Protected Species Observer IHA Report for the Ørsted Ocean Wind 02 High Resolution Geophysical Survey 2022

Prepared for:
Ørsted Wind Power North America, LLC

Submitted by:
Smultea Environmental Sciences

Survey:
Ørsted Ocean Wind 02 Geophysical Survey 2022
BOEM Lease Area OCS-A 0532
Ocean Wind II IHA 10 May 2022-2023

Survey Dates included in Report:
10 May – 17 July 2022

Smultea Environmental Sciences, LLC.
+1 707 362 5376
www.smulteasciences.com

Recommended Citation

Smultea Environmental Sciences, LLC (Smultea Sciences). 2022. Protected Species Observer IHA Report for the Ørsted Ocean Wind 02 High Resolution Geophysical Survey 2022. Final Report. Prepared by M.A. Smultea, R.S. Snyder, C.M. Reiser, and R. Wachtendonk. Prepared for Ørsted Wind Power North America, LLC. 01 September 2022. 71 pp.

Table of Contents

List of Tables

List of Figures

Acronyms and Abbreviations

AA	Applied Acoustics
AIS	A.I.S., Inc.
AMP	Alternative Monitoring Plan
B	Beaufort sea state
BOEM	Bureau of Ocean Energy Management
BOEM PDC	BOEM Atlantic OCS Region Project Design Criteria and Best Management Practices for Protected Species Associated with Offshore Wind Data Collection
BOSIET	basic offshore safety induction and emergency training
CHIRP	compressed high-intensity radiated pulses
CPA	closest point of approach
CSA	CSA Ocean Sciences Inc.
Current Corp IR	Current Night Navigator 3050 VT infrared camera
dB	decibel
delphinid	superfamily including dolphins and harbor porpoise
DMA	Dynamic Management Area
DSLR	digital single-lens reflex
ECR	export cable route
ET	Edgetech
EZ	exclusion zone
FOV	field of view
Fugro	Fugro USA Marine, Inc.
HRG	high resolution geophysical
HSE	health, safety, and environment
IHA	Incidental Harassment Authorization
J	joules
GPS	global positioning system
HF	high frequency
HH	handheld
IR	infrared
kHz	kilohertz
km	kilometer
kt	knot
Lease	Bureau of Ocean Energy Management (BOEM) Commercial Lease of Submerged Lands for Renewable Energy Development on the Outer Continental Shelf OCS-A 0532
LF	low frequency
MBES	multi-beam echosounder
MV	mid-frequency
mm	millimeter
MMPA	Marine Mammal Protection Act
mounted IR	vessel-mounted IR camera system
M-UHRS	multi-channel ultra-high resolution seismic

NARW	North Atlantic right whale
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NVD	night vision device
OCS	Outer Continental Shelf
Ørsted	Ørsted Wind Power North America, LLC
PAM	passive acoustic monitoring
PK	zero to peak sound pressure level in dB re 1 µPa
PSO	protected species observer
PW	phocids in water
RB	reticle binoculars
re	referenced to
RMS	root mean square
RWSAS	Right Whale Sighting Advisory System
SBI	sub-bottom imager
SBP	sub-bottom profiler
SEL_{24h}	cumulative sound exposure level
SMA	Seasonal Management Area
Smultea Sciences	Smultea Environmental Sciences, LLC
SPL	root mean square sound pressure level
SSS	side-scan sonar
Survey Area	waters within and surrounding BOEM Lease Area OCS-A 0532 and the export cable routes
S-UHRS	single-channel ultra-high resolution seismic
TB	Teledyne Benthos
TTS	temporary threshold shift
TVG	transverse gradiometer
UE	unaided eye
UHD	ultra-high definition
USBL	ultra-short baseline
µPa	micro pascal

1 Executive Summary

This report, which summarizes protected species monitoring and mitigation activities for the Ørsted Wind Power North America, LLC (Ørsted) Ocean Wind 02 Wind Farm fulfills the reporting requirements of the Ørsted 2022 Ocean Wind II National Marine Fisheries Service (NMFS) Incidental Harassment Authorization (IHA) issued on 10 May 2022 (NMFS 2022). Dates associated with this report correspond to the active period of the 2022 IHA (10 May 2022 through project completion on 17 July 2022).

Protected species observers (PSOs) were present aboard two HRG survey vessels, the *Fugro Brasilis* (offshore vessel) and the *Substantial* (nearshore vessel), to implement ship strike avoidance and geophysical survey mitigation measures during high resolution geophysical (HRG) surveys off the coast of New Jersey for the Ørsted Ocean Wind 02 Wind Farm from 10 May through 17 July 2022. Mitigation and monitoring requirements were stipulated in the Bureau of Ocean Energy Management (BOEM) *Commercial Lease of Submerged Lands for Renewable Energy Development on the Outer Continental Shelf* OCS-A 0532 (BOEM 2016, BOEM 2021a), BOEM Atlantic OCS Region *Project Design Criteria and Best Management Practices for Protected Species Associated with Offshore Wind Data Collection* (BOEM PDC; BOEM 2021b), BOEM limited waiver, and the 2022 Ørsted Ocean Wind II NMFS IHA (NMFS 2022; collectively referred to herein as regulatory documents).

Monitoring effort was accomplished over a combined (nearshore and offshore vessels) total distance of 9992.9 kilometers (km) and 1599.7 hours of visual observation. Monitoring effort during daylight was conducted for the majority (69%) of the total combined effort, with observations taking place only during daylight on the nearshore vessel *Substantial*. HRG acoustic sources operating below 200 kHz were active for 70% of the combined monitoring effort.

Throughout the surveys, the PSOs recorded a combined total of 101 protected species detections (51 marine mammal and 50 sea turtle) composed of an estimated 282 individuals. Unidentified dolphins and loggerhead sea turtles (*Caretta caretta*) were the most frequently detected group/species at 25 and 31 detections respectively. North Atlantic right whales (NARW, *Eubalaena glacialis*) or other ESA-listed marine mammal species were not confirmed by PSO observations, and no Atlantic sturgeon were detected. More than half (63%) of the protected species detections occurred while HRG acoustic sources operating below 200 kilohertz (kHz) were active. The sparker, a medium penetration sub-bottom profiler (SBP) was active for the majority (77%) of those detections.

The PSOs estimated 3% of protected species detections were observed to change behavior while the sparker and other HRG acoustic sources below 200 kHz were active (two of the 64 detections with HRG sources active) and 5% exhibited a response when acoustic sources below 200 kHz were inactive (two of the 37 detections with HRG sources inactive). One dive response was reported for a loggerhead sea turtle and one response classified as "other" was reported for an unidentified dolphin while HRG sources were active. Behavioral changes were observed as often while the sparker and other HRG sources below 200 kHz were inactive as when they were active, which indicates that behavioral responses to HRG acoustic sources were minimal and that HRG acoustic

sources are not the only stimulus that may induce a behavioral response in marine mammals and sea turtles during HRG surveys for offshore wind farm development.

Protected species mitigation measures were requested and implemented on six occasions, including one shutdown and five strike avoidance speed reductions. In addition to protected species mitigation measures, 12 weather related mitigation measures were implemented for reduced visibility (ten shutdowns and two delays). Most of the 51 hours of PSO related downtime (99%) was attributed to reduced visibility. All mitigation measures were implemented quickly and effectively.

A total of ten marine mammals and 28 sea turtles were observed within the 141 m Level B harassment isopleth for the sparker and may have been exposed to sound levels of at least 160 decibels (dB) root mean square (RMS) from the sparker. All ten potential marine mammal exposures were for unidentified dolphins that voluntarily approached the vessel and, therefore, did not require a shutdown.

Mitigation and monitoring protocols under the Regulatory documents were effectively implemented by the PSOs throughout the Ørsted Ocean Wind 02 survey campaign. Vessel and survey crews assisted PSOs in ensuring appropriate mitigation and strike avoidance measures were implemented as necessary, while maintaining effective communication and vessel safety.

2 Introduction

All marine mammals are protected under the Marine Mammal Protection Act (MMPA) of 1972. Per the MMPA, operations that emit noise into the marine environment must be assessed by NMFS if sound levels produced by the activity have the potential to disturb or injure marine mammals by exceeding pre-determined sound exposure thresholds and frequencies that may rise to NMFS-determined level of "take" (NMFS 2018). HRG surveys conducted to advance the development of the Ørsted Ocean Wind 02 Wind Farm required the use of HRG equipment that produced sounds with the potential to disturb protected marine species. PSOs were therefore required aboard all survey vessels to monitor and mitigate for protected species.

Ocean Wind II, LLC, a subsidiary of Ørsted applied to NMFS for an IHA in October 2021 (revised January 2022; CSA 2022) to support HRG surveys associated with the development of the Ocean Wind offshore wind project within BOEM Lease OCS-A 0532 (BOEM 2016, BOEM 2021a, CSA 2021). It should be noted that BOEM Lease OCS-A 0532 was previously assigned to BOEM Lease OCS-A 0498 (reassignment in March 2021; BOEM 2021a). NMFS subsequently issued an IHA to Ocean Wind II, LLC on 10 May 2022 (NMFS 2022). The 2022 Ocean Wind II IHA (NMFS 2022) replaced the 2021 Ocean Wind IHA (NMFS 2021), which expired during Ocean Wind 02 survey operations at midnight on 10 May 2022. This report includes protected species observation during survey operations corresponding to the active dates of the 2022 Ocean Wind II IHA (from 10 May 2022 through project completion). Both IHAs were valid for one year from the date of issuance and covered all HRG survey work in New Jersey coastal waters, including the OCS-A 0532 lease area and associated export cable routes (ECRs; Figure 1).

HRG surveys were conducted by the marine survey companies Fugro USA Marine, Inc. (Fugro) and Geodynamics. PSOs provided by A.I.S., Inc (AIS) and Smultea Environmental Sciences, LLC (Smultea Sciences), together referred to herein as PSO providers, were present aboard two HRG survey vessels, the Fugro Brasilis and the Substantial (Figures 2-3). The PSO providers were contracted by the marine survey companies to conduct BOEM and NMFS required monitoring and mitigation for protected species during the HRG surveys. PSO providers supplied PSOs and night vision equipment as required by the BOEM Lease OCS-A 0532, BOEM approved survey and monitoring plan (including the Alternative Monitoring Plan [AMP]), and the IHAs. Fugro provided vessel-mounted infrared (IR) camera systems for use by PSOs aboard the survey vessel Fugro Brasilis. Marine survey companies, survey vessels, and PSO providers who monitored from each respective vessel are provided in Table 1.

The primary on-site responsibilities of the PSO teams were to monitor for protected marine species (i.e., marine mammals, sea turtles, Atlantic sturgeon, and manta rays) and implement mitigation measures to avoid and minimize potential adverse impacts to those species. This was accomplished by conducting visual observations 24 hours per day utilizing infrared (IR) and night vision monitoring technologies during darkness. Specific mitigation measures for the survey and associated regulatory documents are described in the Section 4.

Smultea Sciences was contracted by Ørsted to prepare this PSO IHA Report for the Ocean Wind 02 2022 HRG surveys, combining all PSO monitoring and mitigation data for the two survey vessels that operated within the BOEM Lease OCS-A 0532 and associated

ECR corridors.

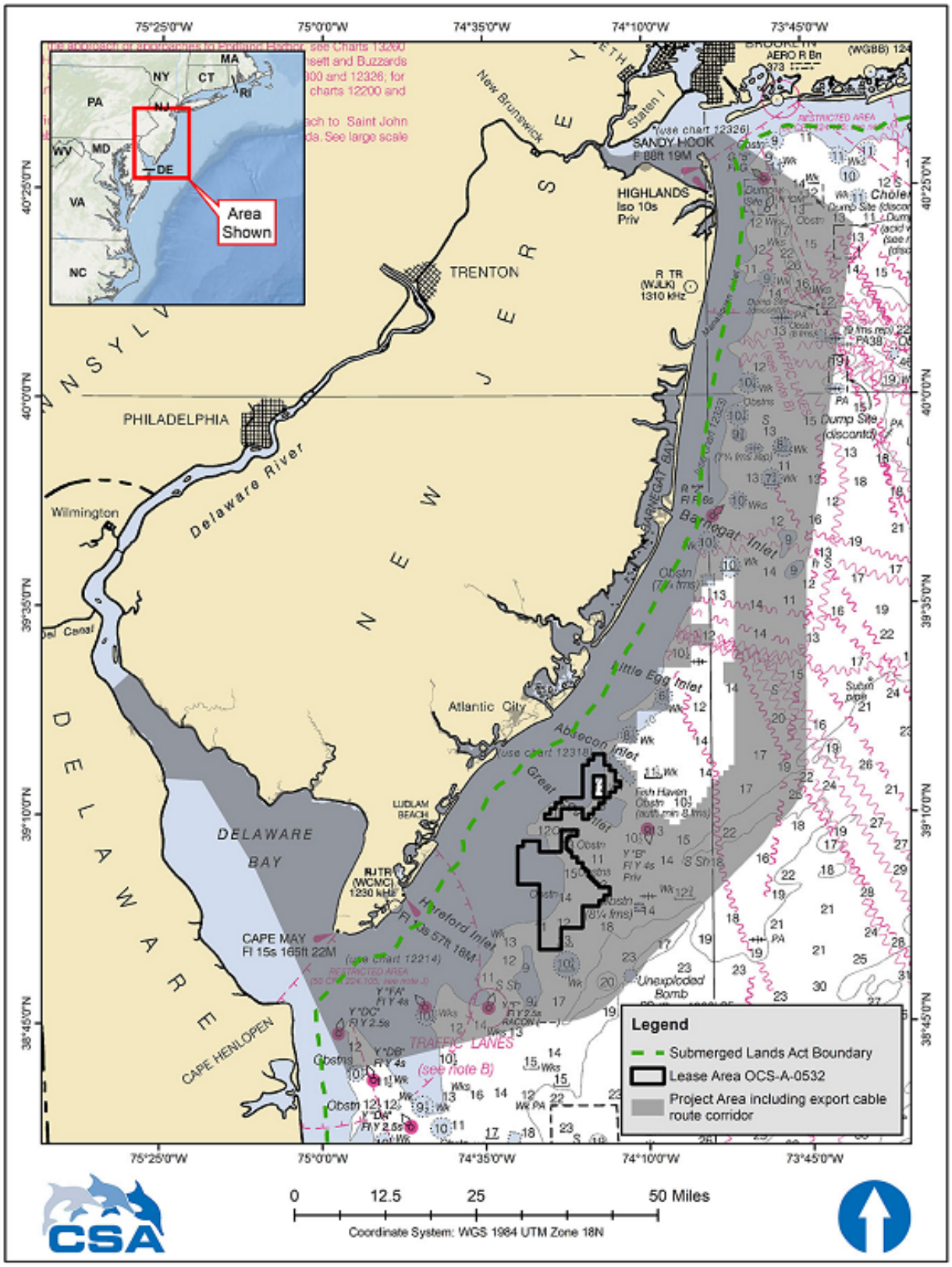


Figure 1. Ocean Wind 02 HRG survey area. Figure from the Ørsted Ocean Wind II IHA application (CSA 2022).

Table 1. Survey vessels, marine survey operators, and PSO providers that operated on the Ocean Wind 02 HRG surveys.

Survey Vessel	Marine Survey Company	PSO Provider
Offshore Vessel		
Fugro Brasilis	Fugro	Smultea Sciences
Nearshore Vessel		
Substantial	Geodynamics	AIS

Figure 2. Offshore survey vessel *Fugro Brasilis*. Photograph provided by Fugro.

Figure 3. Nearshore survey vessel *Substantial.* Photograph provided by Morgan Smith on behalf of Geodynamics.

3 Survey Overview

Survey activities were conducted by two survey vessels from 10 March through 17 July 2022. The nearshore vessel *Substantial* was in operation from 10 March through 02 June 2022, while the offshore vessel *Fugro Brasilis* was active from 08 April through 12 July 2022. The *Fugro Brasilis* conducted HRG survey operations on the Ørsted Sunrise Wind lease area from 13-17 July before returning to the Construction and Marine Equipment (CME) dock in Elizabeth, New Jersey on 17 July for demobilization of both projects. The complete timeline for HRG operations for each vessel is provided in Table 2, however the remainder of this report only includes data collected between 10 May and 12 July 2022.

Table 2. Summary of HRG events for the two survey vessels on the Ocean Wind 02 surveys.

Event	Date (2022)
Technical kick-off meeting at Fugro office in Lafayette, Louisiana and virtual	16 February
Technical kick-off meeting at Geodynamics office in Morehead City, North Carolina (NC)	18 February
Substantial mobilization and vessel kick-off meeting in Morehead City, NC	10-11 March
Substantial departs Beaufort, NC for testing location, returning to dock due to equipment issue	13 March
Substantial departs Beaufort, NC and begins transit to Point Pleasant Beach New Jersey (NJ)	14-16 March
Substantial begins HRG equipment testing (daylight hours only), returning to dock in Point Pleasant Beach, NJ before darkness each day	18 March
Fugro Brasilis mobilization and vessel kick-off meeting at CME dock in Elizabeth, NJ	08-10 April
Substantial begins HRG operations (daylight hours only) on Ocean Wind 02, returning to dock in Point Pleasant Beach, NJ before darkness each day	11 April
Fugro Brasilis departs CME in Elizabeth, NJ for survey area	11 April
Fugro Brasilis begins 24-hour HRG equipment testing	11 April
Fugro Brasilis begins 24-hour HRG operations on Ocean Wind 02	13 April
Substantial completes HRG operations on Ocean Wind 02; demobilization in Point Pleasant Beach, NJ	02 June
Fugro Brasilis completes HRG operations on Ocean Wind 02 and begins transit to Ørsted Sunrise Wind lease area	12 July
PSO effort on Ocean Wind 02 complete	12 July
Fugro Brasilis returns to CME dock in Elizabeth, NJ for demobilization	17 July

HRG survey equipment consisted of medium penetration SBP sparkers (single-channel ultra-high resolution seismic [S-UHRS] and multi-channel ultra-high resolution seismic [M-UHRS] configurations), multi-beam echosounders (MBES), parametric Innomar shallow-bottom SBPs, side-scan sonars (SSS), magnetometers (transverse gradiometers [TVG]), and ultra-short baseline (USBL) positioning systems. The sparker, Innomar SBP, and USBL equipment operated at frequencies below 200 kHz (Table 3).

Mitigation measures applied only to the sparker. Non-parametric SBPs also required mitigation (except for shutdowns) but only parametric SBPs were used on the two survey vessels.

Table 3. Geophysical survey equipment used on each vessel during the Ocean Wind 02 HRG surveys.

Survey Equipment	Make	Model	Operating Frequency (kHz)
Offshore Survey Vessel *Fugro Brasilis*			
Multi-Beam Echosounder	Kongsberg	EM2040	200-400
Side-Scan Sonar	Edgetech	4205	600/900
Magnetometer	Geometrics	G-882	passive
Ultra-Short Baseline Positioning System (USBL)	Kongsberg	C-Node	20-30
Medium Penetration SBP (S-UHRS and M-UHRS)	GeoMarine	Dual 400, GeoSource 800 Sparker	0.4-5
Parametric Shallow Penetration SBP	Innomar	SES 2000 Medium	5-15
Nearshore Survey Vessel *Substantial*			
Multi-Beam Echosounder	Kongsberg	EM2040C	200-400
Side-Scan Sonar	Edgetech	4205	400/600/900/1600
Magnetometer	Geometrics	G-882	passive
Ultra-Short Baseline Positioning System	Sonardyne	MiniRanger 2	19-34
Medium Penetration SBP (S-UHRS)	Applied Acoustics	Dura-Spark 400 UHD Sparker	0.3-1.2
Parametric Shallow Penetration SBP	Innomar	SES 2000 Medium	5-15

kHz = kilohertz, SBP = sub-bottom profiler, S-UHRS = single-channel ultra-high resolution seismic, M-UHRS = multi-channel ultra-high resolution seismic, UHD = ultra-high definition

4 Monitoring and Mitigation Program

The protected species monitoring and mitigation program for the survey was established to satisfy the monitoring and mitigation requirements outlined in the Regulatory documents. The objectives of this program were to (1) minimize disturbance to protected species from HRG acoustic equipment operating below 200 kHz and (2) reduce the risk of vessel collision with protected species. Specific monitoring and mitigation regulations are described in detail in the following sections.

