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**Final Cruise Report, Marine Species Monitoring &
Lookout Effectiveness Study
Submarine Commanders Course, February 2013,
Hawaii Range Complex**

Prepared for:
U.S. Pacific Fleet



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14. ABSTRACT In accordance with the HRC Monitoring Plan, implemented in January 2009, data were collected 18–22 February 2013 during a SCC event, with the following stated goals: (1) collect data to assess the effectiveness of the Navy lookout team, and (2) obtain data to characterize the possible exposure of marine species to MFAS. Three U.S. Navy civilian MMOs (MMOs and one contractor MMO) were stationed aboard a U.S. Navy-guided DDG for observation of marine species. MMO surveys were conducted on a not-to-interfere basis, which means that the MMOs did not replace required Navy lookouts and did not dictate operational requirements or maneuvers. If a marine mammal or sea turtle was visually detected by the MMOs or by Navy watchstanders, information was collected on the sighting and concurrent operational and environmental parameters. For the duration of the embark, the MMO team spent 27 hours and 17 minutes searching for marine species during the training event. For whole days out at sea, approximately 6.8 hours per day were spent on effort. The majority of the on-effort time (64 percent) was in Beaufort Sea State (BSS) 6, with the range being BSS 4–7. Sightings occurred in all BSS, with the majority (55 percent) occurring in BSS 7. In total, 13 unique sightings comprising at least 28 individual MM/ST were recorded during the 4 days of observation. Visual sightings included one unidentified blackfish, four unidentified whales, two unidentified marine mammals, one spinner dolphin (<i>Stenella longirostris</i>), two humpback whales (<i>Megaptera novaeangliae</i>), and two green sea turtles (<i>Chelonia mydas</i>). MMOs made seven sightings independent of the ship's watchstander team. There were two sightings made concurrently by both the MMO and watchstander team. The ship's passive acoustic detection team detected three marine mammal groups independent of the MMOs and one marine mammal group visually confirmed by a MMO sighting. Forty-three visual observations made of birds were also reported during the observation period.					

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List of Acronyms and Abbreviations

BSS	Beaufort Sea State
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
HST	Hawaii Standard Time
LMMO	liaison marine mammal observer
m	meter(s)
min	minute(s)
MFAS	mid-frequency active sonar
MMO	marine mammal observer
NMFS	National Marine Fisheries Service
PMAP	Protective Measures Assessment Protocol
SMMO	survey marine mammal observer
U.S.	United States
yd	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 a Biological Opinion under the 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 permits. The monitoring plan and reporting requirements provide science-based answers to questions regarding whether or not marine mammals are exposed and react 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 or on the bridge wings. 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. Julie Rivers, and Ms. Christiana Boerger) and one contractor MMO (Dr. Thomas Jefferson) embarked from 18-22 February 2013 during a Submarine Commanders Course event in HRC. These MMOs were stationed aboard a U.S. Navy guided missile destroyer, hereafter referred to as DDG-I. The goals of the monitoring and this study were to:

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-I 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-I 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 10 degrees on the opposite side of 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, with a 20 degree overlap in the area forward of the trackline covered by both observers.

If a marine mammal or sea turtle was visually detected by the SMMOs, information would be collected on both the 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 7D digital camera with a 100 – 300 millimeter 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-I 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. Seabirds are not the focus of this study, however, as they represent a white cue against a dark background, they were often observed during routine searches for marine mammals. They were only reported if the SMMO could quickly identify them and report to the DMMO without distracting from the primary mission. 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 27 hours and 17 minutes searching for marine species during the training event (Table 1). For whole days out at sea, approximately 6.8 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. Each observation day was spent in a BSS of 4 or greater, which amounts to inferior environmental sighting conditions (Table 1).

