Protected Species Observer NE IHA Report for the Ørsted South Fork Wind 01, Revolution 01, and Sunrise Wind 01 High Resolution Geophysical Survey 2022

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Submitted by:
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Survey:
Ørsted South Fork Wind 01, Revolution 01, and Sunrise Wind 01 Geophysical Survey 2022
BOEM Leases OCS-A 0486, OCS-A 0517, and OCS-A 0487
Ørsted New England IHA 03 March - 24 September 2022

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Acronyms and Abbreviations

AA	Applied Acoustics
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
eNGO	environmental non-government organization
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 0486, OCS-A 0517, and OCS-A 0487
LF	low frequency
MBES	multi-beam echosounder
MF	mid-frequency
mm	millimeter
MMPA	Marine Mammal Protection Act
mounted IR	vessel-mounted IR camera system

NARW	North Atlantic right whale
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NVD	night vision device
NVTS IR	NVTS Reliant 640HD IR camera
Ocean Infinity	Ocean Infinity America, Inc.
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 0486, OCS-A 0517, and OCS-A 0487 and the export cable routes
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) South Fork Wind 01 (SFW01), Revolution Wind 01 (REV01), and Sunrise Wind 01 (SRW01) Wind Farms (collectively referred to herein as Ørsted New England Wind Farms) fulfills the reporting requirements of the Ørsted 2022 New England National Marine Fisheries Service (NMFS) Incidental Harassment Authorization (IHA) issued on 26 September 2019 (NMFS 2019) and renewed on 25 September 2020 (NMFS 2020) and again on 03 March 2022 (NMFS 2022). Dates associated with this report correspond to the active period of the 2022 IHA (28 April 2022 through project completion on 17 July 2022).

Protected species observers (PSOs) were present aboard two HRG survey vessels, the *Fugro Brasilis* and the *Deep Helder*, to implement ship strike avoidance and geophysical survey mitigation measures during high resolution geophysical (HRG) surveys off the New England coast for the Ørsted New England Wind Farms from 28 April 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 0486 (BOEM 2013a), OCS-A 0517 (BOEM 2020), and OCS-A 0487 (BOEM 2013b), BOEM Atlantic OCS Region *Project Design Criteria and Best Management Practices for Protected Species Associated with Offshore Wind Data Collection* (BOEM PDC; BOEM 2021), BOEM limited waiver, and the 2022 New England NMFS IHA (NMFS 2022; collectively referred to herein as regulatory documents).

Monitoring effort was accomplished over a combined (both vessels and all three lease areas) total distance of 10,808 kilometers (km) and 1,583 hours of visual observation. Monitoring effort during daylight was conducted for the majority (66%) of the total combined effort and was largely attributed to seasonally longer summer days. HRG acoustic sources operating below 200 kHz were active for 63% of the combined monitoring effort.

Throughout the surveys, the PSOs recorded a combined total of 194 protected species detections (189 marine mammal and five sea turtle) composed of an estimated 942 individuals. Unidentified mysticete whales and short-beaked common dolphins (*Delphinus delphis*) were the most frequently detected group/species at 80 and 42 detections respectively. North Atlantic right whales (NARW; *Eubalaena glacialis*) and Atlantic sturgeon were not detected. More than half (67%) 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 (99%) of those detections.

The PSOs did not observe any reactions from protected species while the sparker and other HRG acoustic sources below 200 kHz were active. However, 3% of protected species exhibited a response when acoustic sources below 200 kHz were inactive (two of the 72 detections with HRG sources inactive). Both reactions were from loggerhead sea turtles looking towards the vessel while HRG sources were inactive. Behavioral changes were only observed when the HRG sources below 200 kHz were inactive, which indicates that behavioral responses to HRG acoustic sources were minimal or non-existent 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 25 occasions, including 14 shutdowns, two delays, three calls for engines to be switched to neutral, and six strike avoidance course alterations. In addition to protected species mitigation measures, 21 weather related mitigation measures were implemented for reduced visibility (19 shutdowns and two delays). Most of the 155 hours of PSO related downtime (93%) was attributed to reduced visibility. All mitigation measures were implemented quickly and effectively. There were also six non-PSO shutdowns made by the survey crew for equipment getting tangled or snagged.

A total of 332 marine mammals and 1 sea turtle 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. The marine mammals exposed included one minke whale, five bottlenose dolphins, 320 short-beaked common dolphins, five unidentified dolphins, and one unidentified seal. One shutdown was called for the mysticete detection, and one conservative shutdown was called for a sea turtle within the exclusion zone. A shutdown was not required for the pinniped sighting, as the animal was already deceased. All 330 potential marine mammal exposures for delphinids 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 South Fork Wind 01, Revolution Wind 01, and Sunrise Wind 01 survey campaigns. 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 South Fork Wind 01, Revolution Wind 01, and Sunrise Wind 01 Wind Farms 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.

Ørsted applied to NMFS for an IHA in June 2019 to support HRG surveys associated with the development the New England offshore wind farms (South Fork Wind 01, Revolution Wind 01, and Sunrise Wind 01 within BOEM Leases OCS-A 0486, OCS-A -0517, and OCS-A 0487 [BOEM 2013a, BOEM 2013b, BOEM 2020 Ørsted 2019]). NMFS subsequently issued the Ørsted New England IHA on 26 September 2019 (NMFS 2019). Ørsted submitted two IHA renewal requests in July 2020 (CSA 2020) and August 2021 (Ørsted 2021), with renewal IHAs issued on 25 September 2020 (NMFS 2020) and 03 March 2022 (NMFS 2022). The first two IHAs were valid for one year from the date of issuance. The 2022 IHA is valid through 24 September 2022. All three IHAs covered HRG survey operations for Ørsted from New York to Massachusetts, including the three lease areas mentioned herein and associated export cable routes (ECRs; Figure 1).

HRG surveys were conducted by the marine survey companies Fugro USA Marine, Inc. (Fugro) and Ocean Infinity America, Inc. (Ocean Infinity). PSOs were provided by Smultea Environmental Sciences, LLC (Smultea Sciences), referred to herein as the PSO provider, were present aboard two HRG survey vessels, the *Fugro Brasilis* and the *Deep Helder* (Figures 2-3). The PSO provider was 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 Leases OCS-A 0486, OCS-A 0517, and OCS-A 0487, BOEM approved survey and monitoring plan (including the Alternative Monitoring Plan [AMP]), and the IHA. Vessel-mounted infrared (IR) camera systems on the *Deep Helder* and *Fugro Brasilis* were provided by Smultea Sciences and Fugro respectively. Marine survey companies, survey vessels, and the PSO provider 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 Section 4.

Smultea Sciences was contracted by Ørsted to prepare this PSO IHA Report for the New England 2022 HRG surveys, combining all PSO monitoring and mitigation data for the two survey vessels that operated within the BOEM Leases OCS-A 0486, OCS-A 0517, and

OCS-A 0487 and associated ECR corridors.

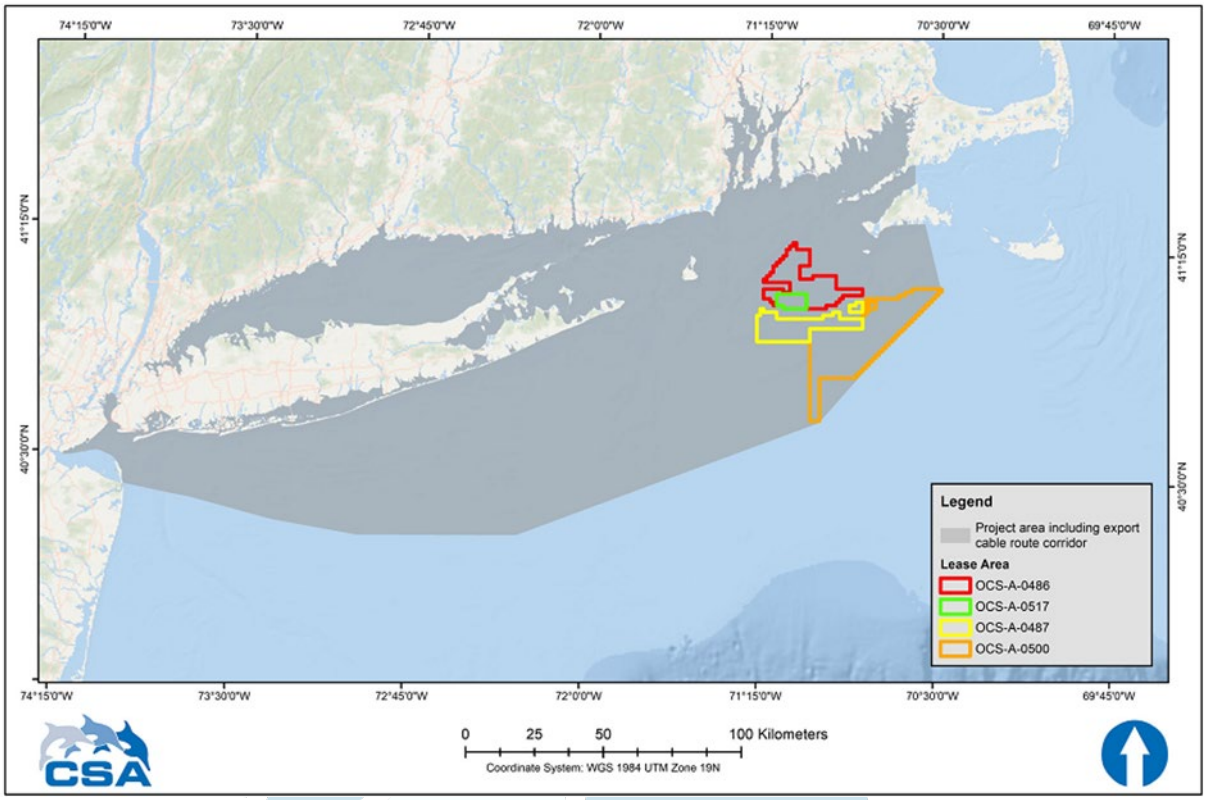

Figure 1. South Fork Wind 01 (OCS-A 0517, green polygon), Revolution Wind 01 (OCS-A 0486, red polygon), and Sunrise Wind 01 (OCS-A 0487, yellow polygon) HRG survey areas. Figure from the Ørsted New England IHA renewal application (CSA 2020).

Table 1. Survey vessels, marine survey operators, and PSO providers that operated on the South Fork Wind 01 (SFW01), Revolution Wind 01 (REV01), and Sunrise Wind 01 (SRW01) HRG surveys.

Survey Vessel	Project	Marine Survey Company	PSO Provider
Deep Helder	SFW01	Ocean Infinity	Smultea Sciences
Deep Helder	REV01	Ocean Infinity	Smultea Sciences
Deep Helder	SRW01	Ocean Infinity	Smultea Sciences
Fugro Brasilis	SRW01	Fugro	Smultea Sciences

Figure 2. Survey vessel *Deep Helder*. Photograph provided by MMT on behalf of Ocean Infinity.

Figure 3. Survey vessel *Fugro Brasilis*. Photograph provided by Fugro.

3 Survey Overview

Survey activities were conducted by two survey vessels from 28 April through 17 July 2022. The *Deep Helder* was in operation from 1 May through 10 July 2022, while the *Fugro Brasilis* was active from 13 July through 17 July 2022. The complete timeline for HRG operations for each vessel is provided in Table 2.

Table 2. Summary of HRG events for the two survey vessels on Ørsted New England Wind Farm surveys.

Event	Date (2022)
Deep Helder mobilization and vessel kick-off meeting in New Bedford, MA and virtual for all survey areas	28 April
Deep Helder begins wet testing HRG equipment at the dock in New Bedford, MA	1 May
Deep Helder departs Bedford, MA and begins transit to South Fork Wind 01 survey area and continue HRG testing	5 May
Deep Helder continues HRG testing	6 May
Deep Helder finishes HRG testing and transits to anchorage in Newport, RI	7 May
Deep Helder continues HRG testing	11 May
Deep Helder finishes HRG testing and transits and begins 24-hour HRG operations on South Fork Wind 01	12 May
Deep Helder transits to dock in New Bedford, MA due to poor weather	17 May
Deep Helder has partial crew change and transits to South Fork Wind 01 survey area and deploys equipment	18 May
Deep Helder resumes 24-hour HRG operations on South Fork Wind 01	19 May
Deep Helder completes HRG operations on South Fork Wind 01 and begins transit to Revolution Wind 01 lease area	23 May
End of survey for South Fork 01	23 May
Deep Helder transits to dock in New Bedford, MA	14 June
Deep Helder transits back to Revolution Wind 01 lease area and resumes 24-hour HRG operations	15 June
Deep Helder completes HRG operations on Revolution Wind 01 and begins transit to Sunrise Wind 01 lease area and begins 24-hour HRG operations	25 June
Deep Helder stops HRG operations on Sunrise Wind 01 and begins transit back to Revolution Wind 01 lease area to attempt to finish survey lines	2 July
Fishing gear prevented the *Deep Helder* from finishing survey lines on Revolution Wind 01 and the vessel transits back to Sunrise Wind 01 and resumes 24-hour HRG operations	3 July
End of survey for Revolution Wind 01	3 July
Deep Helder completes HRG operations on Sunrise Wind 01 and returns to dock in New Bedford, MA	10 July
Deep Helder de-mobilization in New Bedford, MA	11-12 July
Fugro Brasils virtual vessel kick-off meeting for Sunrise Wind 01 (vessel had already mobilized and was leaving a previous survey area)	13 July
Fugro Brasilis begins transit to Sunrise Wind 01 survey area and begins 24-hour HRG operations	13 July
Fugro Brasilis completes HRG operations on Sunrise Wind 01 begins transit to Elizabeth, NJ	16 July
End of survey for Sunrise Wind 01	16 July

Fugro Brasilis completes arrives at dock in Elizabeth, NJ	17 July
Fugro Brasils de-mobilization in Elizabeth, NJ	17 July

HRG survey equipment consisted of medium penetration SBP sparkers, 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 Ørsted New England Wind Farm HRG surveys.

Survey Equipment	Make	Model	Operating Frequency (kHz)
Deep Helder			
Multi-Beam Echosounder	Kongsberg	2040D	200-400
Medium Penetration SBP (S-UHRS and M-UHRS)	GeoSource	GeoSource 200-400	0.1-5
Fugro Brasilis			
Multi-Beam Echosounder	Kongsberg	EM2040C	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

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 teams aboard the two survey vessels were comprised of four PSOs each, including one lead PSO and one or more additional senior PSOs to ensure an experienced PSO was available 24 hours per day.

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 always available at the PSO station on each vessel.

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 *Fugro Brasilis* and *Deep Helder*, 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 either survey vessel.

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 both vessels. 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 Ørsted New England Wind Farm surveys. X indicates device was available for use by PSOs on the vessel.

Survey Vessel	NVD		HH IR		Mounted IR Camera		RB (various models)
	PVS-7 Biocular	PVS-14 Monocular	FLIR BHM 6XR Biocular	FLIR Scout III 640	Current Corp Night Navigator 3050	NVTS Reliant 640HD	
Deep Helder	X		X	X		X	X
Fugro Brasilis	X	X	X	X	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 bridge and forecastle decks on the *Deep Helder*. 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 Ørsted New England Wind Farm HRG surveys.

Vessel	Monitoring Location	Height of Deck (m)	Height of Deck (m) + 1.6 m[1]	Distance to Horizon (km)
Deep Helder	Bridge Deck[2]	9.75	11.35	12.03
Fugro Brasilis	Bridge Deck[2]	10.7	12.3	12.5
Fugro Brasilis	Forecastle Deck	8.01	9.61	11.1

[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.
[2] Bridge deck includes inside and outside bridge, with same deck heights.

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). Two PSOs were on watch during darkness, one monitoring with NVD and one monitoring a pair of mounted Current Corp (*Fugro Brasilis*) or NVTS (*Deep Helder*) IR cameras.

The PSO monitoring with NVD 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 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 of the *Fugro Brasilis*, one port and one starboard. The two NVTS Reliant IR cameras were mounted on the flying bridge deck of the *Deep Helder*. Each 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 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 100 m off the bow, and 30 to 100 m off the stern were sufficiently illuminated for them to observe using only the UE on the *Fugro Brasilis*. On the *Deep Helder* the waters approximately 30 to 50 m abeam, 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 the sparker. 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 agreement between Ørsted and an environmental non-government organization (eNGO).

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 sparker 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. 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

Sparker activation 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 the sparker was 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 and underwent slight adjustments throughout the survey to reflect updates in the Regulatory documents. EZs were as follows:

- 500 m for NARW and unidentified large whales
- 100 m all other marine mammals*

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

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 or sparker equipment did not require a shutdown. Sea turtles also did not require a shutdown.

Reactivation or ramp up of the sparker 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 HRG survey equipment operating below 200 kHz was active, 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

The sparker 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 sparker ramp-up 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 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 low frequency (LF) and mid-frequency (MF) cetacean hearing groups and less than 40 m for high frequency (HF) hearing groups (Table 6, CSA 2020). 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 2020 New England IHA application (CSA 2020). The Level B isopleth was modeled to 141 m for the sparker systems used on the New England Wind Farms. The Level B harassment zones were modeled for all HRG survey equipment below 200 kHz, however only non-parametric SBPs (CHIRPS), boomers, and sparkers were expected to result in Level B exposures (Table 6). A GeoMarine sparkers were deployed on the two survey vessels (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 2020).

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)
Shallow SBPs						
ET 216 CHIRP	< 1	< 1	2.9	n/a	0	12
ET 424 CHIRP	0	0	0	n/a	0	4
ET512i CHIRP	0	0	< 1	n/a	0	6
GeoPulse 5430	< 1	< 1	36.5	n/a	< 1	29
TB CHIRP III	< 1	< 1	16.9	n/a	< 1	54
Parametric SBPs						
Innomar	< 1	< 1	1.7	n/a	< 1	4
Medium SBPs						
AA Triple Plate S-Boom (700/1000J)	< 1	0	0	4.7	< 1	76
AA Dura-Spark UHD Sparkers	< 1	0	0	2.8	< 1	141
GeoMarine Sparkers	< 1	0	0	2.8	< 1	141
Acoustic Corers						
Pangeo LF CHIRP	< 1	0	< 1	n/a	< 1	4
Pangeo HF CHIRP	< 1	< 1	< 1	n/a	< 1	4
Acoustic Positioning						
USBL (all models)	0	0	1.7	n/a	0	50

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 *Deep Helder* from 28 April through 17 July 2022 during the Ørsted New England Wind Farm 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 *Deep Helder* and *Fugro Brasilis* accrued a combined total 10,808 km of vessel trackline while PSOs were monitoring for protected species during 1,583 hours of monitoring effort (Table 7). Monitoring effort was greater during daylight hours than during darkness, with 1,052 hours during daylight and 531 hours during darkness. Trackline coverage was also greater during daylight at 7,350 km than during darkness at 3,458 km. Figure 4, 5, 6, and 7 provide vessel tracklines for the *Deep Helder* and *Fugro Brasilis* for each survey area. The same vessel tracklines were separated by daylight and darkness in Figure 8, 9, 10, and 11.

The majority of PSO monitoring efforts (67%) took place while HRG sources below 200 kHz were active, of which the sparker was active for 93% of that time. Vessel tracklines for the *Deep Helder* and *Fugro Brasilis* were separated by HRG sources active and inactive in Figure 12, 13, 14 and 15.

Monitoring effort was completed primarily during survey operations, weather standby (including periods of weather related delays and shutdowns), and transit (Figure 16).

Table 7: Monitoring effort (hours) and vessel trackline in km completed by the *Fugro Brasilis* and *Deep Helder* during daylight and darkness, as well as when HRG equipment operating below 200 kHz were active and inactive. Note that any discrepancy in totals is due to rounding.

