Prepared for National Marine Fisheries Service
Office of Protected Resources
Prepared by US Pacific Fleet Environmental

Mariana Islands Range Complex Monitoring Plan

May 2010

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

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

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LIST OF ACRONYMNS

AMR	Adaptive Management Review
CFR	Code of Federal Regulations
CNO	Chief of Naval Operations
DoD	Department of Defense
EIS	Environmental Impact Statement
OEIS	Overseas Environmental Impact Statement
DON	Department of the Navy
ESA	Endangered Species Act
FY	fiscal year
GPS	global positioning system
HQ	headquarters
HRC	Hawaii Range Complex
ICMP	Integrated Comprehensive Monitoring Program
ITA	Incidental Take Authorization
LOA	Letter of Authorization
MIRC	Mariana Islands Range Complex
MMO	marine mammal observer
MMPA	Marine Mammal Protection Act
NEPA	National Environmental Policy 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
R&D	Research and Development

EXECUTIVE SUMMARY

The U. S. Navy's Integrated Comprehensive Monitoring Program (ICMP) provides the overarching structure for the monitoring program. The ICMP umbrella covers both research and development studies and Fleet compliance monitoring for the range complexes. Marine species monitoring plans have been developed and implemented by the Navy on other range complexes. These plans have primarily focused on gathering conducting visual and acoustic surveys before, during and after training events that can be used to assess any potential effects from training activities and to evaluate the effectiveness of the Navy's current mitigation practices.

The 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 (NMFS) must set forth "requirements pertaining to the monitoring and reporting of such taking." The MMPA implementing regulations in 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 effects to populations of marine mammals that are expected to be present. 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.

The Draft MIRC Monitoring Plan (http://www.nmfs.noaa.gov/pr/pdfs/permits/mirc_monitoring.pdf) outlined study questions that have been used in other range complex monitoring plans, directed at gathering data for determining potential effects from training. Methods proposed were 1) passive acoustic monitoring, 2) marine mammal observers aboard Navy vessels, 3) near shore visual observers and 4) collaboration with NMFS during an oceanographic survey. NMFS released the Draft Monitoring Plan to the public as part of the MMPA Proposed Rule review process and provided verbal and e-mail feedback to the Navy based upon this review. NMFS suggested that although the Navy conducted a four month line-transect survey in 2007 (DoN 2007), the MIRC, unlike other range complexes, is a region where limited data from systematic surveys for marine mammals and sea turtles exists. Therefore, NMFS recommended that the Navy re-focus the monitoring plan to augment the limited distribution and abundance data for this region. This data will be used to support the Navy's future environmental compliance under MMPA and ESA.

As a result of Navy/NMFS discussions, the overall objective of the MIRC Monitoring Plan was revised to collect field data that will enable the Navy and NMFS to better understand the distribution and abundance of marine mammals and sea turtles in the Mariana Islands. Methods that will be implemented are 1) analysis of an existing acoustic data set, 2) passive acoustic monitoring and 3) visual surveys (Table ES-1).

Table ES-1. Summary of monitoring methods and level of effort

	FY10		FY11		FY12		FY13		FY14		FY15
Passive Acoustic Monitoring		ADAPTIVE MANAGEMENT REVIEW (AMR)	Deploy four passive acoustic monitoring devices around the Mariana Islands that are capable of gathering data throughout the year.	AMR	Continue recording from PAM devices and begin data analysis.	AMR	Continue recording from PAM devices and conduct data analysis.	AMR	Continue recording from PAM devices and conduct data analysis.	AMR	Continue recording from PAM devices and conduct data analysis.
Acoustic Data Analysis			Analyze existing acoustic data set which was collected during Navy's 2007 MISTCS survey.								
Visual Surveys	- Small boat surveys around Guam, Tinian and Saipan. - Visual observations using marine species observers aboard NMFS/PIFSC oceanographic survey in the Region, as well as during transits between Hawaii and Guam.		Conduct summer and winter visual surveys using a small boat and/or airplane around Guam, Tinian, Rota and Saipan in cooperation with NMFS and/or DAWR. Visual surveys would integrate methods such as photo ID that provide data that can be used for distribution and abundance. 45 days total.		Conduct summer and winter visual surveys using a small boat and/or airplane around Guam, Tinian, Rota and Saipan in cooperation with NMFS and/or DAWR. Visual surveys would integrate methods such as photo ID that provide data that can be used for distribution and abundance. 45 days total.		Conduct summer and winter visual surveys using a small boat and/or airplane around Guam, Tinian, Rota and Saipan in cooperation with NMFS and/or DAWR. Visual surveys would integrate methods such as photo ID that provide data that can be used for distribution and abundance. 45 days total.		Conduct summer and winter visual surveys using a small boat and/or airplane around Guam, Tinian, Rota and Saipan in cooperation with NMFS and/or DAWR. Visual surveys would integrate methods such as photo ID that provide data that can be used for distribution and abundance. 45 days total.		Conduct summer and winter visual surveys using a small boat and/or airplane around Guam, Tinian, Rota and Saipan in cooperation with NMFS and/or DAWR. Visual surveys would integrate methods such as photo ID that provide data that can be used for distribution and abundance. 45 days total.