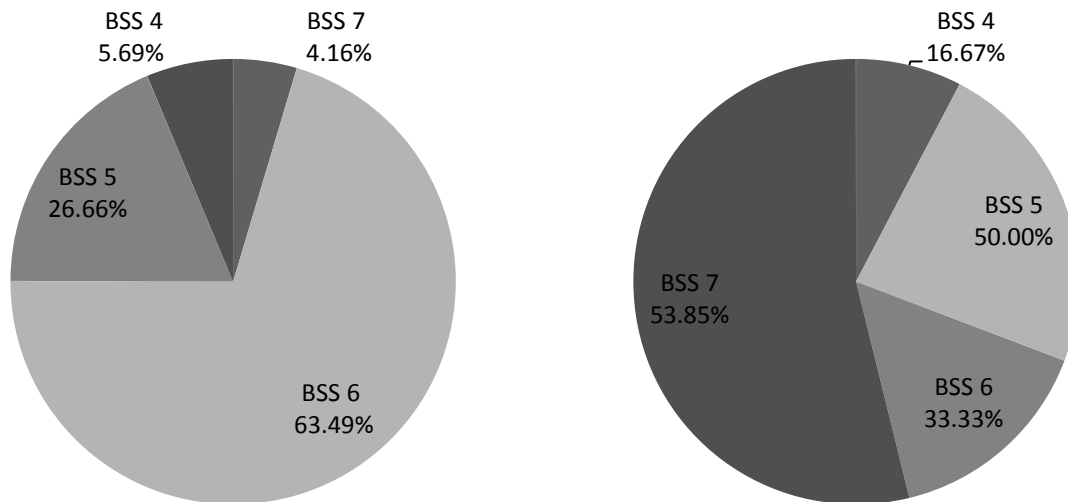


Figure 1. Total percentage of effort (left) and sightings (right) at various Beaufort Sea States (BSS)

In total, 13 unique sightings comprising at least 28 individual marine mammals and sea turtles were recorded during the four days of observation. MMOs made seven sightings independent of the ship's watchstander team (Table 2). There were two sightings made concurrently by both the MMO and watchstander team. The ship's passive acoustic detection detected three marine mammal groups independent of the MMOs (sightings 1, 8 and 9) and one marine mammal group visually confirmed by a MMO sighting (sighting 10).

Eight species of seabirds were confirmed (Table 5). They were identified and reported opportunistically and only if the SMMO could do so without distracting from the primary mission of observing marine mammals. Given that they were not logged consistently throughout the embark, distribution should not be interpreted as an index of abundance.

Table 1. Effort Hours and Environmental Conditions

Date	Team Hours On-Effort	Time	Beaufort Sea State (range)	% Cloud Cover (range)	Visibility
19 Feb	5 hr 57 min	1010-1124, 1236-1356, 1409-1715, 1753-1810	5 - 6	7 - 40	Good-Excellent
20 Feb	9 hr 19 min	727-1145, 1250-1743, 1823-1841	5 - 6	10 - 90	Poor-Excellent
21 Feb	7 hr 34 min	745-837, 849-1047, 1101-1145, 1301-1701	4 - 6	38 - 100	Poor-Good
22 Feb	4 hr 27 min	719-1030, 1154-1310	4- 7	5 - 57	Good-Excellent
Total	27 hr 17 min		4 - 7	0 - 100	Poor-Excellent

A total of 162 photographs were taken, none of which include visible cetaceans or sea turtles. All photos are of seabirds, vessels, airplanes, staff, and procedures.

Table 2. Number of Sightings

Date	Independent MMO Sightings	Independent Navy Watchstander Team Sightings	Sightings by both Teams
19 Feb	0	1	0
20 Feb	1	0	0
21 Feb	4	0	0
22 Feb	2	2	3
Total	7	3	3

