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# **Cruise Report, Marine Species Monitoring & Lookout Effectiveness Study Submarine Commanders Course, February 2018 Hawaii Range Complex**

Prepared for:  
U.S. Pacific Fleet



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<b>13. SUPPLEMENTARY NOTES</b>		
<b>14. ABSTRACT</b> <p>The Navy conducts monitoring within Navy Range Complexes and testing ranges, guided by the Integrated Comprehensive Monitoring Program, as required under the MMPA and the ESA, data were collected during 10-16 February 2018 during a Submarine Commanders Course (SCC) training event. This event is the eighteenth aboard a DDG. 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). Data collected are intended to be combined with current and future data in order to determine the effectiveness of Navy lookout teams as a whole, rather than specific to each vessel.</p> <p>Four Marine Mammal Observers (MMOs) (four U.S. Navy civilian 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-R 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.</p> <p>For the duration of the embark, the MMO team spent 50 hours 32 minutes searching for marine species during the training event. For whole days out at sea, approximately 8 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 3 to 5.</p>		

In total, 22 unique sightings comprising at least 83 individual marine mammals were recorded during the 7 days of observation.

Of the 22 sightings, humpback whales (*Megaptera novaeangliae*), short-finned pilot whales (*Globicephala macrorhynchus*), and an orca (*Orcinus orca*) were the species positively identified, accounting for 68% of individuals sighted. Unidentified large whales (which were also most likely humpback whales, with one unidentified large whale, that upon resighting was determined a potential sei whale [*Balaenoptera borealis*]). Four sightings occurred while sonar was active.

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**List of Acronyms and Abbreviations**

°	degrees
%	percent
BSS	Beaufort Sea State
DDG	United States Navy guided missile destroyer
DMMO	data marine mammal observer
ESA	Endangered Species Act
ft	foot (feet)
GPS	global positioning system
hr(s)	hour(s)
HRC	Hawaii Range Complex
HST	Hawaii Standard Time
ICMP	Integrated Comprehensive Monitoring Program
LMMO	liaison marine mammal observer
LO	Navy lookout
m	meter(s)
min(s)	minute(s)
MFAS	mid-frequency active sonar
MMO	marine mammal observer
MMPA	Marine Mammal Protection Act
SCC	submarine command course
SMMO	survey marine mammal observer
U.S.	United States

## SECTION 1 INTRODUCTION

In order to train with mid-frequency active sonar (MFAS), the United States (U.S.) Navy (Navy) has obtained a Letter of Authorization from the National Marine Fisheries Service under the Marine Mammal Protection Act (MMPA) and a Biological Opinion under the Endangered Species Act (ESA). The Navy conducts monitoring within Navy Range Complexes and testing ranges, guided by the Integrated Comprehensive Monitoring Program (ICMP), as required under the MMPA and the ESA (Department of the Navy 2010).

The ICMP provides the overarching framework for coordination of the Navy Marine Species Monitoring Program (Department of the Navy 2010). The ICMP outlines objectives for marine species monitoring and Navy-funded research relating to the effects of Naval training and testing activities on protected marine species (Department of the Navy 2010). The ICMP includes the following scientific objectives (Department of the Navy 2014):

1. monitor and assess the effects of Navy activities on protected marine species;
2. ensure that data collected at multiple locations is collected in a manner that allows comparison between and among different geographic locations;
3. assess the effectiveness and practicality of the monitoring and mitigation techniques; and
4. add to the overall knowledge base of protected marine species and the effects of Navy activities on these species.

In order to address these objectives, 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 accordance with objective 3 above, a study was initiated to determine the effectiveness of the Navy lookout (LO) team, including lookouts in the pilot house or on the bridge wings. Trained biologists are utilized for the study to collect data that would characterize the likelihood of detecting marine species in the field from a U.S. Navy guided missile 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 current and future data 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, four U.S. Navy civilian MMOs (Ms. Erin Oliveira, Dr. Thomas Jefferson, Mr. Benjamin Bartley, and Ms. Angela Bostwick) embarked on a DDG from February 10-16, 2018 during a Command Pacific Fleet Submarine Command Course (SCC) Exercise in the Hawaii Range Complex (HRC). These MMOs were stationed aboard a U.S. Navy guided missile destroyer, hereafter referred to as DDG-R. 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 MFAS.