INTRODUCTION

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 (NMFS) must set forth "*requirements pertaining to the monitoring and reporting of such taking*." The MMPA implementing regulations in 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 effects on populations of marine mammals that are expected to be present. 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. The Mariana Islands Monitoring plan is one component of the Integrated Comprehensive Monitoring Program (ICMP) which is described in the next section.

The Draft MIRC Monitoring Plan (http://www.nmfs.noaa.gov/pr/pdfs/permits/mirc_monitoring.pdf) outlined study questions that have been used in other range complex monitoring plans, directed at gathering data for determining potential effects from training. Methods proposed were 1) passive acoustic monitoring, 2) marine mammal observers aboard Navy vessels, 3) near shore visual observers and 4) collaboration with NMFS during an oceanographic survey. NMFS released the Draft Monitoring Plan to the public as part of the MMPA Proposed Rule review process and provided verbal and e-mail feedback to the Navy based upon this review. NMFS suggested that although the Navy conducted a four month line-transect survey in 2007 (DoN 2007), the MIRC, unlike other Navy range complexes, is a region where limited data from systematic surveys for marine mammals and sea turtles exists. Therefore, NMFS recommended that the Navy re-focus the monitoring plan to augment the limited distribution and abundance data for this region. This data will be used to support the Navy's future environmental compliance under MMPA and ESA. Once this baseline is better established, the Navy and NMFS will determine through adaptive management if a shift to monitoring that focuses on potential effects from Navy training is recommended.

As a result of Navy/NMFS discussions, the overall objective of the MIRC Monitoring Plan was revised to collect field data that will enable the Navy and NMFS to better understand the distribution and abundance of marine mammals and sea turtles in the Mariana Islands. Methods that will be implemented are 1) analysis of an existing acoustic data set, 2) passive acoustic monitoring and 3) visual surveys (Table ES-1). The Navy has already completed its commitment to collaborate with NMFS Pacific Islands Regional Office (PIRO) to conduct visual observations of marine mammals and sea turtles during their 2010 oceanographic survey in the Marianas.

