Prepared for National Marine Fisheries Service

Office of Protected Resources

Prepared by the U.S. Pacific Fleet

DRAFT Mariana Islands Range Complex Monitoring Plan

DRAFT

September 2009

This Monitoring Plan is submitted to NMFS in support of the Taking and Importing Marine Mammals; U.S. Navy Training in the Mariana Islands Range Complex

AND

Biological Opinion on the U.S. Navy's Training in the Mariana Islands Range Complex, in progress

EXECUTIVE SUMMARY

The U.S. Navy has developed this Mariana Islands Range Complex (MIRC) 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 this proposed MIRC monitoring plan, a number of other Navy range complex monitoring plans have been or 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. The goals of these monitoring plans are to assess if there are impacts associated with training activities on marine species and evaluate the effectiveness of the Navy's current mitigation practices. This MIRC Plan proposes field monitoring studies for marine mammals and sea turtles that have been designed relative to the training and species that occurs in the Marianas. Data generated via implementation of this monitoring plan will be integrated into the Navy-wide Integrated Comprehensive Monitoring Program (ICMP).

To accomplish these goals, the Navy will use similar methods of implementation and data analyses which have demonstrated success in comparable monitoring programs regarding the effects of anthropogenic sound on marine animals. This MIRC Monitoring Plan complements Navy's other range complex monitoring plans which have been designed as a collection of focused "studies" to gather data that will aid the National Marine Fisheries Service (NMFS) in addressing the following questions:

Question 1. Are marine mammals and sea turtles exposed to MFAS, especially at levels associated with adverse effects (i.e., based on NMFS' criteria for behavioral harassment, temporary threshold shift (TTS), or permanent threshold shift (PTS)? If so, at what levels are they exposed?

Question 2. If marine mammals and sea turtles are exposed to MFAS in the MIRC, do they redistribute geographically as a result of continued exposure? If so, how long does the redistribution last?

Question 3. If marine mammals and sea turtles are exposed to MFAS, what are their behavioral responses to various levels?

Question 4. What are the behavioral responses of marine mammals and sea turtles that are exposed to explosives at specific levels?

Question 5. Is the Navy's suite of mitigation measures for MFAS and explosives (e.g., Protective Measures Assessment Protocol (PMAP), major exercise measures agreed to by the Navy through permitting) effective at avoiding TTS, injury, and mortality of marine mammals and sea turtles?

Given the large number and differences in scope of training events within other Navy range complexes as compared to MIRC, not every one of these original five study questions will be address within MIRC (Tables ES-1). Rather, data collected from MIRC monitoring will be used to supplement a consolidated range complex marine mammal monitoring report incorporating data from the Navy's range complex monitoring plans.

Monitoring methods proposed for the MIRC include a combination of research elements designed to support Range-specific monitoring and contribute information to the ICMP. These research elements include passive acoustic monitoring (PAM), marine mammal observers (MMO), and near-shore visual monitoring. (Table ES-1)

In addition to the U.S. Pacific Fleet funded initiative, Chief of Naval Operations (CNO) Environmental Readiness Division and the Office of Naval Research (ONR) have developed a coordinated Science, Technology, Research & Development program focused on marine mammals and sound. Total investment in this program from 2004-2008 was $100M. Fiscal year 2009 funding was $22 million. Continued funding at levels greater than $14 million is expected in subsequent years (>2010).

Table ES-1. Summary of monitoring studies and level of effort in support of the MIRC Monitoring Plan.

Exposures and behavioral responses								
	FY10	ADAPTIVE MANAGEMENT REASSESSMENT (AMR)	FY11	AMR	FY12	AMR	FY13	AMR	FY14
Passive acoustic monitoring (Study 2, 3, 4)			Deploy 4 autonomous devices. Continue recording from all and begin data analysis		Data Analysis and continue recording from devices and data analysis; integrate data collected on other ranges		Data Analysis and continue recording from devices and data analysis; integrate data collected on other ranges		Data Analysis and continue recording from devices and data analysis; integrate data collected on other ranges
Marine Mammal Observers aboard Navy vessels (Study 1, 3)	2 aboard one MFAS-capable surface combatant during multi-carrier strike group exercise (e.g. Valiant Shield) if it occurs.		2 aboard MFAS-capable surface combatants during multi-carrier strike group exercise (e.g. Valiant Shield) if it occurs.		Four aboard MFAS-capable surface combatants during multi-carrier strike group exercise (e.g. Valiant Shield) if it occurs.		Four aboard MFAS-capable surface combatants during multi-carrier strike group exercise (e.g. Valiant Shield) if it occurs.		Four aboard MFAS-capable surface combatants during multi-carrier strike group exercise (e.g. Valiant Shield) if it occurs.
Near-shore visual observers (Study 4)	Visual observers will monitor before, during and after 2 nearshore explosive events inside Apra Harbor and Piti if they occur.		Visual observers will monitor before, during and after 4 nearshore explosive events inside Apra Harbor and Piti if they occur.		Visual observers will monitor before, during and after 4 nearshore explosive events inside Apra Harbor and Piti if they occur.		Visual observers will monitor before, during and after 4 nearshore explosive events inside Apra Harbor and Piti if they occur.		Visual observers will monitor before, during and after 4 nearshore explosive events inside Apra Harbor and Piti if they occur.
Geographic redistribution									
Passive Acoustics Monitoring (PAM)		AMR	4 PAM autonomous devices deployed. Continue recording from all and begin data analysis	AMR	Data Analysis and continue recording from devices and data analysis; integrate data collected on other ranges	AMR	Data Analysis and continue recording from devices and data analysis; integrate data collected on other ranges	AMR	Data Analysis and continue recording from devices and data analysis; integrate data collected on other ranges
Total Commitment									
	- 2 MMOs on surface combatants during multi-carrier strike group exercise if it occurs -Observations of 2 nearshore explosive events if they occur		- 4 PAM autonomous devices deployed and begin analysis - 4 MMOs on surface combatants during multi-carrier strike group exercise if it occurs - Observations of 4 nearshore explosive events if they occur		- 4 PAM autonomous devices and data analysis - 4 MMOs on surface combatants during multi-carrier strike group exercise if it occurs - Observations of 4 nearshore explosive events if they occur		- 4 PAM autonomous devices and data analysis - 4 MMOs on surface combatants during multi-carrier strike group exercise if it ocurs - Observations of 4 nearshore explosive events if they occur		- 4 PAM autonomous devices and data analysis - 4 MMOs on surface combatants during multi-carrier strike group exercise if it occurs - Observations of 4 nearshore explosive events if they occur