## SECTION 2 METHODS

MMO surveys were conducted on a not-to-interfere basis, which means that the MMOs would not replace required Navy LOs, would not dictate operational requirements or maneuvers, and would remove themselves from the bridge wings if necessary for DDG-R 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, 183 meters [m]) and was not sighted by the Navy LO 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 LO team for appropriate reporting and action. The initial protocol for data collection was developed by the University of St. Andrews and refined by the MMOs on subsequent embarks.

The MMO survey on DDG-R 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° field in front of the ship that was covered by the MMOs, with a 20° 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, such as sea state and cloud cover, were collected routinely. Sightings obtained first by the SMMOs before the Navy LO were considered to be “trials.” If applicable, photographs were taken using a Canon EOS 7D digital camera with a 100 – 400 millimeter zoom lens. No photographs would be taken until the Navy LO had also made the sighting so as not to call attention to the sighting.

The track of the DDG-R would not be 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 would report sightings made by the Navy bridge wing LOs and by the bridge team. After a sighting by the Navy LO or bridge team, the LMMO would query the personnel to clarify information on the sighting such as animals seen, bearing, distance, and time. All four MMOs would typically be equipped with a headset/two-way radio setup in order to maintain communications without leaving their posts, as well as to communicate sighting and effort data without cueing the Navy LOs to sightings. However, one headset was not working properly throughout the embark; therefore, the LMMO did not use a headset/two-way radio setup for the duration of the trip. The DMMO would record all data and make initial determinations as to whether sightings were considered a duplicate, e.g., the same animal seen by two observers. The DMMO would also 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 global positioning system (GPS) waypoint would immediately be taken by the DMMO such that the accurate time and location of the event/sighting would be recorded, with associated information to be appended. Effort and



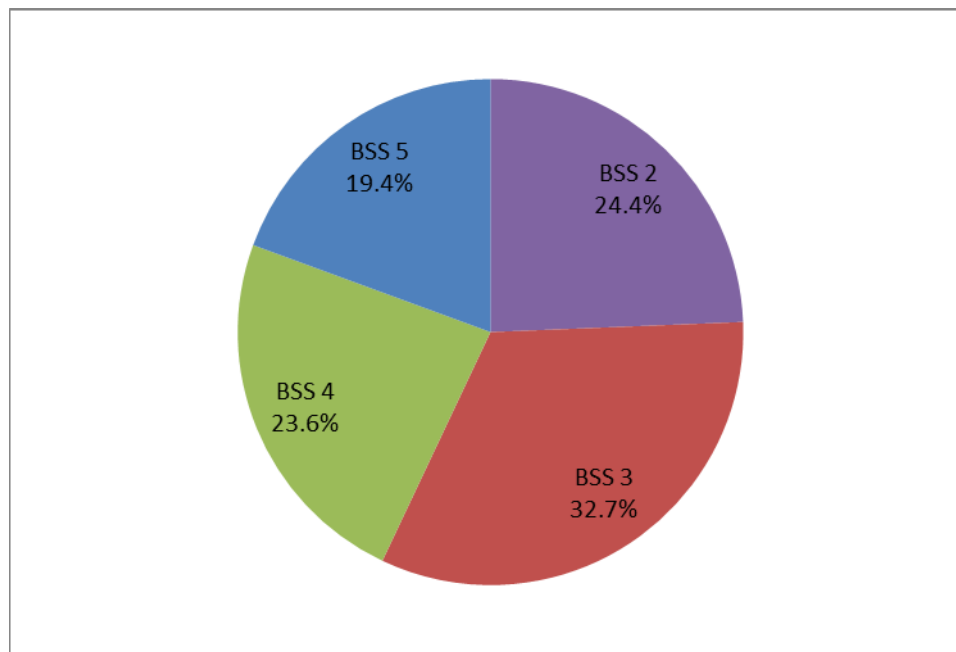
environmental information would be collected when the MMOs began effort, at each rotation, as weather changes occurred, and when the MMOs went off effort. At the conclusion of each observation day, if any photographs were taken, they would be reviewed to assist with species identification.