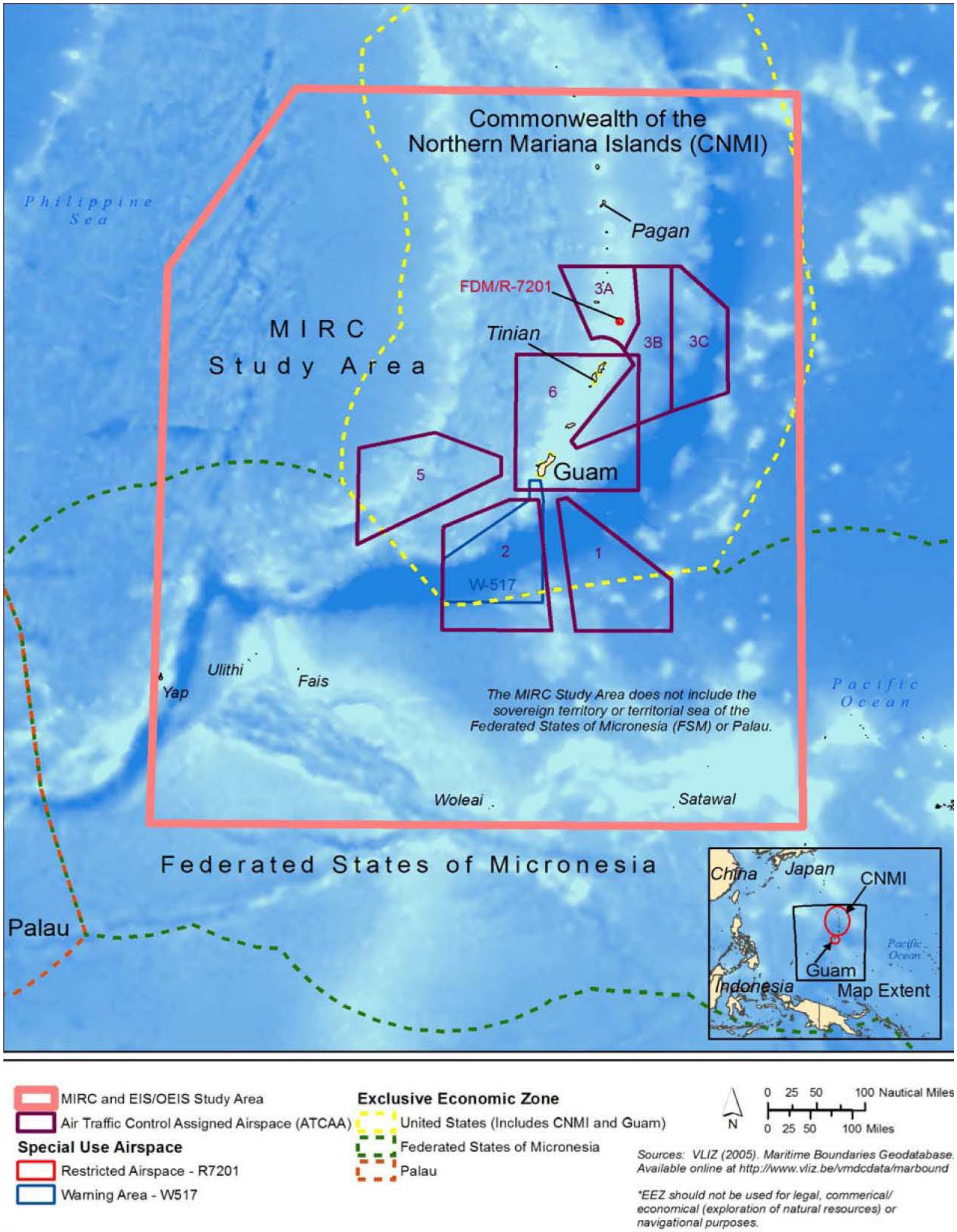

Figure 1. MIRC Study Area

INTEGRATED COMPREHENSIVE MONITORING PROGRAM (ICMP)

The Navy submitted the Integrated Comprehensive Monitoring Program (ICMP) plan to NMFS in December 2009. A revised ICMP will be submitted to NMFS by 31 October and finalized by 31 December 2010.

The ICMP provides the overarching framework for coordination of the United States Navy monitoring program. It is intended for use as a planning tool to focus Navy monitoring priorities pursuant to ESA and MMPA requirements and as an adaptive management tool to analyze and refine monitoring and mitigation techniques over time. The ICMP was developed in direct response to Navy Range permitting requirements established in the various MMPA Final Rules, ESA Consultations, Biological Opinions, and applicable regulations. As a framework document, the ICMP applies by regulation to those activities on ranges and operating areas for which the Navy sought and received incidental take authorizations. The ICMP currently includes specific monitoring plans that have been or are being developed for the Navy's range complexes and operating areas, depicted in Figure 2. Additional ranges or study areas may be added to the ICMP consistent with future Navy range permitting requirements.

The MMPA Final Rules provides that the primary objectives of the ICMP are to:
• Monitor and assess the effects of Navy activities on protected marine species;
• Ensure that data collected at multiple locations is collected in a manner that allows comparison between and among different geographic locations;
• Assess the efficacy and practicality of the monitoring and mitigation techniques;
• Add to the overall knowledge base of protected marine species and the effects of Navy activities on these species.

The ICMP meets these requirements and objectives by:
• Identifying top-level goals for the monitoring program, as well as guidelines for use in prioritizing monitoring projects and related R&D;
• Defining standard procedures for the compilation and management of data from range/project-specific monitoring plans;
• Establishing an adaptive management process that includes annual reviews with NMFS;
• Making provisions to review relevant monitoring-related research and, where appropriate, incorporate findings as updates to the range/project-specific monitoring plans and mitigation measures through adaptive management; and
• Providing an unclassified recordkeeping system that will allow interested parties to see how each Range Complex is contributing to ongoing monitoring.

The ICMP will be evaluated annually through the adaptive management process to assess progress, provide a matrix of goals for the following year, and make recommendations for refinement and analysis of the monitoring and mitigation techniques. This process includes conducting an Adaptive Management Review (AMR) at which Navy and National Marine Fisheries Service (NMFS) will jointly consider the prior year goals, monitoring results, and related science advances to determine if modifications are needed to more effectively address monitoring program goals. Adaptive management will occur annually, with some likely modifications to the process in 2011, when the Navy, with guidance and support from NMFS, is to host a Monitoring Workshop that incorporates outside experts and expanded participation.

