Prepared for

National Marine Fisheries Service

Office of Protected Resources

Prepared by

Department of the Navy

Gulf of Alaska
Temporary Maritime Activities Area
Monitoring Plan

DRAFT

20 June 2010

DRAFT FINAL

This Monitoring Plan is submitted to NMFS in support of the

Taking and Importing Marine Mammals; Request for Letter of Authorization for the Incidental Harassment of Marine Mammals Resulting from Navy Training Activities in the Gulf of Alaska Temporary Maritime Activities Area; Final Rule

AND

Biological Opinion on the U.S. Navy's training in the Gulf of Alaska Temporary Maritime Activities Area

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EXECUTIVE SUMMARY

The Gulf of Alaska Temporary Maritime Activities Area (GOA TMAA) Monitoring Plan proposes monitoring goals for marine mammals that are unique with regard to their breadth as well as their focus on potential impacts of mid-frequency active sonar on marine mammals.

To accomplish these goals, the Navy will use similar methods of implementation and data analysis which have demonstrated success in comparable monitoring programs studying the effects of anthropogenic sound on marine animals. To this end, the Navy in consultation with the National Marine Fisheries Service (NMFS) designed a series of focused "study questions" to gather data in various combinations within the Navy's range complexes to address:

Question 1. Are marine mammals and sea turtles exposed to mid-frequency active sonar (1-10 kHz), especially at levels associated with adverse effects (i.e., based on NMFS' criteria for behavioral harassment, Temporary Threshold Shift, or Permanent Threshold Shift)? If so, at what levels are they exposed?

Question 2. If marine mammals and sea turtles are exposed to mid-frequency active sonar, 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 mid-frequency active sonar, 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 mid-frequency active sonar and explosives [e.g., Protective Measures Assessment Protocol, major exercise measures agreed to by the Navy through permitting] effective at avoiding temporary threshold shifts, injury, and mortality of marine mammals and sea turtles?

Given the larger scope of training events within other Navy range complexes as compared to the GOA, not every one of these original five study questions will be address within the GOA TMAA (**Tables ES-1** and **ES-2**). Rather, data collected from the GOA TMAA monitoring will be used to supplement a consolidate range complex marine mammal monitoring report incorporating data from the Hawaii Range Complex, Marianas Island Range Complex, Northwest Training Range Complex, and Southern California Range Complex.

Monitoring methods proposed for the GOA TMAA include use of passive acoustic monitoring (PAM) to primarily focus on providing additional data for study questions 2 and 3. In April of 2009, the U.S. Pacific Fleet also contributed approximately $250,000 in funding to support a NMFS marine mammal density survey of the offshore waters in the GOA. The goal of this validation monitoring was to increase the state of awareness on marine mammal occurrence, density, and distribution within the GOA.

In addition to the U.S. Pacific Fleet funded monitoring initiative, the Chief of Naval Operations Environmental Readiness Division and the Office of Naval Research have developed a coordinated Science & Technology and Research & Development program focused on marine mammals and sound. Total investment in this program from 2004-2008 was $100 million. FY09 funding was $22 million. Continued funding at levels greater than $14 million is foreseen in subsequent years (>2010).

Table ES-1. Summary Of Proposed Monitoring Studies And Level Of Effort In Support Of The GOA TMAA Monitoring Plan.

Monitoring Technique									
	Calendar Year 2011 Implementation	ADAPTIVE MANAGEMENT REASSESSMENT (AMR)	Calendar Year 2012 Implementation	AMR	2013	AMR	2014	AMR	2015
Passive Acoustics Monitoring (PAM) STUDIES 2,3	Deploy two long-term PAM devices for annual coverage including during any Navy training event: deploy minimum of two (2) passive acoustic buoys; conduct data analysis as available		Maintain two long-term PAM devices for annual coverage including during any Navy training event: continue data analysis		TBD pending AMR review		TBD pending AMR review		TBD pending AMR review
	Navy commitment : - Deploy minimum of two (2) passive acoustic buoys and associated data analysis		**Navy commitment:** - Maintain minimum of two (2) passive acoustic buoys and continue associated data analysis		**Navy commitment:** To be determined (TBD) pending AMR review		**Navy commitment:** To be determined (TBD) pending AMR review		**Navy commitment:** To be determined (TBD) pending AMR review
Study Question 2= If marine mammals and sea turtles are exposed to sonar, do they redistribute geographically as a result of continued exposure? If so, how long does the redistribution last? Study Question 3= If marine mammals and sea turtles are exposed to mid-frequency active sonar, what are their behavioral responses to various levels?									

51 **Table ES-2. Breakdown Of Monitoring Elements By NMFS Research Objectives.**

Monitoring element	NMFS research objectives				
	Q1 MFAS exposure assessment	**Q2** Geographical redistribution	**Q3** MFAS behavioral response	**Q4** Explosive exposure assessment	**Q5** Mitigation effectiveness
Aerial Survey	√		√	√	√
Marine Mammal Observers (MMO)	√		√	√	√
Vessel Survey	√		√	√	
Tagging- Satellite Tags	√	√	√		C
Tagging- Acoustic Tags	√		√		C
Passive Acoustics Monitoring (PAM)	C	√	C	C	C
Other Technology / Technique	TBD	TBD	TBD	TBD	TBD

√ = primary Plan support

C = contributory support

TBD = to be determined in future iterations of the Plan

Q1 = Question 1 MFAS exposure assessment: Are marine mammals and sea turtles exposed to mid-frequency active sonar (1-10 kHz), especially at levels associated with adverse effects (i.e., based on NMFS' criteria for behavioral harassment, Temporary Threshold Shift, or Permanent Threshold Shift)? If so, at what levels are they exposed?

Q2 = Question 2 Geographical redistribution: If marine mammals and sea turtles are exposed to mid-frequency active sonar in the GOA TMAA, do they redistribute geographically as a result of continued exposure? If so, how long does the redistribution last?

Q3 = Question 3 MFAS behavioral response: If marine mammals and sea turtles are exposed to mid-frequency active sonar, what are their behavioral responses to various levels?