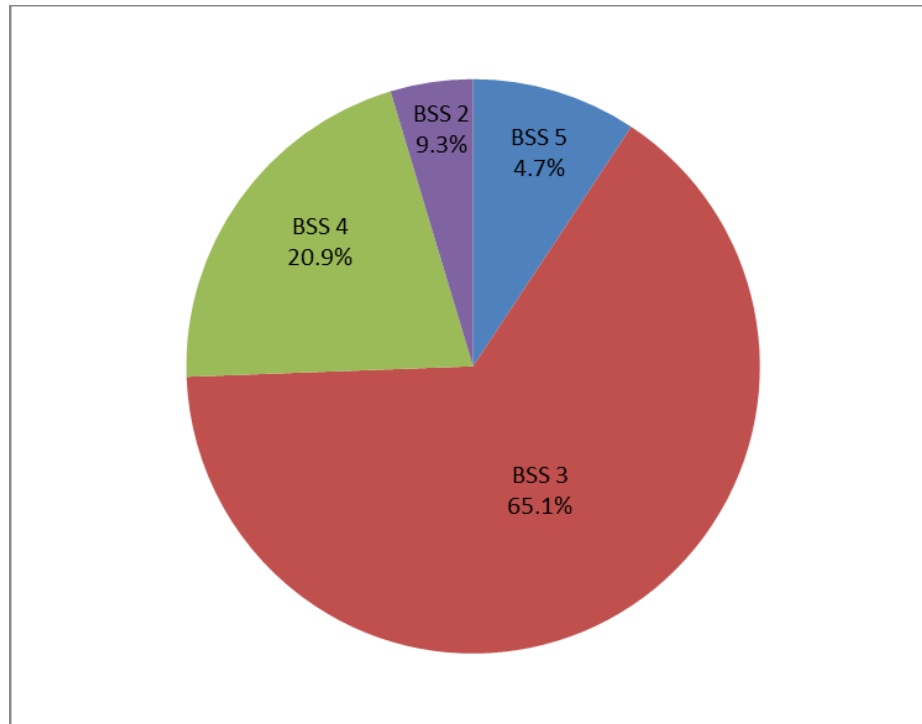
**SECTION 3 RESULTS**

The MMO team spent 50 hours (hrs) and 32 minutes (mins) searching for marine species during the SCC training event over seven days (Table 1). During whole days out at sea (excluding the day of departure, 10 February), approximately eight hours per day were spent on effort. Figure 1 shows the breakdown of the 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 percent [%]; Figure 1), while sightings were mostly distributed among BSS of 3–5 (Figure 2). Sightings occurred at every BSS throughout the observation period.

**Table 1. Effort Hours and Environmental Conditions**

Date	Team Hours On-Effort	Time	Beaufort Sea State (range)	% Cloud Cover (range)	Visibility
10 Feb	3 hrs 5 mins	1424-1729	3-5	15-95	Good to Excellent
11 Feb	6 hrs 5 mins	0718-0830, 1203-1221, 1250-1724	2-5	43-98	Poor to Excellent
12 Feb	9 hrs 7 mins	0714-1118, 1212-1715	2-5	5-97	Good to Excellent
13 Feb	8 hrs 32 mins	0720-0754, 0759-1126, 1250-1720	2-4	55-99.5	Good to Excellent
14 Feb	7 hrs 40 mins	0713-1115, 1215-1552	2-4	25-100	Moderate to Excellent
15 Feb	7 hrs 39 mins	0716-1117, 1215-1553	3-5	5-88	Good to Excellent
16 Feb	8 hrs 25 mins	0710-1112, 1204-1627	2-3	5-65	Excellent
<b>Total</b>	<b>50 hrs 32 mins</b>		<b>2-5</b>	<b>5-100</b>	<b>Poor to Excellent</b>