4.1 Protected Species Observers (PSOs)

The PSO team aboard the offshore survey vessel *Fugro Brasilis* was comprised of four PSOs, including one lead PSO and one or more additional senior PSOs to ensure an experienced PSO was available 24 hours per day. The nearshore vessel *Substantial* was staffed by a team of two PSOs, one of which was a lead PSO.

All PSOs met the minimum requirements identified by BOEM and NMFS in the Regulatory documents and were certified in basic offshore safety induction and emergency training (BOSIET) or an equivalent offshore safety certification. Prior to mobilization, PSOs were trained on specific project details and requirements including the identification, behavior, and occurrence of local protected species inhabiting the general survey area (i.e., northeastern US waters). Species identification guides and references were available at the PSO station on each vessel at all times.

PSOs monitored during all vessel operations, including transit to and from the survey area, equipment calibration, HRG survey operations, and when the vessel conducted weather patterns (i.e., weather standby and positioning the vessel to minimize pitch and roll during rough weather).

Monitoring occurred 24 hours on the offshore vessel *Fugro Brasilis*, with one PSO monitoring during daylight and two PSOs monitoring concurrently during darkness: one PSO used a handheld (HH) night vision device (NVD) and the second PSO monitored vessel-mounted Current Corp IR cameras. Passive acoustic monitoring (PAM) was not used to supplement visual monitoring during darkness on the *Fugro Brasilis*. Monitoring on the nearshore vessel *Substantial* was conducted only during daylight hours, with one PSO on watch.

PSOs maintained clear and effective communication at all times with the survey chain of command on and off the vessels. On board, PSOs attended the daily Health, Safety, and Environment (HSE) meetings with the vessel and survey crew. Any project questions were addressed in that setting or as needed in real time.

4.2 Visual Observation Methods

During the survey, PSOs conducted visual monitoring using four different methods: the unaided eye (UE, which includes systematic use of reticle binoculars [RB]), NVD, HH IR devices, and vessel-mounted IR camera systems. HH IR devices were available as backup to the mounted IR cameras on the *Fugro Brasilis*. PSOs aboard the *Substantial* also had access to a HH IR device, but the equipment was not used during the reporting period. Monitoring equipment available to PSOs on each vessel is summarized in Table 4;

model specifications for monitoring equipment are provided in Appendix A. PSO teams aboard each vessel also were provided with a digital single-lens reflex (DSLR) camera with 70–300-millimeter (mm) lenses to document visual detections of protected species and to verify species identification when possible.

Table 4. Monitoring equipment available on each vessel during the Ocean Wind 02 HRG surveys. X indicates device was available for use by PSOs on the vessel.

Survey Vessel	NVD PVS-7 Biocular	NVD PVS-14 Monocular	HH IR FLIR BHM 6XR Biocular	HH IR FLIR Scout III 640	Vessel-Mounted Current Corp Night Navigator 3050 IR Camera	RB (various models)
Offshore Survey Vessel						
Fugro Brasilis	X	X	X	X	X	X
Nearshore Survey Vessel						
Substantial				X		X

HH = handheld, NVD = night vision device, IR = infrared, RB = reticle binocular

Visual monitoring was conducted from the bridge (inside and outside on the bridge wings) and forecastle decks on the *Fugro Brasilis* and from the flying bridge on the *Substantial*. These monitoring locations provided a 360° view of the water surrounding the survey equipment and vessel, offered the highest vantage points deemed safe for observers, and provided shelter from inclement weather. Visual observations were conducted outside as much as possible. Monitoring took place from inside the bridge when weather and/or high sea states made observation conditions detrimental to equipment or personal safety.

The distance to the unobstructed horizon at sea was calculated for each monitoring location on the vessels using known observer eye height and deck height above water and applying trigonometry and corrections for curvature of the earth (Table 5). Individual PSO eye heights and deck heights were measured prior to the surveys during mobilization. This information was entered into *Mysticetus*™ observation software (*Mysticetus*) data collection system, which then automatically calculated distance to visual detections and plotted them on the *Mysticetus* digital map interface.

Table 5. Distance to the horizon from each observing location on each vessel used during the Ocean Wind 02 HRG surveys.

Vessel	Monitoring Location	Height of Deck (m)	Height of Deck (m) + 1.6 m[1]	Distance to Horizon (km)
Offshore Vessel				
Fugro Brasilis	Bridge Deck	10.7	12.3	12.5
Fugro Brasilis	Forecastle Deck	8.01	9.61	11.1
Nearshore Vessel				
Substantial	Flying Bridge	2.45	4.05	7.2

[1] 1.6 m is the average eye height based on the average male (5 feet 9 inches) and female (5 feet 4 inches) heights minus 4 inches to adjust to eye height.

Positioning of PSOs on the bridge and bridge wings allowed for clear and effective communication with the vessel crew and survey team, which facilitated quick mitigation requests and implementation. Additionally, PSOs carried HH radios for communication with bridge and survey crews. PSOs rotated on-watch shifts every 1 to 4 hours to avoid

observer fatigue, with a minimum 2-hour rest period after shifts of 4 hours. Time on-watch for each observer did not exceed 12 hours in a 24-hour period.

During survey operations, PSOs monitored 360° around their vessel. While underway (when the vessels were moving between survey locations or transiting to/from port), PSOs focused monitoring forward and to approximately 90° on either side of their vessel heading, occasionally scanning astern in a sweeping pattern. Crew aboard the vessel also watched for protected species (insofar as practical) and alerted the PSOs in the event of a protected species detection.

All methods of visual monitoring (UE, NVD, HH IR, and mounted IR) complemented each other depending on the environmental and vessel conditions, thus enabling PSOs to effectively monitor the applicable mitigation zones.

4.2.1 Visual Observations in Daylight

During daylight hours, which was defined as the period between civil twilight rise and set (i.e., when the sun is higher than 6° below the horizon), PSOs scanned the waters surrounding the vessel in a sweeping pattern with the unaided eye (UE) and reticle binoculars (RB) as needed. RB were used to confirm species' identification, group size, behavior, to estimate distance to the animal(s), and to scan for smaller or less-demonstrative species. The tradeoff for increased magnification with RBs was a narrower field of view (FOV); alternating between the two methods was an effective means of covering the entire visible surrounding area during daylight.

Daylight observations were dependent on weather conditions, particularly cloud cover, and would occasionally begin late or end early if there was insufficient ambient light to monitor the mitigation zones without the aid of NVD or IR device.

Estimates of distance to visual detections were made using the built-in RB reticles when conditions allowed (i.e., when the horizon was visible), by comparing an animal's location to objects or other vessels at a known distance (including use of the vessel's radar), and/or by previous observer training and experience in estimating distances.

4.2.2 Visual Observations in Darkness

Visual monitoring during darkness (i.e., nighttime; defined as the period between civil twilight set and rise) was accomplished with the aid of low light technologies, including NVD and IR devices (HH or mounted; Table 4). Only the offshore vessel *Fugro Brasilis* conducted 24-hour HRG survey operations and thus required observations during darkness. Two PSOs were on watch during darkness, one monitoring with NVD and one monitoring a pair of mounted Current Corp IR cameras.

The PSO monitoring with NVD on the *Fugro Brasilis* scanned the waters surrounding the vessel in the same sweeping pattern employed during daylight. To reduce eye strain from NVD use, the PSO would periodically monitor with the UE. Monitoring with the NVD was primarily conducted from outside, as this optimized performance of the NVD. However, if weather conditions were not suitable for the PSO to safely monitor from outside, they would conduct watch from inside the bridge. Whether monitoring from inside or outside, bridge and forward deck lighting were set to the lowest level that would safely allow movement in those areas.

The second PSO on the *Fugro Brasilis* monitored continuous, live IR video feeds from two

vessel mounted IR cameras from inside the bridge. Video was displayed on external monitors that interfaced with the laptop running *Mysticetus*. The two Current Corp Night Navigator 3050 IR cameras were mounted on the forecastle deck, one port and one starboard. Both IR cameras were set to scan 180° port or starboard of the bow, ensuring near 360° around the vessel (excluding obstructions). The PSO would assume manual control of camera scanning to investigate objects of interest, including potential protected species detections. HH IR devices were available for use on the *Fugro Brasilis* in the event of a mounted IR camera system failure.

Monitoring with the UE was, however, possible with the aid of vessel lighting (back deck lighting and spotlights). Back deck lights remained on for safety during all periods of darkness. PSOs reported that when these deck lights were on, the waters approximately 30 to 50 m abeam, 30 to 200 m off the bow, and 30 to 200 m off the stern were sufficiently illuminated for them to observe using only the UE. Spotlights were typically only used on request or when the bridge crew was attempting to locate and track fishing gear during darkness.

Detection distances during darkness were estimated from known reference distances and professional judgement based on observations during daylight for NVD, HH IR, and mounted IR camera detections. None of the devices have built-in distance estimation functions.

4.3 Mitigation Measures

Mitigation measures for the surveys were identified in the BOEM lease, BOEM limited waiver, BOEM PDC, and NMFS IHA. Where regulations differed among documents the more conservative measure was implemented in nearly all cases. Summary graphics of the mitigation measures described below are provided in Appendix B.

HRG acoustic equipment that operated at frequencies below 200 kHz included the sparker, Innomar SBP, and USBL (Table 3). Mitigation measures applied only to the sparker. Although not used on the surveys, non-parametric SBPs also required mitigation (except for shutdowns).

Mitigation measures were requested by PSOs and implemented by the survey crew aboard the vessels throughout the surveys whenever safe to do so.

4.3.1 Pre-Clearance Monitoring

Pre-clearance monitoring zones were established and monitored prior to the activation of HRG survey equipment operating below 200 kHz. The size of the pre-clearance monitoring zones was species or group specific. Each zone was centered around the relevant HRG equipment. Pre-clearance monitoring zones were as follows:

- 500 m for NARW, ESA-listed whales, unidentified large whales, and sea turtles
- 100 m all other marine mammals*

* The pre-clearance monitoring zone increased to 500 m for all protected species, except dolphins, prior to activation of the sparker per an Ørsted eNGO agreement.

Prior to activating HRG survey equipment below 200 kHz, the above noted pre-clearance monitoring zones must be clear of marine mammals and sea turtles for the durations noted below:

- 15 minutes for small odontocetes and pinnipeds
- 30 minutes for all other marine mammals and sea turtles

Visibility of at least 500 m was required for the full duration of pre-clearance. If the 500 m monitoring zone was not visible, the pre-clearance period could not begin and HRG source activation would be delayed until at least the full duration of pre-clearance had elapsed after reestablishing full 500 m visibility.

4.3.2 Ramp-Up Procedures

If technically feasible, HRG survey equipment operating below 200 kHz should be ramped up by progressively increasing the acoustic output from a minimum output to the maximum survey output. Both the BOEM lease (Addendum C stipulation 4.4.6.8) and IHA (stipulation 4[d]) require ramp-up procedures. The sparker was the only HRG system capable of ramp-up prior to surveying at the full operational output. The sparker ramp-up procedure was as follows: discharge at shot point intervals of 60 seconds for the first 5 minutes; 30 seconds for the next 5 minutes; 15 seconds for the following 5 minutes; and 1 second for the last 5 minutes, totaling a 20-minute ramp-up. Sparker ramp up was implemented upon initial start up after the completion of pre-clearance and following sparker shutdowns.

4.3.3 Delay to Source Activation or Ramp-Up

The activation of HRG survey equipment operating below 200 kHz was delayed if marine mammals or sea turtles were observed within their respective monitoring zones during pre-clearance. Ramp-up or source activation would be delayed until the designated pre-clearance times noted above in Section 4.3.1 had elapsed from the last detection of the marine mammal or sea turtle within its respective monitoring zone.

4.3.4 Exclusion Zones*

After HRG sources were activated, PSOs continued monitoring designated areas around the center location of survey equipment operating below 200 kHz known as exclusion zones (EZs). As with the pre-clearance monitoring zones, the size of EZs were species or group specific. EZs were as follows:

- 500 m for NARW and unidentified large whales
- 100 m for all other large whales, harbor porpoise, long-finned pilot whale, and Risso's dolphin
- No EZ required for seals and the following dolphin species: Atlantic-white sided, Atlantic spotted, common bottlenose, and common

* The EZ increased to 500 m for all protected species, except dolphins, when the sparker was active per an Ørsted eNGO agreement.

4.3.5 Protected Species Shutdown

The sparker was immediately shutdown, including during ramp-up, when a marine mammal was detected within or about to enter its respective EZ whether due to the animal's movement, the vessel's movement, or because the marine mammal surfaced within its EZ. Dolphin species from the genera *Delphinus*, *Lagenorhynchus*, *Stenella*, and *Tursiops* that actively or voluntarily approached the vessel and/or sparker did not require a shutdown. Sea turtles were also exempt from shutdowns.

Reactivation or ramp up of the HRG equipment shut down was permitted as soon as was practically possible after the animal(s) was seen leaving its respective EZ or after the following periods had elapsed from the last detection of the animal(s) inside the EZ:

- 15 minutes for small odontocetes and pinnipeds
- 30 minutes for all other marine mammals

4.3.6 Reduced Visibility Shutdown

If visibility diminished to less than 500 m while the sparker had to be shutdown until visibility improved. Pre-clearance and ramp-up procedures as described above (Sections 4.3.1 and 4.3.2) were completed prior to reactivation of survey equipment.

4.3.7 Non-Biological and Mechanical Pauses in HRG Equipment

HRG survey equipment below 200 kHz could be reactivated at full power as soon as was possible after a non-biological or mechanical pause in activity of less than 30 minutes if:

- protected species observations were continuous,
- the EZs were clear of protected species, and
- all EZs were fully visible during the pause in source activity.

If the above conditions were not met, or the pause in source activity was greater than 30 minutes, a full pre-clearance and ramp-up (sparker) were required to resume operations.

4.3.8 Vessel Strike-Avoidance for Survey Vessels

While underway, either during survey operations or transit, PSOs, bridge crew, and survey crew were required to monitor the area and ensure the species or group specific separation zones listed below for marine mammals and sea turtles were maintained.

- 50 m from any small cetacean, pinniped, or sea turtle (exceptions for voluntary approaches)
- 100 m from any ESA-listed whales and humpbacks
- 500 m from NARW and unidentified large marine mammals

Vessels were required not to exceed 10 knots (kt) at any time while within NARW Seasonal Management Area (SMA) or Dynamic Management Area (DMA) established for aggregations of NARW as observed by aerial and ship-based observers. Vessels were further required to operate at 10 kt or less when in the presence of any mother/calf pairs, pods, or large assemblages of marine mammals observed near the underway vessel. Vessel operators were also required to maintain the separation distances noted to prevent potential strikes.

If any animal was detected within the separation distance while the vessel was underway, required mitigation varied by species. The vessel was not permitted to divert course to approach small cetaceans, pinnipeds, or sea turtles. If a small cetacean or pinniped approached the vessel underway, the vessel was required to avoid excessive speed or abrupt changes in direction.

If a large whale, other than a NARW, was within the defined 100 m separation distance, the vessel was required to reduce speed and shift to neutral, if possible, until the whale was beyond 100 m.

If a NARW was within 100 m, the vessel would reduce speed and shift to neutral, if possible, until the whale was beyond 100 m. The vessel could not engage engines if the vessel was stationary while a NARW was detected within 100 m until the animal moved beyond 100 m. If a NARW was detected within the 500 m separation distance while the vessel was towing gear and restricted in the ability to maneuver, the vessel would reduce speed and steer course away from the whale.

4.3.9 North Atlantic Right Whale Mitigation Measures

Mitigation measures specific to NARWs were implemented during the survey. The PSO teams regularly monitored the National Oceanic and Atmospheric Administration (NOAA) Right Whale Sighting Advisory System (RWSAS), WhaleMap, and/or Whale Alert App for the establishment of DMAs and for the presence of any NARWs in or near the survey area.

A DMA is any area designated by NMFS consisting of a regulatory polygon centered on a confirmed aggregation of NARWs within which vessels must not exceed 10 kt. The PSO on duty checked the NOAA RWSAS at least once every four hours. If a DMA was established in or near the survey area, the lead PSO would immediately inform the designated survey point of contact on the vessel and ensure that Ørsted was notified. Each time a DMA check was undertaken by the PSO a column was marked in the *Mysticetus* data entry form and was automatically time stamped, georeferenced, and linked to any relevant comments. PSOs were also aware of all NARW SMAs within or near the survey area. All vessels more than 19.8 m long were not to exceed 10 kt when within DMAs and/or SMAs to reduce the risk of ship collisions with NARWs.

In addition, PSOs on the vessel prepared NMFS sighting reports for all NARWs detected from a survey vessel, including photographs, when possible, for Ørsted to submit to NMFS. *Mysticetus* automatically sent out alert texts and/or email notifications to Ørsted, Fugro, Geodynamics, and the PSO providers upon entry of a NARW sighting in the *Mysticetus* software.

4.4 Data Collection and Analysis Methods

Consistent data collection protocols were applied to all survey operations and analyses. PSOs documented all protected species detections and effort throughout all project operations. All data identified in the regulatory documents were collected in a predetermined template on a laptop using *Mysticetus*. Effort data consisted of environmental variables, vessel activity, and survey activity. Effort data were recorded every 30 minutes when PSOs were on effort, when monitoring conditions changed, and during each protected species detection.

Effort data are summarized as two different categories: monitoring effort and PSO effort. Monitoring effort captures any time when at least one visual or acoustic PSO was on watch. Monitoring effort, by definition, cannot exceed 24 hours in a single day. Regardless of how many PSOs conducted active monitoring during a given day, monitoring effort is present across a range of environmental and operational conditions and is reported as both time (e.g., hours) and vessel track line distance (e.g., kilometers). PSO effort is the total PSO person-hours allocated to monitoring for protected species across all monitoring methods (e.g., UE, NVDs, and mounted IR camera system). PSO effort, therefore, can exceed 24 hours in a day to reflect all hours of monitoring across all PSOs independently. PSO effort is presented across different

monitoring methods to compare the relative detection effectiveness between methods. PSO hours are also summarized based on daylight versus darkness, HRG sound source operating below 200 kHz on versus off, and which HRG sources were operational.

For each protected species detection, PSOs reported the lowest taxonomic level of identification for which they were confident, down to species when possible. Detection distances, including closest point of approach (CPA), were measured or estimated from the animal to the CPA to sound sources and/or CPA to PSO. For every detection, protected species movements relative to the vessel and/or sound source, initial and secondary behaviors, and any behavioral reactions were recorded based on a predefined protocol. A list of behaviors, behavioral reactions, and their corresponding definitions are provided in Appendix C.

Detection rates were used to standardize the number of detections by PSO unit of effort. Detection rates were calculated as the number of detections per hour of PSO effort. For different/alternative monitoring devices, detection rates were calculated as the number of detections by monitoring method, divided by the number of hours of PSO effort for each respective method. Hours were used as the effort until for detection rate analysis because trackline distance in km was not considered appropriate, as some vessels alternated between stationary and underway (i.e., moving) periods, and vessels were not traversing a survey corridor designed for systematic biological sampling.

4.4.1 Estimating Number of Potential Marine Mammal Exposures

NMFS defines a Level B harassment, or a "take by harassment," for marine mammals as any exposure to sound levels that could potentially result in temporary threshold shift (TTS) or a behavioral disturbance to the animals (NMFS 2018). NMFS considers a Level B take to occur at anthropogenic sound levels greater than or equal to 120 dB re 1 µPa m RMS for continuous sound and 160 dB re 1 µPa m RMS for intermittent sound that is either impulsive or non-impulsive. The sparker was the only HRG sound source operating below 200 kHz used during the survey determined to have the potential to result in Level B harassment. Although not used during the survey, non-parametric SBP (CHIRPS) also had the potential to result in Level B harassment.