Q4 = Question 4 Explosive exposure assessment: What are the behavioral responses of marine mammals and sea turtles that are exposed to explosives at specific levels?

Q5 = Question 5 Mitigation effectiveness: Is the Navy's suite of mitigation measures for MFAS and explosives (e.g., Protective Measures Assessment Protocol, major exercise measures agreed to by the Navy through permitting) effective at avoiding temporary threshold shift, injury, and mortality of marine mammals and sea turtles?

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LIST OF ACRONYMNS

AMR	Adaptive Management Review
GOA	Gulf of Alaska
ICMP	Integrated Comprehensive Monitoring Program
NMFS	National Marine Fisheries Service
PAM	passive acoustic monitoring
TMAA	Temporary Maritime Activities Area

INTRODUCTION

The U.S. Navy has developed this Gulf of Alaska Temporary Maritime Activities Area (GOA TMAA) (**Figures 1 and 2**) Monitoring Plan to provide marine mammal and sea turtle monitoring as required under the Marine Mammal Protection Act of 1972 and the Endangered Species Act of 1973.

In order to issue an Incidental Take Authorization for an activity, Section 101(a) (5) (a) of the Marine Mammal Protection Act states that National Marine Fisheries Service (NMFS) must set forth "*requirements pertaining to the monitoring and reporting of such taking*". The Marine Mammal Protection Act implementing regulations at 50 Code of Federal Regulations Section 216.104 (a) (13) note that requests for Letters of Authorization 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 (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.

Additional Navy funded research and development studies and ancillary research collaborations with academia and other institutions will be integrated as 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 GOA TMAA 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. While final areas within the GOA TMAA will be selected after consultations with NMFS and the science community (**Figures 1** and **2**), preliminary recommendations for deployment of passive acoustic monitoring (PAM) devices was developed in May 2010 after talks with marine mammal PAM academic experts at Scripps Institute of Oceanography (**Figure 3**).

In April of 2009, U.S. Pacific Fleet provided contributory funds of approximately $250,000 combined with additional funding from Chief of Naval Operations for a NMFS led marine mammal survey within the GOA. The objective of this project was to conduct a rigorous scientific abundance and density survey in a region such as GOA that NMFS recognizes has been under surveyed in the past. The goal of this project was to further advance the state of knowledge on marine mammal occurrence within the offshore waters of the GOA. The formal NMFS report for this survey effort was released in May 2010 (*see* Rone et al. 2010).

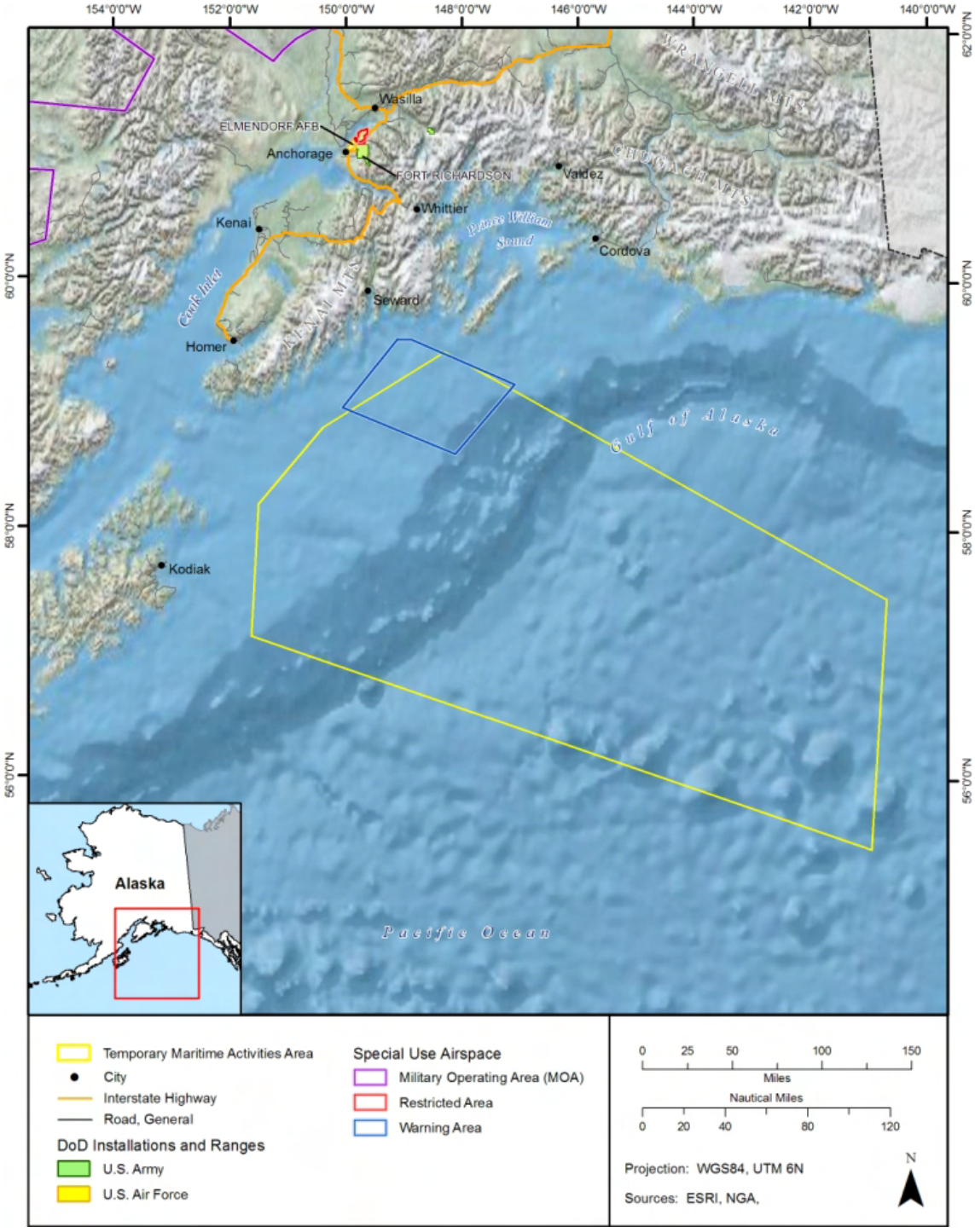

Figure 1. Gulf of Alaska Temporary Maritime Activities Area (From DoN 2009a).