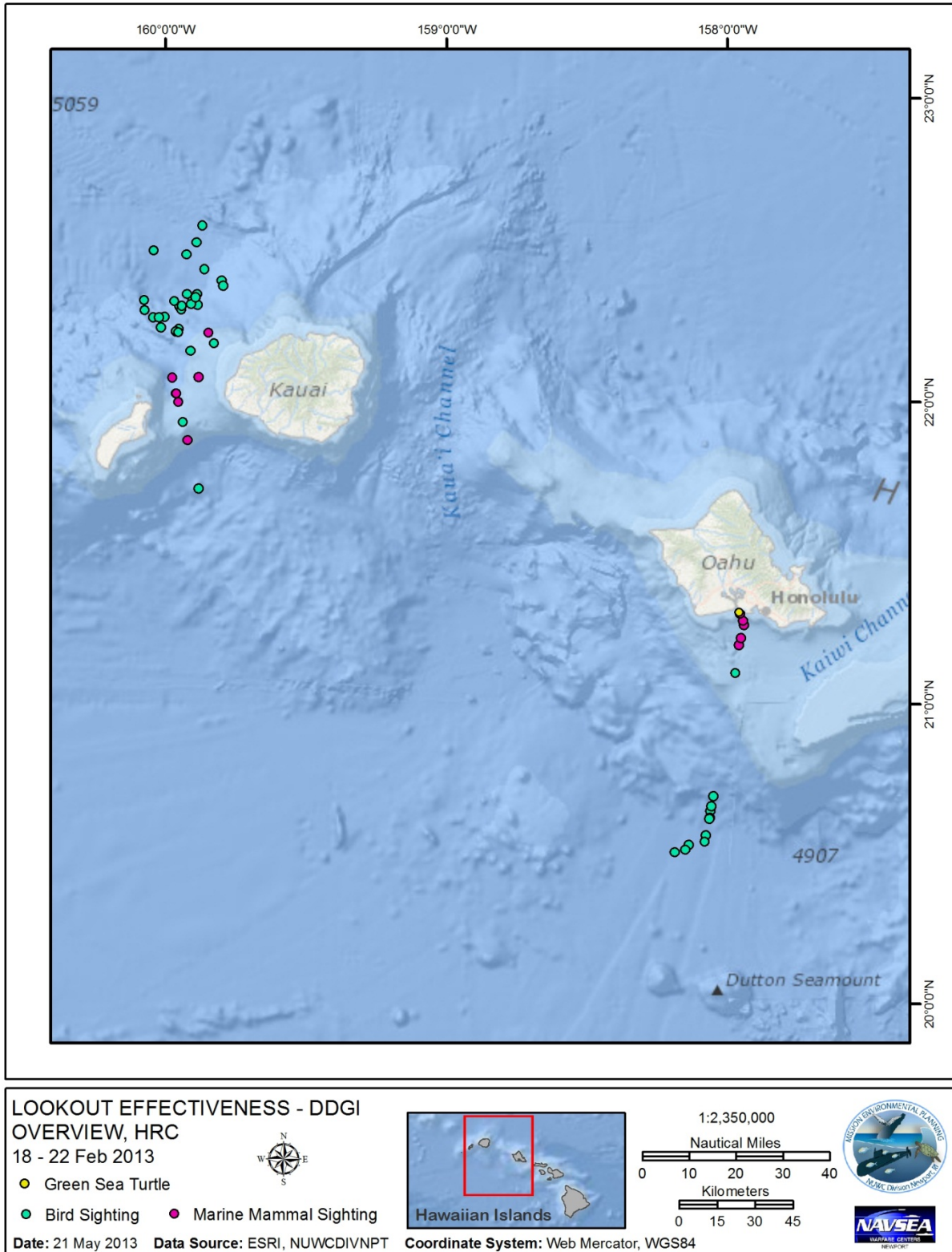


Figure 2. Locations of all marine mammal and seabird sightings

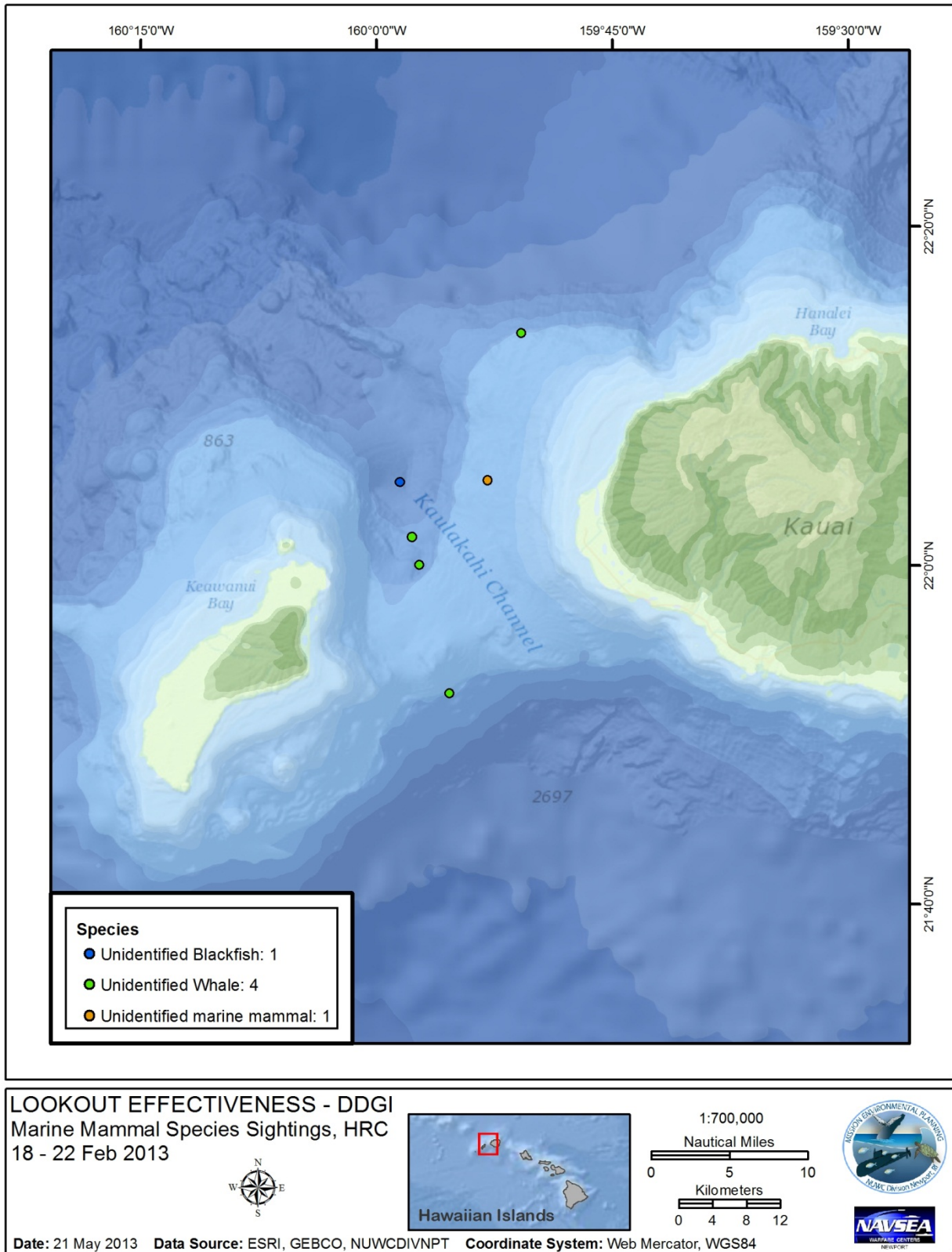


Figure 3. Marine mammal sightings near Kauai

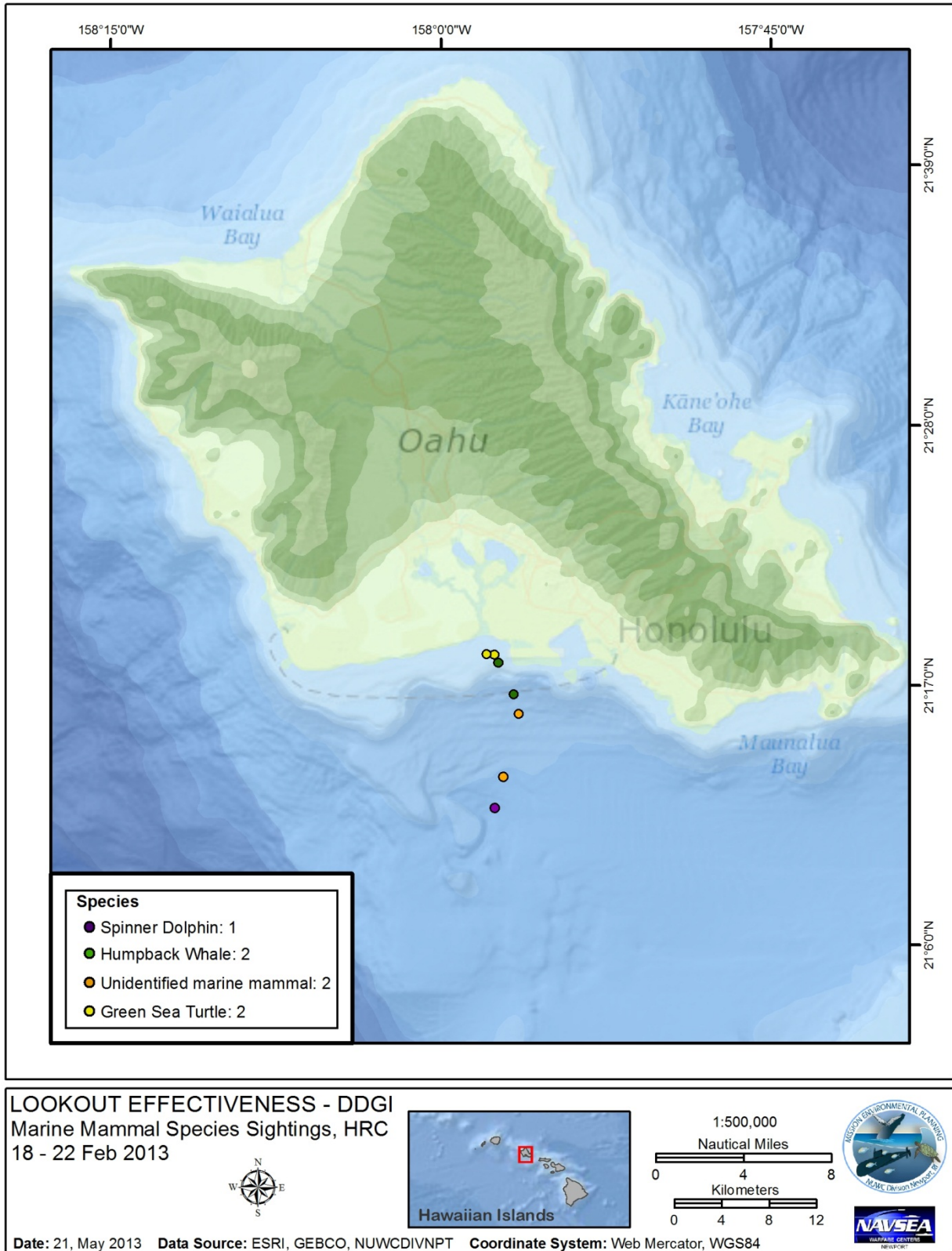


