HAWAII RANGE COMPLEX MONITORING PLAN DECEMBER 2008

INTRODUCTION

The U.S. Navy has developed the Hawaii Range Complex (HRC) Monitoring Plan to provide marine mammal and sea turtle monitoring as required under the Marine Mammal Protection Act (MMPA) of 1972 and the Endangered Species Act (ESA) of 1973.

In order to issue an Incidental Take Authorization (ITA) for an activity, Section 101(a) (5) (a) of the MMPA states that National Marine Fisheries Service (NOAA/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) note that requests for Letters of Authorization (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 (NOAA/NMFS, 2005).

While the Endangered Species Act does not have specific monitoring requirements, recent Biological Opinions issued by NMFS have included terms and conditions requiring the Navy to develop a monitoring program.

In addition to the HRC monitoring plan, a number of other Navy range complex monitoring plans are being developed for protected marine species, primarily marine mammals and sea turtles, as part of the environmental planning and regulatory compliance process associated with a variety of training activities. Goals of these monitoring plans are to assess the impacts of training activities on marine species and effectiveness of the Navy's current mitigation practices.

Navy-wide Integrated Comprehensive Monitoring Program (ICMP):

The Integrated Comprehensive Monitoring Program (ICMP) is Navy-wide and will provide the overarching structure and coordination that compiles data from range specific monitoring plans. The HRC plan is one component of the ICMP and many studies outlined here will also be implemented in other range complexes (Figure 1). The overall objective of the ICMP is to assimilate relevant data collected across Navy range complexes in order to answer questions pertaining to the impact of mid-frequency active sonar (MFAS) and explosives on marine mammals and sea turtles.

The primary objectives of the ICMP are to:

- Coordinate monitoring of Navy training events, particularly those involving mid-frequency active sonar (MFAS) and underwater detonations (explosives), for compliance with the terms and conditions of ESA Section 7 consultations or MMPA authorizations;

- Coordinate data collection to support estimating the number of individual marine mammals and sea turtles exposed to sound levels above current regulatory thresholds;
- Assess the efficacy of the Navy's current marine species mitigation;
- Add to the knowledge base on potential behavioral and physiological effects to marine species from mid-frequency active sonar and underwater detonations; and
- Assess the practicality and effectiveness of a number of mitigation tools and techniques (some not yet in use).

Additional Navy funded research and development (R&D) studies and ancillary research collaborations with academia and other institutions will be integrated as possible to enhance the data pool, and will be used in part to address objectives of the ICMP. Lastly, as an adaptive management strategy, the HRC monitoring plan will integrate elements from Navy-wide marine mammal research into the regional monitoring and data analysis proposed in this plan when new technologies and techniques become available.

Hawaii Range Complex (HRC) Monitoring Plan

The Hawaii Range Complex Monitoring Plan has been designed as a collection of focused "*studies*" to gather data that will allow us to attempt to address the following questions which are described fully in the following sections:

1. Are marine mammals and sea turtles exposed to mid-frequency active sonar (MFAS) at regulatory thresholds of harm or harassment? If so, at what levels and how frequently are they exposed?
2. If marine mammals and sea turtles are exposed to MFAS in the HRC, do they redistribute geographically in the HRC as a result of repeated exposure? If so, how long does the redistribution last?
3. If marine mammals and sea turtles are exposed to MFAS, what are their behavioral responses? Are they different at various levels?
4. What are the behavioral responses of marine mammals and sea turtles that are exposed to various levels and distances from explosives?
5. Are the Navy's suite of mitigation measures for MFAS and explosives (e.g., PMAP, measures agreed to by the Navy through permitting and consultation) effective at avoiding harm or harassment of marine mammals and sea turtles?

Marine Mammal and Sea Turtle Species within the HRC

There are twenty-seven species of marine mammals that may be observed either seasonally or year-round in the Hawaiian Islands Range Complex, seven of them are listed as endangered (DoN 2008b, DoN 2005). The list of species (Table 1) range from the endangered humpback whale (*Megaptera novaeangliae*) whose Hawaii population

appears to be increasing (Calambokidis et al. 2008, Mobley et al. 2001), to the endangered Hawaiian monk seal (*Monachus schauinslandi*) with its population on a decline, as well as other species of non-listed cetaceans. Table 2 includes the four species of threatened and endangered sea turtles.

The HRC Monitoring Plan is designed to collect data on all marine mammals and sea turtles encountered during monitoring studies. However, priority will be given to ESA-listed species and taxa in which MFAS exposure, under certain circumstances, and strandings have been linked. Species will be prioritized as follows: ESA-listed species (with an emphasis on humpback whales because of the important reproductive area in the HRC), beaked whales, other deep diving species, and monk seals. Given the apparent low densities of marine mammals in areas where the Navy trains, other species will not be entirely excluded from consideration. However, focus on other species will likely only occur if survey observations are low and prioritized species do not appear to be present.

The Plan recognizes that deep-diving and cryptic species of marine mammals such as beaked whales, sperm whales, pygmy sperm whales and minke whales have a low probability of visual detection (Barlow and Gisiner 2006). Therefore, methods described in the next section such as passive acoustic monitoring and tag deployment, will be used in an attempt to address this issue.

Monitoring methods will be the same across all species. However endangered species and species of concern will be of high priority during all monitoring efforts.

MONITORING PLAN

Research Elements

Every known monitoring technique has advantages and disadvantages that vary temporally and spatially. The Navy intends to use a combination of techniques so that the detection and observation of marine animals is maximized. Monitoring methods proposed during training events in the HRC include a combination of the following research elements (described below) that will be used to collection data for comprehensive assessment:

- Visual Surveys - Vessel, Aerial and Shore-based
- Passive Acoustic Monitoring (PAM)
- Marine Mammal Observers (MMOs) on Navy vessels
- Marine mammal tagging

Visual Surveys – Vessel, Aerial and Shore-based

Visual surveys of marine animals can provide detailed information about the behavior, distribution, and abundance. Baseline measurements and/or data for comparison can be obtained before, during and after training exercises. Changes in behavior and geographical distribution may be used to infer if and how animals are impacted by sound. In accordance with all safety considerations, observations will be maximized by working

from all available platforms: vessels, aircraft, land and/or in combination. Vessel and aerial surveys will be conducted on commercial vessels and aircraft. Visual surveys will be conducted during Navy training events that have been identified to provide the highest likelihood of success.

Vessel surveys are often preferred by researchers because of their slow speed, offshore survey ability, duration and ability to more closely approach animals under observation. They also result in higher rate of species identification, the opportunity to combine line-transect and mark-recapture methods of estimating abundance, tag deployment and retrieval, and collection of oceanographic and other relevant data. Vessels can be less expensive per unit of time, but because of the length of time to cover a given survey area, may actually be more expensive in the long run compared to aerial surveys (Dawson et al., 2008). Changes in behavior and geographical distribution may be used to infer if and how animals are impacted by sound. However, it should be noted that animal reaction (reactive movement) to the survey vessel itself are possible (Dawson et al., 2008). Vessel surveys typically do not allow for observation of animals below the oceans surface (e.g. in the water column) as compared to aerial surveys (DoN 2008a, Slooten et al., 2004).

Aerial surveys offer an excellent opportunity for detailed behavioral focal observations using established protocol (Richardson et al. 1985, 1986, 1990; Wursig et al. 1985, 1989; Smultea and Wursig 1995; Patenaude et al. 2002). Data collected for behavioral observations are more fully described under Study 3.

Although photo-identification studies are not typically a component of Navy exercise monitoring surveys, the Navy supports using the contracted platforms to obtain opportunistic data collection. Therefore, any digital photographs that are taken of marine mammals and sea turtles during visual surveys will be provided to local researchers for their regional research.

Passive Acoustic Monitoring

There are both benefits and limitations to passive acoustic monitoring (Mellinger et al. 2007). Passive acoustic monitoring allows detection of marine mammals that may not be seen during a visual survey. When interpreting data collected from PAM, it is understood that species specific results must be viewed with caution because not all animals within a given population are calling, or may only be calling only under certain conditions (Mellinger, 2007; ONR, 2007). Because the HRC does not have some of the advanced features that the SOAR and AUTEC ranges have, allowing for the potential to track real-time, passive acoustic monitoring in the HRC will utilize methods such as deployment of acoustic recording packages (ARPs), towed arrays and, potentially sonobuoys.

Marine Mammal Observer on Navy ships

Civilian Marine Mammal Observers (MMOs) aboard Navy vessels will be used to research the effectiveness of Navy lookouts (see Study 5 for full description), as well as for data collection during other monitoring surveys (Studies 1 and 3).