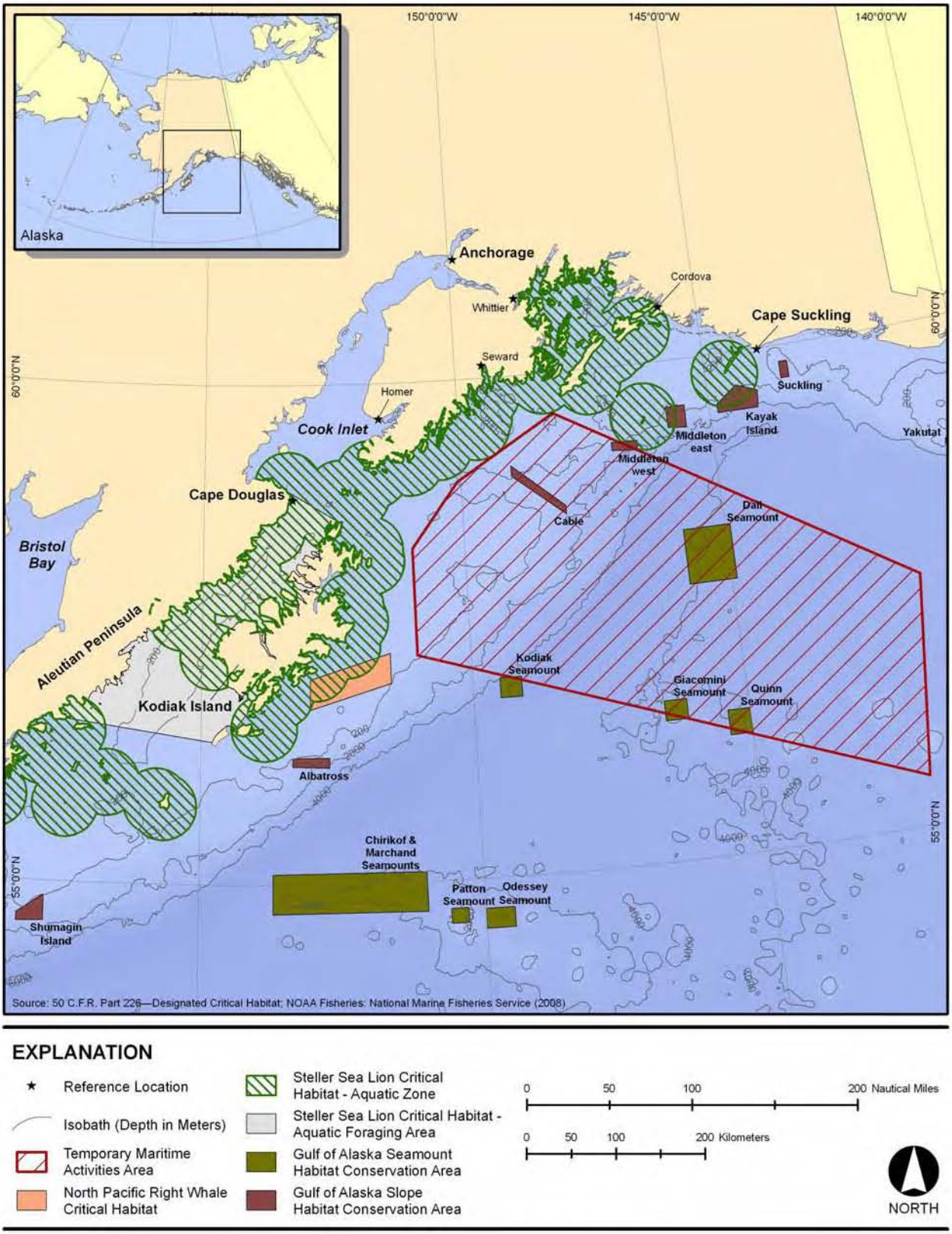

Figure 2. Critical Habitat and Habitat Conservation Areas in Vicinity of the Temporary Maritime Activities Area (from DoN 2009b).

