DEPARTMENT OF THE NAVY
OFFICE OF THE CHIEF OF NAVAL OPERATIONS
2000 NAVY PENTAGON
WASHINGTON, DC 20350-2000

IN REPLY REFER TO

5090
N456/8U158353
25 November 2008

Mr. Jim Lecky, Director
Office of Protected Resources
National Marine Fisheries Service (NMFS)
National Oceanic and Atmospheric Administration
B-SSMC3 Room 13821
1315 East-West Highway
Silver Spring, MD 20910-3282

Dear Mr. Lecky,

On behalf of Commander, U.S. Pacific Fleet (CPF), attached please find the written report summarizing the Navy's Rim of the Pacific (RIMPAC) exercise that occurred in the Hawaii Range Complex (HRC) from 29 June 2008 through 31 July 2008. This report is submitted in accordance with the requirements contained in the January 23, 2007, National Defense Exemption (NDE) from the requirements of the Marine Mammal Protection Act (MMPA) and in accordance with the June 21, 2008 (as amended on 24 June 2008) NMFS Biological Opinion for the Navy's Proposed RIMPAC 2008 exercise.

As always, please extend my thanks to your staff for the continued support of the U.S. Navy's compliance processes. We are available to meet with you or your staff should you have any comments on the attached report or recommendations for future After Action Reports. My point of contact for this matter is Mr. Ronald Tickle at (703) 602-2787, ronald.tickle@navy.mil and the CPF point of contact is Mr. Chip Johnson, (619) 767-1567, chip.johnson@navy.mil.

L. RICE
Rear Admiral, U. S. Navy
Director, Environmental Readiness Division
(OPNAV N45)

Enclosure: After Action Report for U.S. Navy Hawaii Rim Of The Pacific
Exercise 29 June - 31 July 2008

Copy to (with enclosure):
Mr. Michael Payne,
Chief, Permits, Conservation, and Education Division

Ms. Angela Somma,
Chief, Endangered Species Division

Copy to (without enclosure):
OPNAV N43
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CPF N01CE

Prepared for
National Marine Fisheries Service
Office of Protected Resources

Prepared by
Department of the Navy

In accordance with
Biological Opinion 21 June 2008 (as amended on 24 June 2008)
National Defense Exemption 23 January 2007

U.S. Navy
HAWAII
RIM OF THE PACIFIC EXERCISE 2008
(RIMPAC '08)
After Action Report
29 June - 31July 2008

SUBMITTED TO
Office of Protected Resources, National Marine Fisheries Service

30 November 2008

Abstract
This report presents an analysis of the effectiveness of the mitigation and monitoring measures as required under the 21 June 2008 Biological Opinion (BO) (as amended on 24 June 2008) on the U.S. Navy's Proposed Rim of the Pacific exercise (RIMPAC) in the Hawaii Range Complex (HRC) from July 2008 to January 2009

AND

Discussion of the nature of effects on marine mammals, if observed, under the National Defense Exemption (NDE) from the requirements of the Marine Mammal Protection Act (MMPA) for Mid-Frequency Active Sonar

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EXECUTIVE SUMMARY

As required by the 23 January 2007 National Defense Exemption (NDE) from the Requirements of the MMPA for Certain DoD Military Readiness Activities That Employ Mid-Frequency Active Sonar (MFAS) or Improved Extended Echo Ranging Sonobuoys and the 21 June 2008 Biological Opinion (BO) (as amended on 24 June 2008) on the U.S. Navy's Proposed Rim of the Pacific exercise (RIMPAC) in the Hawaii Range Complex (HRC) from July 2008 to January 2009, this report summarizes marine mammal sightings and provides an assessment of mitigation effectiveness for the U.S. Navy's Rim of the Pacific 2008 (RIMPAC '08) from 29 June to 31 July 2008 within the offshore waters of the Hawaii Range Complex.

A total of 4,800 hours of visual sighting effort from MFAS equipped surface ships occurred during RIMPAC '08 (25 days x 24 hrs/day = 600 hrs x 8 ships = 4,800 visual survey hours). This accounts for visual survey during the entire exercise, including both MFAS and non-MFAS exercise events.

There were 29 marine mammal sightings by U.S. Navy RIMPAC '08 exercise participants. These 29 sightings represented 203 animals. (Note: A single sightings could contain multiple animals). Dolphins accounted for the majority of animals sighted. There were 21 dolphin sightings for an estimated 125 animals. This represented 72% of the total marine mammal sightings and 62% of the total number of animals. There were six whale sightings for 11 animals (21% of total sightings, 5% of total animals). Another two sightings of groups of pinnipeds, were likely misidentified given the solitary nature of Hawaiian monk seals, and these two sightings were likely dolphin pods. All of the whale sightings were in deep off-shore waters greater than 100 nm west of the main island of Hawai'i. There were limited sightings of marine mammals within NDE safety zones by U.S. Navy ships during RIMPAC '08. Only one of the 29 marine mammal sightings occurred within a NDE safety zone when a pod of dolphins was observed riding the bow wake of a MFAS ship, which subsequently turned off its sonar.

A dedicated scientific monitoring program, separate from, but complimentary to the U.S. Navy exercise lookout reports was used during RIMPAC '08. A civilian (i.e., non-Navy) science team conducted aerial surveys and ship borne marine mammals surveys in ocean areas used by RIMPAC '08 participants. In addition, during a cooperative NOAA/Navy project, satellite and radio tracking tags were attached to several species to track animal movement, and in some cases vocal behavior. Accomplishments of this effort include:

- Aerial Survey: 25 total flight hours over 2,600 nm^2 area south of Kaua'i. 25 sightings of eight species, all toothed whales including beaked whales. Of note, no ESA-listed whales were sighted.
- Vessel Survey: 65 total ship hours over 474 nm south of Kaua'i. Nine sightings of three species, all dolphins species. No ESA-listed whales were sighted.
- Tagging: 31 field days covered 1,964 nm south of Kaua'i and west of Hawai'i. 110 sightings of 13 species, all toothed whales. Of the 110 sightings there were two sightings of ESA-listed sperm whale groups. 38 tags were attached to four species (Blainville's beaked whale, false killer whale, melon-headed whale, short-finned pilot whale). Analysis of the tagging study undertaken during RIMPAC is underway and results will be provided in separate subsequent reports.

Based on the limited marine mammal sightings from U.S. Navy lookouts during RIMPAC 08 active MFAS transmission (n = 0 ESA species), the U.S. Navy's acoustic modeling appears to have over-estimated the amount of potential acoustic exposures, including those to ESA-listed species. The acoustic model tends to over predict exposures due to limitations of available marine mammal density estimates and assumptions that animals are universally distributed throughout an area and do not leave or enter. Additionally, exposures are calculated without accounting for any mitigation measures that are used. NMFS (2008) RIMPAC BO Terms and Conditions require the U.S. Navy to estimate the number of ESA-listed marine mammals that may have been exposed to received energy level equal to or greater than 173 dB and 190 dB re 1 $\mu Pa^2 \bullet s$. Based solely on pre-exercise acoustic impact modeling, RIMPAC '08 was expected to potentially expose 335 ESA-listed marine mammals from all MFAS sources to potential Level B exposures that NMFS would classify as harassment under

the MMPA. There were no or limited ESA-listed whales (blue, fin, humpback, sei, sperm whales) potentially exposed to MFAS greater than 173 dB during RIMPAC '08.

On 28 July, toward the end of RIMPAC '08 exercise, a Cuvier's beaked whale was found live stranded on the south coast of Molokai. After several unsuccessful attempts to refloat the animal MFS deemed the animal too ill and the animal was humanely euthanized. As of the RIMPAC AAR report deadline for submission to NMFS, a final analysis of the results from the subsequent necropsy, performed by NMFS and local scientists, have not been completed. However, data review and analysis in partnership with NFMS continues to make progress. Further speculation as to cause of death without this critical piece of information would be speculative at this time.

For RIMPAC '08, there were marine mammal sightings from Navy lookouts and civilian scientists detecting and monitoring marine mammal behaviors during and after the exercise. There were no indications or reports of any unusual or abnormal marine mammal behaviors or behavior in a manner not associated with normal movement or foraging.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

INTRODUCTION

This report is presented to fulfill U.S. Navy written reporting requirements of the 23 January 2007 National Defense Exemption (NDE) from the Requirements of the MMPA for Certain DoD Military Readiness Activities That Employ Mid-Frequency Active Sonar (MFAS) or Improved Extended Echo Ranging Sonobuoys. Additionally, the 21 June 2008 National Marine Fisheries Service (NMFS) Biological Opinion (BO) (as amended on 24 June 2008) on the U.S. Navy's Proposed Rim of the Pacific exercise (RIMPAC) in the Hawaii Range Complex (HRC) from July 2008 to January 2009 requires the submittal of a written report to the Office of Protected Resources at NMFS (reporting requirements outlined in box below). This report also fulfills the BO reporting requirements.

RIMPAC BO (NMFS 2008) Reporting Requirements:

4. Within 120 calendar days of completing an exercise, the U.S. Navy shall provide the Chief, Endangered Species Division, Office of Protected Resources (with a copy provided to the Assistant Regional Administrator for Protected Resources in NMFS' Pacific Islands Regional Office) with a written report that shall include the following information:

a. Summary of the exercise (starting and ending date of the exercise, the number of ships and aircraft involved in the exercise, and the number of hours passive and active sonar was used during the exercise)

b. Specific mitigation measures Navy implemented during the exercise;

c. Number of blue whales, fin whales, humpback whales, sei whales, and sperm whales that (i) **had been detected within 500, 1,000 and 2,000 yards of a sonar dome during an active transmission** and (ii) the Navy's estimate of the number of fin whales, humpback whales, sei whales, and sperm whales that had been exposed to mid-frequency sonar at received levels equal to or greater than 173 dB and 190 dB;

d. the reports of the activity or activities that blue whales, fin whales, humpback whales, sei whales, and sperm whales had been observed to exhibit while they were within 500, 1,000, and 2,000 yards of a sonar dome that were actively transmitting during exercise. For example, a report should not identify "playing"; it should identify the behavior that allowed the observer to conclude the animal was "playing")

Reports of observations shall identify the date, time, and visual conditions associated (for example, if the observation is produced from a helicopter, the report should identify the speed, vector, and altitude of the airship; the sea state, and lighting conditions) with the observation; and how long an observer or set of observers maintained visual contact with a marine mammal;

e. an evaluation of the effectiveness of those mitigation measures at avoiding exposing endangered whales to ship traffic and endangered whales to ship traffic and mid-frequency sonar. This evaluation shall identify the specific observations that support any conclusion the Navy reaches about the effectiveness of the mitigation measures;

f. an evaluation of monitoring program's ability to detect whales that occur within 500, 1,000, and 2,000 yards of a sonar dome, during an active transmission (or close enough to an exercise to be exposed to mid-frequency sonar at received levels equal to or greater than 173 dB) with specific evidence that supports any conclusions the Navy reaches;

g. Estimates of the number of sonar hours during an exercise that occurred between the coastline and the 200 meter isopleth.

REPORT ORGANIZATION

This report contains unclassified material and provides the information and analysis for RIMPAC ’08 and is submitted in fulfillment of NDE and BO written requirements. The report focuses on addressing the biological impact questions presented in the RIMPAC BO (NMFS 2008) Reporting Requirements text box shown on the preceding page. Discussion on impacts of mitigation measures on U.S. Navy training are contained in separate, classified reporting.

This report is organized by section in the following order:

Background

Section A - Exercise Summary: provides exercise specific information including the starting and ending dates, the number of ships and aircraft participating, and the number of hours of MFAS used by all emitters.

Section B - Mitigation Measure Summary: describes specific mitigation measures implemented.

Section C/D - Biological Observations and Exposure Assessment: provides an overview of marine mammal observations obtained during the exercise in terms of BO required Terms and Conditions statements 4c and 4d listed previously. The exposure assessment during RIMPAC ‘08, estimates potential MFAS exposure for animals observed within 2,000 yards. The BO required this analysis to focus on marine mammal observations within 2,000 yards of a MFAS transmission.

Section E/F - Mitigation Assessments: discusses the effectiveness of the MFAS safety zones when marine mammals are sighted in the vicinity of ships using MFAS.

Section G- MFAS Hours Between 200-M Contour And Shoreline: Discusses the amount of RIMPAC ’08 MFAS hours that occurred between the 200-m bathymetric contour and the shoreline, a smaller subset of the exercise’s total hours described in Section A above. Note, at no time was MFAS used less than 12-nm from shore.

Appendix A- presents the final report for civilian scientific aerial based marine mammal monitoring conducted during RIMPAC ’08.

Appendix B- presents the final report for civilian scientific vessel based marine mammal monitoring conducted during RIMPAC ’08.

Appendix C- presents the final report for civilian scientific marine mammal tagging studies conducted during RIMPAC ’08.

BACKGROUND

RIMPAC, hosted by Commander, U.S. Pacific Fleet, demonstrates the Navy's commitment, as expressed in the Maritime Strategy, to working with the Navy’s global partners to protect maritime freedom that is the basis for global prosperity and to ensuring stability throughout the Pacific Rim. The RIMPAC ’08 exercise was the twenty-first in a series of RIMPAC exercises conducted periodically since 1971. RIMPAC allows the U.S. Navy to remain a powerful component of combined and joint warfare and exhibits our close cooperation with other services and international partners. Engagements like RIMPAC support the Maritime Strategy by building trust. Trust enables partnerships and strong partnerships increase maritime security. Individual units remain under operational command of their respective national commanders throughout the exercise.

RIMPAC ’08 exercise consisted of three major phases:

1) Phase I, the Harbor Phase took place June 29 through July 8 and consisted of operational planning meetings and safety briefings. This phase was designed to make final preparations for the at-sea phases of the exercise, as well as foster teamwork and international goodwill.

2) Phase II, the Operational Phase, took place July 8 through July 20. This phase is driven by a schedule of events and included live fire exercises, anti-surface warfare, undersea warfare, and naval maneuvers. At the completion of the Operational Phase, participating units repositioned to prepare for the final phase of RIMPAC.

3) Phase III, the Tactical Phase of the exercise, was scenario-driven and took place July 24 through July 28. This phase concluded with the ships’ return to Pearl Harbor or departure from the Hawaii Operating Area.

Prior to the exercise, NMFS-approved Marine Species Awareness Training (MSAT) was provided to exercise participants through a variety of methods including live briefings. A Letter of Instruction (LOI) reiterating the mitigation measures to be employed during the exercise was distributed to participants and explained procedures for reporting marine mammal sightings discussed in Section C/D. For mitigation associated with the use of the MFAS, the LOI incorporated the January 23, 2007 National Defense Exemption (NDE). On 23 January 2007, the Deputy Secretary of Defense granted the US Navy an exemption from permitting requirements of the MMPA for Certain DOD Military Readiness Activities That Employ Mid-Frequency Active Sonar (MFAS) or Improved Extended Echo Ranging Sonobuoys (IEER). This exemption included a list of mitigation measures developed in coordination with NMFS to be used when operating MFAS. The NDE mitigation measures implemented during RIMPAC ’08 are presented in SECTION B. During RIMPAC ‘08, the U.S. Navy adhered to the NDE mitigation measures.

SECTION A EXERCISE SUMMARY

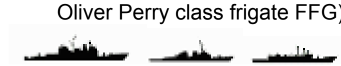
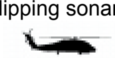
EXERCISE PARTICIPANTS

RIMPAC '08 was conducted from 29 June to 31 July 2008 (**TABLE A-1 AND FIGURE A-1**). Of note, the significant at-sea portion of RIMPAC '08 that involved use of MFAS was between July 7-31 (25 days). All references to RIMPAC '08 MFAS hours and visual sighting computations will be based on the July 7-31 date range.

There were 27 participating U.S. ships in RIMPAC '08 which included the U.S. Navy CSG and ESG assigned ships, (aircraft carrier, amphibious transport ships, surface combatants, submarines, and supply ships), and MFAS-equipped opposition forces (including submarines). Of these 27 ships, there were six SQS-53 MFAS-equipped ships and two SQS-56 MFAS-equipped ships. There was minimum MFAS use by non-CSG or ESG assigned platforms because of either tactical considerations for submarines or lack of MFAS capability (aircraft carrier, amphibious assault ships, supply ships). There were approximately six ASW-capable helicopters with dipping sonar available for training during the exercise on any given day, depending on maintenance availability. The number of helicopters used in any given exercise event is driven by tactical and training objectives. Depending upon the training scenario there were also 8 to 10 P-3C maritime patrol aircraft (MPA) participating.

TOTAL MFAS USE

During RIMPAC '08, 547 hours of MFAS time was reported from all sources. This number includes all hull mounted surface ship sonar (AN/SQS-53, AN/SQS-56), helicopter dipping sonar, and DICASS sonobuoys. Use of helicopter dipping sonar is more variable given the unique tactical and training objectives required by each ESG or CSG. Per reporting requirements of NMFS BO (NMFS 2008), of these 547 hours of total sonar hours during RIMPAC '08, approximately six hours of sonar or 1.1% of total RIMPAC '08 sonar (6/547 x100= 1.1%) occurred between the 200-meter bathymetric contour and shoreline. No MFAS use occurred in water less than 12 nm from shore. Key caveats to the derivation of these sonar total hours are presented in **SECTION C/D**.

Table A-1. Exercise summary for RIMPAC '08 June 29 to July 31 2008.			
Participants	**Event Name**	**Dates 2008**	**Exercise Particulars[1]**
USS KITTY HAWK CSG USS BONHOMME RICHARD ESG	RIMPAC '08	29 June- 31 July At sea portion: 07-31 July	547 hrs = total MFAS time conducted during entire exercise (541 > 200 m and 6 < 200 m) 6 hrs = # of hours within total MFAS listed above that occurred between 200-m contour but >12 nm from shoreline
Number of MFAS equipped surface ships			
(Ticonderoga class guided cruiser CG, Arleigh Burke class destroyer DDG, Oliver Perry class frigate FFG) 			8
Estimated number of ASW helicopters with dipping sonar: 			6
Estimated number of MPA:			8-10

[1] MFAS total hours represents summary of all U.S. Navy MFAS equipped units reporting MFAS use between July 7-31.

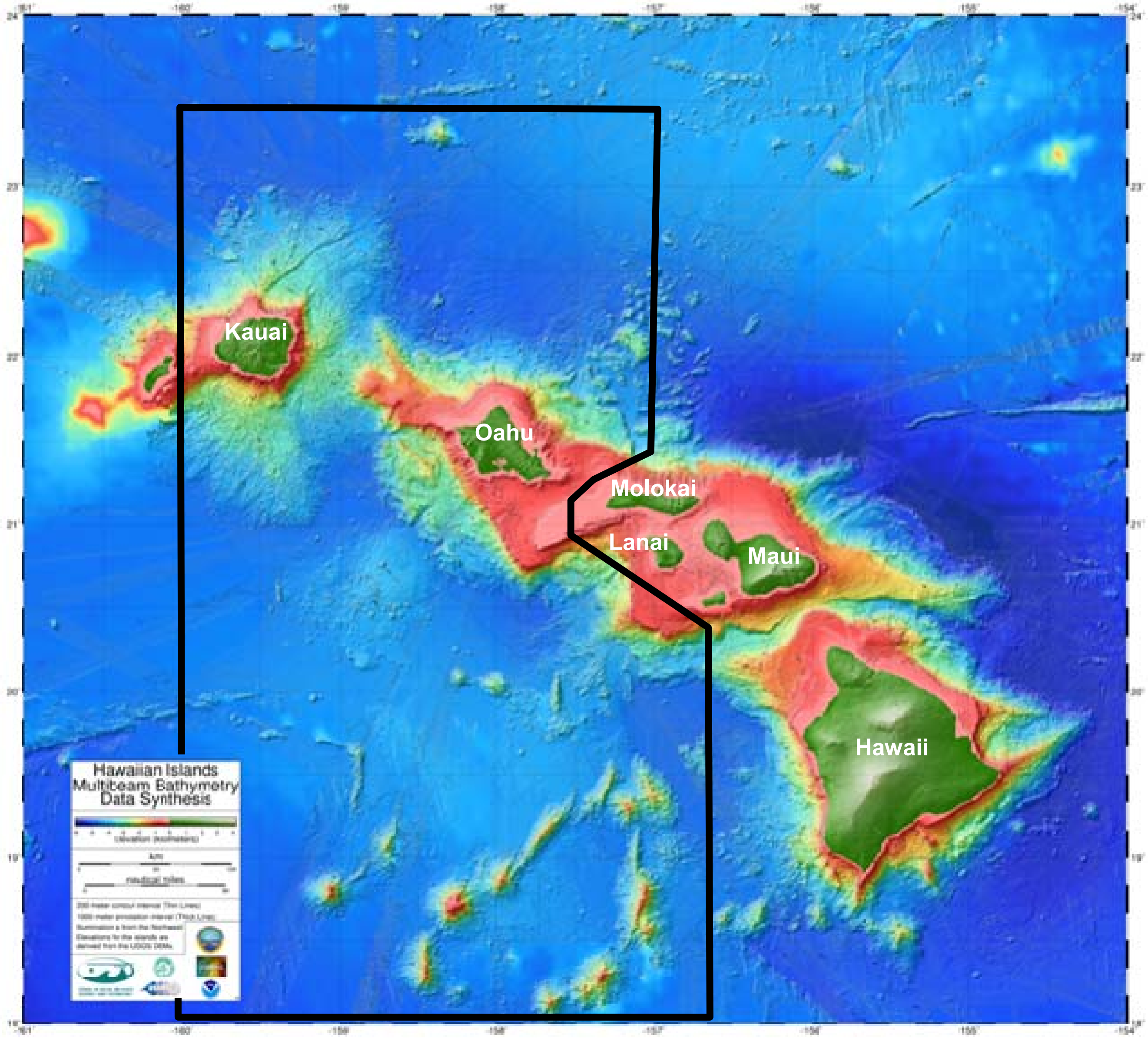


Figure A-1. Approximate RIMPAC '08 area. Note: area represents regions with U.S. Navy visual survey during exercise and does not imply full operational area. Base map from School of Ocean and Earth Science and Technology and the Hawaii Mapping Research Group http://www.soest.hawaii.edu/HMRG/Multibeam/index.php

SECTION B MITIGATION MEASURES FOLLOWED

The NDE issued on January 23, 2007 provides for protection of marine mammals, in the absence of an MMPA Letter of Authorization, by delineating specific measures to minimize potential impacts on marine mammals. These mitigation measures were developed in coordination with NMFS, the agency with substantive responsibility for marine mammals. All mitigation measures were adhered to during RIMPAC '08. Included in the measures are specific details for personnel training, lookout and watchstander responsibilities, specific operating procedures, and detailed coordination and reporting requirements, (**TABLE B-1**).

Table B-1. Mitigation measured performed by U.S. Navy exercise participants.

	NDE (01/07 Exemption Measures)
PERSONNEL TRAINING	All Lookouts onboard platforms involved in ASW training events will review the NMFS-approved Marine Species Awareness Training (MSAT) material prior to use of mid-frequency active sonar. All Commanding Officers, Executive Officers, and officers standing watch on the bridge will have reviewed the MSAT material prior to training event employing MFA sonar. Navy lookouts will undertake extensive training in order to qualify as a watchstander in accordance with Lookout Training Handbook (NAVEDTRA 12968D). Lookout training will include on-the-job instruction under the supervision of a qualified, experienced watchstander. Following successful completion of this supervised training period, lookouts will complete Personal Qualification Standard program, certifying that they have demonstrated the necessary skills (such as detection and reporting of partially submerged objects). This does not preclude personnel being trained as lookouts from being counted as those listed in previous measures so long as supervisors monitor their progress and performance. Lookouts will be trained in the most effective means to ensure quick and effective communication within the command structure in order to facilitate implementation of protective measures if marine species are spotted.
PRE-USE MONITORING	Prior to start-up or restart of active sonar, operators will check that the Safety Zone radius around the sound source is clear of marine mammals. Helicopters shall observe/survey the vicinity of an ASW exercise for 10 minutes before the first deployment of active (dipping) sonar in the water. Submarine sonar operators will review detection indicators of close-aboard marine mammals prior to the commencement of ASW operations involving active mid-frequency sonar. *(See pre-exercise monitoring requirements under Environmental Factors Measure, below.)*
DURING USE MONITORING	**Surface Vessels**: On the bridge of surface ships, there will always be at least three people on watch whose duties include observing the water surface around the vessel. In addition to the three personnel on watch noted previously, all surface ships participating in ASW exercises will have at all times during the exercise at least two additional personnel on watch as lookouts. Personnel on lookout and officers on watch on the bridge will have at least one set of binoculars available for each person to aid in the detection of marine mammals. On surface vessels equipped with MFA, pedestal-mounted "Big Eye" (20x110) binoculars will be present and in good working order to assist in the detection of marine mammals in the vicinity of the vessel. Personnel on lookout will employ visual search procedures employing a scanning methodology in accordance with the Lookout Training Handbook (NAVEDTRA 12968D). After sunset and prior to sunrise, lookouts will employ Night Lookout Techniques in accordance with the Lookout Training Handbook. Personnel on lookout will be responsible for reporting all objects or anomalies sighted in the water (regardless of the distance from the vessel) to the Officer of the Deck, since any object or disturbance (i.e., trash, periscope, surface disturbance, discoloration) in the water may be indicative of a threat to the vessel and its crew or indicative of a marine species that may need to be avoided as warranted. **Aircraft**: Navy aircraft participating in exercises at sea will conduct and maintain, when operationally feasible and safe, surveillance for marine species of concern as long as it does not violate safety constraints or interfere with the accomplishment of primary operational duties. **Passive Acoustic**: All personnel engaged in passive acoustic sonar operation (including aircraft, surface ships, or submarines) will

	NDE (01/07 Exemption Measures)
	monitor for marine mammal vocalizations and report the detection of any marine mammals to the appropriate watch station for dissemination and appropriate action. During MFA operations, personnel will utilize all available sensor and optical systems (such as Night Vision Goggles) to aid in the detection of marine mammals. *(See additional exercise monitoring measures under Environmental Factors Measure, below.)*
MFAS OPERATIONS	Sonar levels (generally) – The ship or submarine will operate sonar at the lowest practicable level, not to exceed 235 dB, except as required to meet tactical training objectives.
SAFETY ZONE SHIPS	Safety Zones – When marine mammals are detected by any means (aircraft, shipboard lookout, or acoustically) within 1,000 yards of the sonar dome (the bow), the ship or submarine will limit active transmission levels to at least 6 dB below normal operating levels. (i) Ships and submarines will continue to limit maximum transmission levels by this 6-dB factor until the animal has been seen to leave the area, has not been detected for 30 minutes, or the vessel has transited more than 2,000 yards beyond the location of the last detection. (ii) Should a marine mammal be detected within or closing to inside 500 yards of the sonar dome, active sonar transmissions will be limited to at least 10 dB below the equipment’s normal operating level. Ships and submarines will continue to limit maximum ping levels by this 10-dB factor until the animal has been seen to leave the area, has not been detected for 30 minutes, or the vessel has transited more than 2,000 yards beyond the location of the last detection. (iii) Should the marine mammal be detected within or closing to inside 200 yards of the sonar dome, active sonar transmission will cease. Sonar will not resume until the animal has been seen to leave the area, has not been detected for 30 minutes, or the vessel has transited more than 2,000 yards beyond the location of the last detection. (iv) Special conditions applicable for dolphins and porpoise only: If, after conducting an initial maneuver to avoid close quarters with dolphins or porpoises, the Officer of the Deck concludes that dolphins or porpoises are deliberately closing to ride the vessel’s bow wave, no further mitigation actions are necessary while the dolphins or porpoises continue to exhibit bow wave riding behavior. (v) If the need for power-down should arise as detailed in “Safety Zones” above, the ship or submarine shall follow the requirements as though they were operating at 235 dB – the normal operating level (i.e., the first power- down will be to 229 dB, regardless of at what level above 235 dB sonar was being operated).
SAFETY ZONE SONOBUOYS	Aircraft with deployed sonobuoys will use only the passive capability of sonobuoys when marine mammals are detected within 200 yards of the sonobuoy.
HELO DIPPING	Helicopters shall observe/survey the vicinity of an ASW exercise for 10 minutes before the first deployment of active (dipping) sonar in the water. Helicopters shall not dip their sonar within 200 yards of a marine mammal and shall cease pinging if a marine mammal closes within 200 yards after pinging has begun.
ENVIRON-MENTAL FACTORS MEASURE	Increased vigilance during major ASW training exercises with tactical active sonar when critical conditions are present: Based upon lessons learned from strandings in the Bahamas (2000), the Madeiras (2000), the Canaries (2002) and Spain (2006), beached whales are of particular concern since they have been associated with MFA operations. Navy should avoid planning major ASW training exercises with MFA in areas where they will encounter conditions that, in their aggregate, may contribute to a marine mammal stranding event. The conditions to be considered during exercise planning include: (1) Areas of at least 1,000 m depth near a shoreline where there is a rapid change in bathymetry on the order of 1,000-6,000 meters occurring across a relatively short horizontal distance (e.g., 5 nm). (2) Cases for which multiple ships or submarines (≥ 3) operating MFA in the same area over extended periods of time (≥ 6 hours) in close proximity (≤ 10 nm apart). (3) An area surrounded by land masses, separated by less than 35 nm and at least 10 nm in length, or an embayment, wherein operations involving multiple ships/subs (≥ 3) employing MFA near land may produce sound directed toward the channel or embayment that may cut off the lines of egress for marine mammals. (4) Although not as dominant a condition as bathymetric features, the historical presence of a significant surface duct (i.e., a mixed layer of constant water temperature extending from the sea surface to 100 or more feet). If the major exercise must occur in an area where the above conditions exist in their aggregate, these conditions must be fully analyzed in environmental planning documentation. Navy will increase vigilance by undertaking the following protective measure: A dedicated aircraft (Navy asset or contracted aircraft) will undertake reconnaissance of the embayment or channel ahead of the exercise participants to detect marine mammals that may be in the area exposed to active sonar. Where practical, advance survey should occur within about two hours prior to MFA use, and periodic surveillance should continue for the duration of the exercise. Any unusual

	NDE (01/07 Exemption Measures)
	conditions (e.g., presence of sensitive species, groups of species milling out of habitat, any stranded animals) shall be reported to the Officer in Tactical Command (OTC), who should give consideration to delaying, suspending or altering the exercise. The post-exercise report must include specific reference to any event conducted in areas where the above conditions exist, with the exact location and time/duration of the event, and noting results of surveys conducted.
REPORTING REQUIRE-MENTS	Navy will coordinate with the local NMFS Stranding Coordinator regarding any unusual marine mammal behavior and any stranding, beached live/dead, or floating marine mammals that may occur at any time during or within 24 hours after completion of mid-frequency active sonar use associated with ASW training activities. Navy will submit a report to the Office of Protected Resources, NMFS, within 120 days of the completion of a Major Exercise. This report must contain a discussion of the nature of the effects, if observed, based on both modeled results of real-time events and sightings of marine mammals. If a stranding occurs during an ASW exercise, NMFS and Navy will coordinate to determine if MFA should be temporarily discontinued while the facts surrounding the stranding are collected. *(See special reporting requirements under Environmental Factors Measures.)*

SECTION C/D- BIOLOGICAL OBSERVATIONS AND EXPOSURE ASSESSMENT

SECTION C/D provides an overview of marine mammal observations that require reporting under the Terms and Conditions of the NMFS RIMPAC '08 BO (NMFS 2008).