MMOs will be field-experienced observers that are Navy biologists or contracted observers. These civilian MMOs will be placed alongside existing Navy lookouts during a sub-set of training events. This can only be done on certain vessels and observers may be required to have security clearance. Use of MMOs will verify Navy lookout sighting efficiency, offer an opportunity for more detailed species identification, provide an opportunity to bring animal protection awareness to the ships' crew, and provides the opportunity for an experienced biologist to collect data on marine mammal behavior. Data collected by the MMOs is anticipated to assist the Navy with potential improvements to lookout training as well as providing the lookouts with a chance to gain additional knowledge on marine mammals.

Events selected for MMO participation will be an appropriate fit in terms of security, safety, logistics, and compatibility with Navy training. The MMOs will not be part of the Navy's formal reporting chain of command during their data collection efforts and Navy lookouts will follow their chain of command in reporting marine mammal sightings. Exceptions will be made if an animal is observed by the MMO within the shutdown zone was not seen by the lookout. The MMO will inform the lookout of the sighting so that appropriate action may be taken by the chain of command. For less biased data, it is recommended that MMOs will schedule their daily observations to duplicate the lookouts' schedule.

Marine Mammal Tagging

Technological advancements in recent years now provide opportunity for data collection by deploying tags on individual marine mammals (Baird, et al 2008; Baird et al 2006). Individuals can be tracked using VHF radio or satellite tags. These types of tags, as well as acoustic recording tags that provide more discreet information about pitch, roll, vertical and horizontal movement, can provide significant new information about animal movement and habitat use. This tool is especially useful when deployed on medium-sized, difficult-to-observe and deep-diving target species such as beaked whales. To date, some tag attachments are lasting in excess of 60 days (Baird, pers. comm. 2008). A variety of long and short term tags will be used to obtain a broad-scale data set.

Coordination with tagging efforts (e.g. collaborative NOAA/Navy project during RIMPAC 2008) in the HRC and other Navy ranges will continue. ONR-funded research for marine mammal tag development and improvement is also expected to continue.

<u>Navy training events for monitoring and determination of effort</u>

In order to effectively meet the goals outlined in this Plan, it was determined that training events recommended for monitoring should contain: 1) one or more surface combatants conducting ASW during a regularly scheduled training event; 2) training events that occur close enough to shore that re-fueling does not become an issue with the aerial survey team; and 3) for some studies, the ability to conduct aerial surveys in close proximity to Navy assets.

Based upon this guidance, the goals of the Plan, and knowledge of training events in the HRC, the Pacific Fleet operational community was asked to provide recommendations for appropriate training events for Study 1 and 3. Based upon safety considerations, MFAS use and available airspace, Pacific Fleet determined that the three training events that would be most appropriate are 1) Submarine Commander's Course Operations (SCC OPS), 2) Tactical Readiness Evaluation (TRE) and 3) unit level training (ULT).

SCC OPS is comprised of one-to-three surface ships using mid-frequency active sonar, aircraft (e.g. helicopters and P-3s) and a submarine. They typically last one to five days and are currently scheduled to occur in February and August in the Pacific Missile Range Facility instrumented ranges.

TRE is comprised of one-to-three surface ships using mid-frequency active sonar, aircraft such as helicopters and P-3s, and a submarine. TRE operations annually certify individual submarine tactical proficiencies, last four to five days and can occur at any time of the year.

Unit level training (ULT) occurs regularly throughout the HRC and typically involves one surface ship tracking a torpedo or similar device. If scheduled far enough in advance, ULT will likely be one of the most appropriate training events for the majority of the monitoring studies.

The proposed hours for conducting each study are shown in Table 3. The target hours of effort for each study have been determined based upon what methods are thought to be the most effective based upon sea states and marine mammal densities in the Hawaiian Islands. For example, as a proof-of-concept, a combination of Study's 1 and 3 was first attempted in August 2008 during SCC Ops off Kauai. SCC Ops, as well as other training events in Hawaii, are usually conducted in offshore areas, where sea states are higher and marine mammal densities are lower. During 20.5 hours of survey effort, the aerial survey team surveyed in Beaufort States ranging from 3 to 7 and did not observe any marine mammals other than coastal spinner dolphins on the transit to the survey area (Mobley 2008a). This is consistent with other aerial monitoring surveys conducted during USWEXs in 2007 and 2008 (Mobley 2007, 2008a, 2008b). As a result, the Navy will attempt to conduct these types of surveys during humpback season (e.g. February SCC Ops) or during ULT that are situated in areas with favorable sighting conditions. Additionally, monitoring in the HRC will place more emphasis on methods for which Hawaii is better suited such as passive acoustics and tagging.

The hours listed in Table 3 represent actual study hours when active sonar is being used (e.g. aerial survey in conjunction with training event), with darkness and non-ASW hours removed. They represent the minimum number of hours available per year. If additional funding and survey hours become available, they will be utilized, allowing for a more timely collection of a statistically significant sample size. Additionally, to best utilize resources, opportunities and adaptive management recommendations, hours may vary slightly between years within a survey type, or even between survey types, but overall effort will not fall below the minimum amount indicated in the table.

Monitoring Plan Study Descriptions

Study 1

Are marine mammals and sea turtles exposed to mid-frequency active sonar (MFAS)? If so, at what levels are they exposed?

To address this question, there is a need to detect marine mammals and sea turtles both at the surface and to the extent possible, in the water column. Tagging will provide complimentary information on the movements of submerged animals. MMOs will assist with species identification aboard the Navy ships and coordination.

Methods

A combination of aerial surveys, marine mammal observers, and tagging is recommended for this study, in conjunction with regularly scheduled Naval training events. Tagging will allow for assessment of location, vertical and horizontal movements, and acoustic behavior (including sounds produced and received). Tagging is particularly important to gather data on cryptic and deep diving species such as minke and beaked whales.

Visual Surveys - Aerial

During ULT, TRE and/or SCC OPS, an aerial survey team will fly transects relative to a Navy surface combatant that is transmitting MFA sonar. The aerial survey team will collect both visual sightings and behavioral observations of marine animals. These transect data will provide an opportunity to collect data of marine mammals at different received levels and their behavioral responses and movement relative to the Navy vessel's position. Surveys will include time with and without active sonar in order to compare density, geographical distribution and behavioral observations as shown in Table 3. After declassification, related sonar transmissions will be used to calculate exposure levels.

Behavioral observation methods will involve three professionally trained marine mammal observers and a pilot. Two observers will observe behaviors, one with hand-held binoculars and one with the naked eye per Wursig et al. (1985) and Richardson et al. (1986). If there is >1 whale, each observer will record respirations of different animals, ideally from the same animal. In the case of large groups, e.g., of delphinids, group behavior, speed, orientation, etc., will be recorded as described in Smultea and Wursig (1995). An observer will use a video camera to record behaviors in real time. Two external microphones will be input and attached to the video camera to record vocal behavioral descriptions on two different channels of the video camera. The videotape will be time-stamped and observers will also call out times. The third observer will record notes, environmental data, and operate a laptop connected to a GPS and the plane's altimeter,

Detailed behavioral focal observations of cetaceans will be recorded the following variables as possible: species, group size and composition (number of calves, etc.),

latitude/longitude, surface and dive durations and times, number and spacing/times of respirations, conspicuous behaviors (e.g., breach, tail slap, etc.), behavioral states, orientation and changes in orientation, estimated group travel speed, inter-individual distances, defecations, social interactions, aircraft speed, aircraft altitude, distance to focal group (using the plane's radar) and any unusual behaviors or apparent reactions following previously established protocol (Richardson et al. 1985, 1986, 1990; Wursig et al. 1985, 1989; Smultea and Wursig 1995; Patenaude et al. 2002).

A subset of data will be obtained from Penguin Banks and off Kauai's northshore near Pacific Missile Range Facility instrumented ranges as they are areas with high densities of humpback whales (*Megaptera novaeangliae*). As much as possible, the remaining survey hours will be conducted in geographic areas that provide calmer sea states to provide the highest probability of seeing animals in the water column (e.g. lees of islands and Penguin Banks). Visual survey teams will collect: 1) location of sighting; 2) species; 3) number of individuals; 4) number of calves present; 5) duration of sighting; 6) behavior of marine animals sighted; 7) direction of travel; 8) environmental information associated with sighting event including Beaufort sea state, wave height, swell direction, wind direction, wind speed, glare, percentage of glare, percentage of cloud cover; and 9) when in relation to navy exercises did the sighting occur (before, during or after detonations/exercise

Animal sightings and relative distance from the ship will be used post-survey to estimate received levels for MFAS transmission periods. These data will be used to estimate the numbers of marine mammals and sea turtles exposed at different received levels and their corresponding behavior.