Figure 2. Navy Range Complexes and Study Areas included under the ICMP

MARIANA ISLANDS RANGE COMPLEX MONITORING PLAN

Background Data

Prior to 2007 there was little information available on the abundance and density of marine mammals and sea turtles in the MIRC Study Area. Most information on the occurrence of marine mammals came from short surveys (several days) and opportunistic sightings (NMFS Platform of Opportunity, oceanographic cruises or strandings). Eldredge (1991) compiled the first list of published and unpublished records for the greater Micronesia area, reporting 19 marine mammal species. Some of these species accounts were based on unsubstantiated reports and may not reflect true species distribution in the region. Eldredge (2003) refined this list specifically for 13 cetacean species thought to occur around Guam (Eldredge 2003).

The first comprehensive survey of the area, Mariana Islands Sea Turtle and Cetacean Survey (MISTCS) was conducted by the Navy from January to April 2007 (DoN 2007b, Fulling et al *in prep*, Norris et al 2007, Thorson et al 2007). Although not required under NEPA, the survey was proactively initiated by the Navy to gather data to support analysis of potential effects in the Mariana Islands Environmental Impact

Statement and associated MMPA and ESA consultations. The visual survey was conducted using the systematic line-transect survey protocol developed by the NMFS Southwest Fisheries Science Center (Kinsey et al. 1998; Barlow 2006; Ferguson and Barlow 2001, 2003). Acoustic detection methods were made using two towed arrays and sonobuoys, adding to the visual detections. MISTCS was implemented to provide species identification and density data to support ongoing activities in the Mariana Islands and the Mariana Islands Range Complex Environmental Impact Statement/Overseas Environmental Impact Statement (MIRC EIS/OEIS). Observers visually surveyed 11,033 kilometer (km) (6,063 nm) of trackline during the MISTCS cruise. There were 148 total sightings of 12 marine mammal species. The sperm whale was the most frequently seen species (21 sightings) followed by Bryde's and sei whales (18 and 16 sightings, respectively). The pantropical spotted dolphin was the most frequently encountered delphinid species (16 sightings) followed by the false killer whale and the striped dolphin (both 10 sightings). There were also three sightings of beaked whales. Only one sea turtle was observed. The full MISTCS report is provided at http://www.nmfs.noaa.gov/pr/permits/incidental.htm#applications under the section title *2008 Mariana Island Range Complex.*

Prior to MISTCS, a U.S. Pacific Fleet funded aerial monitoring survey was conducted after the Valiant Shield training exercise in July 2007. The survey covered 2,352 km of linear effort, with transect grids distributed randomly throughout an 163,300 km^2 area. A total of 8 sightings were recorded during the five-day period including seven cetacean and one unidentified turtle species. (Mobley, J.R. 2007)

Additionally, from January to May 2010, NMFS, Pacific Islands Fisheries Science Center (PIFSC) and the U.S. Pacific Fleet collaborated to conduct visual surveys from both small boats and a large research vessel. Area of coverage was along transits between Hawaii and Guam and through the Mariana Island chain. At this writing, a technical report is not yet available.

MONITORING PLAN OBJECTIVES

The overall objective of the monitoring plan is to collect field data that will augment the limited distribution and abundance data for marine mammal and sea turtles in the Mariana Islands. As discussed in earlier sections, this revised objective resulted from coordination with NMFS during the MMPA Proposed Rule comment period.

This data will be used to support the Navy's future environmental compliance under MMPA and ESA. Once this baseline is better established, the Navy and NMFS will determine through adaptive management if a shift to monitoring to that which is done in other range complexes is recommended.

MARINE SPECIES UNDER CONSIDERATION

The Mariana Islands Marine Resources Assessment (DoN 2005) provided a compilation of all existing marine data for the region and predicted occurrence based upon those data. Created to support environmental planning documents (e.g. EIS), the MRA used a very conservative approach and included species that were extralimital to the Mariana Islands region. MISTCS provided additional visual and acoustic data that added to what was reported in the MRA, notably the presence of sei whales (DoN 2007. Data presented in Tables 1 and 2 are from DoN 2005 and 2007, however extralimital species are not included.