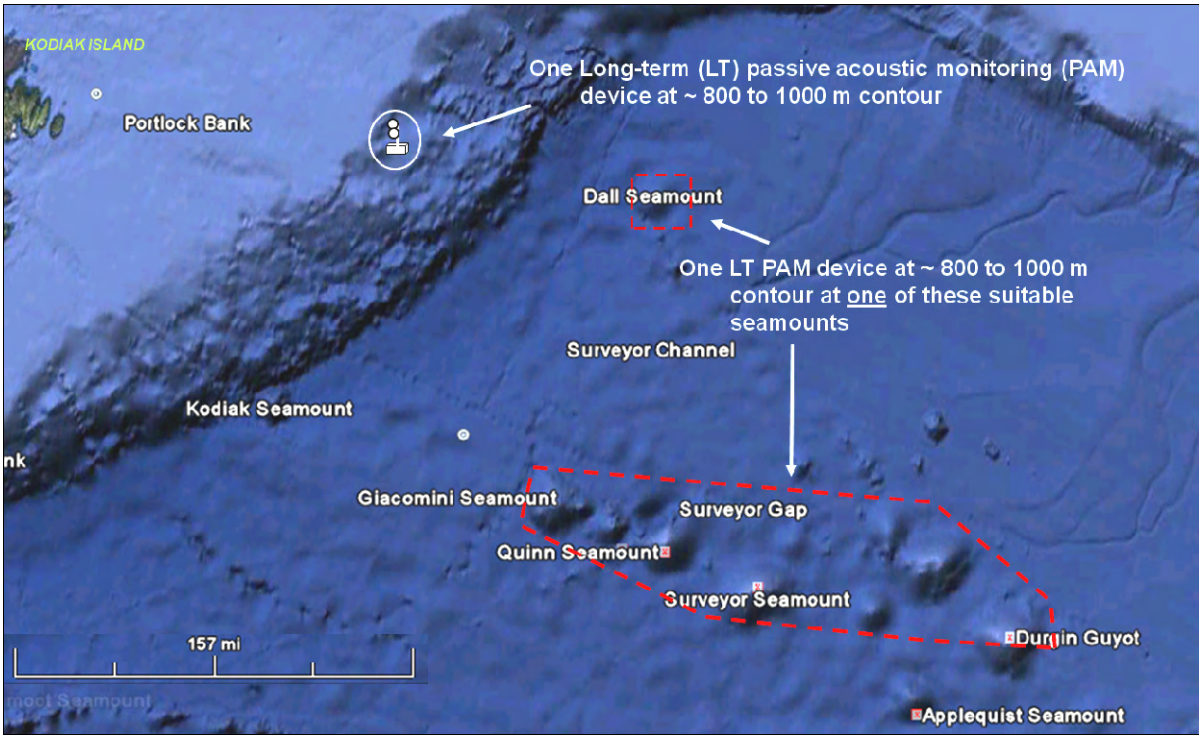

Figure 3. Potential underwater deployment sites for passive acoustic monitoring devices within the Gulf of Alaska Temporary Maritime Activities Area.

INTEGRATED COMPREHENSIVE MONITORING PROGRAM (ICMP)

The Integrated Comprehensive Monitoring Program (ICMP) is Navy-wide monitoring framework and will provide an overarching structure and coordination that compiles data from all Navy range specific monitoring plans (**Figure 4**).

In addition to the GOA TMAA, a number of other Navy range complex monitoring plans are being developed for protected marine species, primarily marine mammals and sea turtles, as part of the environmental planning and regulatory compliance process associated with a variety of training 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 within the Pacific Ocean with the largest amount of operations will be prioritized for monitoring based on availability of both funding and scientific resources. These include the Hawaii Range Complex, Marianas Island Range Complex, Northwest Training Range Complex, and Southern California Range Complex.

The GOA TMAA plan is one component of the ICMP and the studies outlined here will also be implemented in various combinations within other range complexes. 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 and underwater explosive detonation on marine mammals and sea turtles.

Monitoring measures prescribed in range/project-specific monitoring plans and Navy-funded research relating to the effects of anthropogenic sound on protected marine species should be designed to accomplish one or more of the following top-level goals:

- An increase in the probability of detecting marine mammals and other threatened or endangered marine species, both within the safety zone (thus allowing for more effective implementation of the mitigation) and in general to generate more data to contribute to the effects analyses.
- An increase in our understanding of how many marine mammals and other threatened or endangered marine species are likely to be exposed to levels of mid-frequency active sonar, high-frequency active sonar, underwater detonations, or other stimuli that are associated with specific adverse effects, such as behavioral harassment, Temporary Threshold Shift, or Permanent Threshold Shift.
- An increase in our understanding of how marine mammals and other threatened or endangered marine species respond (behaviorally or physiologically) to sonar, underwater detonations, or other stimuli at specific received levels that result in the anticipated take of individual animals.
- An increase in our understanding of how anticipated adverse effects on individual animals may impact the population, species, or stock (specifically through effects on annual rates of recruitment or survival).
- An increase in our understanding of the effectiveness of certain mitigation and monitoring measures.
- A better understanding and record of the manner in which the authorized entity complies with the incidental take authorization.

Under the ICMP and given the larger scope of training events within other Navy range complexes as compared to the GOA TMAA, not every one of these original five study questions will be addressed within the GOA (**Table ES-2**). Rather, data collected from the GOA TMAA monitoring will be used to supplement a consolidated range complex marine mammal monitoring report incorporating data from the Hawaii Range Complex, Marianas Island Range Complex, Northwest Training Range Complex, and Southern California Range Complex.

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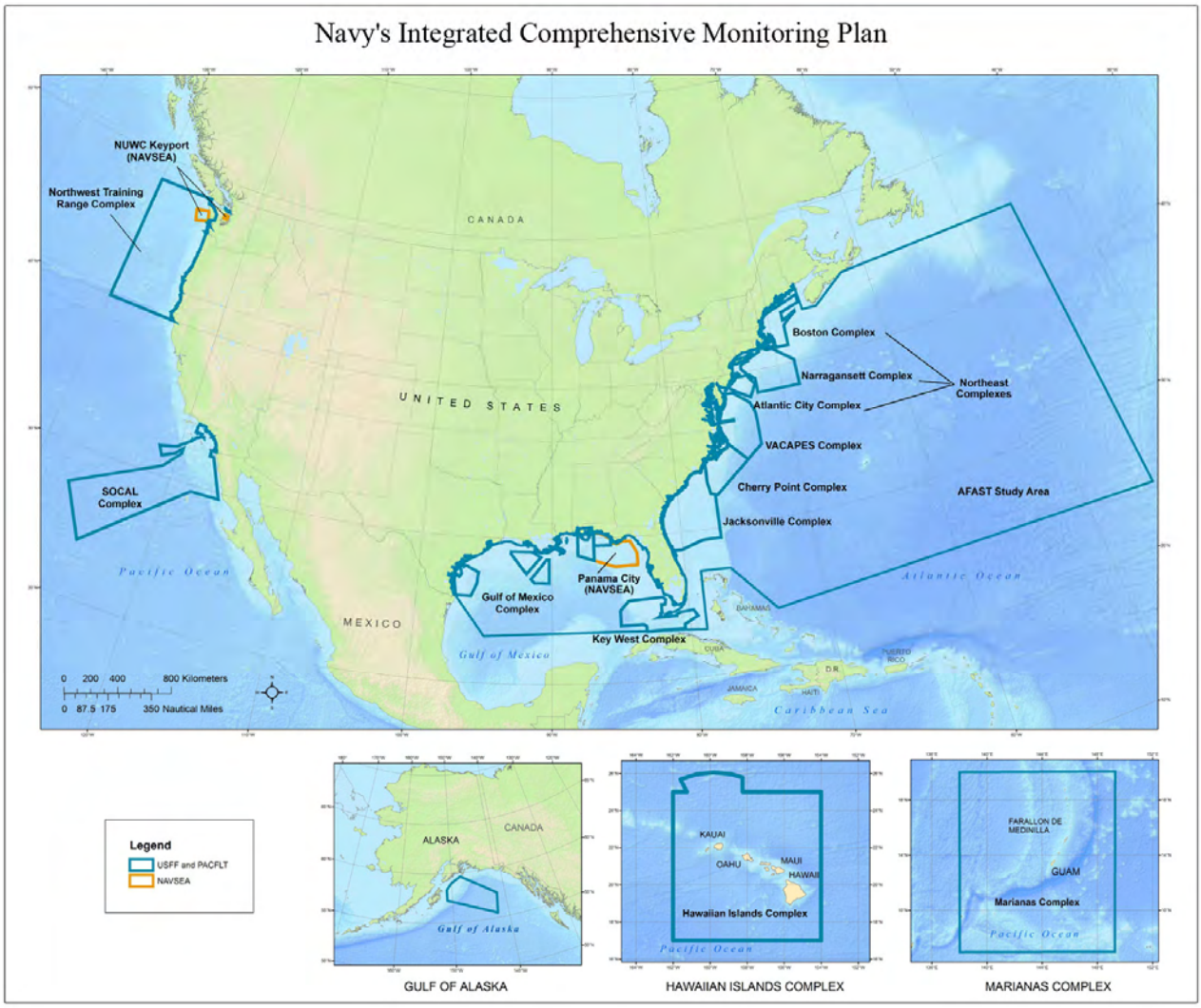

