will provide the public a period of 30 days for review and comment on the request. Review and comment on renewals of Letters of Authorization are restricted to:

(1) New cited information and data indicating that the determinations made in this document are in need of reconsideration, and

(2) Proposed changes to the mitigation and monitoring requirements contained in this subpart or in the current Letter of Authorization.

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

§ 216.179 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 216.177 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 § 216.178, 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 § 216.170(b), a Letter of Authorization issued pursuant to §§ 216.106 and 216.177 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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Table 1 to Part 216 Subpart P. Summary of monitoring effort proposed in Monitoring Plan for the Hawaii Range Complex

STUDY 1,3, 4 (exposures and behavioral responses)	**FY08**	**FY09**	**FY10**	**FY11**	**FY12**	**FY13**
Aerial surveys	Award monitoring contract, develop SOP, obtain permits	SCC OPS, or TRE or Unit Level - 60 hours of active sonar	SCC OPS or TRE or Unit Level - 60 hours of active sonar	SCC OPS or TRE or Unit Level - 60 hours of active sonar	(Only if not enough data to complete study)	(Only if not enough data to complete study)
		Three nearshore underwater detonation events	Three nearshore underwater detonation events	Three nearshore underwater detonation events	SCC OPS or TRE or Unit Level - 60 hours of active sonar	
			1-2 SINKEX events		Three nearshore underwater detonation events	SCC OPS or TRE or Unit Level - 60 hours of active sonar
					1-2 SINKEX events	
Marine Mammal Observers	Opportunistic as staff and SOP developed	SCC OPS or TRE or Unit Level - 60 hours	SCC OPS or TRE or Unit Level - 60 hours	SCC OPS or TRE or Unit Level - 60 hours	(Only if not enough data to complete study)	(Only if not enough data to complete study)
					SCC OPS or TRE or Unit Level - 60 hours	SCC OPS or TRE or Unit Level - 60 hours if study not completed
Tagging before during and after training events	NOAA project in conjunction with RIMPAC 08 (partial Navy funding)	Order tags and secure tagging permit	SCC OPS August and February – 5 animals	SCC OPS August and February – 5 animals	SCC OPS August and February – 5 animals	(Only if not enough data to complete study)
	Award monitoring contract		Unit level - 5 animals	Unit level – 5 animals	Unit level – 5 animals	SCC OPS August and February – 5 animals
						Unit level – 5 animals
Vessel surveys (study 3 and 4 only)	NOAA project in conjunction with RIMPAC 08 (partial Navy funding)	USWEX – 40 hours	USWEX – 40 hours	USWEX – 40 hours	(Only if not enough data to complete study)	(Only if not enough data to complete study)
	Award monitoring contract, develop SOP	Unit level – 100 hours	Unit level – 100 hours	Unit level – 100 hours	USWEX – 40 hours	USWEX – 40 hours
		Three nearshore underwater detonation events	Three nearshore underwater detonation events	Three nearshore underwater detonation events	Unit level – 100 hours	Unit level – 100 hours
					Three nearshore underwater detonation	Three nearshore underwater detonation
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	(Only if not enough data to complete study)	(Only if not enough data to complete study)
					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	USWEX – 60 hours	Unit level – 40 hours	Unit level – 40 hours	Unit level – 40 hours	(Only if not enough data to complete study)	(Only if not enough data to complete study)
	RIMPAC – 40 hours				Unit Level - 40 hours	Unit Level - 40 hours
Passive Acoustics	Award monitoring contract	Order devices and determine best location	Installation of 10 autonomous devices in the HRC	Continue recording from 10 devices	Continue recording from 10 devices and data analysis	Data Analysis and continue recording from 10 devices only if not enough data to complete study
			Begin recording	Begin data analysis		
Study 5 (mitigation effectiveness)	**FY08**	**FY09**	**FY10**	**FY11**	**FY12**	**FY13**
Marine mammal observers/lookout comparison	Training Events – 40 hours	Unit level – 100 hours	Unit level – 100 hours	Unit level – 100 hours	(Only if not enough data to complete study)	(Only if not enough data to complete study)
		Training events – 40 hours	Training Events– 40 hours	Training Events – 40 hours	Unit level – 100 hours	Unit level – 100 hours
					Training Events – 40 hours	Training Events – 40 hours
Aerial surveys before and after training events, exercise area and coastlines	USWEX – 60 hours	Unit level – 40 hours	Unit level – 40 hours	Unit level – 40 hours	(Only if not enough data to complete study)	(Only if not enough data to complete study)
	RIMPAC – 40 hours				Unit level – 40 hours	Unit level – 40 hours

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