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Cruise Report, Marine Species Monitoring & Lookout Effectiveness Study Koa Kai, November 2011, Hawaii Range Complex

Prepared for:
Commander, Pacific Fleet



Prepared by:

Dr. Stephanie Watwood – Naval Undersea Warfare Center Division, Newport
Ms. Meredith Fagan – Naval Facilities Engineering Command, Pacific
Ms. Angela D’Amico – Space and Naval Warfare Systems Command, Pacific
Dr. Thomas Jefferson, HDR, Inc.

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List of Acronyms and Abbreviations

DDG	United States Navy guided missile destroyer
DMMO	data marine mammal observer
ft	foot (feet)
GPS	global positioning system
hr	hour(s)
HRC	Hawaii Range Complex
km	kilometer(s)
LMMO	liaison marine mammal observer
LO	Navy Lookout
m	meter(s)
min	minute(s)
mm	millimeter(s)
MFAS	mid-frequency active sonar
MMO	marine mammal observer
nm	nautical mile(s)
NMFS	National Marine Fisheries Service
Nov	November
PMAP	Protective Measures Assessment Protocol
SMMO	survey marine mammal observer
U.S.	United States
yd(s)	yard(s)

SECTION 1 INTRODUCTION

In order to train with mid-frequency active sonar (MFAS), the United States (U.S.) Navy has obtained a permit from the National Marine Fisheries Service (NMFS) under the Marine Mammal Protection Act and Endangered Species Act. The Hawaii Range Complex (HRC) Monitoring Plan, implemented in January 2009, was developed with NMFS to comply with the requirements under the permit. The monitoring plan and reporting requirements provide science-based answers to questions regarding whether or not marine mammals are exposed and reacting to Navy MFAS. The objectives of the monitoring plan address the following questions:

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

In order to address these questions, data would be collected through various means, including contracted vessel and aerial surveys, tagging, passive acoustic monitoring, and placing marine mammal observers (MMOs) aboard Navy warships.

In a concerted effort to address the fifth question above, a study was initiated to determine the effectiveness of the Navy lookout team, including lookouts in the pilot house, on the bridge wings, and/or the forward lookout on the flying bridge. Trained biologists were utilized for the study to collect data that would characterize the likelihood of detecting marine species in the field from a U.S. Navy destroyer (DDG). The University of St. Andrews, Scotland, under contract to the U.S. Navy, developed an initial protocol for use during this study. Necessary changes to the protocol were identified and made during prior cruises. Data collected are intended to be combined with future monitoring efforts in order to determine the effectiveness of Navy lookout teams as a whole, rather than specific to each vessel.

As part of this data collection effort, three U.S. Navy civilian MMOs (Dr. Stephanie Watwood, Ms. Meredith Fagan, and Ms. Angela D'Amico) and one contractor (Dr. Thomas Jefferson) embarked from 10-17 November 2011 during a major training exercise in the HRC called Koa Kai. These MMOs were stationed aboard a U.S. Navy guided missile destroyer, hereafter referred to as DDG-F. The goals of the monitoring and this study were:

1. Collect data to assess the effectiveness of the Navy lookout team.
2. Obtain data to characterize the possible exposure of marine species to MFAS.

SECTION 2 METHODS

MMO surveys were conducted on a not-to-interfere basis, which means that the MMOs would not replace required Navy lookouts, would not dictate operational requirements or maneuvers, and would remove themselves from the bridge wing if necessary for DDG-F to accomplish its mission objectives. The exceptions would be if a marine mammal was sighted by the MMO within the shut-down zone during MFAS operations (200 yards [yds], 183 meters [m]) and was not sighted by the Navy lookout team, or if the vessel was in danger of striking the marine species. In these cases, the MMO would report the sighting to the Navy lookout team for appropriate reporting and action.

The initial protocol for data collection was developed by the University of St. Andrews which was modified by the MMOs on prior surveys. Additional changes were made as necessary during these events. The MMO survey on DDG-F was conducted on the bridge wings (elevated 60 feet (ft; 20 m) above the waterline), with one MMO on each wing (called survey MMOs, or SMMOs). One MMO acted as a liaison to the starboard and port lookouts (called liaison MMO or LMMO). The fourth MMO was primarily responsible for recording data (data MMO or DMMO) reported by the two SMMOs and the LMMO. A rotation schedule was used, such that an MMO would be on effort for one hour on port, one hour as the LMMO, one hour as an SMMO on starboard, and one hour as DMMO. While on effort, MMOs used naked eye and 7 X 50 magnification binoculars to scan the area from dead ahead to just aft of the beam. This equates to a 180 degree field in front of the ship that was covered by the MMOs.