Survey Vessel and Survey Area	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)
Deep Helder														
SFW01	214	1572	115	708	128	870	201	1411	128	870	201	1411	329	2281
REV01	537	3310	269	1569	539	3762	267	1118	539	3762	267	1118	806	4879
SRW01	234	1599	106	650	340	1878	0	371	262	1878	78	371	340	2250
Fugro Brasilis														
SRW01	67	868	40	530	49	349	58	1049	49	349	58	1049	107	1398
Total	**1052**	**7350**	**531**	**3458**	**1057**	**6859**	**526**	**3949**	**979**	**6859**	**604**	**3949**	**1583**	**10808**

TL = trackline, km = kilometers, SFW01=South Fork Wind 01, REV01=Revolution Wind 01, SRW01=Sunrise Wind 01

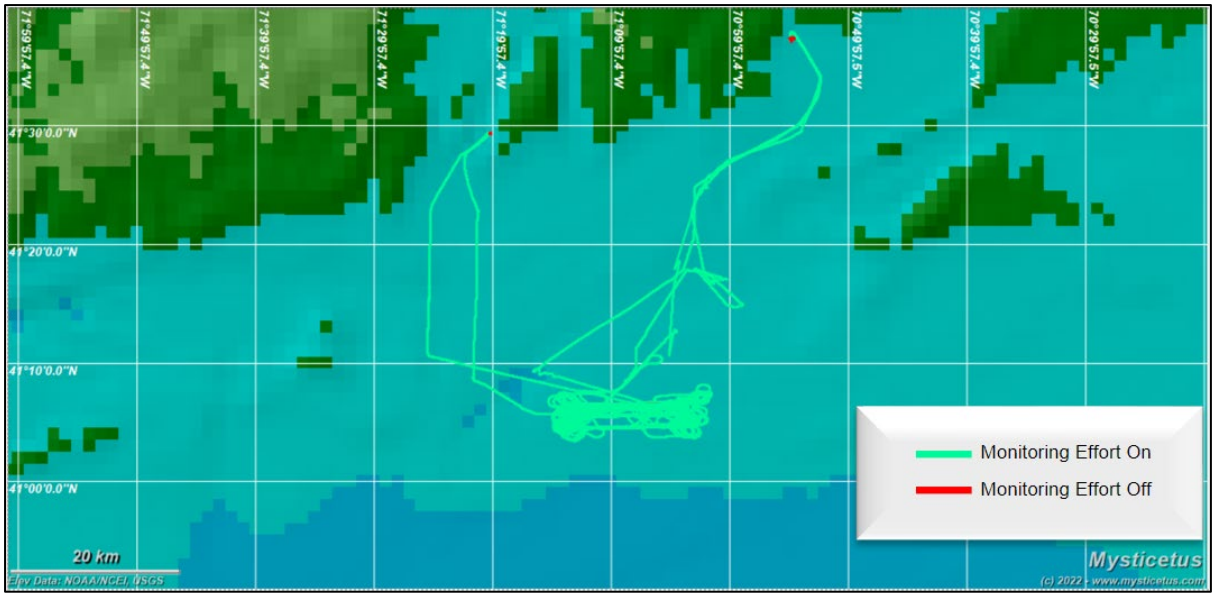

Figure 4. *Deep Helder* tracklines for the SFW01 survey. Green tracks correspond to periods when PSOs were on effort (monitoring) and red tracks when PSOs were off effort (not monitoring).

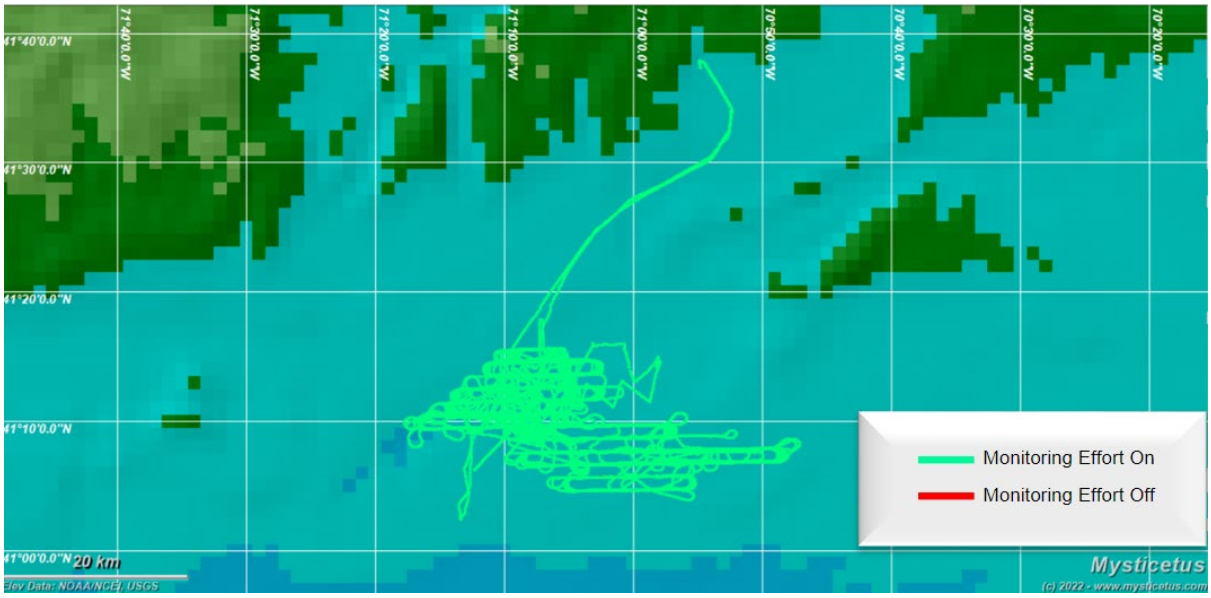

Figure 5. *Deep Helder* tracklines for the REV01 survey. Green tracks correspond to periods when PSOs were on effort (monitoring) and red tracks when PSOs were off effort (not monitoring).

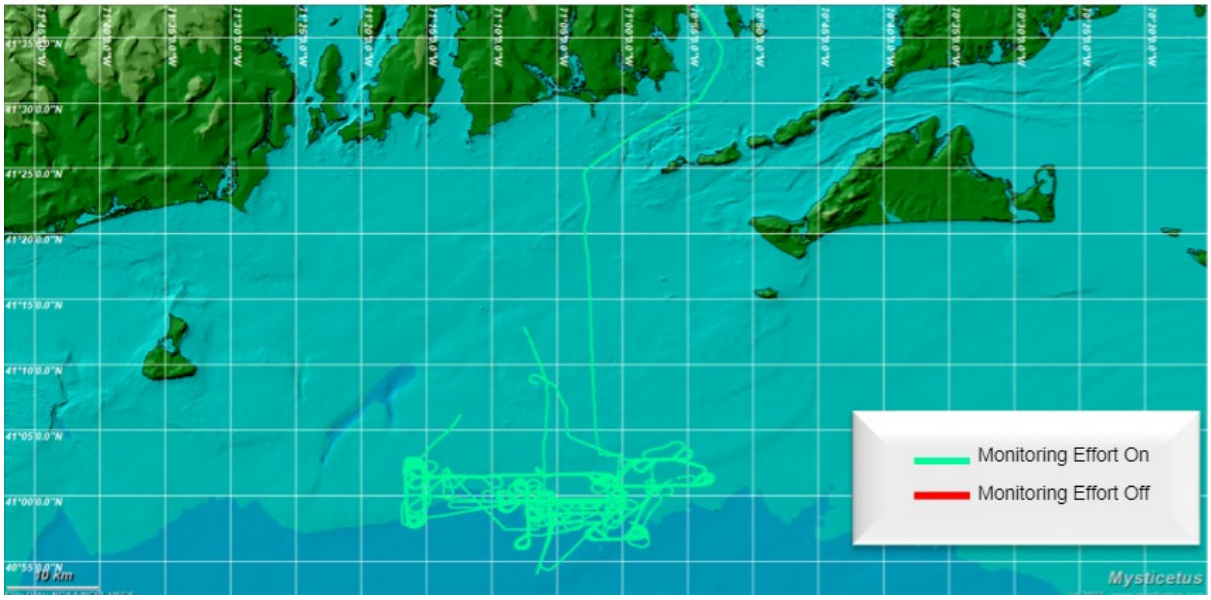

Figure 6. *Deep Helder* tracklines for the SRW01 survey. Green tracks correspond to periods when PSOs were on effort (monitoring) and red tracks when PSOs were off effort (not monitoring).

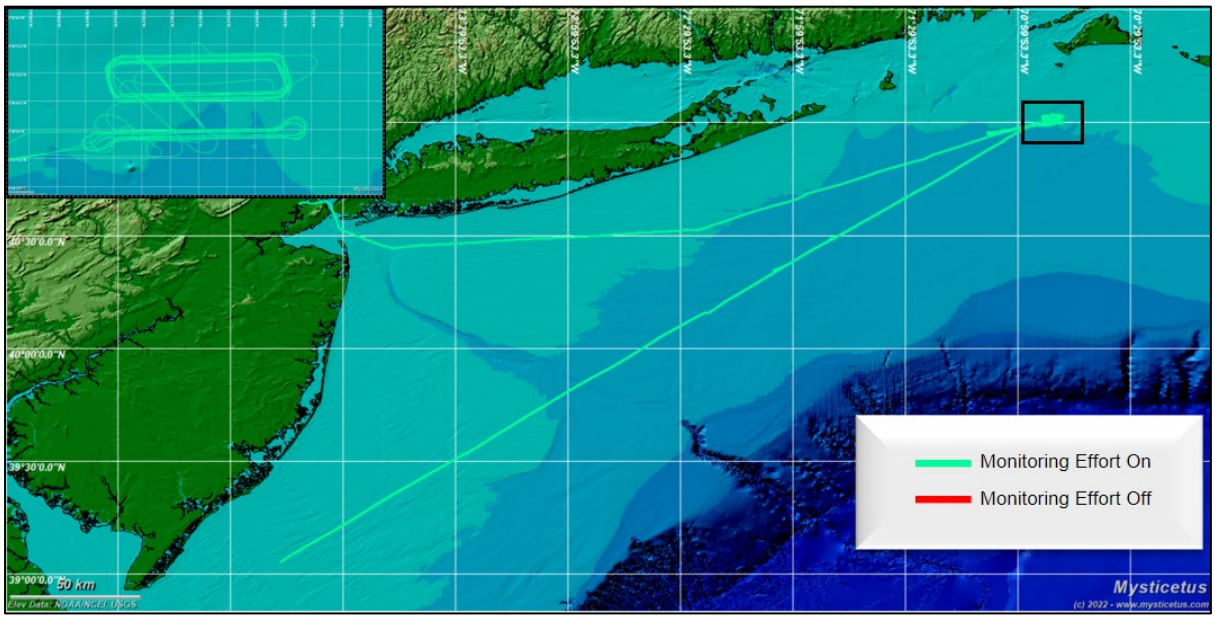

Figure 7. *Fugro Brasilis* tracklines for the SRW01 survey. Green tracks correspond to periods when PSOs were on effort (monitoring) and red tracks when PSOs were off effort (not monitoring). Map insert is an enlargement of the northern portion of the track within the OCS-A 0487 lease (black box).

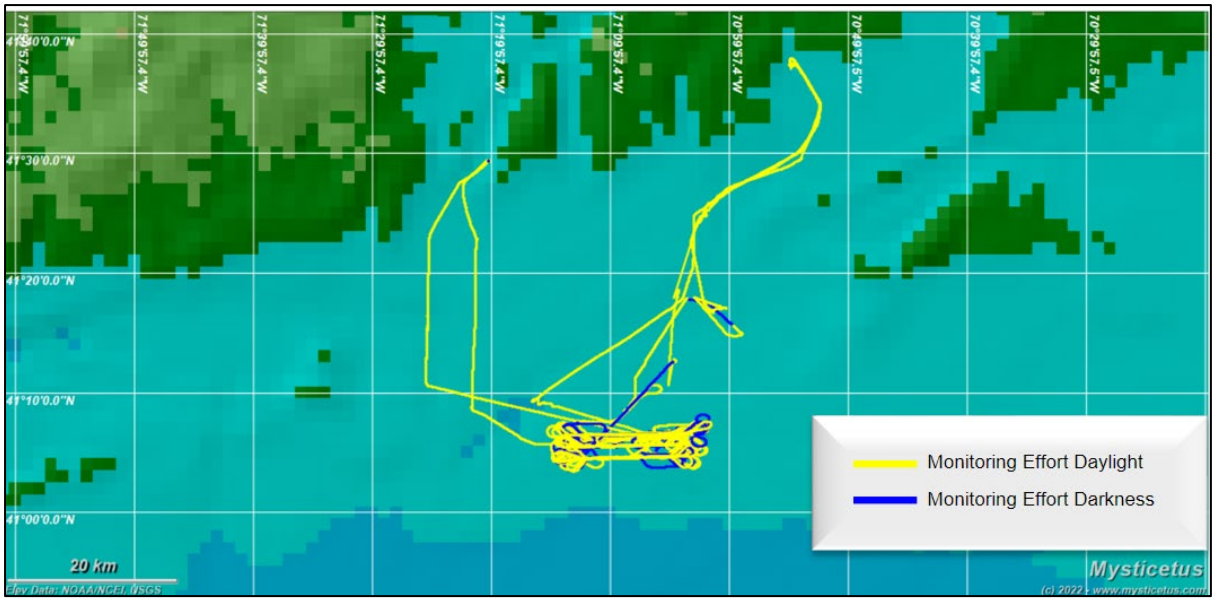

Figure 8. *Deep Helder* tracklines for SFW01 showing PSO monitoring effort during daylight (yellow tracks) and darkness (blue tracks).

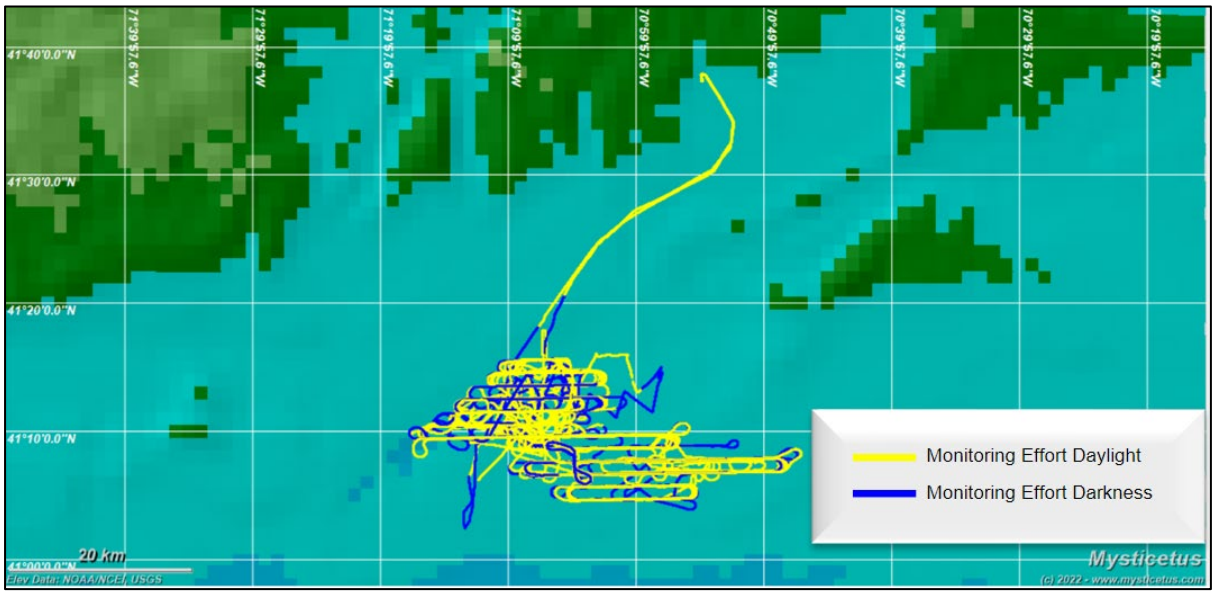

Figure 9*. Deep Helder* tracklines for REV01 showing PSO monitoring effort during daylight (yellow tracks) and darkness (blue tracks).

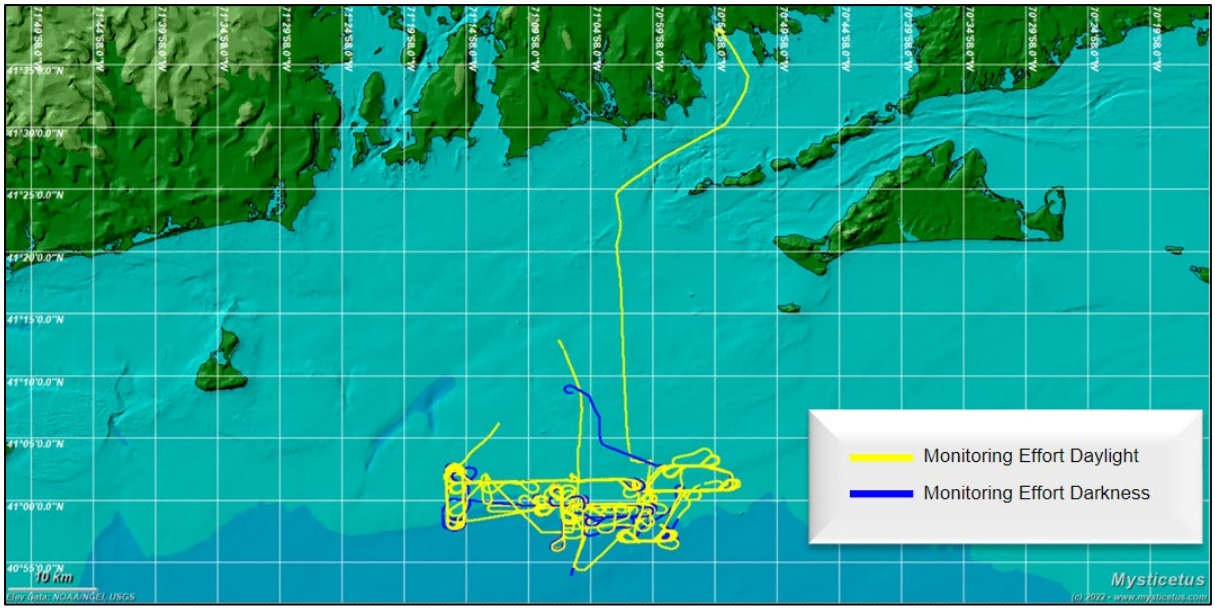

Figure 10. *Deep Helder* tracklines for SRW01 showing PSO monitoring effort during daylight (yellow tracks) and darkness (blue tracks).