**Figure 1. Total Percentage of Effort at Various Beaufort Sea States**

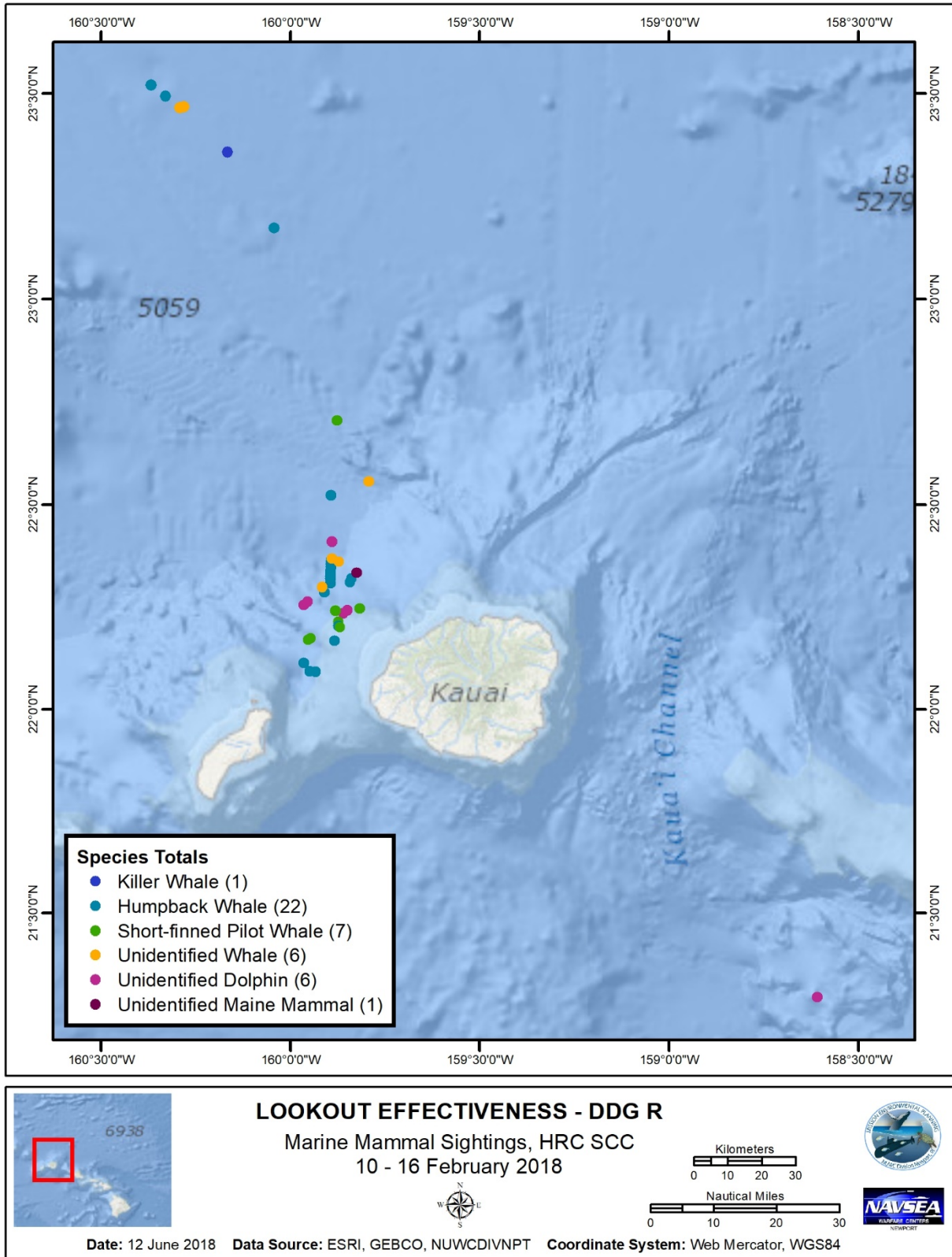


**Figure 2. Total Percentage of Sightings at Various Beaufort Sea States**

In total, 22 unique sightings (in which each sighting does not include subsequent re-sightings or separate sightings by the MMOs and LOs), comprising at least 83 individual marine mammals, were recorded during the seven days of observation. MMOs made 20 sightings independent of the Navy's LO team (Table 2). There were two sightings made concurrently by both the MMO and LO team. There were no sightings by the LO team independent of the MMOs.