If an animal was visually detected by the SMMOs, information would be collected on both the marine mammal sighting and concurrent operational parameters. Environmental data were collected routinely. Sightings obtained first by the SMMOs before the Navy lookout were considered to be "trials." If applicable, photographs would be taken using a Canon EOS 20D digital camera with a 100 – 300 millimeter (mm) zoom lens. No photographs would be taken until the Navy lookout had also made the sighting so as not to inappropriately call attention to the sighting. The track of the DDG-F was not altered as result of the sightings. Therefore, the species identification level represents the best ability to recognize species specific characteristics at a distance from the ship, without approaching the animals for study.

The LMMO or SMMOs reported sightings made by the Navy bridge wing lookouts. The LMMO was also responsible for noting sightings made by the bridge team or watchstanders. After a sighting by the Navy lookout or bridge team, the LMMO would also query the personnel to clarify information on the sighting such as animals seen, bearing, distance, and time. All four MMOs were equipped with headset two-way radios in order to maintain communications

without leaving their post, as well as communicating sighting and effort data without cueing the Navy lookouts to sightings. The DMMO was responsible for recording all data and making initial determination as to whether sightings were considered a duplicate, e. g., the same animal seen by two observers.

The DMMO recorded effort-related events (e.g., begin effort, end effort, observer rotation, weather change) in addition to time, location, and weather information as per the protocol. At the time of events and sightings, a waypoint was immediately taken by the DMMO such that the accurate time and location would be recorded, with associated information to be appended. Effort and environmental information was collected when the MMOs began effort, at each rotation, as weather changes occurred, and when the MMOs went off effort. At the conclusion of each observation day, all photographs were reviewed to assist with species identification.

SECTION 3 RESULTS

The MMO team spent 48 hours and 26 minutes searching for marine species during the Koa Kai event (Table 1). Time considered off-effort included some training activities of the DDG-F that precluded conducting observations from the bridge wings; however observations were still possible and sightings were made from inside the bridge during these activities. Activities that required the team to vacate the bridge level entirely were not counted towards effort totals, and included a PHOTOEX event, underway refueling events, GUNEX events, freshwater wash down, ship officers' meetings on the bridge wings, and meals. For whole days out at sea, approximately 6.06 hours per day were spent on effort. Figure 1 shows the breakdown of Beaufort Sea State (BSS) as a total of the on-effort observation period and the percentage of sightings that occurred at each BSS. Just under half of the observation period occurred in BSS of 3 or less, which increases the probability of detecting marine mammals visually. November 13-15 presented almost ideal environmental sighting conditions (Table 1).

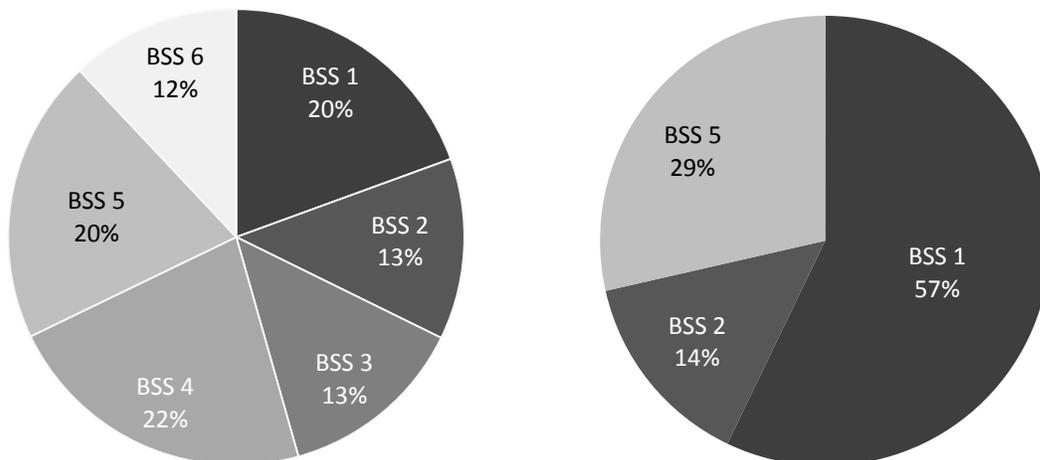


Figure 1. Total percentage of effort (left) and sightings (right) at various Beaufort Sea States (BSS)