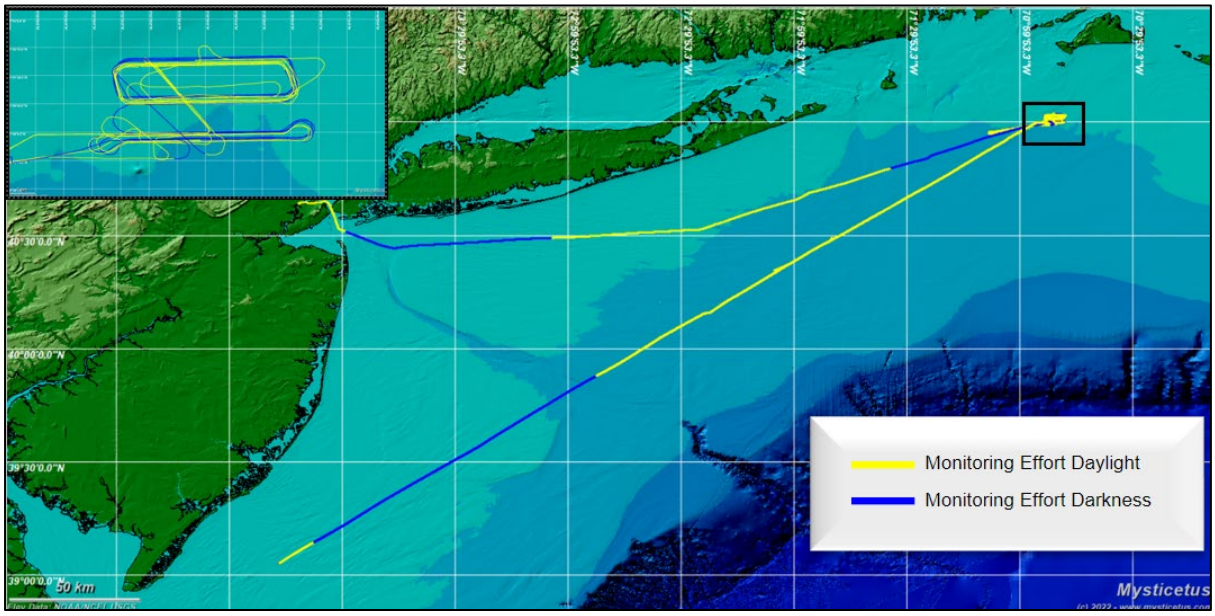

Figure 11. *Fugro Brasilis* tracklines for SRW01 showing PSO monitoring effort during daylight (yellow tracks) and darkness (blue tracks). Map insert is an enlargement of the northern portion of the track within the OCS-A 0487 lease (black box).

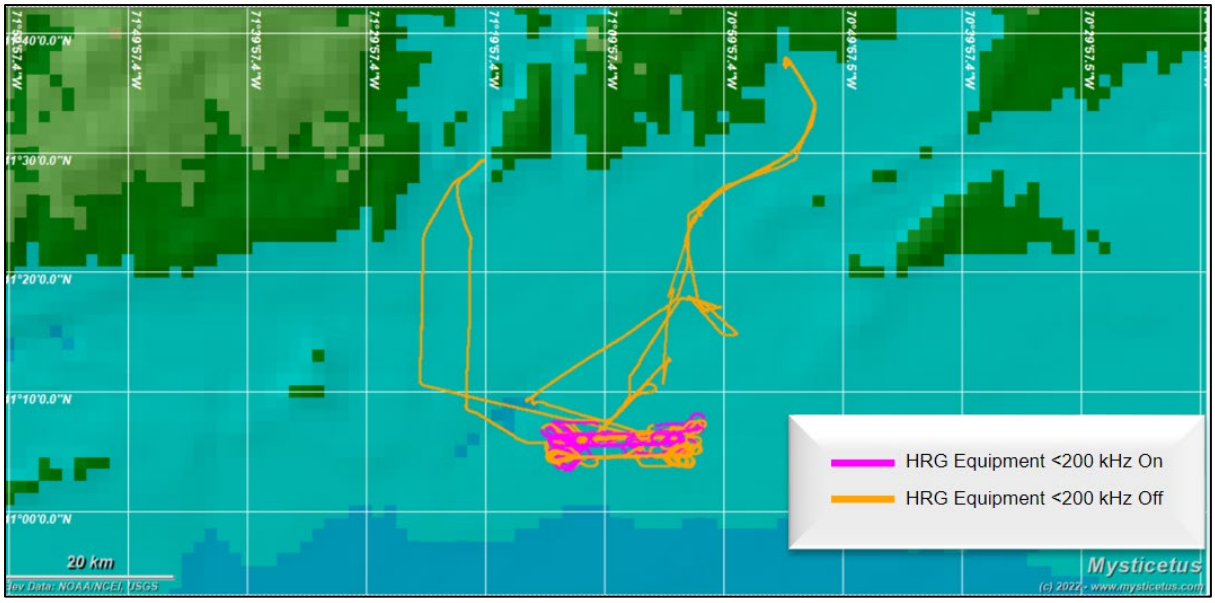

Figure 12. *Deep Helder* tracklines for SFW01 showing PSO effort when HRG equipment operating below 200 kHz was active (on; pink tracks) and inactive (off; orange tracks).

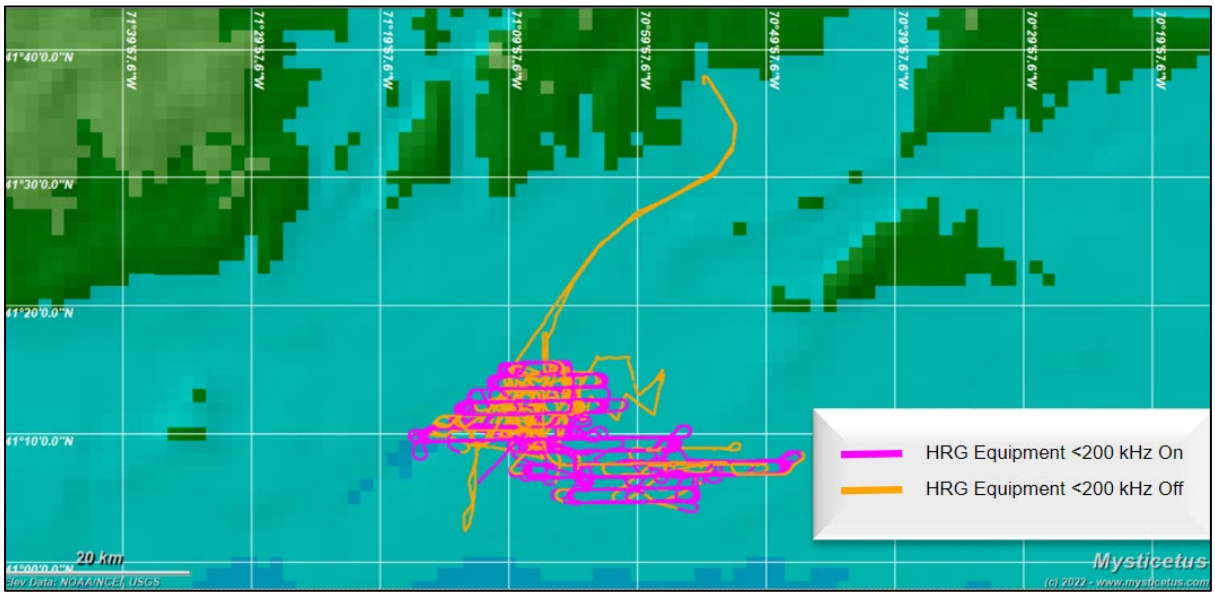

Figure 13. *Deep Helder* tracklines for REV01 showing PSO effort when HRG equipment operating below 200 kHz was active (on; pink tracks) and inactive (off; orange tracks).

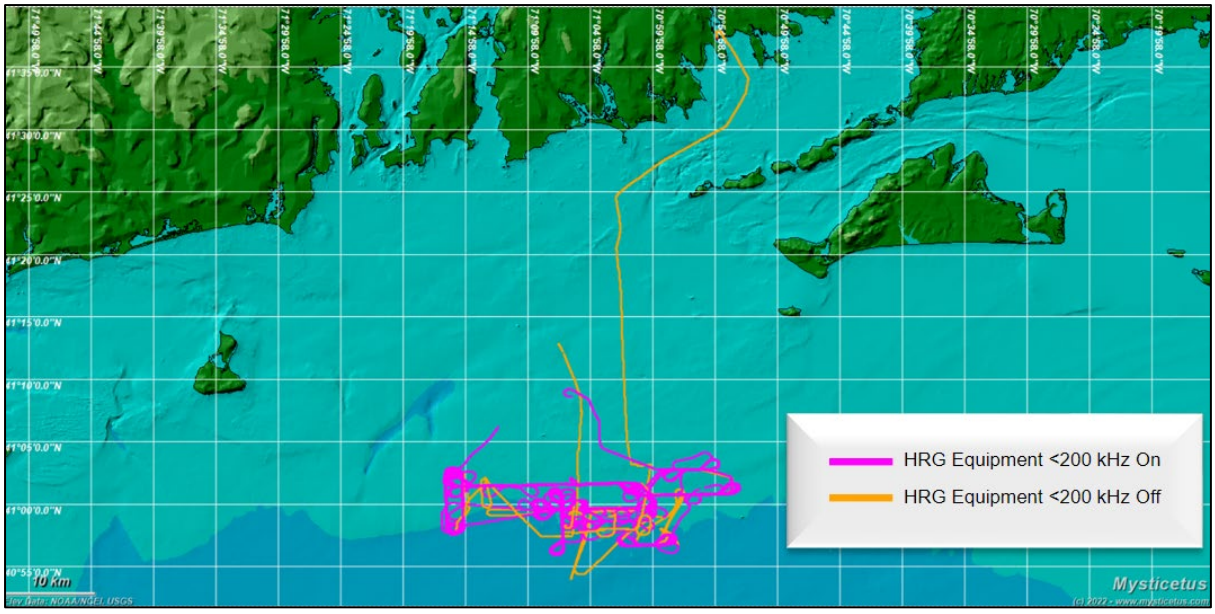

Figure 14. *Deep Helder* tracklines for SRW01 showing PSO effort when HRG equipment operating below 200 kHz was active (on; pink tracks) and inactive (off; orange tracks).

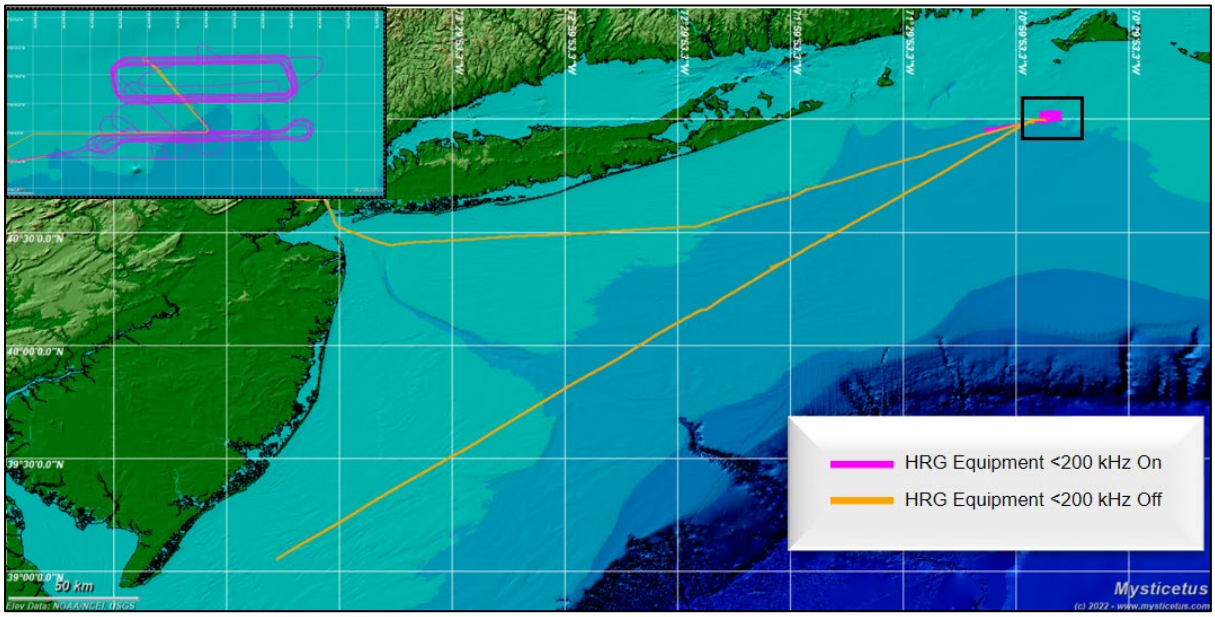

Figure 15. *Fugro Brasilis* tracklines for SRW01 showing PSO effort when HRG equipment operating below 200 kHz was active (on; pink tracks) and inactive (off; orange tracks). Map insert is an enlargement of the northern portion of the track within the OCS-A 0487 lease (black box).

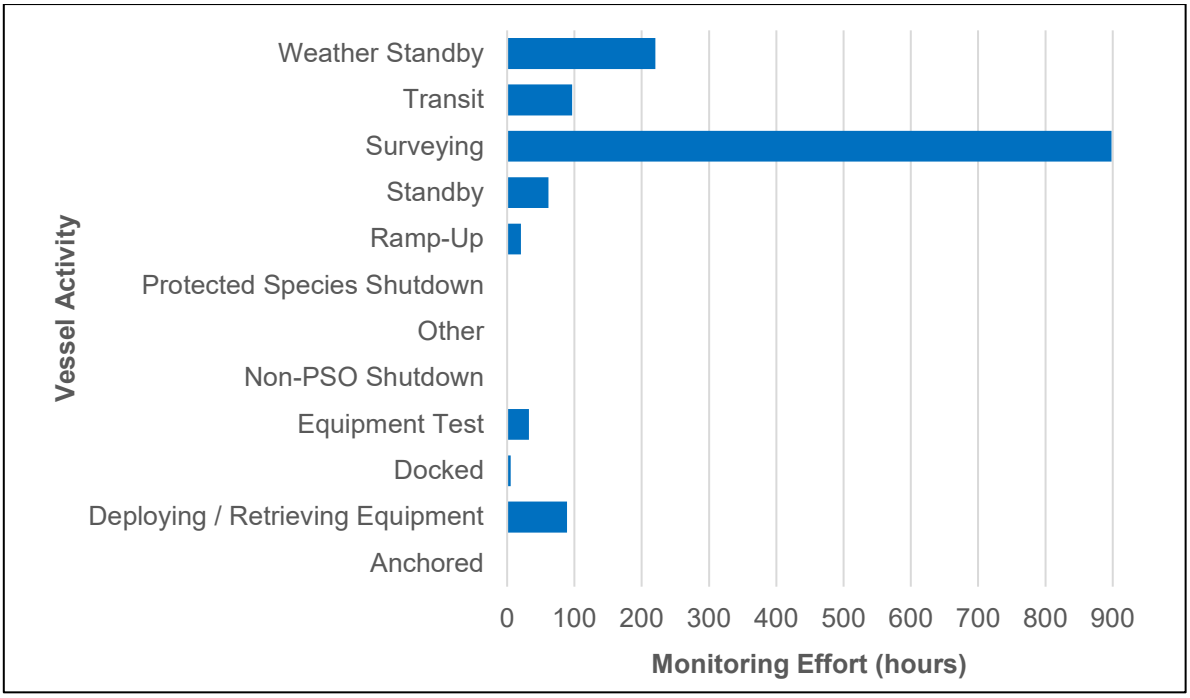

Figure 16. Monitoring effort by vessel activity during the Ørsted New England Wind Farm HRG surveys.

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 58% of monitoring effort during Beaufort sea states of B2 and B3 (Figure 17) and 55% of effort with clear and partly cloudy atmospheric conditions (Figure 18).

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 (53% of effort during daylight and 35% of the total monitoring effort), with both low Beaufort sea states and high visual distances experienced on most days (Figure 19). Moderate visual quality was experienced for 72% of monitoring effort during darkness (38% of the total monitoring effort).

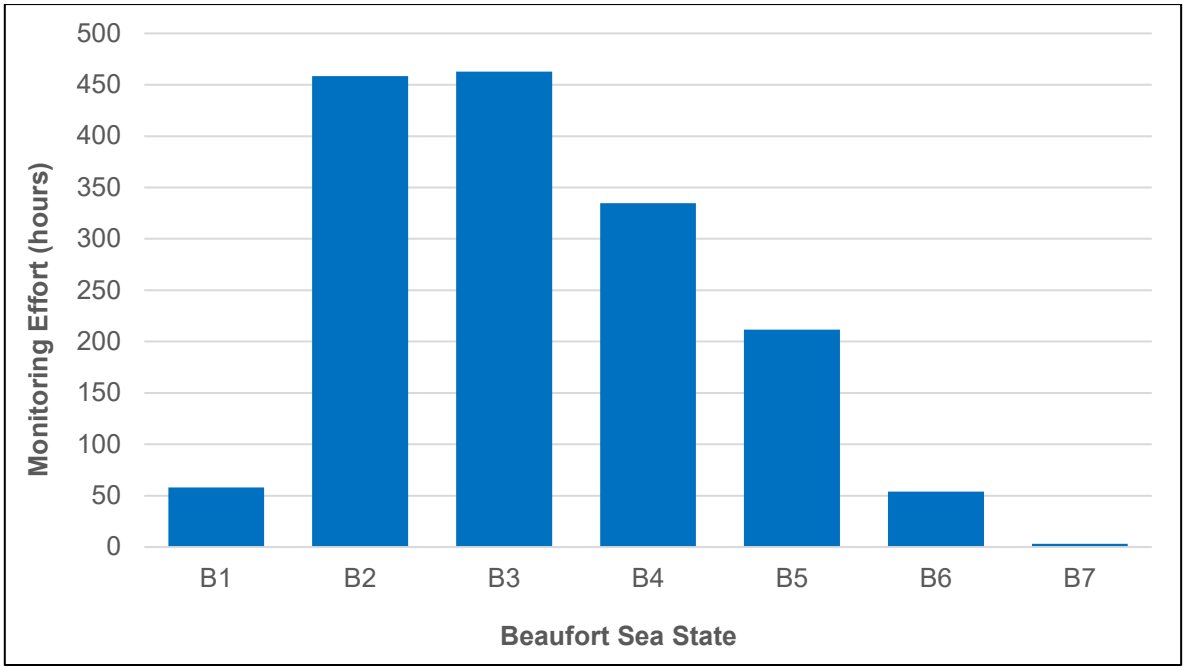

Figure 17. Monitoring effort by Beaufort sea state (B) during the Ørsted New England Wind Farm HRG surveys.

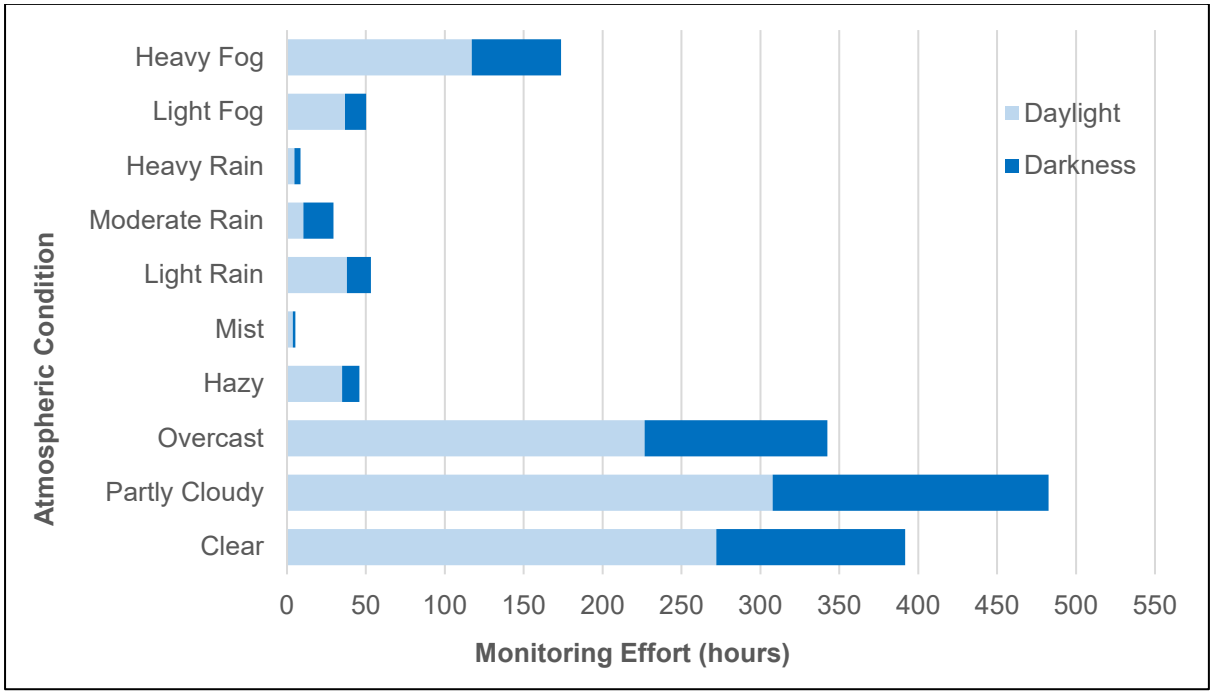

Figure 18. Monitoring effort during the various atmospheric conditions experienced during the Ørsted New England Wind Farm HRG surveys for periods of daylight and darkness.