LIST OF ACRONYMNS

AFAST	Atlantic Fleet Active Sonar Training Range
AMR	Adaptive Management Review
ANOVA	analyses of variance
ARP	acoustic recording package
ASW	anti-submarine warfare
ATOC	Acoustic Thermometry of Ocean Climate
CFR	Code of Federal Regulations
CNO	Chief of Naval Operations
COMNAVMARIANAINST 5090.7	Commander Naval Forces Marianas Instruction 5090.7
DoD	Department of Defense
DEIS	Draft Environmental Impact Statement
DOEIS	Draft Overseas Environmental Impact Statement
DON	Department of the Navy
EAR	Ecological Acoustic Recorder
EOD	Explosive Ordnance Disposal
ESA	Endangered Species Act
FY	fiscal year
GPS	global positioning system
GUNEX	Gunnery Exercise, Surface-to-Surface
HARP	high-frequency acoustic recording package
HQ	headquarters
HRC	Hawaii Range Complex
ICMP	Integrated Comprehensive Monitoring Program
ITA	Incidental Take Authorization
LOA	Letter of Authorization
MCM	Mine Countermeasure
MFAS	mid-frequency active sonar
MIRC	Mariana Islands Range Complex
MMO	marine mammal observer
MMPA	Marine Mammal Protection Act
NMFS	National Marine Fisheries Service
NOAA	National Oceanographic and Atmospheric Administration
ONR	Office of Naval Research
PAM	passive acoustic monitoring
PIFSC	Pacific Islands Fisheries Science Center
PMAP	Protective Measures Assessment Protocol
PTS	permanent threshold shift
R&D	research and development
SINKEX	Sinking Exercise
SLMRROG	Sonar and Living Marine Resources Research Oversight Group
SOCAL	Southern California
SOP	Standard operating procedure
SPORTS	Sonar Positional Reporting System
SURTASS LFA	Surveillance Towed Array Sensor System Low Frequency Active
TTS	temporary threshold shift
UNDET	Underwater Detonation

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INTRODUCTION

The Navy has developed this Mariana Islands Range Complex (MIRC) (Figure 1) 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 Code of Federal Regulations (CFR) Section 216.104 (a) (13) states 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 ESA does not have specific monitoring requirements, recent NMFS section 7, ESA and biological opinions have included terms and conditions requiring the Navy to develop a monitoring program.

Additional Navy-funded research and development (R&D) studies and ancillary research collaborations with academia and other institutions will be integrated where possible to enhance the available data, and will be used in part to address objectives of a larger Navy-wide initiative discussed in this Plan. Lastly, as an adaptive management strategy, the MIRC 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.

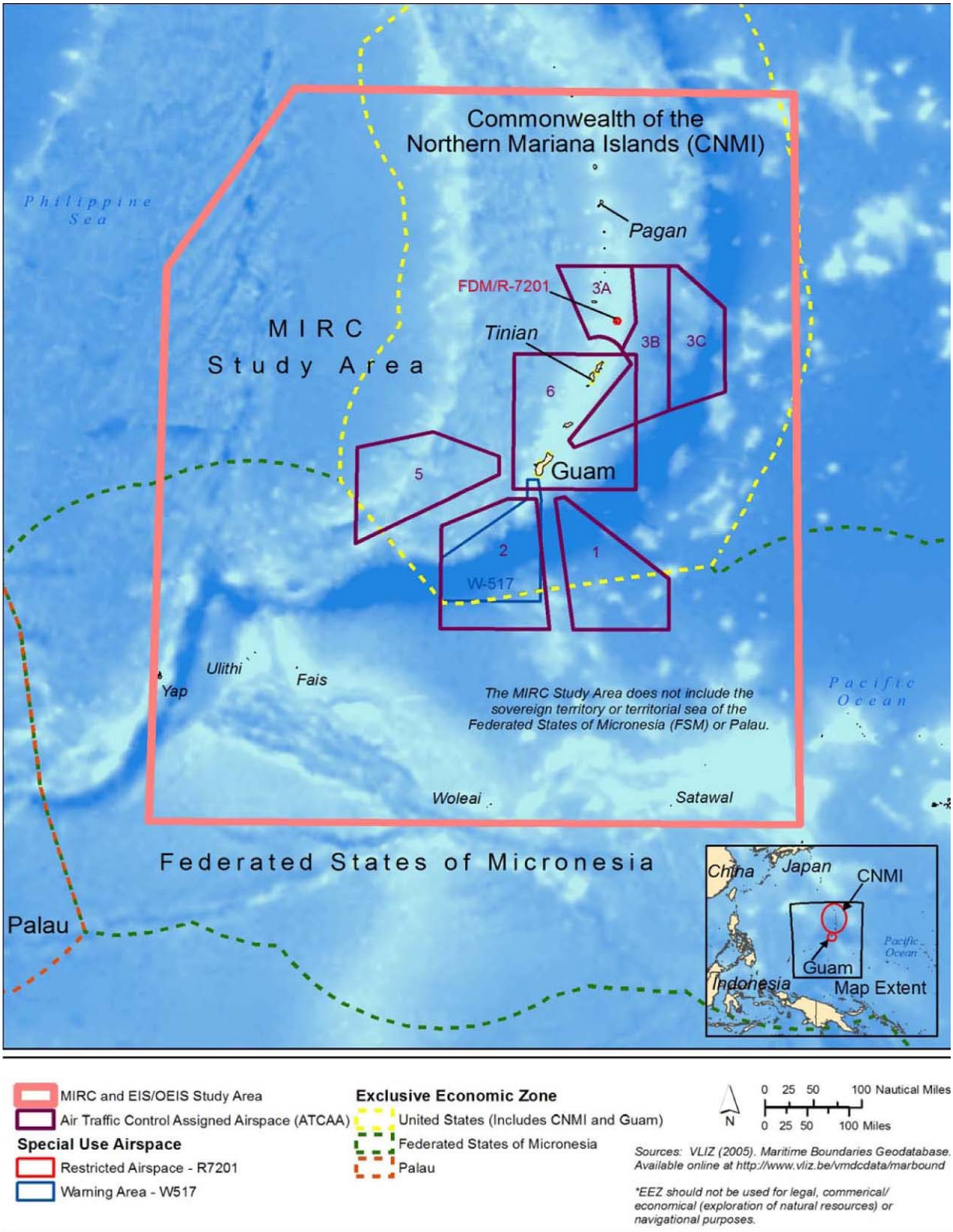

Figure 1. MIRC Study Area (inclusive).

INTEGRATED COMPREHENSIVE MONITORING PROGRAM (ICMP)

The Integrated Comprehensive Monitoring Program (ICMP) is Navy-wide and will provide an overarching structure and coordination that compiles data from all Navy range specific monitoring plans (Figure 2).

In addition to the MIRC monitoring plan, a number of other Navy range complex monitoring plans have been or are being developed for protected marine species, primarily marine mammals and sea turtles. These plans are part of the environmental planning and regulatory compliance process associated with a variety of training actions in those regions. 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. Ranges with the largest amount of training will be prioritized for monitoring based on availability of both funding and scientific resources. These include the Atlantic Fleet Active Sonar Training Range (AFAST), Hawaii Range Complex (HRC), and Southern California Range Complex (SOCAL). 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 MIRC 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.