Table 1. Effort hours and environmental conditions

Date	Team Hours On-Effort	Time	Beaufort Sea State (range)	% Cloud Cover (range, conditions)	Visibility
10 Nov	1 hr 56 min	1249-1729	3 – 5	20 – 60	Good
11 Nov	6 hr 32 min	0714-0745, 0820-1123, 1237-1638	5 – 6	8 - 80	Good
12 Nov	6 hr 4 min	0711-0913, 0953-1154, 1304-1506, 1526-1626	4 – 5	5 - 50	Good
13 Nov	6 hr 50 min	0753-1056, 1241-1443, 1518-1700	2 – 4	0 – 15	Good – Excellent
14 Nov	6 hr 51 min	0703-0920, 0953-1153, 1303-1538	1 – 3	2 – 80	Excellent
15 Nov	8 hr 33 min	0706-0800, 0808-0908, 0947-1147, 1306-1507, 1547-1746	1 – 3	2 – 90	Good – Excellent
16 Nov	7 hr 58 min	0701-0902, 0940-1138, 1308-1508, 1541-1740	3 – 5	85 - 100	Poor - Good
17 Nov	3 hr 39 min	0706-1000, 1049-1135	4 – 6	30-68	Poor - Good
Total	48 hr 26 min		1 – 6	0 – 100	Poor – Excellent

In total, six unique sightings comprising at least 80 individual marine mammals were recorded during the eight days of observation, primarily in the waters near Oahu and Kauai (Figure 2). The MMOs recorded two independent sightings of marine mammals, that is, sightings not seen by the Navy lookout team (Table 2). Both of these sightings were at distances less than 1000 yd (914 m), which is within the MFAS mitigation zone. Additionally, the Navy lookout team recorded one independent sighting (unconfirmed by the MMO team), and three sightings were seen by both the MMOs and the Navy lookout team (Table 2). A total of 326 photographs were taken, 44 of which were of cetaceans from two unique sightings (see Figure 3 for selected photographs) and 219 were of seabirds, with the remainder being of vessels, staff, and procedures.

Table 2. Number of sightings

Date	Independent MMO Sightings	Independent Navy Lookout Team Sightings	Sightings by both Teams
10 Nov	2	0	0
11 Nov	0	0	0
12 Nov	0	0	0
13 Nov	0	0	0
14 Nov	0	0	2
15 Nov	1	1	0
16 Nov	0	0	0
17 Nov	0	0	0
Total	3	1	2