Figure 4. Marine mammal and sea turtle sightings near Oahu

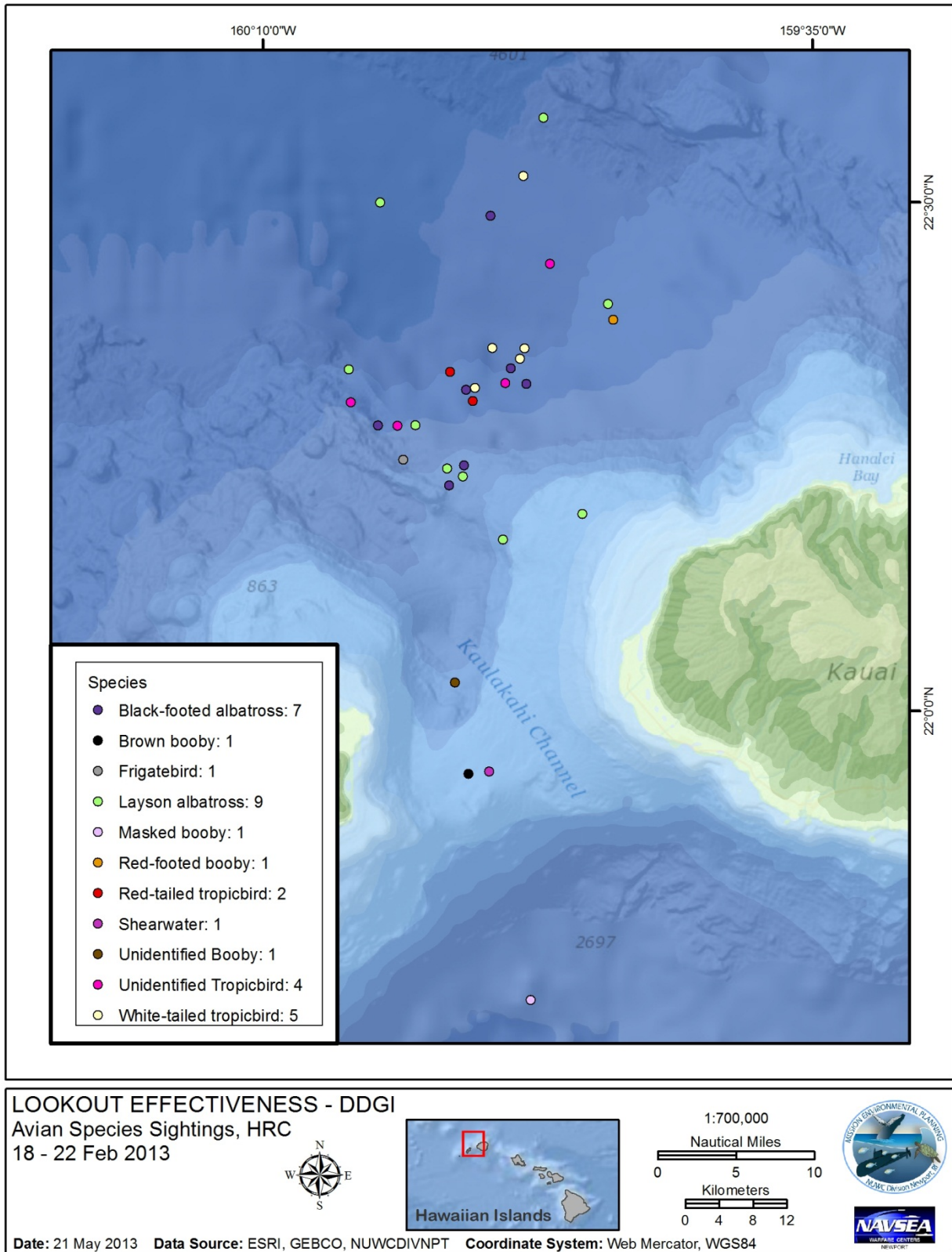


Figure 5. Seabird sightings near Kauai

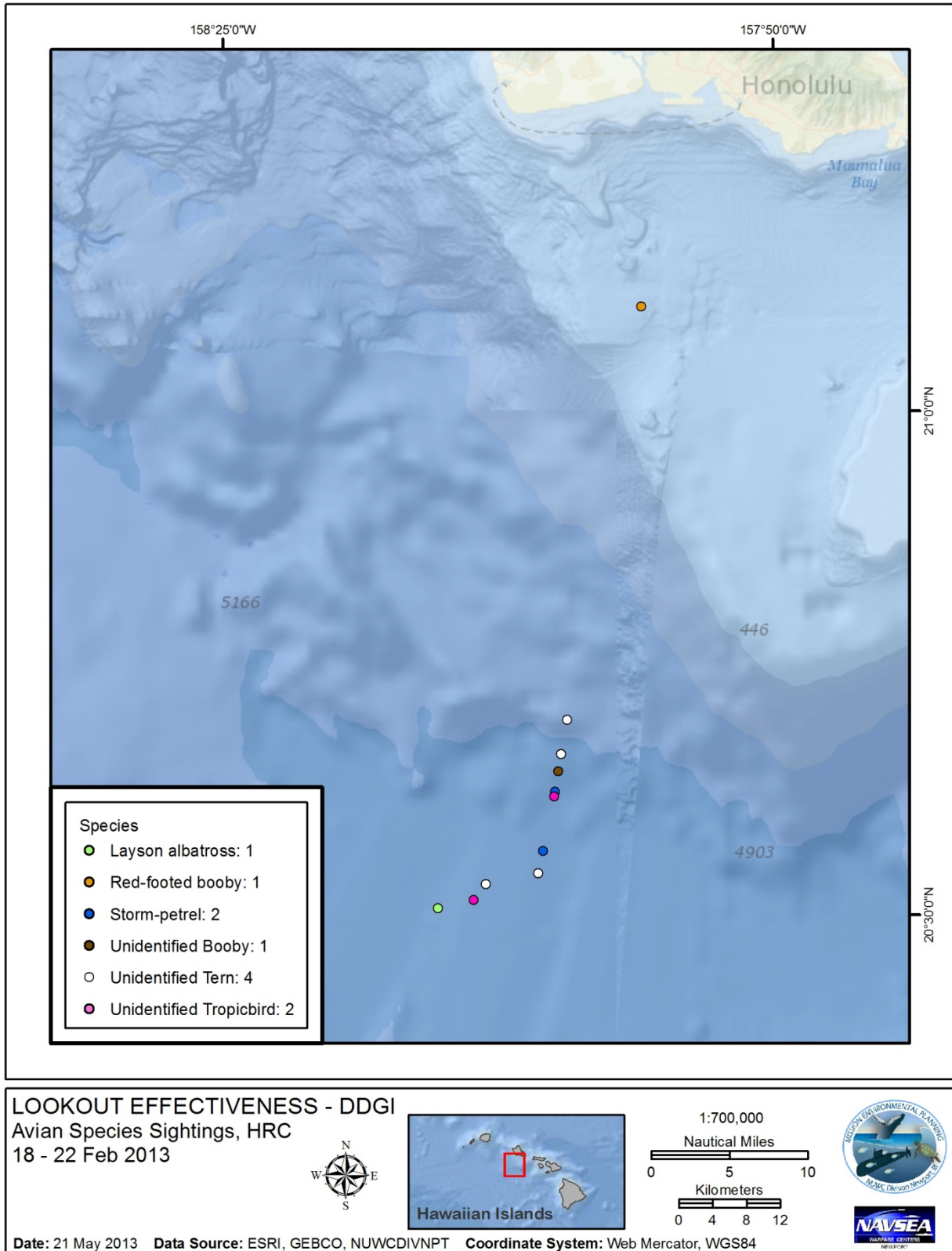


Figure 6. Seabird sightings near Oahu

Trials were successfully conducted on two days of the event, with 5 of the 13 sightings (38%) available for trials, or an average rate of 0.18 trials per hour of effort across all four days (Table 3). Sightings 1, 8 and 9 were detections of marine mammal vocalizations by the sonar crew. An additional sighting (sighting 10) was a marine mammal vocalization detection by the sonar crew and visually verified by a MMO.