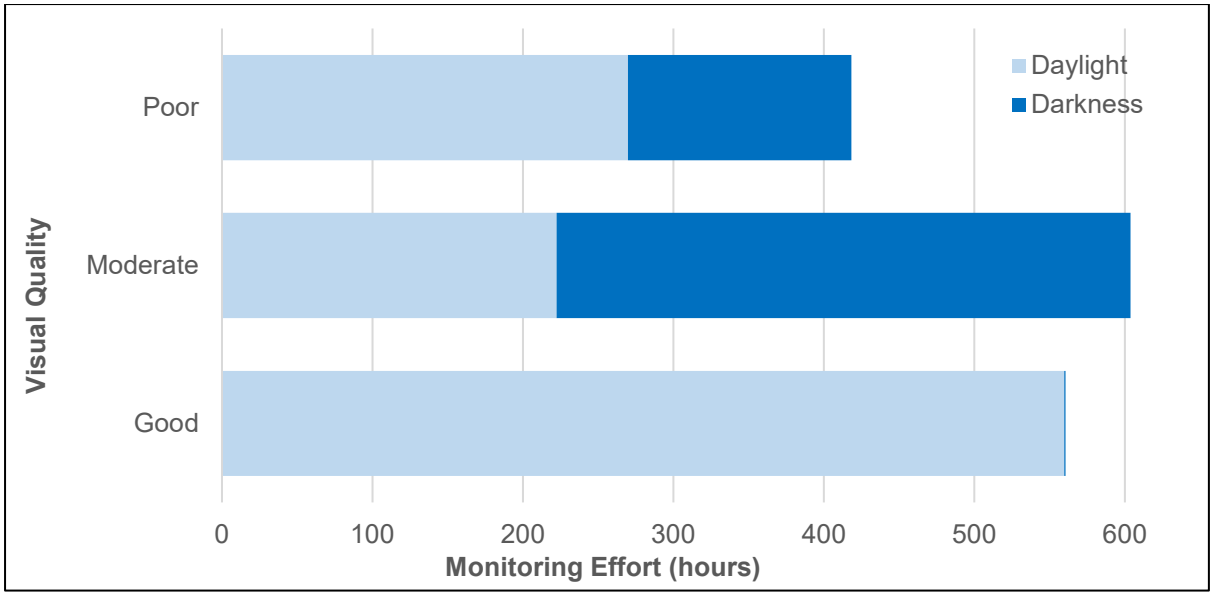

Figure 19. Monitoring effort with good (sea state of B0-3 and/or visual distance of 2-10 km), moderate (sea state of B4 and/or visual distance of 0.5 ≥ 1 km), or poor (sea state of >B4 and/or visual distance of 0.5 km or less) visual quality for daylight and darkness during the Ørsted New England Wind Farm HRG surveys.

5.3 PSO Effort

The cumulative PSO effort across all monitoring methods was 2145 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). 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 with the unaided eye (UE) accounted for just over half (51%) of the total PSO effort for both survey vessels combined. PSO effort on the *Deep Helder* was conducted primarily during daylight (51%), compared to during darkness with NVD and IR technologies (49%). However, the reverse was true for the *Fugro Brasilis*, with 45% of PSO effort during daylight compared to 55% during darkness.

Table 8. PSO effort (hours) by monitoring method and vessel during the Ørsted New England Wind Farm HRG surveys. Note that any discrepancy in totals is due to rounding.

Monitoring Method	Effort by Monitoring Method (hours)		
	Daylight	Darkness	Total Effort
***Deep Helder* SFW01**			
UE	552	0	552
NVD	0.5	227	227.5
Mounted IR Camera	0	266	266
HH IR	0	0.5	0,5
***Deep Helder* REV01**			
UE	230	0	230
NVD	1	115	116
Mounted IR Camera	0.5	109	109.5
HH IR	0	9	9
***Deep Helder* SRW01**			
UE	235	0	235
NVD	0	106	106
Mounted IR Camera	0	106	106
***Fugro Brasilis* SRW01**			
UE	67	0	67
NVD	0	40	40
Mounted IR Camera	0	40	40
All Vessels and Survey Areas Combined			
UE	1084	0	1084
NVD	2	528	530
Mounted IR Camera	0.5	522	522
HH IR	0	9	9
PSO Effort	**1086**	**1059**	**2145**

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

5.4 Protected Species Detections

The PSOs recorded a total of 194 protected species detections (189 marine mammal and five sea turtle) composed of an estimated 942 individuals (Table 9). Unidentified mysticete whales and short-beaked common dolphins (*Delphinus delphis*) were the most frequently detected group/species at 80 and 42 detections respectively. NARWs (*Eubalaena glacialis*) and Atlantic sturgeon were not detected. The locations of all protected species for the two survey vessels are provided in Figures 20, 21, 22, and 23. 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 (67%) of the protected species detections occurred while HRG acoustic sources operating below 200 kHz were active, of which the sparker was active for 99% of those detections (Table 9). The overall mean CPA to the sparker was 1017 m (Table 10). Delphinids pinnipeds, and sea turtles had lower CPAs to HRG acoustic sources than mysticete whales.

Nearly all (88%) of the protected species detections were made using the UE (Table 11). There were 20 detections using NVD during darkness, which consisted of 14 delphinids and six mysticetes. There were also four detections using the mounted IR cameras,

three of delphinids and one unidentified mysticete whale. A total of five detections were made on both NVD and mounted IR cameras, all of which were of short-beaked common dolphins. Protected species detection rates (detections per hour of PSO effort) were 0.157 (UE), 0.038 (NVD), and 0.008 (mounted IR camera; Table 12).

Table 9. Total number of protected species detections and estimated number of individuals detected during the Ørsted New England Wind Farm 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									
Fin Whale	*Balaenoptera physalus*	3	4	0	0	15	36	18	40
Humpback Whale	*Megaptera novaeangliae*	8	26	0	0	15	30	23	56
Minke Whale	*Balaenoptera acutorostrata*	4	4	0	0	2	2	6	6
Unidentified Mysticete Whale	n/a	19	44	0	0	61	105	80	149
Odontocete									
Bottlenose Dolphin	*Tursiops truncatus*	2	9	0	0	3	19	5	28
Short-beaked Common Dolphin	*Delphinus delphis*	13	133	1	25	28	420	42	578
Harbor Porpoise	*Phocoena phocoena*	1	2	0	0	0	0	1	2
Unidentified Dolphin	n/a	4	54	0	0	4	18	8	72
Pinnipeds									
Gray Seal	*Halichoerus grypus*	3	3	0	0	0	0	3	3
Unidentified Pinniped	n/a	2	2	0	0	1	1	3	3
Sea Turtles									
Kemp's Ridley Sea Turtle	*Lepidochelys kempii*	1	1	0	0	0	0	1	1
Loggerhead Sea Turtle	*Caretta caretta*	3	3	0	0	0	0	3	3
Unidentified Sea Turtle	n/a	1	1	0	0	0	0	1	1
Totals		**64**	**286**	**1**	**25**	**129**	**631**	**194**	**942**

kHz = kilohertz, n/a = not applicable

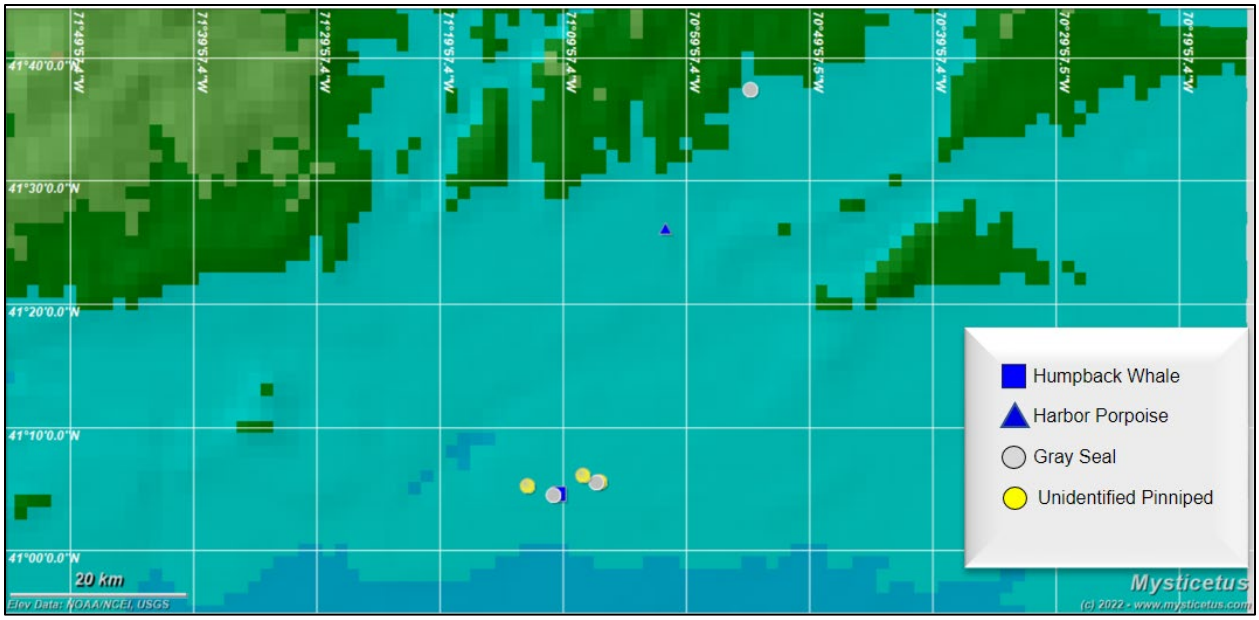

Figure 20. Locations of all protected species detections made from the *Deep Helder* in the SFW01 lease area.

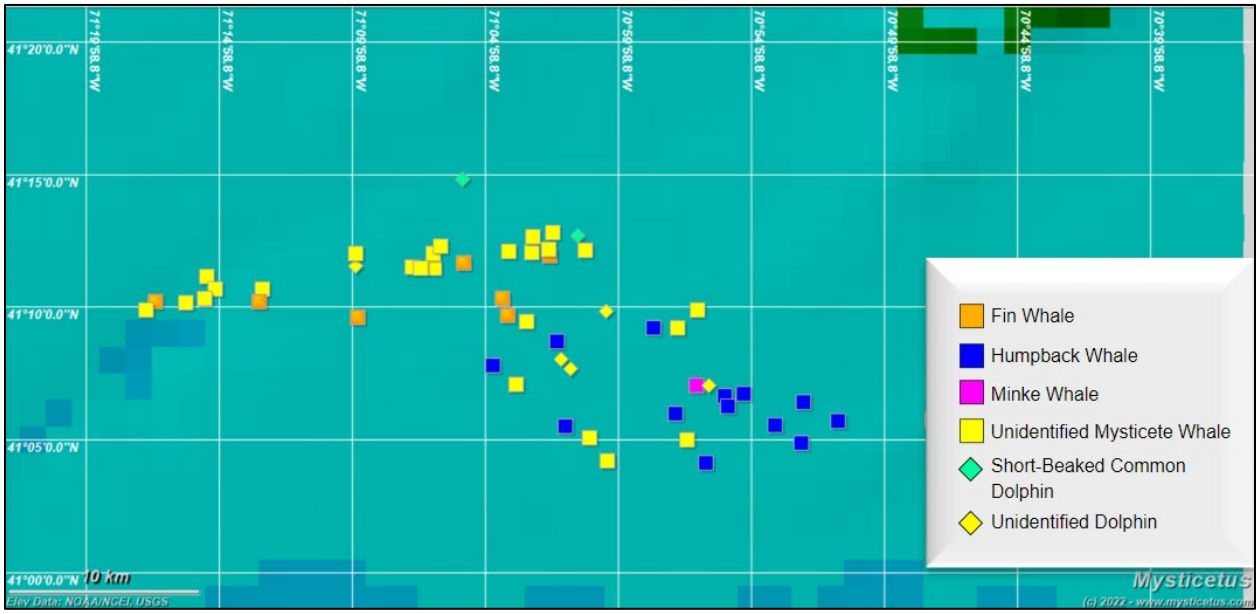

Figure 21. Locations of all protected species detections made from the *Deep Helder* in the REV01 lease area.

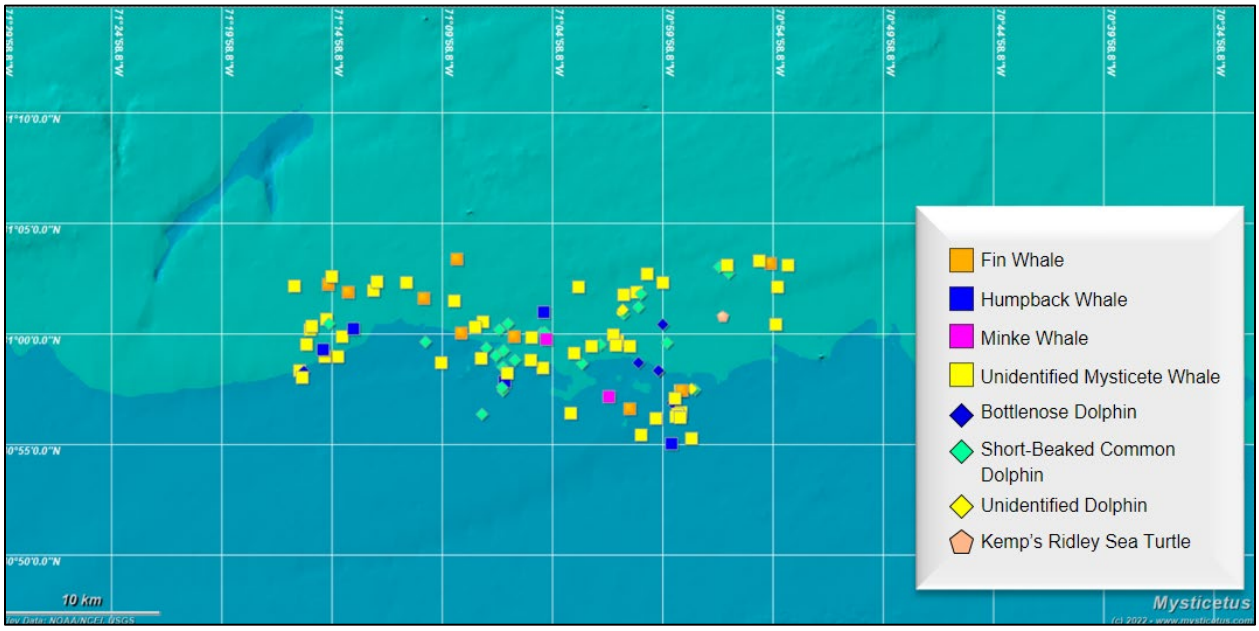

Figure 22. Locations of all protected species detections made from the *Deep Helder* in the SRW01 lease area.

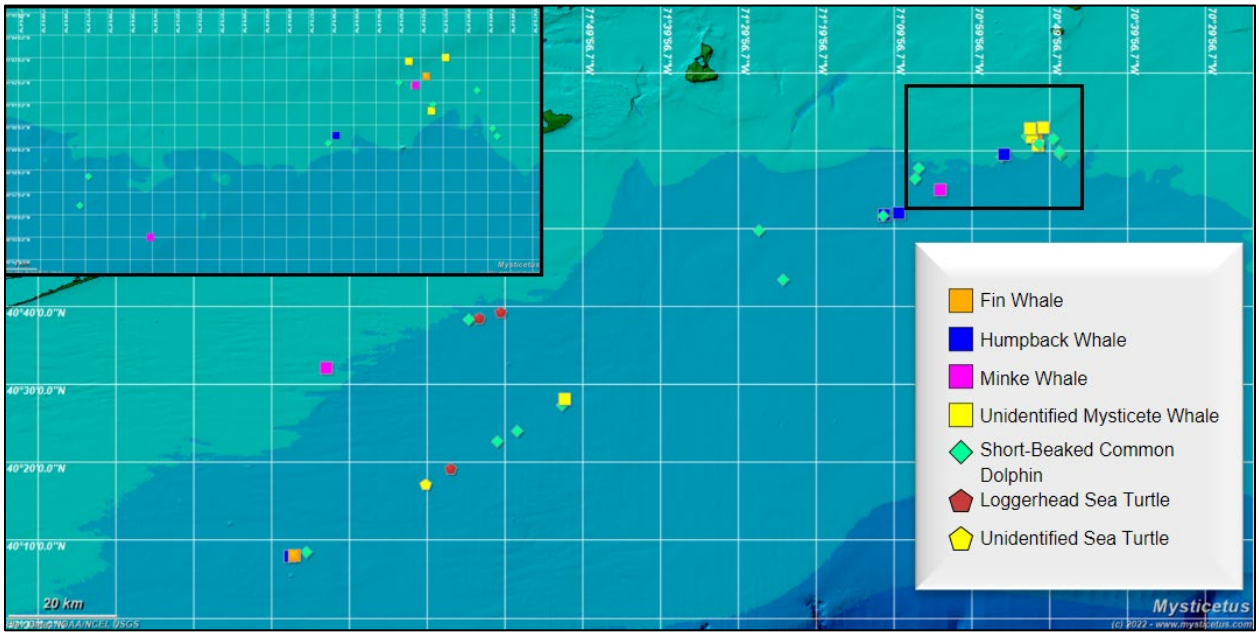

Figure 23. Locations of all protected species detections made from the *Fugro Brasilis* in the SRW01 lease area. Map inset is an enlargement of the northern portion of the sightings within the OCS-A 0487 lease (black box).

Table 10. CPA (m) to active HRG survey equipment operating below 200 kHz for protected species observed when the sparker was active and inactive during the Ørsted New England Wind Farm surveys. Minimum (min.), maximum (max.), and mean values are provided.

Species	CPA (m) to Active Sparker			CPA (m) to Inactive Sparker		
	min.	max.	mean	min.	max.	mean
Mysticete						
Fin Whale	400	1300	698	100	100	100
Humpback Whale	620	4572	1667	100	1300	599
Minke Whale	100	600	350	5	300	103
Unidentified Mysticete Whale	300	4572	1488	80	1786	669
Odontocete						
Bottlenose Dolphin	70	650	335	60	80	70
Harbor Porpoise	n/a	n/a	n/a	381	381	381
Short-beaked Common Dolphin	5	900	183	50	80	65
Unidentified Dolphin	100	1163	511	200	280	240
Pinniped						
Gray Seal	n/a	n/a	n/a	150	250	200
Unidentified Pinniped	25	25	25	100	326	213
Sea Turtle						
Kemp's Ridley Sea Turtle	50	50	50	n/a	n/a	n/a
Loggerhead Sea Turtle	n/a	n/a	n/a	20	80	40
Unidentified Sea Turtle	n/a	n/a	n/a	40	40	40
All Combined	**5**	**4572**	**1017**	**5**	**1786**	**19310**

CPA = closest point of approach, m = meters, kHz = kilohertz, n/a = not applicable

Table 11. Number of protected species detections by detection method and protected species group during the Ørsted New England Wind Farm HRG surveys.