The MIRC monitoring plan is just one component of the ICMP. The studies outlined here will be implemented in various combinations within other range complexes (Figure 2). 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 underwater explosive detonation (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, 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).

The design for the ICMP will be completed in 2009. The proposed elements of the ICMP include defining organizational responsibilities, program coordination, and oversight responsibilities; identifying optimum monitoring strategies; identifying region-specific monitoring that has applicability for all Navy ranges; seeking collaboration with non-Navy government and academic scientists in monitoring review via an "expert team" concept; and defining appropriate levels of statistical analyses and data set management leveraged across multiple Range Complex Monitoring Plans, working toward an approach that allows data to be compared across Range Complexes and identifying the appropriate level of statistical power required to address basic monitoring plan research objectives. These along with selecting the best analysis strategy, are a critical short term task of the ICMP.

Given the relatively new direction and design of the Navy-wide ICMP, specific details of the ICMP will be promulgated as they are finalized in a separate report from the current range complex monitoring plans. During the Adaptive Management Reassessment of the MIRC Monitoring Plan (discussed later in this report), plan monitoring elements may be adjusted based on direction of the ICMP and with concurrence of NMFS.

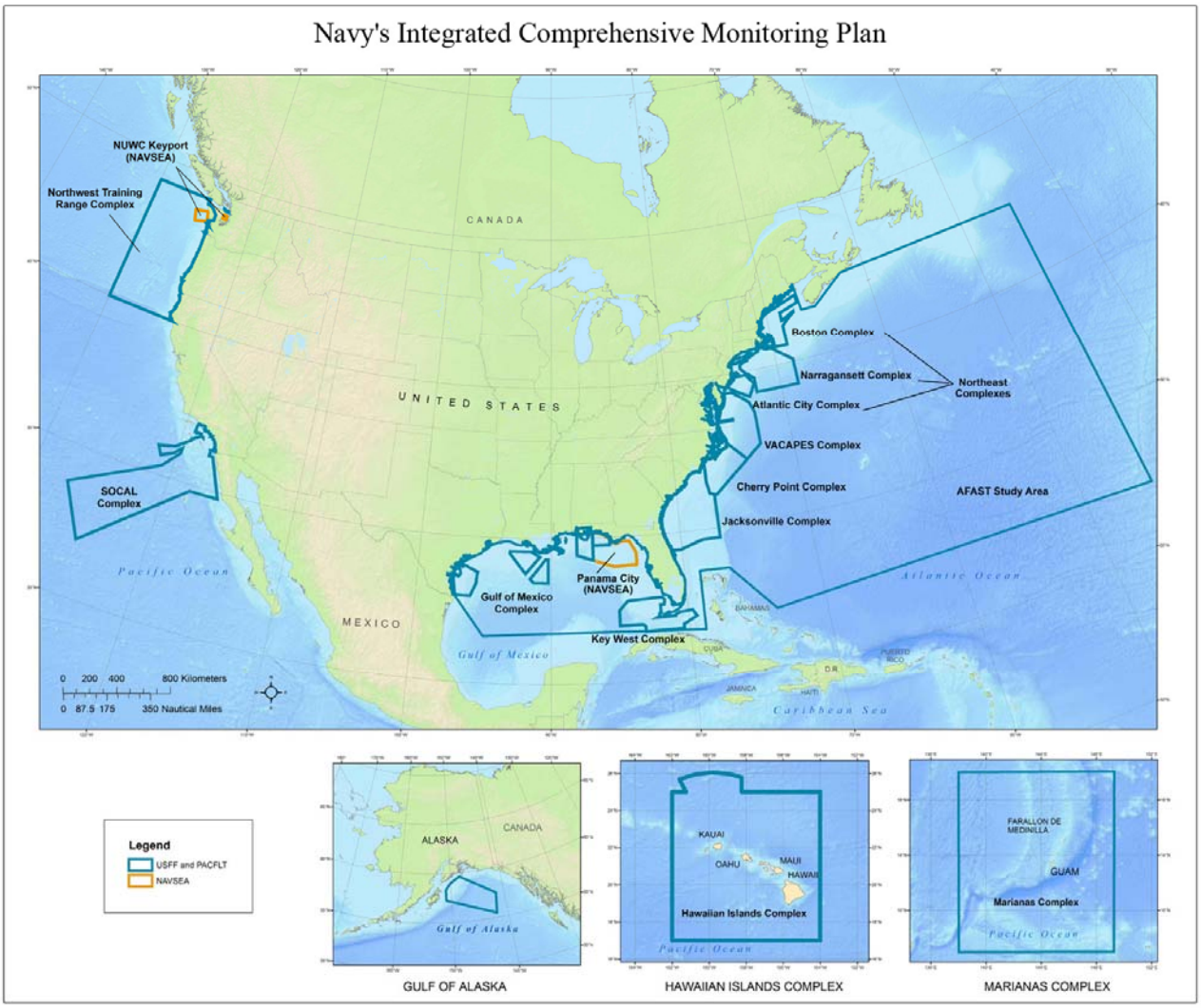

Figure 2. Integrated Comprehensive Monitoring Program – map of ranges where data collection is expected to occur.

MONITORING PLAN OBJECTIVES

The MIRC 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 succeeding sections:

1. Are marine mammals and sea turtles 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?
2. If marine mammals and sea turtles are exposed to MFAS in the MIRC, do they redistribute geographically as a result of continued 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 to various levels?

4. What are the behavioral responses of marine mammals and sea turtles that are exposed to explosives at specific levels?

MARINE SPECIES UNDER CONSIDERATION

As reviewed in the Mariana Islands Marine Resources Assessment (DoN 2005), there are five sea turtle species and 32 potential marine mammal species or stocks with possible or confirmed occurrence in the marine waters associated with the MIRC Range Complex (29 cetaceans (whales, dolphins, and porpoises), 2 pinnipeds (seals), and 1 sirenia (dugong) (Tables 1 and 2)). The Navy's Mariana Islands Sea Turtle and Cetacean Survey (MISTCS) confirmed 14 species of cetaceans either acoustically or visually (Norris et al 2007, Thorson et al 2007). Full descriptions of all species and a summary of the scientific literature are provided in the Mariana Islands Range Complex Draft Environmental Impact Statement/Overseas Environmental Impact Statement (DEIS/DOEIS) (DoN 2009). Additional distribution information may be found in publications from MISTCS, (Norris et al 2007, Thorson et al 2007) as well as the NMFS U.S. Pacific Stock Assessment Reports (http://www.nmfs.noaa.gov/pr/sars).