MMOs on Navy Vessels

Civilian MMOs will be aboard Navy vessels involved in the study. As described earlier, MMOs will meet and adhere to necessary qualifications, security clearance, logistics and safety concerns. MMOs will monitor for marine mammals from the same height above water as the lookouts (e.g. bridge wings) and as all visual survey teams, they will collect the same data collected by Navy lookouts, including but not limited to: 1) location of sighting; 2) species; 3) number of individuals; 4) number of calves present; 5) duration of sighting; 6) behavior of marine animals sighted; 7) direction of travel; 8) environmental information associated with sighting event including Beaufort sea state, wave height, swell direction, wind direction, wind speed, glare, percentage of glare, percentage of cloud cover; and 9) when in relation to navy exercises did the sighting occur (before, during or after detonations/exercise.

Marine Mammal Tagging

Tagging will be done in conjunction with a subset of the aerial surveys to collect information on animals not observed by the aerial survey team or MMOs. Although species will be tagged opportunistically, the focus will be on cryptic and deep diving

species such as beaked, sperm and minke whales that have the lowest rates of detectability (Barlow, 2003; 2006).

Ideal tag deployment would be conducted during those days prior to the Navy training exercise, so as to allow animals time to distribute naturally before potential, immediate MFAS exposure. Goals of the tagging effort are to examine spatial distribution and behavior of animals before, during and after training events, as well as potential long-term habitat associations and distributions independent of Navy training events. Tags will be deployed on animals in geographical areas that are likely to be transited by Navy vessels during the training event.

Study 2

<u>If marine mammals and sea turtles 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?</u>

Line-transect shipboard surveys are regularly conducted by NOAA/NMFS in the HRC to assess distribution and long-term trends in abundance (e.g., Barlow, 2003; Mobley, 2004). While funding dependent, it is assumed that the NOAA data collection will continue. These NOAA surveys are often funded, in part, by the Navy and serve to address questions about long-term trends in abundance. However, since these surveys will not detect short-term shifts in distribution, redistribution of marine mammals on the order of days will be addressed by this study.

Marine mammal densities will be calculated from aerial survey data conducted immediately before and after training events. Additionally, autonomous recording devices will be used to gather additional data on animal movements through the HRC, which will provide baseline data as well as animal redistribution that might occur and go undetected by the aerial survey team which is not surveying during the training event.

Surveys will be conducted before and after training events, hence it is feasible for this type of survey to be conducted during major exercises (e.g., Undersea Warfare Exercises (USWEX) and Rim of the Pacific (RIMPAC). RIMPAC and USWEX typically involve more than three ships using MFAS as well as submarines and aircraft therefore, they will provide data on behavioral responses to larger scale training events.

Methods

Visual Surveys – Aerial

Systematic line-transect aerial surveys will be conducted on the two days before and a variation of one to five days after a Navy training events to collect relative density data in the exercise area for marine mammals and sea turtles in the area. Attempts will be made to survey during an exercise, but safety of navigation for the survey vessel may preclude conducting this kind of survey during certain Fleet events. Rationale supporting variation in the number of days after an exercise allows for detection of animals that gradually return to an area, if their distribution changes as a response. One survey day

following the training event will be devoted to flying coastlines of the islands nearest the training event to look for potential marine mammal strandings. If a stranding is observed, an assessment of the animal's condition (alive, injured, dead, and/or decayed) will be immediately reported to the Navy for appropriate action.

Standard distance sampling methodology and techniques will be used and are described in the following paragraph (Buckland et al., 2001, 2004; Kinsey et al., 2002; Strindberg et al., 2004; Thomas et al., 2007; Dawson et al., 2008). Surveys will be conducted from a twin-engine aircraft, with at least two experienced NMFS trained observers. Dawson et al. (2008) contains a thorough review of numerous considerations in marine mammal survey design, and information from this reference, combined with direct consultation with NMFS Southwest Fisheries Science Center (SWFSC) will be integrated into the HRC Monitoring Plan aerial survey design.

Two observers will spot marine mammals during the surveys and report data to a recorder. Information recorded will include species sighted, numbers of individuals, presence, or absence of a calf, behavior, angle to the sighting and any apparent reaction to the aircraft. It is important to note any unusual behavior or species associations. Additionally, GPS locations and altitude will be automatically recorded at 30-sec intervals, as well as manually whenever a sighting is made. Environmental data (sea-state, glare and visibility) will be manually recorded at the start of each transect leg and whenever conditions change. When opportunity to observe behavior and/or obtain species identification, the aircraft will go off effort (off the trackline) in order to conduct observations or to confirm species. Digital photographs or possible video may be taken as conditions permit. In the event that a given flight date is canceled, due to weather conditions, safety concerns, or mechanical problems, the survey will be flown when the safety or mechanical issue is resolve, next available good weather date, or if prolonged next available training event

Passive Acoustic Monitoring

The Navy will deploy autonomous acoustic recording buoys (see Newcomb et al., 2002; Wiggins and Hildebrand, 2007; Lammers et al., 2008) in the HRC. It is anticipated that several complimentary types will be used. The buoys will be distributed in an array to facilitate data collection on finite geographical movements; however, the exact placement of the buoys each year will be determined using operational guidance to maximize the likelihood of capturing data during training events. It is likely that the arrays will use differing formations and distances between buoys depending on what the target species are, as animals that vocalize at higher frequencies (e.g. beaked whales vice humpback whales) will require the buoys to be closer together. These buoys will be left in place for a long enough duration (e.g. months) that data are collected before, during and outside of training events. Acoustic data collected from the buoys will be used in order to detect, locate, and potentially track calling whales/dolphins. Ideally, this data will, over time, allow an assessment of any short or long term geographic redistribution of animals relative to Navy training events. As Table 3 demonstrates, it is anticipated that the number of buoys will grow as the method is proven over several fiscal years.

All passive acoustic recording packages will be set on a duty cycle to provide appropriate sampling coverage and maximize battery power and data storage space. Buoys will be retrieved as required for maintenance and downloading of data. Autonomous acoustic recording buoys will provide long term, daily information on the presence and absence of marine mammals in each area and their movements through the area. These systems will also provide information on the species present and their movements when an exercise occurs in that area (Mellinger and Barlow, 2003; Oswald et al., 2003; Mellinger et al., 2007). Acoustic data will be collected according to standard and accepted passive acoustic monitoring protocols.

Study 3

<u>If marine mammals and sea turtles are exposed to MFAS, what are their behavioral responses to various levels?</u>

Note: the methods used in Study 3 are the same as those used for Study 1, with the addition of vessel surveys. Vessel surveys are used here specifically for their ability to collect behavioral data and focal follows.

In order to address this question, marine mammals and sea turtles must be observed on the surface and at depth in the water column. MMOs aboard either Navy vessels or contracted research vessels will have difficulty observing animals below the surface. While vessel surveys are preferable in many ways (slow speed, offshore survey ability and duration, close approaches), they typically do not allow for observation of animals that are below the surface as do aerial surveys. Therefore, a combination of aerial surveys, vessel surveys, MMOs aboard Navy vessels and tagging will be used for this study. Since this study uses many of the same methods as Study 1, data will likely be collected simultaneously for both studies.

Methods

A combination of vessel and aerial surveys, MMOs on Navy ships, and tagging will be used in conjunction with training events. Two visual survey methods are recommended for this study because they provide complimentary data.

Marine mammal tagging provides the opportunity to collect location, movement and acoustic behavior. The study design also allows data collection to come from areas known to have high densities of humpback whales (*Megaptera novaeangliae*).

Visual Surveys - Aerial

During regularly scheduled training events, an aerial survey team will fly pre-determined zigzag transects relative to a Navy warship which is transmitting sonar. The aerial survey team will collect both visual sightings (to be used for densities) and behavioral observations from observed animals. These transects will allow for gathering information regarding movement of a species relative to the ship and behavioral responses of marine mammals at different received levels. The same altitude above water will be used for all surveys however, will alter slightly in the event of behavioral

observations (higher ~1500 feet) and species identification (lower ~600 feet or as NMFS permit allows). The surveys will be conducted both during and outside of sonar transmissions to allow for comparative densities and behaviors. Behavioral observations for this study will be conducted as detailed in Study 1.

A subset of data will be collected from Penguin Banks and instrumented ranges adjacent to Pacific Missile Range Facility as they are areas with high densities of humpback whales. The remainder of the studies will be conducted in geographic areas that provide calmer sea states to provide the highest probability of seeing animals in the water column (e.g. lees of islands and Penguin Banks). The aerial survey team will collect the same data that are collected by Navy lookouts, including but not limited to: 1) location of sighting; 2) species; 3) number of individuals; 4) number of calves present; 5) duration of sighting; 6) behavior of marine animals sighted; 7) direction of travel; 8) environmental information associated with sighting event including Beaufort sea state, wave height, swell direction, wind direction, wind speed, glare, percentage of glare, percentage of cloud cover; and 9) when in relation to navy exercises did the sighting occur (before, during or after detonations/exercise.