Level A take is defined as injury or mortality to marine mammals and occurs at higher acoustic thresholds than Level B harassment, which also vary by species based on their hearing sensitivity (NMFS 2018). The maximum estimated Level A harassment isopleth was less than less than 1 m (cumulative sound exposure level [SEL_{24h}]) for all cetacean hearing groups (Table 6, CSA 2021, CSA 2022). Thus, the risk of Level A exposure from active HRG equipment of any kind was considered highly unlikely. Level A take is not typically authorized by NMFS for HRG survey activities and it is assumed that project mitigation measures will protect marine mammals from Level A exposures as well as the vast majority of potential Level B exposures. Furthermore, what does or does not rise to the level of take is assessed and determined solely by NMFS on a case-by-case basis. Therefore, only potential Level B exposure estimates are reported herein.

Distances to the Level A and Level B exposure thresholds for equipment meeting or exceeding NMFS exposure guidelines were calculated on behalf of Ørsted by CSA Ocean Sciences Inc. (CSA) in the Application for Incidental Harassment Authorization for the Non-Lethal Taking of Marine Mammals: Site Characterization Surveys (CSA 2021, CSA 2022). The Level B isopleth was modeled to 141 m for the sparker system. The Level B harassment zones were modeled for all HRG survey equipment below 200 kHz, however

only non-parametric SBPs, boomers, and sparkers were expected to result in Level B exposures (Table 6). A GeoMarine sparker was deployed on the *Fugro Brasilis* and an Applied Acoustics (AA) Dura-Spark ultra-high definition (UHD) sparker was deployed on the *Substantial* (Table 3).

Table 6. Maximum distance to weighted Level A and unweighted Level B thresholds for HRG survey equipment below 200 kHz included in take analysis for all marine mammal hearing groups (CSA 2021, CSA 2022).

Source	Distance to Level A Threshold (m)					Distance to Level B Threshold (m)
	LF (SEL_{24h} threshold)	MF (SEL_{24h} threshold)	HF (SEL_{24h} threshold)	HF (PK threshold)	PW (SEL_{24h} threshold)	All (SPL threshold)
Non-Impulsive, Non-Parametric, Shallow SBP (CHIRPs)						
ET 216 CHIRP	<1	<1	<1	-	<1	9
ET 424 CHIRP	<1	<1	<1	-	<1	4
ET512i CHIRP	<1	<1	<1	-	<1	6
GeoPulse 5430	<1	<1	21	-	<1	21
TB CHIRP III	1.5	<1	18	-	<1	48
Pangeo SBI	<1	<1	3.5	-	<1	22
Impulsive, Medium SBP (Boomer and Sparkers)						
AA Triple Plate S-Boom (700/1000J)	<1	0	0	4.7	0	34
AA Dura-Spark UHD Sparkers	<1	0	0	2.8	0	141
GeoMarine Sparkers	<1	0	0	2.8	0	141

µPa = micro pascal; AA = Applied Acoustics; CHIRP = compressed high-intensity radiated pulses; dB = decibel; ET = Edgetech; HF = high-frequency; J = joules; LF= low-frequency; MF = mid-frequency; PK = zero to peak sound pressure level in dB re 1 µPa; PW = phocids in water; re= referenced to; SBI = sub-bottom imager; SBP = sub-bottom profiler; SEL_{24h} = cumulative sound exposure level in dB re 1 μPa^2 s; SPL = root-mean-square sound pressure level; TB = Teledyne benthos; UHD = ultra-high definition.

The number of potential exposures was based on direct observations of protected species within this 141 m Level B isopleth of the sparker when in operation. The estimated number of animals detected within this distance were considered potential exposures.

5 Results

Monitoring effort and protected species detection data collected by PSOs aboard the *Fugro Brasilis* and *Substantial* from 10 May through 12 July 2022 during the Ocean Wind 02 surveys are summarized in the following sections.

Please note that any discrepancies in table totals are due to rounding.

5.1 Monitoring Effort

PSOs aboard the *Fugro Brasilis* and *Substantial* accrued a combined total 9992.9 km of vessel trackline while PSOs were monitoring for protected species during 1599.7 hours of monitoring effort (Table 7). Monitoring effort was greater during daylight hours than during darkness, with 1107.1 hours and 492.6 hours during darkness. Trackline coverage was also greater during daylight at 7084.3 km than during darkness at 2908.6 km. Figures 4 and 5 provide vessel tracklines for the *Fugro Brasilis* and *Substantial* respectively. The same vessel tracklines were separated by daylight and darkness in Figures 6 and 7.

The majority of PSO monitoring efforts (70%) took place while HRG sources below 200 kHz were active, of which the sparker was active for 74% of that time. Vessel tracklines for the *Fugro Brasilis* and *Substantial* were separated by HRG sources active and inactive in Figures 8 and 9.

Monitoring effort was completed primarily during survey operations, weather standby (including periods of weather related delays and shutdowns), and transit (Figure 10).

Table 7: Monitoring effort (hours) and vessel trackline in km completed by the *Fugro Brasilis* and *Substantial* during daylight and darkness, as well as when HRG equipment operating below 200 kHz were active and inactive.

Survey Vessel	Daylight		Darkness		HRG Equipment <200 kHz Active		HRG Equipment <200 kHz Inactive		Sparker Active		Sparker Inactive		Totals	
	Effort (hours)	TL (km)	Effort (hours)	TL (km)	Effort (hours)	TL (km)	Effort (hours)	TL (km)	Effort (hours)	TL (km)	Effort (hours)	TL (km)	Effort (hours)	TL (km)
Offshore vessel														
Fugro Brasilis	947.0	5722.8	492.6	2908.6	1029.1	6638.1	410.5	1993.3	766.7	5320.6	672.9	3310.8	1439.6	8631.4
Nearshore Vessel														
Substantial	160.1	1361.5	0	0	97.3	660.9	62.8	700.6	65.7	441.9	94.4	919.6	160.1	1361.5
Total	**1107.1**	**7084.3**	**492.6**	**2908.6**	**1126.4**	**7299.0**	**473.3**	**2693.9**	**832.4**	**5762.5**	**767.3**	**4230.4**	**1599.7**	**9992.9**

TL = trackline, km = kilometers

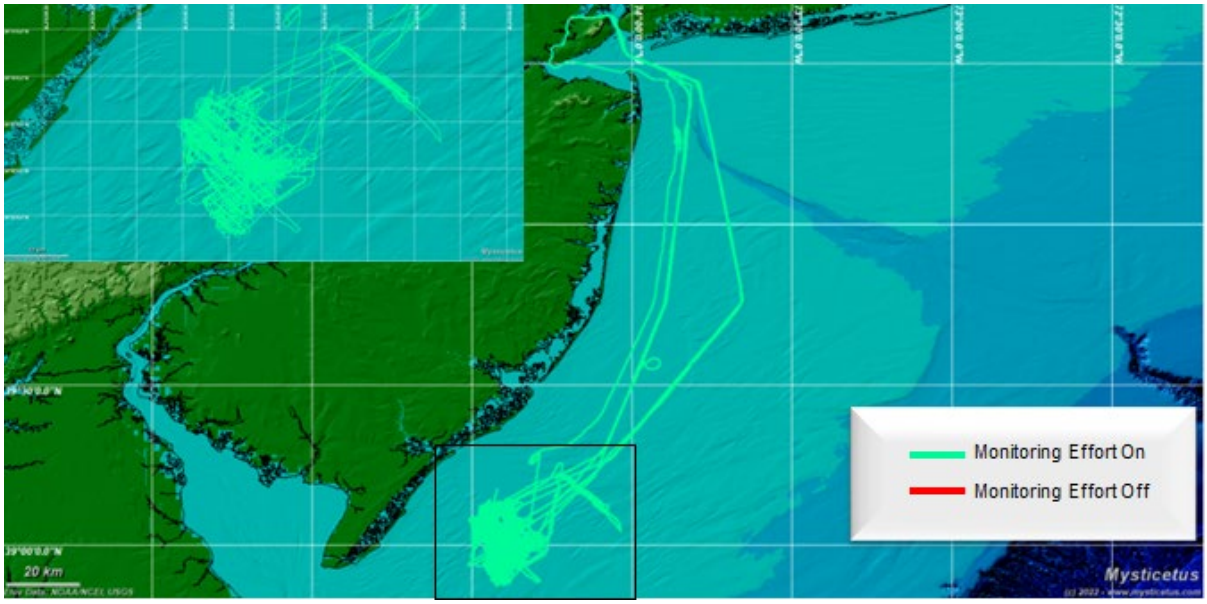


Figure 4. *Fugro Brasilis* tracklines for the survey. Green tracks correspond to periods when PSOs were on effort (monitoring) and red tracks when PSOs were off effort (not monitoring). Map inset is an enlargement of the sourthern portion of the track within the OCS-A 0532 lease (black box).

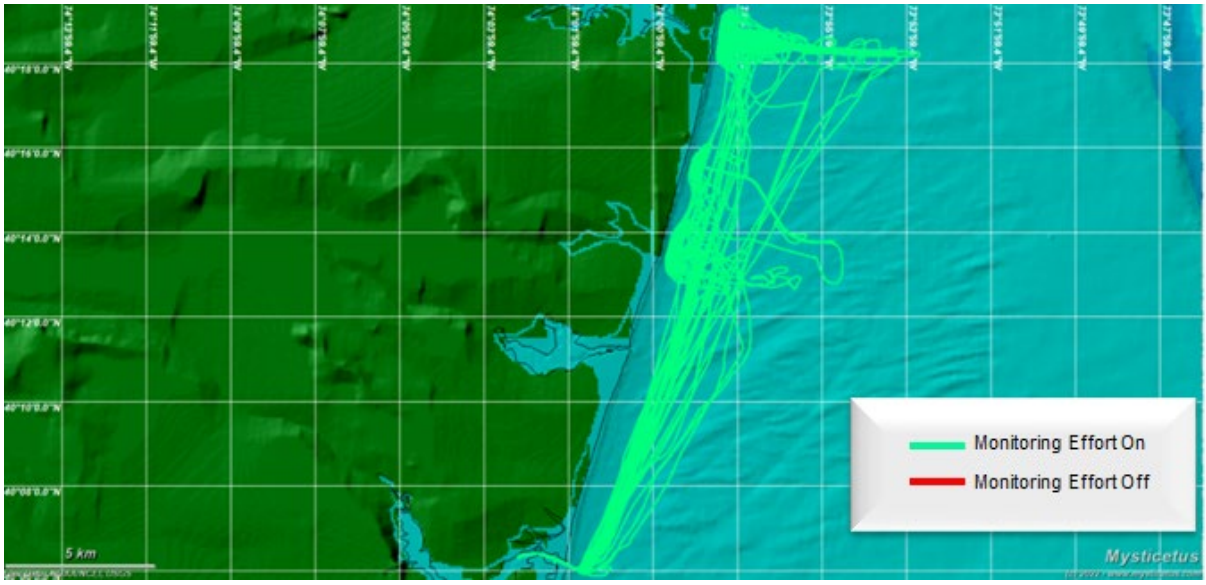


Figure 5. *Substantial* tracklines for the survey. Green tracks correspond to periods when PSOs were on effort (monitoring) and red tracks when PSOs were off effort (not monitoring).

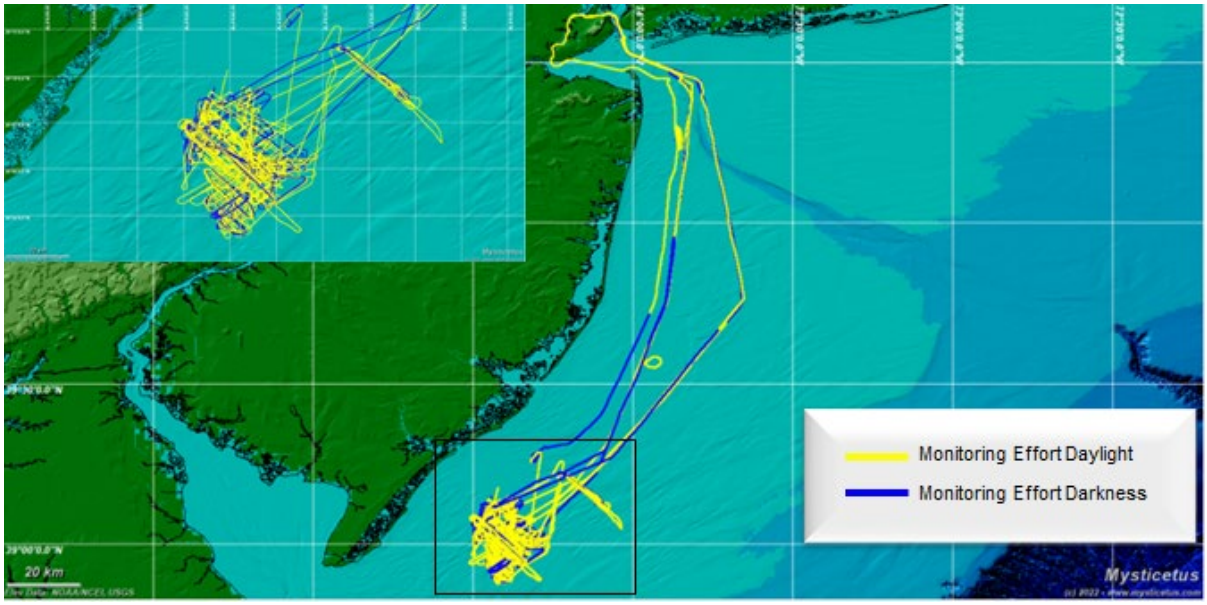


Figure 6. *Fugro Brasilis* tracklines showing PSO monitoring effort during daylight (yellow tracks) and darkness (blue tracks). Map inset is an enlargement of the sourthern portion of the track within the OCS-A 0532 lease (black box).

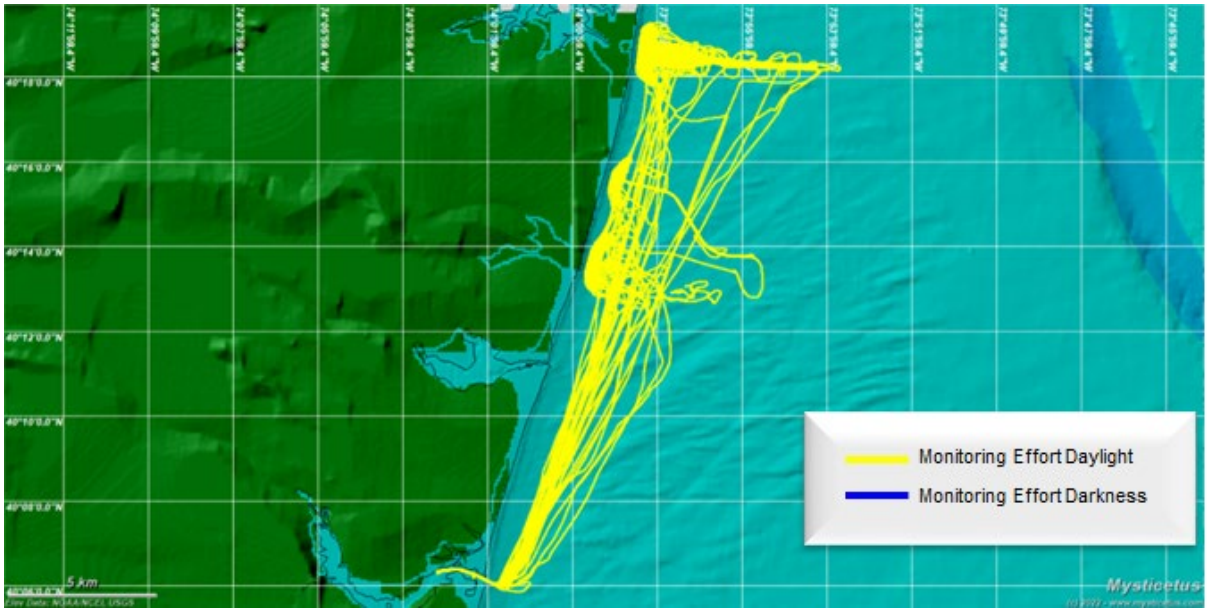


Figure 7. *Substantial* tracklines showing PSO monitoring effort during daylight (yellow tracks) and darkness (blue tracks).

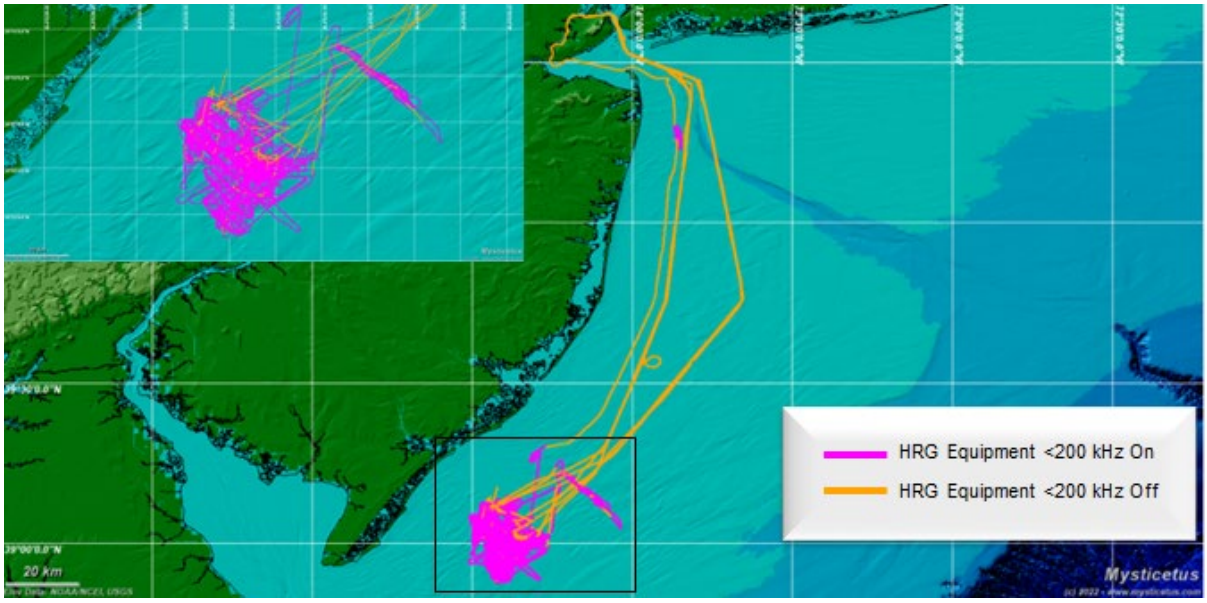


Figure 8. *Fugro Brasilis* tracklines showing PSO effort when HRG equipment operating below 200 kHz was active (on; pink tracks) and inactive (off; orange tracks). Map inset is an enlargement of the sourthern portion of the track within the OCS-A 0532 lease (black box).