**Table 2. Number of Sightings Made by MMO and LO Teams**

Date	Independent MMO Sightings	Independent Navy LO Team Sightings	Sightings by both Teams
10 Feb	1	0	0
11 Feb	2	0	1
12 Feb	1	0	0
13 Feb	3	0	0
14 Feb	1	0	1
15 Feb	6	0	0
16 Feb	6	0	0
<b>Total</b>	<b>20</b>	<b>0</b>	<b>2</b>



**Figure 3. Sighting and Resighting Locations During the February 2018 SCC**

Trials, or sightings in which the MMOs detected animals before the Navy LOs, were successfully conducted on seven days. Not all of these sightings occurred during MFAS, as the SCC event was only in progress from February 12 through February 16. Eighteen sightings and 18 trials occurred over the days of the SCC event. The rate of trials averaged 0.43 trials per hour of effort across seven days of effort (Table 3). The sighting rate was highest on February 15 and 16, when there were steady conditions including BSS of 2 or 3 and good to excellent visibility. This highest rate of sightings occurred in the channel between Kauai and Niihau (Figure 3).

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

Date	Hours MMO Team Effort	# of Unique Sightings	Sightings/Hour	# of Trials	Trials/Hour
10 Feb	3 hrs 5 mins	1	0.32	1	0.32
11 Feb	6 hrs 5 mins	3	0.49	3	0.49
12 Feb	9 hrs 7 mins	1	0.11	1	0.11
13 Feb	8 hrs 32 mins	3	0.35	3	0.35
14 Feb	7 hrs 40 mins	2	0.26	2	0.26
15 Feb	7 hrs 39 mins	6	0.78	6	0.78
16 Feb	8 hrs 25 mins	6	0.71	6	0.71
<b>Cumulative</b>	<b>50 hrs 32 mins</b>	<b>22</b>	<b>0.43</b>	<b>22</b>	<b>0.43</b>

Of the 22 sightings, humpback whales (*Megaptera novaeangliae*), short-finned pilot whales (*Globicephala macrorhynchus*), and an orca (*Orcinus orca*) were the species positively identified, accounting for 68% of individuals sighted. Unidentified large whales (which were also most likely humpback whales, with one unidentified large whale, that upon resighting was determined a potential sei whale [*Balaenoptera borealis*]). Unidentified whales and dolphins together accounted for the remaining 32% of individuals sighted (Table 4). Four sightings occurred while sonar was active.

**Table 4. Marine Mammal Sightings**

Data Category	Sighting 1	Sighting 2	Sighting 3	Sighting 4	Sighting 5	Sighting 6
<b>Sighting Information</b>						
Effort	ON	ON	ON	ON	ON	ON
Date	2/10/2018	2/11/2018	2/11/2018	2/11/2018	2/12/2018	2/13/2018
Time (HST)	16:10:55	13:31:55	14:35:47	15:34:54	10:35:20 11:13:05	13:39:23
Location	21.29281 °N 158.6090 °W	23.52064 °N 160.3674 °W	23.35843 °N 160.1654 °W	23.1734 °N 160.0430 °W	22.36622 °N 159.8913 °W	22.55613 °N 159.7927 °W
Detection Sensor	MMO	MMO	MMO	MMO	MMO	MMO
Species/Group	Unidentified dolphin	Humpback whale	Orca	Humpback whale	Humpback whale	Unidentified large whales
Group Size (estimated range)	1	4	1	1	2	2
# Calves	0	0	0	0	0	0
Bearing (relative degrees)	90°	315°	42°	0°	310°	5°
Distance (m)	50 m	Horizon	1,600 m	4,300 m	7,500 m	8,600 m
Animal motion	None	None	Closing	Closing	None	None
Sighting Cue	Dorsal fin	Splash	Dorsal fin	Blow	Blow	Splash
Behavior	Traveling	Breaching	Traveling	Other	Other	Unknown
<b>Environmental Information</b>						
Wave height (ft)	4-6 ft	4-6 ft	4-6 ft	4-6 ft	0-3 ft	4-6 ft
Visibility	Excellent	Good	Excellent	Excellent	Excellent	Good
Beaufort Sea State	3	4	5	5	3	2
Cloud cover (%)	93%	95%	43%	43%	5%	77.5%
Glare (%)	3%	18%	20%	25%	7.5%	5%
<b>Operational Information</b>						
Sonar	OFF	OFF	OFF	OFF	OFF	ON
Ship bearing (true)	294°	145°	122°	183°	190°	200°
Mitigation implemented	N	N	N	N	N	N
Comments	Animal had a spotted back.	Thought two animals initially, determined to be 4 after further observation.			Sonar heard "biologics."	No re-sighting after initial. Possible MEGNO. Possibly 2 animals.