The biological summary in this section includes the total number of marine mammals sighted, the number of marine mammals observed within 2,000 yards of sonar source during MFAS transmission, and a science-based analysis of species likely present in Hawaii during the time of year of this exercise.

RIMPAC '08 U.S. NAVY BIOLOGICAL OBSERVATIONS

There were 29 live marine mammal sightings for an estimated total of 203 animals by RIMPAC exercise participants. A single sighting could contain more than one marine mammal. **FIGURE C/D-1** shows the location of these marine mammal sightings during RIMPAC '08. Dolphins accounted for the majority of animals sighted. There were 21 dolphin sightings for an estimated 125 animals. This represented 72% of the total marine mammal sightings and 62% of the total number of animals. There were 6 whale sightings for 11 animals (21% of total sightings, 5% of total animals). Of note, all of the whale sightings reported by U.S. exercise participant were in deep off-shore waters greater than 100 nm west of the main island of Hawaii within and adjacent to a 100-nm wide warm core oceanographic feature reported by Navy oceanographers.

Two of the total 29 sightings for 67 "seals" are likely errors in identification. The only pinniped that is resident to the Hawaiian Islands is the monk seal. Monk seals are solitary animals and not typically seen at sea in large numbers. These two sightings were made from maritime patrol aircraft at altitudes >800 feet and ranges of 2,000 and 8,000 yards. Given the distances involved, most likely these sightings represent pods of dolphins misidentified as seals.

Given the time of year this exercise occurred (JULY) likely ESA species present in Hawaii include sei whales, and sperm whales (Barlow et al. 2008, Baird et al. 2008 **APPENDIX C**). Two groups of sperm whales were sighted during visual survey associated with marine mammal tagging studies during RIMPAC '08 (Baird et al. 2008). Blue whales are rare, with only one confirmed fall/winter sighting in Hawaiian waters. Therefore, blue whales would not be expected during RIMPAC '08. Fin whales are not present in high densities, but appear to be seasonal migrants. Humpback whales are not present in Hawaii during July.

Non-ESA species observed during RIMPAC '08 civilian scientific tagging studies include Blainville's beaked whale, Cuvier's beaked whale, bottlenose dolphin, dwarf sperm whale, false killer whale, pan-tropical spotted dolphin, melon-headed whale, Risso's dolphin, rough-toothed dolphin, short-finned pilot whale, spinner dolphin, and striped dolphin (Mobley 2008, **APPENDIX A**; Baird et al. 2008, **APPENDIX C;** Smultea 2008, **APPENDIX B**).

Estimated numbers of marine mammals observed by U.S. Navy ships during RIMPAC '08 are presented in **Table C/D-1**, which lists the individual sightings. These sightings were taken during the exercise based on visual observations from trained U.S. Navy lookouts on each ship. There were two instances where Navy ships either not using MFAS at the time, or not equipped with MFAS proactively maneuvered to avoid pods of dolphins.

Based on reports from individual U.S. Navy ships, Beaufort sea states during reported marine mammal sightings were between 2 and 5. See **TABLE C/D-2 f**or descriptions and examples of Sea States 2 through 7.

Whale carcass

On 25 July at approximately 11:00 am, a single whale carcass was spotted by Navy lookouts floating in the vicinity of a non-MFAS surface ship 100 nm south of Niʻihau.. A Navy helicopter flew over the carcass and took photographs which were immediately forwarded to U.S. Pacific Fleet and then to the NMFS Pacific Islands Regional Office (PIRO) stranding coordinator. Subsequent examination of the photos by NMFS confirmed the carcass was that of a sperm whale. PIRO informed the Navy that both NMFS headquarters and PIRO did not need to further assess the carcass and that periodic sightings of single marine mammal carcasses at-sea are not unexpected given many potential sources of natural mortality. Following this determination, the group of Navy vessels continued with their original mission.

Beaked whale stranding

On 28 July around 7:30 am, a single beaked whale was found live stranded on the south central coast of Molokai by a civilian beach visitor. A more thorough discussion of the event based on information known at this time is contained at the end of this Section.

Table C/D-1. Marine mammal sightings and actions by exercise participants for marine mammals sighted within 2,000 yards of a U.S. Navy vessel during RIMPAC '08.

(nr = not reported; n/a = not applicable)

Date	Platform	Active Sonar Type	Type of Detect-ion	# of MM	MM Type	Sea State	Range From Ship/Plane To MM (yards)	Amt. Time MM Obs. (min)	MM behavior	MFAS Status	Mitigation Performed?
08 July	Non-MFAS surface ship	none	visual	10	dolphin	3	800	8	swimming and breaching	sonar not on	n/a
01 July	destroyer (DDG)	SQS-53	visual	2	dolphin	4	50	5	swimming and breaching along side ship	sonar not on	n/a
08 July	cruiser (CG)	SQS-53	visual	3	dolphin	2	100	10	riding ship's bow wake; ship altered course to assess dolphin's intent to bow ride	sonar not on	Yes
9 July	CG	SQS-53	visual	8	dolphin	nr	400	1	swimming; **ship altered course to avoid**	sonar not on	Yes
9 July	Non-MFAS surface ship	none	visual	10	dolphin	nr	800	8	swimming; **ship altered course to avoid**	no sonar	Yes
09 July	DDG	SQS-53	visual	1	whale	2	2,000	nr	swimming; ship altered course to avoid	sonar not on	Yes
09 July	DDG	SQS-53	visual	20	dolphin	2	20	nr	swimming	sonar not on	n/a
09 July	maritime patrol aircraft (MPA)	DICASS sono-buoy	visual	30	seal *	nr	2,000	30	not reported (nr)	sonar in use	not required
09 July	Non-MFAS surface ship	none	visual	20	dolphin	1	500	5	swimming and breaching	sonar not on	n/a
10 July	CG/DDG	SQS-53	visual	5	whale	nr	unk	47	not reported	sonar not on	n/a
10 July	CG/DDG	SQS-53	visual	1	whale	nr	unk	5	not reported	sonar not on	n/a
10 July	CG/DDG	SQS-53	visual	1	whale	nr	3,000	3	not reported	sonar not on	n/a
10 July	DDG	SQS-53	visual	1	dolphin	5	50	2	swimming	sonar not on	n/a
12 July	Non-MFAS surface ship	none	visual	1	whale	nr	unk	nr	not reported	no sonar	n/a
12 July	Non-MFAS surface ship	MFAS	visual	6	dolphin	3	1,000	3	swimming	sonar not on	n/a
12 July	MPA	DICASS sono-buoy	visual	37	seal *	nr	8,000	15	swimming	sonar not on	n/a
13 July	Non-MFAS surface ship	none	visual	2	dolphin	3	1,000	2	swimming	sonar not on	n/a
13 July	DDG	SQS-53	passive, visual	3	dolphin	nr	50	3	swimming from bow to aft	sonar not on	n/a

Date	Platform	Active Sonar Type	Type of Detect-ion	# of MM	MM Type	Sea State	Range From Ship/Plane To MM (yards)	Amt. Time MM Obs. (min)	MM behavior	MFAS Status	Mitigation Performed?
14 July	DDG	SQS-53	visual	2	dolphin	nr	2,000	1	nr	sonar not on	n/a
16 July	DDG	SQS-53	visual	1	dolphin	3	20	1	swimming in bow wake and along starboard side of ship	**sonar on**	**sonar turned off**
20 July	DDG	SQS-53	visual	2	whale	nr	> 2,000	nr	report from other ship the MM were in area	**sonar on**	**sonar turned off**
21 July	CG	SQS-53	visual	4	dolphin	2	100	nr	swimming near ship's bow	sonar not on	n/a
23 July	DDG	SQS-53	visual	1	dolphin	4	65	2	swimming to approach ship and then swimming alongside	sonar not on	n/a
24 July	DDG	SQS-53	visual	1	dolphin	nr	nr	2	swimming behind ship	sonar not on	n/a
24 July	DDG	SQS-53	visual	3	dolphin	3	25	nr	spinning and jumping in ship's wake	sonar not on	n/a
24 July	DDG	SQS-53	visual	4	dolphin	4	250	nr	spinning and jumping	sonar not on	n/a
24 July	DDG	SQS-53	visual	13	dolphin	nr	220	1000	nr	sonar not on	n/a
25 July	Non-MFAS surface ship	none	visual	1	carcass	nr	nr	nr	whale carcass floating at sea. Navy command and NMFS notified	no sonar	n/a
26 July	Non-MFAS surface ship	none	visual	8	dolphin	4	400	4	observed breaching multiple times (5 times)	no sonar	n/a
28 July	DDG	SQS-53	visual	3	dolphin	4	65	5	swimming and diving to approach ship	sonar not on	n/a

* animals reported as "seals" most likely are misidentified dolphin pods as explained in the text.

Table C/D-2. Sea states reported during marine mammal sightings by U.S. Navy exercise participants for RIMPAC '08 and civilian scientists engaged in concurrent marine mammal survey within the Hawaii from 07-31 July 2008.

Graphic	Beaufort Wind Force Scale *	Observed Sea Surface Condition	Sailor's Term	Effects on Land	Typical Wind Speed (MPH)
	2	Small wavelets, still short but more pronounced; crests have glassy appearance and do not break: Probable wave height: 0-1 ft, 0-0.3 m	Light Breeze	Leaves begin to rustle; wind felt on face	4-7
	3	Wavelets of irregular direction and shape; a few crests break on glassy surface; Probable wave height: 1-2 ft, 0.3-0.6 m	Gentle Breeze	Small flags extend; leaves in constant motion	8-12
	4	Small chop, defined direction; numerous whitecaps; Probable wave height: 2-4 ft, 0.6-1.2 m	Moderate Breeze	Dust, leaves, and loose paper move	13-18
	5	Heavy chop; many white foaming crests; some spray; Probable wave height: 4-8 ft, 1.2-2.4 m	Fresh Breeze	Small trees begin to sway	19 - 24
	6	Larger surface waves form; whitecaps everywhere; more spray; Probable wave height: 8-13 ft, 2.4-4	Strong Breeze	Large branches move; whistling heard in wires	25-31
	7	Sea heaps up; white foam starts to blow in streaks along direction of wind; spindrift forms; Probable wave height: 13-20 ft, 4-6 m	Near Gale	Resistance strong when walking	32-38

* One of the first scales to estimate wind speeds and the effects at sea was created by Britain's Admiral Sir Francis Beaufort (1774-1857) who developed the scale in 1805 to help sailors estimate winds via visual observations. The scale starts with 0 and goes to a force of 12. The Beaufort scale is still used today to estimate wind strengths.

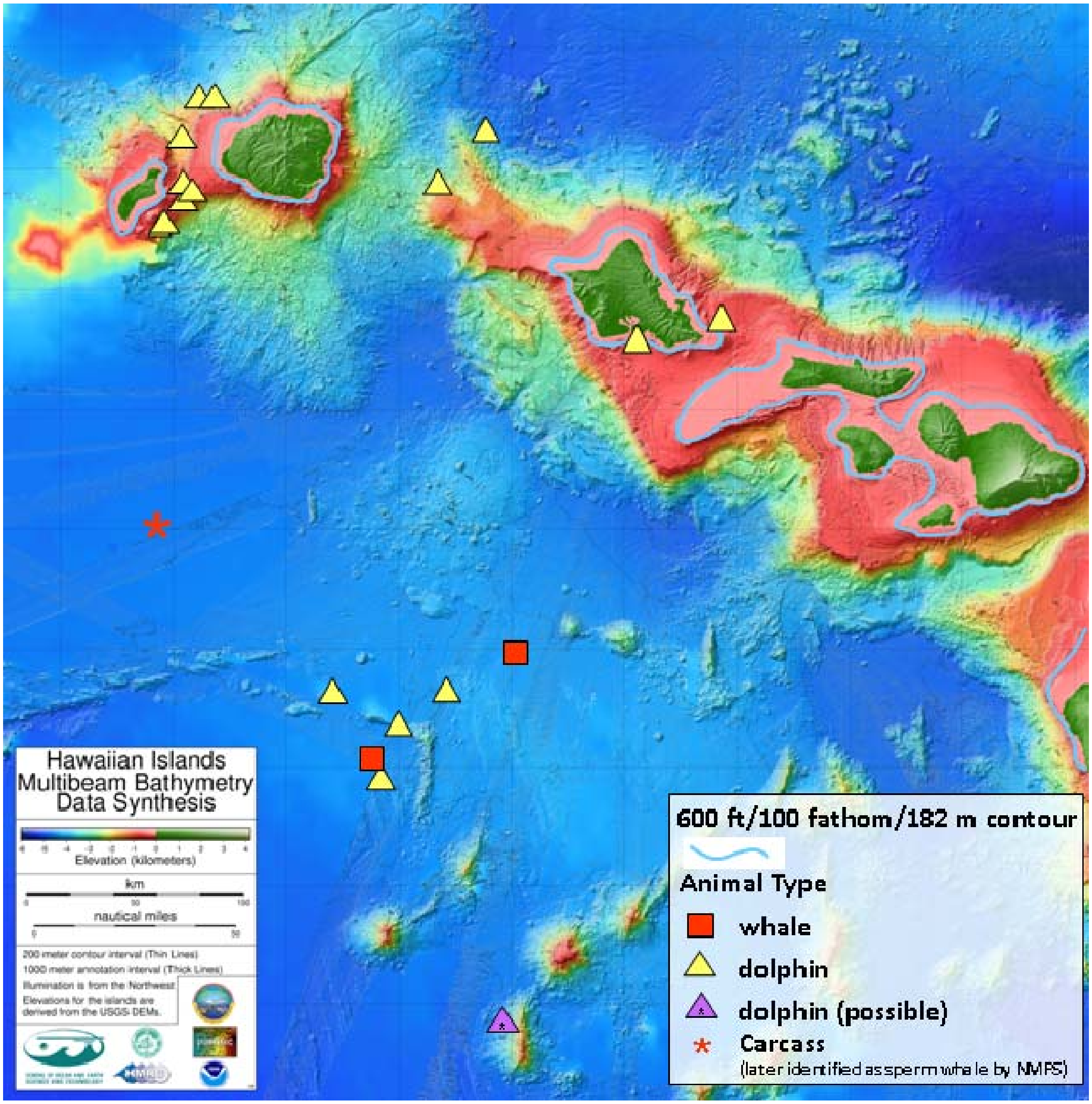


Figure C/D-1. Marine mammal sightings by U.S. Navy exercise participants during RIMPAC '08.

<u>notes</u>:

1) these sightings only represent the area in which marine mammal sightings were reported by exercise participants and does not imply overall operational region or areas where MFA sonar was used

2) * symbol represents approximate location of floating sperm whale carcass

3) possible dolphin sighting likely since original sighting of "seals" not consistent with at sea behavior of Hawaiian monk seal. Seal sightings were made at large distances by maritime patrol aircraft at ranges >2000 yards

SCIENTIFIC SURVEYS AND MONITORING IN SUPPORT OF RIMPAC ‘08

A dedicated RIMPAC ’08 monitoring program, separate from, but complementary to, the observations conducted by U.S. Navy exercise participants, was used coincident with RIMPAC ’08. This series of scientific marine mammal surveys and animal tagging was conducted at various locations around the Hawaiian Islands (FIGURE C/D-2) and are summarized below with full reports contained in APPENDICES A-C.

Type	Principle Investigator and Affiliation	Dates 2008	Location
Aerial Marine Mammal Survey	PI: Dr. Joe Mobley, Univ. Hawaii/Marine Mammal Research Consultants	13-17 July	Kaua’i, Ni’ihau
Shipboard Marine Mammal Survey	PI: Mari Smultea, Smultea Environmental Sciences /Marine Mammal Research	12-17 July	Kaua’i, Ni’ihau
Marine Mammal Tagging	PI’s: Dr. Peter Tyack, Woods Hole Oceanographic Institution, Dr. Robin Baird, Cascadia Research Collective, Dave Johnston, Duke University	25 June – 28 July	Kaua’i, Hawaii

CIVILIAN MARINE MAMMAL AERIAL SURVEY

An aerial survey that covered an area of approximately 2,600 nm^2 primarily south of the island of Kaua’i was conducted for marine mammals (APPENDIX A). Transects followed a pre-specified grid for the first four days (July 13-16) followed by circumnavigation of Kauai and Niihau on the fifth day, (July 17th). All surveys were flown in a twin-engine Partenavia Observer (P68) aircraft, specifically designed for search-and-rescue as well as biological surveys. The transect surveys utilized design and methods prescribed by accepted distance sampling theory (Buckland et al., 2001). Survey crew and pilot were not informed as to the status or location of Navy exercises to minimize observational bias. A total of 24 sightings were recorded either during transects or during circumnavigation of the islands. These sightings involved eight identified species (Blainville’s beaked whale, bottlenose dolphin, Cuvier’s beaked whale, Hawaiian monk seal, rough-toothed dolphin, short-finned pilot whale, spinner dolphin, striped dolphin) and two unidentified species (unidentified dolphin species, unidentified turtle species). Based on behavioral observation of these marine mammal species, no indications of distressed or unusual behavior were seen. The circumnavigation survey (July 17th) yielded no evidence of stranded or near stranded animals.

CIVILIAN MARINE MAMMAL SHIP SURVEY

A vessel-based visual survey for marine mammals and sea turtles was conducted in Hawaiian waters near Kauai and Niihau from 12-17 July 2008 in conjunction with RIMPAC ‘08 from aboard a 96-ft research vessel (APPENDIX B). The purposes of this project were to systematically locate, identify, and monitor occurrence, distribution and surface behavior of marine mammals and sea turtles in the vicinity of scheduled RIMPAC training exercises. These exercises involved Navy vessel activities including MFAS transmission on a schedule and unbeknownst to the civilian visual observers. Effort included monitoring for any potentially injured or harmed animals and/or any unusual changes in behavior, distribution, or numbers of animals. As feasible, attempts were made to remain within view of any opportunistically seen Navy vessels while conducting line-transect surveys and focal group behavioral sampling.

Observation effort was focused within a designated Survey Area measuring approximately ~50 nm wide by 70 nm long and encompassed the waters between Kaua‘i and Ni‘ihau (i.e., the

Kaulakahi Channel, those surrounding Niʻihau and waters up to ~40 nm south of Kauaʻi). A total of five experienced marine mammal observers conducted visual observations in the Survey Area using the naked eye, handheld binoculars, and two sets of “Big Eyes” binoculars. Bathythermograph (XBT) data were also collected twice per day and/or near marine mammal sightings.

A total of 474 nm or ~65 hours (hr) of visual observation effort occurred on six consecutive days from 12-17 July. This total includes the 12 July transit from Oahu to the Kauaʻi-Niʻihau survey area (unacceptable survey conditions precluded observations during the return transit to Oahu on 18 July). Of the total 474 nm of effort, most (79% or 373 nm) consisted of line-transect survey effort and the remaining 21% (34 nm) consisted of focal sessions involving seven groups of cetaceans. One to 14 Navy vessels were within view at any one time during 39% of the total 474 nm of observation effort on four of six days, including all day on July 17. No Navy vessels were seen on the July 12 transit and on July 16. On several occasions, particularly on July 15 and 17, systematic vessel transect lines had to be aborted and shifted to avoid close encounters with Navy activities. Beaufort sea state (Bf) ranged from 0 to 7+, although only effort during Bf <7 was considered useable. The most common Bf was 4 (25%) followed by Bf 5 at 22% and calm Bf 0-2 at 19%. In general, Bf increased across the survey period. Survey tracks were sometimes adjusted to avoid Bf >5. Ten XBT drops were conducted during the survey usually twice daily in the survey area and near marine mammal sightings.

A total of nine cetacean groups comprising an estimated 283 individuals and no sea turtles were observed during the entire six-day survey. All cetaceans were identified to species and comprised four groups of bottlenose dolphins, three groups of rough-toothed dolphins, and two groups of Hawaiian spinner dolphins. Based on the small sample size, sightings appeared to be concentrated near the 1000-m contour line, mainly along the NE shore of Niʻihau, including all three rough-toothed dolphin sightings; however, this is also where a lee commonly occurred. Rough-toothed dolphins have been previously reported to concentrate in this area (Baird 2008a). An exception to this general trend was that bottlenose dolphins typically were seen in shallower water. No sightings occurred in the NE and S Kaulakahi Channel, although Bf was typically >3 and vessel effort was excluded on some occasions by Navy activities in these areas. Focal behavior follows ranged from 5-81 min long and were conducted on seven of the total nine cetacean groups. The longest continuous observation session of 81 min occurred with a group of ~120 rough-toothed dolphins in the Kaulakahi Channel. All focal sessions were documented with photographs, digital video, and/or detailed behavioral notes.

No dead or injured marine mammals or sea turtles were seen during the survey, and no unusual behaviors or reactions were observed. Delphinids were seen on three days when Navy vessels were within view and on three days when they were not in view. Thus, at least some delphinids occurred within the general survey area while Navy activities were ongoing. The most common behavior states exhibited by all nine dolphin groups were travel with bouts of surface-active travel. Surface-active milling and milling occurred less frequently and twice involved probable foraging by rough-toothed dolphins. Dolphins bowrode the research vessel during eight of the nine total sightings, often for extended periods. Individual surface-active behaviors observed consisted of breaching, spinning, porpoising, and tail slapping.

Because observers were not informed of the times and types of underwater transmissions during Navy activities, it is not possible at this time to assess any related potential effects; the Navy plans to conduct these analyses at a later date. However, a number of general observations were drawn from the survey as follows. At least one cetacean sighting was made on each of the six survey days in the survey area; thus, some animals occurred in the survey area during Navy activities. Shadowing, i.e., following Navy vessels at a safe (>3 nm) distance proved to be a feasible monitoring approach during the circumstances encountered, similar to past monitoring surveys. However, exclusion from certain areas during some Naval activities or Bf >6 precluded fully covering the pre-determined transect lines; in these cases, alternate survey routes were followed dependent on weather conditions. As expected, the number of sightings decreased as Bf increased based on the small sample size of nine sightings. There were benefits to communicating with the aerial survey observers who concurrently monitored marine mammals and sea turtles in the same survey area following similar transect lines.

Data collected during this US Navy-sponsored survey provide baseline information on the occurrence, distribution, and behavior of marine mammals during Navy activities involving MFAS operations. This survey also contributes data on the occurrence of cetaceans near Kauai and Niihau during the summer , a period which historically has had very little survey effort expended. Furthermore, much of our effort was conducted during optimal (Bf <5) survey conditions considered rare at this time of year when strong NE trade winds and large swells predominate. Results assist in identifying and evaluating the feasibility of monitoring approaches, including monitoring cetaceans near Navy vessels and concurrent to aerial surveys.

CIVILIAN MARINE MAMMAL TAGGING

As part of a larger effort to examine the diving behavior of deep diving odontocetes (toothed whales and dolphins) and characterize their movement and acoustic behavior in association with RIMPAC ‘08, the Navy and NOAA funded Pacific Islands Fisheries Science Center, NMFS, Woods Hole Oceanographic Institution, Duke University and Cascadia Research Collective to deploy medium-term satellite and suction cup d-tags on a number of species of small and medium-sized cetaceans around the main Hawaiian Islands in June and July 2008 (**APPENDIX C**).

Over 31 field days[2] between June 25 and July 28, 2008, small-boat operations were based first off Kaua‘i (7 days) and then both small-boat and the NOAA R/V Oscar Elton Sette operations off Hawai‘i Island (24 days). The two ships covered over 4,000 km of trackline resulted in 199 sightings of 13 species of cetaceans. Tagging efforts resulted in the deployment of 33 medium-term satellite tags and 5 suction cup d-tags on four species of odontocetes over this period. This is the largest number of satellite tags ever deployed on multiple species of cetaceans in this short of a time period. Species tagged were: Blainville’s beaked whales (five individuals), melon-headed whales (five individuals), false killer whales (seven individuals) and short-finned pilot whales (21 individuals). Average transmission duration of the tags was 37 days (median = 34 days, n = 33), allowing for examination of movements before, during, and in many cases after the completion of the RIMPAC ‘08.