176 **Figure 4. Integrated Comprehensive Monitoring Plan – Navy-wide Map of Ranges where data**
177 **collection is expected to occur.**

GOA TMAA MONITORING PLAN

MONITORING PLAN OBJECTIVES

The GOA TMAA Monitoring Plan proposes monitoring objectives that are unique with regard to their breadth as well as their focus on potential impacts of mid-frequency and high-frequency active sonar and underwater explosions on marine mammals and sea turtles.

To accomplish these goals, the Navy will use similar methods of implementation and data analysis which have demonstrated success in comparable monitoring programs studying the effects of anthropogenic sound on marine animals. To this end, the Navy in consultation with the NMFS designed a series of focused "study questions" to gather data in various combinations within the Navy's range complexes to address:

1. Are marine mammals and sea turtles exposed to mid-frequency active sonar, especially at levels associated with adverse effects (i.e., based on NMFS' criteria for behavioral harassment, Temporary Threshold Shift, or Permanent Threshold Shift)? If so, at what levels are they exposed?
2. If marine mammals and sea turtles are exposed to mid-frequency active sonar in GOA TMAA, 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 mid-frequency active sonar, 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?
5. Is the Navy's suite of mitigation measures for mid-frequency active sonar and explosives (e.g., Protective Measures Assessment Protocol, major exercise measures agreed to by the Navy through permitting) effective at avoiding Temporary Threshold Shift, injury, and mortality of marine mammals and sea turtles?

Given the larger scope of training events within other Navy range complexes as compared to the GOA TMAA, not every one of these original five study questions will be address within the GOA TMAA (**Tables ES-1** and **ES-2**). Rather, data collected from the GOA TMAA monitoring will be used to supplement a consolidate range complex marine mammal monitoring report incorporating data from other Pacific Ocean range complexes (*see ICMP section*).

To this end, monitoring techniques for the GOA TMAA will be focused to address:

2. If marine mammals and sea turtles are exposed to mid-frequency active sonar in GOA TMAA, 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 mid-frequency active sonar, what are their behavioral responses to various levels?

MARINE SPECIES UNDER CONSIDERATION

There are 26 potential marine mammal species or separate stocks with possible or confirmed occurrence in the marine waters within the GOA, but not all species are expected within the TMAA. **Appendix A Table A-1** has marine mammal species with possible occurrence within the GOA TMAA (derived from DoN 2009a). The beluga whale, false killer whale, harbor seal, northern right whale dolphin, Risso's dolphin, sea otter, and short-finned pilot whale are considered extralimital in the TMAA and not expected to be present given their documented habitat preferences.

There are several sources of information on Pacific marine mammals, including the NMFS Stock Assessment Reports for marine mammals, and the Navy's Gulf of Alaska Navy Training Activities Draft Environmental Impact Statement\Draft Overseas Environmental Impact Statement (DoN 2009a). The NMFS U.S. Pacific Stock Assessment Reports are prepared annually and available at:

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

The Gulf of Alaska Navy Training Activities Draft Environmental Impact Statement\Draft Overseas Environmental Impact Statement contains a summary of the scientific literature on animal distribution and likely occurrence within the GOA TMAA. In addition, DoN 2009a also summarized some of the general science on past studies of anthropogenic (i.e., human generated) noise on marine mammals. Other related references also include Cox et al. 2006, Deeck 2006, Nowacek et al. 2007, and Southall et al. 2008).

This GOA TMAA Monitoring Plan has been designed to attempt gathering data on all species of marine mammals and sea turtles observed in the GOA TMAA study area. However, the Navy will prioritize monitoring efforts for species based on regulatory requirement due to ESA-listing, and on beaked whale species where mid-frequency use and strandings have been linked in certain circumstances. Of note, all of the beaked whale strandings and association with sonar have been in specific geographic locations of the Atlantic Ocean (Bahamas, Canary Islands) and Mediterranean Sea (Greece). There have been no beaked whale atypical mass strandings associated with sonar use on U.S. Navy Range Complexes within the Pacific. A detailed discussion on marine mammal stranding is contained in the Gulf of Alaska Navy Training Activities Draft Environmental Impact Statement\Draft Overseas Environmental Impact Statement (DoN 2009a).