**Table 4. (cont.) Marine Mammal Sightings**

Data Category	Sighting 7	Sighting 8	Sighting 9	Sighting 10	Sighting 11	Sighting 12
<b>Sighting Information</b>						
Effort	ON	ON	ON	ON	ON	ON
Date	2/13/2018	2/13/2018	2/14/2018	2/14/2018	2/15/2018	2/15/2018
Time (HST)	15:28:26	16:10:14 16:12:00	10:54:15 11:06:00	14:43:47 14:50:00	09:04:58	09:25:10 09:27:06
Location	22.5232 °N 159.8931 °W	22.32942 °N 159.8938 °W	22.30982 °N 159.8925 °W	22.70555 °N 159.8774 °W	22.23524 °N 159.8592 °W	22.24106 °N 159.8812 °W
Detection Sensor	MMO	MMO	MMO	MMO	MMO	MMO
Species/Group	Humpback whale	Unidentified dolphin	Humpback whales	Short-finned pilot whales	Unidentified dolphins	Short-finned pilot whales
Group Size (estimated range)	1	1	1	7	5	2
# Calves	0	0	0	0	0	0
Bearing (relative)	60°	10°	85°	280°	350°	15°
Distance (m)	6,150 m	4,300 m	6,750 m	2,050 m	500 m	3,850 m
Animal motion	Parallel	None	None	Parallel	Closing	None
Sighting Cue	Body	Body	Blow	Body	Dorsal fin	Dorsal fin
Behavior	Breaching	Other	Other	Tail slap	Traveling	Traveling
<b>Environmental Information</b>						
Wave height (ft)	4-6 ft	4-6 ft	4-6 ft	4-6 ft	4-6 ft	4-6 ft
Visibility	Good	Good	Excellent	Good	Excellent	Excellent
Beaufort Sea State	4	3	4	2	3	3
Cloud cover (%)	90%	99.5%	27.5%	100%	75%	75%
Glare (%)	0%	5%	17.5%	0%	5%	5%
<b>Operational Information</b>						
Sonar	OFF	OFF	ON	OFF	ON	OFF
Ship bearing (true)	121°	6°	356°	194°	180°	116°
Mitigation implemented	N	N	N	N	N	N
Comments	2 breaches by whale, then it passed the beam.	Leaped 3 times, then ship turned drastically and lost sight.	probable humpback, confirmed by resighting.	Traveling. Head seen on animal to make positive ID.	Closed to 200 m, then passed beam. Thick, dark gray body. Standard dorsal.	Pilot whales sighted while turning. Black in color.