This effort demonstrated feasibility and future lesson from this approach to examine movements of individuals in relation to a large scale naval exercise, as well as provide a basis for future planning of similar efforts. In addition, these tags have provided unprecedented information on movements and vocalizations of individuals of four species in relation to the main Hawaiian Islands. Movements of tagged individuals have spanned an area greater than 13,000 km2. Analyses of movements are ongoing, and this data set will potentially allow for an assessment of movements in relation to MFAS when comparing Navy ship sonar use and animal locations.

[2] Typical field days were defined as approximately sunrise to sunset

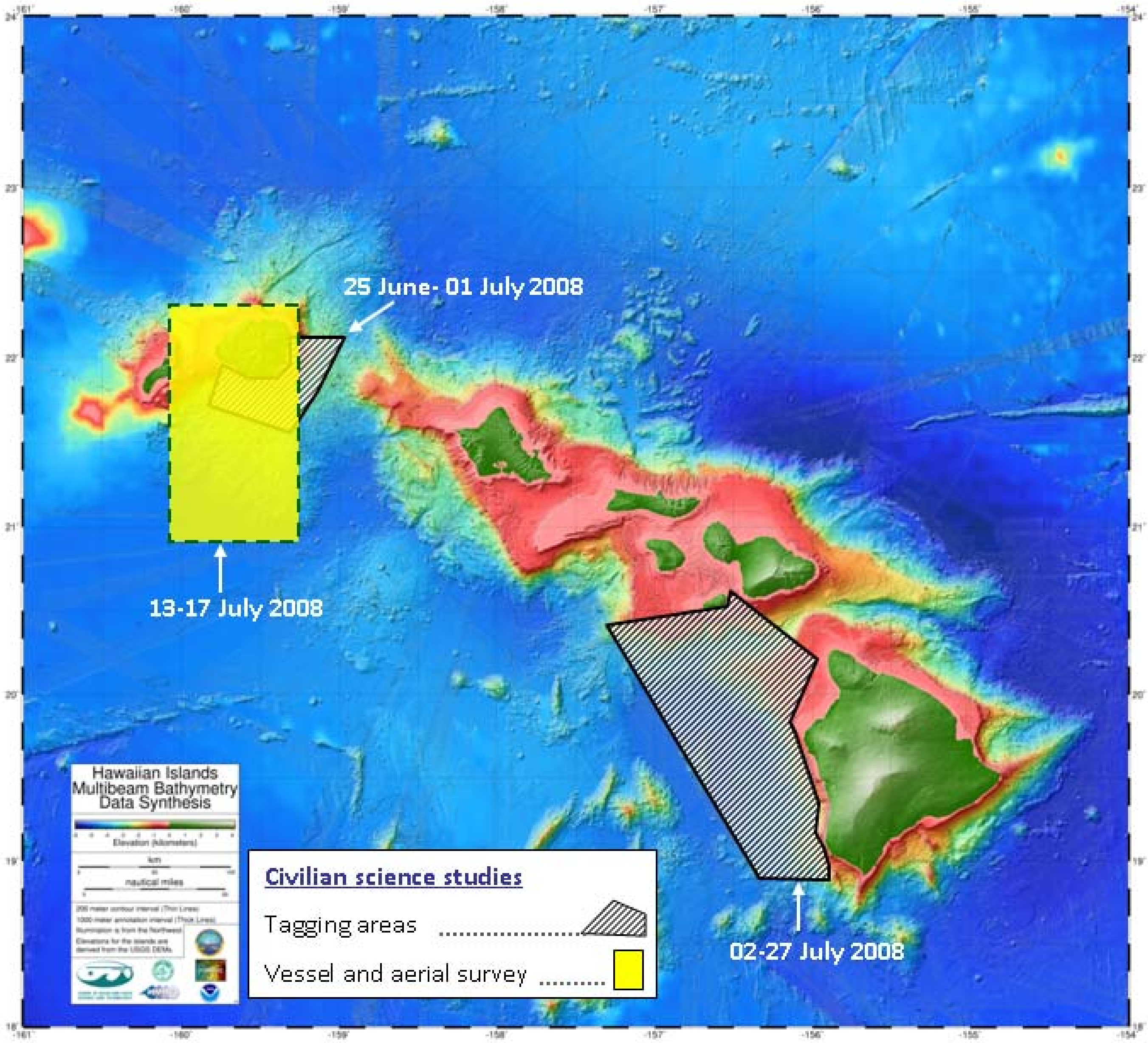


Figure C/D-2. Civilian marine mammal surveys (aerial and shipboard) and animal tagging areas during RIMPAC '08.

MFAS EXPOSURE ASSESSMENT

As in any review of the operational aspects of U.S. Navy ASW operations using MFAS, specific source levels, numbers of sources, and frequencies of sonars used during RIMPAC ’08 are classified because release of this information may provide potential adversaries with critical tactical data. The following discussion is focused on the 1) amount of time spent visually searching the ocean, 2) the amount of time conducting MFAS training, and 3) a discussion of individual events when MFAS was active and marine mammals were spotted within 2,000 yards.

This report presents all marine mammal sighting information. Mitigation discussions reference the 200, 500, and 1,000 meter NDE safety zones applicable to this exercise.

Visual sighting effort: Visual sighting effort by ship for RIMPAC ‘08 is calculated using the length of the major exercise (25 days), the number of hours per day (24 hours) with the normal standard operating procedure for all vessels to have at least 3 lookouts on watch and scanning the ocean at all times (24/7), and the presence of 8 MFAS-equipped vessels. Therefore, a total of 4,800 hours of visual sighting effort from MFAS equipped surface ships occurred during RIMPAC ‘08 (25 days x 24 hrs/day = 600 hrs x 8 ships = 4,800 visual survey hours). This accounts for visual survey over the entire exercise, including both MFAS and non-MFAS events.

MFAS use: During RIMPAC ‘08, 547 hours of MFAS time were reported from all sources including hull-mounted (AN/SQS-53 and AN/SQS-56), helicopter dipping sonar, and DICASS sonobuoys (**TABLE A-1**). Of these 547 hours, only six hours or 1.1% occurred in water less than 200 m deep. These six hours of MFAS use within 200 m is particular to RIMPAC ’08, and may not be representative of the future RIMPAC exercise series or other Hawaii exercise events. Activities and locations change depending on exercise planning, assets, and continuously changing tactics.

Note, however, that the 547 hours of MFAS time is not indicative of continuous and consecutive use. MFAS is only used for a relatively small portion of any given exercise time frame. Total active sonar hours represent the sum of the total time of a number of individual training events during RIMPAC ‘08. In other words, an individual unit using MFAS records when the sonar was turned on at the beginning of a training event and reports MFAS time until the event is finished. These sonar hours are reported into the U.S. Navy's Sonar Positional Reporting System (SPORTS) as a conservative estimate of total sonar hours based on a unit reporting it had sonar "on" for a training event, and then sonar "off". The sonar “on period” may not always be directly equivalent to all actual active sonar transmission (i.e., sound in the water) since there may be tactical and maintenance reasons why MFAS may not be in transmit mode during the entire portion of a training event reported in SPORTS. Therefore, MFAS hours derived from SPORTS and presented in this after action report are a conservative over estimate of total MFAS hours.

Passive Sonar

Passive sonar is an acoustic device used for listening to underwater sound and does not involve transmitting active sound into the water column. Passive sonar use is driven by the tactical nature of an ASW or training event, and is employed whenever possible. Given the nature of passive sonar technology and underwater sound propagation, determining range and absolute position of a marine mammal is exceedingly difficult and generally not possible with any single ship-based passive sonar. Skilled operators or unique circumstances may sometimes allow real-time or near-real time determinations of marine mammal range at the expense of interrupting the ship’s ASW training at the time. Active sonar, on the other hand, is critical in providing range and bearing to potential underwater submarines and mines.

In addition, passive sonar can only detect marine mammals that are vocalizing (i.e., making underwater sound as part of communication and echolocation). Marine mammal vocalization is based on individual needs at a particular moment, species-level foraging, and mating strategies, and other oceanographic or biological factors. For instance, for some species, only males typically vocalize (ex. humpback whales, blue whales, fin whales, and minke whales). Depending on oceanographic conditions and animal source levels, when marine mammals do vocalize, sounds can easily travel one to several tens of kilometers (km) (0.5 nautical mile (nm) to tens of nm) for some mid-to-low frequency animals, and tens to hundreds of km for very low frequency baleen whales (i.e., blue and fin whales). These ranges demonstrate that even if the marine mammal vocalization can be detected, it does not mean the mammal is necessarily close to the passive sonar sensor. Determining when or if a marine mammal is within an NDE mitigation restriction zone by passive acoustic detection is not always possible.

NDE SAFETY ASSESSMENT FOR RIMPAC '08

To address NMFS requirements to assess potential exposure levels of marine mammals to sonar, general transmission loss formulas derived from Urick (1982) were used and results are presented in **TABLE C/D-3**. Estimated exposures can be determined based on standard generic formulas of how sound propagates in water [defined as spherical spreading where propagation loss from a source = 20 log [R] with "R" being range from the source (Urick 1982)]. However, spherical spreading is only an appropriate sound propagation formula to a range of 1,000 yards from a source in open ocean, after which sound propagation is determined by cylindrical spreading [defined as spherical spreading where propagation loss from a source = 10 log [R]+30 with "R" being range from the source >1,000 yards and 30 being the spherical loss from 0 to 1,000 yards]. Depending on the range of the sighting reported in **TABLE C/D-3**, either Urick's spherical or cylindrical formula was used.

During RIMPAC '08 there were only two sightings of marine mammals while MFAS was transmitting. On 16 July a pod of 20 dolphins began bow riding a MFAS equipped DDG. The DDG subsequently turned off their sonar (**TABLE A-2**). On 20 July, a DDG turned off sonar not based on a visual sighting under NDE mitigation safety zone criteria, but due to direction of a second ship that saw two whales (**TABLE A-2**). The vessels were in a spread out formation of ships where the other ship was in tactical command of the group. Based on direction from the ship that saw the marine mammals, the DDG was ordered to turn off its sonar although the whales were not observed by the transmitting DDG. In classified post-exercise analysis of relative ship locations and sighting, it was determined that the whales were > 2,000 yards from the transmitting DDG. Therefore, given the likely distance >2,000 yards and active sonar use ceasing, it is probable that these animals were exposed to RL much less than < 173 dB.

The following assessment addresses potential exposure to possible ESA-species as described in the NMFS BO Terms and Conditions (NMFS 2008). This assessment applies to fin whales, sei whale, sperm whales, and monk seals. (Humpback whales are excluded as they are not in the HRC during this time of year) **TABLE C/D-3** shows RIMPAC '08 marine mammal sightings of marine mammal species in relation to applicable safety zones. For all species, there was only one mitigation event where MFAS was secured upon sighting a marine mammal within 2,000 yards. Of note, this was for a pod of dolphins and not an ESA-listed species.

<u>< 200 yards NDE safety zone</u>:

Within this range category based on the visual sightings described in **TABLES A-2** and **C/D-3**, it is estimated that no potential ESA marine mammals (blue whales, fin whales, humpback whales, sei whale, sperm whales, and monk seals) were exposed to RL equal to or greater than 173 and 190 dB re 1 μPa^2•s.

<u>200-500 yards NDE safety zone</u>: .

Within this range category based on the visual sightings described in **TABLES A-2** and **C/D-3**, it is estimated that no potential ESA marine mammals (blue whales, fin whales, humpback whales, sei whale, sperm whales, and monk seals) were exposed to RL equal to or greater than 173 and 190 dB re 1 μPa^2•s

<u>500-1,000 yards NDE safety zone:</u>

Within this range category based on the visual sightings described in **TABLES A-2** and **C/D-3**, it is estimated that no potential ESA marine mammals (blue whales, fin whales, humpback whales, sei whale, sperm whales, and monk seals) were exposed to RL equal to or greater than 173 and 190 dB re 1 μPa^2•s

SUMMARY

In relation to the NMFS BO Terms and Condition reporting requirements, factoring the conservative estimation of Receive Level (RL) discussed above, there were no events for potential Hawaii ESA-listed marine mammals that might have initially been exposed to RL >173 dB re 1 Pa^2•s as required to be reported to NMFS under the BO.

Table C/D-3. Sightings during RIMPAC ’08 where MFAS was on and mitigation occurred (listed by distance from ship).

Assessment by Distance From Surface Ship MFA sonar		
Distance	**Marine Mammal Type**	**Comments** *Estimated exposure based on 20Log[R] spherical spreading propagation loss for ranges less than 1000 meters and where nominal MFAS source level (SL) assumed to be 235 dB (Urick 1982)*
200 yards **Sonar secured** **(turned off)**	dolphin	16 Jul: DDG surface ship using MFAS (AN/SQS-53) sights 20 dolphins swimming in bow wake and along starboard side of ship; sonar secured. MAX. est. MFAS exposure: 209 to 167 dB re 1 Pa2•s *; exposure after securing sonar: 0 dB  (* Exposure prior to secure assuming initial equipment SL of 235 dB. Note, however, there are combinations of factors that reduce acoustic energy received by dolphins approaching ships to ride in bow waves Once dolphins are riding a ship’s bow wave, they are outside of the main beam of the MFAS vertical beam pattern. Source levels drop quickly outside of the main beam. Sidelobes of the sonar beam pattern that point to the surface are significantly lower in power. Together with spherical spreading losses, receive levels in the ship’s bow wave can be more than 42 dB down power. Finally, bow wave riding dolphins are frequently in and out of a bubble layer generated by the breaking bow waves. This bubble layer is an excellent scatterer of acoustic energy and can further reduce received energy. It is unlikely that these dolphins were exposed to SEL greater than 173 dB re 1 µPa2.s when riding the bow wave. Likely exposure may have been more on the order of 167 dB. In any event, these dolphins did elect to deliberately close with the ship to bow ride.)
200-500 yards **Sonar reduced -10 dB** **90% power reduction**		No reports
500- 1000 yards **Sonar reduced -6 dB** **70% power reduction**		No reports
1000- 2000 yards		No reports
Assessment by Range for Helicopter MFA dipping sonar		
Range	**Marine Mammal**	**Comments**
< 200 yards- Sonar secured (turned off)		No reports

OTHER EVENTS
No marine mammal ship strikes from U.S. Navy ships occurred during RIMPAC ‘08. There were four instances where a ship not using MFAS at the time, actively maneuvered to open the range between the ship and marine mammal. There were no reports of unusual behavior or activity from marine mammals as a reaction to the presence of surface ships, with or without use of MFAS. There was one report of a floating sperm whale carcass, but no indication that either U.S. Navy ship traffic or MFAS contributed to its condition, which was likely a natural mortality event. The single beaked whale stranding on the last day of RIMPAC ’08 ASW is discussed below.

BEAKED WHALE SINGLE LIVE STRANDING ON MOLOKAI 28 JULY 2008

DESCRIPTION

Around 7:30 am on 28 July, a beaked whale was found live stranded on some mud flats along the south coast of Molokai by a visiting civilian. After the stranding was reported to the Navy by NMFS PIRO, a Navy helicopter was tasked to perform a Molokai shoreline flight to see if other animals had stranded. There were no additional strandings reported from Navy or non-Navy observers. Independent of this stranding, all RIMPAC ’08 ASW ops were completed as previously planned by 1200 local time on the 28th and no MFAS was used afterwards.

NMFS flew a response team to Molokai to investigate the stranding on the morning of the 28th. The animal was briefly refloated, but returned to the beach after a short time. Consequently, it was determined by the NMFS stranding team that the animal was too ill to be successfully returned to sea, and the whale was euthanized by a veterinarian. The whale carcass was taken to Oahu by a U.S. Coast Guard plane where if was later identified as a sub-adult male Cuvier’s beaked whale. A necropsy was performed at Hawaii Pacific University (HPU) on the 29th by NMFS PIRO assisted by several local veterinarians, graduate students, and HPU professors. Results from this necropsy are still pending.

In any stranding analysis, a number of additional factors to consider in a weight of evidence approach to analysis include the stranding information itself, regional oceanographic and beach conditions at the time of stranding (geographic, local adjacent bathymetry weather, sea state, surface currents, type of beach, tide and moon phases), species information and distribution for the area, previous stranding history within the area (i.e., are there previous stranding records from natural and human causes within the region, when available?), plots of current and previous strandings, and final results for any necropsy.

<u>Location</u>: The initial stranding site was an offshore mud flat approximately 5-6 miles east of Kaunakakai on Molokai’s south shore. This site is between the islands of Molokai and Lana’i (**FIGURE C/D-3**). While the animal was sighted alive on the mud flat at approximately 7:30 am, it is unknown precisely when the animal came ashore and at what time, but given the live status it had to have been relatively recent.

<u>Oceanography</u>: Weather on 28 July was party sunny with NE trade winds at 15-20 mph (**FIGURE C/D-4**). Low tide occurred around 5:26 am just prior to the 7:00 am sighting. The tide was beginning to flood after this low tide with the next high tide at 1:30 pm on the 28th (FIGURE C/D-5). The moon rose at 1:57 am and was in a 3rd quarter waning crescent (heading toward a new moon).

<u>Species history</u>: The Hawaiian stock of Cuvier’s beaked whale is not listed as endangered under the ESA and is not a depleted or strategic stock under the MMPA (Carretta et al. 2007). There is no information on the population trend of Cuvier’s beaked whales within Hawaii, although there have been at sea sightings of Cuvier’s beaked whale around most of the Hawaiian Islands (Carretta et al. 2007, Mobley 2008). While data is limited, estimated abundance of the Hawaiian stock of Cuvier’s beaked whales is around 12,728 to 15,242 animals (Barlow 2006; Carretta et al. 2007). Beaked whales including Cuvier’s beaked whales in Hawaii are typically deep diving offshore species (MacLeod et al. 2006, Tyack et al. 2006, Baird et al. 2008b, Baird et al. 2008c). For instance, Baird et al. (2005) reported sightings of beaked whales off the west side of the island of Hawaii in depths between 4,531- 11,991 ft (1,381-3,655 m).

Previous stranding history in Hawaii: While not common, beaked whale stranding events in Hawaii have been reported previously (Maldini et al. 2005). There have been periodic single animal stranding events of beaked whales in Hawaii since more accurate record keeping began around 1950. Since 1950, there have been 12 previous single animal beaked whales stranding in Hawaii, nine Cuvier’s beaked whale, two Blainville’s beaked whales, and one unidentified beaked whale (**FIGURE C/D-5**).

SUMMARY

On 28 July, toward the end of RIMPAC ’08, a Cuvier’s beaked whale was found live stranded on the south coast of Molokai. As of the RIMPAC AAR report deadline for submission to NMFS, final analysis of the results from the subsequent necropsy, performed by NMFS and local scientists, have not been completed. Further speculation as to cause of death without this critical piece of data is premature at this time. Continued data review along with NFMS is ongoing.

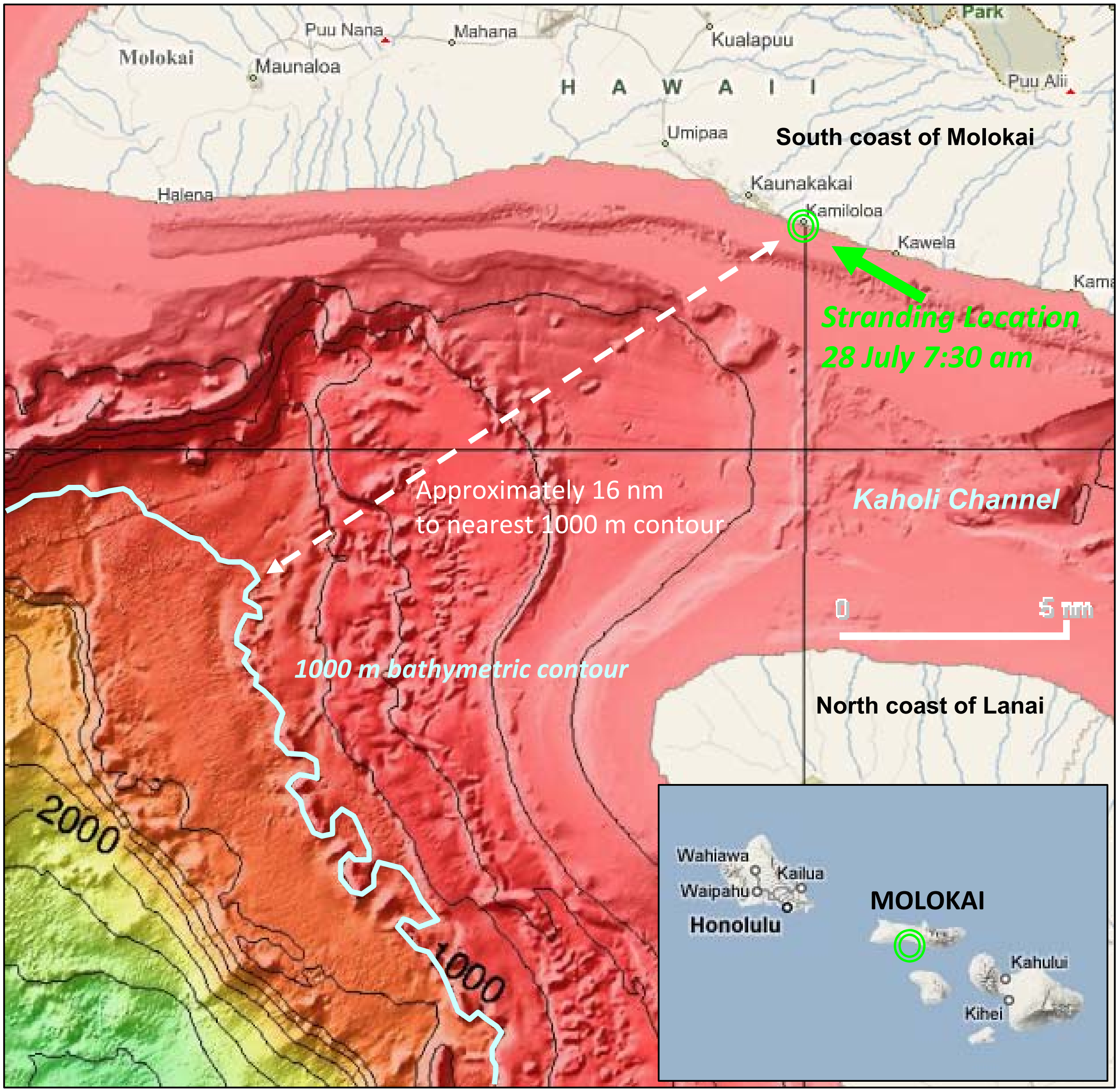


Figure C/D-3. Approximate beaked whale stranding location along south-central Molokai on 28 July 2008.

Base map from School of Ocean and Earth Science and Technology and the Hawaii Mapping Research Group; contour lines in meters

http://www.soest.hawaii.edu/HMRG/Multibeam/online/

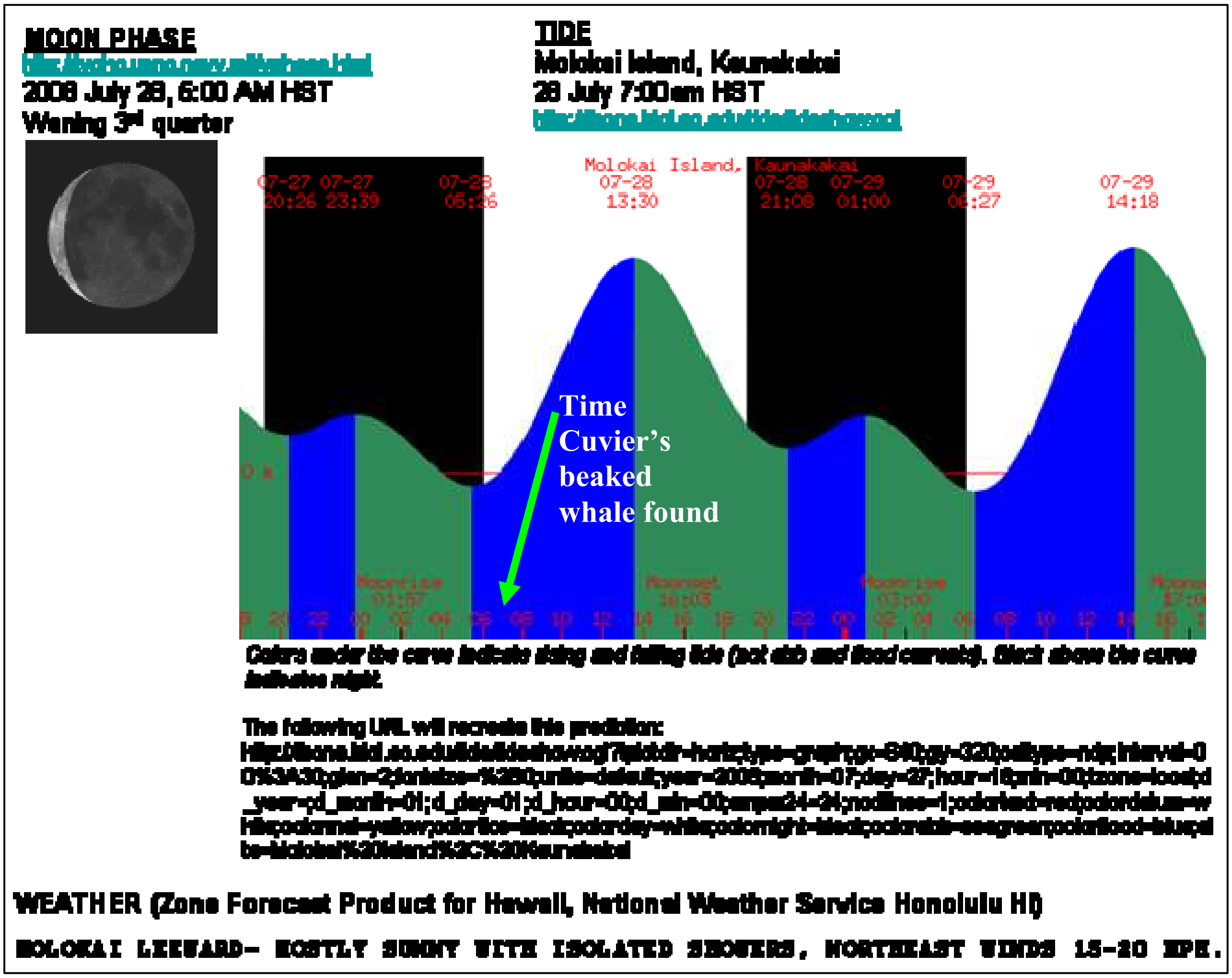
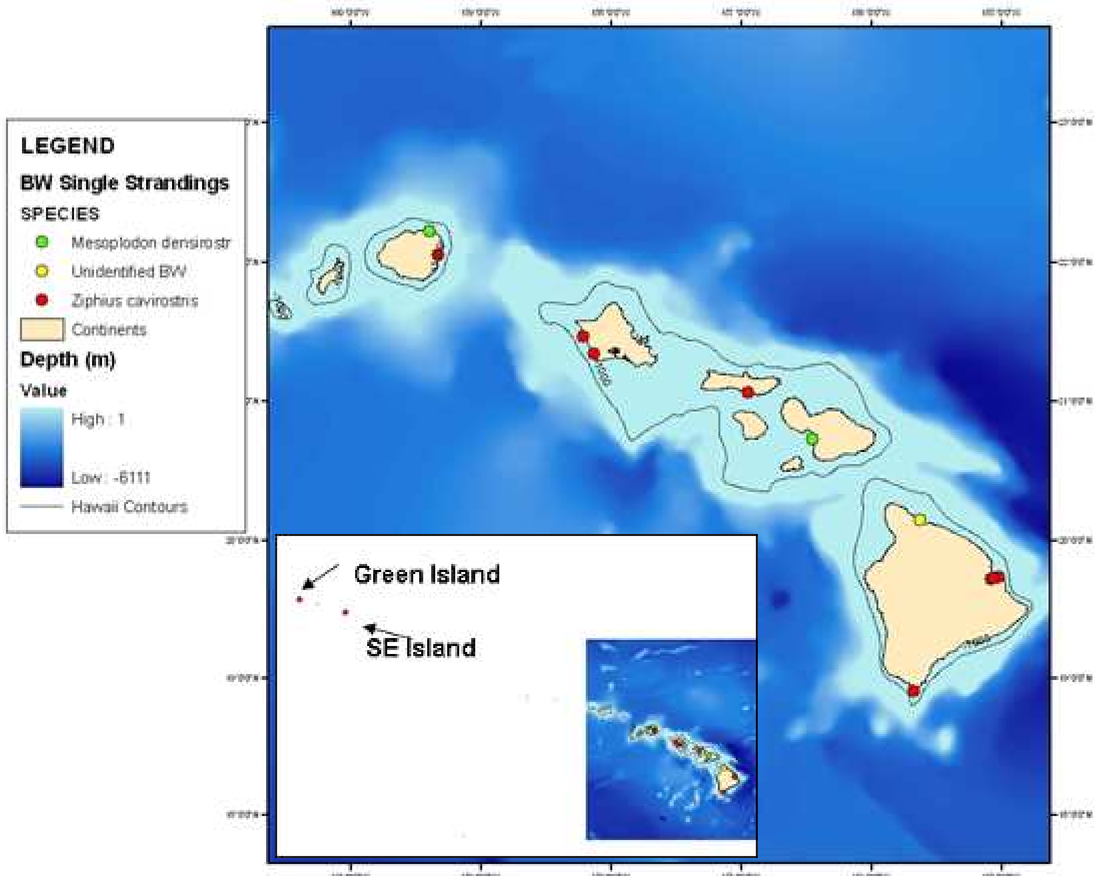


Figure C/D-4. Moon phase, tide, and weather for southern Molokai on 28 July 2008.



