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**Cruise Report, Marine Species Monitoring &
Lookout Effectiveness Study
Submarine Commanders Course, February 2015
Hawaii Range Complex**

Prepared for:
U.S. Pacific Fleet



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14. ABSTRACT In accordance with the Hawaii Range Complex (HRC) Monitoring Plan, data were collected during 17-18 February 2015 during a Submarine Commanders Course (SCC) training event. The goals of the monitoring and this study were to: (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 mid-frequency active sonar (MFAS). This event is the twelfth aboard a U.S. Navy guided missile destroyer (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. Four Marine Mammal Observers (MMOs) (two U.S. Navy civilian MMOs and two contractor MMOs) were stationed aboard a DDG for observation of marine species. 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-L to accomplish its mission objectives. If a marine mammal or sea turtle was visually detected by a survey marine mammal observer (SMMO), information was collected on both the sighting and concurrent operational parameters. Environmental data were collected routinely. For the duration of the embark, the MMO team spent 16 hours 10 minutes searching for marine species during the training event. For whole days out at sea, approximately 8.1 hours per day were spent on effort. The majority of observation time was spent in a Beaufort Sea State (BSS) of 2, 3, or 4 (81%), while sightings were mostly distributed among BSS 1-4. In total, 36 unique sightings comprising at least 61 individual marine mammals were recorded during the 2 days of observation. Of the 36 sightings, humpback whales (<i>Megaptera novaeangliae</i>) were the only species positively identified, accounting for 31% of sightings. Unidentified large whales (most likely humpback		

whales) accounted for 58% of sightings. MMOs made 26 sightings independent of the ship's watchstander team. There were 7 sightings made concurrently by both the MMO and watchstander team. There were 3 sightings by the watchstander team independent of the MMOs.

15. SUBJECT TERMS

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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
SMMO	survey marine mammal observer
U.S.	United States
yd	yard(s)

SECTION 1 INTRODUCTION

As part of the regulatory compliance process associated with the Marine Mammal Protection Act and the Endangered Species Act, the U.S. Navy is responsible for meeting specific monitoring and reporting requirements for military training and testing activities.

In support of these monitoring requirements, marine mammal monitoring was conducted in the Hawaii Range Complex during 16 Feb - 19 Feb 2015. This report provides findings from this monitoring effort that was conducted in order to further our understanding of the following monitoring questions:

1. Determine what species and populations of marine mammals and sea turtles are present in Navy range complexes;
2. Determine what populations of marine mammals are exposed to Navy training and testing activities;
3. Develop analytic methods to evaluate behavioral responses based on passive acoustic monitoring techniques;
4. Evaluate behavioral responses by marine mammals exposed to Navy training and testing activities;
5. Establish the baseline habitat uses and movement patterns of marine mammals where Navy training and testing activities occur;
6. Determine the effectiveness of Navy watch-standers/ lookouts;
7. Assess existing data sets which could be utilized to address the above objectives.

To help answer this question, the monitoring effort was structured around two objectives:

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-L 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 refined by the MMOs on the first few embarks and solidified in 2010. . The MMO survey on DDG-L 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 was 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 were 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-L 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 16 hours 10 minutes searching for marine species during the training event over only 2 days (Table 1). For whole days out at sea, approximately 8.1 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. The majority of observation time was spent in a BSS of 2, 3, or 4 (81%), while sightings were mostly distributed among BSS 1-4 (Figure 1). Only 5% of sightings occurred in BSS 5.

Table 1. Effort Hours and Environmental Conditions

Date	Team Hours On-Effort	Time	Beaufort Sea State (range)	% Cloud Cover (range)	Visibility
17 Feb	8 hr 17 min	0738-1145, 1308-1718	1-5	0-20	Good-Excellent
18 Feb	7 hr 53 min	0731-1132, 1314-1551, 1607-1718	2-5	3-55	Excellent
Total	16 hrs 10 min		1-5	3-55	Good-Excellent

In total, 36 unique sightings comprising at least 61 individual marine mammals were recorded during the two days of observation. MMOs made 26 sightings independent of the ship's watchstander team (Table 2; Figure 2). There were seven sightings made concurrently by both the MMO and watchstander team. There were three sightings by the watchstander team independent of the MMOs.