Table 1. Sea Turtles Associated With the MIRC Study Area

Common Name	Scientific Name	ESA Status	Potential Occurrence
Green sea turtle	*Chelonia mydas*	Threatened	Regular
Hawksbill sea turtle	*Eretmochelys imbricata*	Endangered	Regular *
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, Fulling et al *in prep*, Norris et al 2007, Thorson et al 2007)

Key

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

Table 2. Marine Mammal Species Associated with the MIRC Study Area

Common Name	Species Name	Status[1]			Occurrence	
		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 novaeangliae*	V	E	D	Rare	Regular*
Odontocetes						
Sperm whale	*Physeter macrocephalus*	V	E	D	Regular	Regular*
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
Killer whale	*Orcinus orca*	LR	-	ND	Regular	Regular
Longman's beaked	*Indopacetus pacificus*	DD	-	ND	Regular	Regular
Melon-headed	*Peponocephala electra*	LR	-	ND	Regular	Regular*
Pan-tropical 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	*Globicephala macrorhynchus*	LR	-	ND	Regular	Regular*
Spinner dolphin	*Stenella longirostris*	LR	_	ND	Regular	Regular*
Striped dolphin	*Stenella coeruleoalba*	LR	-	ND	Regular	Regular*

Sources Mariana Islands Marine Resources Assessment (DoN 2005) and Mariana Islands Sea Turtle and Cetacean Survey results (DoN 2007, Fulling et al *in prep*, Norris et al 2007, Thorson et al 2007)

Notes and Key:

(1) International Union for Conservation of Nature (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

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

MONITORING PLAN METHODS

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 range complexes, limiting access to large research vessels and non-military aircraft appropriate for offshore field surveys. Methods were evaluated based upon monitoring goals and feasibility. To the extent practicable, the Navy plans to coordinate with NMFS and local researchers to maximize expertise, equipment and fiscal resources.

Monitoring methods for the MIRC are:

- Passive Acoustic Monitoring
- MISTCS acoustic data analysis
- Visual surveys

Passive Acoustic Monitoring

As with any field method, there are both benefits and limitations to passive acoustic monitoring (PAM) 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).

Autonomous acoustic 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 (Mellinger and Barlow, 2003, Oswald et al. 2003; Mellinger et al. 2007). Use of autonomous buoys in the MIRC may be challenging due to a long and intense typhoon season, so success will be determined as methods are implemented and evaluated. Autonomous buoys can be deployed from vessels that are currently available in the MIRC (e.g. tugs) and be used for year-round, long term monitoring. If platforms of opportunity become available through partnerships between Navy and NMFS, future MIRC monitoring may include other PAM tools, including stationary surface sonobuoys, towed passive acoustic arrays and other technology if available.

It is likely that differing formations, distances between buoys and duty cycles, if appropriate, will be used depending on what the target species are. 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, which will be developed under the ICMP.

MISTCS acoustic data analysis

Many terabytes of passive acoustic data were obtained during MISTCS that were summarized with only some preliminary analysis. Given the paucity of marine mammal data for this region, analysis of this existing data set will provide a more complete understanding of distribution, occurrence and acoustic behavior of marine mammal species in the region.

Based upon preliminary results, the acoustic data will be analyzed to explore the possibility of:

- Using classification software to identify acoustic detections of odontocetes that were not visually observed. Detections would be identified to genus or species, as applicable. In order for this software to be applied in this study area, spectrographic features will be measured from whistles recorded during acoustic detections that included visual confirmation of species identity. Measurements from these whistles will be included in the classification algorithms, which will then be applied to recordings of whistles that were not detected visually. This work will provide a more complete understanding of the occurrence and distribution of species in the area.
- Derivation of distribution and abundance estimates of minke and sperm whales using acoustic localizations collected during towed array surveys. Minke whales are very rarely sighted but often detected acoustically. Sperm whales dive for extended periods of time and can be missed if in small groups, or during poor sighting conditions but vocalize continuously and can easily be detected and localized using passive acoustics. If determined to be feasible, this work could use similar methodology as has been used to estimate abundances of sperm whales in the eastern North Pacific and is being developed for minke whales off Kauai.
- Detailed analysis of minke, sperm, and sei whale sounds. A detailed analysis of sounds from these species would be useful to identify potential stocks of animals (e.g. pulse repetition rate for minke whales, and coda patterns for sperm whales). Sounds from sei whales were recorded during a few brief visual encounters. A detailed description and characterization of these sounds would help in identifying this species in future surveys and could also be used for automatic detection methods. Such a detailed analysis might help identify characteristics that can be use for stock population identification in this species.
- Humpback song was detected in the region off Saipan and Tinian. Detailed analysis and comparison of humpback whale song recorded from the Marianas to songs from other geographic regions (e.g. Japan and Hawaii) might provide information about stock identity of this migratory population.

Visual surveys – using a small vessel or airplane

Visual surveys of marine mammals and sea turtles using small boats or airplanes may provide information about their behavior, distribution, and abundance. Small boat surveys conducted by PIFSC in early 2010 were challenging due to difficult weather conditions, however, they demonstrated success when seas were calm. PIFSC and the Navy have established relationships with local universities, government agencies and researchers that should enhance opportunities for field work in this region.