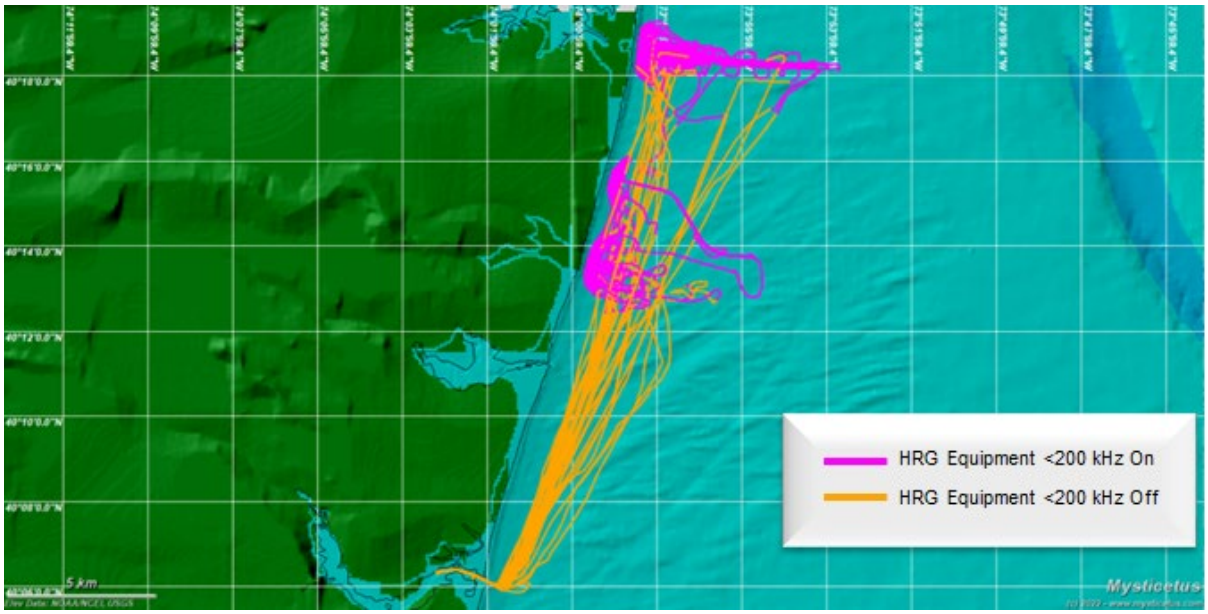


Figure 9. *Substantial* tracklines showing PSO effort when HRG equipment operating below 200 kHz was active (on; pink tracks) and inactive (off; orange tracks).

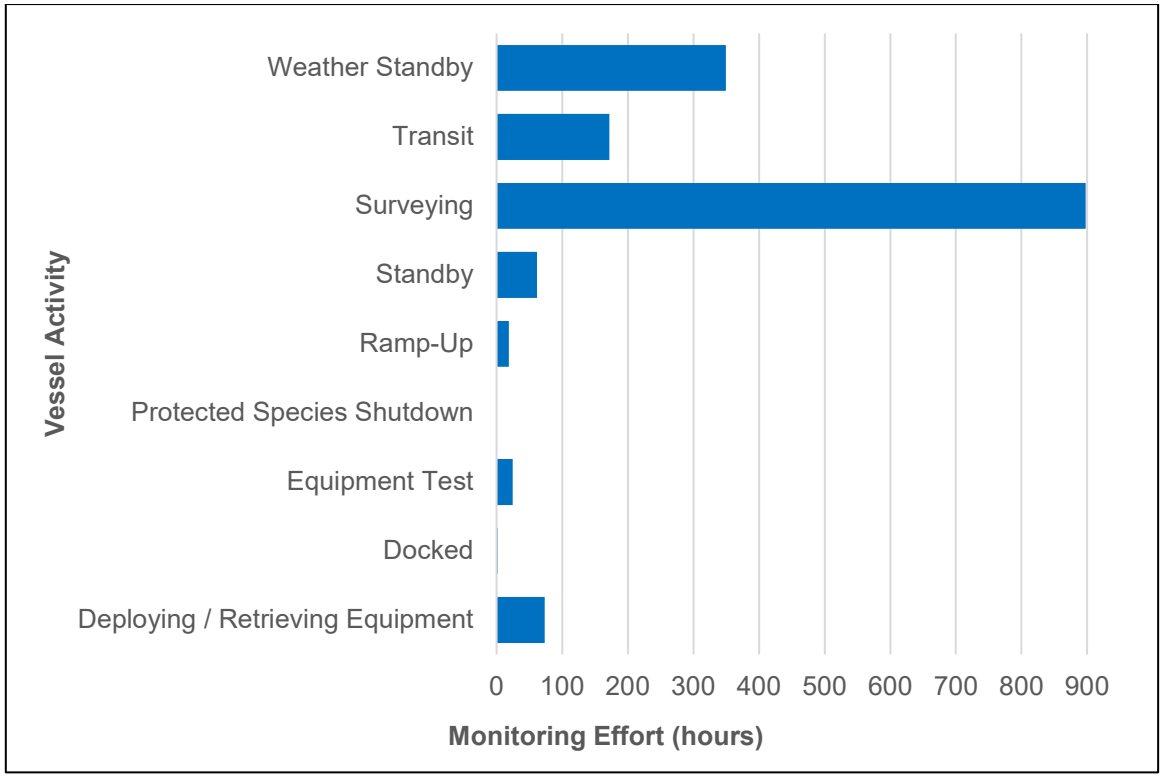


Figure 10. Monitoring effort by vessel activity during the Ocean Wind 02 HRG surveys.

5.2 Monitoring Conditions

Environmental conditions, such as Beaufort sea state (B) and atmospheric conditions can influence a PSO's ability to detect marine mammals visually, therefore details on various environmental conditions were recorded by the PSOs every 30 minutes or when conditions changed. Conditions were relatively consistent for the duration of the survey, with 68% of monitoring effort during Beaufort sea states of B2 and B3 (Figure 11) and 61% of effort with clear and partly cloudy atmospheric conditions (Figure 12).

An overall visual quality metric was developed to classify conditions for visual observations by combining Beaufort sea state and visual distance. The three visual quality classifications were determined as follows:

- Good: sea state B0-B3 and/or a visual distance of 2-10 km,
- Moderate: sea state B4 and/or a visual distance of 0.5 ≥ 1 km, and
- Poor: sea state >B4 and/or a visual distance of 0.5 km or less.

Good visual quality was prevalent during the day (65% of effort during daylight and 45% of the total monitoring effort), with both low Beaufort sea states and high visual distances experienced on most days (Figure 13). Moderate visual quality was experienced for 83% of monitoring effort during darkness (39% of the total monitoring effort).

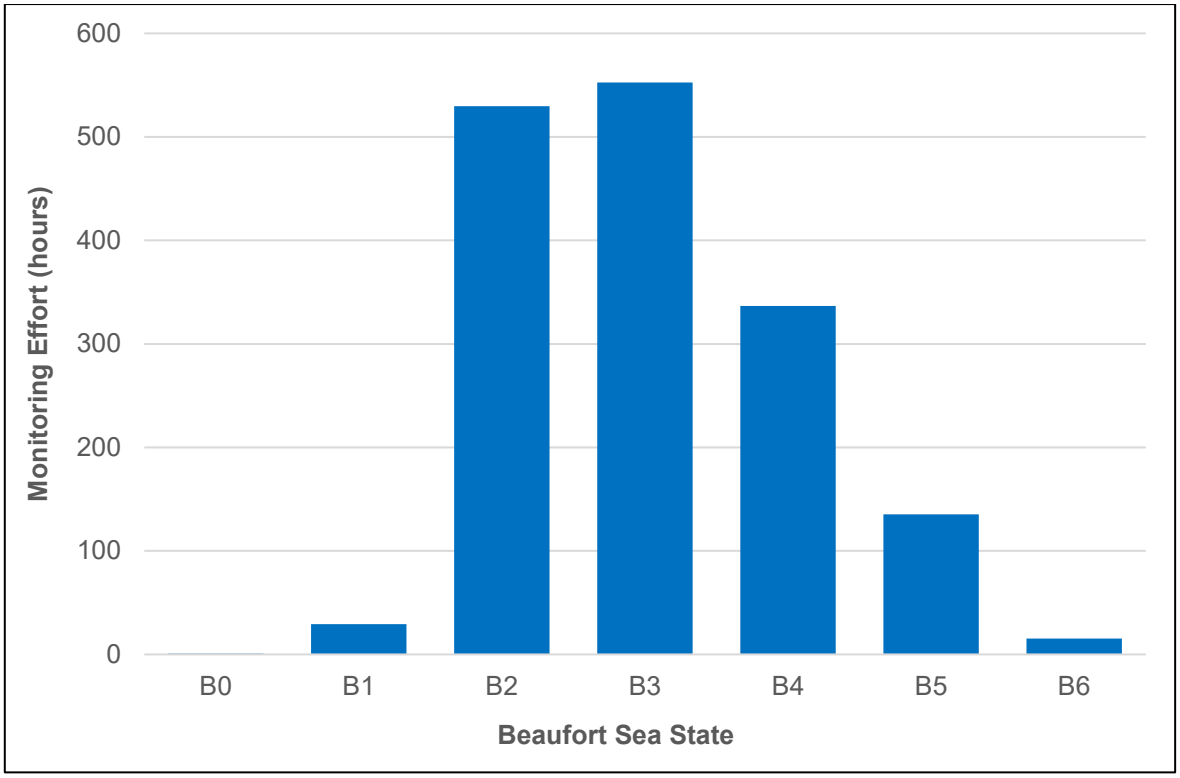


Figure 11. Monitoring effort by Beaufort sea state (B) during the Ocean Wind 02 HRG surveys.

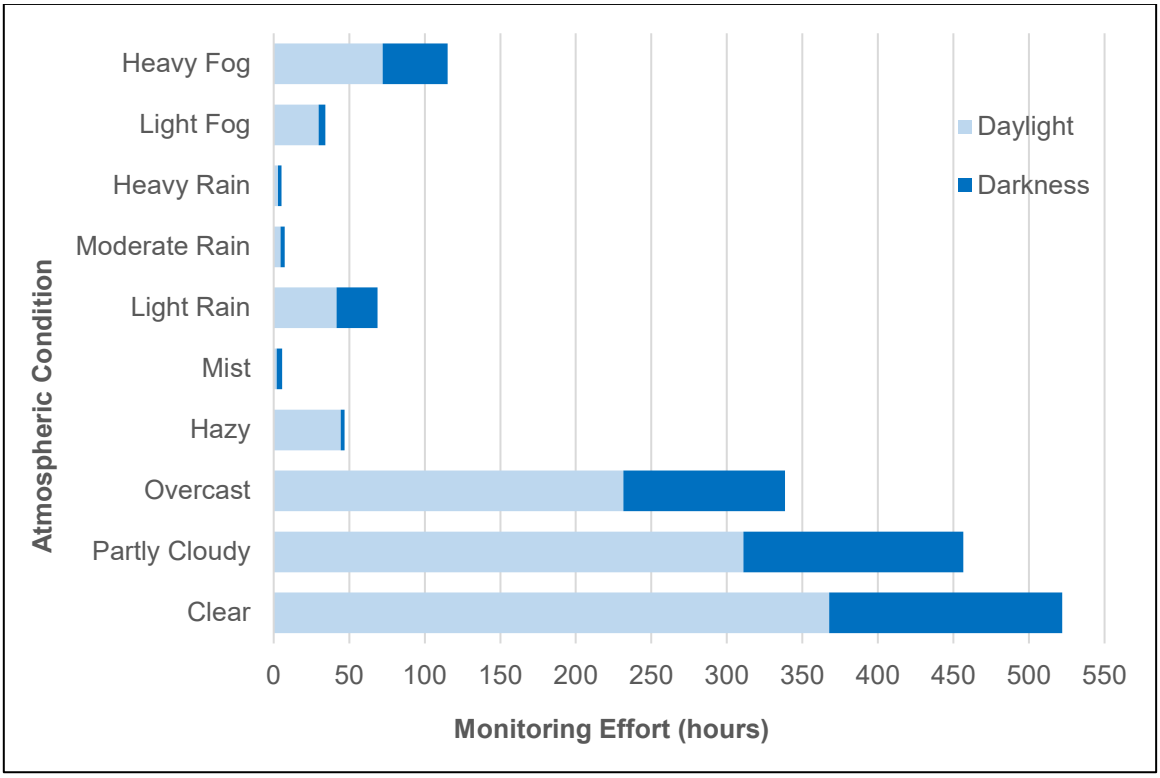


Figure 12. Monitoring effort during the various atmospheric conditions experienced during the Ocean Wind 02 HRG surveys for periods of daylight and darkness.

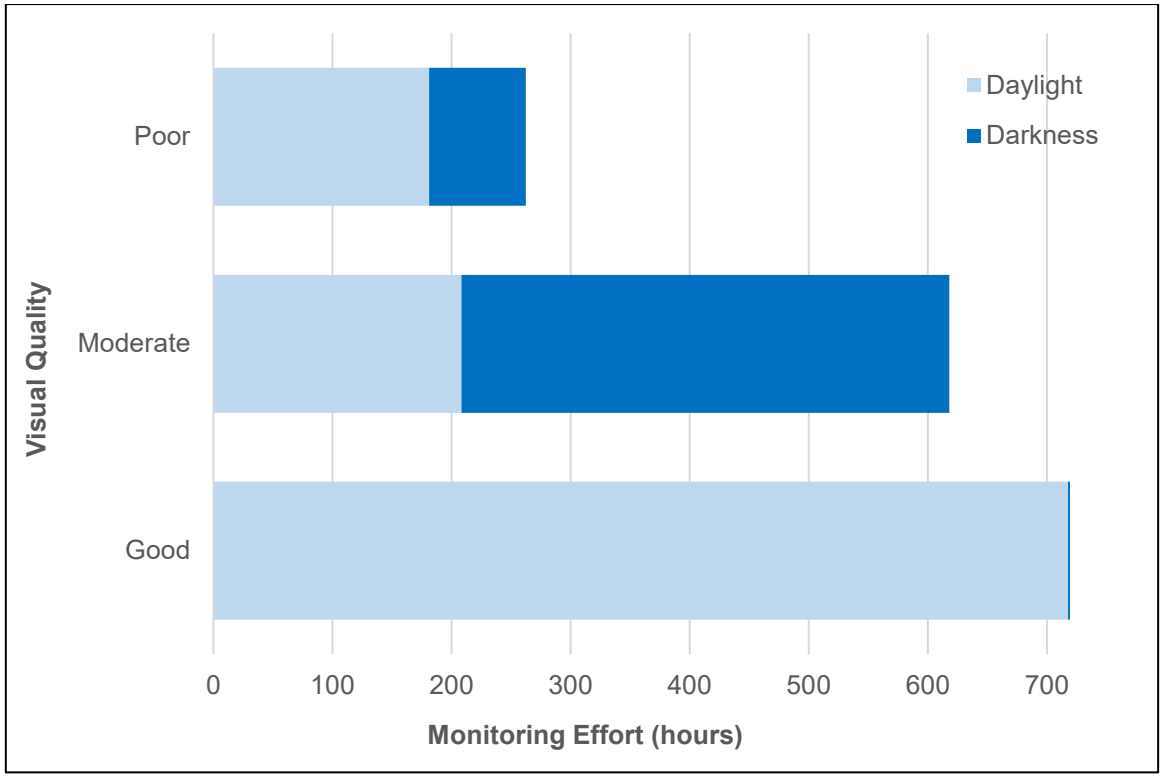


Figure 13. Monitoring effort with good (sea state of B0-3 and/or visual distance of 2-10 km), moderate (sea state of B4 and/or visual distance of 0.5 ≥ 1 km), or poor (sea state of >B4 and/or a visual distance of 0.5 km or less) visual quality for daylight and darkness during the Ocean Wind 02 HRG surveys.

5.3 PSO Effort

The cumulative PSO effort across all monitoring methods was 2120.6 hours (Table 8). The difference in PSO effort and monitoring effort is attributed to periods when two PSOs conducted protected species monitoring simultaneously, often using different monitoring methods (NVD and mounted IR cameras, for example, as was the case on the *Fugro Brasilis*). By definition, PSO effort can exceed 24 hours in a day to reflect all hours of monitoring across all PSOs independently.

Daylight monitoring of the mounted IR cameras was due to overlap with UE visual monitoring prior to civil twilight set.

PSO effort during daylight accounted for just over half (54%) of the total PSO effort, which was primarily attributed to the nearshore vessel *Substantial* operating only during daylight hours. PSO effort during daylight and darkness was near equal on the *Fugro Brasilis*, with only 10 hours of additional PSO effort during darkness (985.3 hours) compared to daylight (975.3 hours).

Table 8. PSO effort (hours) by monitoring method and vessel during the Ocean Wind 02 HRG surveys.

Monitoring Method	Effort by Monitoring Method (hours)		
	Daylight	Darkness	Total Effort
Offshore Vessel *Fugro Brasilis*			
UE	947.0	0	947.0
NVD	0	492.6	492.6
Mounted IR Camera	28.3	492.6	520.9
Nearshore Vessel *Substantial*			
UE	160.1	0	160.1
Both Vessels Combined			
UE	1107.1	0	1107.1
NVD	0	492.6	492.6
Mounted IR Camera	28.3	492.6	520.9
PSO Effort	**1135.4**	**985.2**	**2120.6**

UE = unaided eye, NVD = night vision device, IR = infrared

5.4 Protected Species Detections

The PSOs recorded a total of 101 protected species detections (51 marine mammal and 50 sea turtle) composed of an estimated 282 individuals (Table 9). Unidentified dolphins and loggerhead sea turtles (*Caretta caretta*) were the most frequently detected group/species at 25 and 31 detections respectively. Unidentified mysticete whales were the most frequently observed mysticete whale with six detections, each consisting of a single whale. NARWs (*Eubalaena glacialis*) or other ESA-listed marine mammal species were not confirmed by PSO observations, and no Atlantic sturgeon were detected.

Two of the six unidentified mysticetus whales observed by PSOs were noted as "possible humpbacks," a third was recorded as having a "gray/blue" fluke, and a fourth displayed a series of tall, narrow blows, suggesting none of these four whales were NARWs. The other two unidentified mysticete whales had short, bushy blows, and no diagnostic identification features were observed. The locations of all protected species for the two survey vessels are provided in Figures 14 and 15. Sea turtle detection locations for the *Fugro Brasilis* are provided in Figure 16. A complete list of all protected species detections is provided in Appendix D. Protected species detection photographs are provided in Appendix E.

More than half (63%) of the protected species detections occurred while HRG acoustic sources operating below 200 kHz were active, of which the sparker was active for 77% of those detections (Table 9). The overall mean CPAs to the sparker and other HRG equipment operating below 200 kHz were 225 m and 542 m respectively (Table 10). Delphinids and sea turtles had lower CPAs to HRG sources than mysticete whales.

Nearly all (91%) of the protected species detections were made using the UE (Table 11). There were nine detections using NVD during darkness, all of which were of sea turtles. Protected species were not detected on the mounted IR cameras. Although NVD and mounted IR cameras were monitored simultaneously during darkness, there were no concurrent detections of protected species. Protected species detection rates (detections per hour of PSO effort) were 0.083 (UE), 0.018 (NVD), and 0 (mounted IR camera; Table 12).

Table 9. Total number of protected species detections and estimated number of individuals detected during the Ocean Wind 02 HRG surveys while HRG equipment operating below 200 kHz were inactive (off) and active (on). Detections made while HRG sources below 200 kHz were active is further broken down to when the sparker was inactive and active. Atlantic sturgeon were not detected.