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

Date	Hours MMO Team Effort	# of Unique Sightings	Sightings/Hour	# of Trials	Trials/Hour
19 Feb	5 hr 57 min	1	0.17	0	0
20 Feb	9 hr 19 min	1	0.11	1	0.11
21 Feb	7 hr 34 min	4	0.53	4	0.53
22 Feb	4 hr 27 min	7	1.57	0	0
Cumulative	27 hr 17 min	13	0.48	5	0.18

Of the 13 sightings, three species were positively identified. Visual sightings included one unidentified blackfish, four unidentified whales, two unidentified marine mammals, one spinner dolphin (*Stenella longirostris*), two humpback whales (*Megaptera novaeangliae*), and two green sea turtles (*Chelonia mydas*). The first sighting was identified by the passive acoustics team simply as “biologics.” The fourth day of the effort had the greatest frequency of unique sightings, 1.57 sightings/hour of effort. Forty-three visual observations made of birds were also reported during the observation period (Table 5).

Table 4. Unique Marine Mammal and Sea Turtle Sightings

Data Category	Sighting 1	Sighting 2	Sighting 3	Sighting 4	Sighting 5	Sighting 6
Sighting Information						
Effort	On	On	On	On	On	On
Date	2/19/2013	2/20/2013	2/21/2013	2/21/2013	2/21/2013	2/21/2013
Time (HST)	16:20:40	14:06:33	15:52:37	16:02:23	16:07:24	16:30:24
Location	22.08397 N 159.88216 W	22.22824 N 159.84619 W	22.08179 N 159.9754 W	22.02819 N 159.96223 W	22.00048 N 159.95468 W	21.87434 N 159.92244 W
Detection Sensor	Sonar	MMO	MMO	MMO	MMO	MMO
Species/Group	Biologics	Unidentified Whale	Unidentified Blackfish	Unidentified Whale	Unidentified Whale	Unidentified Whale
Group Size estimate (estimated range)	Unknown	1 (1-2)	2 (2-3)	1 (1)	1 (1)	2 (1-3)
# Calves	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
Bearing (relative)	180	10	5	10	0	80
Distance (m)	Unknown	1623.26	2040.42	457.2	5213.82	4863.86
Animal motion	Unknown	Opening	Closing	Unknown	Unknown	Unknown
Sighting Cue	Acoustics	Blow	Back	Blow	Blow	Blow
Behavior	Unknown	Dive	Dorsal	Unknown	Unknown	Unknown
Environmental Information						
Wave height (ft)	3-5	3-5	3-5	3-5	3-5	< 3
Visibility	Good	Good	Moderate	Moderate	Moderate	Good
Beaufort Sea State	6	6	5	5	5	4
Cloud cover (%)	17	15	100	100	100	95
Glare (%)	22	27	0	0	0	12
Operational Information						
Sonar	Off	Off	Off	Off	Off	Off
Ship bearing (true)	185	179	166	185	182	166
Mitigation implemented	None	None	None	None	None	None
Comments	Sonar detect. No MMO Visual	Two blows followed by fluke up dive. Dark body.	Unidentified blackfish, could be pilot whale.			

Table 4. Unique Marine Mammal and Sea Turtle Sightings (cont'd)

Data Category	Sighting 7	Sighting 8	Sighting 9	Sighting 10	Sighting 11	Sighting 12	Sighting 13
Sighting Information							
Effort	On	On	On	On	On	On	On
Date	2/22/2013	2/22/2013	2/22/2013	2/22/2013	2/22/2013	2/22/2013	2/22/2013
Time (HST)	12:43:16	12:47:52	12:58:39	13:03:35	13:09:05	13:10:37	13:10:37
Location	21.19675 N 157.95905 W	21.21859 N 157.95248 W	21.2628 N 157.9409 W	21.27672 N 157.94481 W	21.29893 N 157.95633 W	21.30492 N 157.9594 W	21.30492 N 157.9594 W
Detection Sensor	Bridge	Sonar	Sonar	Sonar	Lookout	MMO	MMO
Species/Group	Spinner Dolphin	Unidentified Marine Mammal	Unidentified Marine Mammal	Humpback Whale	Humpback Whale	Green Turtle	Green Turtle
Group Size estimate (estimated range)	10	Unknown	2	1	2	1	1
# Calves	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
Bearing (relative)	60	Port Bow	10	35	200	75	200
Distance (m)	91.44	Unknown	Unknown	Unknown	1473.18	6.1	200
Animal motion	Closing	Unknown	Unknown	Parallel	Closing	Closing	Unknown
Sighting Cue	Body	Acoustics	Acoustics	Acoustics	Blow	Body	Head
Behavior	Travel	Unknown	Unknown	Travel	Travel	Dive	Float
Environmental Information							
Wave height (ft)	> 5 ft	> 5 ft	> 5 ft	> 5 ft	> 5 ft	> 5 ft	> 5 ft
Visibility	Good	Good	Good	Good	Good	Good	Good
Beaufort Sea State	7	7	7	7	7	7	7
Cloud cover (%)	57	57	57	57	57	57	57
Glare (%)	37	37	37	37	37	37	37
Operational Information							
Sonar	Off	Off	Off	Off	Off	Off	Off
Ship bearing (true)	14	14	10	336	335	332	332
Mitigation implemented	None	None	None	None	None	None	None
Comments	From port heading toward sonar dome	Hearing sounds on underwater telephone.		MMO visual sighting confirmed	Lookout saw first then MMO		