For this monitoring plan, the Navy plans to continue partnering with PIFSC to conduct seasonal visual surveys using small boats around the islands of Guam, Rota, Tinian and Saipan. Visual surveys of this kind, that incorporate photo-identification for mark recapture have been used in the Pacific Islands and elsewhere (e.g. Baird et al. 2002, 2003, 2006, Benson et al. 2002, Galindo et al. 2009; Jefferson 1996, Laran et al. 2002, MacLeod et al. 2004, Martien et al. 2005, McSweeney et al. 2005, Smith et al. 2003). Visual surveys may also use airplanes if suitable aircraft are available, particularly if collaboration with existing survey efforts becomes available.

Appendix B provides additional discussion on using small vessel surveys for population and abundance.

Visual surveys – using a large vessel

Line-transect surveys are often used to conduct population and density surveys over large areas. If additional opportunities to partner with NMFS become available, the Navy may contribute to a line-transect large vessel survey in the Marianas to augment available density data.

Appendix B provides additional discussion on using large vessel surveys for population and abundance.

IMPLEMENTATION, ANALYSIS and REPORTING

Implementation

Table ES-1 provides detail about how the MIRC Monitoring Plan will be implemented from FY 2010 to FY 2015.

The Navy has already completed the 2010 commitment to collaborate with NMFS on visual surveys for marine mammals and sea turtles in the Mariana Islands. This effort was conducted by NMFS during an oceanographic survey in the region. Navy contributed funding for marine mammal observers during the transits between Hawaii and the Marianas, during the oceanographic survey transects and during near-shore small vessel surveys.

The Navy will be investing significant effort towards its monitoring program and is committed to conducting the monitoring until the original program objectives have been answered to the satisfaction of both NMFS and the Navy. To this end, 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. This range of species will make each study unique in the sense of knowing when enough data have been collected.

Under this plan and the ICMP, adaptive management 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. A data management system will be developed under the ICMP to assure standardized, quality data are collected towards meeting of the goals.

New technology and techniques may 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.

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.

Analysis and Reporting

The ICMP provides the overarching structure and coordination that will, over time, incorporate data from range-specific monitoring plans (e.g., Hawaii Range Complex, Southern California Range Complex, MIRC, Atlantic Fleet Active Sonar Training Range, Northwest Training Range Complex and Gulf of Alaska) and Navy-funded research and development (R&D) studies. 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. 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.

All available data will be included in Navy's annual monitoring report for the MIRC. The Navy's reports will provide information on the amount and spatial/temporal distribution of the 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 is targeted for completion in time for Navy's five year report to NMFS.

ADAPTIVE MANAGEMENT

Background

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. 2007). 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

Implementation

There are periodic exercise and annual reporting requirements that will be contained in NMFS MMPA authorization associated with the MIRC EIS/OEIS. Following the Navy's Annual Report to NMFS, the Navy and NMFS will meet to review the past year's 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 particular 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 Review (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 potential effects on the species or the efficiency in which such data is gathered and/or analyzed.

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 technologies 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 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.

The Navy's investment on marine mammal research in 2010 exceeds $34 million and continued funding at this level is foreseen for subsequent years. The CNO N45 and ONR coordinated Science & Technology and Research & Development program is currently focused in the following areas:

- 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 EIS/OEIS summarizes some of the general science on past studies of anthropogenic (i.e., human generated) noise on marine mammals (DoN 2010). 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 Science and Technology program will be achieved via consensus with the SLMRROG in order to advance the knowledge of marine mammal science.

APPENDIX B- VISUAL SURVEY METHODOLOGY DISCUSSION

The primary methods used for the estimation of the abundance of marine mammals are distance sampling and mark-recapture (Buckland et al. 1993, Evans and Hammond 2004), as well as migration and colony counts for certain species during special circumstances of distribution (Buckland and York 2008). Because marine mammals known to inhabit the waters of Guam and CNMI do not have seasonal breeding or pupping colonies, nor suitable coastal observation points for observing a large fraction of a population known to migrate, only distance sampling and mark-recapture are appropriate for the population of marine mammals in these waters. Passive acoustic monitoring methods have shown promise as a future tool in abundance estimation, but are still in development for such use (e.g., CIBRA 2009, SIO 2009), although abundance and density data obtained from the subset of fixed-point sampling methods are not necessarily amenable to geographic generalization to wider areas (Thompson et al. 2004) such as the Guam and CNMI project area.