Date	Species	Location	Reference
1950	*Z. cavirostris*	South Point, Hawaii	2
14-Jul-64	*Z. cavirostris*	Hilo, Hawaii	1
25-Jul-66	*Z. cavirostris*	Green Island	1
1-Jul-70	*Z. cavirostris*	Makaha, Oahu,	1
31-Mar-73	*Z. cavirostris*	Southeast Island	1
6-Jan-80	*Z. cavirostris*	Hilo, Hawaii	1
1981	*Z. cavirostris*	Hilo, Hawaii	2
16-Jan-96	*Z. cavirostris*	Nanakuli, Oahu	3
1998	*Z. cavirostris*	Wailua, Kauai	2
2002	*M. densirostris*	Kamaole, Maui	2
13-Jun-03	*M. densirostris*	Anini Beach, Kauai	1
17-Jul-03	Unidentified BW	Waimanu Valley, Hawaii	4
28-Jul-08	*Z. cavirostris*	Kaunakakai, Molokai	

[1] Smithsonian Institution, 2000. Cetacean Distributional Database, Marine Mammal Program, Washington, D.C.
[2] Maldini, D., Mazzuca, L., Atkinson, S., 2005. Odontocete stranding patterns in the main Hawaiian Islands (1937 – 2002): How do they compare with live animal surveys? Pacific Science. 59(1), 55-67
[3] Dalebout, M.L., Robertson, K.M., Frantzis, A., Engelhaupt, D., Mignucci-Giannoni, A.A., Rosario-Delestre, R.J., and Baker, C.S., Worldwide structure of mtDNA diversity among Cuvier's beaked whales (*Ziphius cavirostris*): implications for threatened populations, Molecular Ecology (2005) **14**, 3353-3371
[4] The Cetacean data base [www.legaad.org/strandings]

Figure C/D-5. Plot and data for past single beaked whale strandings in Hawaii.

SECTION E/F MITIGATION ASSESSMENT

RIMPAC ’08 ASSESSMENT

OVERVIEW

This section of the report provides an assessment of the effectiveness of the mitigation and monitoring measures used in RIMPAC ‘08. The NDE requires the U.S. Navy to submit a report to NMFS that includes a discussion of the nature of any effects or lack of effects of mitigation measures based on modeling results and marine mammal sightings. In addition, the BO Terms and Conditions (NMFS 2008) require a report that evaluates the mitigation measures and provides results of the U.S. Navy’s exercise monitoring and reporting program. In this case, the mitigation measures under the BO are the same as the NDE measures; therefore, the discussion is presented together in this section.

ASW proceeds slowly and requires careful development of a tactical frame of reference over time. Data is integrated from a number of sources and sensors. Once MFAS is turned off for a period of time, turning it back on later does not usually allow a commander to simply continue from the last frame of reference. From an individual operator perspective, securing sonar essentially clears the screen of all information, which then has to be rebuilt over time when the system power is restored. Lost MFAS time not only equates to lost exercise time, but has a broader, overall impact on the tempo and development of a “tactical picture” shared among exercise participants as they train toward the goal of improving ASW skills in general.

Mitigation measures were designed to minimize interactions between marine mammals and Navy vessels. Specifically with regard to MFAS use, the mitigation measures were designed to preclude MFAS exposures at levels with the potential to result in a Temporary Threshold Shift (TTS) or Permanent Threshold Shift (PTS) (DoN 2007).

Navy ships were not tasked nor expected to maintain contact with marine mammals sighted for purposes of monitoring requirements. To do so would have unnecessarily interfered with military readiness activities and may have resulted in concerns with whether Navy ships were intentionally harassing marine mammals.

MODELING ESTIMATES APPLICABLE TO RIMPAC ‘08

For the RIMPAC ’08 (DoN 2007) an estimate of potential acoustic exposures to marine mammals was generated in support of the NEPA process. **TABLE E-1** shows estimated marine mammal acoustic exposures from model-derived calculations based on estimated marine mammal densities, operational parameters, sound transmission loss, and potential energy accumulated based strictly on pre-exercise acoustic impact modeling (NMFS 2008). The table highlights the ESA-listed species described in the RIMPAC BO (NMFS 2008).

Approximately 203 marine mammals from 29 sightings were observed during RIMPAC ’08. However, only one of these 29 sightings occurred during MFAS transmission within 2,000 yards, and this for a non-ESA dolphin pod of 20 animals (see **Section C/D**). Given that only small numbers of marine mammals were visually sighted during RIMPAC ’08 MFAS use, exposure estimated by pre-exercise modeling are potentially over predictive of exposures, even acknowledging difficulty of observing species like deep diving sperm whales at depth. It’s also apparent that pre-exercise predictions for ESA-listed species (fin whale, sei whale, sperm whale, and monk seal) are high and not reflective of actual animal occurrence in all parts of the RIMPAC ’08 exercise area during July. From **FIGURE A-2**, all whale and hence potential ESA-species were sighting in the offshore waters > 100 nm west of the island of Hawaiʻi. No large baleen whale species or toothed sperm whales were sighted around Kaua’i or Ni’ihau by either U.S. Navy participants, or civilian science surveys (see Section C/D and Appendices B-D)

Table E/F-1. Modeling estimates of the number of individuals of different endangered species that might experience behavioral harassment, temporary threshold shifts (TTS), or permanent threshold shifts (PTS) as a result of being exposed to active sonar associated with the 2008 Rim of the Pacific exercise

(From NMFS 2008).

Species	Risk Function	195 db TTS	215 dB PTS
fin whale	15	0	0
sei whale	15	0	0
sperm whale	264	3	0
monk seal	37	1	0
total:	331	4	0

RIMPAC ’08 Minimum Total Marine Mammals Sighted During MFAS Operations at RL ≥173 dB (**TABLE A-2**) =

20 non-ESA dolphins, 0 ESA-listed whales

Total Pre-exercise Estimated Exposures at RL ≥173 dB For **ALL Marine Mammals** (**TABLE E-1**) =

335 ESA-listed whales and monk seals

RIMPAC ’08 # of **Potential ESA Species Exposed** at RL ≥173 dB (at ranges < 2,000 yards) =

0 animals

SECTION G ESTIMATE OF NUMBER OF MFAS HOURS OCCURRING BETWEEN 200-M CONTOUR AND COASTLINE

During RIMPAC '08, approximately six hours of MFAS occurred between the 200 meter bathymetric contour and the coastline. At no point however, did any MFAS occur within 12 nm of the any coastline within Hawaii. The six hours of MFAS use within the 200-m contour occurred west of Oahu.

FINAL NDE AND BO ASSESSMENT

1) All measures promulgated in the 23 January 2007 *Mid-Frequency Active Sonar Mitigation Measures during Major Training Exercises or within Established DoD Maritime Ranges and Established Operating Areas* (NDE) were implemented before and during RIMPAC '08.

2) In addition to the above assessment of the NDE, the BO calls for a report that evaluates the effectiveness of the U.S. Navy's exercise mitigation measures. The three categories of measures (Personnel Training, Lookout and Watchstander Responsibilities, and Operating Procedures), outlined in the NDE, are effective in detecting and responding appropriately to the presence of marine mammals, when visually observed. Fleet commanders and ship watch teams continue to improve individual awareness and enhance reporting through various pre-exercise conferences, lessons learned, and after action reports. The NDE safety zones are adhered to and vessels apply mitigation when marine mammals are visually observed within a zone. The U.S. Navy acknowledges that the mitigation measures do not account for potential marine mammals not visually observed, which is a difficult determination even within the marine mammal scientific survey community. Deep diving animals, if exposed, may not be exposed to significant sound levels for long periods of time, given the moving nature of ship MFAS use and limited pings from lower power aviation deployed MFAS systems (dipping sonar, sonobuoys). For instance, during a one hour dive by a beaked whale or sperm whale, a MFAS ship moving at a nominal 10 knot speed would cover about 10 nm from its original location, well beyond ranges predicted to have significant exposures. For cryptic, hard to spot species when at the surface such as beaked whales, real-time detection is difficult given any U.S. Navy or non-Navy science tool presently available.

3) NMFS (2008) RIMPAC BO Terms and Conditions require the U.S. Navy to estimate the number of ESA-listed marine mammals that may have been exposed to received energy level equal to or greater than 173 dB and 190 dB re 1 $\mu Pa^2 \cdot s$. From **TABLE E-1**, RIMPAC '08 was expected to potentially expose 335 ESA-listed marine mammals from all MFAS sources to potential Level B exposures that NMFS would classify as harassment under the MMPA based solely on pre-exercise predicted impact models. Discounting the dolphin pod sighting on 16 July since this is not an ESA-listed species (**TABLE A-2**), there were no or limited ESA-list whales (fin, sei, sperm whales) potentially exposed to MFAS greater than 173 dB during RIMPAC '08. (Blue whales in Hawaii are more rare and likewise potentially not present in the waters off Hawaii during RIMPAC '08.)

4) For all of RIMPAC '08 marine mammal sightings from Navy lookouts, and during and post-exercise civilian monitoring, there was no obvious indication or report that any animal behaved in a manner not associated with normal movement, or foraging.

Data Limitations and Improvements

There is no information from which to assess how many, if any, animals not observed by Navy lookouts may have been exposed to MFAS received levels greater than 173 dB and 190 dB re 1 $\mu Pa^2 \cdot s$.

Data needed to address this question will be reviewed as they become available for potential incorporation into future exercises, although this remains a problematic science issue for even non-Navy marine mammal surveys. Real-time passive sonar systems used by the U.S. Navy, and to some degree by most of the marine mammal science community, lack the ability to automatically classify detected species, although there is substantial academic research into improving this capability. Most current passive data sets rely on extensive post-collection analysis by skilled subject matter experts to conclusively establish species identification. Trained operators on U.S. Navy ships can sometimes classify certain common species such as humpback whales, minke whales, and sperm whales, and dolphin-like sounds. Automatic determination of range from the ship, however, is not within the technical capability of existing systems. Range detection using moving passive acoustic systems on U.S. Navy ships is limited in real time by the typical 8-10 knot speeds at which many ASW training events occur. Indeed, if passive range detection of any submerged contacts (submarines or marine mammals) was more advanced and easier, then there would be less tactical reliance on active sonar systems. Also, passive detection is only effective for animals that vocalize (i.e., make underwater sound). There are documented seasonal and daily variations in vocalization, species variations in vocalization frequency, and differences in vocalization rates between males and females. Therefore, non-vocalizing marine mammals cannot currently be detected using passive systems.

The U.S. Navy continues conducting robust and realistic exercises, and development of long-term range complex monitoring plans. The goal of these plans is to integrate multiple tools such as surveys in an effort to generate better assessments of marine mammal occurrence and possible MFAS effects, or lack thereof. In accordance with the RIMPAC BO, data collection needs to address unresolved questions regarding likely area-specific species composition and the potential for alternative detection technologies to be incorporated into future exercises as the U.S. Navy's exercise monitoring program evolves.

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APPENDIX A- CIVILIAN SCIENTIFIC AERIAL MARINE MAMMAL SURVEY

Aerial Surveys of Marine Mammals and Sea Turtles

in Conjunction with RIMPAC 2008 Exercises
near Kauai and Niihau, Hawaii
July 13-17, 2008

KAUAI

NIIHAU

Field Summary Report

October 2008
DRAFT REPORT

Contract #N62742-08-P-1935

Submitted to:

NAVFAC Pacific
EV2 Environmental Planning
258 Makalapa Drive, Ste. 100
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Table of Contents

Executive Summary

Aerial surveys were performed in support of the 21st multi-national "Rim of the Pacific" (RIMPAC) naval exercises on July 13-17, 2008. The mission was to detect, locate and identify all marine mammal and sea turtle species. Also, for marine mammal species, additional observation time was spent characterizing behavior and direction of travel at the time of sighting. The surveys covered an area of approximately 2600 nm^2 (8,880 km^2) lying primarily south of the island of Kauai. Transects followed a pre-specified grid for the first four days (July 13-16) followed by circumnavigation of Kauai and Niihau on the fifth day (July 17). All surveys were flown in a twin-engine Partenavia Observer (P68) aircraft, specifically designed for search-and-rescue as well as biological surveys. The transect surveys utilized design and methods prescribed by accepted distance sampling theory (Buckland et al., 2001). Survey crew and pilot were not informed as to the status or location of Navy exercises to minimize observational bias. A total of 24 sightings were recorded either during transects or during circumnavigation of the islands. These sightings involved eight identified species (bottlenose dolphin, Blainville's beaked whale, Cuvier's beaked whale, Hawaiian monk seal, rough-toothed dolphin, Short-finned pilot whale, spinner dolphin, striped dolphin) and two unidentified species (unidentified dolphin species, unidentified turtle species) (Tables 2-3). Based on behavioral observation of the marine mammal species, no indications of distressed or unusual behavior were seen. The circumnavigation survey (July 17) yielded no evidence of distressed, near-stranded or stranded animals.

Section 1 Introduction

The 21st multi-national Rim of the Pacific (RIMPAC) Exercise spanned a month-long period from June 29 through July 31, 2008.

Based on concerns over potential injury to marine mammals due to the operation of mid-frequency sonar during RIMPAC 08, an expanded marine mammal research program was organized. Part of this research program included aerial surveys focused in waters of the Pacific Missile Range Facility (PMRF) off Barking Sands, Kauai. The aerial surveys were designed based on current accepted distance sampling theory (Buckland et al, 2001) using methods consistent with those used in previously as part of RIMPAC 2006 (Mobley, 2006). Results of those surveys are reported here.

Section 2 Methods

Aerial surveys were performed over a five-day period, consisting of four days (July 13-16) of transect-based surveys that followed a pre-specified grid followed by a one-day circumnavigation of Kauai and Niihau on the fifth day (July 17) (Table 1; Figure 1). All surveys were flown in a twin-engine Partenavia Observer (P68) aircraft outfitted with bubble windows to permit unobstructed downward views. The transect surveys utilized design and methods prescribed by accepted distance sampling theory (Buckland et al., 2001).

Table 1. Description of surveys

Date	Survey Type	Hrs Effort--Transect	Transit Hrs	No. Sightings*	Mean Beaufort	Range Beaufort
July 13	Transect grid	3.45	1.62	1	4.69	3-6
July 14	Transect grid	3.50	1.67	2	3.26	2-6
July 15	Transect grid	4.35	2.22	7	3.35	1-5
July 16	Transect grid	2.92	1.93	2	5.13	2-6
July 17	Circumnavigate Kauai/Niihau	1.23	1.73	12	4.57	2-7
	Totals:	**15.45**	**9.17**	**24**	**4.20**	**1-7**

Transect grids were designed for maximum coverage within range limits of the aircraft. Six north-south transect lines were placed approximately 7 nm (14 km) apart to cover the approximate 2600 sq nm (8,880 sq km) target area (Figure 1). The circumnavigation portion (July 17) involved flying along the coasts of Kauai and Niihau with the mission of identifying any distressed, near-stranded, or stranded cetaceans.

Aircraft flew at an average 100 knots ground speed and altitude of 800 ft (244 m). Survey crew consisted of two observers, one on each side of the plane, and a data recorder. Survey crew and pilot were not informed as to the status or location of navy exercises to minimize observational bias. When target species were detected, an angle was taken to the sighting using hand-held Suunto clinometers, typically followed by orbiting to identify species and in the case of marine mammals, to characterize behavior and direction of travel. Photographs were taken opportunistically by the data recorder to assist in species identification. Environmental data (Beaufort seastate, glare, visibility) were taken at the start of each transect leg or when conditions changed. Positional data via GPS were automatically recorded every 30-sec and manually when sightings occurred.

Total flight time consisted of a total of approximately 25 hrs, including 9 hrs of transiting to and from the survey grid, and approximately 16 hrs of survey "effort" (i.e., trackline or coastal coverage) (Table 1). Observers were told to monitor continuously during both transiting and transect portions.

Section 3 Results and Discussion

A total of 24 sightings were recorded during the five days of aerial surveys (Table 2) consisting of eight identified species. Nineteen of these sightings occurred during survey effort (either during transects or circumnavigation) and five occurred during transits between Oahu and Kauai (Figure 1). Positively identified species included six sightings of Hawaiian monk seals (*Monachus schauinslandi*), two of rough-toothed dolphins (*Steno bredanensis*) and one sighting each of Blainville's beaked whales (*Mesoplodon densirostris*), bottlenose dolphins (*Tursiops truncatus*), Cuvier's beaked whales (*Ziphius cavirostris*), short-finned pilot whales (*Globicephala macrorhynchus*), spinner dolphins (*Stenella longirostris*) and striped dolphins (*Stenella coeruleoalba*) (Table 3). Unidentified species consisted of seven sightings of delphinid species and three sightings of turtle species.

Sighting probability is primarily dependent on Beaufort seastate (Buckland et al., 2001) which is in turn controlled by wind speed. Survey conditions ranged from calm seas (Beaufort 1) to near gale force winds (Beaufort 7) with 50% of total effort spent in Beaufort 5 or higher (Figure 2). Sightings tended to occur in lower Beaufort seastate conditions with the majority (70%) occurring in Beaufort 2-3.

The number of sightings (N=24) and species diversity of the present surveys was substantially greater than that reported across a three-day period during the 2006 RIMPAC exercises (N=5) (Mobley, 2006). Seastate conditions were similar in both instances, so there is no clear explanation for the greater sighting densities of the 2008 effort.

Since the status of sonar transmissions (i.e., whether on or off) was not known during these surveys, it was not possible to address the issue of species' reactions to mid-frequency sonar. Here we limit our report to the incidence and location of the target species, with brief descriptions of the behavior of cetacean species sighted.

The presence of Cuvier's and Blainville's beaked whales in the study area is of interest due to their involvement in previous stranding incidents involving mid-frequency sonar (e.g., Balcomb and Claridge, 2001). The Cuvier's sighting occurred outside of the study area during transit from Oahu to Kauai in deep water (> 1000 fathoms) consistent with known dive depths reported from tagged specimens (Schorr et al., 2008). The pod of Blainville's beaked whales was sighted within the study area between Kauai and Niihau in depths between 100 and 1000 fathoms. Behavioral observations did not reveal unusual or distressed behavior (e.g., unusually tight aggregations of pod members).

The six sightings of Hawaiian monk seals hauled out on the island of Niihau were also noteworthy. Though the primary habitat of Hawaiian monk seals is the Northwestern Hawaiian Islands, sightings in the main Hawaiian Islands have increased in recent years (Baker & Johanos, 2004). The seals tend to prefer haul-out areas like Niihau that are low in human population density.

Table 2. Summary of Sightings, Positions and Behavior

7/13/2008	ZC	3	14:23	22 04.05	159 9.07	--	surface resting for 3 orbits then dove
7/14/2008	UD	3	10:19	21 35.59	159 20.90	--	(not resighted)
7/14/2008	SB	5	13:30	21 58.62	159 56.21	NW	fast swimming, porpoising (photos available)
7/15/2008	UD	5	10:15	21 27.01	158 17.25	--	(not resighted)
7/15/2008	UD	3	10:46	21 51.91	159 21.67	--	(not resighted)
7/15/2008	MD	6	14:07	21 51.51	159 58.37	SE	swimming staggered line abreast formation; dove (photos available)
7/15/2008	SB	1	14:23	22 05.49	159 54.22	S	
7/15/2008	UD	4	14:48	22 11.88	159 18.53	--	(not resighted)
7/15/2008	GM	2	14:54	22 10.51	159 15.86	--	resting at surface
7/15/2008	SC	75	15:10	22 01.51	159 3.32	SE	fast swimming, porpoising; spread-out, no clear formation (photos available)
7/16/2008	TT	2	10:25	21 28.34	158 22.63	NE	UW swimming; visible for only 2 orbits
7/16/2008	UD	1	10:58	21 49.15	159 8.65	N	observed UW swimming belly-up
7/17/2008	UT	1	10:50	22 13.61	159 26.47	--	
7/17/2008	UT	1	10:53	22 13.11	159 31.52	--	
7/17/2008	UT	1	11:03	22 03.74	159 47.47	--	
7/17/2008	UD	3	11:10	21 58.41	159 58.98	SW	(not resighted)
7/17/2008	UD	1	11:14	21 58.39	160 1.68	SE	(not resighted)
7/17/2008	SL	70	11:21	22 01.64	160 5.66	NW	milling; moving away from Lehua Rock
7/17/2008	MS	2	11:27	22 0.25	160 5.32	--	beached monk seals
7/17/2008	MS	3	11:32	21 55.07	160 11.75	--	beached monk seals
7/17/2008	MS	1	11:34	21 51.29	160 14.42	--	beached monk seal
7/17/2008	MS	1	11:35	21 50.55	160 14.89	--	beached monk seal
7/17/2008	MS	1	11:38	21 46.86	160 12.01	--	beached monk seal
7/17/2008	MS	1	11:39	21 47.74	160 12.01	--	beached monk seal

Species Code: SC = striped dolphin; SL = spinner dolphin; UD = unidentified dolphin species; UT = unidentified turtle species

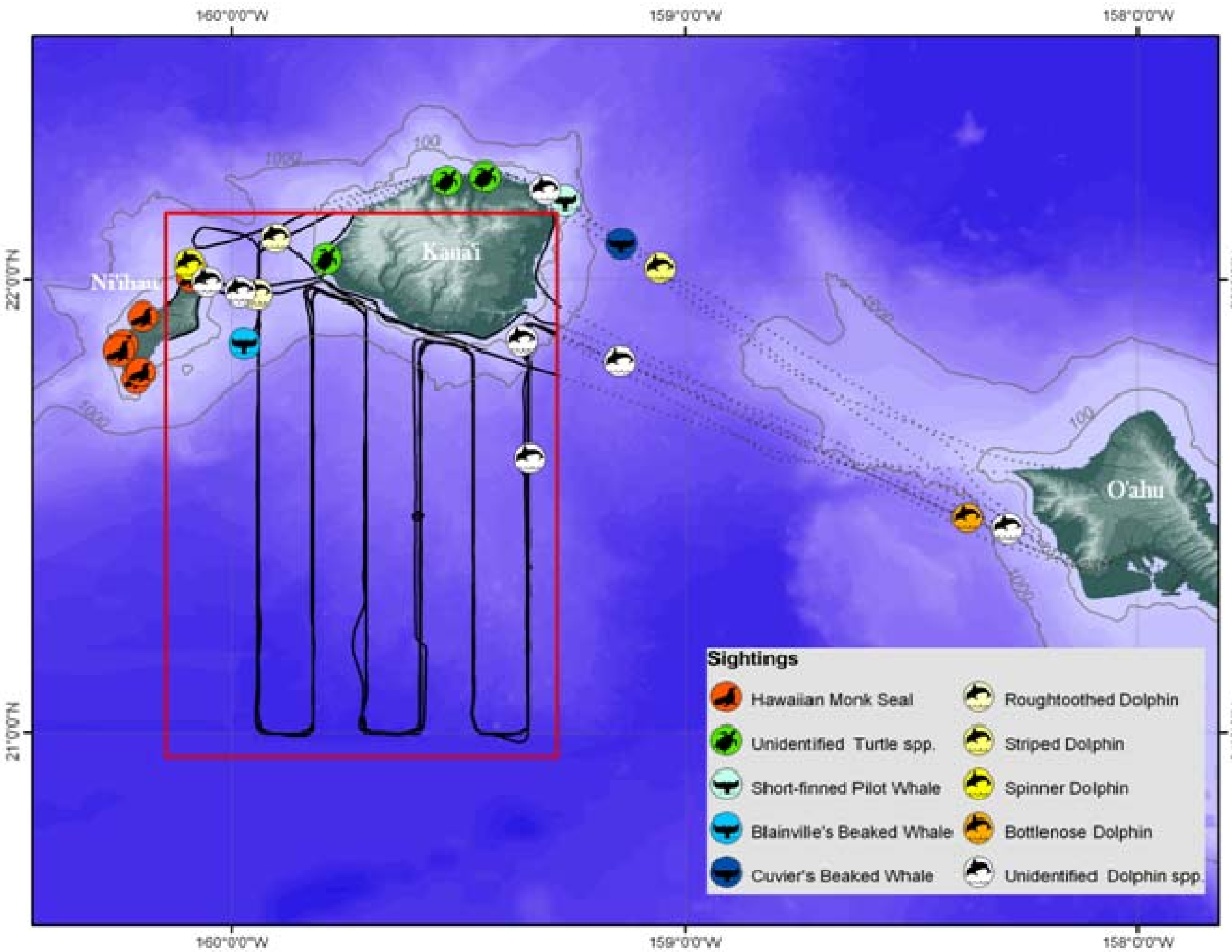

Figure 1. **Survey effort and species locations--**Survey effort based on GPS location data. Red lines indicate the boundaries of the survey area. Surveys were constructed around north-south systematic lines approximately 8 nmi (15 km) apart. Circles with silhouettes indicate locations of sightings. Inner and outer bathymetry lines refer to 100- and 1000-fathom contours respectively.

The remaining species sighted, including bottlenose, rough-toothed, spinner, and striped dolphins, as well as short-finned pilot whales, are fairly common in Hawaiian waters based on previous surveys (Mobley et al., 2000; Mobley, 2004; Barlow, 2006).

In summary, the results of aerial surveys conducted during the 2008 RIMPAC exercises in the waters south of Kauai did not reveal any obvious indications of disturbance on the part of resident marine mammals and sea turtles. Observations revealed no unusual behavior or signs of distress. The coastal survey produced no evidence of stranded or near stranded cetaceans. That being said, it is important to note that the absence of evidence in this case should not be construed as demonstrating the absence of any effect of the exercises. Merely that no obvious effect was discernible.