The MIRC Monitoring Plan is designed to collect data on all marine mammals and sea turtles encountered during monitoring studies. Priority will be given to ESA-listed marine mammals and sea turtles and species of special concern including beaked whales and other deep divers (e.g *Kogia* spp, melon-headed whales and false killer whales). However, due to the apparent low densities of marine mammals expected in the MIRC, data will be gathered from all marine mammals and sea turtles that are encountered.

Table 1. Sea Turtles Associated With the MIRC Action Area

Common Name	Scientific Name	ESA Status	Potential Occurrence
Green sea turtle	*Chelonia mydas*	Threatened	Regular
Hawksbill sea turtle	*Eretmochelys imbricata*	Endangered	Regular *
Loggerhead sea turtle	*Caretta caretta*	Threatened	Extralimital
Olive ridley sea turtle	*Lepidochelys olivacea*	Threatened	Extralimital
Leatherback sea turtle	*Dermochelys coriacea*	Endangered	Rare

Sources Mariana Islands Marine Resources Assessment (DoN 2005) and Mariana Islands Sea Turtle and Cetacean Survey results (DoN 2007)

Key

* = visually or acoustically detected during MISTCS survey (DoN 2007)

Table 2. Marine Mammal Species Associated With the MIRC Action Area

Common Name	Species Name	Status[1]		Occurrence[2]		
		IUCN	ESA	MMPA	Summer Jul-Nov	Winter Dec-June
ESA Species						
Mysticetes						
Blue	*Balaenoptera musculus*	E	E	D	Rare	Rare
Fin	*Balaenoptera physalus*	E	E	D	Rare	Regular
Sei	*Balaenoptera borealis*	E	E	D	Rare	Regular*
Humpback	*Megaptera*	V	E	D	Rare	Regular*
North Pacific right	*Eubalaena japonica*	E	E	D	Rare	Rare
Odontocetes						

Sperm whale	*Physeter macrocephalus*	V	E	D	Regular	Regular*
Pinniped						
Hawaiian monk seal	*Monachus schauinslandi*	E	E	D	Extralimital	Extralimital
Sirenia						
Dugong	*Dugong dugong*	E	E	D	Extralimital	Extralimital
Non-ESA Species						
Mysticetes						
Bryde's	*Balaenoptera edeni*	DD	-	ND	Regular	Regular*
Minke	*Balaenoptera acutorostrata*	LR	-	ND	Rare	Regular*
Odontocetes						
Blainville's beaked	*Mesoplodon densirostris*	DD	-	ND	Regular	Regular
Bottlenose dolphin	*Tursiops truncatus*	DD	-	ND	Regular	Regular*
Cuvier's beaked	*Ziphius cavirostris*	DD	-	ND	Regular	Regular
Dwarf sperm	*Kogia sima*	LR	-	ND	Regular	Regular
False killer	*Pseudorca crassidens*	LR	-	ND	Regular	Regular*
Fraser's dolphin	*Lagenodelphis hosei*	DD	-	ND	Regular	Regular
Ginkgo-tooth beaked	*Mesoplodon ginkgodens*	DD	-	ND	Rare	Rare
Hobbs beaked	*Mesoplodon carlhubbsi*	DD	-	ND	Extralimital	Extralimital
Indo-Pacific bottlenose	*Tursiops aduncus*	DD	-	ND	Extralimital	Extralimital
Killer whale offshore	*Orcinus orca*	LR	-	ND	Regular	Regular
Longman's beaked	*Indopacetus pacificus*	DD	-	ND	Regular	Regular
Melon-headed	*Peponocephala electra*	LR	-	ND	Regular	Regular*
Pantropical spotted	*Stenella attenuata*	LR	-	ND	Regular	Regular*
Pygmy killer	*Feresa attenuata*	DD	-	ND	Regular	Regular*
Pygmy sperm	*Kogia breviceps*	LR	-	ND	Regular	Regular
Risso's dolphin	*Grampus griseus*	DD	-	ND	Regular	Regular
Rough-toothed dolphin	*Steno bredanensis*	DD	-	ND	Regular	Regular*
Short-beaked common	*Delphinus delphis*	LR	-	ND	Rare	Rare
Short-finned pilot whale	*Globicephala macrorhynchus*	LR	-	ND	Regular	Regular*
Spinner dolphin	*Stenella longirostris*	LR	_	ND	Regular	Regular*
Striped dolphin	*Stenella coeruleoalba*	LR	-	ND	Regular	Regular*
Pinniped						
Northern elephant seal	*Mirounga angustirostris*	LR	-	ND	Extralimital	Extralimital

Sources Mariana Islands Marine Resources Assessment (DoN 2005) and Mariana Islands Sea Turtle and Cetacean Survey results (DoN 2007)

Notes and Key:

(1) IUCN Listing Status E=endangered, V=Vulnerable, LR=Least Risk, DD=Data Deficient

ESA Listing Status: E=Endangered, T=Threatened

MMPA Listing Status: D=Depleted Stock, ND=Not Depleted

(2) Extralimital: Species that have occurred rarely in the past, may be only one or several documented sightings.

* = visually or acoustically detected during MISTCS survey (DoN 2007)

OVERVIEW OF MONITORING PLAN RESEARCH ELEMENTS

Each monitoring technique has advantages and disadvantages that vary temporally and spatially, as well as support one particular study objective better than another. Based upon input from subject matter experts, the Navy intends to use a combination of techniques so that detection and observation of marine animals is maximized and meaningful information can be derived to answer the research objectives. Monitoring methods proposed for the MIRC are designed to contribute to data gathered in other ranges in order to support both range complex specific monitoring and the ICMP.

The MIRC presents a challenging environment for monitoring. The area is well known for its year round high sea states and frequent, unpredictable typhoons. It is also less commercially developed than other locations where the Navy trains. This limits access to large research vessels and non-military aircraft appropriate for offshore field work. Consideration of these factors, along with the nature of Navy's seasonal and generally offshore training events has led to choosing monitoring methods that are feasible and have the best chance of success.

Monitoring methods proposed for the MIRC are:

- Passive Acoustic Monitoring (PAM)
- Marine mammal observers aboard Navy vessels
- Visual observers

Passive Acoustic Monitoring (PAM)

There are both benefits and limitations to passive acoustic monitoring as discussed in Mellinger and Barlow (2003) and Mellinger et al. (2007). PAM allows detection of marine mammals that may not be seen during a visual survey, and monitoring of vocalization/echolocation rates before, during, and after Navy training events. When interpreting data collected from PAM, it should be noted that species specific results must be viewed with caution because not all animals within a given population may be vocalizing, or may only vocalize only under certain conditions (Mellinger et al., 2007; ONR, 2007). Because the MIRC does not have an instrumented range, passive acoustic monitoring in the MIRC will be conducted by deploying autonomous buoys.