Species	Scientific Name	HRG Sources <200 kHz Inactive		HRG Sources <200 kHz Active				Total	
				Sparker Inactive		Sparker Active			
		Number Detections	Number Individuals	Number Detections	Number Individuals	Number Detections	Number Individuals	Number Detections	Number Individuals
Mysticete									
Humpback Whale	*Megaptera novaeangliae*	1	1	1	1	0	0	2	2
Minke Whale	*Balaenoptera acutorostrata*	0	0	0	0	1	1	1	1
Unidentified Mysticete Whale	n/a	3	3	1	1	2	2	6	6
Odontocete									
Bottlenose Dolphin	*Tursiops truncatus*	12	75	1	4	3	3	16	82
Unidentified Dolphin	n/a	16	91	5	26	4	19	25	136
Unidentified Porpoise	n/a	1	5	0	0	0	0	1	5
Sea Turtles									
Kemp's Ridley Sea Turtle	*Lepidochelys kempii*	0	0	0	0	1	1	1	1
Leatherback Sea Turtle	*Dermochelys coriacea*	1	1	1	1	4	4	6	6
Loggerhead Sea Turtle	*Caretta caretta*	2	2	6	6	23	23	31	31
Unidentified Sea Turtle	n/a	1	1	0	0	11	11	12	12
	Totals	**37**	**179**	**15**	**39**	**49**	**64**	**101**	**282**

kHz = kilohertz, n/a = not applicable

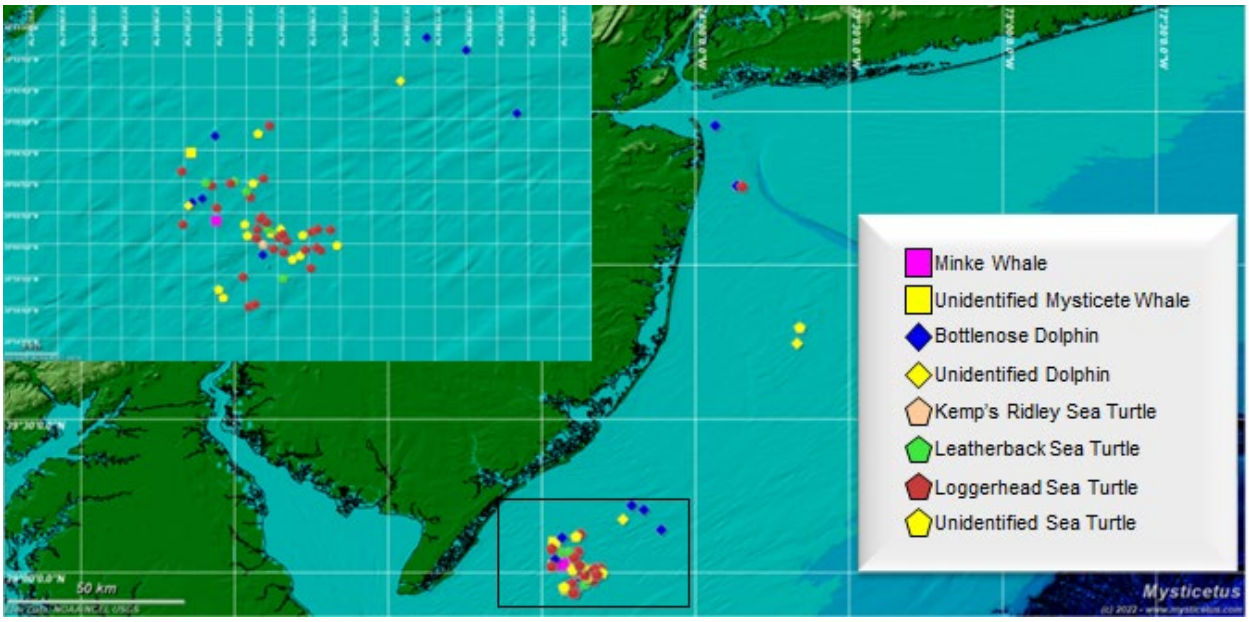


Figure 14. Locations of all protected species detections made from the *Fugro Brasilis*. Map inset is an enlargement of the concentration of detections within the OCS-A 0532 lease (black box).

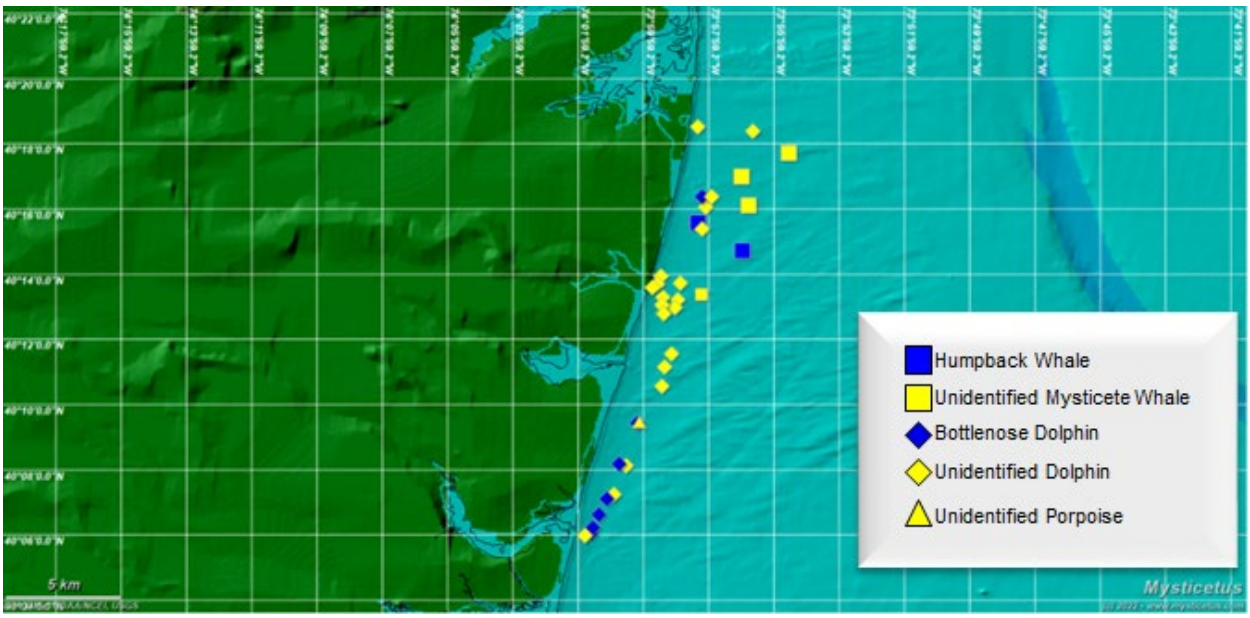


Figure 15. Locations of all protected species detections made from the *Substantial*.

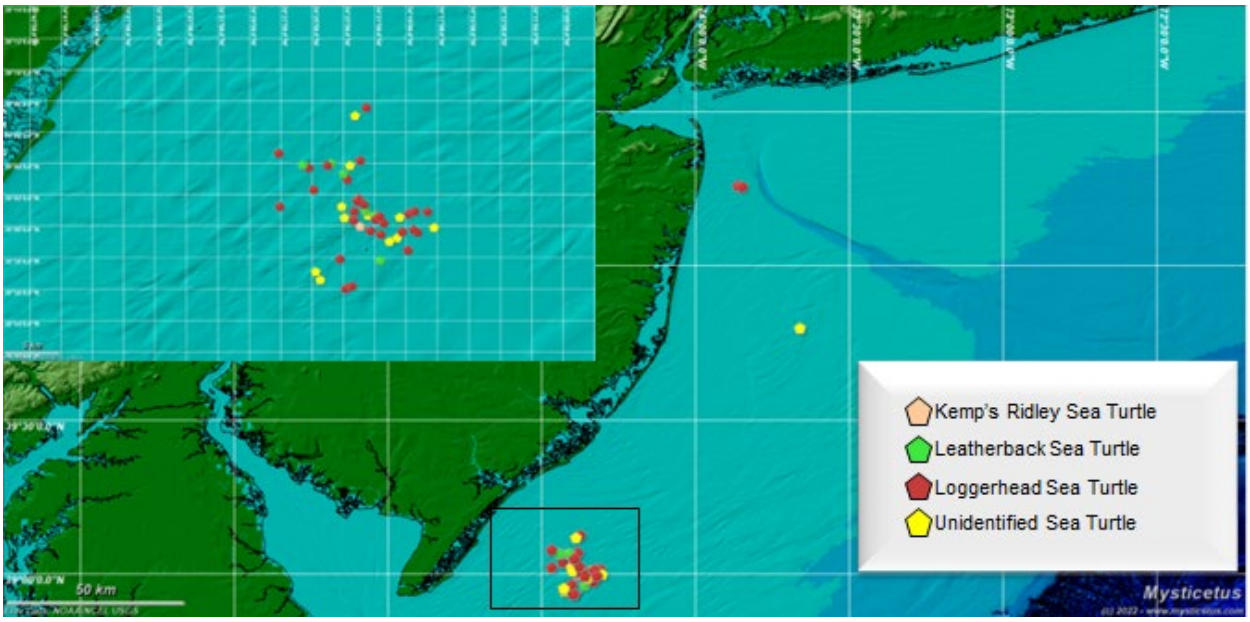


Figure 16. Locations of all sea turtle detections made from the *Fugro Brasilis*. Map inset is an enlargement of the concentration of sea turtle detections within the OCS-A 0532 lease (black box).

5.5 Numbers of Marine Mammals Potentially Exposed

Marine mammals observed within Level B Harassment Zones for active HRG sources operating at <200 kHz may have been exposed to underwater noise levels at or above the 160 dB RMS threshold defined by NMFS as having the potential to result in behavioral "take." The sparker was the only sound source operating below 200 kHz during the Ocean Wind 02 HRG Survey determined to have the potential to result in Level B harassment within a radial distance of 141 m from the source.

There were 10 marine mammal sightings consisting of 25 individual animals detected by PSOs while the sparker was active (Table 10); however, only two groups of unidentified dolphins totaling 10 individual dolphins were observed within 141 m from an active sparker. It is possible these 10 unidentified dolphins with an estimated CPA to the sparker of 120 m may have been exposed to levels of noise above the Level B harassment threshold. All other marine mammals observed during active sparker operations were outside the 141-m Level B Harassment radius.

Table 11. CPA (m) to active HRG survey equipment operating below 200 kHz for protected species observed when the sparker was active and inactive during the Ocean Wind 02 surveys. Minimum (min.), maximum (max.), mean, and median values are provided. Other HRG sources below 200 kHz include Innomar parametric SBP and USBL.

Species	CPA (m) to Active HRG Equipment Operating Below 200 kHz							
	Sparker				Other HRG Sources <200 kHz			
	min.	max.	mean	median	min.	max.	mean	median
Mysticete	**510**	**1000**	**753**	**750**	**1200**	**3500**	**2350**	**2350**
Humpback Whale	n/a	n/a	n/a	n/a	3500	3500	n/a	3500
Minke Whale	510	510	n/a	510	n/a	n/a	n/a	n/a
Unidentified Mysticete Whale	750	1000	875	875	1200	1200	n/a	1200
Odontocete	**120**	**1100**	**559**	**500**	**50**	**820**	**360**	**215**
Bottlenose Dolphin	750	1100	892	800	130	130	n/a	130
Unidentified Dolphin	120	500	310	310	50	820	406	300
Sea Turtle	**10**	**600**	**125**	**75**	**30**	**420**	**181**	**150**
Kemp's Ridley Sea Turtle	50	50	n/a	50	n/a	n/a	n/a	n/a
Leatherback Sea Turtle	75	350	200	187.5	250	250	n/a	250
Loggerhead Sea Turtle	10	600	143	100	30	420	169	125
Unidentified Sea Turtle	15	150	66	70	n/a	n/a	n/a	n/a
All Combined	**10**	**1100**	**225**	**100**	**30**	**3500**	**542**	**250**

CPA = closest point of approach, m = meters, kHz = kilohertz, SBP = sub-bottom profiler, USBL = ultra-short baseline, n/a = not applicable

Table 12. Number of protected species detections by detection method and protected species group during the Ocean Wind 02 HRG surveys.

Detection Method	Number of Detections			Total
	Mysticete	Odontocete	Sea Turtle	
UE	9	42	41	92
NVD	0	0	9	9
Mounted IR Camera	0	0	0	0
Total	**9**	**42**	**50**	**101**

UE = unaided eye, NVD = night vision device, IR = infrared, HH = handheld

Table 13. Protected species detection rates for each detection method, as well as combined PSO effort across all monitoring platforms.

Method of Detection	PSO Effort (hours)	Number of Detections	Detection Rate (detections per hour of effort)
UE	1107.1	92	0.083
NVD	492.6	9	0.018
Mounted IR Camera	520.9	0	0
Totals and Overall Detection Rate	**2120.6**	**101**	**0.048**

UE = unaided eye, NVD = night vision device, IR = infrared, HH = handheld

5.6 Protected Species Behavior

To the best of PSOs' abilities, initial behavior, second behavior, and possible behavioral response data were recorded for each protected species detection. Identifying behavioral response of marine mammals and sea turtles during vessel-based surveys is difficult, particularly when behavioral response is not the primary objective of PSOs. A PSO's primary responsibility upon detection of a protected species is to assess the need for appropriate mitigation measures. Only after all mitigation measures have been assessed and possibly implemented do PSOs dedicate additional observation effort to assess animal behavior and potential reactions to the vessel or survey operations.

Initial behavior of mysticete whales consisted primarily of blow (44%), swim (22%), and tail slap (22%; Figure 17). Travel (29%), porpoise (19%), and surface-active travel (19%) were the most reported initial behaviors for odontocetes, specifically delphinids. Nearly all sea turtle detections (84%) were recorded with swim as the initial behavior. "None" was the most reported second behavior for mysticete whales (56%), odontocetes (26%), and sea turtles (90%; Figure 18). Behaviors for each protected species detection are provided in Appendix D.

Many of the initial and second behaviors noted by the PSOs were the same whether HRG survey equipment below 200 kHz was active or inactive (Figures 17 and 18). The behaviors noted were also common behaviors exhibited by whales, dolphins, and sea turtles.

The PSOs estimated 3% of protected species detections were observed to change behavior while the sparker and other HRG acoustic sources below 200 kHz were active and 5% exhibited a response when acoustic sources below 200 kHz were inactive (Table 13). One dive response was reported for a loggerhead sea turtle and one response classified as "other" was reported for an unidentified dolphin while HRG sources were active. Behavioral changes were observed as often while the sparker and other HRG sources below 200 kHz were inactive as when they were active, which indicates that behavioral responses to HRG acoustic sources were minimal and that HRG acoustic sources are not the only stimulus that may induce a behavioral response in marine mammals and sea turtles during HRG surveys for offshore wind farm development.

Table 14. Number of protected species detections for which a behavioral change was noted while HRG survey equipment operating below 200 kHz were inactive (off) and active (on).

Species	Number of Detections Exhibiting a Behavioral Change							
	HRG Sources <200 kHz Inactive				HRG Sources <200 kHz Active			
	Change Direction	Dive	Other	None	Change Direction	Dive	Other	None
Mysticete								
Humpback Whale	0	0	0	1	0	0	0	1
Minke Whale	0	0	0	0	0	0	0	1
Unidentified Mysticete Whale	0	0	0	3	0	0	0	3
Odontocete								
Bottlenose Dolphin	1	0	1	10	0	0	0	4
Unidentified Dolphin	0	0	0	16	0	0	1	8
Unidentified Porpoise	0	0	0	1	0	0	0	0
Sea Turtle								
Kemp's Ridley Sea Turtle	0	0	0	0	0	0	0	1
Leatherback Sea Turtle	0	0	0	1	0	0	0	5
Loggerhead Sea Turtle	0	0	0	2	0	1	0	28
Unidentified Sea Turtle	0	0	0	1	0	0	0	11
Total	**1**	**0**	**1**	**35**	**0**	**1**	**1**	**62**

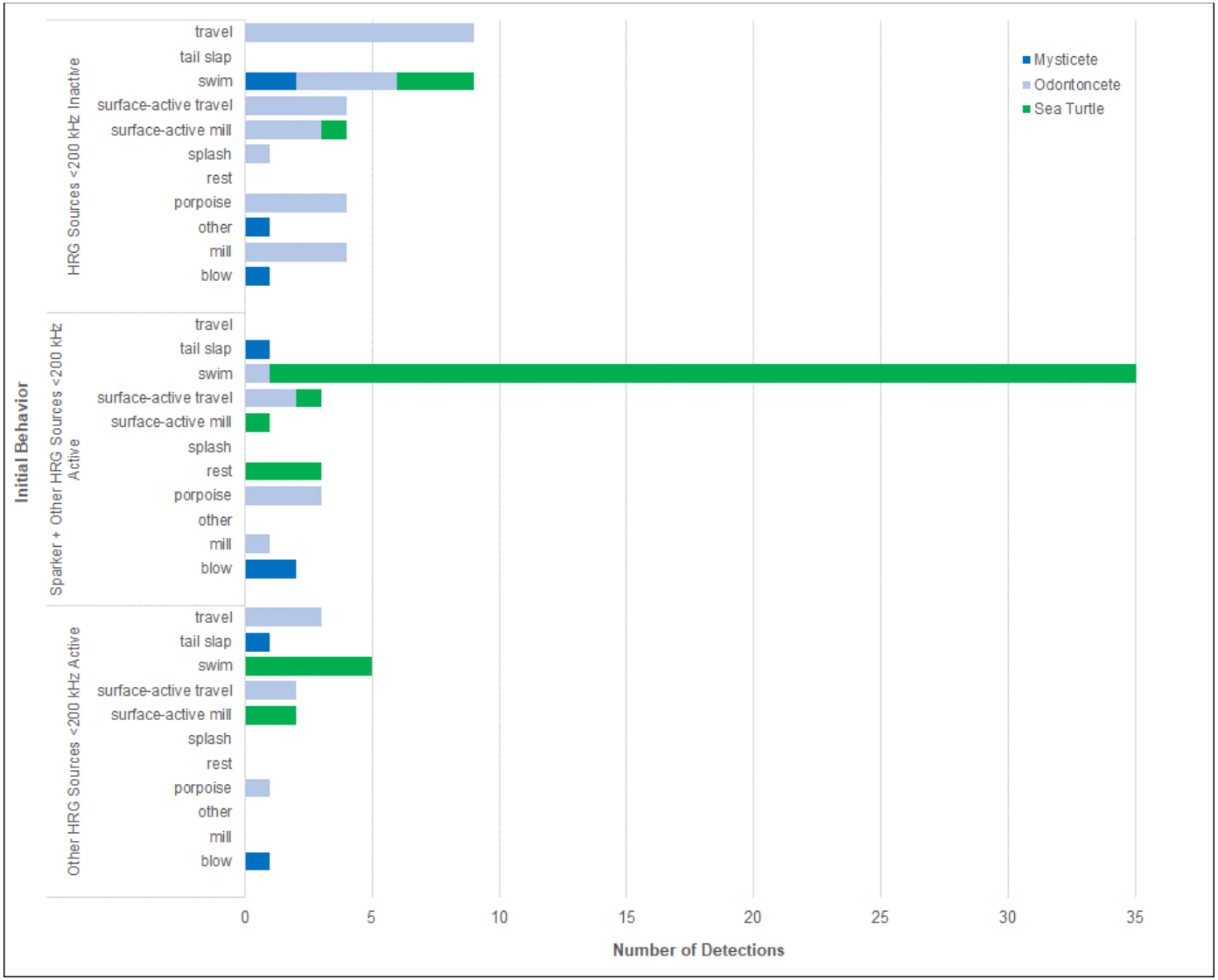


Figure 17. Initial behavior of marine mammals and sea turtles detected while HRG equipment operating below 200 kHz were inactive (off) and active (on). Detections made while HRG sources below 200 kHz were active is further broken down to when the sparker was inactive and active.