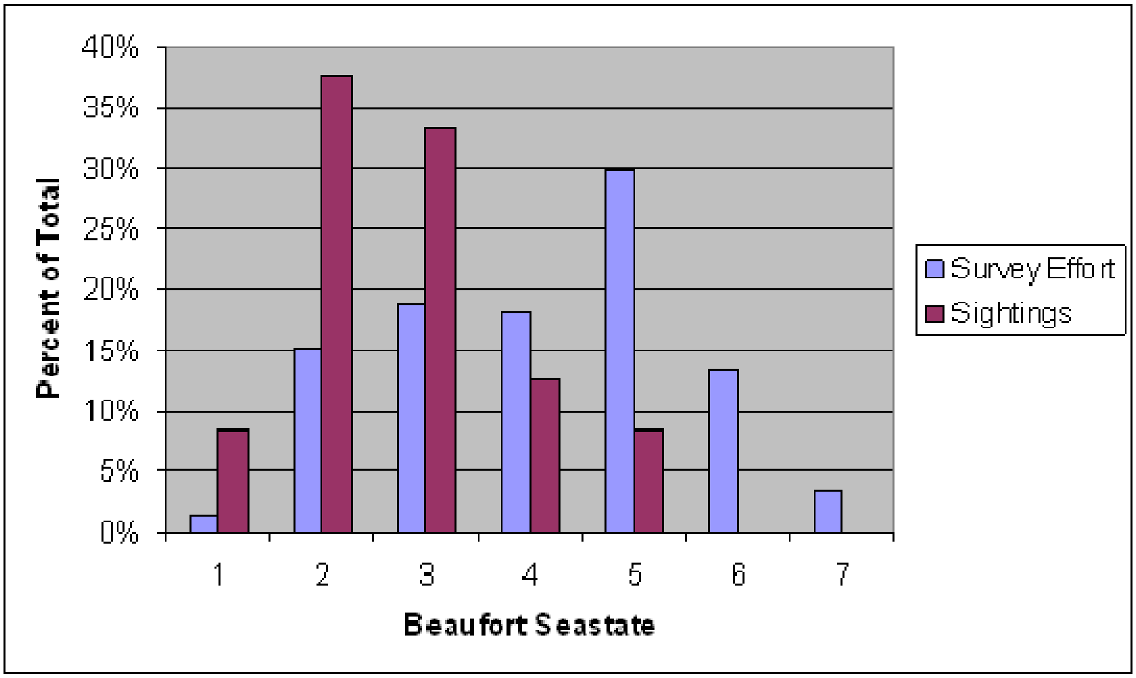

Figure 2. Beaufort seastate conditions—Effort occurred in Beaufort seastate conditions spanning from nearly flat seas (Beaufort 1) to near gale conditions (Beaufort 7). As shown, the majority of sightings occurred in more favorable seastate, with the majority (70%) occurring in Beaufort 2-3.

Table 3. Summary of Sightings by Species

Species	No. Sightings	No. Individuals
Blainville's beaked whale (*Mesoplodon densirostris*)	1	6
Bottlenose dolphins (*Tursiops truncatus*)	1	2
Cuvier's beaked whale (*Ziphius cavirostris*)	1	3
Hawaiian monk seals (*Monachus schauinslandi*)	6	9
Rough-toothed dolphin (*Steno bredanensis*)	2	6
Short-finned pilot whale (*Globicephala macrocephalus*)	1	2
Spinner dolphins (*Stenella longirostris*)	1	70
Striped dolphins (*Stenella coeruleoalba*)	1	75
Unidentified dolphin species	7	20
Unidentified turtle species	3	3

Section 4 Acknowledgements

I would like to thank our observers Julie Oswald and Robert Uyeyama for their excellent work. Mahalo also to our pilot John Weiser for his usual superb piloting. These data were obtained under NOAA permit no. 642-1536-03 issued to the author (JRM).

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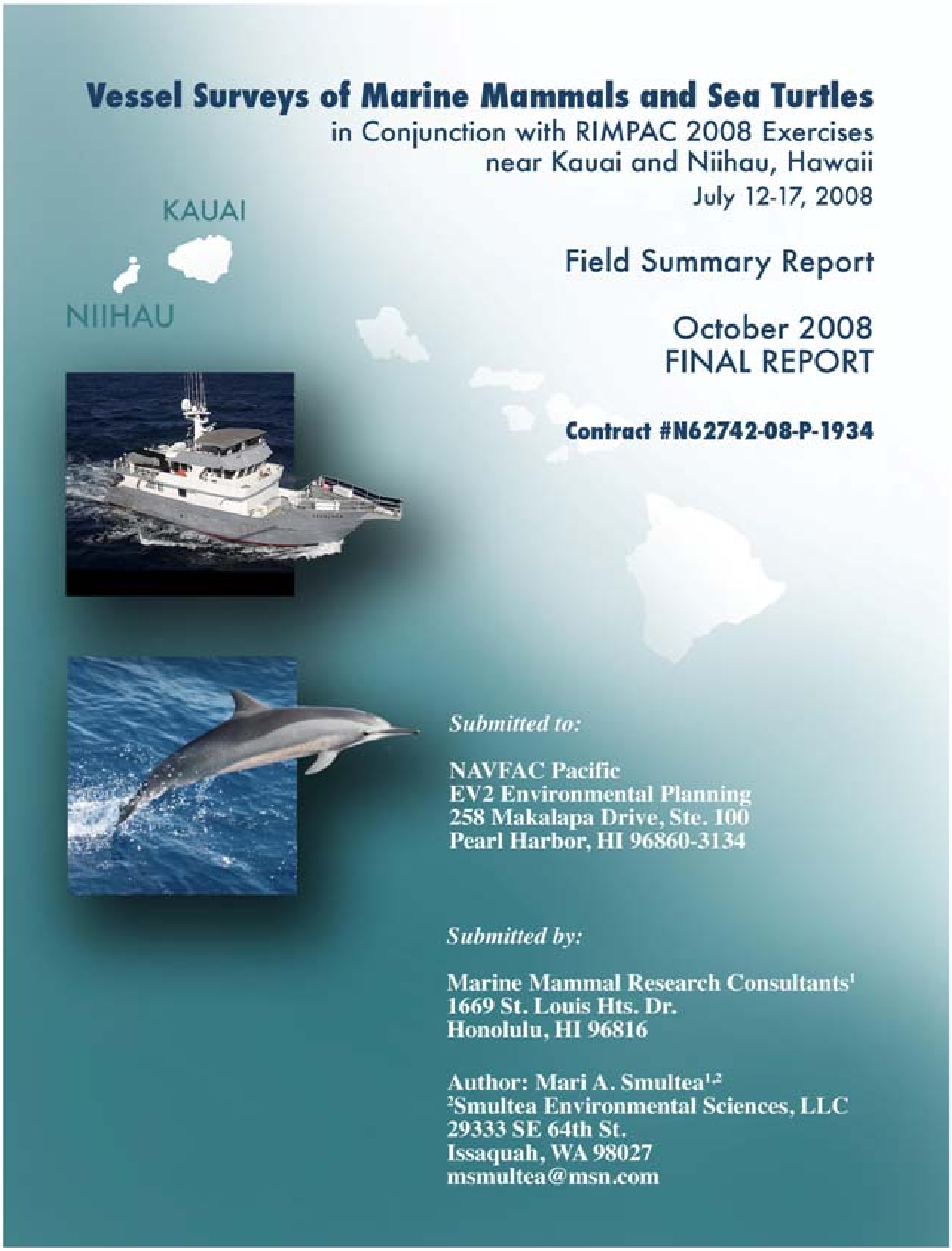
APPENDIX B- CIVILIAN SCIENTIFIC SHIP MARINE MAMMAL SURVEY



Vessel Surveys of Marine Mammals and Sea Turtles
in Conjunction with RIMPAC 2008 Exercises
near Kauai and Niihau, Hawaii
July 12-17, 2008

Field Summary Report

October 2008
FINAL REPORT

Contract #N62742-08-P-1934

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EV2 Environmental Planning
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Table of Contents

List of Tables

List of Figures

Executive Summary

A vessel-based visual survey for marine mammals and sea turtles was conducted in Hawaiian waters near Kauai and Niihau from 12-17 July 2008 in conjunction with Navy Rim-of-the-Pacific (RIMPAC) training exercises within the Hawaii Range Complex (HRC), from aboard the 96-ft R/V *Searcher*. The purposes of the project were to systematically locate, identify, and monitor the occurrence, distribution and surface behavior of marine mammals and sea turtles in the vicinity of scheduled RIMPAC training exercises. These exercises involved large Navy vessel activities including transmission of mid-frequency active sonar (MFAS) on a schedule unbeknownst to the visual observers. Effort included monitoring for any potentially injured or harmed animals and/or any unusual changes in behavior, distribution, or numbers of animals. As feasible, attempts were made to remain within view of any opportunistically seen Navy vessels while conducting line-transect surveys and focal group behavioral sampling.

Observation effort was focused within a designated Survey Area measuring approximately ~50 nm wide by 70 nm long and encompassed the waters between Kauai and Niihau (i.e., the Kaulakahi Channel, those surrounding Niihau and waters up to ~40 nm south of Kauai). A total of five experienced marine mammal observers conducted visual observations in the Survey Area using the naked eye, handheld binoculars, and two sets of "Big Eyes" binoculars. Bathythermograph (XBT) data were also collected twice per day and/or near marine mammal sightings.

A total of 474 nm or ~65 hours (hr) of visual observation effort occurred on six consecutive days from 12-17 July. This total includes the 12 July transit from Oahu to the Kauai-Niihau survey area (unacceptable survey conditions precluded observations during the return transit to Oahu on 18 July). Of the total 474 nm of effort, most (79% or 373 nm) consisted of line-transect survey effort and the remaining 21% (34 nm) consisted of focal sessions involving seven groups of cetaceans. One to 14 Navy vessels were within view at any one time during 39% of the total 474 nm of observation effort on four of six days, including all day on July 17. No Navy vessels were seen on the July 12 transit and on July 16. On several occasions, particularly on July 15 and 17, systematic vessel transect lines had to be aborted, as *Searcher* was redirected by the United States Coast Guard (USCG) and the Pacific Missile Range Facility (PMRF) to move and remain a minimum 20 nm radius from Naval activities in the area for safety reasons. Beaufort sea state (Bf) ranged from 0 to 7+, although only effort during Bf <7 was considered useable. The most common Bf was 4 (25%) followed by Bf 5 at 22% and calm Bf 0-2 at 19%. In general, Bf increased across the survey period. Survey tracks were sometimes adjusted to avoid Bf >5. Ten XBT drops were conducted during the survey usually twice daily in the survey area and near marine mammal sightings.

A total of nine cetacean groups comprising an estimated 283 individuals and no sea turtles were observed during the entire six-day survey. All cetaceans were identified to species and comprised four groups of bottlenose dolphins, three groups of rough-toothed dolphins, and two groups of Hawaiian spinner dolphins. Based on the small sample size, sightings appeared to be concentrated near the 1000-m contour line, mainly along the NE shore of Niihau, including all three rough-toothed dolphin sightings; however, this is also where a lee commonly occurred. Rough-toothed dolphins have been previously reported to concentrate in this area (Baird 2008a). An exception to this general trend was that bottlenose dolphins typically were seen in shallower water. No sightings occurred in the NE and S Kaulakahi Channel, although Bf was typically >3 and vessel effort was excluded on some occasions by Navy activities in these areas. Focal behavior follows ranged from 5-81 min long and were conducted on seven of the total nine cetacean groups. The longest continuous observation session of 81 min occurred with a group of ~120 rough-toothed dolphins in the Kaulukahi Channel. All focal sessions were documented with photographs, digital video, and/or detailed behavioral notes.

No dead or injured marine mammals or sea turtles were seen during the survey, and no unusual behaviors or reactions were observed. Delphinids were seen on three days when Navy vessels were within view and on three days when they were not in view. Thus, at least some delphinids occurred within the general survey area of ongoing Naval activities. The most common behavior states exhibited by all nine dolphin

groups were travel with bouts of surface-active travel. Surface-active milling and milling occurred less frequently and twice involved probable foraging by rough-toothed dolphins. Dolphins bowrode the *Searcher* during eight of the nine total sightings, often for extended periods. Individual surface-active behaviors observed consisted of breaching, spinning, porpoising, and tail slapping.

Because observers were not informed of the times and types of underwater transmissions during Navy activities, it is not possible at this time to assess any related potential effects; the Navy plans to conduct these analyses at a later date. However, a number of general observations were drawn from the survey as follows. At least one cetacean sighting was made on each of the six survey days in the survey area; thus, some animals occurred in the survey area during Navy activities. Shadowing, i.e., following Navy vessels at a safe (>3 nm) distance proved to be a feasible monitoring approach during the circumstances encountered, similar to past monitoring surveys. However, exclusion from certain areas during some Naval activities or Bf >6 precluded us from fully covering the pre-determined transect lines; in these cases, alternate survey routes were followed dependent on weather conditions. As expected, the number of sightings decreased as Bf increased based on the small sample size of nine sightings. There were benefits to communicating with the aerial survey observers who concurrently monitored marine mammals and sea turtles in the same survey area following similar transect lines.

Data collected during this US Navy-sponsored survey provide baseline information on the occurrence, distribution, and behavior of marine mammals during Navy activities involving MFAS operations. This survey also contributes data on the occurrence of cetaceans near Kauai and Niihau during the summer when very little historical survey effort has been expended. While Bf <5 conditions are considered rare at this time of year when strong NE tradewinds are predominant, most of the survey effort was conducted during Bf <5 due to protected leeward areas. Results assist in identifying and evaluating the feasibility of monitoring approaches, including monitoring cetaceans near Navy vessels and concurrent to aerial surveys. This information can be used to continue to develop effective monitoring approaches and to minimize potential related effects on marine resources. Recommendations for marine mammal monitoring during future similar Navy activities have been presented.

Citation for this report is as follows:

Smultea, M.A. 2008. Visual Survey for Marine Mammals and Sea Turtles in Conjunction with RIMPAC Navy Exercises off Kauai and Niihau, 12-17 July 2008, Final Field Summary Report. Prepared by Marine Mammal Research Consultants, Honolulu, HI, and Smultea Environmental Sciences, LLC., Issaquah, WA, under Contract No. N62742-08-P-1934 for Naval Facilities Engineering Command Pacific, EV2 Environmental Planning, Pearl Harbor, HI.

Photo Credits on Cover: R/V *Searcher* vessel used during the survey, photo courtesy of Lori Mazzuca; spinner dolphins observed during the survey, photo courtesy of Thomas Jefferson. Cetacean photo taken under NOAA Permit No. 642-1536-03 issued to Joseph R Mobley, Jr. Graphics: Stasia Buffenbarger.

Section 1 Introduction

Marine Mammal Research Consultants (MMRC), Honolulu, HI, was contracted by the US Navy (Navy) to conduct a vessel-based visual monitoring survey for marine mammals and sea turtles in conjunction with Rim-of-the Pacific (RIMPAC) naval exercises in Hawaiian waters off the islands of Kauai and Niihau, in the Hawaii Range Complex (HRC), from aboard the vessel R/V *Searcher, ,* hereafter referred to as *Searcher*. Observations occurred from 12-17 July 2008, including one day of transit from Oahu to Kauai on 12 July; poor weather conditions precluded effort during the return transit to Oahu on 18 July. Concurrently, visual monitoring for marine mammals was conducted from a small fixed-wing aircraft that was in communication with our vessel team. Aerial survey results are reported separately in Mobley (2008).

The primary goals of the survey were to systematically locate, identify, and monitor the occurrence, distribution, and surface behavior of marine mammals and sea turtles in the vicinity of RIMPAC vessel training exercises. This included monitoring for any potentially injured or harmed animals and/or any unusual changes in behavior, distribution, numbers, or species associations of animals. As opportunistically feasible, to help meet these goals, the research vessel was directed to attempt to remain within view of but no closer than 3 nm from any opportunistically seen Navy vessels while conducting line-transect surveys and focal-group behavioral sampling. Herein we report the results of our vessel-based visual survey and compare them to results of previous surveys conducted in the same region. We also evaluate the effectiveness of our survey approach and provide recommendations for future efforts designed to monitor marine mammals and sea turtles in relation to naval exercises and short- and long-term goals as summarized in he associated National Marine Fisheries Service (NMFS) Biological Opinion for 2008 RIMPAC Exercise, Several Continuing Exercises, and Research Test and Evaluation Activities (NMFS 2008), the Hawaii Range Complex Final Environmental Impact Assessment/Overseas Environmental Impact Statement (FEIS/OEIS) and Hawaii Range Complex Draft Monitoring Plan (Navy 2008a,b).

Section 2 Methods

Survey protocols were designed to meet the Navy goals outlined in the Statement of Work (SOW) while remaining adaptable to both *in-situ* and predicted weather conditions, as well as to naval activities. The methodology and sampling design for this survey were submitted and approved in advance, per the SOW, to the Navy Technical Representative (NTR). Visual observations for marine mammals and sea turtles were conducted using vessel-based line-transect survey and opportunistic behavioral focal sampling from aboard the *Searcher* during 12-17 July 2008 (including one day of transit from Oahu to Kauai on 12 July) off Kauai and Niihau within the survey area identified in the SOW. The rectangular study area was ~50 nm wide by 70 nm long, and encompassed the waters surrounding Niihau, the Kaulakahi Channel between Niihau and Kauai, and waters up to ~40 nm north and south of Kauai within the Navy operational area (OPAREA) of the HRC (Figure 1).

The *Searcher* is a 96-ft. American Bureau of Shipping classed vessel (see www.searcherhawaii.com/searcher/index.html for further description). Visual observations were made from the flying bridge where approximate observer eye-level height was 7.97 m above sea level. Distance to the horizon from this height was ~8 nm. A canopy structure covered the flying bridge to minimize the exposure of observers and equipment to sun and rain.

Data collection protocols and forms generally followed those used during previous vessel-based monitoring programs conducted in conjunction with other naval exercises in the HRC (Smultea et al. 2007, 2008a - see associated appendices for data forms used). The primary goals of this project were to locate and identify marine mammals and sea turtles observed during the training exercise, and to monitor and report observations of their surface behavior. In particular, we were to monitor for any potentially injured or harmed marine mammals and/or any unusual behavior or changes in behavior, distribution, numbers and species associations of animals observed during the training exercise. Additionally, the research vessel was directed to try and observe marine mammals in the vicinity of Navy ships from a safe distance of >3 nm.

The five-person visual team consisted of three senior observers (each with >15 years experience observing marine mammals, including identification of tropical Pacific species and of behavior) and two observers with <1 year related experience. At any one time, as logistically feasible, three observers maintained a visual watch from the flying bridge; at least one observer on each watch was a senior observer. Observations occurred during all daylight hours during "acceptable" survey conditions (i.e., Bf <7 with no rain or other environmental conditions impeding the ability to sight marine mammals near the vessel). During inclement conditions (e.g., Bf 6 with large swell or Bf>6), one or two observers watched until observation conditions were deemed unsafe. Observation effort consisted of either "survey" or "focal" effort as described in the following subsections.

Survey Effort

The survey objective as feasible was to follow six pre-determined north-south transect lines laid-out in a grid pattern spaced ~7.14 nm apart with random lines connecting the end points following accepted distance sampling methods (Buckland et al. 2001). The linear total of these lines within the survey area grid was ~360 nm. However, real time and prevalent weather conditions (e.g., large swells, high winds, wind direction, strong sun glare) sometimes necessitated modifying the orientation or location of survey lines in consultation with the vessel Captain regarding operational safety. Survey line position was to be modified by up to 30 degrees when needed to improve sighting conditions and effectiveness per the SOW. In addition, effort sometimes deviated from pre-set lines to (1) conduct focal animal follows, (2) remain within view of but avoid close (<3 nm) encounters with Navy operations, (3) relocate due to Navy operations as requested via radio communications with the Pacific Missile Range Facility (PMRF), or (4) transit to and from lines between protected nighttime anchorages. Wind and swell conditions also sometimes made it difficult to maintain a specific line position/orientation.

During survey watches, two observers used two "Big Eyes" 25 x 50 binoculars with reticles. The Big Eyes were securely mounted on pedestals located on the left and right forward corners of the flying bridge, respectively. The two Big Eyes observers scanned the waters from approximately 090 degrees left or right of the bow to ten degrees right or left of 0 degrees, respectively. A third observer functioned as the recorder and used the naked eye and 7 x 50 Steiner reticle binoculars to scan the waters from 090 left to 090 right and close to the vessel. Observers rotated between watch positions every 30 min to reduce observer fatigue. However, the three most experienced observers spent more time on the Big Eyes while conversely, the remaining two observers spent more time in the middle recorder position.

WinCruz, a Windows-based data logging program for recording line-transect data for marine mammals (developed by NOAA Fisheries' Southwest Fisheries Science Center [SWFSC], La Jolla, CA) was used to collect and record survey data. WinCruz automatically recorded derived latitude and longitude data from a hand-held Garmin GPS at 30-sec intervals. (Further detail about WinCruz can be obtained online at www.swfsc.nmfs.noaa.gov/PRD/software/WinCruz.pdf.) Remaining information was entered into WinCruz by the recorder and consisted of sighting details and environmental conditions. When a sighting was made, the estimated horizontal bearing and distance to the sighting was recorded; distance was determined using either binocular reticles or the naked eye. Other recorded sighting data included the time, species identification (or lowest taxonomic level that could be confidently discerned), estimated group size (best, high and low estimates), number of calves, other species associations, sighting cue, and heading/orientation relative to the vessel. A modified scan sampling protocol (Altmann 1974; Smultea 1994) was used to collect behavioral information on all encountered cetacean groups. This included behavioral state, conspicuous individual behavior(s) particularly any observed reaction(s) or unusual behavior, and estimated speed of movement. These data were recorded in WinCruz as a comment. Environmental conditions (weather, swell height, Beaufort wind force (sea state), visibility conditions) and effort status (observer initials and positions, observation effort type) were recorded in WinCruz at every watch change and when conditions changed. The number of Navy vessels within view (including those over the horizon) was recorded as a comment in WinCruz whenever observers changed positions.

For each sighting, a SWFSC sighting form and behavior summary sheet (www.corporateservices.noaa.gov/~foia/asdhome/frmscat.pdf) were filled out daily by the observer who initially made the sighting. A summary of each day's activities and observations were recorded by the survey leader in a field journal and a sighting log. All completed survey forms were reviewed by the survey leader. Each evening, WinCruz data were reviewed and edited by one assigned visual observer experienced with WinCruz and the survey leader. WinCruz data were later exported to an Excel database designed to summarize survey-specific data using a program custom-created to post-process WinCruz data (see Smultea et al. 2008a). GPS vessel track and sighting location data were later plotted geographically on a map using GIS software. For the purposes of this report, sighting locations were mapped at the ship track location where they were first seen.

Focal Behavior Observations

Upon locating a cetacean species the survey leader assessed whether conditions were suitable to break off survey effort and conduct an opportunistic focal session to obtain detailed behavioral information (i.e., "focal effort"). Focal effort involved following and monitoring a group of animals using the naked eye, Big Eyes and hand-held binoculars, as appropriate, to observe and record their behavior. The following information was recorded (and updated as applicable) for each focal effort session: group size/composition, start/end times, observer initials/positions, photos/video taken, environmental conditions, and number of Navy vessels within view.

Scan-sampling and zero-one sampling approaches (Altmann 1974; Shane 1990; Smultea 1994; Mann 2000) were used to record the following behavioral information on the focal group at 1-2 min intervals as possible: (1) behavior state (travel, surface-active travel, mill, surface-active mill, rest), (2) occurrence/non-occurrence and type of "conspicuous" individual behaviors (e.g., individual non-respiratory and typical splash-creating behaviors including breaches, tail slaps, headrises, spinning, bowriding, porpoising, etc.), (3) estimated speed of travel (slow – 1-3 kt, medium – 4-6 kt, fast – >6 kt), (4) distance and bearing (range) relative to the vessel, (5) number of individuals bowriding, and (6) minimum and maximum spacing between individuals within the subgroup closest to the vessel (see

Smultea et al. 2008a) for definitions of some of these variables). *Ad libitum* (Altmann 1974) detailed notes were also taken in the comments column of the form on school configuration, unusual behaviors or circumstances (e.g., birds feeding nearby, description of Navy activity), and/or any observed reactions to the vessel. Digital photographs and video were made for photo-ID, species verification, and detailed behavior documentation.

During focal effort, one observer functioned as the primary behavioral observer. A second observer served as the note-taker/recorder and filled-out behavioral observation forms by hand; these forms were later entered into an Excel spreadsheet (see Smultea et al. 2007, 2008a for sample field forms). A third observer was the primary photographer and a fourth observer was the dedicated video recorder. The fifth observer functioned as a "big picture" observer, assisting in locating animals and directing the vessel captain regarding where and how to position the vessel relative to the sighting, assisted in calling out behaviors, and was the secondary photographer.

Notably, close approaches to, or behavioral harassment of, certain species of cetaceans were allowed under the auspices of a state permit and federal NOAA Permit No. 642-1536-03 issued to Joseph R Mobley, Jr. Cetacean behavior considered potential harassment as defined under the US Marine Mammal Protection Act of 1972 or the Endangered Species Act of 1973 (both as amended) was recorded.

Photography / Videography

Digital photographs and digital video of cetaceans were taken opportunistically during survey and focal effort for species identification/verification, documentation of behavior, and photo-ID of individuals. These data also facilitate re-identification and comparisons of behavior of individuals in HRC waters during past or future Navy exercises or studies. Photographs were taken with 35-mm digital Canon EOS camera equipped with up to a 500 mm lens. Video recordings were made with a Sony digital video camera. A photograph/video log was completed to keep track of this information relative to sightings, etc.

Communications

The *Searcher* was equipped with several means of communicating with personnel aboard vessels, aircraft, and shore, the former as required by the US Coast Guard. These included vessel-to-vessel VHF marine radios, an IMMARSET satellite phone, and several cellular phones. Coordination of *Searcher* locations and operations with Navy activities was facilitated via VHF marine communications through USCG and PMRF. Searcher was contacted on several occasions to relay safety information and direct *Searcher* to move and maintain a minimum 20-nm radius away from ongoing or planned Naval activities.

Oceanography

Subsurface oceanographic data were obtained by launching T-7 expendable bathythermograph, i.e., XBT probes provided by the Navy. Each day, a designated observer launched XBTs from the stern of the *Searcher* at ~0900 and 1500 hours local ship time and after focal effort sessions. The XBTs recorded information on temperature-depth profiles from the water surface to a maximum depth of 760 m. Data were recorded for each drop using WinMK21 SURFACE (Lockhead Martin Sippican, v2.7.1 2006) software on a laptop PC. Additional information recorded on a data sheet during an XBT launch included XBT launch number, date, time, latitude/longitude, Beaufort sea state, focal group number if applicable, and comments.

Section 3 Results

Results are described below in the following sections: effort, sightings, focal behavior observations, photography/videography, communications, and oceanography. A chronology of events is presented in Table 1. Table 2 summarizes observation effort by survey type and Bf. Tables 3 and 4 provide information on sightings including focal behavioral observations, while Table 5 summarizes photos and video taken. Figure 1 displays vessel tracks during visual observations by effort type and survey date and shows the locations of marine mammal sightings. Figure 2 presents vessel tracks during visual effort by Bf and also includes sighting locations.

It was not possible to conduct continuous *Ad Libitum* sampling (Altmann 1974) during focal sessions because there were too many individuals in the groups of dolphins that were seen, unlike for small whales groups during past Navy monitoring surveys (e.g., Smultea et al. 2008a). Instead, 1-min scan sampling and zero-one sampling (occurrence/non-occurrence) (Altmann 1974) were implemented (see Methods). This protocol approach facilitated systematic collection of pre-selected detailed behavioral data on the small to large groups of dolphins encountered and followed for extended periods. Focal observation sessions typically ended when at least 30-60 min of observations had occurred, the animals were lost from sight, when visibility or sighting conditions precluded continuation of the session (e.g., darkness), or at the discretion of the lead scientist in order to meet other goals of the study. None of the nine dolphin groups exhibited any obvious evasive or disturbance behavior related to the observation vessel or as defined under the MMPA. No "unusual" behavior was noted from any of the cetaceans observed.