Use of autonomous buoys in the MIRC will be challenging due to a long and intense typhoon season, so success will be determined as methods are implemented and evaluated. Autonomous buoys such as Ecological Acoustic Recorder (EARs) and high-frequency ARPs (HARPs) can be deployed from vessels that are currently available in the MIRC (e.g. tugs) and be used for long term monitoring. This allows the capture of trends both outside and during Navy training events. For this reason, they are preferred for the initial year of monitoring in the MIRC. As the field work progresses within the first year and experience is gained, future MIRC monitoring may include a other PAM tools, including fixed bottom-mounted ARPs, stationary surface sonobuoys, towed passive acoustic arrays, and other technology if available.

Marine Mammal Observers aboard Navy vessels

Civilian Marine Mammal Observers (MMOs) will be used to gather scientific monitoring data aboard MFAS-capable surface combatants during multi-carrier strike group exercise (e.g. Valiant Shield). MMOs will be Navy or contracted biologists with field experience in the identification of tropical and sub-tropical species. They will conduct observations from the bridge wing, alongside existing Navy lookouts during a portion (e.g. one week) of the exercise. This can only be done on certain vessels and observers will be required to have security clearance. Navy vessels provide a safe platform for MMOs to gather scientific

data including species identification and behavioral observations that lookouts are not trained to collect. Data will be from animals that are within the distances that can be observed using hand held or pedestal mounted 25x binoculars ("big-eyes") where contracted vessels and aircraft may not be allowed (e.g. within 3 miles).

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. Presence of MMOs is also anticipated to provide the lookouts with a chance to gain additional knowledge on marine mammals and sea turtles.

Visual monitoring – shore-based and near-shore

Visual surveys of marine mammals and sea turtles may provide detailed information about their behavior, distribution, and abundance. Baseline measurements and/or data for comparison can be obtained before, during and after training events. Changes in behavior and geographical distribution may be used to infer if and how animals are impacted by training. Given that the MIRC training events occur far out to sea, potentially available small vessel and aircraft are judged to be unsafe and not recommended. Therefore, visual observations will be conducted during nearshore underwater detonations at locations that have been identified to provide the highest likelihood of success (e.g. Apra Harbor and Piti mine neutralization area).

NOTE: Visual monitoring – 3rd party large vessel

NOAA Pacific Islands Fisheries Science Center (PIFSC) is currently planning a temporary relocation of a large NOAA research vessel, capable of conducting offshore visual and acoustics surveys, to the Marianas. PIFSC has informed Navy that a marine mammal survey is planned for 2010, however, financial and ship availability uncertainties may affect our ability to do collaborate with this survey during the planned dates. Navy and NMFS will make every effort to ensure the survey takes place as scheduled and amend this monitoring plan through Adaptive Management. See Appendix C for more detail.

NAVY TRAINING EVENTS FOR MONITORING AND DETERMINATION OF EFFORT

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) underwater detonation events that occur close enough to shore for near-shore monitoring for turtles and coastal species. Based upon this guidance, monitoring goals, safety considerations and knowledge of training events in the MIRC, it was determined that a multi-carrier strike group exercise currently called "Valiant Shield" and near-shore explosive events are the most appropriate. Valiant Shield is a major Navy training exercise proposed to occur in 2010 in the western Pacific Ocean. The purpose of this exercise is to demonstrate the Navy's ability to operate a large Naval force in coordination with other Services and support the Navy's requirement to maintain, train and equip combat-ready naval forces. Activities conducted during the exercise could include anti-air warfare, anti-surface warfare including sinking exercise(s), strike warfare, and anti-submarine warfare, including use of active sonar and sonobuoys. Due to Fleet scheduling and operational requirements, Valiant Shield does not occur every year and may change names. Underwater detonation events occur close to shore and are coordinated by units assigned to Guam. The purpose of these events is to demonstrate the Navy's ability to clear under water obstacles including shallow underwater mines. These events occur close to shore at locations near Apra Harbor and Agat Bay and provide an opportunity to study near shore effects in resident species.

The proposed hours for conducting each study are shown in Table ES-1. The target effort for each study has been determined based upon what methods are believed will be the most effective in the Mariana Islands. The hours listed in ES-1 represent the minimum number of hours anticipated 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. However, overall effort will not fall below the minimum requirements indicated in the table.

MONITORING PLAN STUDY DESCRIPTIONS

Actions that implement various MIRC-specific studies are shown in Table ES-1.

STUDY 1: ARE MARINE MAMMALS AND SEA TURTLES EXPOSED TO MID-FREQUENCY ACTIVE SONAR (MFAS)? IF SO, AT WHAT LEVELS ARE THEY EXPOSED?

Documenting known at-sea behavioral reactions of marine mammals to military sonar is complicated because of lack of quantitative scientific data and direct observations of cause-and-effects. Any particular reaction is likely to be conditional on the species in question, and a host of other factors such as feeding status, breeding status, time of day, overall health, and other issues. In order to address this question, there is a need to assess whether marine mammals and sea turtles are not only at the surface, but those in the water column where they could potentially be exposed to sonar. Given that MIRC training events employing MFAS occur far out to sea, potentially available small vessel and aircraft are judged to be unsafe and not recommended. For these reasons, data collection using methods other than MMOs will be collected on other ranges for this study.

Methods: MMOs

Marine Mammal Observers on Navy Vessels

Civilian Marine Mammal Observers (MMOs) will conduct observations from aboard Navy vessels for a portion of Valiant Shield (or similar multi strike group exercise) when it occurs. MMOs will meet and adhere to necessary security clearance, logistics and safety concerns as defined by the vessel. They will observe from the same height above water as the lookouts (e.g. bridge wings) and will collect data including: 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 training event did the sighting occur (before, during or after detonations/exercise).

STUDY 2: IF MARINE MAMMALS AND SEA TURTLES ARE EXPOSED TO MFAS IN THE MIRC, DO THEY REDISTRIBUTE GEOGRAPHICALLY AS A RESULT OF CONTINUED EXPOSURE? IF SO, HOW LONG DOES THE REDISTRIBUTION LAST?

Data to assess geographic redistribution is typically collected using tags or line-transect surveys. However, given the pelagic nature of training events involving MFAS and the lack of appropriate platforms in the MIRC, small vessel and aerial surveys have been determined to be unsafe and are not recommended. For this study, passive acoustic monitoring will be used to gather data on movements of vocalizing animals through the MIRC. PAM will provide baseline data as well as data on short and long term animal redistribution.

Methods:

Passive Acoustic Monitoring (PAM)

Autonomous recording devices (see Newcomb et al., 2002; Wiggins and Hildebrand, 2007; Lammers et al., 2008 for examples) provide an opportunity for long term data on the presence and absence of vocalizing marine mammals. These systems also provide information on the species present and their movements when a training event occurs in that area (Mellinger and Barlow, 2003; Oswald et al., 2003; Mellinger et al., 2007).