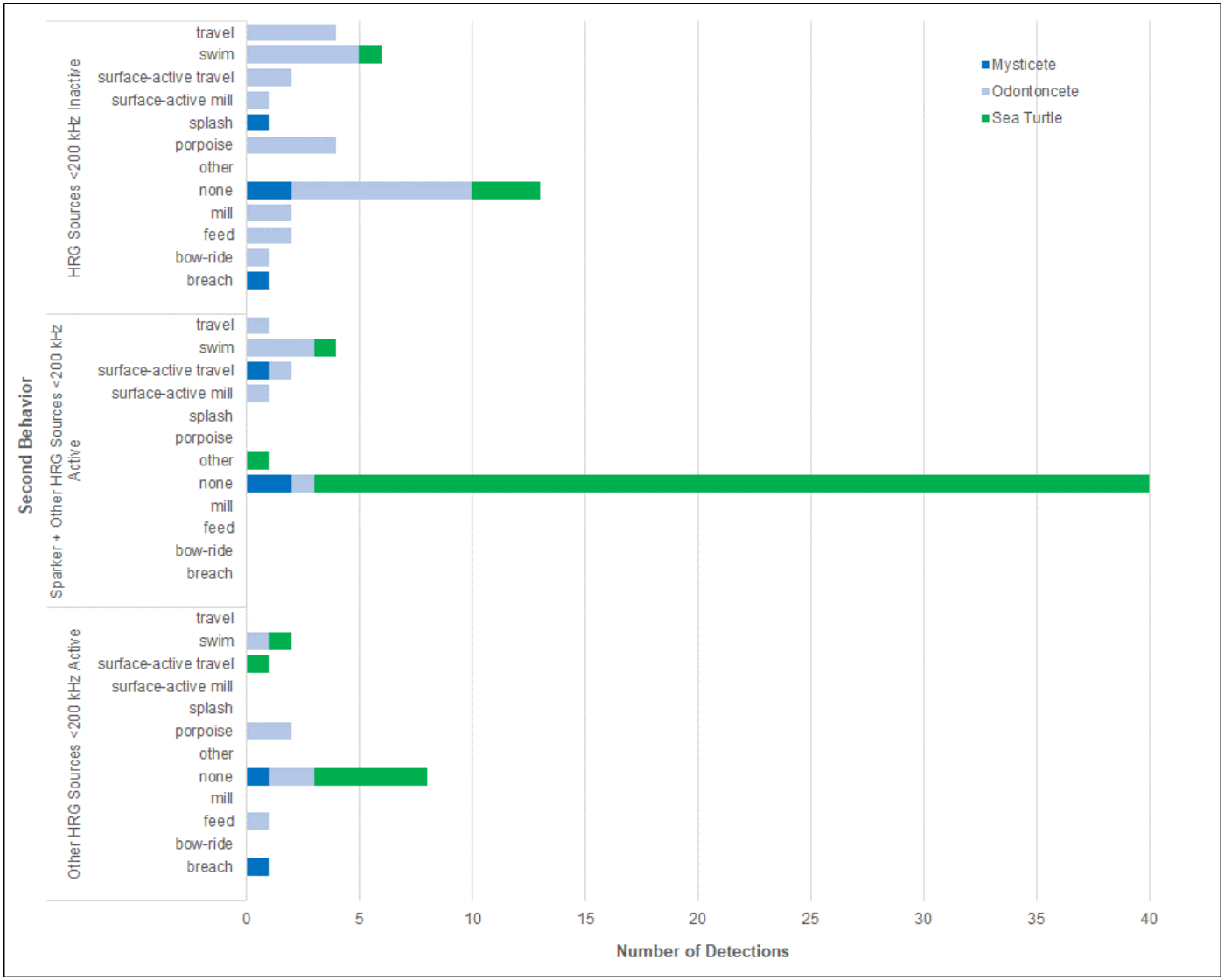


Figure 18. Second behavior of marine mammals and sea turtles detected while HRG equipment operating below 200 kHz were inactive (off) and active (on). Detections made while HRG sources below 200 kHz were active is further broken down to when the sparker was inactive and active.

5.7 Mitigation Measures

5.7.1 Protected Species Mitigation

Mitigation measures were requested and implemented for six (6%) of the 101 protected species detections (Table 14). The majority (75%) of these mitigation measures were for speed reductions related to strike avoidance. A single shutdown of the sparker was implemented for a minke whale. The shutdown resulted in 13 minutes of sparker downtime. Dolphins were the primary cause of strike avoidance speed reductions.

Table 15. Protected species mitigation measures implemented by PSOs on the *Fugro Brasilis* and *Substantial* during the Ocean Wind 02 HRG surveys.

Vessel	Date	Time (UTC)	Detection Number	Species	Mitigation	Duration (HH:MM)
Substantial	17 May 22	11:21	V43	Unidentified Dolphin	reduce speed	n/a
Substantial	17 May 22	21:18	V46	Bottlenose Dolphin	reduce speed	n/a
Substantial	18 May 22	21:17	V49	Unidentified Dolphin	reduce speed	n/a
Substantial	19 May 22	18:30	V51	Unidentified Dolphin	reduce speed	n/a
Substantial	26 May 22	10:08	V62	Unidentified Dolphin	reduce speed	n/a
Fugro Brasilis	04 Jun 22	17:24	V31	Minke Whale	shutdown	00:13
					Total Duration	**00:13**

HH:MM = hours: minutes

5.7.2 Weather Related Mitigation

In addition to protected species mitigation measures, 12 weather related mitigation measures were implemented for reduced visibility (ten shutdowns and two delays; Table 15). Nearly all (99%) of the 51 hours of PSO related downtime (protected species and weather related combined) was attributed to reduced visibility. There were no weather related mitigation measures on the *Substantial*.

5.8 Protected Species Exposures

A total of ten unidentified dolphins and 28 sea turtles were observed within the 141 m Level B isopleth for the sparker and may have been exposed to sound levels of at least 160 dB_{RMS} from the sparker (Table 16). All ten unidentified dolphins approached the vessel and, therefore, did not require a shutdown. Shutdown was also not required for the 28 sea turtles observed within the exposure zone.

Implementing shutdowns for protected species observed within the conservative 500 m exclusion zone prevented the potential exposure of one minke whale.

5.9 Protected Species Incident Reports

The PSOs did not observe dead or injured protected species or complete any incident reports.

Table 16. Weather related mitigation measures implemented by PSOs on the *Fugro Brasilis* during the Ocean Wind 02 HRG surveys. There were no weather related mitigation measures on the *Substantial*.

Vessel	Date	Time (UTC)	Weather	Mitigation	Duration (HH:MM)
Fugro Brasilis	13 May 22	05:31	fog	delay	12:18
Fugro Brasilis	14 May 22	02:00	fog	delay	25:24
Fugro Brasilis	20 May 22	14:02	fog	shutdown	03:37
Fugro Brasilis	20 May 22	19:09	fog	shutdown	00:01
Fugro Brasilis	27 May 22	05:16	fog	shutdown	00:14
Fugro Brasilis	27 May 22	18:24	fog	shutdown	00:19
Fugro Brasilis	01 Jun 22	16:09	fog	shutdown	01:18
Fugro Brasilis	01 Jun 22	20:52	fog	shutdown	05:06
Fugro Brasilis	03 Jun 22	09:29	fog	shutdown	01:18
Fugro Brasilis	13 Jun 22	04:20	fog	shutdown	00:34
Fugro Brasilis	24 Jun 22	10:39	fog	shutdown	00:16
Fugro Brasilis	06 Jul 22	10:15	fog	shutdown	00:50
				Total Duration	**51:15**

Table 17. Protected species observed within the 141 m Level B isopleth for the sparker.

Species	Protected Species Observed within 141 m Level B Isopleth for Sparker		
	Number of Detections	Number of Individuals	Mitigation Implemented
Odontocete			
Unidentified Dolphin	2	10	none
Sea Turtle			
Kemp's Ridley Sea Turtle	1	1	none
Leatherback Sea Turtle	2	2	none
Loggerhead Sea Turtle	15	15	none
Unidentified Sea Turtle	10	10	none
Total	**30**	**38**	

5.10 Avian and Bat Detections

A single unidentified passerine was found dead on 10 July 2022. There were no other reports of dead or injured birds. The PSO teams did not detect bats during their monitoring efforts.

5.11 Unusual Biological Events

There were no unusual biological events reported by PSOs during the survey.

6 Monitoring Device Effectiveness

Insufficient data were collected using the low-light monitoring technologies (NVD and IR) to conduct a full evaluation of device effectiveness. Alternatively, the strengths and limitations of the two technologies used on the *Fugro Brasilis* will be discussed.

6.1 Monitoring Device Strengths and Limitations

6.1.1 Night Vision Device

NVDs capture and enhance small amounts of visible light and near infrared energy to brighten the image being viewed. The technology significantly improves a PSO's ability to monitor for protected species during darkness over the unaided eye. On clear nights, with high ambient light levels (moonlight) the detection range for NVD may extend as far as 1 km. In most cases, the detection range for the UE at night is much less than 500 m.

Too much light, however, can be detrimental and the image may become washed out or even damage the NVD. On the opposite end of the spectrum, too little light will result in a dark image that may not be much better than the UE.

Vessel lighting, especially on working decks, can be an issue for PSOs. Often the vessel crew is able to reduce the amount of lighting in the accommodation area of the vessel (bridge, bridge wings, deck areas forward of mid-ship), however lighting on working decks is required for safety and cannot be dimmed. As a result, observation of the area behind the vessel is often difficult with NVDs.

Moisture in the air from fog and/or rain can limit the effectiveness of NVDs. Light reflected off the moisture droplets has a similar effect as too much light and causes a general washed-out appearance of the image.

Most NVDs also have a relatively small field of view when compared to monitoring with the UE. Constant scanning can help reduce the effects of this, however, this then could lead to eye fatigue from looking through an illuminated tube for hours. PSOs often alternate between NVD and UE during darkness to help minimize eye fatigue. PSOs average anywhere from 40-45 minutes of NVD use with 15-20 minutes of monitoring with the UE at night. Regular breaks between shifts also helps.

NVDs do not require protected species to be at or above the surface for detection, which makes them an ideal alternative to the UE for sea turtle detection during darkness. All nine NVD detections during the Ocean Wind 02 survey were of sea turtles that were fully or partially submerged at the time of detection. Detection of protected species close to the vessel is also often better with NVDs than with mounted IR cameras due to tilt angle of the cameras which is typically set to monitor at further distance than NVDs.

6.1.2 Mounted IR Cameras

IR technologies can be using during both daylight and darkness for protected species monitoring. IR devices detect infrared energy emitted by objects and converts the resulting

thermal pattern into an image. IR devices do not require light to function and are not light sensitive except when the light source emits high levels of heat. IR is, therefore, a good complimentary method to NVDs in areas with elevated lighting (working decks for example). Additionally, the detection range for IR is much greater than that of NVDs or UE during darkness. Blows from large whales can be detected on IR at distances of at least 2km.

Areas of exhaust/ventilation are big heat sources and can overwhelm an IR device in a manner similar to that of elevated light levels and NVDs. The vessel super-structure can also periodically obstruct the view of panning mounted IR cameras. Like NVDs, IR devices are highly affected by moisture in the air. The image becomes completely washed-out during periods of dense fog and moderate to heavy precipitation.

IR energy reflects off standard glass. Special germanium glass is required to view IR energy. Because of this, HH IR cameras cannot be used from inside the vessel. Mounted IR cameras are housed in weather tight containers that have germanium glass and monitoring is conducted from inside the vessel.

System malfunctions and technical issues may result in observational downtime. The PSOs on the *Fugro Brasilis* experienced a few, minor short duration camera malfunctions during the survey. Most issues were resolved within 10-20 minutes. Only one issue with pan controls resulted in a long duration camera shutdown. Fortunately, the issue arose just before sunrise and was resolved just before sunset on the same day and did not affect monitoring. Power cycling the affected camera system resolved the issue.

7 Summary

The PSO teams aboard the *Fugro Brasilis* and *Substantial* completed 2120.6 hours of protected species monitoring across all monitoring methods (PSO effort), covering 9992.9 km of trackline during the Ørsted Ocean Wind 02 HRG survey campaign. During that time, 101 protected species detections were recorded for which six mitigation measures were implemented.

Monitoring conditions were favorable during the survey with sea states of B3 or less and visibility of at least 1 km for 70% and 65% of the monitoring effort respectively. Reduced visibility (<500 m) from fog did, however, result in ten shutdowns of the sparker and two delays to sparker ramp-up.

The PSOs recorded a total of 101 protected species detections including 51 marine mammal detections and 50 sea turtle detections. The majority (78%) of detections made by PSOs aboard the nearshore vessel *Substantial* were of unidentified dolphins. Sea turtles (Kemp's Ridley, leatherback, loggerhead, and unidentified sea turtles) were the primary group of protected species observed on the offshore vessel *Fugro Brasilis*, accounting for 77% of the detections.

Only one protected species detection resulted in a shutdown of the sparker, resulting in 13 minutes of operational downtime. Strike avoidance mitigation measures were implanted on five occasions (5% of protected species detections). Most strike avoidance measures (80%) were implemented during transit and had little impact on operations. All mitigation requests by PSOs were implemented immediately by the survey and bridge crews.

Behavioral changes were noted for a small number of protected species detections during periods of active surveying with HRG equipment below 200 kHz and during periods of inactivity. With the low number of behavioral changes reported and the observation of changes while acoustic sources were active as well as inactive, it does not appear as through protected species detected during the survey experienced an observable behavioral response to the HRG acoustic sources. Additionally, any number of variables, anthropogenic or natural, may contribute to a behavioral change.

Although numerous protected species and weather related mitigation measures were implemented during the Ocean Wind 02 survey, the overall impact to operations was minimal contributing only 51 hours of operational downtime.

The mitigation and monitoring protocols established in the regulatory documents were effectively implemented by the PSOs throughout the Ørsted Ocean Wind 02 HRG survey.

8 Literature Cited

CSA Ocean Sciences Inc (CSA). 2021. Application for incidental harassment authorization for the non-lethal taking of marine mammals: site characterization surveys Lease OCS-A 0498. Submitted to Ørsted. November 2020, Revised March 2021. 81 pp.

CSA Ocean Sciences Inc (CSA). 2022. Application for incidental harassment authorization for the non-lethal taking of marine mammals: site characterization surveys Lease OCS-A 0532. Submitted to Ørsted. October 2021. Revised January 2022. 81 pp.

National Marine Fisheries Service (NMFS). 2018. 2018 Revisions to: Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing (Version 2.0): Underwater Thresholds for Onset of Permanent and Temporary Threshold Shifts. U.S. Dept. of Commerce, NOAA. NOAA Technical Memorandum NMFS-OPR-59, 167 p. https://www.fisheries.noaa.gov/national/marine-mammal-protection/marine-mammal-acoustic-technical-guidance

National Marine Fisheries Service (NMFS). 2021. Incidental Take Authorization: Ocean Wind, LLC Marine Site Characterization Surveys off of New Jersey. https://media.fisheries.noaa.gov/2021-05/Ocean%20Wind_2021IHA_FIHA508_OPR1.pdf?null=

National Marine Fisheries Service (NMFS). 2022. Incidental Take Authorization: Ocean Wind II, LLC Marine Site Characterization Surveys off of New Jersey. https://media.fisheries.noaa.gov/2022-05/Ocean%20Wind%20II_2022IHA_Issued_OPR1.pdf

United States Department of the Interior Bureau of Ocean Energy Management (BOEM). 2016. Commercial Lease of Submerged Lands for Renewable Energy Development on the Outer Continental Shelf, Lease Number 0CS-A 0498. Sterling, Virginia. 48 pp.

United States Department of the Interior Bureau of Ocean Energy Management (BOEM). 2021a. Notice of Partial Assignment of Lease Approved Lease Segregated, Creating New Lease OCS-A 0532. Effective March 26, 2021. Washington, DC.

United States Department of the Interior Bureau of Ocean Energy Management (BOEM) Office of Renewable Energy Programs, Atlantic OCS Region. 2021b. Project Design Criteria and Best Management Practices for Protected Species Associated with Offshore Wind Data Collection. Revised November 2021. 18 pp.

Appendix A Night Vision Equipment Specifications

ARMASIGHT by FLIR PVS-7

Night Vision Goggles

The Armasight by FLIR PVS-7 is the most widely recognized and dependable United States Military night vision goggle system available. The AN/PVS-7B/D system has proven itself in combat due to its rugged, ergonomic design.

The PVS-7 is equipped with Automatic Brightness Control (ABC), which automatically adjusts the brightness of the image tube to achieve the highest quality image resolution under varying light conditions, as well as a built-in infrared illuminator that allows the user to operate in total darkness. The PVS-7 also has an excessive-light cut-off feature that protects the image tube from bright light sources, and a flip-up shut-off feature when used with the optional helmet mount assembly. The PVS-7 is equipped with two LED indicators: yellow for a low battery, and red to alert the operator that the IR illuminator is on. Both are displayed on the eyepiece screen. Lightweight, rugged, and versatile, the PVS-7 can be handheld, head-mounted, and helmet-mounted. The dismounted goggle can also be used as an excellent long-range viewer with optional afocal magnifier lenses.

FEATURES

- Compact, rugged design
- Waterproof
- Head or helmet-mountable for hands-free usage
- Ergonomic, simple, easy to operate controls
- Built-in Infrared illuminator and flood lens
- Limited two-year warranty

www.flir.com/ots
www.armasight.com

ARMASIGHT BY FLIR

Specifications

Overview	
Image intensifier tube	ID MG – Gen 2+; "Improved Definition" HD MG – Gen 2+; "High-Definition" 3 Bravo – Gen 3+ 3 Alpha – Gen 3+; High-Performance 3P – Gen 3; High-Performance Thin-Filmed Auto-Gated IIT
Magnification	1x standard; (3x,5x optional)
Lens system	27mm, F/1.2
FOV	40°
Focus range	0.20 m to Infinity
Exit pupil	15 mm
User Interface	
Function switch	On/ Off unit and built-in IR illuminator
Focus ring	Focuses the objective lens
Diopter adjustment rings	Focuses the eyepieces
System Specifications	
Bright light cut-off	Yes
Automatic shut-off system	Yes
IR indicator	Yes
Low battery indicator	Yes
Infrared illuminator	Yes (built-in with flood lens)
Power	
Battery type	Two AA batteries
Battery life (operating)	Up to 30hrs
Environmental	
Operating temperature range	-40°C to +50°C (-40°F to +122°F)
Storage temperature range	-50°C to +70°C (-58°F to +158°F)
Physical	
Weight (without mount)	0.68 kg (1.4 lbs)
Size (with mount)	162× 152 × 76 mm (6.4 × 6 × 3 in)
Color (housing)	Black
Package Includes	
Night Vision Goggles, Lens Cap, Eyecup, Head Mount Assembly,Sacrificial Window, Demist Shields, Shoulder Strap, Neck Cord, AA Batteries, Operation and Maintenance Manual, Soft Carrying Case	
Optional Accessories	
ANHMI000005 – Norotos MICH Helmet Mount Assembly USA #107 ANHMI000006 – Norotos PASGT Helmet Mount Assembly USA #108 ANAF3X0003 – 3x A-Focal Mil-Spec Lens #99 ANAF3X000P – 3x A-Focal Lens #22 with Adapter #24/#25 ANAF5X000P – 5x A-Focal Lens with Adapter #24/#25 ANAMRF0003 – ARFS3 - Advanced Range-Finding Stadia for 3x A-Focal Lens ANAMRF0005 – ARFS5 - Advanced Range-Finding Stadia for 5x A-Focal Lens ANKIXLR017 – IR850-XLR Detachable X-Long-Range Infrared Illuminator w/Dovetail to Weaver Transfer Piece #21, Rechargeable Battery, and Charger ANHC000001 – Hard Shipping/ Storage Case #101	

FLIR Outdoor & Tactical Systems
815 Dubuque Avenue, South San Francisco, CA 94080
Phone: 1-888-959-2259 or (650) 492-7755
Fax: 1-888-959-2260
International Phone/Fax: (650) 492-7755

US Commercial Sales
OTS-Sales@flir.com

Government Sales
OTS-Gov@flir.com

International Sales and Export
OTS-Export@flir.com

Technical Support, Repairs, Returns, Refunds & Warranty
OTS-Support@flir.com

www.flir.com/ots
www.armasight.com

www.flir.com/ots
www.armasight.com

ARMASIGHT BY FLIR

NVD
NIGHT VISION DEVICES

PVS-14 NIGHT VISION MONOCULAR

SPECIFICATIONS

EYE RELIEF:	25 MM
POWER SOURCE/LIFE:	(1) AA-SIZE BATTERY/50+ HRS
FOCUS RANGE:	9.8" TO INFINITY
SUBMERSIBLE:	66 FEET
MAGNIFICATION:	ONE POWER (1X)
FIELD OF VIEW:	40°
DIOPTER ADJUSTMENT:	-6 TO +2
OBJECTIVE LENS:	26MM, F/1.2
WEIGHT:	307 G (10.8 OZ) W/O BATTERIES
DIMENSIONS:	4.5" X 2.5" X 2.75"

FEATURES

- TEN YEAR WARRANTY
- SINGLE AA BATTERY USAGE
- SUBMERSIBLE TO 66 FEET
- INFRARED LED INDICATOR
- HIGH LIGHT CUTOFF
- LOW BATTERY LED INDICATOR
- GAIN CONTROL

The **NVD-PVS-14 Night Vision Monocular** is the all around best multi functional night vision monocular available. Head or helmet mounted, the PVS-14 allows the user to retain their night adapted vision in one eye while viewing their surroundings through the illuminated eyepiece of the PVS-14. The new battery housing completes the perfect package by allowing the user to power off the unit when in an upright position and power on when flipped down.