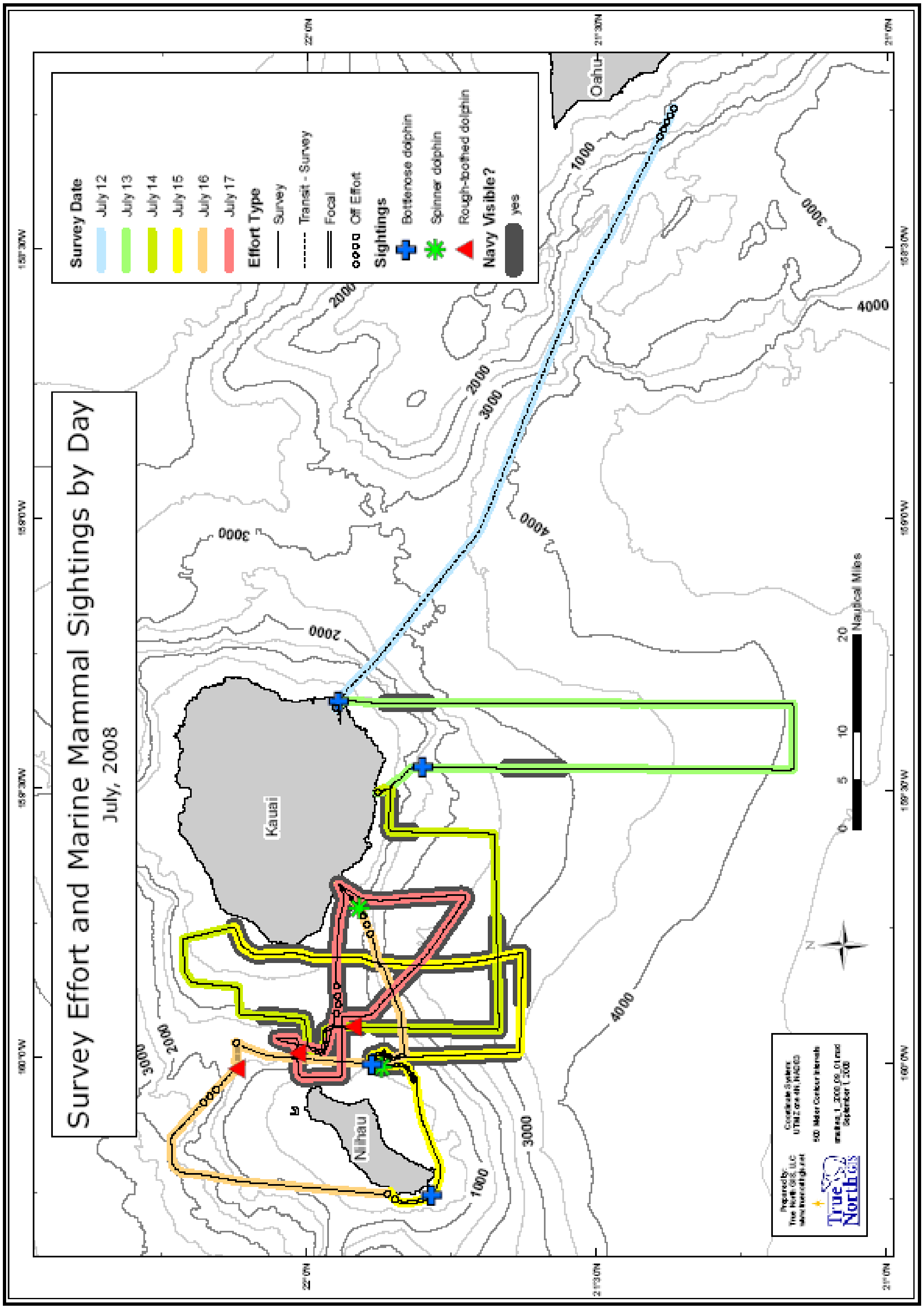

Figure 1: R/V *Searcher* vessel tracks during visual observations by effort type and survey date, locations of marine mammal sightings and periods when a Navy vessel(s) was in view.

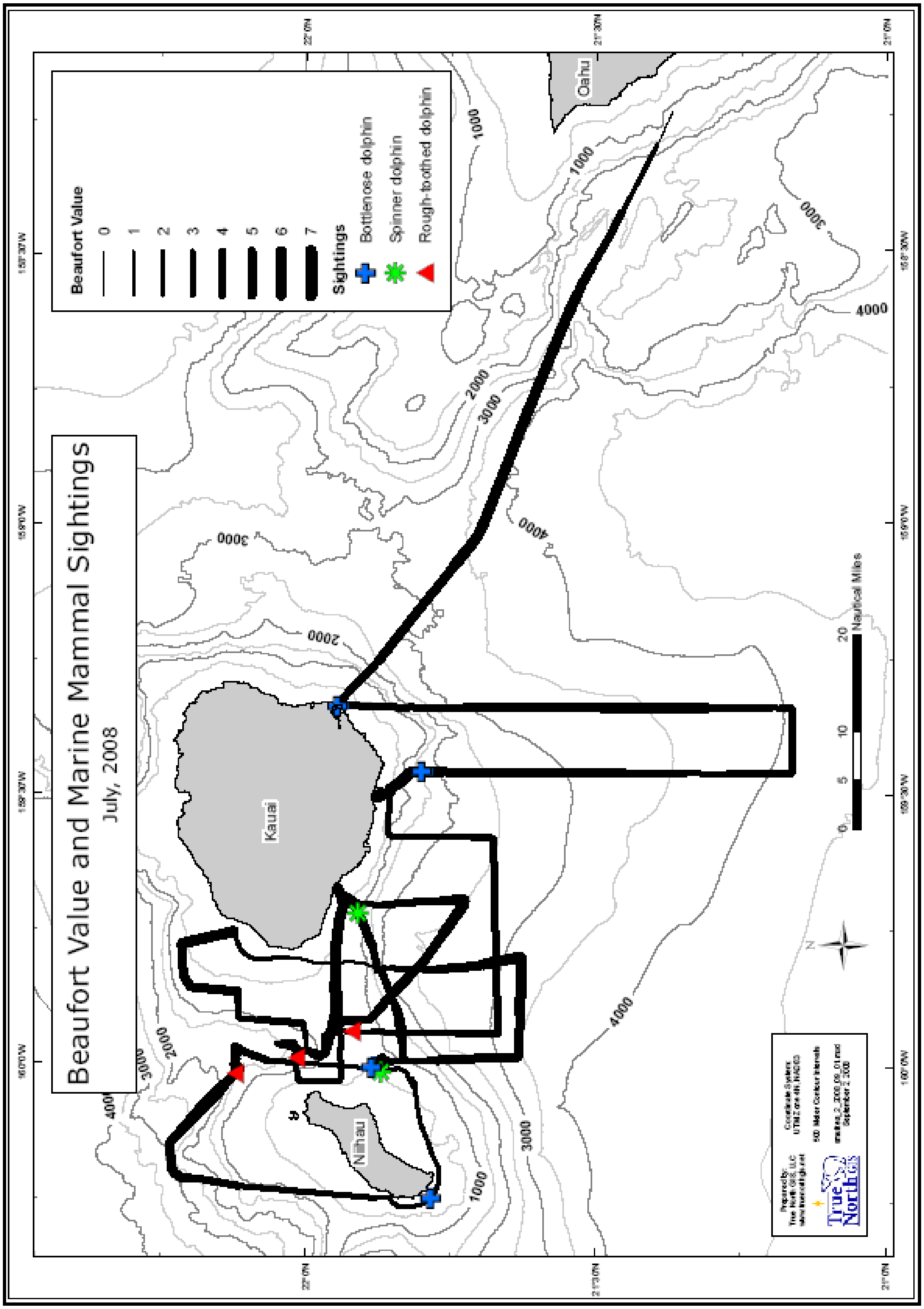

Figure 2: R/V *Searcher* vessel tracks during visual observations by Bf type and locations of marine mammal sightings 12-17 July 2008.

Effort

A total of 474 nm of visual effort (i.e., "on effort" with Bf <7) occurred on six consecutive days from 12-17 July 2008 (Table 2, Figure 1). Most (373 nm or 79%) of this total consisted of survey effort; the remaining 34 nm (21%) consisted of focal effort (Table 2, Figure 1). Effort occurred primarily (86% or 406 nm) within the main Kauai-Nihau survey area; the remaining 68 nm occurred during one day of transit from Oahu to Kauai on 12 July (Table 2). Excluded from the total effort are 12 nm of "off effort" daylight periods when no observations occurred during set-up at the start of the first transit day and during poor weather conditions (e.g., Bf >6, rain) within the Kauai-Niihau survey area. In addition, no observations occurred during the ~90 nm of return transit from Kauai to Oahu on 18 July when Bf was >6. Observations occurred from sunrise to sunset as practicable during suitable conditions, averaging 79 nm and 10.9 hr of effort per day.

Sea state conditions ranged from 1 to 8 on the Beaufort scale during the survey, although only visual effort during Bf <7 was considered useable (Table 2, Figure 2). Sightings of marine mammals and sea turtles are greatly reduced during higher Bf conditions, and most surveys truncate effort above Bf 5 or 6, with effort for some species truncated at lower Bf conditions (e.g., Barlow 2006, etc.). Beaufort conditions were fairly evenly distributed, although the most common (25%) Bf was 4, followed by Bf 5 (22%), and calm Bf 0-2 (19%) conditions (Table 2). On several occasions, the direction and height of sea swell combined with Bf 6 made observations with the Big Eyes binoculars impossible. In these cases, hand-held binoculars (7x25) were substituted until observers could return to the Big Eyes. In particular, Bf >5 and higher conditions in offshore areas during the latter half of the survey period precluded effort from occurring on the southern portions of the pre-determined transect lines (Figure 1). For example, on July 13 the vessel traveled south on a pre-determined transect line up to ~40 nm south of Kauai; however, adjacent transect lines to the west had to be truncated or abandoned due to Bf >6 conditions (Figure 2). As predicted for the region, the calmest waters were found in the W and SW lees of Kauai and Niihau but also along the E side of Niihau (Figure 2).

At least one Navy vessel was within view of observers during 39% (187 nm) of the total 474 nm of effort. Of the total six days of survey, the only days when no Navy vessels were within view was on the July 12 transit and on July 16. On July 17, Navy vessels were within view all day for ~10 hr. The maximum number of Navy vessels within view (below and above the horizon) at any one time was 14 on July 17. On several occasions, Searcher was directed by USCG or PMRF via VHF marine radio to redirect *Searcher* outside a 20-nm radius of Navy activities for safety reasons, including on July 15, 16, and 17 (Table 1). Thus, pre-determined transect survey lines could not always be followed. For example, near mid-day on July 15, the Searcher was directed to stay west of its location and thus could not complete the southern offshore portion of the survey line that day (Figure 1). On the morning of July 16, the Searcher was directed to turn back from its northerly heading. On July 17, the Searcher could not complete pre-determined survey lines nor conduct surveys in the available small lees as the Searcher's location was limited through the day to small areas in the W and SW portions of the Kaulakahi Channel between Kauai and Niihau where the Bf was largely >5 (Figures 1 and 2).

Sightings

A total of nine marine mammal groups (all cetaceans) were sighted during the six days of observations, all of which were seen near Kauai and Niihau (Table 3, Figs. 3 and 4). No sea turtles were observed from the vessel. All nine cetacean sightings were confirmed to species and consisted of four groups of bottlenose dolphins (*Tursiops truncatus*), three groups of rough-toothed dolphins (*Steno bredanensis*), and two groups of spinner dolphins (*Stenella longirostris*). These sightings are summarized in Table 3 and plotted in Figures 1 and 2. Most (56%) of the nine sightings occurred in Bf <4, two were in Bf 4, one in Bf 5, and none in Bf 6 (Table 2).

Table 1: Chronology of events during the July 2008 RIMPAC marine mammal and sea turtle vessel survey near Kauai and Niihau.

Date	Time	Event
11 July	11:00-17:00	Observers board *Searcher* for the day to load, set-up, and test equipment (e.g., Big Eyes binoculars, XBT operations, WinCruz, GPS, etc.) and supplies.
12 July	7:40	*Searcher* departs Ko'olina Marina, Koonelani Harbor, to transit to Kauai.
12 July	7:40	Orientation, safety meeting. Unpack/set-up equipment.
12 July	9:30	Begin observations.
12 July	17:58	End observations. Setting anchor at Nawiliwili Harbor, Kauai.
13 July	6:29	Begin observations and head S from top of easternmost transect line 1.
13 July	19:14	End observations. Anchor at Lawai Bay.
14 July	6:34	Begin observations. Surveyed S offshore on Line 3.
14 July	8:30	Truncated Line 3 due to Bf >6 wind line, turned W then N on Line 5.
14 July	18:08	End observations. Anchor near W end of Napali Coast just N of Kekaha.
15 July	6:47	Begin observations and head S offshore down Line 6 but had to truncate line due to Bf 6+ so headed W toward Line 7. Coast Guard calls *Searcher* to change heading to N to clear area <20 nm from Kaula Rock for Navy activities. Had seen 8 Navy vessels by 8:30.
15 July	18:16	End observations. Set anchor near central W shore of Niihau. Saw total of >14 Navy vessels today mostly in mid- to upper Kaulakahi Channel.
16 July	7:17	Begin observations. Head NNE to NE corner of survey box. Near N edge of box, PMRF calls *Searcher* to turn S and clear area to N for Navy activities. After focals on rough-toothed dolphins ends at 12:41, *Searcher* heads E to Barking Sands. PMRF calls *Searcher* to turn S.
16 July	18:08	End observations. Anchor at Waimea Bay.
17 July	6:18	Begin observations. Head S on Line 4 but hit Bf 6+ by 8:00 so we truncate survey line and head back N toward lee area parallel and close to E Niihau shore. PMRF calls *Searcher* to stay clear of E Kaulakahi Channel so we head W.
17 July	11:00	Aerial survey observers call *Searcher* and report Bf 6+ through most of survey area.
17 July	13:00	PMRF calls *Searcher* to stop heading E and to stay W and S of southernmost Navy vessel in Kaulakahi Channel. Six Navy vessels in view.
17 July	14:00	*Searcher* headed back E to Waimea because southernmost Navy ship has moved N and Bf 6+ wind line is closing in on us from S. Wind line hits us at 14:35 with Bf 7+.
17 July	16:24	End observations due to Bf 6-7+ and because calmer lee waters are off limits due to Navy exercises. Counted >14 Navy vessels today. Anchor at Waimea Bay.
18 July	05:00	Depart Waimea in darkness for Oahu. Bf 7-8 and large swells 10-12 ft. No visual effort conducted due to unacceptable survey conditions all day.
18 July	21:15	Arrive Ko'olina Harbor, Oahu. Spend night on *Searcher* in harbor.
19 July	~11:00	Disembark *Searcher* after packing gear. Return equipment to Navy storage.

Table 2: Summary of survey effort (nm) and Beaufort sea state (Bf) during the 12 - 17 July 2008 RIMPAC marine mammal and sea turtle vessel survey near Kauai and Niihau.

Effort or Bf Type	Total (nm)
"On Effort":	
Survey	
Kauai & Niihau (July 13-17)	370
Transit (12 July)	68
Focal	32
Total	**474**
Subtotal - Navy in View (Survey & Focal)	182
"Off Effort":	
Rain/Other [1]	11
Return Transit (Bf >6, swell >10 ft)	87
Total off effort [2]	**98**
Beaufort	
0-2	89
3	77
4	119
5	106
6	83
>6	7
Total	**474**

[1] Includes 7 nm of Off Effort during unacceptable survey conditions (e.g., Bf >6, rain), 4 nm during initial set up on 12 Nov transit, and <1 nm during XBT drops.

[2] Includes only periods when *Searcher* was underway.

Table 3: Summary of the nine marine mammal sightings made during the 12-17 July 2008 RIMPAC vessel survey near Kauai and Niihau. See Table 4 for further detail on the seven groups that were followed as focal groups.

Date	Species	Estimated Group Size (# Young)	Latitude (N)	Longitude (W)	Focal Group? (ID #)	Bf	Water Depth (m)	Total Time Observed	# Navy Vessel in View	Photo/ Video?	Behavior
July 12	Bottlenose dolphin (*Tursiops truncatus*)	2 (incl. 1 juvenile)	21 56.95	159 20.33	No	4	~25	17:54-17:58	0	-	Approached/bowrode ~5 min near Nawiliwili Harbor at end of transit from Oahu to Kauai
July 13	Bottlenose dolphin	5	21 48.22	159 27.57	No	6	~1500	18:28-18:31	0	-	Approached/briefly bowrode while *Searcher* headed in for night at Waimea
July 14	Rough-toothed dolphin *(Steno bredanensis)*	22 (incl. 1 juvenile & 2 subadults)	21 55.36	159 56.39	Yes (F1)	2	~900	13:31-14:55	2	Y/Y	Approached/bowrode frequently; mostly travel with some surface-active behaviors and milling/probable foraging
15 July	Spinner dolphin *(Stenella longirostris)*	122 (<10% calves)	21 52.35	160 00.79	Yes (F2)	2	~500	15:30-17:08	1	Y/Y	Approached/extensive bowriding, travel with frequent surface-active behaviors, loosely spread in clumps over large area, appeared to later split into 2 large groups
15 July	Bottlenose dolphin	4	21 47.07	160 14.89	Yes (F3)	2	~100	18:16-18:36	0	-/Y	Approached vessel/ bowrode for ~10 min, seen in W lee of Niihau near shore
16 July	Rough-toothed dolphin	85 (incl. 1 juvenile & 1 calf)	22 07.37	160 01.04	Yes (F4)	5	~1800	11:29-12:41	2	Y/Y	Approached/bowrode, overall behavior travel or mill with frequent surface-active behaviors, some milling, probable foraging
16 July	Bottlenose dolphin	26 (incl. 2 juveniles)	21 53.31	160 00.45	Yes (F5)	2	~400-500	14:50-15:15	0	Y/Y	Approached/bowrode, travel, some surface active-behaviors
16 July	Spinner dolphin	7	21 54.78	159 43.17	Yes (F6)	4	~700	17:40-17:50	0	Y/Y	Approached/bowrode, travel
17 July	Rough-toothed dolphin	12 (incl. 1 calf)	22 01.09	159 59.29	Yes (F7)	3	~1100	12:14-12:23	6	Y/-	Approached and traveled past *Searcher*, did not bowride, some surface-active behaviors

Focal Behavior Observations

Table 4. Summary of behavior and sighting information for the seven focal sessions conducted on dolphins during the 12-17 July 2008 RIMPAC vessel survey near Kauai and Niihau.

Date	Focal Session ID No.	Focal Session Period	Dolphin Species	Grp Size (min-max)	Total 1-min Scan Samples	Bowriding (% of scan samples)	SAC Behavior Events	Behavior State (% of scan samples)			
								Travel	SAC Travel	Mill	SAC Mill
14 July	F1	13:49-15:10	Rough-toothed	22 (14-40)	54	52%	US, PO	90%	9%	1%	-
15 July	F2	15:34-16:37	Spinner	120 (95-160)	59	47%	SP, PO, TS, US, BR	31%	61%	7%	1%
15 July	F3	18:30-18:36	Bottlenose	4 (4-4)	7	100%	-	100%	-	-	-
16 July	F4	11:38-12:38	Rough-toothed	85 (40-100)	56	38%	BO, BR, PO, US, TS	39%	22%	7%	32%
16 July	F5	14:56-15:15	Bottlenose	26 (18-35)	20	100	PO, BR, TS	80%	20%	-	-
16 July	F6	17:42-17:48	Spinner	7 (5-9)	7	86%	-	100%	-	-	-
17 July	F7	12:18-12:23	Rough-toothed	12 (10-14)	4	-	PO	75%	25%	-	-

Abbreviations: SAC = surface-active, US = unidentified splash, PO = porpoising, SP = spinning, TS = tail slap, US = unidentified splash, BR = breach.

Focal observations were conducted whenever conditions were feasible, resulting in seven focal sessions on seven of the total nine cetacean sightings (Table 4). Focal sessions ranged in duration from 5-81 min and averaged 27 min. The remaining two groups for which focal sessions were not conducted were two different small groups of bottlenose dolphins seen at dusk while looking for moorage for the night (Table 3). Focal sessions conducted on the seven dolphin groups are described below and summarized in Table 4. Video and/or photographs were taken on six of the seven focal groups (Table 5).

No "harassment" under the MMPA or ESA was judged to occur during the survey based on observations made by the experienced observer team. Close encounters with dolphins typically occurred when the animals approached the survey vessel; no "fleeing" or behavioral avoidance of the vessel was observed.

Rough-toothed Dolphins July 14

A group of ~22 rough-toothed dolphins, including one juvenile and two subadults, was first seen 4 nm away at 13:31 near the circling RIMPAC survey research aircraft ~6 nm ENE of Pueo Pt, Niihau, in the Kaulakahi Channel (Figure 1, Tables 3 and 4). The *Searcher* headed toward the sighting and the dolphins approached and bowrode when the *Searcher* neared the dolphins. Detailed behavioral data were collected from 13:49-15:10 (excluding 15 min from 14:46-15:05 when the vessel left the dolphins but the session recommenced briefly when the dolphins were resighted near the bow). Two Navy ships were within view during the focal session and the Bf was 2 (Table 3). Based on a total of 54 ~1-min scan samples, the primary behavioral state was travel (90%) followed by surface-active travel (9%); in addition, milling consisting of probable foraging was seen on three occasions (1%) near feeding seabirds. From 1-8 dolphins bowrode during 52% of the 54 1-min scan samples. The number of bowriders changed frequently (every ~1-2 min) and included one large probable male and a juvenile and a subadult. Dolphins were also occasionally seen riding the stern wave. Bowriding dolphins were heard whistling by observers on the bow on several occasions. The *Searcher* left the dolphins at 14:46. However, at 15:05 a subgroup from the same apparent group was resighted resting and logging in a tight formation at the surface ~0.2 nm away as the *Searcher* approached them while following its transect line course. The dolphins briefly approached the *Searcher* at a fast porpoising speed then turned and slowly swam away in a tight formation with synchronized surfacings. Both digital video (14 min) and photographs (>361 photos) were taken on this group (Table 5).

Spinner Dolphins July 15

A group of ~ 122 spinner dolphins was first seen ~3 nm away at 14:28 (~4 nm ESE of Pueo Pt., Niihau) while the *Searcher* was looking for beaked whales seen by the RIMPAC aerial survey observers ~ 28 min earlier (see Mobley 2008)(Tables 3 and 4, Figs. 1 and 2). Detailed focal behavioral observations occurred from 15:34-16:37 and the dolphins were last seen at 14:29. One Navy vessel was within view with a Bf 2 throughout the encounter.

When the *Searcher* neared the spinners, some individuals approached and bowrode, and the group as a whole was engaged in surface-active travel involving porpoising, spins, breaches, etc. (Tables 1 and 2). Overall, the predominant behavior states were surface-active travel (61%) and travel (31%) at slow to medium speed (~3-5 kt) to the south. The spinners were initially spread-out over ~0.5 nm in a loose aggregation of scattered subgroups; after ~10 min, one large subgroup appeared to split from the other dolphins and moved >1.5 km from the main focal group, the latter which remained <0.1-0.8 nm from the *Searcher*. Bowriding was initiated by a calf; whistles were heard in the air at this time and the apparent mother quickly joined the calf at the bow, and both bowrode for ~11 min. From 1-12 dolphins bowrode during 47% of the 59 1-min scan samples. Whistling was heard in the air during a later bowriding episode by adults. Over 630 digital photographs and 18 min of digital video tape were collected on these dolphins. No unusual behaviors were observed and the only reaction was approaching the bow of the *Searcher* to bowride for short periods. When the *Searcher* circled back several times to rejoin the dolphins, they maintained their speed and behavior state while some individuals approached the *Searcher* to bowride.

Bottlenose Dolphins July 15

Four adult bottlenose dolphins were first seen 0.9 nm off the SW shore of Niihau while the *Searcher* headed NNW along the coast of Niihau during Bf 2 (Figs. 1 and 2). The dolphins changed course to approach the *Searcher* and three of the four dolphins bowrode for ~7 min then broke off and headed back toward shore (Tables 3 and 4). The *Searcher* did not change its speed or course during the short focal session, as dusk was approaching and we were headed to a safe anchorage. No Navy vessels were seen during the encounter. The group traveled at ~8 kt and bowrode/traveled throughout observations; no surface-active behaviors were seen (Table 4). No digital photographs and 5 min of digital video tape were collected on these dolphins. No unusual behaviors were observed and the only reaction seen was approaching the bow of the *Searcher* to bowride.

Rough-toothed Dolphins July 16

At 11:29, a group of ~85 rough-toothed dolphins was seen from the *Searcher* ~7 nm NNE of Niihau (Figure 1). As the *Searcher* neared the group, some individuals approached and bowrode. Detailed focal observations occurred from 11:38-12:38. Two Navy vessels were within view during the encounter during a Bf 5. Overall, the group appeared to forage with frequent surface-active behaviors and intermittent bouts of bowriding (Table 4). The predominant behavior states were travel (39%), surface-active mill (32%), and surface-active travel (22%) based on 56 1-min scan samples (Table 4). At 14:33, some dolphins appeared to be feeding, making quick short dives with asynchronous headings near diving booby birds. Bowriding occurred during 38% of the total 56 1-min scan samples, and up to 14 dolphins bowrode at one time. Whistling was heard in the air on two occasions while dolphins bowrode. Similar to the spinners described above, these rough-toothed dolphins repeatedly approached the *Searcher* for short bowriding bouts then headed away or slowed down, and would return to bowride for short periods when the *Searcher* turned around and re-approached the dolphins. Over 780 digital photographs and 21 min of digital video tape were collected on these dolphins. No unusual behaviors were observed and the only notable reaction seen was approaching the *Searcher* to bowride on numerous occasions.

Bottlenose Dolphins 16 July

At 14:50, a group of 26 bottlenose dolphins (including at least two juveniles) was seen 0.8 nm away and ~4 nm east of Pueo Pt., Niihau (near where the spinners had been seen on July 15) (Figure 1). Detailed focal observations occurred from 14:56-15:15. No Navy vessels were within view during the encounter and the Bf was 2. Bowriding occurred throughout the 19-min focal session with up to 10 dolphins bowriding at one time, including two juveniles (Table 4). Based on 20 1-min scan samples, the only behavior states observed were travel (80%, including bowriding) and surface-active travel (20%) including breaching and tail slapping (Table 4). The focal session ended when the last bottlenose dropped off the bow and behind the *Searcher*. Over 100 digital photographs and ~12 min of digital video tape were collected on these dolphins. No unusual behaviors were observed and the only notable reaction was approaching the bow of the *Searcher* to bowride.

Spinner Dolphins 16 July

At 17:40, a group of seven spinner dolphins (all adults) was seen 0.1 nm away heading toward the port bow of the *Searcher*, ~4 nm SW of Waimea, Kauai (Figure 1). The dolphins began bowriding at 17:41 and detailed focal observations occurred from 17:42-17:48. No Navy vessels were within view during the encounter and the Bf was 4. Bowriding occurred during 86% of the seven total 1-min scan samples until the dolphins dropped off and behind the *Searcher* at 17:48 (Table 4). Up to four of the seven total dolphins bowrode at one time. Travel while bowriding was the only behavior state observed and the animals were heading ESE along with the *Searcher* during the focal session. The *Searcher* did not change its ENE heading throughout the encounter but dropped its speed from ~10 kt to 8 kt upon encountering the spinners. No digital photographs and ~4 min of digital video tape were collected on these dolphins. No unusual behaviors were observed and the only reaction seen was approaching the bow of the *Searcher* to bowride.