Therefore, based on the requirements listed above, offshore species for study within the GOA TMAA Monitoring Plan that regularly occur within GOA TMAA will be prioritized for research as follows:

- **Beaked whale species** (Baird's beaked whale, Cuvier's beaked whale, Stejneger's beaked whale)
- **ESA-listed cetacean species** (blue whale, fin whale, humpback whale, North Pacific right whale, sei whale, and sperm whale)

The Plan recognizes that deep diving and cryptic species of marine mammals such as beaked whales, and sperm whales, may have low probability of visual detection (Barlow and Gisiner 2006). Therefore, methods will be utilized to address this issue (e.g., passive acoustic monitoring).

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 (**Table ES-2**). Given potential sea states and ocean conditions during both winter and summer, and the relative infrequent Navy presence in the GOA, passive acoustic monitoring represents the best technique to employ within the GOA TMAA.

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). Passive acoustic monitoring 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 passive acoustic monitoring, 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, Oleson et al. 2007a, 2007b, ONR 2007, NMFS 2008, Oleson et al. 2008, Mouy et al. 2009, Oleson et al. 2009, Southall and Nowacek 2009). Deployable acoustic recording packages may offer the first immediately available tools (see Newcomb et al. 2002, Hildebrand 2005, Hildebrand 2007, Wiggins and Hildebrand 2007, Lammers et al. 2008, Oleson et al. 2008). Other acoustic monitoring buoy types will also be considered for deployment as well (Lammers et al. 2005). At this preliminary stage, no particular PAM technique is immediately preferred. As the Plan progresses within the first year and experience gained within the GOA TMAA, either through direct measurement of results, review of technical PAM specifications, and from guidance of subject matter experts within the field, future GOA TMAA monitoring may include a different sub-set of PAM devices.

PAM in the GOA TMAA will be used to detect, locate, and potentially track vocalizing marine mammals, as well as provide seasonal estimates of presence/absence. Buoys will be set on a duty cycle that maximizes battery power, data storage space and provides adequate sampling. All passive acoustic recording packages will be set on a duty cycle to provide appropriate sampling coverage and maximize battery power and data storage space. Buoys will be retrieved as required for maintenance and downloading of data. Autonomous acoustic recording buoys will provide long term, daily information on the presence and absence of marine mammals in each area and their movements through the area. These systems will also provide information on the species present and their movements when an exercise occurs in that area (Mellinger and Barlow 2003, Oswald et al. 2003, Melliger et al. 2007). In addition, by collecting marine mammal vocalization and echolocation data before, during, and after any Navy training event, information can be inferred as to whether the training event has an effect or no effect on observed vocalizations.

All acoustic data will be collected according to standard and accepted passive acoustic monitoring protocols (NMFS 2008 Passive Acoustic guidelines).

OTHER POTENTIAL MONITORING ELEMENTS FOR FUTURE CONSIDERATION

There may be a number of potential additional marine mammal monitoring techniques, or variations of those already described, that could be attempted under this Plan. Future modifications to the GOA TMAA Monitoring Plan may include integration of additional marine mammal monitoring techniques and research as either new technology or new information becomes available. The previously discussed list of elements is based on initial identification of the research questions promulgated by NMFS and subsequent dialog on best immediate techniques to attempt at the outset of this Plan (>Spring 2011) based on past non-integrated monitoring, and regional availability. As part of future dialog to begin in the summer of 2011 with NMFS marine mammal scientists, academic scientists, and other subject matter experts with extensive field monitoring experience, the Navy will continually solicit input and recommendations to this Plan. An annual formal review with NMFS is being proposed at the end of each year's monitoring to capture lessons learned, and seek concurrence as to the best mix of monitoring techniques to employ in the next year's sampling based on scientific merit, applicability to the direct research questions posed in this Plan, and logistic and economic feasibility (**Table ES-1**). As additional recommendations are made from the Navy's ICMP as it develops, these too will be integrated into future GOA TMAA monitoring.

MONITORING PLAN STUDY DESCRIPTIONS

The implementation of various GOA TMAA specific studies and proposed goals for conducting these monitoring studies are shown in **Table ES-1** and repeated below.

As described later in this Plan, at the end of each monitoring and reporting year, a review of monitoring results, expectations, and fit in answering the Plan's overall objectives will be conducted, termed an Adaptive Management Review (AMR).

Monitoring Technique								
	Calendar Year 2011 Implementation	ADAPTIVE MANAGEMENT REASSESSMENT (AMR)	Calendar Year 2012 Implementation	AMR	2013	AMR	2014	AMR	2015
Passive Acoustics Monitoring (PAM) STUDIES 2,3	Deploy two long-term PAM devices for annual coverage including during any Navy training event: deploy minimum of two (2) passive acoustic buoys; conduct data analysis as available		Maintain two long-term PAM devices for annual coverage including during any Navy training event: continue data analysis		TBD pending AMR review		TBD pending AMR review		TBD pending AMR review
	Navy commitment : - Deploy minimum of two (2) passive acoustic buoys and associated data analysis		**Navy commitment:** - Maintain minimum of two (2) passive acoustic buoys and continue associated data analysis		Navy commitment: To be determined (TBD) pending AMR review		Navy commitment: To be determined (TBD) pending AMR review		Navy commitment: To be determined (TBD) pending AMR review

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

Methods- In order to address this question, there is a need to detect marine mammals and sea turtles not only at the surface, but to the extent possible in the water column. To this effect, passive acoustic monitoring offers the best technique within the GOA TMAA.

PAM- PAM devices can be used to track the presence and absence of vocalizing marine mammals over both short (hours-days) and long time scales (weeks-months-annually). Depending on PAM location in relation to training events, data from monitoring buoys might be used to assess potential sound exposure levels based on receive levels recorded by the buoys. The extent of actual exposure is an extrapolation of potential exposure between the source and the buoy, but is not an exact measure of the actual sound level to which an individual marine mammal was actually exposed. **Figure 5** shows representative data from Navy funded PAM in Southern California as an example of representative information that will be derived from GOA TMAA PAM deployment.

STUDY 3: If marine mammals and sea turtles are exposed to mid-frequency active sonar, what are their behavioral responses to various levels?