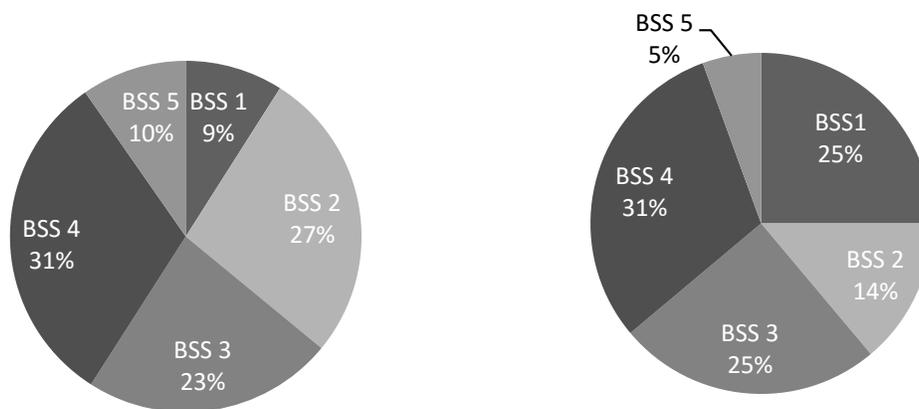


Figure 1. Total Percentage of Effort (left) and Sightings (right) at various Beaufort Sea States

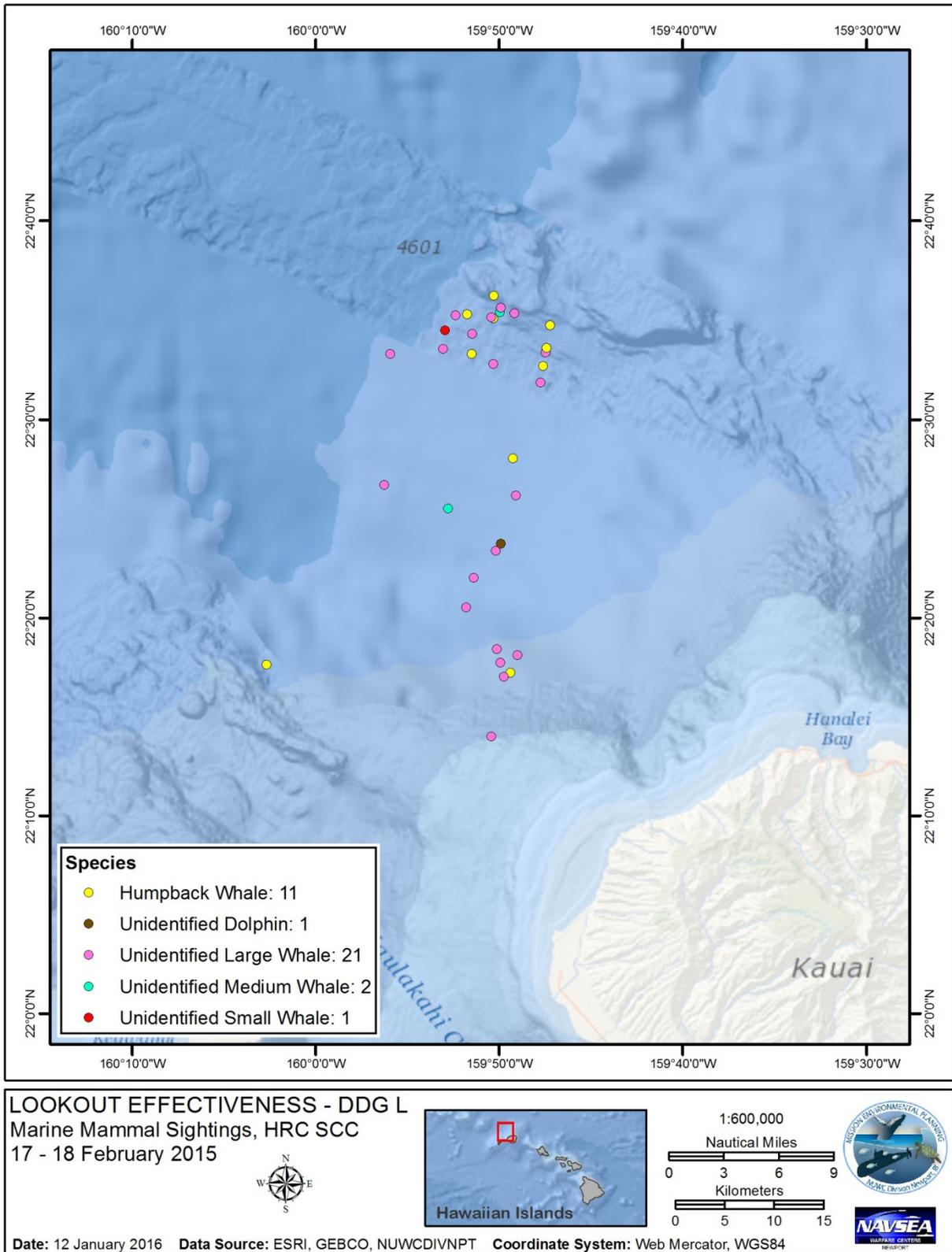


Figure 2. Marine mammal sightings around Kauai

Table 2. Number of Sightings

Date	Independent MMO Sightings	Independent Navy Watchstander Team Sightings	Sightings by both Teams
17 Feb	18	4	3
18 Feb	8	0	3
Total	26	4	6