Animal sightings and relative distance from the ship will be used post-survey to determine received levels for active transmission periods. This data will be used, post-survey, to estimate the number of marine mammals and sea turtles exposed to different received levels and their corresponding behavior.

Visual Surveys - Vessel

The primary purpose of vessel surveys will be to document and monitor potential behavioral effects of the training event on marine mammals and sea turtles. As such, parameters to be monitored for potential effects are changes in the occurrence, distribution, numbers, surface behavior, and/or disposition (injured or dead) of marine mammal and sea turtle species before, during and after the training event. While challenging, the vessel surveys will attempt to conduct focal follows on animals with Navy vessels in view. Particular attention will be given to obtaining focal follows on monk seals, humpback whales and beaked whales.

As with the aerial surveys, the vessel surveys will be designed to maximize detections of any target species near training event for focal follows. Systematic transects will be used to locate marine mammals, however, the survey should deviate from transect protocol to collect behavioral data particularly if a Navy vessel is visible on the horizon or closer. At this point, they will approach within three nautical miles of the vessel(s), if weather and conditions allow, and will work in ‘focal follow mode’ (e.g. collect behavioral data using the big eyes, and observe the behavior of any animals that are seen). The team will go off effort for photo-id and close approach ‘focal animal follows’ as feasible, and when marine animal encounters occur in proximity to the vessel. While in focal follow mode, observers will gather detailed behavioral data from the animals, for as long as the animal allows. Analysis of behavioral observations will be made after the exercise or training event (Altman, 1974; Martin and Bateson, 1993). While the Navy vessels are within view, attempts will be made to position the dedicated survey vessel in the best possible

way to obtain focal follow data in the presence of the Navy exercise. If Navy vessels are not in view, then the vessel will begin a systematic line transect surveys within the area to assess marine mammal occurrence and observe behavior. The goal of this part of the survey is to observe marine mammals that may not have been exposed to MFAS or explosions. Therefore, post-analysis will focus on how the location, speed and vector of the survey vessel and the location and direction of the sonar source (e.g. Navy surface ship) relates to the animal. Any other vessels or aircraft observed in the area will also be documented. Data will be logged using software which can be specifically designed to facilitate collection of behavioral data and be specifically tailored to the needs of the HRC Plan and ICMP.

Marine mammal observers aboard Navy vessels:

Marine mammal observers (MMOs) will observe alongside existing lookouts aboard Navy vessels. Qualifications must include expertise in species identification of regional marine mammal and sea turtle species and conducting behavioral observations.

The MMOs will collect will collect the same data that are collected by Navy lookouts, including but not limited to: 1) location of sighting; 2) species; 3) number of individuals; 4) number of calves present; 5) duration of sighting; 6) behavior of marine animals sighted; 7) direction of travel; 8) environmental information associated with sighting event including Beaufort sea state, wave height, swell direction, wind direction, wind speed, glare, percentage of glare, percentage of cloud cover; and 9) when in relation to navy exercises did the sighting occur (before, during or after detonations/exercise.. All MMO sighting and associated data collection will be conducted according to a standard operating procedure (SOP), and will be integrated into the ICMP data set.

Marine Mammal Tagging

Tagging will be done in conjunction with a subset of the above visual surveys to collect information on animals that are not observed by the visual teams. Species will be tagged opportunistically. However, focus will be on cryptic and deep diving species such as beaked, sperm and minke whales that have the lowest rates of detection (Barlow, 2003; 2006).

Attempts to tag suitable animals will be conducted prior to a given Navy event. Tagging will be conducted during the week prior to a specified Navy training event, allowing animals the opportunity to distribute naturally prior to any potential immediate exposure to training activities. Tags will be applied in a geographical area within HRC likely to be transited by Navy vessels during the training event.

As part of the Monitoring Plan implementation, specific tagging SOPs and protocols will be developed. Various categories of tags will be reviewed for ease of use, data quality, longevity, and availability. A benefit to a mix of tag types is the maximization of data collections. Some tags have longer durations over days-week-months (e.g., satellite), while others provide more discreet data on vertical and horizontal movements as well as pitch, roll and acoustics (suction cup).

Study 4

What are the behavioral responses of marine mammals and sea turtles exposed to specific types and levels of explosives?

Explosives training can take the form of nearshore detonations such as mine neutralization and demolition of debris, or offshore events such as SINKEX or GUNEX. A number of shallow, nearshore water ranges (e.g., Puuloa Underwater Range, Ewa Training Minefield, Barbers Point Underwater Range, and Lima Landing) are used for underwater detonation training (i.e. mine neutralization, demolition of debris) in the HRC. Offshore detonation training also occurs and includes GUNEX and SINKEX.

The sinking exercise (SINKEX) involves a vessel towed to a deep water offshore area (greater that 50 nm from shore) that is then sunk using a variety of munitions (5 in shell, bombs, missiles or torpedoes). The duration of a SINKEX is unpredictable since it ends when the target sinks, either immediately after the first weapon impact or only after multiple impacts by a variety of weapons. Typically, the exercise lasts for 4 to 8 hours over 1 to 2 days. A GUNEX involves firing weapons with shells of various sizes from a surface ship at a target up to 1-4 miles away.

Nearshore detonation events use relatively small areas in comparison to MFAS training events, which typically occur over large offshore areas of the range. Offshore explosive training events are often a component of other training activities involving MFAS although they are not conducted simultaneously.

Methods

To address this question, there is a need to observe marine mammals and sea turtles at the surface and to the extent possible, in the water column. Due to the varied nature of training events that might utilize explosives, a combination of visual methods are recommended.

Visual Surveys - Shore-based (for nearshore events)

If explosive training events are planned in advance to occur adjacent to nearshore areas where there are elevated coastal structures (e.g. lighthouses) or topography (e.g. accessible cliffs or ridges such as Makaha Ridge), then shore-based monitoring, using binoculars or theodolite, may be used to augment other visual survey methods. These methods have been proven valuable in similar monitoring studies such as ATOC and others (Frankel and Clark, 1998; Clark and Altman, 2006)

Aerial or vessel surveys of the detonation area and nearby beaches will be conducted for stranded marine animals following nearshore events. If any distressed, injured or stranded animals are observed, an assessment of the animal's condition (alive, injured, dead, or degree of decomposition) will be reported immediately to the Navy for appropriate action.

Visual Surveys - Shore-base (for offshore events)

If the location for offshore explosives training is planned in advance, aerial or vessel surveys would be conducted before, during (if determined to be safe) and post detonations. Number of days post survey will vary (e.g. 1-5 days) so as to allow adequate time for animals to return in the event they geographically redistributed in response to underwater detonations.

The appropriate size for the survey area will be determined by the visual survey crew based upon the type of explosive training event that is planned. If animals are observed prior to or during an explosion, a focal follow of that individual or group will be conducted to record behavioral responses. Navy mitigation measures will prevent the training event from occurring should animals be seen within certain distances of the event, so the amount of data that can be gathered is unknown.

The visual survey team will collect the same data that are collected by Navy lookouts, including but not limited to: 1) location of sighting; 2) species; 3) number of individuals; 4) number of calves present; 5) duration of sighting; 6) behavior of marine animals sighted; 7) direction of travel; 8) environmental information associated with sighting event including Beaufort sea state, wave height, swell direction, wind direction, wind speed, glare, percentage of glare, percentage of cloud cover; and 9) when in relation to navy exercises did the sighting occur (before, during or after detonations/exercise. Animal sightings and relative distance from a particular detonation site will be used post-survey to estimate the number of marine mammals and sea turtles exposed to different received levels (energy and pressure of discharge based on distance to the source, bathymetry, oceanographic conditions and the type and size of detonation) and their corresponding behavior. For vessel based surveys a passive acoustic system (hydrophone or towed array) or sonobuoys may be used to help determine if marine mammals are in the area before and after a detonation event.

Study 5

Is the Navy's suite of mitigation measures for MFAS and explosives effective in avoiding injury and mortality of marine mammals and sea turtles?

It is the Navy's position that the suites of mitigation measures for sonar and explosives are effective at avoiding exposures of marine mammals to levels of energy or pressure from sonar or explosives that would result in harm or mortality of marine mammals. Through several methods, this study will provide the scientific data needed to support that position. The Navy will 1) conduct aerial surveys before and after two major exercises per year (at least one of which includes multiple explosive detonations) to determine whether animals have been injured in the exercise area; and 2) conduct a comparison of professional marine mammal observers and Navy lookouts.