Detection Method	Number of Detections				Total
	Mysticete	Odontocete	Pinniped	Sea Turtle	
UE	120	39	6	5	170
NVD	6	14	0	0	20
Mounted IR Camera	1	3	0	0	4
Total	**127**	**56**	**6**	**5**	**194**

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

Table 12. 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	1084	170	0.157
NVD	530	20	0.038
Mounted IR Camera	522	4	0.008
Totals and Overall Detection Rate	**2136**	**194**	**0.091**

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

5.5 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 (82%), surface-active travel (9%), and breach (3%; Figure 24). Surface-active travel (60%), porpoise (13%), and surface-active mill (6%) were the most reported initial behaviors for odontocetes. Most initial behaviors for pinnipeds consisted of deceased individuals ("dead," 40%). Most sea turtle detections (67%) were recorded with rest as the initial behavior. "None" was the most reported second behavior for mysticete whales (26%) and sea turtles (67%; Figure 25). The most reported second behavior for odontocetes were surface-active travel (28%), bow ride (20%), and "none" (18%). The most reported second behavior for pinnipeds were "none" (40%) and swim (40%). 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 (Figure 24 and 25). The behaviors noted were also common behaviors exhibited by whales, dolphins, pinnipeds, and sea turtles.

The PSOs did not observe protected species behavioral changes while the sparker and other HRG acoustic sources below 200 kHz were active and 3% exhibited a response when acoustic sources below 200 kHz were inactive (Table 13). Both reactions observed were loggerhead turtles looking towards the vessel. Behavioral changes were observed more 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 13. 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	Look	None	Change Direction	Dive	Look	None
Mysticete								
Fin Whale	0	0	0	3	0	0	0	17
Humpback Whale	0	0	0	11	0	0	0	18
Minke Whale	0	0	0	4	0	0	0	2
Unidentified Mysticete Whale	0	0	0	25	0	0	0	72
Odontocete								
Bottlenose Dolphin	0	0	0	2	0	0	0	4
Short-beaked Common Dolphin	0	0	0	13	0	0	0	38
Harbor Porpoise	0	0	0	1	0	0	0	0
Unidentified Dolphin	0	0	0	0	0	0	0	0
Pinniped								
Gray Seal	0	0	0	2	0	0	0	0
Unidentified Pinniped	0	0	0	2	0	0	0	1
Sea Turtle								
Kemp's Ridley Sea Turtle	0	0	0	1	0	0	0	1
Loggerhead Sea Turtle	0	0	2	1	0	0	0	0
Unidentified Sea Turtle	0	0	0	1	0	0	0	0
Total	**0**	**0**	**2**	**70**	**0**	**0**	**0**	**158**

n/a = not applicable

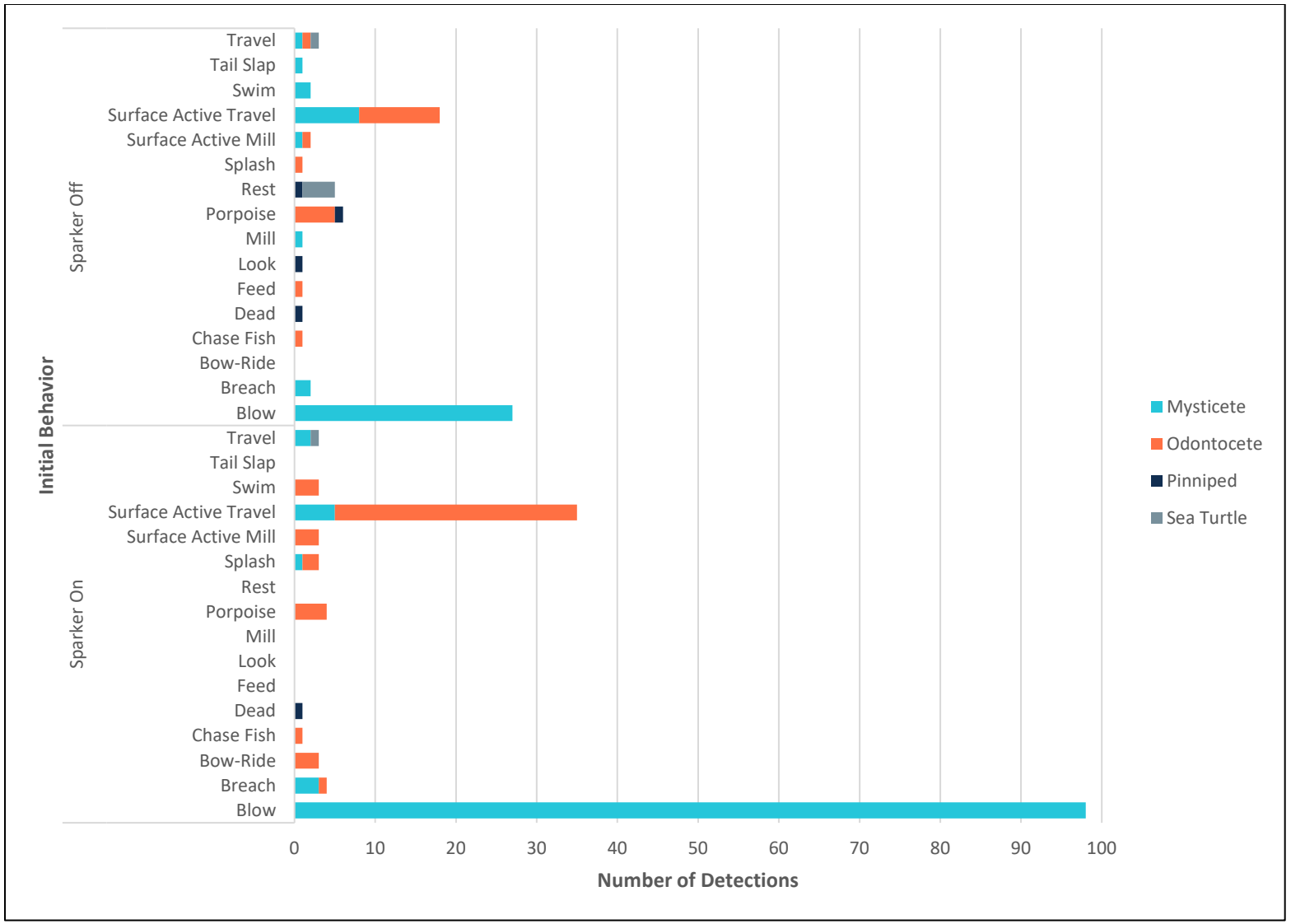

Figure 24. Initial behavior of marine mammals and sea turtles detected while HRG equipment below 200 kHz (sparker) were inactive (off) and active (on).

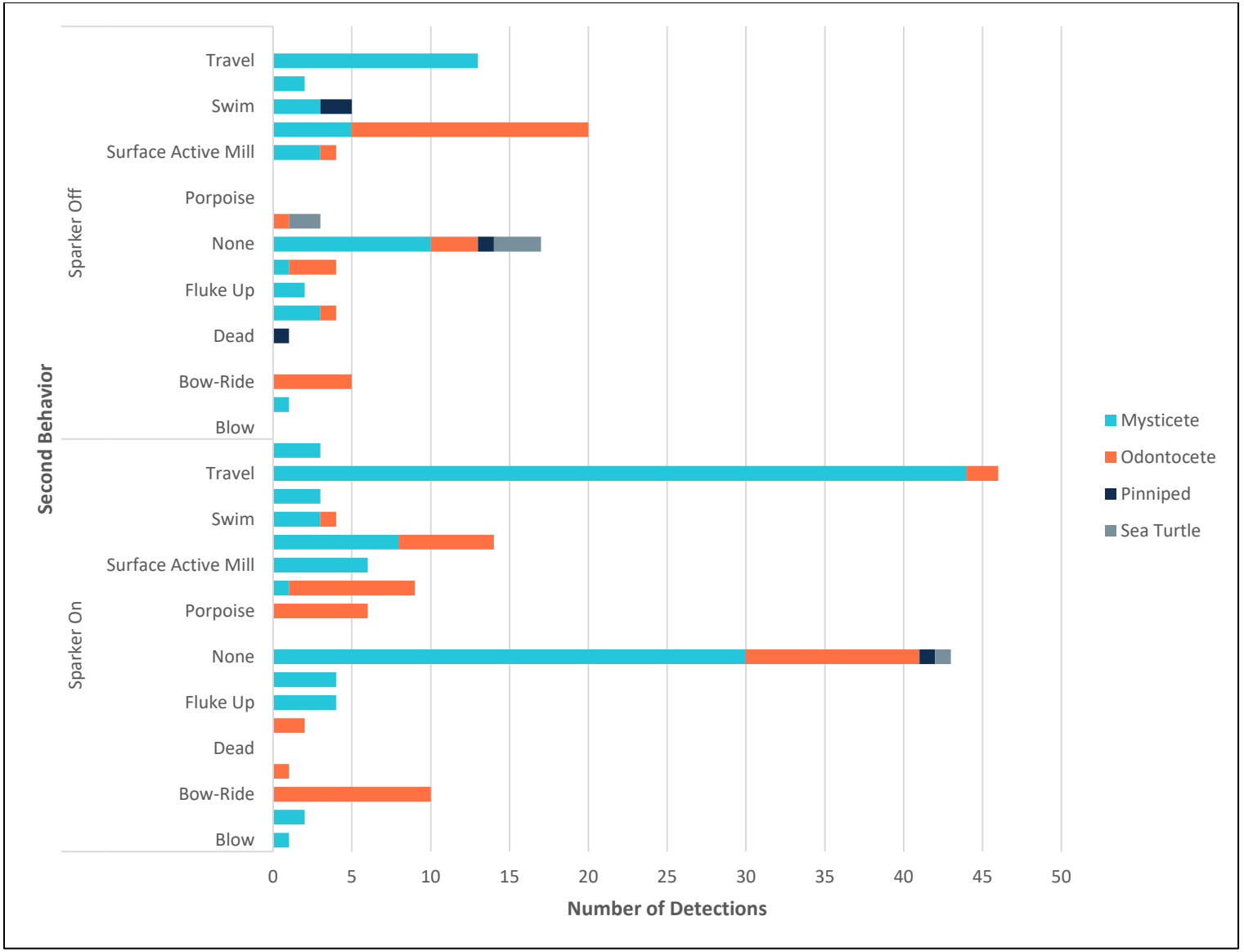

Figure 25. Second behavior of marine mammals and sea turtles detected while HRG equipment operating below 200 kHz (sparker) were inactive (off) and active (on).

5.6 Mitigation Measures

5.6.1 Protected Species Mitigation

Mitigation measures were requested and implemented for 25 (13%) of the 194 protected species detections (Table 14). The majority (56%) of these mitigation measures were for sparker shutdowns. The rest of the mitigation measures were sparker delays (8%), calls to alter course (24%) and switching the vessel to engine neutral (12%) for vessel strike avoidance. The shutdowns and delays resulted in 9.62 hours of sparker downtime. Unidentified mysticete whales were the primary cause of strike avoidance speed reductions (71%).

Table 14. Protected species mitigation measures implemented by PSOs on the Deep Helder and Fugro Brasilis during the Ørsted New England Wind Farm HRG surveys..

Vessel	Survey Area	Date	Time (UTC)	Detection Number	Species	Mitigation	Duration (HH:MM)
Deep Helder	REV01	2022-06-11	2:02:40	V28	Unidentified Mysticete Whale	Shutdown[1]	0:43:20
Deep Helder	REV01	2022-06-11	2:46:00	V29	Unidentified Mysticete Whale	Standby[1]	0:30:33
Deep Helder	REV01	2022-06-11	3:16:33	V30	Unidentified Mysticete Whale	Standby[1]	0:44:27
Deep Helder	REV01	2022-06-11	8:53:00	V31	Unidentified Mysticete Whale	Shutdown[1]	0:35:00
Deep Helder	REV01	2022-06-13	0:22:00	V34	Unidentified Mysticete Whale	Shutdown[1]	0:07:53
Deep Helder	REV01	2022-06-14	11:38:51	V41	Unidentified Mysticete Whale	Shutdown[1]	0:52:07
Deep Helder	REV01	2022-06-14	15:05:44	V44	Unidentified Mysticete Whale	Alter Course	n/a
Deep Helder	SRW01	2022-06-25	14:26:03	V2	Kemp's Ridley Sea Turtle	Shutdown[1,2]	0:04:00
Deep Helder	SRW01	2022-06-29	8:43:00	V31	Fin Whale	Alter Course	n/a
Deep Helder	SRW01	2022-07-01	16:44:10	V37	Humpback Whale	Shutdown[1] Alter Course	0:54:28
Deep Helder	SRW01	2022-07-03	18:16:25	V40	Unidentified Mysticete Whale	Shutdown[1]	0:36:04
Deep Helder	SRW01	2022-07-03	22:32:00	V44	Unidentified Mysticete Whale	Alter Course	n/a
Deep Helder	SRW01	2022-07-04	0:50:10	V49	Unidentified Mysticete Whale	Shutdown[1] Alter Couse	0:37:50
Deep Helder	SRW01	2022-07-04	11:21:15	V50	Unidentified Mysticete Whale	Shutdown[1]	0:29:55
Deep Helder	SRW01	2022-07-06	15:40:15	V62	Minke Whale	Shutdown[1]	0:55:45
Deep Helder	SRW01	2022-07-08	23:21:00	V77	Unidentified Mysticete Whale	Alter Course Shutdown[1] Engine Neutral	0:37:00

Deep Helder	SRW01	2022-07-09	22:26:20	V85	Unidentified Mysticete Whale	Shutdown[1]	0:34:40
Deep Helder	SRW01	2022-07-10	10:05:00	V91	Humpback Whale	Shutdown[1]	0:41:00
Deep Helder	SRW01	2022-07-10	11:34:00	V93	Unidentified Mysticete Whale	Shutdown[1]	0:33:00
Fugro Brasilis	SRW01	2022-07-13	21:00:04	V14	Minke Whale	Engine Neutral	n/a
Fugro Brasilis	SRW01	2022-07-16	18:04:10	V34	Minke Whale	Engine Neutral	n/a
Total							**9:37**

[1] Sparker only; [2] Shutdown not required but was implemented as conservative measure; HH:MM = hours:minutes

5.6.2 Weather Related Mitigation

In addition to protected species mitigation measures, 21 weather related mitigation measures were implemented for reduced visibility (18 shutdowns and two delays; Table 15). There was also a single weather-related shutdown due to lightning nearby. All weather-related shutdowns and delays resulted in 145 hours of downtime. Nearly all (93%) of the 155 hours of PSO related downtime (protected species and weather related combined) was attributed to reduced visibility.

Table 15. Weather related mitigation measures implemented by PSOs on the *Deep Helder* and *Fugro Brasilis* during the Ørsted New England Wind Farm HRG surveys.

Vessel	Survey Area	Date	Time (UTC)	Weather	Mitigation	Duration (HH:MM)
Deep Helder	SFW01	2022-05-12	7:58:00	Fog	Delay	7:25:59
Deep Helder	SFW01	2022-05-12	18:57:46	Fog	Shutdown	1:05:35
Deep Helder	SFW01	2022-05-12	23:12:17	Fog	Shutdown	72:30:00
Deep Helder	SFW01	2022-05-15	23:50:21	Fog	Shutdown	12:03:00
Deep Helder	SFW01	2022-05-16	12:22:18	Fog	Shutdown	2:53:37
Deep Helder	SFW01	2022-05-16	17:08:59	Fog	Shutdown	1:45:16
Deep Helder	SFW01	2022-05-20	2:44:52	Fog	Shutdown	2:00:08
Deep Helder	SFW01	2022-05-20	6:44:10	Fog	Shutdown	4:35:41
Deep Helder	SFW01	2022-05-20	13:15:24	Fog	Shutdown	1:33:36
Deep Helder	SFW01	2022-05-21	9:27:00	Fog	Shutdown	4:13:27
Deep Helder	SFW01	2022-05-22	23:21:55	Fog	Shutdown	5:13:00
Deep Helder	REV01	2022-05-27	13:10:58	Fog	Shutdown	1:38:02
Deep Helder	REV01	2022-05-27	16:00:04	Fog	Shutdown	1:24:09
Deep Helder	REV01	2022-06-02	10:32:00	Fog	Shutdown	7:29:07
Deep Helder	REV01	2022-06-04	3:00:00	Fog	Delay	1:14:18
Deep Helder	REV01	2022-06-13	8:59:44	Lightning	Shutdown	0:47:25
Deep Helder	REV01	2022-06-13	12:34:23	Fog	Shutdown	2:13:27
Deep Helder	REV01	2022-06-22	7:32:51	Fog	Shutdown	8:15:23
Deep Helder	REV01	2022-06-22	21:02:20	Fog	Shutdown	1:43:13
Deep Helder	SRW01	2022-06-25	10:30:00	Fog	Shutdown	1:48:33
Brasilis	SRW01	2022-07-14	9:03:48	Fog	Shutdown	3:46:13
					Total	**145:39:00**

5.6.3 Non-PSO Related Shutdowns

Additionally, there were six non-PSO shutdowns that were implemented by the survey crew which resulted in 7 hours of downtime. All non-PSO shutdowns were due to survey gear becoming tangled or snagged on something in the water column. All shutdowns occurred on

the *Deep Helder* while surveying in Revolution Wind. The *Fugro Brasils* did not have any non-PSO related shutdowns.

5.7 Protected Species Exposures

A total of 333 marine mammals and 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). One shutdown was called for a minke whale that traveled within the mitigation zone. All 21 delphinid groups approached the vessel and, therefore, did not require a shutdown. There was also one conservative shutdown for a sea turtle. However, shutdowns were not needed for sea turtles within the mitigation zone. Additionally, shutdowns were required for pinnipeds in the exposure zone. However, the single pinniped observed within the exposure zone was already deceased, and therefore did not require a shutdown.

Table 1616. 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
Mysticete			
Minke Whale	1	1	Shutdown
Odontocete			
Bottlenose Dolphin	1	5	none
Short-beaked Common Dolphin	19	320	none
Unidentified Dolphin	1	5	none
Pinniped			
Unidentified Pinniped	1	1	none
Sea Turtle			
Kemp's Ridley Sea Turtle	1	1	Shutdown
Total	**24**	**333**	

Implementing shutdowns for protected species observed within the conservative 500 m exclusion zone prevented the potential exposure of two humpback whales and five unidentified mysticete whale.

5.8 Protected Species Incident Reports

The PSOs aboard the *Deep Helder* observed three dead pinnipeds while working in the South Fork Wind 01 lease area and at the dock (Table 17). The cause of death for the animals could not be determined, however the deaths were not a result of any survey vessel activity. Incident reports were completed for each dead pinniped sighting. There were no injured species observed.

Table 17. Protected species incidents reports filed by PSOs on the *Deep Helder* during the South Fork Wind 01 HRG survey.

Vessel	Survey Area	Date	Time (UTC)	Species	Incident Condition
Deep Helder	Dock	2022-04-29	20:55	Gray Seal	Dead
Deep Helder	SFW01	2022-05-13	13:25	Unidentified Pinniped	Dead
Deep Helder	SFW01	2022-05-21	19:44	Unidentified Pinniped	Dead

5.9 Avian and Bat Detections

Observations of dead birds, including seabirds that were floating on the water, were recorded on 14 May, 17 June, 21 June, 23 June, 24 June, 25 June, 26 June, 01 July, and twice on 15 July. In all cases but the first case, species was not provided and none of the birds appeared to be tagged. The dead bird seen on 14 May was noted to be a seagull. There were no reports of injured birds. A single bat was recorded on 7 May.

A single brown booby (*Sula leucogaster*) was also observed circling and landing on the *Deep Helder* on 09 and 10 July (Figure 26). Brown booby are considered a tropical seabird and are rarely observed in New England waters.

Figure 26. Brown booby (*Sula leucogaster*) observed on the *Deep Helder* during the Sunrise Wind 01 HRG survey.

5.10 Unusual Biological Events

Numerous sharks were observed throughout the HRG surveys, including a juvenile white shark, a thresher shark, blue sharks (including a juvenile), hammerhead sharks, and a possible sighting of a basking shark.