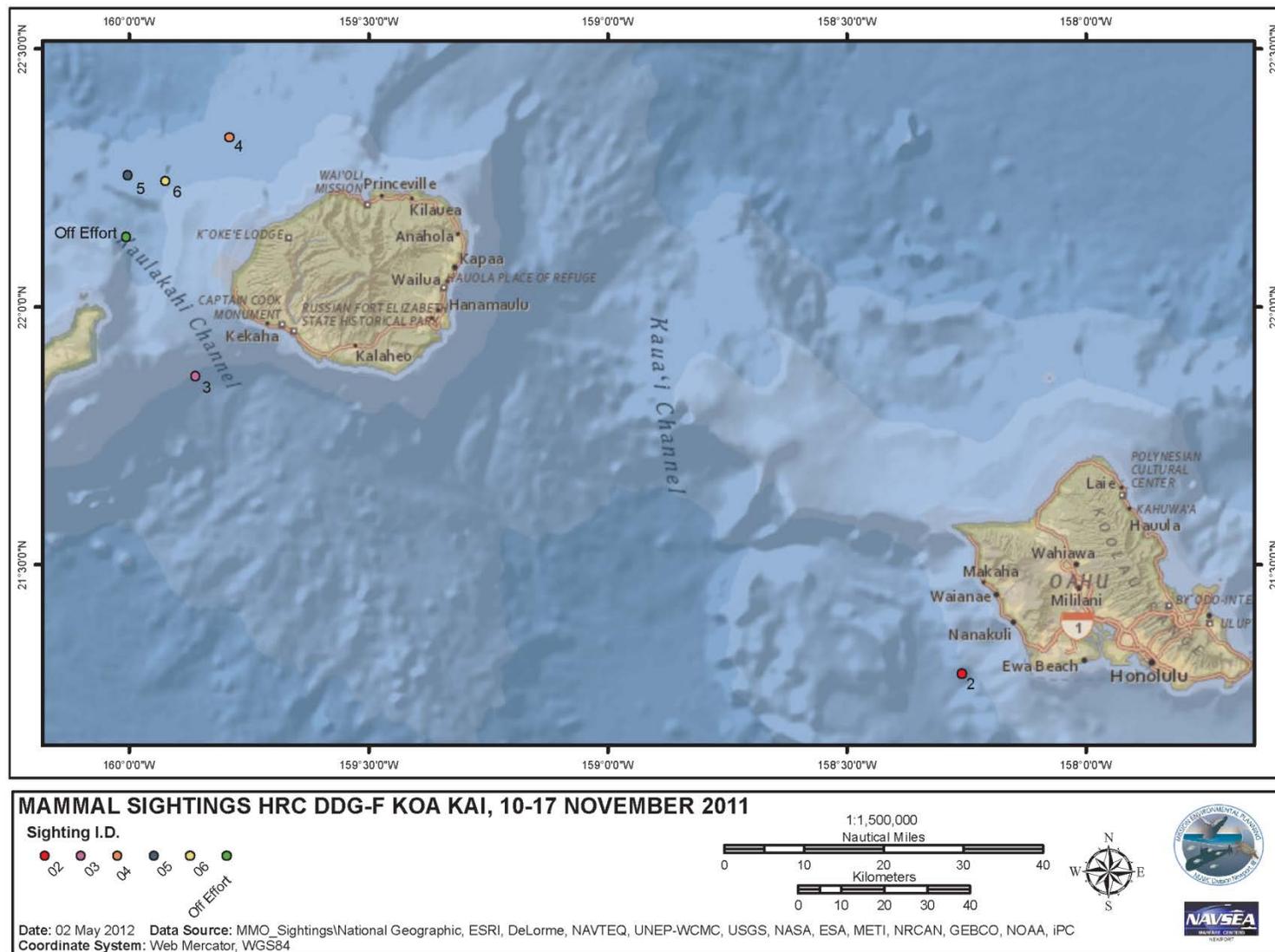


Figure 2. Marine mammal sighting locations (the location of Sighting 1 was not recorded due to equipment malfunction)

Trials were successfully conducted on only two days of the event, with two of six sightings (33%) available for trials, or an average rate of 0.04 trials per hour of effort across all eight days (Table 3).

Table 3. Effort hours, sighting rates, and trial rates

Date	Hours MMO Team Effort	# of Unique Sightings*	Sightings/Hour	# of Trials	Trials/Hour
10 Nov	1 hr 56 min	2	1.03	1.00	0.51
11 Nov	6 hr 32 min	0	0.00	0.00	0.00
12 Nov	6 hr 4 min	0	0.00	0.00	0.00
13 Nov	6 hr 50 min	0	0.00	0.00	0.00
14 Nov	6 hr 51 min	2	0.29	0.00	0.00
15 Nov	8 hr 33 min	2	0.23	1.00	0.12
16 Nov	7 hr 58 min	0	0.00	0.00	0.00
17 Nov	3 hr 39 min	0	0.00	0.00	0.00
Total	48 hr 26 min	6	0.12	2.00	0.04



Figure 3. Cetaceans sighted during DDG-F cruise (Top Panels: Pilot whales from sighting 3 on 14 November; Bottom Panels: Rough-toothed dolphins sighted while off-effort on 15 November)

Of the six sightings, one species was positively identified, the short-finned pilot whale (*Globicephala macrorhynchus*), and accounted for four of the sightings (Table 4). One additional sighting, of rough-toothed dolphins (*Steno bredanensis*), occurred while off-effort on 15 November. The first day of the effort had the greatest frequency of unique sightings, 0.49 sighting/hour of effort. Four of the six sightings, and the one off-effort sighting, occurred on the days with the best sighting conditions (14-15 November; BSS ≤ 3). Nineteen sightings of bird groups were also reported during the observation period (Table 5).