Rough-toothed Dolphins 17 July

The final sighting during the survey was a group of 12 rough-toothed dolphins (including one calf) seen at 12:14 ~800 m away and ~4 nm NE of the northern tip of Niihau (Figure 1). Six Navy vessels were within view and the Bf was 3. The dolphins were first seen approaching the port bow from a distance of 0.1 nm. They maintained their heading toward the *Searcher* and eventually two subgroups spaced ~0.02 nm apart passed within 5-10 m of the bow but did not bowride. Two animals lifted their heads out of the water when ~10 m off the starboard bow and appeared to be looking at the *Searcher* as they passed. The *Searcher* did not change its course or speed (~8 kt) during the sighting. Detailed focal observations occurred for only four ~1-min scan samples from 12:18-12:23. The animals traveled past at slow to medium speed with some surface activity (Table 4). They were last seen in the stern wake traveling at medium speed in a tight synchronized group and were not resighted. No digital photographs or video were collected. No unusual behaviors were observed.

Photography/Videography

Both digital photos and digital video were taken when possible to obtain individual photo-ID data and document behavior. Over 1,880 digital photos were taken during four of the total nine sightings, all four of which were focal groups (Table 5). No photos were taken during the remaining five sightings because the animals were too far away and/or the sighting was too brief. Approximately 83 of these photos were considered useful for photo-ID of individuals, including of rough-toothed, spinner, and bottlenose dolphins (Table 5). A total of ~74 min of digital video was taken during six of the nine sightings, all six of which were focal groups (Table 5). Video included footage of bowriding, tail slapping, breaching, and general behavior states. On July 15, video concentrated on following a spinner dolphin mother-calf pair, including while they bowrode (Table 5).

Communications

Observers aboard a Partenavia fixed-wing aircraft conducted surveys for marine mammals and sea turtles within the Survey Area on 13-16 July concurrently with the *Searcher* observers (Mobley 2008). This was considered a feasibility study to assess the ability and best means of communicating information between the *Searcher* and research aircraft observers. For example, it was useful when the aircraft could alert the vessel observers about Bf conditions in planned survey areas. It was also useful to communicate whether species identification or confirmation was needed by one or the other platform, particularly if the aircraft needed to leave to refuel or return to Oahu (the aircraft flew back and forth to Kauai from Oahu each day). Observations from both platforms overlapped in time within the survey area during ~3-4 hr each day. Vessel and aircraft observers were in visual contact only briefly about twice per day when the aircraft flew over or near the *Searcher* while following pre-determined transect lines. The most convenient and reliable means of communications between *Searcher* observers and the pilot/aircraft observers was via text messaging on cell phones, and was limited to periods when cellular tower reception was sufficient. Voice communications via cell phone was not possible because observers aboard the aircraft were unable to hear via cell phone because the latter system was not connected through the intercom system on the aircraft. Satellite phone communication between aircraft and vessel observers was possible though inconvenient and thus was used infrequently. The only satellite phone on the *Searcher* was in the bridge inside the pilot house which was separated from the flying bridge observer station by a steep set of stairs and a door: when this phone was used, one observer had to leave watch to talk on the phone in the wheelhouse/bridge.

Oceanography

A total of 10 XBTs were successfully launched from the *Searcher* on five of the six survey days (excluding the transit on July 12). Multiple successive XBTs had to be launched occasionally because some of the XBTs were non-functional/did not collect data. XBT drops occurred in the mornings at ~9:00 and in the afternoon between 15:30-18:00; the earlier afternoon drops were associated with marine mammal sightings. Sea surface temperature ranged from ~27-28º C. Temperature profiles extended down to the inherently limited maximum depth of 760 m except in locations where the water depth was shallower. The depth of the surface-mixed layer profile where water temperature remained ~27-28º C extended down to ~12-25 m. After this depth, the water temperature decreased fairly evenly until ~600 m where water temperature was ~6º C; beyond this depth, the temperature-depth profile was nearly vertical until the maximum recording depth of 760 m.

Table 5. Digital photographs and video taken of cetacean sightings during the 12-17 July 2008 RIMPAC Marine Mammal Monitoring Vessel Survey near Kauai and Niihau. 1/

Date	Dolphin Species	Sighting #/ Focal ID #	Total Photos	Approx. # Frames Useful for Species ID	Min of Video	Description
July 14	Rough-toothed	3/F1	361	17	14	Photo-ID/behavioral; bowriding, breach
July 15	Spinner	4/F2	632	19	18	Photo-ID/behavioral; mother and calf bowriding
July 15	Bottlenose	5/F3	-	-	5	Behavioral; tail slapping, bowriding, breaching, rolling
July 16	Rough-toothed	6/F4	784	42	21	Photo-ID/behavioral; synchronized surfacings, breaching, bowriding
July 16	Bottlenose	7/F5	101	5	12	Photo-ID/behavioral; bowriding
July 16	Spinner	8/F6	-	-	4	Behavioral; bowriding
Total			**1,878**	**83**	**74**	

[1] Only those cetacean sightings for which photos or video were taken are listed in this table.

Section 4 Discussion

The following discussion begins with a general review of past data from the survey area to provide a relative context for the contribution of this and future monitoring surveys in the HRC. This is followed by a bulleted list of the general results including their relevance to past, ongoing, and proposed Navy monitoring efforts as pertinent.

Past Cetacean Studies Near Kauai and Niihau

Few intensive systematic data are available on cetaceans in the Kauai-Niihau project area, particularly during summer; thus, comparisons of past studies with results of this survey are problematic. Relatively few cetacean studies have been conducted near Kauai and Niihau compared to the other major Hawaiian Islands. In addition, most studies there have focused on wintering humpback whales (e.g., Smultea et al. 1994, 1995, Smultea and Kieckhefer 1995; Cerchio 1998; Cerchio et al. 1998; Mobley et al. 1999a,b, 2001a; Frankel and Clark 2002; Mobley 2006; Tiemann et al. 2006). Periodic aerial surveys have occurred off Kauai for all cetaceans although again mostly during the winter humpback season (see below). Small-vessel-based surveys were recently conducted for odontocetes near Kauai in spring (May-June) and fall (October-November) (Baird et al. 2006a, 2008a,b). Unfortunately, the predominant, strong NE tradewind and wave conditions with Bf >4-5 typically preclude effective visual observations in the offshore waters of Kauai, Niihau, and the Kaulakahi Channel and sighting rates/densities there are generally low (e.g., Au et al. 2000; Mobley et al. 2000; Norris et al. 2005; Mobley 2006, 2007; Barlow 2006; Baird et al. 2008c). Such conditions reduce sighting effectiveness (e.g., Barlow et al. 2001; Buckland et al. 2001; Barlow and Gisener 2006).

The most extensive systematic data available from Kauai and Niihau have been collected almost yearly since the 1990s during line-transect aerial surveys. Much of this work has occurred primarily during winter off the north shore of Kauai and has often involved monitoring the distribution and abundance of humpbacks and other marine mammals and sea turtles relative to Navy training and other anthropogenic activities (e.g., Mobley 2001, 2002, 2003, 2004a,b, 2005, 2006; Mobley et al. 1996, 1999a,b, 2000, 2001b, 2005; Smultea et al. 2008b). Relatively few cetaceans, mostly odontocetes, have been seen in the offshore, windward survey areas up to 25 nm from shore; it is unclear whether this is due to actual low densities or poor sighting conditions.

Mobley (2004) reported a summer/fall (July-November) sighting rate of 0.011 sightings/nm (0.006 sightings/km) in 2002 in the BARSTUR and BSURE Navy ranges northwest of Kauai and Niihau; this figure was based on 1520 nm of systematic aerial survey effort during 10 surveys and a total of nine odontocete sightings. In comparison, our vessel-based sighting rate per 474 nm of systematic survey effort was nearly twice as high at 0.019 sighting/nm within and near the Kaulakahi Channel.

Vessel-based surveys for marine mammals are particularly lacking in deep offshore waters of Kauai and Niihau in the summer. Since early 2000, small-vessel-based surveys have been conducted in the Kaulakahi Channel between Kauai and Niihau during spring and fall (Baird et al. 2006a), and recent related publications provide the first comprehensive distribution and occurrence study of rough-toothed and common bottlenose dolphins near Kauai (Baird et al. 2008a,b). NOAA Fisheries conducted a comprehensive large-vessel survey of the entire Hawaiian Island chain from August to November 2002 (Barlow 2003, 2006; Barlow et al. 2004). However, minimal effort occurred in the HRC and effort off Kauai was limited to one survey line ~30 nm north of Kauai (Barlow 2003, 2006; Barlow et al. 2004). In addition, a week-long systematic visual-acoustic survey for marine mammals occurred in and near the Kaulakahi Channel in February 2005 (Norris et al. 2005; Rankin et al. 2007).

The continued anticipated accumulation of past and future survey data on marine mammals and sea turtles in the HRC through the Navy's proposed monitoring plans is expected to contribute to the existing database, facilitating future comparisons and assessments of potential effects from Navy activities including mid-frequency sonar. In light of the above, data collected herein contribute to the small existing database on summertime distribution and occurrence of cetaceans near Kauai and Niihau. We were fortunate during our survey to encounter Bf 0-3 during ~35% of the effort, facilitating sightings that otherwise are unlikely to have been made during higher Bf conditions (Tables 2 and 3, Figure 2).

Summary and Relevance of Survey Results

This study contributes the following information relative to the goals identified in the SOW and the Navy's draft monitoring plan for the Hawaiian Islands (Navy 2008b).

- We further demonstrated and supported the findings of Smultea et al. (2008a) that opportunistically "shadowing" or "following" Navy exercise vessels at a safe distance (>3 nm) for extended periods (8-10 hours) is possible, at least under the circumstances we encountered. It was also possible, under these circumstances, to conduct four focal follows of delphinids while within view of Navy vessels.
- We demonstrated that scan sampling can be used to systematically collect behavioral state and event data on focal groups of delphinid species in the presence and absence of Navy activities. This behavior was influenced by the presence of the *Searcher* as indicated by the high proportion (eight of nine groups) of bowriding dolphin groups.
- Results of focal sessions provide some limited and preliminary information on behavioral time budgets of the seven focal dolphin groups as follows. Note, however, that focal follows lasted >50 min for only three of the seven focal follows; one lasted 20 min, and the remaining three were 4-7 min long. Focal sessions >30-60 min are desirable to provide more detailed behavioral information.
    - In general, travel was the most frequently observed behavior state. For five of the seven focal groups, travel without surface activity occurred during >75% of the respective scan samples. For the remaining two groups, travel comprised 31-39% of the behavioral time budget.
    - Surface-active travel was also common, and occurred among five of the seven focal groups, proportionally representing from 9-61% of the scan samples.
    - Milling (without surface activity) was infrequently observed and was seen only among three groups and only during <8% of the total scan samples for each group. Although milling with surface active-behaviors was observed only twice, for one group of rough-toothed dolphins, it comprised 32% of 56 1-min scans; the latter group was believed to be foraging at these times. Probable foraging was also observed among another group of rough-toothed dolphins.
    - Bowriding occurred across all three species observed: rough-toothed, bottlenose, and spinner dolphins. Bowriding by some individuals occurred during ≥50%of the 1-min scan samples for all six groups that bowrode.
- We successfully collected numerous digital photographs and/or video footage of six delphinid focal groups, four while within view of Navy vessels. Although beyond the scope of this study, further analyses of these data may be useful for a number of applications relevant to assessing potential impacts of Navy activities on marine mammals. These include photo-ID of individuals to assess potential changes in residency/site fidelity, distribution, and association patterns. Detailed transcription of video-taped behavior provides a more-detailed database on the behavior of delphinids in this area for which there are very few previous data. The greater detail and accuracy facilitated by recording behavior to videotape may reveal subtle changes in behavior that are not evident during *in situ* observations and from associated field notes, as found in studies of other cetaceans relative to anthropogenic activities (e.g., Malme et al. 1983, 1984; reviewed in Richardson et al. 1995). Videotape also reduces the potential for observer error during field behavioral observations as taped sessions can be reviewed repeatedly. Examination of videotape also allows for more accurate measure and quantification of some behavioral variables that can be indicative of stress, including inter-individual body lengths; the latter variable can be measured relatively from the video tape using calipers (Smultea and Wursig 1995).

- It is not possible herein to assess behavior of observed cetaceans relative to potential received levels of sonar transmissions during the survey. We were not provided transmission times or other relevant sound data as the Navy plans to analyze these data at a later time. However, time-stamped videotaped behavior and other data collected during this survey may later be useful in identifying any potential behaviors correlated with received levels of Navy underwater transmissions.

- The sample size collected during this study is too small to allow meaningful quantification and interpretation of potential behavioral effects of Navy activities. However, some general relevant observations follow.

  - Delphinids were seen on three days when Navy vessels were within view and on three days when they were not in view. Thus, some delphinids occurred within the general survey area during ongoing Navy activities.

  - No dead or injured cetaceans or sea turtles were seen during the survey. In addition, no unusual behaviors or potential "reactions" other than approaching the *Searcher* to bowride and in one instance, apparently watching while passing the *Searcher*, were evident (Tables 3 and 4). Dolphins bowrode the *Searcher* during eight of the total nine sightings and on all six days of the survey. Bowriding commonly occurs among these three dolphin species (rough-toothed, bottlenose, and spinner) (e.g., Reeves et al. 2002; Baird et al. 2008a; Jefferson et al. 2008).

- As expected, sighting rates were higher during Bf <4 than during Bf 4-6, as similarly reported during small-vessel surveys off Kauai by Baird et al. (2006a). However, the total sample size (n = 9 sightings) was very small and other unexamined factors influence the probability of sighting cetaceans as well (e.g., Barlow et al. 2001; Buckland et al. 2001).

- Data from the three rough-toothed dolphin sightings contribute to the little that is known about this species in Hawaii. This information is compared below to data reported by Baird et al. (2008a) for 16 rough-toothed dolphin groups seen off Kauai/Niihau during 2,923 nm of small-vessel (6-18 m) surveys in May-June 2003 and October-November 2005; note that the latter surveys were biased towards deep-water contours where target species were most likely to be encountered.

  - The three groups were sighted over waters ~900-1800 m deep near a steep 1000-1500 m contour over an apparent underwater "canyon" based on bathymetric data (Figure 2). Baird et al. (2008a) reported that sighting rates for this species off Kauai/Niihau and the Island of Hawaii were highest where depth was >1500 m. Interestingly, most of Baird et al.'s (2008a) sightings off Kauai/Niihau were concentrated near the same area as reported herein.

  - Probable foraging behavior was observed (n = 2 of 3 groups) as similarly reported by Baird et al. (2008a) off Kauai/Niihau. The underwater canyon feature may serve to concentrate prey consumed by rough-toothed dolphins. Rough-toothed dolphins prey on cephalopods and fish, including large fish such as mahimahi (Jefferson et al. 2008).

  - Baird et al. (2008a) reported that rough-toothed dolphins frequently bowrode off Kauai/Niihau. However, Baird et al. (2008a) noted that 13% of their 16 sightings off Kauai/Niihau avoided their research vessel. We did not observe any such avoidance behavior from the three groups we approached as all three bowrode the *Searcher* for extended periods.

  - Baird et al. (2008a) found that group sizes off Kauai/Niihau and the Island of Hawaii ranged from 2-90 dolphins, with larger groups seen off Kauai/Niihau (median group size 11). In comparison, the three groups we observed ranged in size from ~12-85 individuals (mean = 40) (Table 3).

- Using two sets of Big Eyes in addition to a naked-eye observer on the *Searcher* was useful in detecting and tracking sightings and identifying them to species during conditions of Beaufort sea state <6 and limited swell conditions as reported previously by Smultea et al. (2007, 2008a). Four of the nine total cetacean sightings were initially made with the Big Eyes (vs. the remaining five made initially with the naked eye).

- Coordinating and communicating in real time with RIMPAC aerial survey observers was beneficial. The aerial observers could communicate localized survey conditions in other parts of the survey area to the *Searcher* observers; this aided in making efficient and reasonable *in-situ* decisions on where to survey to avoid poor conditions. These communications also served as a ground-truthing mechanism for comparison of species identification, group size and composition, behavior, and environmental/sighting conditions between vessel- and aircraft-based observers. Aerial observers also could alert vessel observers about nearby sightings to allow confirmation of species and extended focal observations as the aircraft air time was limited by fuel and related time constraints. It is recognized that these communications compromise the independence of visual observers with respect to line-survey transect protocol and density estimates. However, per the SOW, a higher priority during these monitoring surveys was to locate and assess the behavior and state of marine mammals near Navy activities.

- Data collected during this study contribute to baseline data important in developing and implementing effective marine mammal monitoring for future planned Navy activities identified for the HRC in the 2008 Hawaii Range Complex FEIS/FOEIS and Hawaii Range Complex Draft Monitoring Plan (Navy 2008a,b.

- This survey helped to identify both limitations of and recommendations for future RIMPAC and other monitoring-related efforts as discussed in the following section.

Section 5 Recommendations

As requested in the SOW, this section provides a list of recommendations for future monitoring efforts relative to what was learned during this survey. Recommendations focus on experiences during this survey and those from recent similar past monitoring surveys in the HRC (e.g., Norris et al. 2005; Mobley 2006, 2008; Smultea et al. 2007, 2008a), as well as other relevant professional experience. The recommendations are briefly summarized below.

- Host a Monitoring Workshop. It continues to be highly recommended that a workshop be held on behalf of the Navy to identify, assess and synthesize the effectiveness and feasibility of various monitoring approaches to be implemented during Navy activities as discussed in the Navy's associated FEIS/FOEIS and draft monitoring plan (Navy 2008a,b). Details of these recommendations were provided in Smultea et al. (2007, 2008a). A workshop would also help establish consistent data-collection protocol to ensure that appropriate analyses can be conducted and compared across studies to allow photo-ID, behavioral assessment, potential density estimation, etc. A workshop also facilitates networking and sharing of data and expertise. Other federal agencies have conducted similar needs workshops including NOAA, MMS, etc., for other topics and areas as related to assessing impacts on cetaceans and sea turtles.
- Develop a Photo-ID Catalog. Photos and video collected during this and other Navy-sponsored surveys can be used to photo–document, build in-house, and contribute to other photo-ID catalogs of cetacean species in the HRC. Developing and maintaining this database is important for comparing sightings across and within monitoring studies. It is especially important to collaborate with other researchers to add/compare photos to existing catalogs to maximize what can be learned from the data. Photo-IDs collected during other Navy-sponsored Hawaiian monitoring surveys (e.g., Smultea et al. 2007, 2008a) have been shared with other researchers (including R. Baird). This has resulted in matching of individuals across regions (R. Baird, pers. comm.), contributing to further understanding of residency and movement patterns within the HRC.
    - For example, it can potentially be determined if known individuals remain within or are displaced from a project area during Navy activities if it has been previously established (i.e., through photo-ID or tagging) that they regularly remain there. As a result, correlations of effect/no effect are stronger. While tagging is very important in contributing such information, unlike photo-ID studies, tagging is usually limited to small sample sizes as the logistics, equipment, and tracking are expensive.
    - Photo-ID data can be used to calculate regional population estimates using mark-recapture analyses (e.g., Darling and McSweeney 1985; Calambokidis et al. 2007; Baird et al. 2008a). These data are relevant for assessing whether regional populations are possibly affected by Navy activities.
    - Photo-ID may be especially useful for little-known local Hawaiian species and populations, such as rough-toothed dolphins, false killer whales, pilot whales, pygmy killer whales, beaked whales, *Kogia*, sperm whales, spinner dolphins, bottlenose dolphins, and killer whales. For example, photo-ID catalogs have been developed for some of these species in the Hawaiian Islands and the results have revealed important life history information, including site fidelity, providing a baseline for assessing potential anthropogenic effects (e.g., Baird 2005; Baird et al. 2006a,b, 2008a,b,c,d; McSweeney et al. 2007, 2008). With relevance to this survey, Baird et al. (2008a) reported that rough-toothed dolphins appear to be mostly resident to the Kaulakahi Channel of Kauai based on photo-ID studies; results herein (albeit a small sample size), revealed a similar distribution pattern for this species.
- Continue "Shadow"-Monitoring Near Navy Vessels. This approach should continue to be implemented when feasible/safe relative to Navy activities, given its successful implementation in

two recent Navy-sponsored vessel-based monitoring surveys (herein and Smultea et al. 2008a). This allows data collection on animals at various distances and received sound levels from the Navy source vessel that are out-of-sight of observers on the source vessel. In cases where a Navy vessel(s) moves out-of-sight faster than the survey vessel can follow, the survey vessel should remain in the vicinity where the Navy activities occurred to identify any potential changes in animal behavior or disposition, including "post-Navy activity" behavioral observations.

- Summarize and Obtain PDF Reference Library on Methods Used to Assess Sonar Effects on Marine Mammals and Sea Turtles. This review would be important and useful specifically for the Navy for reasons stated below. The end result could be a summary paper including references and recommendations for the most effective approaches in terms of feasibility, cost, and scientific significance relative to the Navy's short- and long-term monitoring plans, Training Area/Range locations, types of Navy activities, and abundance/density of marine mammals and sea turtles in areas of interest. The latter would refer to the Navy Marine Resources Assessments (MRAs) prepared for the various Navy areas as applicable. Notably, due to the growing concerns and interest focused on this topic, the associated literature requires frequent updating and includes many difficult-to-obtain unpublished reports. This review would
    - \- provide a readily accessible baseline for comparison specifically with data collected during Navy monitoring programs. In particular, the behavioral effects of sonar are of special concern to NMFS and non-government organizations (NGOS), especially since recent studies emphasize that injury to beaked whales exposed to underwater sonar may be related to behavioral reactions that lead to mortal injury (e.g., Rommel et al. 2006; Zimmer and Tyack 2007; Southall et al. 2007)..
    - facilitate development of a behavioral ethogram supported by peer-reviewed scientific documents to define "unusual" and "anomalous" behaviors of various species, as identified and required in the SOW and by NMFS.
    - identify gaps in existing available data.
    - support development and implementation of monitoring techniques, protocols, and approaches suitable for the various types of Navy activities and exercise areas.
    - provide a full original cross-referenced library (e.g., in Endnote or other database) on the topic in pdf form to refer to, of items commonly cited (or not) in EISs relative to impact areas, etc. This would be a companion to existing library(ies) for MRAs
- Review Data on Navy Activities and Strandings. Compilations and analyses of data on marine mammal strandings in Hawaii and other Navy ranges are limited (e.g., Mazzuca et al. 1998, 1999; Maldini et al. 2003; Ligon et al. 2007; Mobley 2007). There are even fewer available reports comparing locations and the nature of Navy activities concurrent to strandings in the Pacific (e.g., NOAA and Secretary of the Navy 2001; NMFS 2005; Southall et al. 2006). Given the elevated public, regulatory, and conservation concerns regarding this issue surrounding many stranding events, yit is prudent to examine historical data to better understand the evidence or lack thereof for correlating strandings with Navy activities. It is known that many cetaceans strand due to natural causes (e.g., Perrin and Geraci 2002; Geraci and Lounsbury 2005), while other strandings have been correlated with military actions at sea (e.g., Balcomb and Claridge 2001; Brownell et al. 2004; Fernández et al. 2005).
- Obtain Behavioral Data Collection Software. WinCruz as used during this and past Navy monitoring surveys in the HRC (e.g., Smultea et al. 2007; 2008a) is considered awkward and inadequate for the purposes of behavioral monitoring surveys. This has been the recommendation since previous surveys (Smultea et al. 2007; 2008a). It is recommended that a specially-designed behavioral data

collection software program be obtained to facilitate faster and more efficient and accurate collection and analysis of this type of information (e.g., see Smultea et al. 2008a for further detail).

- Evaluate Feasibility of Stress Hormone Collection. It is recommended that the feasibility of collecting blood samples from a representative sample of cetaceans ideally before, during and after exposure to mid-frequency sonar transmissions during Navy activities be considered and evaluated, including consultation with experts in this field.

- Tag additional cetacean species that exhibit site fidelity in Navy sonar activity areas before, during, and after exposure to these sounds. Acoustic-, location-, and behavior-recording tags would potentially record received levels of sound near the animals, the animal's and cohorts' sounds, potential dive and respiration responses, locations and movements, etc. This approach was implemented during the 2008 Navy RIMPAC exercises in the Hawaiian Islands (e.g., Baird et al. 2008c). The feasibility of tagging cetaceans opportunistically from other visual survey vessels, such as the *Searcher* as described herein, should be considered. Tagging should include rough-toothed dolphins given their site fidelity in Hawaii as well as other apparently resident species that have been successfully tagged such as false killer whales, melon-headed whales, pilot whales, and beaked whales (e.g., Baird et al. 2008a,b,c,d; McSweeney et al. 2007).

- Conduct a cost-effectiveness analysis of monitoring approaches. This type of analysis would objectively evaluate and quantify the cost-effectiveness of various monitoring techniques to answer the Navy's monitoring objectives/questions related to training events. Such analysis combined with consultation with a professional statistician could determine whether an objective/question can be answered with statistical significance given the anticipated sample sizes and the anticipated cost of obtaining the data. For example, the utility vs. cost of photo-ID vs. various tagging techniques could be evaluated to assess which approaches and in what combination would be most cost-effective but could also feasibly and reasonably address Navy monitoring goals. A similar comparison could be made between vessel-based and aerial surveys, etc.

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APPENDIX C- CIVILIAN SCIENTIFIC MARINE MAMMAL TAGGING- PART 1

MULTI-SPECIES CETACEAN SATELLITE TAGGING TO EXAMINE MOVEMENTS IN RELATION TO THE 2008 RIM-OF-THE-PACIFIC (RIMPAC) NAVAL EXERCISE

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October 19, 2008

A Quick Look report on results of tagging efforts
undertaken under Order No. D1000115 from
the Woods Hole Oceanographic Institution

Burgess tag placed on pilot whale July 2008
(Photo courtesy of Cascadia Research Collective)

Introduction

The Rim-of-the-Pacific (RIMPAC) naval exercise is a biennial multi-week multinational naval exercise that has been undertaken around the main Hawaiian Islands since 1968. Immediately prior to the 2004 RIMPAC exercise a group of 150-200 melon-headed whales, *Peponocephala electra*, a species that is typically found in deep waters in Hawai'i, entered Hanalei Bay on the north shore of the island of Kaua'i, and remained in the bay for more than 24 hours (Southall et al. 2006). While the exact cause of the event remains unknown, a review of available evidence concluded that active sonar transmissions by naval vessels prior to and during the period when the whales were inside the bay were a likely, if not plausible, contributing factor (Southall et al. 2006). Considerable uncertainty remains regarding the cause(s) of this event in part because no information is available on where the group of melon-headed whales was prior to the initiation of sonar use. This example illustrates the difficulty in understanding, assessing, and/or predicting the potential reactions of cetaceans to naval sonar use. Such assessment is problematic for a variety of reasons, including: limited observations of cetaceans before and during active sonar operations; inter-specific variability in reactions (beaked whales appear to be more susceptible to impacts than other cetaceans, see Cox et al. (2006) for a review); likely variable reactions depending on type and number of sound sources and the proximity of individual cetaceans to the sound sources; and potential intra-specific variability in reactions.

Monitoring movements or behavioral reactions of individual cetaceans to large scale naval sonar exercises is particularly difficult due to the wide spatial scale of such exercises, the presence of operations during night-time hours and during sea conditions that preclude effective visual monitoring, and due to uncertainty regarding the distances at which individuals may show reactive movements to sonar use. In theory, the most powerful method to examine movements of individuals in relation to sonar exercises would be to have individuals of multiple species instrumented with tags that determine locations of the individuals prior to the exercise to monitor movements before, during and after the exercise. The recent development of small remotely-deployed satellite tags for use on small and medium-sized cetaceans (Andrews et al. 2008) has allowed for such an operation to be undertaken.