For this study, the Navy plans to deploy autonomous recording devices in order to collect passive acoustic data on the movements and acoustic behavior of vocalizing animals. It is anticipated that several complimentary types of PAM will be used in order to gather data towards answering this question as well as other studies simultaneously. When feasible, 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 differing formations and distances between buoys will be used depending on what the target species are. Animals that vocalize at higher frequencies (e.g. beaked whales vice humpback whales) will require the buoys to be closer together. All ARPs will be set on a duty cycle (e.g. 30 min on, 30 min off) 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. Acoustic data will be collected according to standard and accepted passive acoustic monitoring protocols.

Given the long duration and intensity of the typhoon season in the MIRC, these buoys will likely be deployed just long enough (e.g. months) so that data are collected before, during and outside of training events. Ideally, this data will, over time, allow us to detect and track vocalizing animals to determine if any geographical redistribution is occurring both during and outside Navy training events.

STUDY 3: IF MARINE MAMMALS AND SEA TURTLES ARE EXPOSED TO MFAS, WHAT ARE THEIR BEHAVIORAL RESPONSES TO VARIOUS LEVELS?

Documenting behavioral responses of marine mammals and sea turtles to sonar is complicated because of lack of information and direct observations of cause-and-effects. Any particular reaction is likely to be conditional on the species in question and a host of other factors such as feeding status, breeding status, time of day, overall health, and other issues. In order to address this question, there is a need to assess whether marine mammals and sea turtles are not only at the surface, but those in the water column where they could be potentially exposed to sonar. The pelagic nature of training events and the lack of appropriate platforms in the MIRC, contracted vessel and aerial surveys are currently unsafe and not recommended. Since observers aboard Navy vessels may have difficulty observing behavioral responses of animals below the surface, PAM will complement these efforts with regard to marine mammals.

Methods: PAM and MMOs

Passive Acoustic Monitoring (PAM)

The Navy will deploy autonomous acoustic recording buoys (see Newcomb et al., 2002; Wiggins and Hildebrand, 2007; Lammers et al., 2008) in areas of the MIRC that are used for training. It is anticipated that several complimentary types will be used in order to gather data towards answering this question as well as other studies simultaneously. When feasible, 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 differing formations and distances between buoys will be used depending on what the target species are because animals that vocalize at higher frequencies (e.g. beaked whales vice humpback whales) will require the buoys to be closer together. Given the long duration and intensity of the typhoon season in the MIRC, these buoys will likely be left in place just long enough (e.g. months) so that data are collected before, during and outside of training events. Acoustic data collected from the buoys will be used to detect, locate, and determine received levels of sonar to the animals. Ideally, this data will, over time, allow Navy to track vocalizing animals and determine if they are exposed to MFAS.

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 and MFAS in the study. 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.

Marine Mammal Observers on Navy Vessels

Civilian Marine Mammal Observers (MMOs) will conduct observations from aboard Navy vessels for a portion of Valiant Shield (or similar multi strike group exercise) if it occurs. MMOs will meet and adhere to necessary security clearance, logistics and safety concerns as defined by the vessel. They will observe from the same height above water as the lookouts (e.g. bridge wings) and will collect data including: 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 training event did the sighting occur (before, during or after detonations/exercise.

STUDY 4: WHAT ARE THE BEHAVIORAL RESPONSES OF MARINE MAMMALS AND SEA TURTLES THAT ARE EXPOSED TO EXPLOSIVES?

Underwater detonations (UNDET) that occur within or near Apra Harbor are conducted at designated sites throughout the year. These vary in the type and scale of the action. "Tri-Crab" is one of the larger events. It is a mine-neutralization, anti-mine warfare exercise where charges up to 20 lb net explosive weight are detonated. Some are much smaller in scale, using charges of 10 lbs or less. Regardless of size, all routine underwater detonations are already subject to prescribed mitigation measures (COMNAVMARINST 5090.7). Of particular concern are sea turtle populations whose presence around Guam is well recorded. At least three sea turtle species green (*Chelonia mydas*) hawksbill (*Eretmochelys imbricate*), and leatherback (*Dermochelys coriacea*) have been noted to inhabit the waters surrounding the island (Eldredge, 2003). Despite Apra Harbor being home to the busiest port in Micronesia, both hawksbill and green sea turtles frequently forage in the protected waters of the harbor, and the extensive mangroves of Sasa Bay Marine Preserve which are located there (Porter et al., 2005). Also of interest are resting groups of spinner dolphins (*Stenella longirostrus*) that are known to utilize nearshore habitat near Guam. Using knowledge of the near-shore UNDETs and baseline observations of turtles near Apra Harbor (Eldredge 2003; Porter et al., 2005), two sites were determined to be best suited for near-shore monitoring of explosive impacts to sea turtles or coastal marine mammals: (a) EOD Deepwater Mine Countermeasure (MCM) Site and (b) Piti Mine Neutralization Site. (Figure 3).

Current Mitigation Measures for UNDETs:

The following information summarizes the current suite of mitigation measures which the Navy utilizes during all underwater detonations to protect marine species. All underwater detonations follow COMNAVMARIANAINST 5090.7, which outlines specific responsibilities and establishes policy for the coordination of UNDET of explosives for training purposes in and around Guam. Currently, all training activities must be monitored to insure that the potential for injury or mortality of protected species is reduced or eliminated. A boat sweep occurs around the intended detonation site, from the intended site out to 1000 yards. Surface swims are conducted in and around the area for surface UNDET, or shallow water demolitions, and dives are conducted for bottom or mid-water column UNDET, or MCM. If protected species are present, then the UNDET is delayed until after it is determined that the species has voluntarily left the area. Immediately after the detonation the boat transits the area to look for signs of injured or dead sea turtles, marine mammals, schools of fish, civilian divers and waterborne craft in the immediate vicinity for 30 minutes. After the 30-minute post detonation-waiting period, a verification dive/surface swim is made to ascertain the effectiveness of the demolition and to scan the area for any signs of affected protected species. Annual reports include the number of exercises conducted, number, type and weight of charges detonated, and the number and species of sea turtles or marine mammals observed, disturbed, injured or killed.

Methods - Visual Platform and Shore-based Monitoring*:*

In addition to the mitigation measures already in place, the Navy plans to conduct shore-based and/or platform-based monitoring of a subset of explosive events to gather biological and behavioral data. Figure 3 illustrates the two sites that have been determined to be appropriate for near-shore monitoring of explosive impacts to sea turtles or coastal marine mammals. The Navy plans to conduct shore-based monitoring during three (3) underwater detonations per year at EOD Deep Water MCM (if they occur) as well as from "sweep boats" during one (1) large scale EOD activity (e.g. Tri-Crab) per year (if it occurs) at Piti mine neutralization areas.