Another strength is its ability to be weapon mounted behind most collimated daylight aimers and Reflex sights such as the ACOG, Aimpoint and EO Tech systems. This allows the user the ability to use their PVS-14 both as a night vision monocular for increased mobility and tactical awareness and as a short range weapon sight.

Gain control gives the user the ability to increase or decrease the tube gain. Under extremely dark conditions, gain control allows the user to adjust the gain upward, giving a better image. Under high light conditions, details can be washed out due to an excess of light. Lowering the system gain can allow those details to be better seen. Additional features of the PVS-14 include an infrared LED with LED indicator and a low battery indicator.

With our expansive capabilities and strategic partnerships, we are able to custom build any of our NVD manufactured products with Image Intensifiers from these manufacturers: Harris Corporation®, L3 Insight Technologies®, and Photonis®. This includes green and white phosphor and thin or un-filmed image tubes.

This system complies with MIL-PRF-49324(CR), MIL-PRF-49427(CR) and MIL-STD-810G.

Standard accessories included with each NVD-PVS-14: Soft Carry Case, Operator's Manual, (2) AA Batteries, Demist Shield, Sacrificial Filter for Objective Lens, Head/Helmet Mount Adapter (J-arm), Picatinny Rail Weapon Mount, Shoulder Strap, Head-mount Assembly with 3 Brow Pads, Lens Tissue, Neck Cord, Eye-Cup, Shuttered Eyeguard and Front Lens Cap.

Optional Accessories: Hard Case, 3X Magnifier, 5X Magnifier, Compass Assembly, PASGT Helmet Mount, MICH Helmet Mount, and Camera Adapter.

PVS-14 DATA SHEET - REV - DECEMBER 2017 NVDEVICES.COM » 610-395-9743 » SALES@NVDEVICES.COM

Specifications subject to change without notice. Export of the commodities described herein is strictly prohibited without a valid export license issued by the U.S. Department of State Office of Defense Trade Controls prescribed in the International Traffic in Arms Regulation (ITAR), Title 22, Code of Federal Regulations, Parts 120-130. Approved for public release under International Traffic in Arms Regulations (ITAR) 22CFR 120.11

GSA Schedule Contract GS-07F-0022V

FLIR

BHM-Series

Bi-ocular Handheld Thermal Night Vision Camera

Search and Rescue: Security in Emergencies

BHM-Series imagers make pictures from heat, not light, letting you see other boats, obstructions, land, buoys, and floating debris in total darkness, as well as through haze, smoke, and light fog.

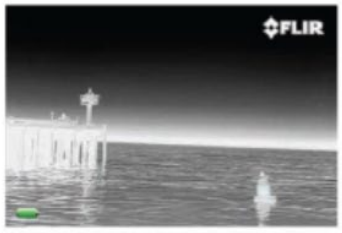
Available with high-resolution 640 x 480 thermal sensors, BHM-Series thermal imagers are the best search and rescue tools on the water, giving you the power to search for disabled vessels and people in the water regardless of lighting conditions. BHM-Series cameras have interchangeable lenses so you can choose the right lens. They also let you visually verify radar returns and see things in the water that radar might miss.

Perfect for use on vessels of any size, the BHM-Series is a handheld, battery-powered, thermal night vision cameras give you the edge in all of your nighttime travels.

- **SAR –** When people have fallen in the water, saving time saves lives. The available high-resolution 640 x 480 thermal sensor give you four times the resolution of other FLIR handhelds, so you can scan large expanses of water at night or in glaring sunlight and find your target quickly from farther away.
- **Situational Awareness** – Easily see how far you are from the shoreline, pilings, docks, floating debris, or boats at anchor.

Compared to monocular (one eyepiece) cameras, the BHM-Series's unique bi-ocular (dual eyepiece) design is less tiring to use over long missions, easier to hold steady on rough waters, and gives you greater range performance. Plus, its Video Out connection makes it easy to connect to an onboard monitor or DVR.

24-hour Vision: Your Vision vs. FLIR Vision



Collision Avoidance: See vessels, land, & buoys anytime

Call 1.877.545.5094 for more information, or visit www.FLIR.com

FLIR

THERMAL IMAGING MONOCULAR

FLIR SCOUT III®

Scout III is the next generation of FLIR's field-proven compact thermal monoculars for outdoor recreation. Featuring a 640 x 480 resolution sensor, smooth 30Hz frame rate, and 640 x 480 pixel LCD screen, the Scout III 640, with better scene contrast than I2 night vision. Scout III displays the heat emitted by animals, humans, and terrain-day or night-and has multiple applications for legal hunting, camping, land management, and outdoor recreation.

www.flir.com

PROVEN PERFORMANCE

Identify predators and track game better than ever

- Detects heat signatures up to 1200 yards away, depending on model.
- High speed 60Hz or 30Hz frame rate displays lifelike thermal video.
- Crisp, clear 640 x 480 display screen.

POWERFUL, YET SIMPLE

Starts up in seconds, no training required

- Easy-to-use buttons: Power, color palettes, E-Zoom and screen brightness.
- Fast startup extends battery life by eliminating need for standby.

COMPACT AND RUGGED

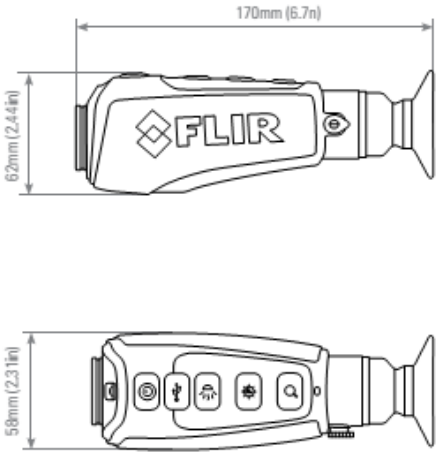
Fits in any pocket, weather and impact-resistant

- Single hand operation.
- Light weight, only 12 ounces.
- Weather-tight, ergonomic design.
- >5-hour Rechargeable Li-ion battery.

SPECIFICATIONS

General	SCOUT III 240	SCOUT III 320	SCOUT III 640
Detector Type	240 x 180 VOx Microbolometer	336 x 256 VOx Microbolometer	640 x 512 VOx Microbolometer
Video Refresh Rate	30Hz NTSC	60Hz NTSC	30Hz NTSC
Field of View (H x V)	24° x 18°	17° x 13°	18° x 14°
Focal Length	13 mm Fixed Focus	19 mm Fixed Focus	35 mm Fixed Focus
Start up	< 1.5 secondsImage		
Image Processing	FLIR Proprietary Digital Detail Enhancement		
User Interface			
Zoom Button	Freeze Frame	2X	2X, 4X
Video Detection Palettes	Black Hot, White Hot, InstAlert™ and Graded Fire		
Brightness	Multiple Brightness Levels		
Task Light	LightLED (operational when imager power off)		
Image Presentation			
Built-In Display	640 X 480 LCD Display		
Video Output	NTSC composite video		
Power			
Battery type	Internal Li-Ion Cell		
Battery life (operating)	>5 hours, Auto-off after 5 minutes of non-use		
Environmental			
Rating	IP-67, Submersible		
Operating temperature range	-20°C to +50°C (-4°F to +122°F)		
Storage temperature range	-40°C to +60°C (-40°F to +140°F)		
Physical			
Weight	0.34 kg (0.75 lbs)		
Overall dimensions	170 x 58 x 62 mm (6.70 x 2.31 x 2.44 in)		
Range Performance (No Extender)*			
Detect Man (1.8 m x 0.5 m):	350 m (380 yd)	550 m (600 yd)	1140 m (1200 yd)
Package includes			

Handheld Thermal Camera,USB Power Adapter/Charger,Wrist strap, Custom Video out cable (320 & 640 version), USB Cable, Quick Start Guide, Molle bag



Specifications are subject to change without notice.
For the most up-to-date specs, go to www.flir.com

FLIR OUTDOOR & TACTICAL SYSTEMS

9 Townsend West,
Nashua, NH 03063

Phone: 1-888-959-2259
or (603) 324-7600
Fax: 1-888-959-2260

FLIR PRODUCT REPAIR CENTER

email: US_CBUrepair@flir.com
Register on: customer.flir.com

ORDER PLACEMENT, RETURN TO STOCK & INQUIRIES

email: OTS-Orders@flir.com

PRODUCT REGISTRATION

flir.com/support-center/support-hq/

TECHNICAL SUPPORT

email: US_CBUsupport@flir.com

www.flir.com
NASDAQ: FLIR

Updated 11/22/2018

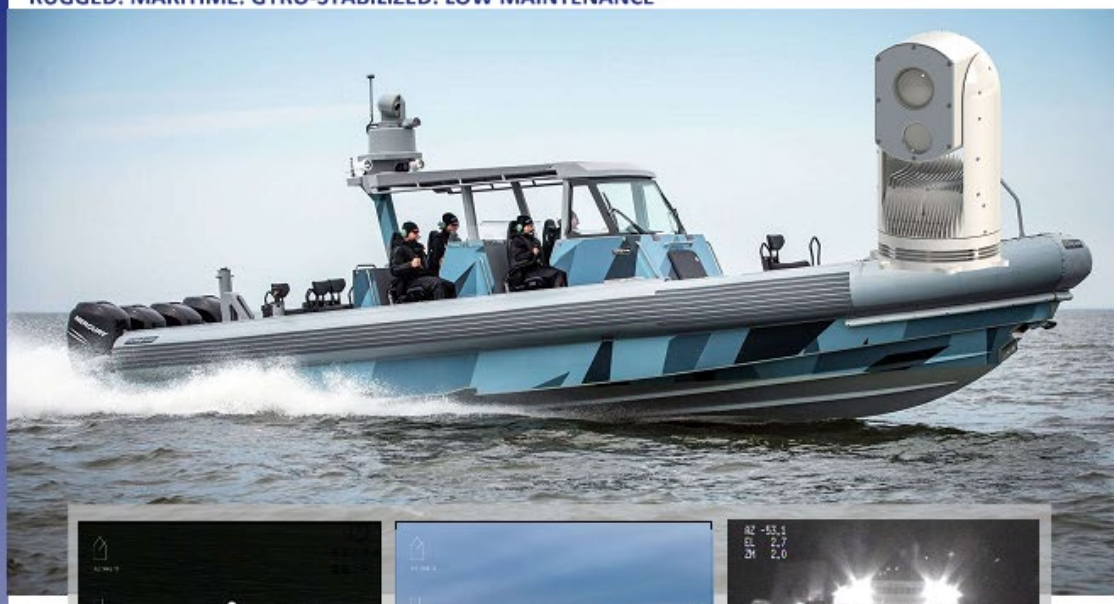
18-2266-OTS

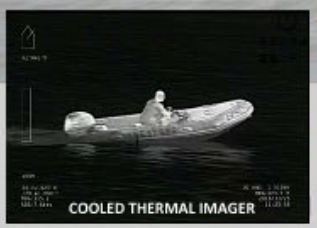
FLIR | The World's Sixth Sense™

NN 3000 Series

NN 3050

RUGGED. MARITIME. GYRO-STABILIZED. LOW MAINTENANCE





Electro-Optical/Infra-Red camera system

The Night Navigator™ 3050 is a rugged, low maintenance, compact electro-optical system designed for military and paramilitary end users. Mast mounted payload, this imaging system offers exceptional performances. It integrates a **MWIR cooled thermal imager** and a **HD day camera / low light** in a **gyro-stabilized** sensor platform. It can be controlled from the bridge of a ship or through IP network in a control room or remote location. This COTS system is built to MIL Std.

APPLICATIONS

- ISR (Intelligence, Surveillance and Reconnaissance)
- EEZ (Exclusive Economic Zone) protection
- Long-Range Surveillance
- Unmanned Surface Vessels operation
- Autonomous Vessels
- Maritime SAR
- Safety and security at anchor and in the harbour
- Tracking of potential threat or man overboard
- Situational awareness
- Anti-smuggling operations

BENEFITS

- **Rugged**, marine, **low maintenance** design
- **Detects** a NATO target over 14km, night and day
- **Provides a clear, highly detailed image**, in HD day, even into the digital zoom range
- **Increases object detection** in low level of light with best of class low light sensitivity
- **Tracks** Radar cursor, ARPA Target, AIS and video targets
- **Streams H.264** (HD) video with PiP or two video streams and **communicates digitally** over IP network (Ethernet)
- **Outputs video in dedicated coax cable to the bridge in SDI**
- **Enables Picture in Picture (PiP)** of two live video signal outputs (zoom synchronized or independent)
- **Single payload** with no junction boxes or interface modules simplifies installations and retro fits, while reducing maintenance
- **Standard mounting and cabling** for all Night Navigator 3000 series enables ease of payload swaps and future upgrades
- **Designed to withstand marine environmental conditions** and proven by over 15 years and hundreds of successful operating installations worldwide

CURRENT

CURRENT Scientific Corporation – Tel: +1 604 461 5555 – sales@currentcorp.com
www.currentcorp.com

NN 3050

SYSTEM FEATURES

THERMAL CAMERA	
Spectral Range:	3 – 5 µm Cooled thermal imager
Sensor type:	MWIR (InSb FPA)
Resolution:	640x512 pixels
Field of View:	28° (wide) to 2° (narrow)
Zoom:	14x continuous optical zoom
Frequency:	30 fps, full frame rate for export
Detection Range [1]:	NATO target over 14km / Human over 5km
DAY / LOW LIGHT CAMERA	
Sensor type:	1/2.8" CMOS
Field of View:	63° to 2.3° FoV in HD mode, 1080p30
Optical zoom:	30x continuous
Digital zoom:	12x continuous
Window coating:	Hydrophobic
LOW LIGHT HD CAMERA (FUNCTION)	
Sensor type:	1/2.8" CMOS
Low light sensitivity:	0.0015 Lux in B&W mode and 0.0008 Lux in Color mode

RADAR CURSOR, ARPA & AIS TARGET TRACKING

Slew-to-cue allows target detected from the Radar and AIS to be tracked automatically by the EO/IR. Interface between Radar and AIS over NMEA0183 communication standard in RS232 or RS422, through supplied Network Interface Box. Ship GPS data is also fed through NMEA 0183 communication to register and display the ship's position in Latitude, Longitude, Date, Time and Speed over Ground. Radar target info displayed in videos (ARPA Target, Range and Bearing).

VIDEO TRACKING OPTION

Automatic pursuit of an object of interest or threat selected on the display by the operator, without any continuous input. Both the infrared and day sensors automatically track the target, even with small obstructions in their path.

CONTROLLER: HARDWARE OR GUI, IP BASED AND REMOTE-CONTROLLED SOLUTIONS (OPTIONS)

1. **Video GUI** (with optional USB joystick / Rugged Rigid Grip): video and control combined on panel PC / Laptop.
2. **Control GUI (Graphical User Interface)**, either on **dedicated touchscreen** display (Panel PC) or as pop up window in PC; with optional USB joystick / Rugged Rigid Grip.
3. **Compact controller** integrating joystick and 2.4" display for orientation & troubleshooting.
4. **Protocol for interface to Command & Control System**

All controllers offer Built-in Test for remote diagnostic and are configured for optional additional controllers, remote control, and autonomous navigation.

PAYLOAD SPECIFICATIONS	
System type:	3 axis gyro stabilization[2] c./w. enhanced video stabilization
Pan Range:	Continuous 360° AZ rotation
Tilt range:	+/-90° elevation movement, including stow position
Colour:	Matterhorn White - gloss. Custom colour upon request.
SYSTEM INTERFACE	
Video format:	SDI
Video streaming:	H.264 in HD with PIP or 2 video streams accessed via net0 and net1
Data:	Radar cursor / ARPA target / AIS over NMEA 0183 via RS422 or RS232
Control:	Over IP network
ENVIRONMENTAL	
Ingress Protection Mark:	IP67
Compliant to:	MIL-STD 810 & MIL-STD 461
Operational temperature:	-20°C to +55°C
WEIGHT AND DIMENSIONS	
Weight:	<20 kg
Diameter payload[3]:	239.7mm
Height payload[3]:	431.5mm
POWER REQUIREMENTS	
Voltage:	24 to 36 VDC
Max. Consumption:	320W
OTHER OPTIONS AND ACCESSORIES	

Other sensors: Contact us with your specific requirements.

[1] theoretical calculation using Johnson's criteria & not accounting for atmospheric conditions/ [2] resolved by 2 axis positioning / [3] Larger movement space required

CONTROL SOLUTIONS

1. Video GUI

2. Control GUI

3. Compact Controller

4. Protocol for interface to Command & Control System

2-Button Joystick

Rugged Rigid Grip

Specifications subject to change or improvement without notice. All Night Navigator sales are conditional to Canadian export license approval – April 21

CURRENT

CURRENT Scientific Corporation – 2933 Murray Street, Port Moody, BC, V3H 1X3, CANADA
Tel: +1 604 461 5555 – sales@currentcorp.com – www.currentcorp.com

Appendix B Mitigation Summary Graphics

Mitigation Action Chart 10 May 2022 through Project Completion

INTERNAL

Geophysical Survey Mitigation Action Chart

Pre-Clearance, Monitoring, and Shutdown Zones

Pre-Clearance and Monitoring Zones:
500 m – NARW, ESA whales, unidentified large whales, ST
100 m – all other MM species*

Shutdown Zones:
500 m – NARW and unidentified large whales
100 m – all other MM species*

(*Within lease area around SBP (sparker/boomer) – **500 m** all species except dolphins)

Equipment Shutdown: Marine Mammal Incursions
Shutdown sparker/boomers **immediately** if **marine mammal detected in Shutdown Zone****

No shutdowns for ST

**Dolphin exception:
No shutdown if from genera *Delphinus, Lagenorhynchus*, *Stenella*, or *Tursiops* and approach is voluntary

Equipment Shutdowns: Visibility Constraints
Shutdown sparkers/boomers if PSOs determine Monitoring Zones cannot be reliably monitored due to reduced visibility

MM = marine mammal; ST = sea turtle

30 min

15 min

30 min

Pre-Clearance

No regulated HRG sources may be ramped-up/activated until Monitoring Zones are clear for 30 min

If MM or ST incursion into Monitoring Zones during pre-clearance, no ramp-up of regulated HRG sources until animal observed exiting Monitoring Zone (**total 30 min clearance**) or the following additional time has elapsed w/no further sightings: **15 min** (small odontocetes and seals), **30 min** (all other MM and ST)

Post-Shutdown

For Marine Mammal Incursions:
Ramp up equipment once MM confirmed to have exited Shutdown Zone or following additional clearance time w/no further sightings:

- **15 min** for small odontocetes and seals
- **30 min** for all other marine mammals

For Reduced Visibility, ramp up after:

- 30 minute Pre-Clearance starting from time visibility >500 m

For Mechanical Pause lasting:
≤ 30 min: restart permitted if continuous visual observation by PSOs and Monitoring Zones clear of MM and ST; if visual observation not continuous, 30 min Pre-Clearance (from start of downtime)
> 30 min: ramp-up following Pre-Clearance watch by PSOs for 30 minutes (from start of downtime/silence) to ensure Monitoring Zones are clear

Site Characterization Survey PECP

Ørsted

Appendix C Mysticetus Data Definitions

Table 18. Behavior Definitions

Behavior	Definition
Blow	Animal (generally cetacean) breathing at surface making a visible column of mist.
Bow Ride	Animal(s) voluntarily approach vessel to surf in waves created by the bow.
Breach	Animal (generally cetacean) leaping clear of the water.
Chase Fish	Animal swimming rapidly toward prey.
Dead	Animal observed no longer living.
Feed	Animal observed eating prey.
Fluke Up	Animal (cetacean) has tail fins out of water.
Injured	Animal(s) has visible wound(s) or displays trauma behaviors.
Look	Animal is watching the vessel, e.g., spy hopping.
Medium Travel	Animal(s) create a wake while swimming.
Mill	Group of animals aggregated at surface with very little activity; >50% of group with asynchronous headings.
None	No behavior observed.
Porpoise	Animal (generally dolphin/porpoises) vigorously traveling where body comes fully out of water.
Rest	Animal(s) creating no wake while swimming or resting (e.g., logging).
Socialize	Animals touching while interacting.
Splash	Animals producing white water.
Surface-Active Mill	Group of animals aggregated at surface with >50% of individuals with asynchronous headings with some splash activity by group members.
Surface-Active Travel	Vigorous swimming including breaching, tail-slapping, creating splashes at the surface, etc.
Swim	Animal moves through water; no other significant behavior evident.
Tail Slap	Animal (generally cetacean) hits surface of water with fluke.
Travel	Animal moves through water in a directed manner.
Unknown	Behavior of animal could not be determined.
Other (See Notes)	Behavior other than listed here—thoroughly described in sighting description notes field (Sighting Desc Notes).