Trials were successfully conducted on both days of the event, with 29 of the 36 sightings (81%) available for trials, or an average rate of 1.78 trials per hour of effort across both days (Table 3). The sighting rate was higher on the first day, when the average BSS was lower, and therefore sighting conditions were better.

Table 3. Effort Hours, Sighting Rates, and Trial Rates

Date	Hours MMO Team Effort	# of Unique Sightings	Sightings/ Hour	# of Trials	Trials/Hour
17 Feb	8 hr 17 min	25	3.02	20	2.41
18 Feb	7 hr 53 min	11	1.40	9	1.14
Cumulative	16 hrs 10 min	36	2.21	29	1.78

Of the 36 sightings, humpback whales (*Megaptera novaeangliae*) were the only species positively identified, accounting for 31% of sightings. Unidentified large whales (most likely humpback whales) accounted for 58% of sightings (Table 4). Only two of the 36 sightings occurred when sonar was active.

Table 4. Unique Marine Mammal 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	2/17/2015	2/17/2015	2/17/2015	2/17/2015	2/17/2015	2/17/2015
Time (HST)	8:14:51	8:21:46	9:39:41	10:41:51	11:42:36	13:14:08
Location	22.38995 N 159.83681 W	22.3956 N 159.83209 W	22.46717 N 159.82094 W	22.34195 N 159.86346 W	22.23368 N 159.84058 W	22.43609 N 159.81834 W
Detection Sensor	MMO	MMO	MMO	BRIDGE	MMO	MMO
Species/Group	Unidentified Large Whale	Unidentified Dolphin	Humpback Whale	Unidentified Large Whale	Unidentified Large Whale	Unidentified Large Whale
Group Size (estimated range)	5	2	2-3	1	2	2-3
# Calves	0	0	0	0	0	0
Bearing (relative degrees)	47	66	340	0	20	352
Distance (m)	13894.08	3349.76	8590.34	3218.68	12874.72	5625.74
Animal motion	Unknown	Parallel	Unknown	Unknown	Unknown	Opening
Sighting Cue	Blow	Splash	Blow	Unknown	Blow	Blow
Behavior	Unknown	Travel	Unknown	Unknown	Unknown	Unknown
Environmental Information						
Wave height (ft)	0-3	0-3	0-3	0-3	0-3	0-3
Visibility	Excellent	Excellent	Excellent	Excellent	Good	Excellent
Beaufort Sea State	2	2	2	2	4	1
Cloud cover (%)	15	13	10	5	5	17.5
Glare (%)	2.5	5	30	10	20	0
Sonar	OFF	OFF	OFF	OFF	OFF	OFF
Ship bearing (true)	113	4	180	70	137	0.7
Mitigation implemented	N	N	N	Ship changed course.	N	N
Comments	Only blows seen.			Sighting not visually verified by MMOs.	Animals close to shore.	Short, bushy blows. 1 animal fluked up. Possible humpback.

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

Data Category	Sighting 7	Sighting 8	Sighting 9	Sighting 10	Sighting 11	Sighting 12
Sighting Information						
Effort	ON	ON	ON	ON	ON	ON
Date	2/17/2015	2/17/2015	2/17/2015	2/17/2015	2/17/2015	2/17/2015
Time (HST)	13:34:56	13:37:42	13:40:51	13:42:29	13:49:53	13:59:44
Location	22.53108 N 159.79605 W	22.54478 N 159.79352 W	22.5563 N 159.7914 W	22.56029 N 159.79071 W	22.57888 N 159.78731 W	22.58681 N 159.8198 W
Detection Sensor	MMO	MMO	MMO	BRIDGE	MMO	MMO
Species/Group	Unidentified Large Whale	Humpback Whale	Unidentified Large Whale	Unidentified Large Whale	Humpback Whale	Unidentified Large Whale
Group Size (estimated range)	1	3	1	5	3-4	1
# Calves						
Bearing (relative)	48	75	15	340	10	0.5
Distance (m)	6120.48	2754.81	6120.48	140012.58	1623.26	4297.88
Animal motion	Parallel	Parallel	Opening	Unknown	Opening	Unknown
Sighting Cue	Splash	Blow	Blow	Fluke	Blow	Blow
Behavior	Unknown	Fluke	Unknown	Fluke, Spyhop, Travel	Fluke	Unknown
Environmental Information						
Wave height (ft)	0-3	0-3	0-3	0-3	0-3	0-3
Visibility	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent
Beaufort Sea State	1	1	1	1	1	1
Cloud cover (%)	17.5	17.5	17.5	17.5	17.5	20
Glare (%)	0	0	0	0	0	0
Sonar	OFF	OFF	OFF	OFF	OFF	OFF
Ship bearing (true)	7	9	9	9	9	32
Mitigation implemented	N	N	N	N	N	N
Comments				Sighting was a "whale tail"		