At EOD Deepwater MCM, the observers will be conduct monitoring from the closest section of the break-wall or elevated platform if possible. They will use binoculars to visually observe for marine animals two hours prior, during and two hours after UNDETs. At Piti which is further offshore, observers would embark

with the Navy boat sweep team to conduct visual observations while the required mitigation surveys occur.

The potential effects of an underwater explosion on marine mammals and sea turtles, are dependent on several factors, including the size, type, and depth of both the animal and the explosive charge; the depth of the water column; and the standoff distance between the explosive charge and the animal, as well as the sound propagation properties of the environment (Viada et al., 2008). For both shore-based and sweep-boat based monitoring, biologists will collect all available scientific data listed above as well as species identification, detailed description of their surface behavior, and movements through the visual field. The biological observer data will be combined with the data collected by the mitigation/sweep teams as those data are expected to complement each other. For any turtles that are observed in conjunction with the UNDET or immediately following it, distances from the explosion will be estimated to estimated received levels to the animal.

Figure 3. Nearshore sites for monitoring of sea turtles and coastal marine mammals during underwater detonations.

STUDY 5: IS THE NAVY'S SUITE OF MITIGATION MEASURES EFFECTIVE AT AVOIDING INJURY AND MORTALITY OF MARINE MAMMALS AND SEA TURTLES?

Field work for this study will not be conducted at the MIRC as it will be conducted on other Navy ranges where opportunities to collect data are more abundant. Knowledge gained from this study in other ranges will be applied in MIRC, if appropriate.

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

MIRC MONITORING PLAN IMPLEMENTATION AND ANALYSIS

Based upon the MIRC DEIS/ODEIS and knowledge of training events in the MIRC, it was determined that the multi-carrier strike group exercise called Valiant Shield along with near-shore explosive events are most appropriate for marine mammal and sea turtle monitoring within the MIRC. The caveat is that major exercises may undergo significant schedule changes in reaction to higher-priority commitments and such changes may limit monitoring opportunities.

Contracted third party data will be collected by marine mammal and sea turtle experts. Researchers will provide annual reports to the Navy, however, this is expected to be an ongoing process with data collected, analyzed and interpreted over many years. It is not likely that firm conclusions can be drawn on most questions within a single year of monitoring effort due to the difficulty in achieving sufficient sample sizes for statistical analysis. The Navy will provide annual reports to NMFS headquarters (HQ) in fulfillment of the MMPA LOA requirements. The report 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.

While the monitoring described in this plan represent the best estimate of availability, there may be instances within any given year where exercise schedules shift, survey crew availability becomes limited, or extreme weather precludes effective sampling. In case of monitoring delay based on these conditions, monitoring will be re-scheduled to the next available opportunity. In the event that a particular target exercise is not available within the remainder of a particular year, monitoring may have to be made up in the subsequent year.

Table ES-1 provides detail about how the MIRC Monitoring Plan will be implemented from FY 2010 to FY 2014. After the issuance of the LOA, implementation of this monitoring plan will commence in mid 2010 and monitoring will begin to add to the data pool being collected on other Ranges.

The Navy will be investing significant funding and personnel towards this monitoring program and intends to conduct the research in a scientifically sound and robust manner. The Navy is committed to conducting research until the original program objectives have been answered to the satisfaction of both NMFS and the 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 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.

The research projects summarized in Appendix A suggest that the sample size required for statistically significant results varies between species, season and project. Therefore, for the MIRC Monitoring Plan, 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 MIRC Plan, as written, covers research on the effects from MFAS and explosives on a diversity of marine mammal and sea turtle species found in the MIRC. 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 Acoustic Thermometry of Ocean Climate (ATOC) and SURTASS Low-Frequency Active Sonar monitoring programs as a guideline for success (Appendix A) highlights that the key to the success of the plan's execution and analysis is employing expertly qualified scientific professionals (Aburto et al., 1997; Au et al., 1997; Frankel and Clark, 1998 and 2000; NRC, 2000, 2003, 2005; Croll et al., 2001; ONR, 2001; Costa et al., 2003; Fristrup et al., 2003; Clark and Altman, 2006; Mobley, 2001, 2006). That is Navy's intention. This team of experts will include statisticians 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 A, 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 most desirable circumstances and conditions.

In addition to the studies conducted under the MIRC Monitoring Plan, the Navy intends to collaborate with other researchers in the Western Pacific who are conducting complimentary research on this topic. Those studies will not replace the Navy's obligation under the NMFS LOA requirements, but will augment the resources provided to the Plan's specific questions.

ICMP AND RELATIONSHIP TO MIRC MONITORING PLAN

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 MIRC monitoring plan. It is intended to provide the overarching coordination that will support compilation of data from both range-specific monitoring plans (e.g. MIRC 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.

ANALYSIS AND REPORTING

The Navy is currently working on the overarching structure and coordination (e.g. ICMP) that will, over time, incorporate data from range-specific monitoring plans (e.g., HRC, SOCAL, MIRC, AFAST, NWTRC, GOA) and Navy-funded research and development (R&D) studies. The analysis protocols are still in the development phase at this time. However, data collection methods will be standardized to allow for comparison from ranges in different geographic locations. The sampling scheme for the program will be developed so that the results are scientifically defensible. For example, since all data will be collected using a behavioral software program, data collection will be standardized between the different geographical regions. A data management system will be developed to assure standardized, quality data are collected towards meeting of the goals. The data management plan shall provide standard marine species sighting forms for Navy lookouts and biologists in order to make data collection uniform. Annual reports summarizing effort, analysis and results will be compiled and submitted to NMFS. These reports will allow the Navy and NMFS to assess and adaptively manage the Navy's monitoring effort to more effectively answer the questions outlined above.

If unique opportunities arise, data collection may begin prior to the issuance of the MIRC LOA. However, it is most likely that implementation will occur after the LOA is published and the monitoring plan finalized (See Table ES-1 for year by year implementation schedule). Data collected from the MIRC 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 MIRC as detailed in the requirements in the MIRC LOA. 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 MIRC monitoring plan. All subsequent analysis shall be completed in time for Navy's five year report to NMFS. All data will be considered "pre-decisional" and proprietary and will be shared among the Navy and NMFS (at a minimum) during the five year period of the LOA.

ADAPTIVE MANAGEMENT

BACKGROUND

Implementation of the Range Complex Monitoring Plans in development in the Pacific will serve to enhance the understanding of how MFAS or underwater detonations (as well as other environmental conditions) may or may not be associated with marine mammal injury or strandings. Information gained from the investigations associated with this MIRC Monitoring Plan may be used in the adaptive management of mitigation or monitoring measures in subsequent LOAs, as appropriate.