6 Monitoring Device Effectiveness

Protected species monitoring was conducted using one of four methods during the South Fork Wind, Revolution Wind, and Sunrise Wind HRG surveys; unaided eye (UE) including systematic use of reticle binoculars, NVD, mounted IR cameras, and HH IR. The list below summarizes when each method was utilized and under what conditions:

- UE
  - during daylight with systematic use of reticle binoculars
  - during darkness when sufficient artificial illumination from vessel lighting
- NVD
  - during darkness, often supplemented with unaided eye observation
- Mounted IR Camera
  - during darkness, simultaneous to observation with NVD
- HH IR
  - during darkness in the event of mounted IR camera system failure

Protected species detections were made using a single or multiple methods of detection. During each protected species detection, the PSO recorded the initial and subsequent methods of detection. Each of the four options listed above (UE, NVD, mounted IR camera, and HH IR) represents a single method of detection. The method of initial detection and the initial detection distances for each detection method for each protected species detection were compared in an effort to evaluate the effectiveness of detection method. HH IR was excluded from the review since the method was used for only 9 hours of observation and there were no protected species detections during that time.

6.1 Initial Detection Method

The primary method of initial detection for marine mammal and sea turtle detections was the unaided eye, accounting for 88% of the total number of detections (Figure 27). Initial detection using NVD and mounted IR cameras accounted for 10% and 2% of the detections respectively.

Mysticete whales were predominantly detected using the unaided eye, with 94% of mysticete whales initially detected with the unaided eye. Odontocetes, specifically delphinids, and mysticete whales were the only protected species groups observed using all three detection methods. Sea turtles and pinnipeds were only observed using the unaided eye.

Detection rates were also highest for the unaided eye, with a rate of 0.157 detections per hour (Table 12). Detection rates for NVD and mounted IR cameras were 0.038 and 0.008 respectively. Of the three methods evaluated, the unaided eye appears to be the most effective method for protected species monitoring. However, it should be noted that all but two detections made with the unaided eye were made during daylight and that monitoring with the unaided eye was the only method utilized during daylight.

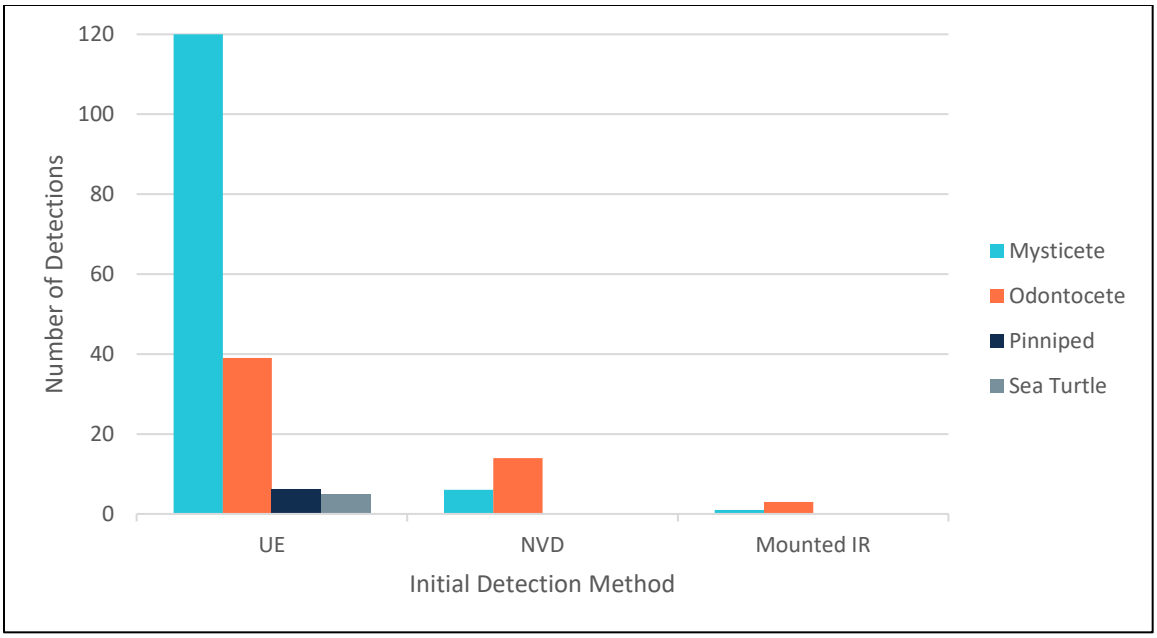

Figure 27. Number of initial detections by monitoring method for marine mammals and sea turtles during the Ørsted New England Wind Farm HRG surveys.

6.2 Initial Detection Distance

Initial detection distances were greatest for all protected species groups when detections were made using the unaided eye. Marine mammals were detected to maximum distances greater than 2,500 m for mysticete whales and 1,751-200 m odontocetes for detections made with the unaided eye (Figure 21). Odontocetes, specifically delphinids, were detected between 0 and 500 m when initially detected using low-light aids of NVD and mounted IR cameras. Mysticete whales were detected to greater maximum distances using NVD (751-1,000 m) and mounted IR cameras (751-1,000 m) than odontocetes.

Pinnipeds and sea turtles were initially detected using only the unaided eye to distances between 0-500 m and 0-250 m respectively.

As with initial detection method, the unaided eye appears to have the largest effective detection distance for marine mammals and sea turtles.

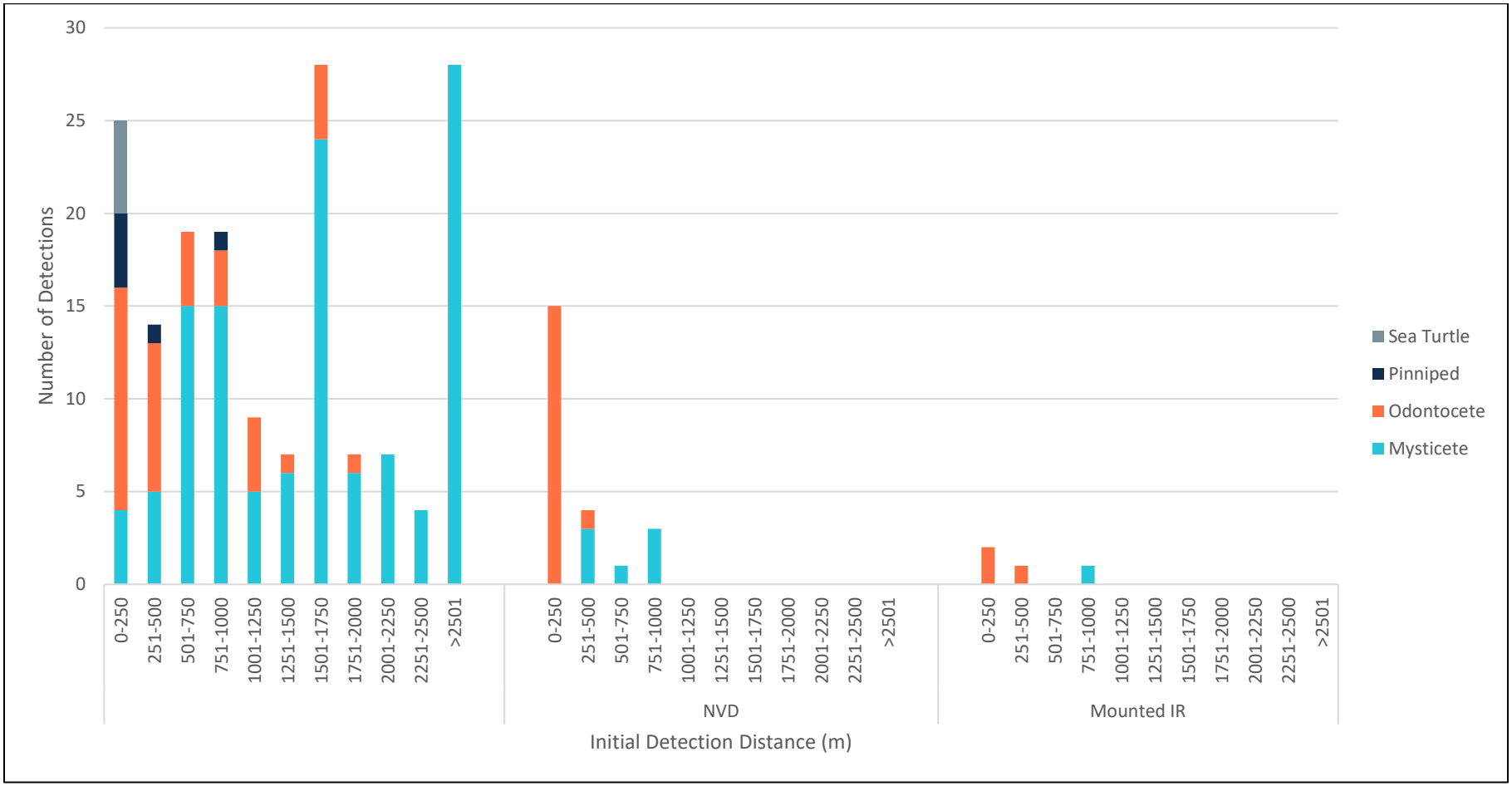

Figure 28. Initial detection distance by monitoring method for marine mammals and sea turtles during the Ørsted New England Wind Farm HRG surveys.

6.3 Detection Method and Device Strengths and Limitations

Many different variables determine the detection rates of protected species and the distance at which a detection is most likely to occur. These variables include environmental factors, operational influences, animal movements and behavior, and the type of monitoring method.

It is important to consider some of the strengths and limitations of the monitoring methods when considering overall effectiveness.

6.3.1 Unaided Eye and Reticle Binoculars

Monitoring with the unaided eye has long been the standard minimum for protected species monitoring. It is the simplest method and works well from a variety of observation platforms (land, sea, and air). Specialized equipment is not required, making visual monitoring with the unaided eye the most cost-efficient method when compared to other methods utilizing more advanced technologies. A good pair of reticle binoculars is a must for a PSO, but inexpensive options are available.

Visual monitoring with the unaided eye can be used during both daylight and darkness, however detection distances during darkness are limited to the area immediately surrounding the vessel out to a few hundred meters (or less if low levels of ambient light). Visual monitoring is also limited to animals at or near the surface regardless of the method used (UE, NVD, or IR).

6.3.2 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.

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.

6.3.3 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 2 km.

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 two survey vessels did not report any issues or malfunctions of the IR camera systems during the survey.

6.4 Summary of Monitoring Method and Device Effectiveness

Based simply on the number of initial detections, detection rate, and initial detection distances, monitoring with the unaided eye is the most effective method for protected species monitoring and detection. However, the most effective or efficient way to monitor for protected species is to use a suite of complementary methods. No one method is the *best* method. Each method has its own set of limitations and many of those limitations can be improved through the use of complementary methods.

7 Summary

The PSO teams aboard the *Deep Helder* and *Fugro Brasilis* completed 1,583 hours of protected species monitoring across all monitoring methods (monitoring effort), covering 10,808 km of trackline during the Ørsted New England Wind Farm HRG survey campaigns. During that time, 194 protected species detections were recorded for which 25 mitigation measures were implemented.

Monitoring conditions were favorable during the survey with sea states of B3 or less and good to moderate visibility for 61% and 74% of the monitoring effort respectively. Reduced visibility (<500 m) from fog did, however, result in 19 shutdowns of the sparker and two delays to sparker ramp-up.

The PSOs recorded a total of 194 protected species detections including 189 marine mammal detections and five sea turtle detections. While the *Deep Helder* was surveying in South Fork Wind, pinnipeds (gray seals and unidentified pinnipeds) were the primary group of protected species observed, accounting for 75% of detections. The majority (87%) of the detections made by PSOs aboard the *Deep Helder* while in Revolution Wind were mysticete whales. Of the mysticete groups, unidentified mysticete whales were observed most often (55%). Unidentified mysticete whales (50%) and short-beaked common dolphins (24%) were the two most sighted groups while the *Deep Helder* was surveying in Sunrise Wind. Aboard the *Fugro Brasilis*, which also surveyed in Sunrise Wind, short-beaked common dolphins were the most observed group (47%).

Protected species detections resulted in 14 shutdowns of the sparker, resulting in 8 hours of operational downtime. Strike avoidance mitigation measures were implanted on nine occasions (six alter course and three engines neutral). 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 inactivity for the HRG sources and no behavioral changes were noted when the HRG equipment were active. With the low number of behavioral changes reported and the observation of changes only while acoustic sources were 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 Ørsted New England Wind Farm surveys, the overall impact to operations was minimal contributing only 155 hours (10% of total effort) of operational downtime.

The mitigation and monitoring protocols established in the regulatory documents were effectively implemented by the PSOs throughout the Ørsted New England Wind Farm HRG surveys.

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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	
ANHM/000005 – Norotos MICH Helmet Mount Assembly USA #107 ANHM/000006 – 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
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ARMASIGHT BY FLIR

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

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.

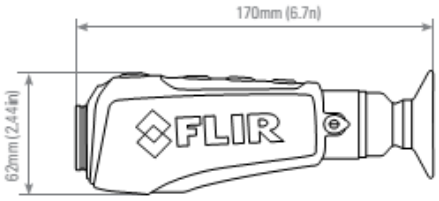
SPECIFICATIONS

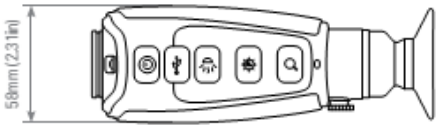
General	SCOUT III 240	SCOUT III 320	SCOUT III 640
Detector Type	240 x 180 VOx Microbolometer	336 x 256 VOx Microbolometer	640 x 512 VOx Microbolometer
Video Refresh Rate	30Hz NTSC	60Hz NTSC	30Hz NTSC
Field of View (H x V)	24° x 18°	17° x 13°	18° x 14°
Focal Length	13 mm Fixed Focus	19 mm Fixed Focus	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





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18-2266-OTS

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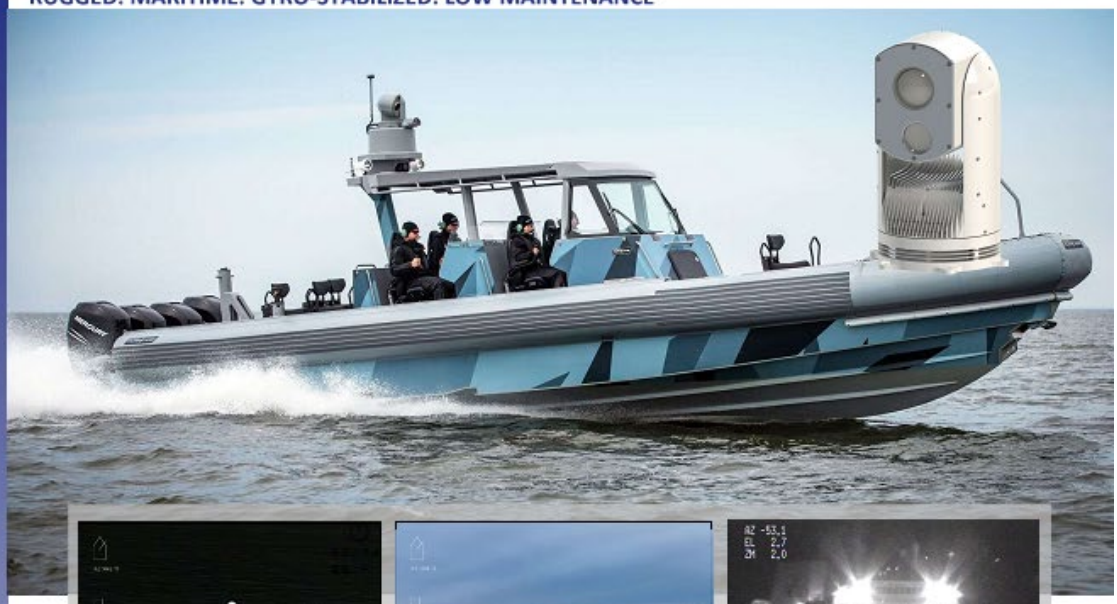
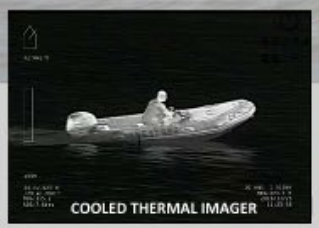
NN 3000 Series

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

Reliant 640HD

Gyro Stabilized Thermal and HD Visible Camera System for Marine or Land Operations

NVTS's new Reliant 640HD is a powerful compact medium range gyro stabilized ISR camera system designed for maritime, ground vehicle and remote surveillance operations.

The Reliant's compact, lightweight design, solves the problem of space without compromising performance.

The Reliant's HD visible camera is equipped with a 20X optical zoom that can also convert to a low light camera for additional night-time use. Our high resolution 640 x 480 thermal camera comes standard with a large 40mm focal length lens for extended detection clarity and range.

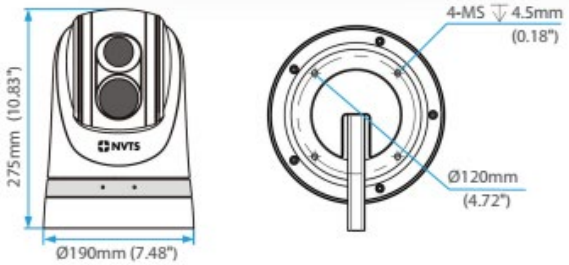
Features:

- Uncooled 640 X 480 Thermal Resolution 2X-4X digital zoom
- CMOS Color HD camera, 2.14MP, 20X optical zoom
- Dual HD-SDI outputs for color visible camera and thermal imaging camera
- HD Visible Camera with ICR (Infrared Cut Filter Removal) for extreme low light visibility
- Digital and Gyro Stabilization
- Wide Dynamic Range (WDR)
- Optional 3 axis joystick controller

Applications:

- Maritime Search and Rescue
- Threat Detection
- Key Asset Protection
- Reconnaissance
- Situational Awareness
- Ground Vehicle ISR
- Portable Tripod Mounted ISR

Dimensions:



NVTS
patrolling the night™

Reliant 640HD *Performance Specifications*

Thermal Imaging Camera

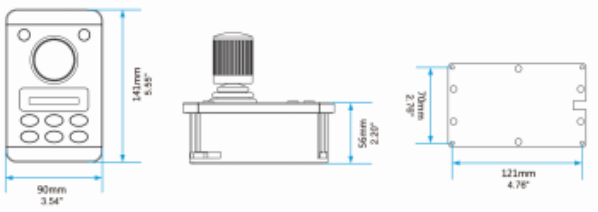
Sensor Type	Uncooled LWIR FPA
Working Band	8μm~14μm
Resolution	640 x 480
Sensor Size	17μm
NETD(300K)	≤60mk
FOV	40mm: 15.5 x 11.6°
Image Enhancement	Support
Video Display	Black Hot / White Hot
Digital Zoom	1X, 2X, 4X

HD Visible Camera with Low Light Sensing

Video Sensor	1/2.8" CMOS , 2.13MP
Signal System (NET)	1080P/30, 1080P/25, 720P/60, 720P/50, 720P/30, 720P/25
Signal System (SDI)	1080P30, 1080I60, 720P60, 720P30, 1080P25,1080I 50, 720P50, 720P25
Zoom	Optical: 20X, Digital: 12X
Lens	f=4.7mm ~ 94mm, F1.6 ~ F3.5
View Angle	59.5° (H) ~ 3.3° (V)
Min Illumination	Color: 0.0013Lux; Mono: 0.0008Lux
WB	Auto
Focus	Auto/Manual
S/N Ratio	Not less than 50 dB
WDR	Yes
BLC	On/Off
Image Stabilization	On/Off
DNR	1-5 Steps/Off
Day / Night	Auto/Manual

Optional Joystick Controller

Model: REL-JS-01
Interface: RS-485, Ethernet (POE)
Joystick: 3 Axis
Display: OLED Backlit
Waterproof: IP66
Power: 12vdc



PTZ

Pan Range	360° Continuous
Pan Speed	Control speed: 0.04° ~ 100°/s, adjustable; Preset speed: 100°/s
Tilt Range	-15°~90°(Auto Flip)
Tilt Speed	Control speed: 0.04° ~ 90°/s, adjustable; Preset speed: 90°/s
Preset	256
Preset Precision	± 0.2°
Stabilization	Gyro and Digital

Network

Image Resolution	1920 * 1080@30fps
Image Compression	H.264
Audio Compression	AAC
Protocols	HTTP, RTSP, TCP, UDP, ONVIF
Simultaneous Live View	Up to 10
Dual Stream	Yes
Ethernet Interface	10 / 100M
Audio Interface	1 LINE IN

General

Control Interface	RS-485
Address	0~255
Comm Protocol	PELCO-P / PELCO-D (Self-Adaptive)
Baud Rate	2400bps, 4800bps, 9600bps, 19200bps (Self-Adaptive)
Voltage	DC 10.8 ~ 28V
Power	35W / 50W (Heater On)
Working Temperature	-35℃ ~ +55℃
IP Index	IP67
Dimension	Φ190mm x 275mm (7.48" x 10.83")
Weight	6.3 ± 0.1Kg (13.89 lb. ± 0.22 lb.)