Table 5. Seabird sightings

Date	Sighting Number	Time	Species	Location	
19-Feb	1	11:03:29	White-tailed tropicbird	22.35655 N	159.88905 W
19-Feb	2	11:13:02	Black-footed albatross	22.33696 N	159.90361 W
19-Feb	3	11:16:27	Tropicbird	22.32242 N	159.90944 W
19-Feb	4	14:43:36	Black-footed albatross	22.32167 N	159.8871 W
19-Feb	5	17:59:50	Red-footed booby	22.38459 N	159.79495 W
19-Feb	6	18:05:56	Layson albatross	22.4001 N	159.80043 W
20-Feb	7	7:38:50	Black-footed albatross	22.23266 N	159.96307 W
20-Feb	8	7:40:05	Layson albatross	22.23408 N	159.96265 W
20-Feb	9	7:55:18	Black-footed albatross	22.2416 N	159.95328 W
20-Feb	10	7:59:52	Layson albatross (juvenile)	22.23073 N	159.95439 W
20-Feb	11	8:43:20	Red-tailed tropicbird	22.30488 N	159.94394 W
20-Feb	12	9:43:27	Tropicbird	22.43949 N	159.86205 W
20-Feb	13	10:19:02	White-tailed tropicbird	22.52558 N	159.89023 W
20-Feb	14	10:45:09	Layson albatross	22.58266 N	159.86891 W
20-Feb	15	12:56:42	White-tailed tropicbird	22.35688 N	159.92319 W
20-Feb	16	14:36:52	Layson albatross	22.19391 N	159.82765 W
20-Feb	17	15:12:27	White-tailed tropicbird	22.34638 N	159.89389 W
20-Feb	18	15:43:45	Black-footed albatross	22.48661 N	159.92513 W
21-Feb	19	8:26:31	Black-footed albatross	22.31589 N	159.95107 W
21-Feb	20	8:31:14	White-tailed tropicbird	22.31769 N	159.94162 W
21-Feb	21	9:22:51	Red-tailed tropicbird	22.33345 N	159.96806 W
21-Feb	22	10:13:40	Layson albatross	22.16875 N	159.91185 W
21-Feb	23	11:08:57	Layson albatross	22.28108 N	160.00471 W
21-Feb	24	11:13:15	Tropicbird	22.28055 N	160.02951 W
21-Feb	25	11:13:15	Black-footed albatross	22.28055 N	160.02951 W
21-Feb	26	11:24:06	Tropicbird	22.3036 N	160.0733 W
21-Feb	27	11:30:43	Layson albatross	22.33589 N	160.07544 W
21-Feb	28	13:02:09	Layson albatross	22.49958 N	160.04214 W
21-Feb	29	14:57:44	Frigatebird	22.24718 N	160.01768 W
21-Feb	30	16:01:00	Booby	22.02819 N	159.96284 W
21-Feb	31	16:19:32	Brown booby	21.93399 N	159.93742 W
21-Feb	32	16:19:32	Shearwater	21.93399 N	159.93742 W
21-Feb	33	16:59:37	Masked booby	21.71558 N	159.88252 W
22-Feb	34	8:12:49	Tern	20.53074 N	158.13756 W
22-Feb	35	8:36:54	Layson albatross	20.50688 N	158.18829 W
22-Feb	36	9:48:59	Tropicbird	20.51508 N	158.15048 W
22-Feb	37	10:05:18	Tern	20.54149 N	158.08202 W
22-Feb	38	10:09:10	Storm-petrel	20.56372 N	158.07687 W

Table 5. Seabird sightings (cont'd)

Date	Sighting Number	Time	Species	Location	
22-Feb	39	10:18:37	Tropicbird	20.61788 N	158.06505 W
22-Feb	40	10:19:26	Storm-petrel	20.62251 N	158.06418 W
22-Feb	41	10:22:57	Booby	20.64281 N	158.06079 W
22-Feb	42	10:25:53	Tern	20.65992 N	158.05771 W
22-Feb	43	10:31:42	White tern	20.69393 N	158.05127 W

SECTION 4 CONCLUSION

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 event is the ninth 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-I. This information can be used to determine the level of exposure a marine mammal or sea turtles may experience during an MFAS event.