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					Probable pilot whales.	
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**Table 4. (cont.) Marine Mammal Sightings**

Data Category	Sighting 13	Sighting 14	Sighting 15	Sighting 16	Sighting 17	Sighting 18
<b>Sighting Information</b>						
Effort	ON	ON	ON	ON	ON	ON
Date	2/15/2018	2/15/2018	2/15/2018	2/15/2018	2/16/2018	2/16/2018
Time (HST)	09:34:09 09:35:00	09:36:36 09:38:00	09:52:35 09:54:35	15:55:16 15:57:00	08:46:42	09:29:33 09:33:00
Location	22.2136 °N 159.8734 °W	22.20443 °N 159.8731 °W	22.24282 °N 159.8489 °W	22.17397 °N 159.9465 °W	22.28624 °N 159.9100 °W	22.09191 °N 159.9332 °W
Detection Sensor	MMO	MMO	MMO	MMO	MMO	MMO
Species/Group	Short-finned pilot whales	Humpback whale	Short-finned pilot whales	Short-finned pilot whales	Humpback whale	Humpback whales
Group Size (estimated range)	12	1	12	5	1	3
# Calves	0	0	0	0	0	0
Bearing (relative)	295°	345°	350°	345°	300°	290°
Distance (m)	3,650 m	200 m	6,100 m	50 m	10,250 m	6,100 m
Animal motion	Parallel	None	Opening	Closing	None	None
Sighting Cue	Body	Dorsal	Dorsal fin	Dorsal fin	Blow	Blow
Behavior	Resting	Other	Traveling	Resting	Diving	Breaching
<b>Environmental Information</b>						
Wave height (ft)	4-6 ft	4-6 ft	4-6 ft	4-6 ft	4-6 ft	0-3 ft
Visibility	Excellent	Excellent	Excellent	Good	Excellent	Excellent
Beaufort Sea State	3	3	3	3	3	3
Cloud cover (%)	75%	75%	75%	65%	10%	30%
Glare (%)	5%	5%	5%	15%	7.5%	7.5%
<b>Operational Information</b>						
Sonar	OFF	OFF	OFF	OFF	OFF	OFF
Ship bearing (true)	180°	140°	88°	308°	181°	275°
Mitigation implemented	N	N	N	N	N	N
Comments		Changed course. Juvenile, maybe calf.	Sight lost during dive.		One blow; dive greater than 5 min. Lost in glare.	Splash, body, tail slapping, and breaching behaviors displayed.

**Table 4. (cont.) Marine Mammal Sightings**

Data Category	Sighting 19	Sighting 20	Sighting 21	Sighting 22
<b>Sighting Information</b>				
Effort	ON	ON	ON	ON
Date	2/16/2018	2/16/2018	2/16/2018	2/16/2018
Time (HST)	09:31:40 09:35:00	10:42:58	12:54:30	13:25:53
Location	22.09329 °N 159.9482 °W	22.25509 °N 159.9645 °W	22.29921 °N 159.9160 °W	22.36753 °N 159.8900 °W
Detection Sensor	MMO	MMO	MMO	MMO
Species/Group	Humpback whales	Unidentified dolphins	Unidentified large whale	Unidentified large whale
Group Size (estimated range)	2	1	1	1
# Calves	0	0	0	0
Bearing (relative)	20°	45°	50°	50°
Distance (m)	8,600 m	2,050 m	6,100 m	400 m
Animal motion	None	Opening	None	Parallel
Sighting Cue	Blow	Body	Blow	Blow
Behavior	Unknown	Breaching	Diving	Diving
<b>Environmental Information</b>				
Wave height (ft)	0-3 ft	0-3 ft	4-6 ft	0-3 ft
Visibility	Excellent	Excellent	Excellent	Excellent
Beaufort Sea State	3	3	3	3
Cloud cover (%)	30%	17.5%	12.5%	5%
Glare (%)	7.5%	10%	2.5%	0%
<b>Operational Information</b>				
Sonar	OFF	OFF	OFF	ON
Ship bearing (true)	275°	97°	89°	81°
Mitigation implemented	N	N	N	Y
Comments	Closed to 200 m, then passed beam.	Only sighting was initial breach.	One blow, nothing further sighted.	Within mitigation zone, reported. Changed course and shut off sonar.

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				Probable sei whale after resighting.
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## **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 assess the effectiveness of the Navy lookout team.

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

## **SECTION 5      REFERENCES**

Department of the Navy. (2010). *United States Navy Integrated Comprehensive Monitoring Program 2010 Update*, 20 December 2010.

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