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Appendix B: Mitigation Summary Graphics

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
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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 Ørsted New England Wind Farm HRG Surveys

Vessel	Survey Area	Date	Time (UTC)	Detection Number	Species	Detection Method	Initial Detection Distance (m)	CPA to PSO (m)	CPA to Active Source <200 kHz (m)	Number Individuals	Initial Behavior	Second Behavior	Reaction	Mitigation
Deep Helder	SFW01	2022-04-29	20:55:00.0	V1	Gray Seal	UE	150	150	n/a	1	Dead	Dead	None	None
Deep Helder	SFW01	2022-05-05	18:00:57.0	V2	Harbor Porpoise	UE	381	381	n/a	2	Travel	Other (see notes)	None	None
Deep Helder	SFW01	2022-05-06	09:30:15.0	V3	Unidentified Pinniped	UE	326	326	n/a	1	Rest	Swim	None	None
Deep Helder	SFW01	2022-05-06	14:06:00.0	V4	Gray Seal	UE	198	198	n/a	1	Look	Swim	None	None
Deep Helder	SFW01	2022-05-13	13:25:28.0	V5	Unidentified Pinniped	UE	100	100	n/a	1	Dead	Dead	None	None
Deep Helder	SFW01	2022-05-15	09:08:27.0	V6	Gray Seal	UE	50	50	n/a	1	Porpoise	None	None	None
Deep Helder	SFW01	2022-05-21	19:44:24.0	V7	Unidentified Pinniped	UE	800	25	25	1	Dead	None	None	None
Deep Helder	SFW01	2022-05-22	17:25:17.0	V8	Humpback Whale	UE	1143	800	750	1	Blow	Fluke Up	None	None
Deep Helder	REV01	2022-05-24	17:30:00.0	V1	Unidentified Mysticete Whale	UE	500	500	470	1	Blow	Travel	None	None
Deep Helder	REV01	2022-05-24	17:38:36.0	V2	Humpback Whale	UE	1143	1143	1143	1	Breach	Tail Slap	None	None
Deep Helder	REV01	2022-05-25	12:34:32.0	V3	Humpback Whale	UE	1786	762	762	3	Blow	Travel	None	None
Deep Helder	REV01	2022-05-25	12:39:37.0	V4	Unidentified Mysticete Whale	UE	4572	2000	2000	3	Blow	Travel	None	None
Deep Helder	REV01	2022-05-25	14:33:00.0	V5	Unidentified Mysticete Whale	UE	1786	1786	n/a	1	Blow	Travel	None	None
Deep Helder	REV01	2022-05-25	15:08:36.0	V6	Unidentified Mysticete Whale	UE	1700	1700	n/a	1	Blow	Feed	None	None
Deep Helder	REV01	2022-05-25	23:24:24.0	V7	Humpback Whale	UE	2286	2286	2286	2	Blow	Travel	None	None

Vessel	Survey Area	Date	Time (UTC)	Detection Number	Species	Detection Method	Initial Detection Distance (m)	CPA to PSO (m)	CPA to Active Source <200 kHz (m)	Number Individuals	Initial Behavior	Second Behavior	Reaction	Mitigation
Deep Helder	REV01	2022-05-26	09:23:00.0	V8	Humpback Whale	UE	3572	1143	1143	2	Blow	Travel	None	None
Deep Helder	REV01	2022-05-26	11:01:00.0	V9	Unidentified Mysticete Whale	UE	4572	4572	4572	1	Blow	None	None	None
Deep Helder	REV01	2022-05-30	11:22:00.0	V10	Unidentified Dolphin	UE	762	762	762	4	Splash	Travel	None	None
Deep Helder	REV01	2022-06-02	12:08:00.0	V11	Unidentified Dolphin	UE	120	120	n/a	3	Surface-active Travel	Swim	None	None
Deep Helder	REV01	2022-06-02	20:07:30.0	V12	Minke Whale	UE	25	20	n/a	1	Travel	Mill	None	None
Deep Helder	REV01	2022-06-03	16:02:02.0	V13	Humpback Whale	UE	4572	3500	3500	2	Blow	Travel	None	None
Deep Helder	REV01	2022-06-03	16:49:33.0	V14	Humpback Whale	UE	4572	1500	1500	4	Breach	Tail Slap	None	None
Deep Helder	REV01	2022-06-04	11:12:00.0	V15	Humpback Whale	UE	1143	762	762	2	Blow	Fluke Up	None	None
Deep Helder	REV01	2022-06-04	11:15:00.0	V16	Unidentified Dolphin	UE	1143	1143	1163	1	Breach	Splash	None	None
Deep Helder	REV01	2022-06-04	11:21:00.0	V17	Humpback Whale	UE	762	762	762	1	Blow	Fluke Up	None	None
Deep Helder	REV01	2022-06-05	14:02:00.0	V18	Humpback Whale	UE	4572	1143	1143	3	Blow	Tail Slap	None	None
Deep Helder	REV01	2022-06-05	14:13:00.0	V19	Humpback Whale	UE	2286	1143	1143	3	Blow	Fluke Up	None	None
Deep Helder	REV01	2022-06-05	14:31:00.0	V20	Humpback Whale	UE	4572	4572	4572	1	Blow	Swim	None	None
Deep Helder	REV01	2022-06-05	15:18:37.0	V21	Humpback Whale	UE	1408	1407	1407	1	Blow	Travel	None	None
Deep Helder	REV01	2022-06-05	18:55:32.0	V22	Unidentified Mysticete Whale	UE	3125	3000	2950	1	Blow	Unknown	None	None
Deep Helder	REV01	2022-06-05	19:16:34.0	V23	Unidentified Mysticete Whale	UE	2235	2000	1950	1	Blow	Travel	None	None
Deep Helder	REV01	2022-06-06	05:14:00.0	V24	Unidentified Dolphin	NVTS IR	300	300	350	8	Swim	Splash	None	None
Deep Helder	REV01	2022-06-06	20:07:29.0	V25	Fin Whale	UE	2746	350	400	1	Blow	Travel	None	None
Deep Helder	REV01	2022-06-06	20:18:43.0	V26	Unidentified Mysticete Whale	UE	1743	1740	1740	1	Blow	Unknown	None	None

Vessel	Survey Area	Date	Time (UTC)	Detection Number	Species	Detection Method	Initial Detection Distance (m)	CPA to PSO (m)	CPA to Active Source <200 kHz (m)	Number Individuals	Initial Behavior	Second Behavior	Reaction	Mitigation
Deep Helder	REV01	2022-06-07	16:22:26.0	V27	Unidentified Mysticete Whale	UE	2809	500	550	2	Blow	Travel	None	None
Deep Helder	REV01	2022-06-11	02:02:00.0	V28	Unidentified Mysticete Whale	NVD	400	200	300	3	Blow	Swim	None	Shutdown
Deep Helder	REV01	2022-06-11	02:46:49.0	V29	Unidentified Mysticete Whale	NVD	400	300	n/a	3	Blow	Swim	None	Alter Course
Deep Helder	REV01	2022-06-11	03:16:00.0	V30	Unidentified Mysticete Whale	NVD	400	400	n/a	2	Blow	Swim	None	Alter Course
Deep Helder	REV01	2022-06-11	08:52:30.0	V31	Unidentified Mysticete Whale	NVD	400	400	400	1	Blow	Travel	None	Shutdown
Deep Helder	REV01	2022-06-11	12:46:19.0	V32	Unidentified Mysticete Whale	UE	2500	2500	2560	1	Blow	Unknown	None	None
Deep Helder	REV01	2022-06-12	12:21:05.0	V33	Fin Whale	UE	558	558	558	1	Blow	Surface-active Travel	None	None
Deep Helder	REV01	2022-06-13	00:21:30.0	V34	Unidentified Mysticete Whale	UE	431	400	470	2	Blow	Travel	None	Shutdown
Deep Helder	REV01	2022-06-13	19:08:33.0	V35	Fin Whale	UE	415	414	500	1	Blow	Travel	None	None
Deep Helder	REV01	2022-06-13	19:16:38.0	V36	Unidentified Mysticete Whale	UE	1238	1238	1250	2	Blow	None	None	None
Deep Helder	REV01	2022-06-13	19:18:39.0	V37	Fin Whale	UE	528	400	450	1	Travel	Blow	None	None
Deep Helder	REV01	2022-06-14	09:40:00.0	V38	Unidentified Mysticete Whale	UE	695	694.9	695	2	Blow	Travel	None	None
Deep Helder	REV01	2022-06-14	09:53:00.0	V39	Unidentified Mysticete Whale	UE	1724	1724	1700	1	Blow	None	None	None
Deep Helder	REV01	2022-06-14	10:48:00.0	V40	Unidentified Mysticete Whale	UE	550	549.9	550	1	Blow	Travel	None	None
Deep Helder	REV01	2022-06-14	11:38:30.0	V41	Unidentified Mysticete Whale	UE	478	100	500	3	Blow	Travel	None	Shutdown

Vessel	Survey Area	Date	Time (UTC)	Detection Number	Species	Detection Method	Initial Detection Distance (m)	CPA to PSO (m)	CPA to Active Source <200 kHz (m)	Number Individuals	Initial Behavior	Second Behavior	Reaction	Mitigation
Deep Helder	REV01	2022-06-14	12:59:57.0	V42	Unidentified Mysticete Whale	UE	2753	1700	1760	1	Blow	Travel	None	None
Deep Helder	REV01	2022-06-14	14:54:00.0	V43	Unidentified Mysticete Whale	UE	989	989.1	1000	1	Blow	Mill	None	None
Deep Helder	REV01	2022-06-14	15:05:44.0	V44	Fin Whale	UE	507	450	530	1	Blow	Mill	None	Alter Course
Deep Helder	REV01	2022-06-14	20:10:07.0	V45	Unidentified Mysticete Whale	UE	4135	4134	4200	1	Blow	None	None	None
Deep Helder	REV01	2022-06-15	00:39:05.0	V46	Fin Whale	UE	530	529	600	4	Blow	Travel	None	None
Deep Helder	REV01	2022-06-15	01:13:17.0	V47	Short-beaked Common Dolphin	NVD	50	15	75	8	Porpoise	Bow Ride	None	None
Deep Helder	REV01	2022-06-15	01:26:26.0	V48	Unidentified Mysticete Whale	NVTS IR	900	750	750	2	Blow	Travel	None	None
Deep Helder	REV01	2022-06-16	11:10:00.0	V49	Unidentified Mysticete Whale	UE	1727	1727	1727	1	Blow	None	None	None
Deep Helder	REV01	2022-06-16	16:28:42.0	V50	Unidentified Mysticete Whale	UE	1724	1724	1750	1	Blow	None	None	None
Deep Helder	REV01	2022-06-19	14:02:00.0	V51	Short-beaked Common Dolphin	UE	100	50	n/a	5	Surface-active Travel	None	None	None
Deep Helder	REV01	2022-06-22	09:27:00.0	V52	Unidentified Dolphin	UE	200	200	n/a	20	Surface-active Travel	None	None	None
Deep Helder	REV01	2022-06-24	11:50:00.0	V53	Humpback Whale	UE	700	700	n/a	1	Surface-active Travel	None	None	None
Deep Helder	SRW01	2022-06-25	12:52:20.0	V1	Unidentified Mysticete Whale	UE	695	550	600	2	Blow	Travel	None	None
Deep Helder	SRW01	2022-06-25	14:26:03.0	V2	Kemp's Ridley Sea Turtle	UE	20	15	65	1	Travel	None	None	Shutdown

Vessel	Survey Area	Date	Time (UTC)	Detection Number	Species	Detection Method	Initial Detection Distance (m)	CPA to PSO (m)	CPA to Active Source <200 kHz (m)	Number Individuals	Initial Behavior	Second Behavior	Reaction	Mitigation
Deep Helder	SRW01	2022-06-25	17:13:19.0	V3	Unidentified Mysticete Whale	UE	1724	700	750	2	Blow	Travel	None	None
Deep Helder	SRW01	2022-06-26	00:21:52.0	V4	Short-beaked Common Dolphin	UE	400	350	400	5	Surface-active Travel	Porpoise	None	None
Deep Helder	SRW01	2022-06-26	00:34:03.0	V5	Short-beaked Common Dolphin	UE	400	375	450	5	Surface-active Travel	Splash	None	None
Deep Helder	SRW01	2022-06-26	12:07:00.0	V6	Short-beaked Common Dolphin	UE	20	20	50	4	Porpoise	Travel	None	None
Deep Helder	SRW01	2022-06-26	13:12:00.0	V7	Short-beaked Common Dolphin	RB	800	540	540	5	Surface-active Mill	Surface-active Travel	None	None
Deep Helder	SRW01	2022-06-26	18:29:45.0	V8	Unidentified Mysticete Whale	UE	989	550	600	2	Blow	Travel	None	None
Deep Helder	SRW01	2022-06-26	20:13:17.1	V9	Fin Whale	UE	690	690	720	2	Blow	Surface-active Travel	None	None
Deep Helder	SRW01	2022-06-26	20:34:00.0	V10	Unidentified Mysticete Whale	UE	2216	2293	2243	5	Blow	None	None	None
Deep Helder	SRW01	2022-06-26	20:50:00.0	V11	Unidentified Mysticete Whale	UE	690	690	640	3	Blow	None	None	None
Deep Helder	SRW01	2022-06-26	22:01:00.0	V12	Short-beaked Common Dolphin	UE	536	15	40	3	Surface-active Travel	Bow Ride	None	None
Deep Helder	SRW01	2022-06-26	23:19:00.0	V13	Unidentified Mysticete Whale	UE	1724	1724	1724	1	Blow	None	None	None
Deep Helder	SRW01	2022-06-26	23:43:00.0	V14	Unidentified Mysticete Whale	UE	1500	1500	1540	1	Blow	None	None	None
Deep Helder	SRW01	2022-06-27	01:10:00.0	V15	Unidentified Mysticete Whale	NVD	1000	1000	1100	1	Blow	None	None	None

Vessel	Survey Area	Date	Time (UTC)	Detection Number	Species	Detection Method	Initial Detection Distance (m)	CPA to PSO (m)	CPA to Active Source <200 kHz (m)	Number Individuals	Initial Behavior	Second Behavior	Reaction	Mitigation
Deep Helder	SRW01	2022-06-27	01:20:00.0	V16	Unidentified Mysticete Whale	NVD	1000	1000	1100	1	Blow	None	None	None
Deep Helder	SRW01	2022-06-27	06:31:00.0	V17	Short-beaked Common Dolphin	NVD	15	15	n/a	5	Splash	Surface-active Mill	None	None
Deep Helder	SRW01	2022-06-27	08:33:00.0	V18	Unidentified Dolphin	UE	300	300	n/a	6	Porpoise	Swim	None	None
Deep Helder	SRW01	2022-06-27	09:42:00.0	V19	Fin Whale	UE	696	700	n/a	1	Surface-active Mill	Feed	None	None
Deep Helder	SRW01	2022-06-27	09:47:00.0	V20	Unidentified Dolphin	UE	696	700	n/a	25	Feed	Surface-active Travel	None	None
Deep Helder	SRW01	2022-06-27	17:27:00.0	V21	Unidentified Mysticete Whale	UE	1724	1724	n/a	1	Blow	Travel	None	None
Deep Helder	SRW01	2022-06-28	12:22:00.0	V22	Fin Whale	UE	1724	695	750	7	Blow	Travel	None	None
Deep Helder	SRW01	2022-06-28	13:31:00.0	V23	Bottlenose Dolphin	UE	985	600	650	10	Chase Fish	Swim	None	None
Deep Helder	SRW01	2022-06-28	14:12:00.0	V24	Unidentified Mysticete Whale	UE	2128	1000	1080	1	Blow	None	None	None
Deep Helder	SRW01	2022-06-28	16:14:00.0	V25	Unidentified Mysticete Whale	UE	2780	1257	1300	6	Blow	Surface-active Mill	None	None
Deep Helder	SRW01	2022-06-28	19:39:56.3	V26	Unidentified Mysticete Whale	UE	1714	1714	1764	1	Blow	None	None	None
Deep Helder	SRW01	2022-06-28	19:53:40.9	V27	Unidentified Mysticete Whale	UE	1714	1714	1664	1	Blow	Surface-active Travel	None	None
Deep Helder	SRW01	2022-06-28	20:19:26.0	V28	Unidentified Mysticete Whale	UE	983	982	852	3	Blow	Travel	None	None
Deep Helder	SRW01	2022-06-28	22:05:50.6	V29	Humpback Whale	UE	4097	4097	4047	2	Blow	Breach	None	None
Deep Helder	SRW01	2022-06-28	22:41:48.0	V30	Unidentified Mysticete Whale	UE	2780	2780	2850	1	Blow	None	None	None
Deep Helder	SRW01	2022-06-29	08:43:00.0	V31	Fin Whale	UE	550	550	580	5	Blow	Surface-active Mill	None	Alter Course

Vessel	Survey Area	Date	Time (UTC)	Detection Number	Species	Detection Method	Initial Detection Distance (m)	CPA to PSO (m)	CPA to Active Source <200 kHz (m)	Number Individuals	Initial Behavior	Second Behavior	Reaction	Mitigation
Deep Helder	SRW01	2022-06-29	21:47:48.3	V32	Fin Whale	UE	4076	1243	1300	4	Blow	Travel	None	None
Deep Helder	SRW01	2022-06-30	02:43:00.0	V33	Unidentified Dolphin	NVD	450	100	180	5	Surface-active Travel	None	None	None
Deep Helder	SRW01	2022-06-30	19:43:08.8	V34	Unidentified Mysticete Whale	UE	1714	1714	1714	3	Blow	None	None	None
Deep Helder	SRW01	2022-07-01	01:58:00.0	V35	Short-beaked Common Dolphin	NVD	100	50	120	1	Surface-active Travel	None	None	None
Deep Helder	SRW01	2022-07-01	10:42:00.0	V36	Unidentified Mysticete Whale	UE	991	991	950	1	Blow	None	None	None
Deep Helder	SRW01	2022-07-01	16:44:00.0	V37	Humpback Whale	UE	100	100	200	5	Surface-active Travel	Fluke Up	None	Shutdown
Deep Helder	SRW01	2022-07-01	16:52:00.0	V37	Humpback Whale	UE	100	50	n/a	5	Surface-active Travel	Feed	None	Alter Course
Deep Helder	SRW01	2022-07-01	18:53:00.0	V38	Humpback Whale	UE	1256	1256	n/a	2	Blow	Tail Slap	None	None
Deep Helder	REV01	2022-07-03	13:41:00.0	V54	Fin Whale	UE	800	800	800	3	Blow	Travel	None	None
Deep Helder	SRW01	2022-07-03	16:40:00.0	V39	Unidentified Mysticete Whale	UE	989	600	600	1	Blow	Travel	None	None
Deep Helder	SRW01	2022-07-03	18:16:00.0	V40	Unidentified Mysticete Whale	UE	200	200	280	4	Blow	Travel	None	Shutdown
Deep Helder	SRW01	2022-07-03	19:35:13.2	V41	Unidentified Mysticete Whale	UE	1714	1714	1714	1	Blow	Surface-active Travel	None	None
Deep Helder	SRW01	2022-07-03	20:03:10.6	V42	Unidentified Mysticete Whale	UE	2765	1714	1714	2	Blow	Mill	None	None
Deep Helder	SRW01	2022-07-03	21:31:34.5	V43	Unidentified Mysticete Whale	UE	983	982	982	1	Blow	Surface-active Travel	None	None
Deep Helder	SRW01	2022-07-03	22:32:00.0	V44	Unidentified Mysticete Whale	UE	536	536	600	1	Blow	Travel	None	Alter Course