The primary methodologies in distance sampling are surveys by line-transect, point-transect, strip-transect, or cue-counting. Point-transect and strip-transect are generally not applicable to marine mammals (other than point-transect methods using passive acoustic monitoring), and cue-counting (i.e., counting blows) has been used infrequently and only for large whales (Buckland and York, 2008). Surveying by line-transect is the primary method for estimating marine mammal abundance across large, species-diverse areas (e.g., Barlow 1997, Barlow 2006, Barlow and Forney 2007, Barlow 1995, Kishira et al. 1997, Buckland et al. 1992); pragmatic considerations tend to limit such surveys that encompass wide geographic areas to execution via large (i.e., >100 ft) research vessels. Line-transect techniques are generally well-suited for estimating abundance of animals that are sparsely distributed across such large regions, given certain assumptions that include: 1) animals near the transect line are always detected, 2) animals are detected before they respond to the observer, and 3) recorded distances are accurate (Thompson et al. 2004).

Mark-recapture methods may be performed with either artificial tags or natural marks, and the resulting estimations of abundance are more sensitive to assumptions and by definition require more effort beyond observations of number, species identification and location. However mark-recapture methods have advantages over distance sampling in some cases, such as the estimation of the abundance of clumped distributions of animals, or when estimates of survival or recruitment are desirable (Buckland and York 2008). For those species with clumped distributions relatively near to shore, the mark-recapture methodology is more amenable to utilization of smaller (i.e., ~<100 ft) research vessels. Assumptions of mark-recapture methods include: 1) a large fraction of the total population can be approached and individually identified, 2) identified individuals will always be recognized on every re-encounter, 3) the marked animals are representative of the population, and 4) the population is closed with no recruitment or emigration out of the area, so that each individual of the population has an equal probability of being sampled (Thompson et al. 2004, Buckland and York 2008, Friday et al. 1997, Evans and Hammond 2004). Furthermore, if artificial tags are not used for individual-identification, the use of mark-recapture methodology via photographic identification for estimating abundance is necessarily limited for use with species that possess natural markings that are known to very reliably lend themselves to individual identification in the field.

Line-transect and mark-recapture have different assumptions and possible failures of these assumptions when applied to estimating the abundance of marine mammals. With regard to mark-recapture, even the rare occurrence of false positives in matching individuals may result in large underestimates of abundance, and biases in estimation become larger when a relatively small proportion of animals within a population can be identified, or when recruitment to or emigration from the study area occurs (Buckland and York 2008, Stevick et al. 2001). In line-transect methods, survey lines should represent the entire study area, with lines perpendicular to the population density contours of the animals, which for most species are likely to correspond with the depth contours, but underestimation of abundance may occur for long-diving species, or species that react to the survey vessel before being detected. Due to these assumptions, as well as pragmatic considerations (e.g., cost, effort, vessel size), the two methods are suited for different contexts; mark-recapture is better suited for smaller populations of local distribution (especially where a large proportion of the total population may be identified), and line-transect for populations dispersed over wide areas, especially those that are infrequently encountered (Cañadas et al.

2006, Buckland and York 2008). In addition to abundance estimation, line-transect may provide data on the presence of rare species over wider areas, and mark-recapture can provide illumination of relative changes in abundance and survival rates as well as socially-related data such as individual life histories, migration routes, and site fidelity (Buckland and York 2008, Stevick 2008). For both methods, single surveys do not capture inter-year changes in populations, and those limited to particular times of the year will not capture seasonal changes within each year, including species that may be completely absent in the study area during a particular season.

Line-transect work over large areas at greater distances for shore are limited by pragmatic considerations to larger survey vessels due to range or safety considerations for smaller vessels or small aircraft. An example of a large-vessel survey of all cetacean species is the work of Barlow and Forney (2007) in the waters offshore of the west coast of the United States, covering an area of 1,141,800 km2 with effort spanning a period of fifteen years. In the Hawaii Range Complex EIS (DoN 2008), data from small plane surveys (Mobley 2004) as well as large-boat line-transect work (Barlow 2006) was available and used to calculate densities for the Hawaii Operating Area, an area spanning 806,027 km^2. The Final Mariana Islands Range Complex EIS/OEIS (DoN 2010) cites cetacean density estimates for 16 species observed during the MISTCS (DoN 2007) covering about a third of the total range complex study area of 1,299,851 km^2. It also used density estimates extrapolated from other tropical Pacific surveys for 11 species not observed during this survey, but presumed to be present in these waters (Ferguson and Barlow 2003; Barlow 2006; Miyashita 1993).