Methods- Documenting known at-sea behavioral reactions of marine mammal to military sonar and explosives are complicated by 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 in the water column where they could be potentially exposed to sonar. If animals are not present, then there would be no exposure and no possibility of behavioral reaction, or lack of reaction.

Passive Acoustic Monitoring- Opportunistic data collected as part of PAM in the GOA TMAA may offer insights to animal vocalization rates, potential dive pattern, and possible movement in relation to Navy training events. This field is relatively new in terms of defining behavioral context of vocalization and is dependent of knowing marine mammal vocalization patterns when no Navy operations are present.

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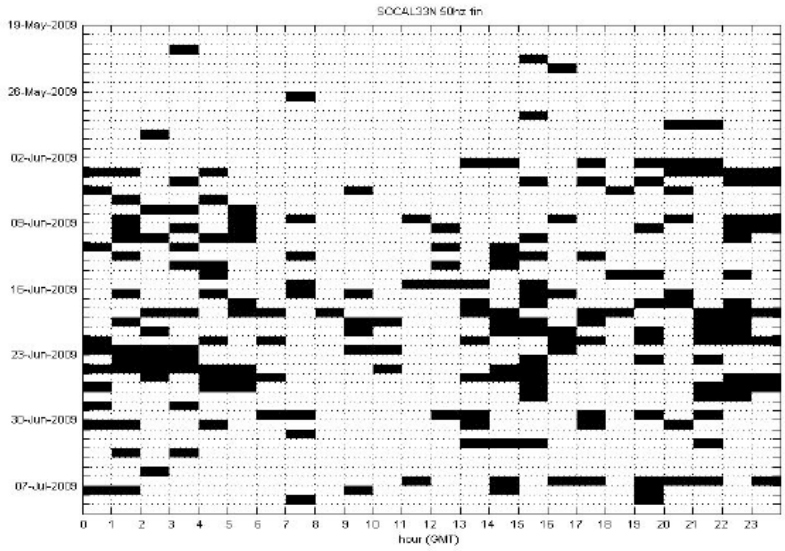
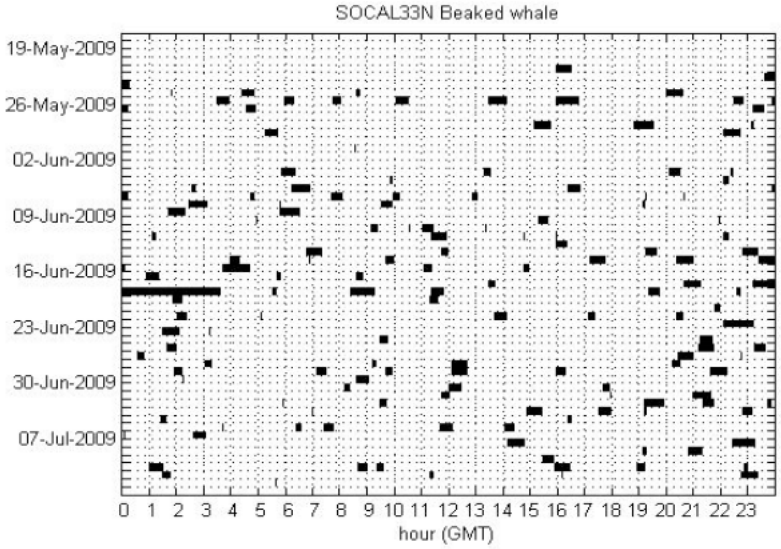
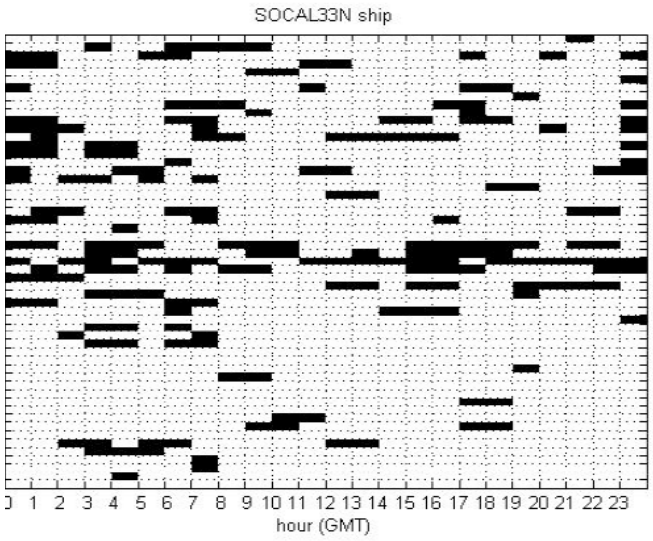


Fin Whale – "50 Hz" Call in Hourly Bins



Beaked whales – Echolocation Pulses in One-Minute Bins



Ship Noise in Hourly Bins

335 **Figure 5. Example long-term spectral average showing marine mammal vocalization and**
336 **echolocation over time.**

337 [from 3-month deployment of PAM device in Southern California showing fin whale (*top*), beaked whale
338 (*bottom left*) and broadband ship noise 10 Hz to 10 kHz (*bottom right*)]

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). The GOA TMAA Monitoring Plan proposes monitoring goals that are unique with regard to their breadth as well as their focus on potential impacts of sonar and underwater explosions on marine mammals and sea turtles. To accomplish these goals, the Navy will use similar methods of implementation and data analysis which have demonstrated success in comparable monitoring programs studying the effects of anthropogenic sound on marine animals.

GOA TMAA MONITORING PLAN IMPLEMENTATION AND ANALYSIS

Data will be collected by qualified, professional marine mammal biologists that are experts in their field. 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 in fulfillment of the Navy's reporting requirements under Marine Mammal Protection Action Letter of Authorization for the GOA TMAA. 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.

Table ES-1 provides detail about how the GOA TMAA Monitoring Plan will be implemented starting at the earliest field effort window in 2011.

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 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.