Methods

Lookout comparison

Navy lookouts are provided with extensive training to detect anything in the water 360 degrees around Navy vessels. This includes marine mammals. Lookouts are not

biologists trained to identify marine animals at the species level, but they do have the skills to detect all marine mammals and sea turtles that are visible at the surface. In order to provide the scientific data to support this position, the Navy will initiate a side-by-side comparison of Navy lookouts ability to detect marine mammals at sea with sightings made by professional marine mammal observers.

Marine mammal observers (MMOs) will be placed alongside Navy lookouts during regularly scheduled training events in the HRC. MMOs will be required to possess expertise in species identification of regional marine mammal and sea turtle species and conducting behavioral observations. Experience as a NMFS marine mammal observer is preferred, but not required. Navy biologists and contracted biologists will both be used; contracted MMOs must have appropriate security clearance to board Navy vessels. As noted above, MMOs will not be placed aboard Navy vessels for every Navy training event or major exercise, but during specifically identified opportunities deemed appropriate for data collection efforts. Additionally, the events selected for MMO participation will take into account safety, logistics, and operational concerns associated with such an endeavor. Navy lookouts will not be specially chosen.

Marine mammal observers will observe from the same height above water as the lookouts. Navy lookouts will officially be on duty and have the same responsibilities that they always do on duty (no more, no less). MMOs will not be part of the Navy's formal reporting chain of command during their data collection efforts; Navy lookouts will continue to serve as the primary reporting means within the Navy chain of command for marine mammal sightings. The only exception is that if an animal is observed within the shutdown zone that has not been observed by the lookout, the MMO will inform the lookout of the sighting for the lookout to take the appropriate action through the chain of command.

To the extent practicable, the MMO and lookouts will avoid divulging to each other when they observe a marine mammal, allowing for a 'blind' study. Depending on ship configuration, the MMOs and lookout may be on the same bridge wing, or the MMO may be at a position above the bridge (about 15 ft or 4.5 m on most MFAS equipped ships). Because of their relative marine mammal experience, MMOs will also attempt species identification to the lowest taxon possible, more detailed information on marine mammal behavior if warranted. All MMO sighting and data collection will be conducted according to a standard operating procedure (SOP), and will be integrated into the ICMP data set.

Comparisons of the following will be made between experienced observers and the lookouts 1) Rate of detection: Comparison of the number of animals sighted per hour (or other appropriate sighting period), 2) Distance of sighting: Comparison of the distance where the sighting was first made, 3) Distance estimation: Consistency of sighting distance estimates, 4) Animal size estimation: Comparison of animal size estimation (either by actual length or by grouping – small or dolphin size, medium and large), 5) Direction of travel relative to the ship or by compass bearing, 6) Behavior categorization: Comparison of the categorized of behaviors.

It is assumed that the abilities of Navy lookouts and professional marine mammal observers will vary; therefore, it is important that data be collected from several locations, in many environmental conditions, with many different lookouts and MMOs.

Visual Surveys - Aerial

For two training events per year (at least one of which includes explosive detonations), a contracted team will conduct pre and post aerial surveys of the exercise area. The survey area should take local oceanographic currents into consideration to allow for assessment of floating/injured animals. If the exercise occurred within 25 miles of the islands, the coastlines of those islands will also be flown to look for potential strandings. If a stranding is observed, an assessment of the animal's condition (alive, injured, dead, or degree of decomposition) will be reported immediately to the Navy for appropriate action (as described in the HRC Stranding Plan).

These aerial surveys will be the same as those conducted for other HRC monitoring studies. However, for this study in particular, survey data will include identification of any distressed, injured or stranded animals both in the training event area and adjacent island coastlines.

IMPLEMENTATION – ANALYSIS – REPORTING

Worldwide, a suite of visual and acoustic monitoring techniques has been used to assess the effects of anthropogenic sound on marine mammals (Barlow and Gisiner, 2006). For example, for more than a decade, studies on low-frequency active (LFA) sonar on marine mammals have been conducted (Aburto et al., 1997; Croll et al., 2001; Fristrup et al., 2003; Clark and Altman, 2006). Similar monitoring techniques were used during low-frequency sound emissions that were conducted for the Acoustic Thermometry of Ocean Climate (ATOC) (Au et al., 1997; NRC, 2000; Frankel and Clark, 1998 and 2000; 2002, Costa et al., 2003) and ATOC's continuation project, the North Pacific Acoustic Laboratory (NPAL) (Office of Naval Research, 2001; Mobley, 2006).

The HRC monitoring plan proposes monitoring goals that are unique with regard to their breadth as well as their focus on potential impacts of MFAS on marine mammals and sea turtles. To accomplish these goals, the Navy will use similar methods of implementation and data analysis which have demonstrated success in comparable monitoring programs studying the effects of anthropogenic sound on marine animals (Detailed in Appendix B).

<u>HRC Implementation and Analysis</u>

Table 3 provides detail about how the HRC Plan will be implemented from 2009 to 2013. Monitoring surveys were conducted in 2007 and 2008 on vessel and aerial platforms, before and after training exercises. After the issuance of the Letter of Authorization (LOA), implementation of this monitoring plan will commence in 2009 at which time monitoring will begin gradually and then ramp up in 2010. Many of the study hours may overlap when implemented, allowing for data to be collected for more than one study simultaneously. For example, during the SCC Ops monitoring completed in August 2008,

the Navy conducted aerial surveys that allowed for data collection on Studies 1 and 3. Therefore, the hours in Table 3 represent those spent on each study, but are not necessarily an additive number of hours per method, per year. Collecting data concurrently for more than one study will only be initiated if doing so does not compromise the data integrity. .

The Navy will be investing significant funding and personnel towards this monitoring program and intends to conduct the research in a scientifically defensible and robust manner. The Navy is committed to conducting research until these questions have been answered to the satisfaction of both NMFS and Navy. Therefore, it is in the best interest of the Navy to choose studies wisely in each range complex that are the most likely to collect large data sets, and will enable the Navy and NMFS to answer the required questions. Some field methods may be applied throughout Navy ranges, while other methodologies may be specially selected for one or two ranges that are most likely to produce the best quality data. For example, in Hawaii, there are some baseline data on odontocetes from previous tagging (Baird et al., 2006), which can be used to provide a context for any tagging data collected during training events.

The four research projects summarized in Appendix B suggest that the sample size required for statistically significant results varies between species, season and project. For the HRC monitoring plan, therefore, it is premature to dictate before data collection begins what sample size will be required from each species in each study. This is particularly true given that research will be conducted on a diversity of species. The HRC plan, as written, covers research on the effects from MFAS and explosives on a diversity of mysticete and odontocete species found in the HRC. This range of species will make each study unique in the sense of knowing when enough data have been collected. As a result, it may be prudent to initially focus some of the studies on prioritized species that are likely to provide more data collection opportunities and use those as representative species.

Using the ATOC and SURTASS monitoring programs as a guideline for success (Appendix B), one thing becomes clear - the key to the success of the plan's execution and analysis is using scientific professionals that are the top of their field. It is the Navy's intention that the HRC plan be implemented by a team of qualified, professional marine mammal and sea turtle biologists who are experts in their field. This team of experts will include statistical analysts to analyze data and make recommendations as to when they are beginning to see a pattern in the data and/or when the study designs need to be slightly altered for more robust data collection. This adaptive management process will provide a critical feedback loop to allow for adapting to new methods and evolving methodology. The process will be transparent to the public in the sense of yearly reporting to NMFS under the MMPA permit as well as encouraging the scientific team to publish results as they become available.

Although it is not typically considered valid to combine data sets from various platforms, (e.g. shipboard and aerial surveys) this will need to occur in order to provide the best possible data coverage. Issues related to data compatibility will be confronted, given that

the use of scientifically acceptable combinations of methods will be critical to accomplishing goals and objectives. Data collection methods will also be standardized to allow for comparison from ranges in different geographic locations. For example, as with the research programs described in Appendix B, it is suggested that data collected for the range complex plans will be assessed using a software program that can be custom designed (e.g. Noldus products, Cornell's Aardvark) to provide the framework for standardization of data collection and analysis between the different geographical regions. A data management system will be developed to assure standardized, quality data are collected towards meeting of the goals.

New technology and techniques will be incorporated as part of the Navy's adaptive management strategy. Adaptive measures and feedback from the experts will allow flexibility within a given year and/or within years so as to best achieve monitoring plan goals and take into consideration shifting demands, inclement weather and other unforeseen events. For example, flexibility is built in to monitor an alternate but equal training exercise within the year and/or in a following year in the instance an operational schedule changes, is delayed or cancelled. This flexibility ensures monitoring will occur under the best of circumstances and conditions.