Small-boat surveys in areas of high diversity but low abundance have also been productive for examining presence and stock structure. For example surveys of odontocetes off the Hawaiian Islands (e.g. Baird et al. 2002, 2003, 2006, Martien et al. 2005) used small boats to obtain sightings, photographic identification and genetic analyses of bottlenose dolphins, rough-toothed dolphins, pantropical spotted dolphins, and short-finned pilot whales. Such results provide data relevant for management decisions that might not be efficiently collected by a large-vessel transect survey including short-term changes in distribution or abundance, the fidelity of populations to certain islands, or distinctions between oceanic and near-shore stocks. Mark-recapture results from small boat surveys also enabled abundance estimates for species, such as Baird et al.'s (2001) research on the bottlenose dolphin, which spanned 49 field days over two years over a 3,000 km2 area. McSweeney et al. (2005) also reported abundance estimates from mark-recapture studies of pygmy killer whales off the island of Hawai'i, and were the result of efforts spanning nineteen years due to the small size of the population and the accompanying rarity of encounters. Thus density estimates using mark-recapture methods are possible, given that: 1) populations of interest have fidelity to relatively nearshore waters accessible by small boats, 2) these waters typically have sea-state amenable to transit and sightings of species of interest via small boats, 3) the depth profiles of such waters accessible by small boats is sufficient to characterize the populations of interest (i.e., such species are likely to exist in the habitat as defined by those depths) 4) the temporal presence of the animals coincides with the seasonality of the surveys, and 5) smaller populations may characterized by longer term multi-year research efforts. Other broad surveys of the distribution and/or abundance of all cetacean species by small boat effort, utilizing both mark-recapture and transect methods include Smith et al (2003), MacLeod et al (2004), Benson et al (2002), Laran et al (2002), Galindo (2009), and Jefferson (1996) [the vessel used was intermediate in size at 105 ft].

Other cetaceans for which mark-recapture photographic identification methods have been utilized specifically for estimating abundance include humpback whales (e.g., Calambokidis et al. 2001; Kinas and Bethlem 1998), blue whales (Calambokidis et al. 2007, 2009, Calambokidis and Barlow 2004, Calambokidis 2009), sperm whales (Gero et al. 2007), false killer whales (Baird et al. 2005a), minke whales (Christensen and Rorvik 1982, Miyashita 1983, Tillman 1982), pygmy blue whale (Jenner et al. 2008), northern bottlenose whales (Gowans et al. 2000), and Bryde's whales (Miyashita and Kasamatsu 1983, Miyashita 1995, Tillman and Mizroch 1982). Other cetaceans that have natural markings that have been used for photographic identification include the dwarf minke whale, right whale spp., fin whale, gray whale, common dolphin, indo-pacific bottlenose dolphin, indo-pacific humpback dolphin, short-beaked common dolphin, spinner dolphin, rough-toothed dolphin, Australian snubfin dolphin, melon-headed whale, pygmy killer whale, pilot whale spp., and Blainville's beaked whale (Gedamke 2007, Gedamke et al. 2009, Josephson 2009).

Baird et al. (2005b) note that when considering data from small boat surveys, variables such as effort with respect to depth and temporal season will affect the likelihood of encountering species according to their specific habitat preferences. Cetacean habitat modeling is a relatively new field that is being developed to better predict distributions of these species (e.g., Redfern et al. 2006), and if enough data are available, may be used to predict cetacean habitats in new regions as Johnston et al. (2007) did for the humpback whale in the Northwestern Hawaiian Islands. Other methodologies for survey techniques include Borchers et al.'s (1998) combination of mark-recapture models for line-transect surveys, where a pairs of observers search independently from one another, to estimate detection probabilities.

The use of large boat surveys able to perform line-transect surveys over wider areas have been complemented by more opportunistic mark-recapture methods utilized by smaller vessels closer to shore. For example Calambokidis and Barlow (2004) compare results from the two methods on the humpback and blue whales, species with different types of distribution. The comparison illustrated that the assumption of population closure within the study area held in the case of humpback whales, as most photographs under both platforms were taken relatively close to shore (<30 nm), and individual identification results showed a clear compartmentalization between the population in the study area with other populations known to exist elsewhere. However in the case of the blue whale, because of the existence of possibly non-migrating subpopulations, the distinctness of these subpopulations was less clear, and therefore it was possible that the capture-recapture method would best cover the entire population. Therefore the use of complementary methodologies may facilitate the estimates of abundance by validating necessary assumptions regarding population structure. Evans and Hammond (2004) note that large scale line-transect surveys are generally too cost-prohibitive to conduct regularly, and therefore will not capture short-term changes in population size and structure, nor will it capture finer-scale distribution patterns that can be obtained by small-boat effort. Small boat survey work would therefore complement the large-boat survey results from the DoN (2007) study as well as the NMFS surveys, especially if it combined mark-recapture efforts via photographic individual identification over wide range of species.

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