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

Data Category	Sighting 13	Sighting 14	Sighting 15	Sighting 16	Sighting 17	Sighting 18
Sighting Information						
Effort	ON	ON	ON	ON	ON	ON
Date	2/17/2015	2/17/2015	2/17/2015	2/17/2015	2/17/2015	2/17/2015
Time (HST)	14:07:37	14:19:16	14:23:30	15:25:48	15:25:48	15:36:03
Location	22.58994 N 159.83311 W	22.57201 N 159.85825 W	22.55503 N 159.85831 W	22.54657 N 159.83905 W	22.54657 N 159.83905 W	22.58502 N 159.83893 W
Detection Sensor	MMO	MMO	MMO	MMO	BRIDGE	MMO
Species/Group	Unidentified Medium Whale	Unidentified Large Whale	Humpback Whale	Unidentified Large Whale	Unidentified Large Whale	Humpback Whale
Group Size (estimated range)	1	2-3	1-2	1	1	1
# Calves						
Bearing (relative)	285	285	270	15	328	75
Distance (m)	5625.74	13894.08	6120.48	6120.48	8046.70	4561.83
Animal motion	Parallel	Unknown	None	None	Unknown	Parallel
Sighting Cue	Body	Blow	Blow, Splash	Blow	Blow	Blow
Behavior	Unknown	Unknown	Tail Lob	Unknown	Unknown	Slow Travel
Environmental Information						
Wave height (ft)	0-3	0-3	0-3	4-6	4-6	4-6
Visibility	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent
Beaufort Sea State	1	1	3	4	4	4
Cloud cover (%)	20.0	20.0	20.0	0	0	0
Glare (%)	0	0	13.0	40.0	40.0	40.0
Sonar	OFF	OFF	OFF	OFF	OFF	OFF
Ship bearing (true)	210	181	195	0	0	0
Mitigation implemented	N	N	N	N	N	N
Comments	No blow seen.		Tail lobbing off bow of another Navy vessel (which turned to avoid).			

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

Data Category	Sighting 19	Sighting 20	Sighting 21	Sighting 22	Sighting 23	Sighting 24
Sighting Information						
Effort	ON	ON	ON	ON	ON	ON
Date	2/17/2015	2/17/2015	2/17/2015	2/17/2015	2/17/2015	2/17/2015
Time (HST)	15:41:03	15:50:02	15:58:18	15:58:18	16:12:20	16:19:51
Location	22.60383 N 159.83844 W	22.59363 N 159.8322 W	22.58584 N 159.84068 W	22.58584 N 159.84068 W	22.58827 N 159.86259 W	22.58749 N 159.87317 W
Detection Sensor	MMO	MMO	MMO	MMO	BRIDGE	BRIDGE
Species/Group	Humpback Whale	Unidentified Large Whale	Humpback Whale	Unidentified Large Whale	Humpback Whale	Unidentified Large Whale
Group Size (estimated range)	2	1-2	2-3	1	1-2	1
# Calves						
Bearing (relative)	270	314	350	95	60	80
Distance (m)	4863.86	6120.48	4561.83	6731.20	457.20	914.40
Animal motion	Parallel	NONE	Opening	None	Parallel	Parallel
Sighting Cue	Blow	Blow	Blow	Blow	Blow	Blow
Behavior	Travel	Unknown	Slow Travel	Unknown	Slow Travel	Unknown
Environmental Information						
Wave height (ft)	4-6	4-6	4-6	4-6	4-6	4-6
Visibility	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent
Beaufort Sea State	4	4	4	4	4	4
Cloud cover (%)	0	0	0	0	0	0
Glare (%)	40.0	40.0	40.0	40.0	15.0	15.0
Sonar	OFF	OFF	OFF	OFF	OFF	OFF
Ship bearing (true)	0	200	267	267	260	291
Mitigation implemented	N	N	Ship changed course.	N	Ship changed course.	N
Comments						