In addition to the studies conducted under the HRC plan, the Navy intends to collaborate with other researchers in Hawaii who are conducting complimentary research on this topic. Those studies will not replace the Navy's obligation under the HRC plan, but will augment the resources provided to the Plan's specific questions. Appendix A provides more discussion on those other Hawaii projects.

ICMP:

The ICMP is currently in development by the Navy, with Chief of Naval Operations (CNO) and the Marine Resources Support Group having the lead. The program does not duplicate the HRC monitoring plan, instead it is intended to provide the overarching coordination that will support compilation of data from both range-specific monitoring plans (e.g. HRC plan) as well as Navy funded research and development (R&D) studies (see Appendix A). The ICMP will coordinate the monitoring programs progress towards meeting its goals and develop a data management plan. A program review board is also being considered to provide additional guidance. The ICMP will be evaluated annually to provide a matrix for progress and goals for the following year, and will make recommendations on adaptive management for refinement and analysis of the monitoring methods.

Due to the complexity of the ICMP and large number of U.S. Navy Range Complexes and training events, the Navy is considering the dedication of a Program Manager to oversee the ICMP. Specific qualifications, roles and responsibilities are yet to be determined but may include the oversight and coordination of all range-complex monitoring plans.

Reporting:

The Navy will provide monitoring reports to NMFS HQ in fulfillment of the MMPA Letter of Authorization (LOA) requirements. The reports will provide information on the amount and spatial/temporal distribution of monitoring effort as well as summaries of data collected and any preliminary results that may be available from analysis. All subsequent analysis shall be completed in time for Navy's five year report to NMFS.

Data collected from the HRC monitoring plan will be added to a Navy wide analysis of monitoring from other permitted Navy range complexes via the ICMP. All available data will be included in Navy's annual report and individual exercise reports for the HRC as detailed in the requirements specified in the NMFS MMPA LOA. All subsequent analysis shall be completed in time for Navy's five year report to NMFS. The Navy's reports will provide information on the amount and spatial/temporal distribution of monitoring effort as well as summaries of data collected and any preliminary results that may be available from analysis. This also includes an evaluation of the effectiveness of any given element within the HRC monitoring program. All data will be considered pre-decisional during the course of the research studies to protect from premature conclusions being drawn. While data will be prepared and analyzed over the course of the five years of the LOA, under no circumstances will conclusions be represented before the studies are completed. Final conclusions cannot be published nor information released outside of their organization without the written consent of the Secretary of the Navy or their designee.

Table 1. Marine Mammal Species in the Hawaii Range Complex*

Order Cetacea	Scientific Name	Status	Occurrence[1]
Suborder Mysticeti (baleen whales)			
Family Balaenopteridae (rorquals)			
Blue whale	*Balaenoptera musculus*	Endangered	Rare
Bryde's whale	*Balaenoptera edeni/brydei*		Regular
Fin whale	*Balaenoptera physalus*	Endangered	Rare
Humpback whale	*Megaptera novaeangliae*	Endangered	Regular
Minke whale	*Balaenoptera acutorostrata*		Regular
Sei whale	*Balaenoptera borealis*	Endangered	Rare
Suborder Odontoceti (toothed whales)			
Family Physeteridae (sperm whales)			
Sperm whale	*Physeter macrocephalus*	Endangered	Regular
Family Kogiidae (pygmy sperm whales)			
Dwarf sperm whale	*Kogia sima*		Regular
Pygmy sperm whale	*Kogia breviceps*		Regular
Family Ziphiidae (beaked whales)			
Blainville's beaked whale	*Mesoplodon densirostris*		Regular
Cuvier's beaked whale	*Ziphius cavirostris*		Regular
Longman's beaked whale	*Indopacetus pacificus*		Regular
Family Delphinidae (dolphins)			
Common bottlenose dolphin	*Tursiops truncatus*		Regular
False killer whale	*Pseudorca crassidens*		Regular
Fraser's dolphin	*Lagenodelphis hosei*		Rare
Killer whale	*Orcinus orca*		Regular
Melon-headed whale	*Peponocephala electra*		Regular
Pantropical spotted dolphin	*Stenella attenuata*		Regular
Pygmy killer whale	*Feresa attenuata*		Regular
Risso's dolphin	*Grampus griseus*		Regular
Rough-toothed dolphin	*Steno bredanensis*		Regular
Short-finned pilot whale	*Globicephala macrorhynchus*		Regular
Spinner dolphin	*Stenella longirostris*		Regular
Striped dolphin	*Stenella coeruleoalba*		Regular
Order Carnivora	**Scientific Name**	**Status**	**Occurrence[1]**
Suborder Pinnipedia (seals, sea lions, walruses)			
Family Phocidae (true seals)			
Hawaiian monk seal	*Monachus schauinslandi*	Endangered	Regular

Sources: Barlow, 2003; Barlow 2006; Caretta et al., 2006; DoN, 2005; DoN 2008; Mobley, 2004, Rankin, et al 2007.

[1] Occurrence: Regular = species that occurs as a regular or normal part of the fauna of the area, regardless of how abundant or common it is, Rare = A species that only occurs in that area sporadically.

*Table does not show extralimital species such as north Pacific right whale and pinnipeds other than monk seals.

Table 2. Sea Turtle Species in the Hawaii Range Complex

Order Testudines	Scientific Name	Status	Occurrence[1]
Family Cheloniidae (hard shelled)			
Green turtle	*Chelonia mydas*	Threatened	Regular
Hawksbill turtle	*Eretmochelys imbricata*	Endangered	Regular
Loggerhead turtle	*Caretta caretta*	Threatened	Regular
Olive ridley turtle	*Lepidochelys olivacea*	Threatened	Regular
Family Dermochelyidae (leatherback)			
Leatherback turtle	*Dermochelys coriacea*	Endangered	Regular

Source: compiled in DoN 2005.

[1] Occurrence: Regular = species that occurs as a regular or normal part of the fauna of the area, regardless of how abundant or common it is, Rare = A species that only occurs in that area sporadically.

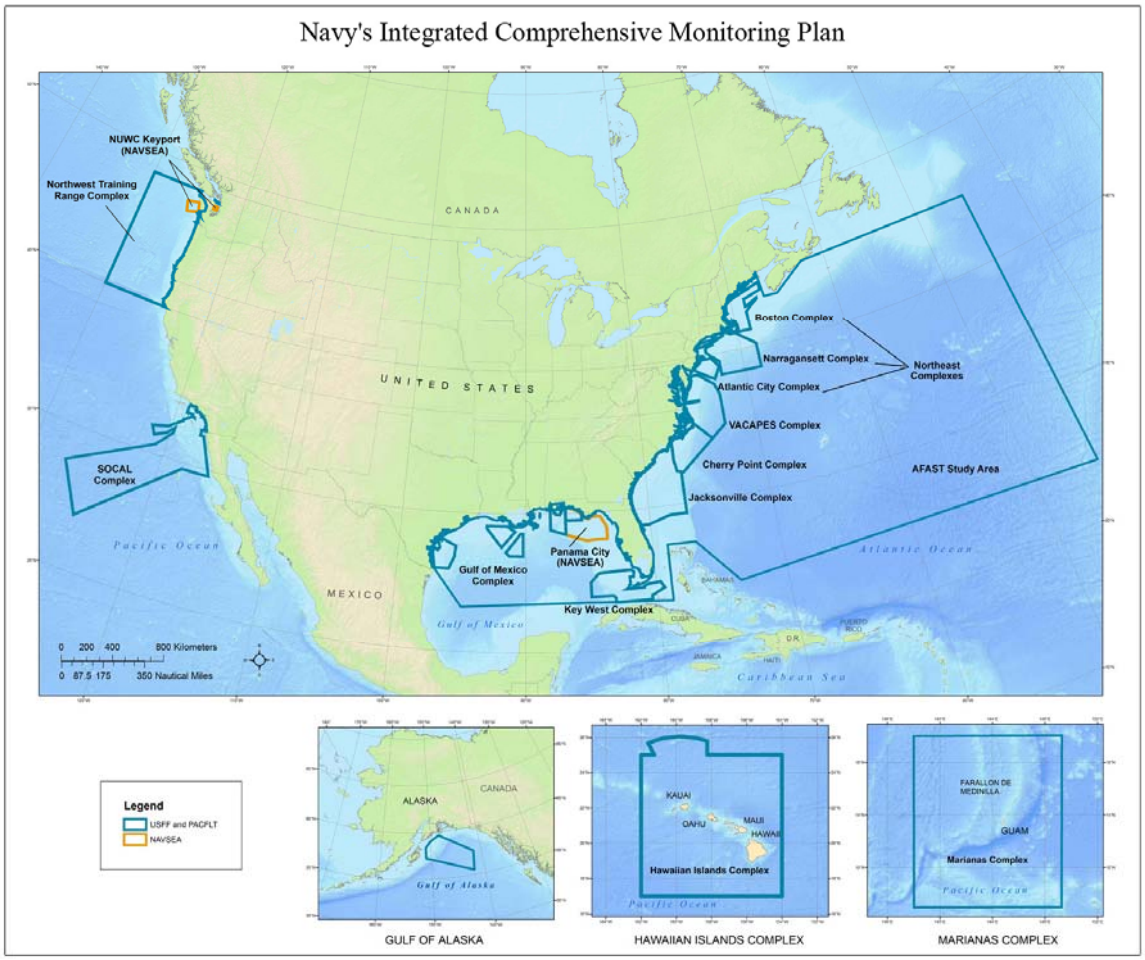
Table 3. Summary of monitoring studies planned each year.