Using previous large scale monitoring programs as a guideline for success, one thing becomes clear - the key to the success of any monitoring plan's execution and analysis is using scientific professionals that are the top of their field (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, Mobley et al. 2001, Mobley 2005, Clark and Altman 2006). It's the Navy's intention that the GOA TMAA Monitoring Plan be implemented by a team of qualified, professional marine mammal biologists that are experts in their field. This team of experts will include statistical analysts to analyze data and make recommendations as to when they are beginning to see a pattern in the data and/or when the study designs need to be slightly altered for more robust data collection. This adaptive management process will provide a critical feedback loop to allow for adapting to new methods and evolving methodology. The process will be transparent to the public in the sense of yearly reporting to NMFS as well as encouraging the scientific team to publish results as they become available. 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. In addition to the studies conducted under the GOA TMAA Monitoring Plan, the Navy intends to collaborate with other researchers in Alaska that are conducting complimentary research on this topic. Those studies will not replace the Navy's obligation under this Plan, but could potentially augment the resources provided to the Plan's specific questions.

ICMP AND RELATIONSHIP TO GOA TMAA MONITORING PROGRAM

The ICMP is currently in development by the Navy. The program does not duplicate the GOA TMAA Monitoring Plan, instead it's intended to provide the overarching coordination that will support compilation of data from range-specific monitoring plans (e.g., GOA TMAA plan) as well as Navy funded studies. 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 (ICMP) that will, over time, compile data from both range-specific monitoring plans (e.g., GOA TMAA monitoring plan) as well as Navy funded research and development studies. The analysis protocols are still in 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 valid. A data management system will be developed to assure standardized, quality data are collected towards meeting of the goals. 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. Data collection is anticipate to begin by the spring of 2011, when the GOA TMAA authorization is issued by NMFS and the monitoring plan finalized (See **Table ES-1** for year by year implementation schedule). Data collected from the GOA TMAA 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 for the GOA TMAA. 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 PAM tool within the GOA TMAA monitoring program. All subsequent analysis shall be completed in time for Navy's five year report to NMFS.

ADAPTIVE MANAGEMENT

BACKGROUND

NMFS acknowledges that the GOA TMAA Monitoring Plan plan will enhance the understanding of how sonar or underwater detonations (as well as other environmental conditions) may, or may not, be associated with marine mammal injury or strandings. Additionally, NMFS also points out that information gained from the investigations associated with this Plan may be used in the adaptive management of mitigation or monitoring measures in subsequent NMFS authorizations, if appropriate.

Adaptive management is an iterative process of optimal decision making in the face of uncertainty, with an aim to reducing 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 FLEXIBILTY in their decisions, knowing that uncertainties exist and provides managers the latitude to change direction; 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

The Navy's adative management of the GOA TMAA Monitoring Plan involves close coordination with NMFS to align marine mammal monitoring with the Plan's overall objectives as stated within earlier sections of this Plan.

To recap, the objectives of the Navy's GOA TMAA Monitoring Plan are to determine:

2. If marine mammals and sea turtles are exposed to mid-frequency active sonar in GOA TMAA, 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 mid-frequency active sonar, what are their behavioral responses to various levels?

ADAPTIVE MANAGEMENT IMPLEMENTATION

There are periodic exercise and annual reporting requirements contained in NMFS authorization associated with the GOA TMAA Letter of Authorization. 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 GOA TMAA. 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, collaberation with regional or recognized NMFS scientists, academic scientists, and other non-Navy subject matter experts will be informally sought. As of this time, there is no formal mechanism in which to compensate a non-Navy "expert team", but this is one goal for the ICMP to designated, structure, and potentially fund. The Navy will then consult with the NMFS Office of Protected Resources in discussion of lessons learned and recommended way forward for the next year's sampling effort.

Until at least one or two years worth of monitoring data are collected and analyzed both within the GOA TMAA and in context of the ICMP, it is premature to guess which, if any of the proposed elements contained in this Plan will provide the most scientifically valid information to address the objectives. The original intent of this Monitoring Plan is to integrated into both the text discussions on research elements, and **Table ES-1** allocation of effort, what is anticipated as being the best allocation of resources to address the Plan's objectives.

Proper application of the adaptive management concept will allow future adjustments to be made to the GOA TMAA 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 GOA TMAA.

469 **APPENDIX A- COMMON MARINE MAMMAL SPECIES IN GOA TMAA**

470 **Table A-1. Common Marine Mammal Species Likely To Occur In The GOA TMAA.**

Common Name	Stock	Population Trend	Occurrence	Designated Critical Habitat in GOA TMAA
ESA Listed				
Blue whale	Eastern North Pacific	May be increasing	Rare	None
Fin whale	California, Oregon, Washington	May be increasing	Common	None
Humpback whale	Central and Western North Pacific	May be increasing	Common	None
North Pacific right whale	Eastern North Pacific	Unknown; may be decreasing	Very rarely sighted	None
Sei whale	Eastern North Pacific	May be increasing	Very rare	None
Sperm whale	California, Oregon, Washington	Unknown	Unknown	None
Stellar sea lion	Eastern U.S.	Increasing	Common	Yes—outside MAA
Stellar sea lion	Western U.S.	Decreasing	Common	Yes—outside MAA
Non-ESA Listed				
Baird's beaked whale	Alaska	Unknown	Rare	None
California sea lion	U.S.	Increasing	Very rare	None
Cuvier's beaked whale	Alaska	Unknown	Common	None
Dall's porpoise	California, Oregon, Washington	Unknown	Abundant	None
Gray whale	Eastern North Pacific	Increasing	Common	None
Harbor porpoise	Gulf of Alaska	Stable	Rare	None
Killer whale	Multiple stocks: ENP Alaska Resident and Northern Resident, Gulf of Alaska, Aleutian Island and Bering Sea, AT1, West Coast and Offshore	Increasing	Common	None
Minke whale	Alaska	Unknown	Rare	None
Northern elephant seal	California Breeding	Increasing	Common	None
Northern fur seal	Eastern Pacific	Increasing	Common	None
Pacific white-sided dolphin	North Pacific	Unknown	Common	None
Stejneger's beaked whale	Alaska	Unknown	Common	None

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