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

Data Category	Sighting 25	Sighting 26	Sighting 27	Sighting 28	Sighting 29	Sighting 30
Sighting Information						
Effort	ON	ON	ON	ON	ON	ON
Date	2/17/2015	2/18/2015	2/18/2015	2/18/2015	2/18/2015	2/18/2015
Time (HST)	17:16:37	8:54:54	10:13:50	10:32:12	10:42:31	10:47:06
Location	22.55515 N 159.93231 W	22.42525 N 159.88013 W	22.36697 N 159.85666 W	22.30694 N 159.83566 W	22.30177 N 159.81706 W	22.28711 N 159.82333 W
Detection Sensor	MMO	MMO	MMO	MMO	MMO	MMO
Species/Group	Unidentified Large Whale	Unidentified Medium Whale	Unidentified Large Whale	Unidentified Large Whale	Unidentified Large Whale	Humpback Whale
Group Size (estimated range)	1-2	1	2	2-4	2	2
# Calves						
Bearing (relative)	290	315	10	10	25	330
Distance (m)	2754.81	8590.34	7515.65	6120.48	7515.65	4297.88
Animal motion	Parallel	Unknown	Opening	Unknown	Unknown	Closing
Sighting Cue	Blow	Blow	Blow	Blow	Blow	Body
Behavior	Travel	Unknown	Unknown	Unknown	Unknown	Fluke
Environmental Information						
Wave height (ft)	4-6	0-3	0-3	0-3	0-3	0-3
Visibility	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent
Beaufort Sea State	5	3	3	3	3	3
Cloud cover (%)	0	3.0	15.0	5.0	15.0	15.0
Glare (%)	15.0	0	20.0	5.0	20.0	20.0
Sonar	OFF	ON	ON	OFF	OFF	OFF
Ship bearing (true)	249	280	170	124	20	238
Mitigation implemented	N	N	N	N	N	N
Comments			Fluke up. Possible humpback.			

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

Data Category	Sighting 31	Sighting 32	Sighting 33	Sighting 34	Sighting 35	Sighting 36
Sighting Information						
Effort	ON	ON	ON	ON	ON	ON
Date	2/18/2015	2/18/2015	2/18/2015	2/18/2015	2/18/2015	2/18/2015
Time (HST)	10:48:59	10:55:28	13:24:25	13:28:26	15:25:47	16:41:43
Location	22.28371 N 159.82912 W	22.29578 N 159.8324 W	22.57505 N 159.88292 W	22.55934 N 159.88469 W	22.44512 N 159.93771 W	22.29388 N 160.04471 W
Detection Sensor	MMO	MMO	MMO	MMO	BRIDGE	MMO
Species/Group	Unidentified Large Whale	Unidentified Large Whale	Unidentified Small Whale	Unidentified Large Whale	Unidentified Large Whale	Humpback Whale
Group Size (estimated range)	1	1	2-3	1	1	2-3
# Calves						
Bearing (relative)	350	280	100	70	20	80
Distance (m)	6120.48	4828.02	3349.76	2343.24	1371.60	2754.81
Animal motion	Closing	Unknown	Parallel	Unknown	Unknown	Parallel
Sighting Cue	Blow	Splash	Body	Blow	Blow	Blow
Behavior	Travel	Possible Breach	Travel	Unknown	Unknown	Slow Travel
Environmental Information						
Wave height (ft)	0-3	0-3	4-6	4-6	4-6	4-6
Visibility	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent
Beaufort Sea State	3	3	3	3	5	4
Cloud cover (%)	5.0	5.0	7.5	7.5	55.0	15.0
Glare (%)	5.0	5.0	15	15	20.0	10.0
Observation Information						
Sonar	OFF	OFF	OFF	OFF	OFF	OFF
Ship bearing (true)	328	2	189	179	280	269
Mitigation implemented	N	N	N	N	N	N
Comments		Possible whale breach. Large splash sighted. Distance estimated by ship.	Not a humpback, smaller, white-ish body. Possible Cuvier's beaked whale?	Probable humpback	Captain was first to sight animal.	

SECTION 4 CONCLUSIONS

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 twelfth 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-L. This information can be used to determine the level of exposure a marine mammal may experience during an MFAS event.