STUDY 1,3, 4 (exposures and behavioral responses)	**FY09**	**FY10**	**FY11**	**FY12***	**FY13***
Aerial surveys	ASW events – 40 hours Explosives: 3 nearshore events	ASW events - 40 hours of active sonar Explosives: 3 nearshore events plus 1-2 SINKEX	ASW events - 40 hours of active sonar Explosives: 3 nearshore events	ASW events - 40 hours of active sonar Explosives: 3 nearshore events plus 1-2 SINKEX	ASW events - 40 hours of active sonar Explosives: 3 nearshore events
Marine Mammal Observers	ASW events – 40 hours	ASW events - 80 hours	ASW events - 80 hours	ASW events - 80 hours	ASW events - 80 hours
Tagging	Order tags, secure permit	ASW events – goal of 15 individuals	ASW events – goal of 25 individuals	ASW events – goal of 30 individuals	ASW events – goal of 30 individuals
Vessel surveys (study 3 & 4 only)	ASW events - 40 hours Explosives- 2 nearshore events	ASW events - 80 hours Explosives- 3 nearshore events	ASW events - 80 hours Explosives- 3 nearshore events	ASW events - 80 hours Explosives- 3 nearshore events	ASW events - 80 hours Explosives- 3 nearshore events
Shore based surveys (study 4 only)	Explosives - nearshore events, as they occur, with “high ground” for monitoring	Explosives - nearshore events, as they occur, with “high ground” for monitoring	Explosives - nearshore events, as they occur, with “high ground” for monitoring	Explosives - nearshore events, as they occur, with “high ground” for monitoring	Explosives - nearshore events, as they occur, with “high ground” for monitoring
STUDY 2 (geographic redistribution)	**FY09**	**FY10**	**FY11**	**FY12**	**FY13**
Aerial surveys before and after training events	ASW events – 40 hours	ASW events – 40 hours	ASW events – 40 hours	ASW events – 40 hours	ASW events – 40 hours
Passive Acoustics	Order devices and determine best location	Install 10 autonomous devices in the HRC & begin recording	Install five more devices (if needed), continue recording & begin analysis	Continue recording and analyzing data from 10-15 devices	Continue recording and analyzing data from 10-15 devices

Study 5 (mitigation effectiveness)	**FY09**	**FY10**	**FY11**	**FY12**	**FY13**
Marine mammal observers and lookout comparison	ASW events – 40 hours Explosives – 40 hrs	ASW events – 60 hours Explosives – 40 hrs	ASW events – 100 hours Explosives – 40 hrs	ASW events – 100 hours Explosives – 40 hrs	ASW events – 100 hours Explosives – 40 hrs
Aerial surveys	ASW – 40 hours	ASW events – 40 hours	ASW events – 40 hours	ASW events – 40 hours	ASW events – 40 hours

* Data collection in FY12 and FY13 will be conducted for that study only if Navy and NMFS determine that additional data collection is needed to obtain a large enough sample size for conclusive analysis.

Figure 1. Integrated Comprehensive Monitoring Plan – Navy-wide Map of Ranges where data collection is expected to occur. Details to be determined as compliance documents are finalized.



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APPENDIX A.
RELATED NAVY FUNDED RESEARCH IN HAWAII AND OTHER AREAS.

Nationwide marine species research:

The Chief of Naval Operations (CNO) Environmental Readiness Division and the Office of Naval Research (ONR) have developed a coordinated Science & Technology and Research & Development program focused on marine mammals and sound. Total investment in this program for FY08 was over 26 million, and continued funding is foreseen in subsequent years. The program does the following:

- Comprises four interrelated areas: determining marine mammal demographics; establishing accepted criteria and thresholds to measure the effects of naval activities; developing effective protective methods to lessen those effects; and further understanding the effects of man-made sound fields on marine life.
- Provides better biological data and tools to enable the Fleet to train prior to deployments at a minimal risk to marine mammals.
- Seeks to make monitoring and mitigation as compatible as possible with Fleet sensors, data displays and personnel training.

Navy funded, related marine mammal research in Hawaii:

Through Strategic Environmental Research and Development Program (SERDP), DoD Center of Excellence for Research in Ocean Sciences (CEROS), CNO and ONR, the Navy has funded marine mammal research in the Hawaiian Islands for many years. Many of these research studies and programs overlap considerably with the goals of the HRC monitoring plan and ICMP. It is important to the Navy to facilitate collaboration with Hawaii academic researchers, scientists at NMFS Pacific Islands Fisheries Science Center (PIFSC), and Navy funded regional science efforts to contribute additional broad area information on marine mammals and sea turtles within the Hawaiian Islands. While some of them have a broader focus than the research questions posed in this Plan, basic biological information from other sources can contributes to better understanding of the biology, distribution and behavior of regional marine mammal populations. Additionally, some of these funding sources provide research opportunities directly related to the Plan, such as the collaborative marine mammal tagging study, funded in-part by the Navy and conducted during RIMPAC 08. Analysis is still ongoing, however it is anticipated that this study will provide valuable information on marine mammal distribution and perhaps behavioral responses to Navy training.

Along the lines of the RIMPAC project, several other studies have been funded by the Navy that may directly or indirectly support the overall goals of the Plan. Many of these are in the area of passive acoustics. The Navy plans to seek better collaboration with these researchers to obtain additional data for inclusion in the HRC monitoring plan and ICMP.

2008-09 Navy-funded studies in the HRC are described briefly below:

1. Nachtigall – ONR has continued to fund Dr. Paul Nachtigall and his graduate students into conduct auditory testing of both captive and wild marine mammals. In the lab, Dr. Nachtigall tests the auditory responses and onset of TTS in captive bottlenose dolphin and false killer whales. Dr. Nachtigall has also conducted auditory testing (called auditory evoked potential) on wild animals as permitting allows. This testing and research provides critical information on hearing capabilities of odontocetes as well as reactions. The data directly feeds into the Navy/NMFS models of onset of TTS and PTS in odontocetes and environmental planning documents.
2. Au/Lammers – ONR has funded Drs. Whitlow Au and Mark Lammers to further develop their autonomous recording devices called Ecological Acoustical Recorders (EAR), as well as deploy them off Kauai to obtain acoustic data on vocalizing animals. This data will be compared with visual surveys also to be conducted in that area. The acoustic data obtained from this study can augment the Acoustic Recording Packages (ARPs) installed under this monitoring plan as well as those deployed by BAE Systems (see below).
3. Nosal – ONR has funded Dr. Eva-Marie Nosal, a physicist at the University of Hawaii to do comparisons of acoustic data collected at PMRF, SOAR and AUTEC ranges. This data analysis …
4. BAE Systems – Ceros has provided funding to BAE Systems to investigate development of technologies that are already used to observe submarines for observation marine mammals. BAE Systems may also install autonomous recording devices or conduct field surveys in the HRC which may be used to augment those proposed under this monitoring plan.
5. NMFS/Baird – CNO provides yearly funding to NMFS Southwest Fisheries Science Center to conduct visual and acoustic surveys for marine mammals in the Pacific. Part of this funding goes to Dr. Robin Baird of Cascadia Research Collective to deploy various types of tags to odontocetes in the Hawaiian Islands. As a result, Dr. Baird and his colleagues have established a fairly solid baseline of information on the distribution and movements of little known species such as Cuvier's beaked whale, Blainville's beaked whale, rough toothed dolphin, pilot whales, and false killer whales.
6. Lockheed Martin – Ceros has recently provided funding to Lockheed Martin to use acoustic data collected from the PMRF instrumented range to further develop automated detection methods for marine mammals. This research will allow for more efficient and accurate analysis of the many terabytes of data that are typically collected from ARPs.