Table 4. Unique marine mammal sightings

Data Category	Sighting 1	Sighting 2	Sighting 3	Sighting 4	Sighting 5	Sighting 6	Sighting 7
Sighting Information							
Effort	On	On	On	On	On	On	Off
Date	11/10/2011	11/10/2011	11/14/2011	11/14/2011	11/15/2011	11/15/2011	11/15/2011
Time	12:49:18	15:03:42	08:51:01	14:00:00	13:49:32	14:17:09	15:12:10
Location	Unavailable	21.287889N 158.259917W	21.8289N 159.8506W	22.32806N 159.85928W	22.25458N 159.85928W	22.24291N 159.85928W	22.13504N 159.85928W
Detection Sensor	MMO	MMO	Bridge	Lookout	Lookout	MMO	Lookout
Species/Group	Short finned Pilot Whale	Short finned Pilot Whale	Short finned Pilot Whale	Short finned Pilot Whale	Unidentified Whale	Unidentified Dolphin	Rough Toothed Dolphin
Group Size	10	10	50	4	Unknown	6	3
# Calves	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
Bearing (relative)	75	315	352	0	270	270	330
Distance (m)	1355	320	4376	182	15000	473	91
Animal motion	Parallel	Opening	Closing	Opening	Unknown	Parallel	Closing
Sighting Cue	Dorsal Fin	Dorsal Fin	Blow	Body	Unknown	Dorsal Fin	Dorsal Fin
Behavior	Travel	Travel	Travel	Travel	Unknown	Travel	Travel
Environmental Information							
Wave height (ft)	4-6	4-6	< 3	< 3	< 3	< 3	< 3 ft
Visibility	Good	Good	Excellent	Excellent	Good	Good	Good
Beaufort Sea State	5	5	2	1	1	1	1
Cloud cover (%)	20	60	4	12	70	70	65
Glare (%)	10	0	0	10	15	15	8
Operational Information							
Sonar	Off	Off	Off	Off	On	On	On
Ship bearing (true)	330	50	342	130	270	290	140
Mitigation implemented	None	None	None	None	None	None	None
Comments	GPS not working correctly during sighting – location information not acquired		Sighting relayed from another ship's bridge. Animals were traveling in 4 sub-groups		Sighting unconfirmed by MMO	Potential species ID = Risso's dolphin	Animals appeared to increase speed and orient towards the bow as they closed as if to bow ride

Table 5. Seabird sightings

Date	Sighting Number	Time	Species	Group Size	Location	
10 Nov	1	14:30:41	Tropic bird	6	21.1543N	158.1252W
10 Nov	2	14:40:59	Shearwaters	70	21.1525N	158.1446W
11 Nov	3	7:24:07	Tropic birds and shearwaters	55	20.79543N	157.9827W
11 Nov	4	8:29:43	Shearwaters	35	20.72623N	157.98119W
12 Nov	5	7:20:39	Shearwaters	20	20.38055N	158.37482W
12 Nov	6	14:43:25	Shearwaters	10	20.32904N	158.34767W
13 Nov	7	8:43:27	Shearwaters	5	20.18752N	158.42619W
13 Nov	8	14:31:11	Terns and shearwaters	12	20.42995N	158.2757W
14 Nov	9	10:09:38	Unidentified white birds	15	22.21143N	159.88861W
14 Nov	10	14:24:30	Shearwaters	15	22.24778N	159.82874W
14 Nov	11	14:58:06	Shearwaters	9	22.17027N	159.83928W
15 Nov	12	8:51:11	Shearwaters and masked boobys	20	22.41023N	159.7843W
15 Nov	13	14:38:35	Shearwaters and boobys	Unknown	22.19529N	159.97311W
15 Nov	14	15:03:49	Sooty terns	100	22.15235N	160.02176W
15 Nov	15	16:02:04	Unidentified birds	20	21.981N	159.90907W
15 Nov	16	16:06:58	Unidentified birds	40	21.97162N	159.90687W
15 Nov	17	16:38:37	Sooty terns, shearwaters and boobys	80	21.93046N	159.88312W
16 Nov	18	7:34:27	Shearwaters	28	20.51896N	158.73611W
16 Nov	19	16:11:30	Shearwaters and boobys	14	20.6899N	159.0629W

SECTION 4 CONCLUSION

4.1. MARINE MAMMAL MONITORING

The goals of the lookout effectiveness monitoring effort are provided below, with a conclusion regarding each of the goals:

1. Collect data to determine the effectiveness of the Navy lookout team.

This study occurred in waters with relatively low marine mammal density. Therefore, the opportunities for trials were few and far between. Collecting data more frequently or in a higher density season/location would improve sample size for analysis.

This event is the fifth aboard a DDG in which data were collected to determine effectiveness; data will be combined with future monitoring efforts in order to determine the effectiveness of Navy lookouts as a whole, rather than specific to each vessel.

2. Obtain data to characterize the possible exposure of marine species to MFAS.

Sighting information included the bearing and distance of the animal to DDG-F. This information can be used to determine the level of exposure a marine mammal may experience during an MFAS event. Reconstruction of the event and the determination of the possible exposures of marine species to MFAS will be completed under separate task. Obtaining the data needed to make these determinations was successful.

4.2. RECOMMENDATIONS

Minor changes to the data forms, protocols, and recommended equipment were made by the MMO team, and will be considered for implementation in future lookout effectiveness studies.

Data-entry on the same day after data collection, especially the first day, was a previous recommendation that is reiterated here, as it is an especially valuable in the process of training of new Navy civilian biologists in the execution of the study.