Adaptive management is an iterative process of optimal decision making in the face of uncertainty, with an aim to reduce uncertainty over time via system monitoring. Within the natural resource management community, adaptive management involves ongoing, real-time learning and knowledge creation, both in a substantive sense and in terms of the adaptive process itself. Adaptive management focuses on learning and adapting, through partnerships of managers, scientists, and other stakeholders who learn together how to create and maintain sustainable ecosystems (Williams el at., 2007). Adaptive management helps science managers maintain flexibillity in their decisions, knowing that uncertainties exist;. It will improve understanding of ecological systems to achieve management objectives and is about taking action to improve progress towards desired outcomes (Williams et al., 2008). Further discussion of adaptive management in the natural resource community is available from the U.S. Department of Interior's Adaptive Management Guidelines: http://www.doi.gov/initiatives/AdaptiveManagement/index.html

The Navy's goal of adaptive management regarding the MIRC Monitoring Plan involves close coordination with NMFS to align marine mammal and sea turtle monitoring with the Plan's overall objectives as stated in earlier sections of the Plan. To recap, the objectives of the Navy's MIRC Monitoring Plan are to answer:

1. Are marine mammals and sea turtles 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?

2. If marine mammals and sea turtles are exposed to MFAS in MIRC, do they redistribute geographically as a result of continued 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 to various levels?

4. What are the behavioral responses of marine mammals and sea turtles that are exposed to explosives at specific levels?

IMPLEMENTATION

There are periodic exercise and annual reporting requirements that will be contained in NMFS MMPA authorization associated with the MIRC DEIS\DOEIS. Following the Navy's Annual Report to NMFS, the Navy will request specific written discussion from NMFS of NMFS's assessment of the Plan's past year results. The goal of this consultation and collaboration would be to determine if these research elements and associated results continue to meet the overall objectives of the Plan specific to the MIRC. For instance, if one particilar research element does not provide direct or indirect support to one of the objectives listed above, then resources for future instances of that element could be re-directed to other research elements that do provide more support.

The actual Adaptive Management Reassessment (AMR) will be a multipart review. Initial accomplishments will be tabulated by Navy subject matter experts familiar with marine mammal monitoring. If available, collaboration with appropriate NMFS scientists, academic scientists, and other non-Navy subject matter experts will be informally sought. The Navy will then consult with the NMFS Office of Protected Resources on lessons learned and recommendations for the following year's sampling efforts and protocols, where changes will serve to benefit the quality and usefulness of the data in assessing impacts on the species or the efficiency in which such data is gathered and/or analyzed.

It is premature to ascertain which, if any of the proposed elements contained in this Plan will provide the most scientifically valid information to address the objectives until at least one or two years worth of monitoring data are collected and analyzed both within the MIRC and in context of the ICMP. Most likely it will be a combination of elements that will provide the best data in addressing MFAS and explosive effects or lack of effects on the marine mammals and sea turtles within the MIRC.

Proper application of the adaptive management concept will allow future adjustments to be made to the MIRC Monitoring Plan that will enhance overall scientific conclusions, lead to better statistical approaches, integrate new technologices in marine mammal monitoring and detection, and provide a stronger foundation upon which to base mitigation and policy decisions. In addition, as part of the annual review, a more complete cost-benefit analysis can be presented based on actual monitoring cost by research element within MIRC.

APPENDIX A- ADDITIONAL NAVY RESEARCH AND OTHER STUDIES

NAVY FUNDED MARINE MAMMAL RESEARCH PROGRAM

In August 2008, a new Navy oversight committee for Navy funded marine mammal research was formed by the Assistant Secretary of the Navy (Installations and Environment) and CNO N4. This oversight committee is called the Sonar and Living Marine Resources Research Oversight Group (SLMRROG). The goal of the SLMRROG is to identify Navy funded marine species research requirements, ensure research meets science and environmental reporting needs, solicit input from the greater marine mammal science community, and establish a consensus on prioritized research requirements. An existing CNO N45 and ONR coordinated Science & Technology and Research & Development program focused on marine mammals and sound for the past twenty years will fall under the SLMRROG umbrella.

Total investment in this program from 2004-2008 was $100M. Fiscal year 2009 funding was $22 million. Continued funding at levels greater than $14 million is foreseen in subsequent years (>2010). The CNO

N45 and ONR coordinated Science & Technology and Research & Development (S&T R&D) program is currently focused in the following areas through the end of FY09:

- 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.

The MIRC DEIS/DOEIS (DoN 2009) summarizes some of the general science on past studies of anthropogenic (i.e., human generated) noise on marine mammals (DoN 2009). Other related references also include Cox et al., 2006; Deeck, 2006; Nowacek et al., 2007; and Southall et al., 2008. In light of continued discoveries and identification of knowledge gaps from scientific references cited above, continuing adjustments and prioritization to the R&D S&T program will be achieved via consensus with the SLMRROG in order to advance the knowledge of marine mammal science.

APPENDIX B - RELATED RESEARCH ON IMPACTS OF ANTHROPOGENIC SOUND

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. Three platforms were employed: 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 data-logging software), (3) vessel movements, and (4) marine mammal vocalizations Marine mammal movements were tracked using a theodolite.

Analysis (of Kauai data only):

Data were processed by a customized software program (Aardvark) that generated descriptive statistics for movement variation; another software program was employed for analysis. A variety of statistical tests were conducted on the data sets, including Watson U^2 test as well as an analysis of variance (ANOVA) to determine the effects of playbacks (Frankel and Clark 1998). Since 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. Lastly, power analysis was conducted to compare phases. Eighty-five trials were conducted in 1996, resulting in a sample size of 50 playback trials of varying lengths. Resulting analyses showed that humpback whales showed no overt responses to the playbacks. However, statistical analyses 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 was based upon a sample size of 265 acoustic samples, and 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 a 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. Three hundred eighty-six hours of acoustic data were analyzed and a linear regression analysis 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-variant (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 - POTENTIAL FOR COLLABORATION WITH VESSEL SURVEY IN THE MARIANA ISLANDS

The National Atmospheric Administration Pacific Islands Fisheries Science Center (NOAA/PIFSC) has an Oceanographic survey tentatively scheduled in the Marianas Islands on the *R/V Oscar Elton Sette*, departing Honolulu in Jan 2010 to Saipan, working in the region for approximately 60 days and return to Honolulu mid-April. While the transits to/from Honolulu are specifically dedicated to cetaceans, there is strong support from the oceanography group to share their 30 days in an effort to do joint oceanographic-cetacean observations. In addition to combined oceanographic/cetacean observation and data collection efforts, survey plans in the region include use and deployment of a number of Passive Acoustic Monitoring devices (PAM) such as, towed arrays and High Frequency Acoustic Recording packages (HARPs). Inclusion of satellite tagging cetaceans, specifically beaked whales and other odontocetes, for such things as movement patterns and potential impact on resident populations is also being considered during survey operations.

If this survey occurs, Navy will make every effort to collaborate with PIFSC to gain additional monitoring data for the region.

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