APPENDIX B.
RELATED RESEARCH ON IMPACTS OF ANTHROPOGENIC SOUND

The HRC EIS/OEIS summarized some of the science on past studies of anthropogenic (i.e., human generated) noise on marine mammals (DoN, 2008b). Other related references also include Cox et al., 2006; Nowacek et al., 2007; and Southall et al., 2008).

1. ATOC Playback

Summary of background and methods:

The overall goal of the Acoustic Thermometry of Ocean Climate project was to measure temperature changes of the ocean using a sound source. It was proposed that projectors near Hawaii and California would transmit a 195 dB re 1 µPa at 1m, 75 Hz signal, which when received at various listening stations throughout the Pacific Ocean, would provide data to estimate temperature along long distance paths. As part of the environmental compliance necessary for the proposed project, a Marine Mammal Research Program was established to study the effects of the proposed signal on the behavior and distribution of selected marine mammals in both Hawaii and California.

Overall, the program consisted of 1) aerial surveys designed to determine any changes in the abundance and distribution of marine mammals in the vicinity of the Pioneer Seamount source; 2) elephant seal tagging studies designed to determine any changes in elephant seal migratory or diving behavior in response to the Pioneer Seamount source transmissions; 3) playback studies to humpback whales off the Kona-Kohala coast of Hawaii designed to look for behavioral changes in response to ATOC-like sounds prior to the actual ATOC source transmissions north of Kauai; 4) aerial surveys designed to determine any changes in the abundance and distribution of humpback whales north of Kauai when the ATOC source was transmitting compared to measurements made in previous years when the source was not transmitting; 5) visual observations of humpback whale abundance, distribution, and behavior north of Kauai to determine if there were any changes in response to the ATOC transmissions; 6) undersea acoustic recordings made with seafloor data recorders north of Kauai to determine any changes in humpback vocalizations in response to the ATOC transmissions; 7) auditory measurements on small odontocetes to determine their sensitivity to the frequencies transmitted by the ATOC sources; and 8) playback studies to fish at the Bodega Bay Marine Laboratory designed to look for behavioral changes in response to ATOC-like sounds.(http://atoc.ucsd.edu)

Baseline research in the form of playback experiments off Kauai and California were conducted for two years. Off Kauai, their work had three components: observations of humpback whale behavior from the air and from shore; underwater recording to measure background ocean noise and normal humpback singing; and aerial surveys to document the abundance and behavior of marine mammals around the Hawaiian Islands. They used three platforms: a shore station for shore based behavioral observations throughout the research area, a playback vessel for the source, and a recording vessel for taking oceanographic measurements, recording the acoustic environment and measuring the acoustic velocity profile (Frankel and Clark 1998).

Data were collected on: 1) ambient noise, 2) marine mammal behaviors including respiration, surface and dive times (which once classified, were entered into a data-logging software) 3) marine mammal movements were tracked using a theodolite, 4) vessel movements, 5) marine mammal vocalizations.

Analysis (of Kauai data only):
Data were processed by a customized software program (Aardvark) that generated descriptive statistics for movement variable, and output was imported into another software program for analysis. A variety of statistical tests were conducted on the data sets, including Watson U^2 test was used as well as an analysis of variance (ANOVA) run for effects of the playbacks (Frankel and Clark 1998). Since the ANOVA does not include the effects of natural variables such as vessel effects, a more detailed analysis was also undertaken using a multifactor general linear model. And, finally, power analysis was conducted to compare phases. Eight-five trials were conducted in 1996, resulting in a sample size of 50 playback trials of varying lengths. Resulting analysis showed that humpback whales showed no overt responses to the playbacks. However, statistical analysis showed that both the dive duration and the distance traveled between successive surfacings increased with increasing received level of the ATOC playback signal.

2. Full scale ATOC signals
Summary of background and methods:
In 1998, the same researchers collected behavioral observations using the same method as during the playback, but with the actual ATOC source replacing the playback speaker (Frankel and Clark 2000). Field observations were collected blind to whether or not the ATOC source was transmitting. Focal follows were conducted using the same methods as used during the playback (Frankel and Clark 1998).

Analysis:
To control for any distinctive behavior patterns in a pod, the analysis focused on potential changes in a pod's behavior between the control, and before and during ATOC transmissions (Frankel and Clark 2000). An analysis of covariance (ANCOVA) test was used so that each pod served as its own control. Each whale behavior was tested separately with the ANCOVA. Vessels, pod composition, etc were included in the analysis. The research was conducted during one field season, and based upon a sample size of 265 acoustic samples, 92 focal pod behavioral follows (100 hours), observations containing control and ATOC portions were obtained for 65 pods. The ANCOVA revealed that both the time and the distance between successive surfacings increased with increasing estimated received sound level (Frankel and Clark 2000) which is consistent with the playback experiments (Frankel and Clark 1998). The results indicate that ATOC transmissions produce subtle short-term behavioral changes in humpback whales (Frankel and Clark 2000). The authors conclude that the operation of ATOC off Kauai is not sufficient to cause biologically significant changes in behavior for the Kauai humpback population. However, they do not generalize to include the combined effects of ATOC, with vessel traffic and other anthropogenic noise (Frankel and Clark 2000).

3. SURTASS LFA for impacts to blue and fin whales:

Summary of background and methods:

Biological acoustic data were collected during an operational SURTASS LFA exercise in 1996 off the coast of southern California. The primary objectives were to determine if there was any indication of whales changing their vocal behavior when the SURTASS LFA system was functioning (Clark and Altman 2006). Using a Cornell developed acoustic analysis workstation installed on the Navy R/V *Cory Chouest*, Navy personnel monitored for blue and fin whale vocalizations. Once calls were heard, they estimated a whale's position relative to the transmitting vessel using customized localization software.

Analysis:

In the lab, spectrograms were made for each vocalizing animal and examined by bioacousticians, estimating whale numbers and calls for each. 386 hours of acoustic data were analyzed and linear regression was performed on the samples. The researchers found that the data were too sparse (e.g. too few call sequences) and the vocal behavior too variable to make any statistical assessment of a relationship between the transmission and the change in vocal behavior. They suggest additional research with longer on/off periods of transmission. Similar studies conducted for behavioral responses of gray whales to SURTASS LFA showed strong responses to signal in their migratory path, but not when the source was moved 2 km. In this case, received levels alone cannot explain the observed behavior (Clark et al 1999).

4. Indo-Pacific dolphins to vessels in Sharks Bay, Australia:

Summary of background and methods:

The researchers studied the effects of experimental vessel approaches on vocal and non-vocal behavior of Indo-Pacific dolphins in two sites. Shore-based observers used a theodolite to conduct focal follows, similar to the ATOC study. Also similar to the ATOC study, they used computer software custom designed for data acquisition. Data were collected from 2001-2002 for a total of 389 hours at the impact site (e.g. vessel interaction) and 120 hours at a control site (Bejder, L et al 2006). This sample represented 18 individuals.

Analysis: The researchers conducted a battery of statistical tests, including a two-way, repeated measures, multivariate analysis of variance (R-MANOVA) and canonical-variate (CV). Results concluded that experimental vessels approaches elicited changes in behavioral responses at both impact and control sites, with a stronger reaction at the control site where dolphins were less habituated to vessel activity (Bejder, L et al 2006).

APPENDIX C
LIST OF ACRONYMS

ARP	Acoustic Recording Package
ASW	Anti-Submarine Warfare
AUTEC	Atlantic Undersea Test and Evaluation Center
CPF	Commander, Pacific Fleet
CNO	Chief of Naval Operations
dB	Decibel
EAR	Ecological Acoustical Recorder
ESA	Endangered Species Act
ft	Feet
GPS	Global Positioning System
GUNEX	Gunnery Exercise
HARP	High Frequency Acoustic Recording Package
HRC	Hawaii Range Complex
ICMP	Integrated Comprehensive Monitoring Program
IAC	Integrated ASW Course
ITA	Incidental Take Authorization
LOA	Letter of Authorization
m	Meters
MFAS	Mid Frequency Active Sonar
MMPA	Marine Mammal Protection Act
MMO	Marine Mammal Observer
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
ONR	Office of Naval Research
PIFSC	Pacific Islands Fisheries Science Center
PMRF	Pacific Missile Range Facility
R&D	Research and Development
RIMPAC	Rim of the Pacific Exercise
SCC OPS	Submarine Commander's Course Operations
SINKEX	Sinking Exercise
SOAR	Southern California Offshore anti-submarine warfare range
SOP	Standard Operating Procedure
SPORTS	Sonar Positional Reporting System
TRE	Tactical Readiness Evaluation
TTS	Temporary Threshold Shift
ULT	Unit Level Training
USWEX	Undersea Warfare Exercise
VHF	Very High Frequency