Since 2006 small remotely-deployed satellite tags have been used to examine movements of five species of cetaceans in waters around the main Hawaiian Islands. Prior to the RIMPAC 2008 exercise these tags had been deployed in Hawaiian waters on three Blainville's beaked whales (*Mesoplodon densirostris*), three Cuvier's beaked whales (*Ziphius cavirostris*), four false killer whales (*Pseudorca crassidens*), five short-finned pilot whales (*Globicephala macrorhynchus*), and three melon-headed whales (Schorr et al. 2007; Baird et al. 2008a; Hanson et al. 2008; Schorr et al. 2008), providing a basis of information against which future results can be compared.

As part of a larger effort to examine the diving behavior of deep diving odontocetes and characterize their foraging habitat, attempts were made to deploy medium-term satellite tags on a number of species of small and medium-sized cetaceans around the main Hawaiian Islands in June and July 2008, in association with the 2008 RIMPAC exercise. Here we provide a quick look at the results of these efforts and discuss factors that need to be taken into account for planning of future efforts to use satellite tags to monitor movements in relation to naval exercises in Hawaiian waters.

Results and Discussion

Information on the methods used are presented in Appendix 1. Over 31 field days between June 25 and July 28, 2008, small-boat operations based first off Kaua'i (7 days) and then Hawai'i (24 days) covered 1,964 nm (3,637 km) of trackline and resulted in 110 sightings of 13 species of cetaceans (Table 1). Tagging efforts resulted in the deployment of 33 medium-term satellite tags on four species of odontocetes over this period, the largest number of satellite tags ever deployed on multiple species of cetaceans in this short of a time period (Table 2). Species tagged were: Blainville's beaked whales (five individuals), melon-headed whales (five individuals), false killer whales (seven individuals) and short-finned pilot whales (16 individuals). Average transmission duration of the tags was 37 days (median = 34 days, n = 33), allowing for examination of movements before, during, and in many cases after the completion of the RIMPAC naval exercise.

This effort has demonstrated the feasibility of this approach to examine movements of individuals in relation to a large scale naval exercise, as well as provide a basis for future planning of similar efforts. In addition, these tags have provided unprecedented information on movements of individuals of four species in relation to the main Hawaiian Islands. Movements of tagged individuals have spanned an area greater than 13,000 km^2 (Figure 1). Analyses of movements are ongoing, and this data set will allow for an assessment of movements in relation to mid-frequency sonar use when sonar data are provided by the Navy.

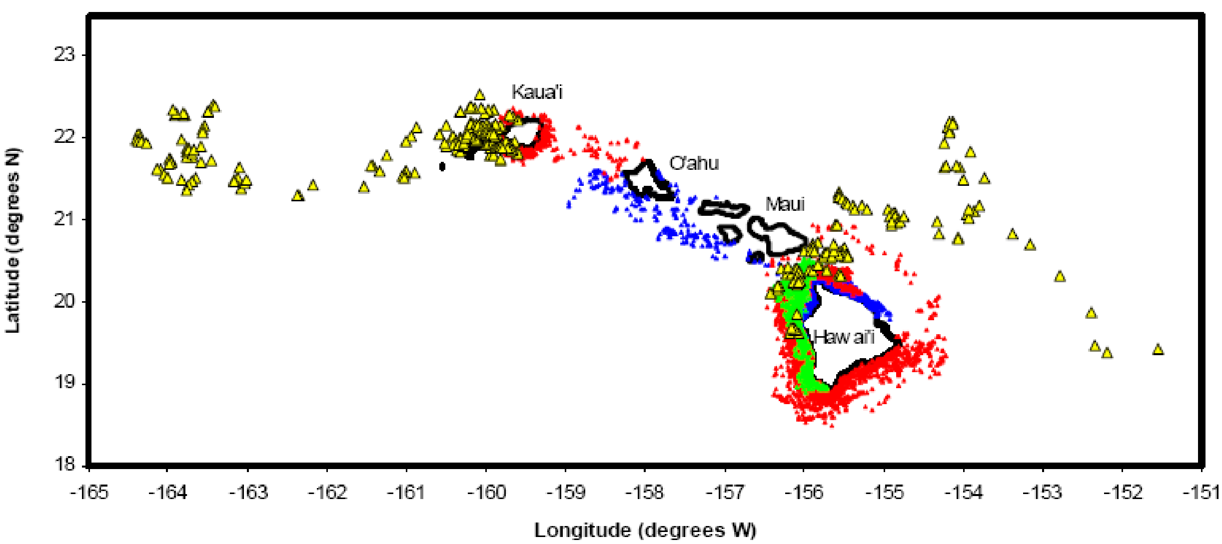

Figure 1. Map showing locations of satellite-tagged cetaceans tagged during June and July 2008. All individuals were tagged either off S.W. Kaua'i or W. Hawai'i. Species: false killer whales – blue; Blainville's beaked whales – green; short-finned pilot whales – red; melon-headed whales – yellow outlined with black. Some points overlap so that not all locations of some species (all except melon-headed whales) may be visible.

Three of the four species remained associated with the main Hawaiian Islands over the duration of tag attachments. Only melon-headed whales exhibited large scale directional movements away from the islands, with two individuals moving greater than 400 km from the initial tagging locations in 18 days, one of which reached a maximum distance from the main islands of 430 km 10 days after tagging (Figure 1). Blainville's beaked whales remained associated with the island off which they were tagged for the entire duration that location data were received (median = 63 days, maximum = 71 days). False killer whales remained associated with the island off which they were tagged for approximately 50 days before making large-scale movements among the main Hawaiian Islands (up to 330 km from the initial tagging location), although remaining within 83 km of shore (Figure 2). One short-finned pilot whale tagged off Kaua'i largely remained associated with the island with one week-long transit to/from O'ahu over a 44-day period. Short-finned pilot whales tagged off the island of Hawai'i remained generally associated with the island.

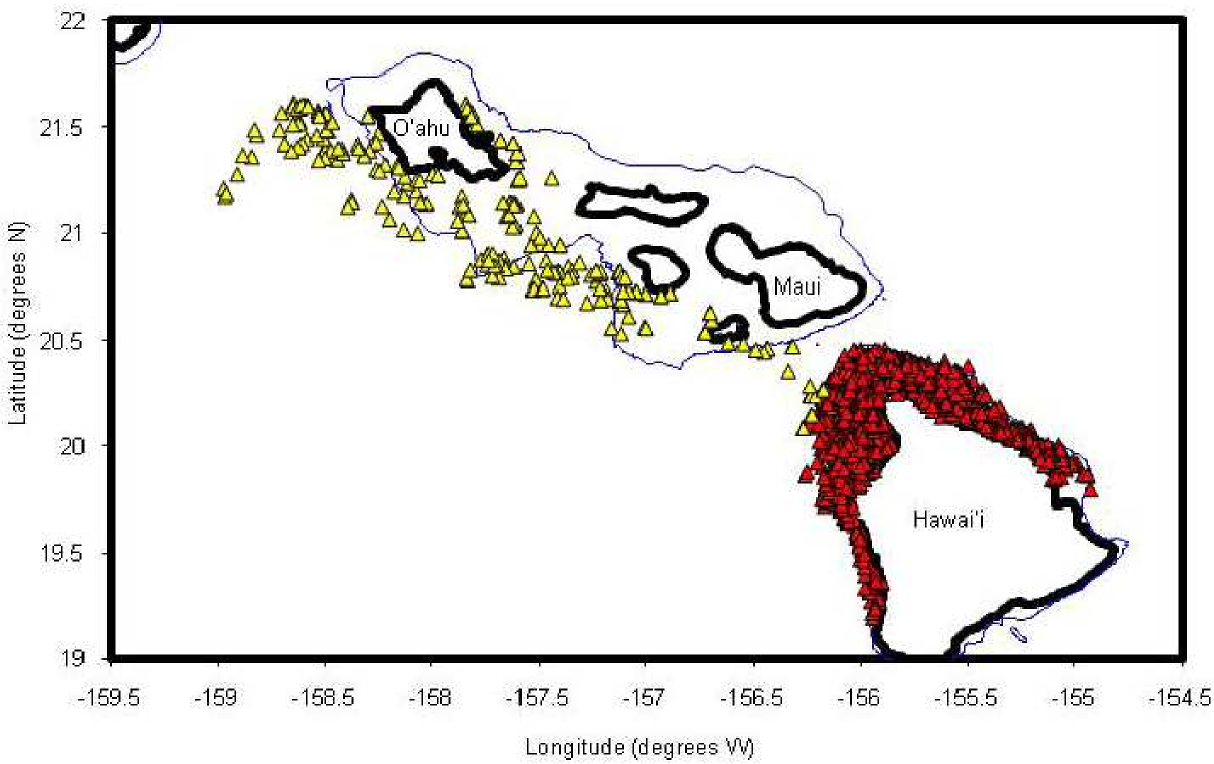

Figure 2. Map showing locations of satellite tagged false killer whales from July 16 through September 30, 2008. The blue line represents the 1000 m depth contour. Only two tags were still transmitting when tagged individuals left the vicinity of the island of Hawai'i, one on September 11 and one on September 14, 2008. Points for these two individuals, starting on those dates, shown in yellow.

In addition to the satellite tag deployments, dive data (using suction-cup attached data logging tags) were collected from two Blainville's beaked whales and one false killer whale, and acoustic data were collected from two short-finned pilot whales tagged with Burgess BioAcoustic Probes. Over 48,000 photographs were taken for contribution to individual photo-identification catalogs of 10 different species, and 30 skin samples were obtained for contribution to stock structure analyses.

While the efforts during RIMPAC '08 demonstrated the feasibility of obtaining movement information of multiple species of cetaceans during a large-scale naval exercise, a variety of considerations need to be taken into account when planning for future efforts along these lines. Tagging operations off the island of Kaua'i utilized a charter vessel (a 6.7 m SeaCat), while off the island of Hawai'i tagging operations utilized a research vessel (a 8.2 m Boston Whaler) owned by a collaborating organization that had been custom-modified specifically for tagging (with an elevated control tower and bow pulpit), and which had been used successfully in numerous previous tagging operations. In seven field days off Kaua'i, four species of cetaceans were encountered and tags were deployed on two species (melon-headed whales and short-finned pilot whales). The overall number of sightings and the number of species sighted was limited primarily by sea conditions, while the ability to deploy additional tags on pilot whales that were encountered was limited by the tagging platform used during the Kaua'i effort. In 24 field days off Hawai'i, 13 species were observed and 29 tags were deployed on four species. Tagging operations for pilot whales off Hawai'i were curtailed after the first week of field effort due to the limited availability of satellite tags. During 24 days of field effort off Hawai'i there were 21 encounters with pilot whale groups that did not contain satellite tagged individuals. If the availability of satellite tags were not limited it would have been feasible to deploy tags on twice as many groups.

In order to have a reasonable probability of being able to assess the impact of a naval exercise on the movement patterns of cetaceans (monitored using remotely-deployable satellite tags), at least four conditions have to be met:

A sufficient number of groups of the target species need to be encountered prior to the start of an exercise.

- A sufficient number of tags need to be deployed on individuals of the target species prior to the start of the exercise, in order to have sufficient sample sizes for each species.

- The tags need to remain attached and continue to transmit through the period of the exercise.

- The tagged individuals need to either remain in the general area of tagging (if the exercise is to occur in that area) or move into the exercise area.

There were a number of lessons learned from this and prior tagging projects in Hawaiian waters relevant to these factors:

- The amount of effort required to find a sufficient number of groups will depend on the number and type of tagging platforms, the sea conditions, and the species-specific encounter rates. Long-term average encounter rates and typical sea conditions in different areas can be used to predict the likelihood of encountering different target species. Depending on the target number of tag deployments for each species, the amount of effort required can be determined in advance for different target areas. In Hawaiian waters, working conditions for tagging operations are good off the west side of the island of Hawai'i but are generally poor off all other islands. Thus the number of species as potential tagging targets will be greater off the island of Hawai'i than elsewhere, and toobtain similar sample sizes the amount of effort off other islands will have to be substantially greater than off Hawai'i.

• The ability to approach individuals close enough to deploy tags is influenced by the specific configuration of the tagging platform (height of the driver above water to be able to track animals underwater, vessel maneuverability, presence of a sturdy bow-pulpit to provide a stable platform for tagging), the skill of the vessel operator, the skill of the tagger, the sea conditions, and the general approachability of different species. Tagging vessels with a high steering platform and bow pulpit are not readily available off islands other than Hawai'i. Vessel charters that allow individuals other than owner/captain to drive the vessel are difficult to find, yet the experience of the vessel operator driving small vessels around cetaceans for the purposes of tagging is critical in deploying tags, and should be of primary importance when choosing a suitable tagging vessel. Similarly, there are a limited number of individuals who have the skill and experience to successfully deploy satellite tags in a variety of sea conditions and circumstances. All of these factors may limit the ability to deploy sufficient numbers of tags off different islands to assess impacts, and should be taken into account in long-term planning for future efforts.

• Duration of tag function varies by species, with small fast moving species appearing to have shorter attachment durations than large slow moving species. While we are often unable to assess attachment duration accurately, as it requires re-locating a tagged animal immediately after a tag falls off, transmission duration varied considerably: melon-headed whales, median = 10 days, maximum = 18 days; false killer whales, median = 34 days, maximum = 76 days; short-finned pilot whales median = 35 days, maximum = 72 days; Blainville's beaked whales, median = 63 days, maximum = 71 days. Transmission duration is unlikely to be related to pressure, as the deepest-diving species, Blainville's beaked whales (Baird et al. 2008b; Baird unpublished) had the longest average transmission duration, thus it is more likely that the shorter duration attachments for other species reflect tag loss. Maximum transmission duration is also limited by duty cycling of the transmitters due to battery capacity. During June/July 2008 duty cycling chosen varied by species taking into account diving behavior and the need to get higher resolution movement data during the RIMPAC exercises.

• Movement rates and patterns vary both by species (e.g., pilot whales and beaked whales show much more limited movements than melon-headed whales), and within-species (e.g., tagged false killer whales remained in localized areas for extended periods followed by long-range rapid movements to new areas). Such movement patterns must be taken into account when planning for future efforts to examine movements of cetaceans in relation to naval exercises. For example, the relatively rapid directional movements of melon-headed whales documented suggest that exposure of animals to sonar in the area tagged is unlikely to occur unless the sonar operations were to take place within a few days of tagging, while for short-finned pilot whales and Blainville's beaked whales, movements over periods of days to weeks were generally limited to the area tagged.

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Table 1. Summary of sightings by species during June and July 2008. Depths of sightings determined using ArcGIS.

Species	# of sightings	Group size median (range)*	Depth (m) median (range)*
Short-finned pilot whale	43	19 (2-50)	1445 (1021-3085)
Rough-toothed dolphin	23	7 (2-70)	1768 (970-2706)
Pantropical spotted dolphin	7	45 (4-120)	2284 (121-4692)
Bottlenose dolphin	7	12 (5-34)	121 (70-880)
Dwarf sperm whale	5	1 (1-2)	1268 (106-4727)
Melon-headed whale	4	320 (220-340)	1633 (1211-1965)
False killer whale	4	22 (13-30)	634 (109-1485)
Spinner dolphin	4	12 (10-25)	13 (5-217)
Blainville's beaked whale	2	9, 11	946, 1492
Cuvier's beaked whale	2	1, 4	1400, 2383
Risso's dolphin	2	1, 4	1366, 3450
Striped dolphin	2	20, 35	2495, 4790
Sperm whale	2	9, 13	4220, 4645
Unidentified odontocetes	3	1 (1)	2131 (1624-2708)

Table 2. Summary of satellite tags deployed during June and July 2008.

Species	# individuals tagged	Transmission duration (days) median (range)
Melon-headed whale	5	10 (3-18)
Blainville's beaked whale	5	63 (45-71)
False killer whale	7	34 (6-76)
Short-finned pilot whale	16	35 (12-72)
Total	33	34 (3-76)

Appendix 1. Methods
Tags and tag programming

Tags were constructed with a SPOT5 “Fin Mount” (Wildlife Computers, Redmond, Washington, USA), Argos-linked location-only Platform Transmitter Terminal (PTT). The Fin Mount configuration includes two fiberboard plates with helicoils inserted at each end for dart attachment, with the PTT and plates cast in epoxy. Dimensions of the tags were 63 x 30 x 21 mm. Each tag incorporated two 6.5 cm (for beaked whales, false killer whales or short-finned pilot whales) or 4.5 cm (for melon-headed whales) long medical-grade titanium darts that were screwed into the holes in the bottom of the tag. The darts were designed to penetrate the connective tissue in the dorsal fin and remain embedded with a series of backwards facing ‘barbs’ which acted as anchors for the darts (see Andrews et al. 2008). Weight of the entire package was approximately 49 g. The transmitter itself was designed to remain external to the body to reduce the invasiveness of the technique.

Duty cycling (maximum number of transmissions/day, hours per day transmitting, minimum time lag between transmissions) was determined taking into account theoretical battery capacity (35,000 transmissions), species-specific diving/surfacing patterns, timing of tag deployment during the study, and timing of satellite overpasses. Beaked whale tags were set to transmit for the greatest number of hours per day due to their long dive durations (which may exceed one hour), thus increasing the likelihood of locations being received over a greater portion of each day. Details of duty cycling are given in Table A1. Transmitters were duty-cycled to turn on during times of the day when satellite overpasses were most likely to occur. The likelihood of satellite overpasses were determined using the pass predictions generated from the Argos website. This predicts the overpass time for all satellites currently orbiting and capable of receiving uplinks from the PTT’s in the general location of deployment. Tags can only be programmed to transmit in hourly blocks, and duty cycling was chosen to take advantage of hours where multiple satellites were passing overhead, with an emphasis placed on obtaining uplinks spread throughout the day. Tags deployed on short-finned pilot whales up to July 8, 2008, were set to transmit daily for the first 43 days and then every second day thereafter.

Field work

Field work was conducted based out of Kekaha, Kaua‘i from June 25 through July 1, 2008, and out of Honokohau Harbor, Hawai‘i from July 2-27, 2008. Off Kaua‘i a 6.7 m Sea Cat was used, and off Hawai‘i the primary research vessel was a 8.2 meter Boston Whaler with a custom-built bowsprit. Searches were conducted in a non-random, non-systematic manner, with effort spread over as broad a range of depths as possible while remaining in areas with sea states of Beaufort 3 or less, and which could be readily reached from Honokohau Harbor. Efforts were made to minimize overlap of survey tracklines among days. For periods when the NOAA R/V *Oscar Elton Sette* was operating in the area, search patterns were modified to minimize overlap of survey coverage as sightings of target species were shared.

Tags were deployed using a Dan-Inject JM Special 25 (Børkop, Denmark) pneumatic projector with a modified arrow to hold the tag in flight, from an estimated range of 2.5 - 10 m. Tags were attached to the dorsal fin or dorsal ridge area, to take advantage of the strong connective tissue in that region and provide the best location for a clear transmission of the signal when the animal surfaced. Both the target animal and other individuals within the groups were photographed before and during tagging. For beaked whales, the sex of tagged whales was determined using the presence/absence of erupted teeth and scarring patterns. For short-finned pilot whales sex of tagged whales was determined based on relative body size and the size/shape of the dorsal fin. Photographs of tagged whales and companion animals were compared to photo-identification catalogs to determine sighting history, and photographs of previously tagged animals were taken on subsequent days that they were encountered to assess tag attachments

Satellite data acquisition and processing

PTT transmissions were received by a series of NOAA Polar Orbiting Environmental Satellites (Argos user manual[1]). Each satellite has a visible circular 'footprint' of about a 5,000 km-diameter in which it can receive signals from transmitting tags. The polar orbiting path of the satellites means that there are fewer overpasses as you get closer to the equator. In June/July 2008 the total number of satellite passes over the region was between 15-18 times per day. The PTT's signal can only be received by the satellite during its overpass (between 8 and 15 minutes, average of 10), but is dependent on the elevation of the overpass above the horizon. The path of each overpass is not the same elevation above the eastern or western horizon. As a result, some overpasses are so low on the horizon that the period where the satellite may receive signals from transmitting tags is of short duration, and consequently the calculation of accurate location, based on the Doppler-shift principle, is compromised. Within a single overpass, a satellite must receive at least two uplinks from the PTT in order to determine a location, and to improve the accuracy of the location these must be spread out across the duration of the overpass. The more messages received and the longer spread between first and last message during the overpass generally leads to a higher location class (see below).

Transmitter locations received from Argos include a location class (LC) indicating degree of accuracy in the reported position based both on the number of messages received in a single overpass, and the temporal spacing of those messages. LC 3, 2, and 1 each have a set estimate of accuracy; whereas LC 0, A, B, and Z are undefined. Therefore, all locations must be assessed for plausibility before being used to estimate an animal's location (*e.g.* Argos User Manual). We used the Douglas Argos-Filter[2], version 7.06, to assess locations for plausibility, using two independent methods (distance between consecutive locations, and rate and bearings among consecutive movement vectors). The Douglas filter incorporates several user-defined variables in the filtering process, including maximum-redundant distance (Maxredun -- temporally near-consecutive points within a defined distance are kept by the filter), maximum sustainable rate of movement (Minrate – speed in km/hr based on a reasonable rate of movement sustainable for several hours or days), location classes to keep (the filter will automatically keep all LC's of this defined class and higher), and Ratecoef. The Ratecoef assesses locations by looking at the angle created by three subsequent points, and is based on the concept that the animal is unlikely to leave one location, travel towards a subsequent location, and then immediately move back to the same location again. The filter passes or fails a point depending on the distance between locations. Larger angles become suspect (i.e. the filter becomes more conservative) as Ratecoef increases.

The maximum-redundant-distance was set at 3 km (two or more near-consecutive points within 3 km of each other are kept by the filter). The maximum sustainable rate of movement varied by species (Table A1), with rates set to be higher than those typically exhibited by

[1] Available from http://www.argos-system.org/manual
[2] Available from http://alaska.usgs.gov/science/biology/spatial/douglas.html

rates between them due to short amount of time between uplinks to the satellite. All Argos locations of class LC2 and better were automatically retained. Bearing between locations (Ratecoef) was assessed to further eliminate outlying points using a rate of coefficient of 25.

Table A1. Tag characteristics by species

Species	Dart length (cm)	Minimum time lag between transmissions (sec)	Total hours per day transmitting	Max speed used in Argos filter (km h^{-1})
Melon-headed whale	4.5	45	16	15
Blainville's beaked whale	6.5	15	18	10
False killer whale	6.5	30	13	20
Short-finned pilot whale	6.5	30	16 (11 ind), 14 (5 ind)	15

APPENDIX C- CIVILIAN SCIENTIFIC MARINE MAMMAL TAGGING- PART 2

PACIFIC ISLAND FISHERIES SCIENCE CENTER (PIFSC) CRUISE REPORT

CR-08-010

ISSUED 16 SEPTEMBER 2008

VESSEL: Oscar Elton Sette, Cruise SE-08-06 (SE-63)

CRUISE PERIOD: July 10–30, 2008

AREA OF OPERATION: Main Hawaiian Islands, specifically southwest of Kauai, at Penguin Banks and west of the Big Island of Hawaii (Figs. 1–3).

TYPE OF OPERATION: In support of a Pacific Islands Fisheries Science Center (PIFSC) research project to conduct cetacean surveys, make ecosystem observations, and deploy short- term monitoring tags (d-tags) on target species.

ITINERARY:

July 10 Embarked scientists Chapla, Nowacek, Dawe, Bendlin, Ü, Yoshinaga, Thorne, Tyson, Herman, McGregor, Gornik, Ligon, and Blevins. Departed Honolulu at 1000. Transited to the Kauai coastline.

July 11–13 Arrived at the southwestern Kauai coast and conducted cetacean observations. Conducted conductivity-temperature-depth (CTD) casts at the beginning and end of surveys. Transited to Penguin Banks.

July 14 Arrived at Penguin Banks and conducted cetacean survey. Conducted CTD casts at the beginning and end of survey. Transited to the Kona Coast of the Big Island.

July 15-20 Arrived at the west coast of the Big Island of Hawaii and conducted cetacean observations. Conducted tagging operations. Conducted CTD casts at the beginning and end of surveys. Conducted expendable bathythermograph (XBT) casts at tagging locations.

July 17 Transited to area off Honokohau Harbor and disembarked Nowacek, Blevins, and Tyson and embarked Rivers and Wiener at 0800. Conducted tag recovery operation for Robin Baird (CRC). Returned to area off Honokohau Harbor and embarked Friedlaender and Southall at 1730.

July 19 Disembarked Ligon to Cascadia Research Collective (CRC) vessel ("Wild Whale") by PIFSC steel toe.

July 21-22 Transited to area off Honokohau Harbor and disembarked Friedlaender, Ü, Southall, and Rivers at 0830. Conducted missing tag search. Recovered tag at 1750 on July 22.

July 23 Transited to area off Honokohau Harbor and embarked Ü at 0800. Conducted cetacean surveys and fisheries acoustics transect. Conducted CTD casts at the beginning of the survey and the beginning and end of the fisheries acoustic transect.

July 24-28 Conducted cetacean surveys and fisheries acoustics. Conducted CTD casts at the beginning and end of the surveys.

July 25 Conducted tracking operations of two b-probe tags deployed by Robin Baird (CRC). Recovered one tag.

July 26 Conducted acoustic search for second b-probe tag beginning at 0400. Transited to area off Honokohau Harbor and disembarked Dawe, Wiener, and Yoshinaga.

	Embarked Graham, VanAtta, and Yuen. Continued recovery operation of second b-probe.
July 29	Conducted CTD casts at stations from south to north along the coast. Conducted XBT casts between stations. Departed for Honolulu at 1800.
July 30	Arrived Honolulu at 1300.

MISSIONS AND RESULTS:

A. Deploy and recover suction-cup tags (d-tags) on cetaceans in the waters off of the Kona Coast of the Big Island to assess movements in relation to habitat parameters and exposure to operational sounds produced during Navy exercises.

1. Five d-tags were successfully deployed and recovered on individual pilot whales during five different days (July 15–20) off the west coast of the Big Island.

2. Tagging operations were conducted during the time period of Navy exercises, but operational areas were separated by approximately 100 nautical miles.

3. XBT casts were conducted at tagging sites (at the time of tagging).

4. Fisheries acoustics transects were conducted at some tagging sites both day and night (July 23–28).

5. CTD casts were conducted at tagging sites (July 29).

B. Collect line-transect data on cetaceans to develop detection functions for species present in the study area.

1. Modified line transect surveys were conducted off southwest coast of Kauai and the west coast of the Big Island.

2. Eighty-nine groups of cetaceans were detected visually, including pilot whales, melon-headed whales, sperm whales, false killer whales, rough-toothed dolphins, pantropical spotted dolphins, spinner dolphins, and a single Blainville’s beaked whale.

C. Collect biopsy samples for genetic studies of cetacean population structure, if possible.

1. Biopsy samples were collected from seven pilot whales and two bottlenose dolphins using crossbow and Ceta-darts. Additionally, two skin samples were collected from the suction cups of the tagged pilot whales.

D. Collect photo-ID data on cetaceans for cetacean population structure and abundance, if possible.

1. Over 22GB of cetacean photos were obtained for ongoing population discrimination studies.

SCIENTIFIC PERSONNEL:

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Appendix: Principal Data Collected during Cruise SE-08-06

1. Cetacean Observations
    a. Species
    b. Group size estimates
    c. Lat./long. position

d. Environmental (sea state, wind)
e. Photos taken (when possible)
f. CTD casts at beginning/end (when possible)
g. Biopsy samples (when possible)

2. Tagging Operations
a. Species
b. Photo of tagged animal
c. Tag frequency
d. Tag on/off/recovery time
e. Position of tag on animal
f. Reaction of tagged/other individuals
g. Lat./long. location of tagging
h. XBT cast at tagging sight

3. Other
a. Fisheries acoustics backscatter
b. CTD stations at tagging locations (conducted July 29)
c. XBT between CTD stations (July 29)
d. Sea surface temperature
e. Acoustic Doppler current profiler
f. Depth (when not tracking a tagged animal)