Table 19. Behavioral Reaction Definitions

Behavioral Reaction	Definition
Look	Animal is watching the vessel, e.g., spy hopping.
Change Direction	Animal(s) alters orientation quickly, noticeably, or abruptly.
Dive	Animal(s) abruptly moves completely below the surface.
None	No change in behavior.
Slow Down	Animal(s) noticeably decrease pace.
Speed Up	Animal(s) noticeably increase pace.
Splash	Animals producing white water.
Other (See Notes)	Behavior other than the listed here is observed—thoroughly described in notes.

Table 20. Monitoring and Mitigation Activity Definitions

Monitoring and Mitigation Activity	Definition
Alter Course	Request by PSO to change direction due to potential encroachment on or vessel strike of protected species.
Detection Delay	PSO postponement of ramp-up or activation of regulated sound sources less than 200 kHz due to protected species approaching or in EZ during pre-clearance monitoring or after shutdown.
Engine Neutral	Vessel shifted out of gear.
Monitoring - No Mitigation	PSO did not request any cessation or delay in operations with a regulated sound source less than 200 kHz during this visual effort entry.
Monitoring - Transit	PSO monitoring during movement of vessel between sampling sites or from/to port.
Other (See Notes)	Should be rarely used to capture a mitigation not covered by options here—thoroughly described in notes field.
Powerdown	Reducing output level of regulated sound sources less than 200 kHz.
Pre-clearance	Initiation or continuation of PSO monitoring of the EZ prior to activation of regulated sound source less than 200 kHz.
Ramp-up	Gradual increase in sound introduced into the water at the beginning of sampling operations
Reduce Speed	Request by PSO to slow momentum of the vessel due to potential encroachment on or vessel strike of protected species.
Shutdown	Request by PSO to turn off all regulated sound sources less than 200 kHz for protected species in or approaching EZ.
Weather Delay	PSO postponement of clearance of use of regulated sound sources less than 200 kHz due to poor atmospheric conditions impairing visibility of the entire EZ.
Weather Shutdown	Request by PSO to turn off all regulated sound sources less than 200 kHz due to impaired visibility of the entire EZ.


Mysticetus
Mysticetus PSO/MMO Technology
www.mysticetus.com
info@mysticetus.com
www.twitter.com/mysticetus
www.facebook.com/mysticetus
Mysticetus is the first—and only—system created specifically for every aspect of PSO operations. It is not just a simple tool bolted onto existing PAM or Seismic toolkits; Mysticetus is designed to solve every technological problem PSOs face.
Mysticetus streamlines op planning, performs take estimates and simplifies field operations. Reporting features, automatic data storage and backup, and full GIS analysis and mapping tools round out the list of advantages brought to the PSO.
Mysticetus saves money by:
• preventing unnecessary shutdowns and delays
• performing all time-consuming calculations
• providing real-time awareness for your team
• automatically generating reports for you
Mysticetus is 100% configurable—from fields to fonts—you decide the best setup for your operations.

Appendix D Protected Species Detections during the Ocean Wind 02 HRG Surveys

Vessel	Date	Time (UTC)	Detection Number	Species	Detection Method	Initial Detection Distance (m)	CPA to Active Source <200 kHz (m)	Number Individuals	Initial Behavior	Second Behavior	Reaction	Mitigation
Substantial	13 May 22	10:46	V38B	Unidentified Dolphin	UE	30	n/a	6	swim	travel	none	none
Brasilis	15 May 22	09:50	V22	Unidentified Dolphin	UE	50	n/a	3	porpoise	surface-active travel	none	none
Substantial	16 May 22	10:27	V39B	Bottlenose Dolphin	UE	75	n/a	5	travel	none	other	none
Substantial	16 May 22	10:31	V40B	Bottlenose Dolphin	UE	100	n/a	2	swim	travel	none	none
Brasilis	16 May 22	10:45	V23	Bottlenose Dolphin	UE	472	n/a	6	surface-active travel	porpoise	none	none
Substantial	16 May 22	19:56	V41	Bottlenose Dolphin	UE	120	n/a	4	mill	none	none	none
Substantial	17 May 22	11:13	V42	Unidentified Dolphin	UE	482	n/a	2	travel	swim	none	none
Substantial	17 May 22	11:21	V43	Unidentified Dolphin	UE	500	n/a	2	travel	swim	none	reduce speed
Substantial	17 May 22	19:06	V44	Unidentified Dolphin	UE	500	500	2	mill	swim	none	none
Substantial	17 May 22	19:15	V45	Unidentified Dolphin	UE	120	120	2	swim	travel	none	none
Substantial	17 May 22	21:18	V46	Bottlenose Dolphin	UE	100	n/a	5	surface-active mill	feed	none	reduce speed
Substantial	17 May 22	21:47	V47	Unidentified Dolphin	UE	100	n/a	3	swim	mill	none	none

Vessel	Date	Time (UTC)	Detection Number	Species	Detection Method	Initial Detection Distance (m)	CPA to Active Source <200 kHz (m)	Number Individuals	Initial Behavior	Second Behavior	Reaction	Mitigation
Brasilis	18 May 22	10:50	V24	Unidentified Mysticete Whale	UE	751	750	1	tail slap	none	none	none
Substantial	18 May 22	12:04	V48	Unidentified Mysticete Whale	UE	1000	1000	1	blow	none	none	none
Substantial	18 May 22	21:17	V49	Unidentified Dolphin	UE	300	n/a	5	travel	mill	none	reduce speed
Substantial	19 May 22	13:23	V50	Unidentified Dolphin	UE	500	500	7	surface-active travel	surface-active mill	none	none
Substantial	19 May 22	18:30	V51	Unidentified Dolphin	UE	60	n/a	6	travel	bow-ride	none	reduce speed
Substantial	20 May 22	11:42	V52	Unidentified Dolphin	UE	100	n/a	5	mill	none	none	none
Substantial	20 May 22	18:04	V53	Unidentified Dolphin	UE	150	120	8	surface-active travel	none	other	none
Substantial	21 May 22	10:43	V54	Unidentified Porpoise	UE	75	n/a	5	swim	travel	none	none
Substantial	21 May 22	11:09	V55	Unidentified Dolphin	UE	118	n/a	8	travel	none	none	none
Substantial	21 May 22	11:14	V56	Unidentified Dolphin	UE	820	820	4	travel	none	none	none
Substantial	21 May 22	11:15	V57	Unidentified Dolphin	UE	75	50	12	travel	porpoise	none	none
Substantial	21 May 22	11:23	V58	Unidentified Dolphin	UE	470	60	4	travel	porpoise	none	none
Substantial	21 May 22	12:33	V59	Humpback Whale	UE	3500	3500	1	tail slap	breach	none	none
Brasilis	22 May 22	13:05	V25	Unidentified Dolphin	UE	271	300	1	surface-active travel	none	none	none

Vessel	Date	Time (UTC)	Detection Number	Species	Detection Method	Initial Detection Distance (m)	CPA to Active Source <200 kHz (m)	Number Individuals	Initial Behavior	Second Behavior	Reaction	Mitigation
Brasilis	25 May 22	14:48	V26	Bottlenose Dolphin	UE	245	n/a	10	surface-active travel	swim	none	none
Substantial	25 May 22	21:15	V60	Bottlenose Dolphin	UE	1000	n/a	7	mill	travel	change direction	none
Substantial	26 May 22	10:01	V61	Unidentified Dolphin	UE	60	n/a	4	porpoise	none	none	none
Substantial	26 May 22	10:08	V62	Unidentified Dolphin	UE	80	n/a	4	travel	porpoise	none	reduce speed
Substantial	26 May 22	12:10	V63	Unidentified Dolphin	UE	820	n/a	12	surface-active mill	surface-active travel	none	none
Brasilis	26 May 22	15:41	V27	Bottlenose Dolphin	UE	742	775	1	porpoise	swim	none	none
Substantial	26 May 22	21:33	V64	Bottlenose Dolphin	UE	100	n/a	20	surface-active mill	feed	none	none
Brasilis	29 May 22	19:50	V28	Unidentified Dolphin	UE	50	n/a	5	surface-active travel	porpoise	none	none
Substantial	31 May 22	10:23	V65	Unidentified Dolphin	UE	834	800	5	surface-active travel	swim	none	none
Substantial	02 Jun 22	14:06	V66	Unidentified Dolphin	UE	820	n/a	20	mill	none	none	none
Substantial	02 Jun 22	14:40	V67	Unidentified Mysticete Whale	UE	3000	n/a	1	swim	breach	none	none
Substantial	02 Jun 22	14:42	V68	Humpback Whale	UE	700	n/a	1	other	splash	none	none
Substantial	02 Jun 22	14:47	V69	Bottlenose Dolphin	UE	1000	n/a	7	travel	swim	none	none

Vessel	Date	Time (UTC)	Detection Number	Species	Detection Method	Initial Detection Distance (m)	CPA to Active Source <200 kHz (m)	Number Individuals	Initial Behavior	Second Behavior	Reaction	Mitigation
Substantial	02 Jun 22	14:48	V70	Unidentified Dolphin	UE	250	n/a	5	travel	swim	none	none
Substantial	02 Jun 22	14:52	V71	Unidentified Mysticete Whale	UE	1180	n/a	1	blow	none	none	none
Substantial	02 Jun 22	15:36	V72	Unidentified Mysticete Whale	UE	1330	1200	1	blow	none	none	none
Substantial	02 Jun 22	17:31	V73	Unidentified Mysticete Whale	UE	80	n/a	1	swim	none	none	none
Brasilis	03 Jun 22	15:47	V29	Bottlenose Dolphin	UE	742	800	1	porpoise	swim	none	none
Brasilis	04 Jun 22	16:56	V30	Bottlenose Dolphin	UE	1054	1100	1	porpoise	surface-active travel	none	none
Brasilis	04 Jun 22	17:14	V31	Minke Whale	UE	1832	510	1	blow	surface-active travel	none	shutdown
Brasilis	06 Jun 22	16:53	V32	Unidentified Sea Turtle	UE	75	75	1	swim	none	none	none
Brasilis	07 Jun 22	19:23	V33	Loggerhead Sea Turtle	UE	45	30	1	surface-active mill	surface-active travel	none	none
Brasilis	09 Jun 22	17:09	V34	Loggerhead Sea Turtle	UE	75	n/a	1	swim	none	none	none
Brasilis	10 Jun 22	15:02	V35	Loggerhead Sea Turtle	UE	100	75	1	swim	none	none	none
Brasilis	10 Jun 22	18:26	V36	Loggerhead Sea Turtle	UE	242	275	1	swim	none	none	none
Brasilis	10 Jun 22	18:48	V37	Loggerhead Sea Turtle	UE	573	600	1	swim	none	none	none

Vessel	Date	Time (UTC)	Detection Number	Species	Detection Method	Initial Detection Distance (m)	CPA to Active Source <200 kHz (m)	Number Individuals	Initial Behavior	Second Behavior	Reaction	Mitigation
Brasilis	12 Jun 22	05:45	V38	Unidentified Sea Turtle	NVD	70	150	1	swim	none	none	none
Brasilis	17 Jun 22	01:21	V39	Unidentified Sea Turtle	NVD	50	n/a	1	swim	none	none	none
Brasilis	18 Jun 22	18:58	V40	Bottlenose Dolphin	UE	75	n/a	3	porpoise	surface-active mill	none	none
Brasilis	18 Jun 22	23:38	V41	Bottlenose Dolphin	UE	40	n/a	1	porpoise	none	none	none
Brasilis	20 Jun 22	15:53	V42	Loggerhead Sea Turtle	UE	50	100	1	swim	none	none	none
Brasilis	20 Jun 22	18:38	V43	Loggerhead Sea Turtle	UE	242	300	1	swim	none	none	none
Brasilis	22 Jun 22	14:47	V44	Unidentified Dolphin	UE	50	n/a	1	splash	none	none	none
Brasilis	23 Jun 22	20:14	V45	Loggerhead Sea Turtle	UE	290	300	1	swim	other	none	none
Brasilis	24 Jun 22	02:24	V46	Unidentified Sea Turtle	NVD	30	15	1	swim	none	none	none
Brasilis	24 Jun 22	19:19	V47	Loggerhead Sea Turtle	UE	397	420	1	surface-active mill	swim	none	none
Brasilis	24 Jun 22	21:56	V48	Loggerhead Sea Turtle	UE	50	n/a	1	swim	none	none	none
Brasilis	25 Jun 22	13:28	V49	Loggerhead Sea Turtle	UE	100	100	1	rest	none	none	none
Brasilis	25 Jun 22	14:18	V50	Loggerhead Sea Turtle	UE	10	45	1	rest	none	dive	none
Brasilis	25 Jun 22	19:19	V51	Loggerhead Sea Turtle	UE	10	10	1	swim	none	none	none
Brasilis	26 Jun 22	17:29	V52	Loggerhead Sea Turtle	UE	242	300	1	swim	none	none	none

Vessel	Date	Time (UTC)	Detection Number	Species	Detection Method	Initial Detection Distance (m)	CPA to Active Source <200 kHz (m)	Number Individuals	Initial Behavior	Second Behavior	Reaction	Mitigation
Brasilis	26 Jun 22	22:18	V53	Loggerhead Sea Turtle	UE	50	120	1	swim	none	none	none
Brasilis	29 Jun 22	12:08	V54	Bottlenose Dolphin	UE	393	n/a	5	surface-active travel	porpoise	none	none
Brasilis	29 Jun 22	16:45	V55	Loggerhead Sea Turtle	UE	300	150	1	swim	none	none	none
Brasilis	29 Jun 22	18:47	V56	Leatherback Sea Turtle	UE	242	250	1	swim	none	none	none
Brasilis	30 Jun 22	12:05	V57	Leatherback Sea Turtle	UE	242	275	1	swim	none	none	none
Brasilis	30 Jun 22	15:36	V58	Loggerhead Sea Turtle	UE	50	50	1	swim	none	none	none
Brasilis	30 Jun 22	15:49	V59	Leatherback Sea Turtle	UE	100	75	1	swim	none	none	none
Brasilis	30 Jun 22	16:02	V60	Loggerhead Sea Turtle	UE	75	75	1	swim	none	none	none
Brasilis	30 Jun 22	17:48	V61	Leatherback Sea Turtle	UE	299	350	1	swim	none	none	none
Brasilis	30 Jun 22	17:56	V62	Loggerhead Sea Turtle	UE	75	75	1	swim	none	none	none
Brasilis	30 Jun 22	21:21	V63	Leatherback Sea Turtle	UE	50	100	1	swim	none	none	none
Brasilis	01 Jul 22	02:35	V64	Unidentified Sea Turtle	NVD	60	120	1	rest	none	none	none
Brasilis	01 Jul 22	11:48	V65	Loggerhead Sea Turtle	UE	100	150	1	swim	none	none	none
Brasilis	01 Jul 22	18:37	V66	Loggerhead Sea Turtle	UE	250	265	1	swim	none	none	none
Brasilis	02 Jul 22	00:11	V67	Bottlenose Dolphin	UE	300	130	4	feed	none	none	none
Brasilis	02 Jul 22	17:23	V68	Loggerhead Sea Turtle	UE	75	100	1	swim	none	none	none

Vessel	Date	Time (UTC)	Detection Number	Species	Detection Method	Initial Detection Distance (m)	CPA to Active Source <200 kHz (m)	Number Individuals	Initial Behavior	Second Behavior	Reaction	Mitigation
Brasilis	04 Jul 22	16:10	V69	Loggerhead Sea Turtle	UE	100	35	1	swim	none	none	none
Brasilis	04 Jul 22	20:30	V70	Loggerhead Sea Turtle	UE	120	70	1	surface-active travel	swim	none	none
Brasilis	05 Jul 22	07:16	V71	Unidentified Sea Turtle	NVD	20	35	1	swim	none	none	none
Brasilis	06 Jul 22	16:05	V72	Unidentified Sea Turtle	UE	35	75	1	swim	none	none	none
Brasilis	07 Jul 22	17:43	V73	Loggerhead Sea Turtle	UE	50	50	1	swim	none	none	none
Brasilis	08 Jul 22	15:15	V74	Unidentified Sea Turtle	UE	35	35	1	swim	none	none	none
Brasilis	08 Jul 22	18:29	V75	Loggerhead Sea Turtle	UE	267	225	1	swim	none	none	none
Brasilis	08 Jul 22	18:51	V76	Loggerhead Sea Turtle	UE	150	150	1	swim	none	none	none
Brasilis	08 Jul 22	19:02	V77	Loggerhead Sea Turtle	UE	100	100	1	swim	none	none	none
Brasilis	09 Jul 22	06:39	V78	Unidentified Sea Turtle	NVD	70	70	1	surface-active mill	none	none	none
Brasilis	09 Jul 22	12:16	V79	Loggerhead Sea Turtle	UE	35	50	1	swim	none	none	none
Brasilis	10 Jul 22	05:48	V80	Unidentified Sea Turtle	NVD	30	30	1	swim	none	none	none
Brasilis	10 Jul 22	07:17	V81	Unidentified Sea Turtle	NVD	40	40	1	swim	none	none	none
Brasilis	11 Jul 22	07:33	V82	Unidentified Sea Turtle	NVD	30	80	1	swim	none	none	none
Brasilis	11 Jul 22	10:08	V83	Loggerhead Sea Turtle	UE	30	40	1	swim	none	none	none

Vessel	Date	Time (UTC)	Detection Number	Species	Detection Method	Initial Detection Distance (m)	CPA to Active Source <200 kHz (m)	Number Individuals	Initial Behavior	Second Behavior	Reaction	Mitigation
Brasilis	11 Jul 22	17:27	V84	Loggerhead Sea Turtle	UE	30	45	1	swim	none	none	none
Brasilis	11 Jul 22	21:21	V85	Kemp's Ridley Sea Turtle	UE	25	50	1	swim	none	none	none
Brasilis	12 Jul 22	19:15	V86	Leatherback Sea Turtle	UE	40	n/a	1	surface-active mill	swim	none	none

UTC = universal time convention, UE = unaided eye, NVD = night vision device

Appendix E Protected Species Detection Photographs

Figure 19. Bottlenose dolphins (*Tursiops truncatus*) observed on 25 May 2022 from the *Fugro Brasilis*. Photo credit: Graham Humphries.

Figure 20. Leatherback sea turtle (*Dermochelys coriacea*) observed on 30 June 2022 from the *Fugro Brasilis*. Photo credit: Chris Werre.

Figure 21. Leatherback sea turtle (*Dermochelys coriacea*) observed on 30 June 2022 from the *Fugro Brasilis*. Photo credit: Chris Werre.

Figure 22. Loggerhead sea turtle (*Caretta caretta*) observed on 04 July 2022 from the *Fugro Brasilis*. Photo credit: Neil Roper.

Figure 23. Unidentified sea turtle observed with NVD on 05 July 2022 from the *Fugro Brasilis*. Photo credit: Gregory Zmirak.

Figure 24. Kemp's Ridley sea turtle (*Lepidochelys kempii*) observed on 11 July 2022 from the *Fugro Brasilis*. Photo credit: Chris Werre.