Vessel	Survey Area	Date	Time (UTC)	Detection Number	Species	Detection Method	Initial Detection Distance (m)	CPA to PSO (m)	CPA to Active Source <200 kHz (m)	Number Individuals	Initial Behavior	Second Behavior	Reaction	Mitigation
Deep Helder	SRW01	2022-07-03	23:25:00.0	V45	Unidentified Mysticete Whale	UE	1724	1724	1680	3	Blow	Travel	None	None
Deep Helder	SRW01	2022-07-04	00:16:00.0	V48	Bottlenose Dolphin	UE	400	400	470	2	Surface-active Travel	None	None	None
Deep Helder	SRW01	2022-07-04	00:50:00.0	V49	Unidentified Mysticete Whale	UE	500	500	480	4	Blow	Surface-active Travel	None	Shutdown
Deep Helder	SRW01	2022-07-04	00:52:00.0	V49	Unidentified Mysticete Whale	UE	500	50	n/a	4	Blow	Surface-active Travel	None	Alter Course
Deep Helder	SRW01	2022-07-04	11:21:00.0	V50	Unidentified Mysticete Whale	UE	400	400	450	7	Surface-active Travel	None	None	Shutdown
Deep Helder	SRW01	2022-07-04	13:08:00.0	V51	Fin Whale	UE	2771	800	750	2	Blow	Surface-active Travel	None	None
Deep Helder	SRW01	2022-07-04	14:04:00.0	V52	Fin Whale	UE	1727	1000	1050	2	Surface-active Travel	None	None	None
Deep Helder	SRW01	2022-07-04	15:35:00.0	V53	Unidentified Mysticete Whale	UE	2780	2780	2850	2	Blow	Travel	None	None
Deep Helder	SRW01	2022-07-04	16:23:00.0	V54	Unidentified Mysticete Whale	UE	1724	1724	1820	2	Blow	Travel	None	None
Deep Helder	SRW01	2022-07-04	18:27:00.0	V55	Unidentified Mysticete Whale	UE	1256	1256	1256	3	Blow	Travel	None	None
Deep Helder	SRW01	2022-07-04	18:54:00.0	V56	Unidentified Mysticete Whale	UE	2765	2756	2776	2	Blow	Splash	None	None
Deep Helder	SRW01	2022-07-04	22:45:00.0	V57	Unidentified Mysticete Whale	UE	2780	2780	2780	1	Blow	Travel	None	None
Deep Helder	SRW01	2022-07-05	11:41:00.0	V58	Bottlenose Dolphin	UE	150	120	150	12	Surface-active Travel	None	None	None
Deep Helder	SRW01	2022-07-05	20:04:00.0	V59	Unidentified Mysticete Whale	UE	3714	4076	4096	1	Blow	None	None	None
Deep Helder	SRW01	2022-07-05	22:10:00.0	V60	Fin Whale	UE	1724	300	n/a	1	Blow	Travel	None	None

Vessel	Survey Area	Date	Time (UTC)	Detection Number	Species	Detection Method	Initial Detection Distance (m)	CPA to PSO (m)	CPA to Active Source <200 kHz (m)	Number Individuals	Initial Behavior	Second Behavior	Reaction	Mitigation
Deep Helder	SRW01	2022-07-06	15:24:00.0	V61	Unidentified Mysticete Whale	UE	1256	1256	1256	1	Blow	Travel	None	None
Deep Helder	SRW01	2022-07-06	15:40:00.0	V62	Minke Whale	UE	75	75	100	1	Travel	None	None	Shutdown
Deep Helder	SRW01	2022-07-06	22:39:00.0	V63	Unidentified Mysticete Whale	UE	2780	1453	1453	1	Blow	Travel	None	None
Deep Helder	SRW01	2022-07-07	03:19:00.0	V64	Short-beaked Common Dolphin	NVD	40	30	50	4	Surface-active Travel	Bow Ride	None	None
Deep Helder	SRW01	2022-07-07	06:22:00.0	V65	Short-beaked Common Dolphin	NVD	70	50	30	1	Swim	None	None	None
Deep Helder	SRW01	2022-07-07	10:25:00.0	V66	Fin Whale	UE	991	800	840	1	Surface-active Travel	None	None	None
Deep Helder	SRW01	2022-07-07	13:17:00.0	V67	Unidentified Mysticete Whale	UE	1718	1750	1700	1	Blow	None	None	None
Deep Helder	SRW01	2022-07-07	13:27:00.0	V68b	Short-beaked Common Dolphin	UE	100	20	5	20	Surface-active Travel	Bow Ride	None	None
Deep Helder	SRW01	2022-07-07	14:14:00.0	V69	Unidentified Mysticete Whale	UE	2034	1000	1030	3	Surface-active Travel	None	None	None
Deep Helder	SRW01	2022-07-07	16:05:00.0	V70	Short-beaked Common Dolphin	UE	1724	400	500	30	Surface-active Travel	Splash	None	None
Deep Helder	SRW01	2022-07-07	18:36:00.0	V71	Unidentified Mysticete Whale	UE	2780	2780	2800	2	Blow	Travel	None	None
Deep Helder	SRW01	2022-07-07	21:01:00.0	V72	Unidentified Mysticete Whale	UE	2113	1012	2032	4	Blow	None	None	None
Deep Helder	SRW01	2022-07-07	23:24:00.0	V73	Short-beaked Common Dolphin	UE	1256	816	900	25	Surface-active Travel	Splash	None	None

Vessel	Survey Area	Date	Time (UTC)	Detection Number	Species	Detection Method	Initial Detection Distance (m)	CPA to PSO (m)	CPA to Active Source <200 kHz (m)	Number Individuals	Initial Behavior	Second Behavior	Reaction	Mitigation
Deep Helder	SRW01	2022-07-07	23:56:00.0	V74	Short-beaked Common Dolphin	UE	300	300	400	5	Surface-active Travel	Splash	None	None
Deep Helder	SRW01	2022-07-08	04:19:00.0	V75	Short-beaked Common Dolphin	UE	70	10	40	8	Surface-active Travel	Feed	None	None
Deep Helder	SRW01	2022-07-08	20:25:00.0	V76	Unidentified Mysticete Whale	UE	1000	1000	1050	2	Blow	None	None	None
Deep Helder	SRW01	2022-07-08	23:21:00.0	V77	Unidentified Mysticete Whale	UE	536	536	600	2	Blow	Travel	None	Alter Course
Deep Helder	SRW01	2022-07-08	23:23:00.0	V77	Unidentified Mysticete Whale	UE	100	100	200	2	Swim	Travel	None	Shutdown
Deep Helder	SRW01	2022-07-08	23:25:00.0	V77	Unidentified Mysticete Whale	UE	50	50	n/a	2	Swim	Travel	None	Engine Neutral
Deep Helder	SRW01	2022-07-09	04:25:00.0	V78	Short-beaked Common Dolphin	NVD	30	10	10	12	Surface-active Travel	Bow Ride	None	None
Deep Helder	SRW01	2022-07-09	05:18:00.0	V79	Short-beaked Common Dolphin	NVD	20	10	10	30	Bow Ride	Feed	None	None
Deep Helder	SRW01	2022-07-09	07:35:00.0	V80	Short-beaked Common Dolphin	NVD	30	10	50	4	Surface-active Travel	Bow Ride	None	None
Deep Helder	SRW01	2022-07-09	09:41:00.0	V81	Unidentified Mysticete Whale	UE	1503	1000	1030	1	Blow	None	None	None
Deep Helder	SRW01	2022-07-09	10:55:00.0	V82	Humpback Whale	UE	2034	1000	1030	2	Blow	Breach	None	None
Deep Helder	SRW01	2022-07-09	17:06:00.0	V83	Minke Whale	UE	536	536	600	1	Splash	Travel	None	None
Deep Helder	SRW01	2022-07-09	22:03:00.0	V84	Unidentified Mysticete Whale	UE	2780	2780	2700	2	Blow	Travel	None	None
Deep Helder	SRW01	2022-07-09	22:26:00.0	V85	Unidentified Mysticete Whale	UE	368	368	450	1	Blow	Travel	None	Shutdown

Vessel	Survey Area	Date	Time (UTC)	Detection Number	Species	Detection Method	Initial Detection Distance (m)	CPA to PSO (m)	CPA to Active Source <200 kHz (m)	Number Individuals	Initial Behavior	Second Behavior	Reaction	Mitigation
Deep Helder	SRW01	2022-07-09	23:50:00.0	V86	Unidentified Mysticete Whale	UE	1724	1724	1800	1	Blow	None	None	None
Deep Helder	SRW01	2022-07-10	03:50:00.0	V87	Short-beaked Common Dolphin	NVD	30	5	10	5	Surface-active Travel	Bow Ride	None	None
Deep Helder	SRW01	2022-07-10	05:14:00.0	V88	Short-beaked Common Dolphin	NVD	15	10	80	4	Bow Ride	Surface-active Travel	None	None
Deep Helder	SRW01	2022-07-10	06:08:00.0	V89	Short-beaked Common Dolphin	Auditory	20	15	15	8	Bow Ride	Chase Fish	None	None
Deep Helder	SRW01	2022-07-10	06:55:00.0	V90	Short-beaked Common Dolphin	Auditory	20	20	20	4	Surface-active Travel	Bow Ride	None	None
Deep Helder	SRW01	2022-07-10	09:48:00.0	V92	Short-beaked Common Dolphin	UE	1503	80	110	80	Surface-active Travel	Splash	None	None
Deep Helder	SRW01	2022-07-10	10:05:00.0	V91	Humpback Whale	UE	150	150	180	3	Surface-active Travel	Surface-active Mill	None	Shutdown
Deep Helder	SRW01	2022-07-10	11:25:00.0	V94	Short-beaked Common Dolphin	UE	1727	80	110	80	Splash	Surface-active Travel	None	None
Deep Helder	SRW01	2022-07-10	11:34:00.0	V93	Unidentified Mysticete Whale	UE	450	450	400	3	Surface-active Travel	None	None	Shutdown
Deep Helder	SRW01	2022-07-10	13:03:00.0	V95	Unidentified Mysticete Whale	UE	2771	1500	n/a	3	Blow	None	None	None
Deep Helder	SRW01	2022-07-10	13:08:00.0	V96	Bottlenose Dolphin	UE	50	20	n/a	6	Surface-active Travel	None	None	None
Deep Helder	SRW01	2022-07-10	13:31:00.0	V97	Bottlenose Dolphin	UE	30	40	n/a	3	Surface-active Travel	None	None	None
Deep Helder	SRW01	2022-07-10	13:31:00.0	V98	Short-beaked	UE	50	40	n/a	5	Surface-active Travel	None	None	None

Vessel	Survey Area	Date	Time (UTC)	Detection Number	Species	Detection Method	Initial Detection Distance (m)	CPA to PSO (m)	CPA to Active Source <200 kHz (m)	Number Individuals	Initial Behavior	Second Behavior	Reaction	Mitigation
					Common Dolphin									
Deep Helder	SRW01	2022-07-10	14:02:00.0	V99	Unidentified Mysticete Whale	UE	2034	800	n/a	3	Blow	Surface-active Travel	None	None
Deep Helder	SRW01	2022-07-10	15:27:00.0	V100	Unidentified Mysticete Whale	UE	2780	816	n/a	3	Blow	Travel	None	None
Fugro Brasilis	SRW01	2022-07-13	11:52:14.0	V1	Humpback Whale	UE	1832	742	n/a	8	Blow	Surface-active Mill	None	None
Fugro Brasilis	SRW01	2022-07-13	11:59:49.0	V2	Fin Whale	UE	742	742	n/a	2	Blow	Surface-active Mill	None	None
Fugro Brasilis	SRW01	2022-07-13	12:09:18.0	V3	Short-beaked Common Dolphin	UE	35	25	n/a	1	Porpoise	Bow Ride	None	None
Fugro Brasilis	SRW01	2022-07-13	13:50:10.0	V4	Unidentified Sea Turtle	UE	60	40	n/a	1	Rest	None	None	None
Fugro Brasilis	SRW01	2022-07-13	14:12:15.0	V5	Loggerhead Sea Turtle	UE	150	80	n/a	1	Rest	Other (see notes)	None	None
Fugro Brasilis	SRW01	2022-07-13	14:51:26.0	V6	Short-beaked Common Dolphin	UE	300	10	n/a	16	Surface-active Travel	Bow Ride	None	None
Fugro Brasilis	SRW01	2022-07-13	15:07:32.0	V7	Short-beaked Common Dolphin	UE	200	200	n/a	5	Porpoise	Surface-active Travel	None	None
Fugro Brasilis	SRW01	2022-07-13	15:45:11.0	V8	Short-beaked Common Dolphin	UE	242	242	n/a	3	Porpoise	Surface-active Travel	None	None
Fugro Brasilis	SRW01	2022-07-13	15:53:00.0	V9	Unidentified Mysticete Whale	UE	1068	1067	n/a	1	Breach	None	None	None
Fugro Brasilis	SRW01	2022-07-13	18:49:01.0	V10	Short-beaked Common Dolphin	UE	393	35	n/a	6	Porpoise	Surface-active Travel	None	None
Fugro Brasilis	SRW01	2022-07-13	20:12:00.0	V11	Short-beaked Common Dolphin	UE	1761	5	n/a	40	Chase Fish	Bow Ride	None	None

Vessel	Survey Area	Date	Time (UTC)	Detection Number	Species	Detection Method	Initial Detection Distance (m)	CPA to PSO (m)	CPA to Active Source <200 kHz (m)	Number Individuals	Initial Behavior	Second Behavior	Reaction	Mitigation
Fugro Brasilis	SRW01	2022-07-13	20:13:06.0	V12	Humpback Whale	UE	1761	400	n/a	4	Blow	Tail Slap	None	None
Fugro Brasilis	SRW01	2022-07-13	20:25:52.0	V13	Humpback Whale	UE	30	30	n/a	2	Breach	Fluke Up	None	None
Fugro Brasilis	SRW01	2022-07-13	21:00:04.0	V14	Minke Whale	UE	40	5	n/a	1	Mill	None	None	Engine Neutral
Fugro Brasilis	SRW01	2022-07-13	22:27:46.0	V15	Humpback Whale	UE	742	742	n/a	1	Blow	Surface-active Travel	None	None
Fugro Brasilis	SRW01	2022-07-13	23:33:47.0	V16	Minke Whale	UE	299	300	n/a	1	Blow	None	None	None
Fugro Brasilis	SRW01	2022-07-14	00:05:00.0	V17	Unidentified Mysticete Whale	UE	650	650	n/a	1	Blow	None	None	None
Fugro Brasilis	SRW01	2022-07-14	07:49:20.0	V18	Short-beaked Common Dolphin	NVD	10	10	10	5	Surface-active Mill	Porpoise	None	None
Fugro Brasilis	SRW01	2022-07-14	08:26:15.0	V19	Short-beaked Common Dolphin	Current Corp IR	20	20	20	8	Surface-active Travel	Porpoise	None	None
Fugro Brasilis	SRW01	2022-07-14	15:15:31.0	V20	Unidentified Mysticete Whale	UE	2403	2400	2450	1	Blow	Travel	None	None
Fugro Brasilis	SRW01	2022-07-14	15:42:02.0	V21	Short-beaked Common Dolphin	UE	690	690	650	6	Porpoise	Surface-active Travel	None	None
Fugro Brasilis	SRW01	2022-07-14	17:18:01.0	V22	Unidentified Mysticete Whale	UE	1916	1900	1950	1	Blow	Surface-active Mill	None	None
Fugro Brasilis	SRW01	2022-07-14	21:12:03.0	V23	Unidentified Mysticete Whale	UE	1848	1800	1800	1	Blow	Surface-active Mill	None	None
Fugro Brasilis	SRW01	2022-07-15	00:08:30.0	V24	Fin Whale	UE	870	870	870	1	Blow	Surface-active Travel	None	None
Fugro Brasilis	SRW01	2022-07-15	10:21:30.0	V25	Short-beaked Common Dolphin	UE	1076	400	400	8	Surface-active Travel	Porpoise	None	None

Vessel	Survey Area	Date	Time (UTC)	Detection Number	Species	Detection Method	Initial Detection Distance (m)	CPA to PSO (m)	CPA to Active Source <200 kHz (m)	Number Individuals	Initial Behavior	Second Behavior	Reaction	Mitigation
Fugro Brasilis	SRW01	2022-07-15	13:08:30.0	V26	Short-beaked Common Dolphin	UE	584	470	470	20	Surface-active Travel	Porpoise	None	None
Fugro Brasilis	SRW01	2022-07-15	21:12:53.0	V27	Short-beaked Common Dolphin	UE	1068	500	500	25	Porpoise	Surface-active Travel	None	None
Fugro Brasilis	SRW01	2022-07-16	01:57:00.0	V28	Short-beaked Common Dolphin	Current Corp IR	20	20	n/a	20	Surface-active Mill	Bow Ride	None	None
Fugro Brasilis	SRW01	2022-07-16	04:13:00.0	V29	Short-beaked Common Dolphin	NVD	20	5	n/a	4	Surface-active Travel	Feed	None	None
Fugro Brasilis	SRW01	2022-07-16	07:43:31.0	V30	Short-beaked Common Dolphin	NVD	20	20	n/a	3	Surface-active Travel	Bow Ride	None	None
Fugro Brasilis	SRW01	2022-07-16	13:43:00.0	V31	Loggerhead Sea Turtle	UE	40	20	n/a	1	Rest	None	Look	None
Fugro Brasilis	SRW01	2022-07-16	14:13:00.0	V32	Loggerhead Sea Turtle	UE	40	20	n/a	1	Rest	Other (see notes)	Look	None
Fugro Brasilis	SRW01	2022-07-16	14:20:00.0	V33	Short-beaked Common Dolphin	UE	1076	400	n/a	20	Surface-active Travel	None	None	None
Fugro Brasilis	SRW01	2022-07-16	18:04:00.0	V34	Minke Whale	UE	300	300	n/a	1	Surface-active Travel	None	None	Engine Neutral

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

Appendix E: Protected Species Detection Photographs

Figure 29. Deceased gray seal (*Halichoerus grypus*) observed on 28 April 2022 from the *Deep Helder*. Photo credit: Richard Rahm.

Figure 30. Minke whale (*Balaenoptera acutorostrata*) observed on 02 June 2022 from the *Deep Helder*. Photo credit: Lisa Yuodelis.

Figure 31. Humpback whale (*Megaptera novaeangliae*) observed on 01 July 2022 from the *Deep Helder*. Photo credit: Jessica Roberts.

Figure 32. Humpback whale (*Megaptera novaeangliae*) observed on 01 July 2022 from the *Deep Helder*. Photo credit: Jessica Roberts.

Figure 33. Unidentified mysticete whale observed on 03 July 2022 from the *Deep Helder*. Photo credit: Jessica Roberts.

Figure 34. Unidentified mysticete whale observed on 03 July 2022 from the *Deep Helder*. Photo credit: Sophie Cleland.

Figure 35. Unidentified mysticete whale observed on 03 July 2022 from the *Deep Helder*. Photo credit: Jessica Roberts.

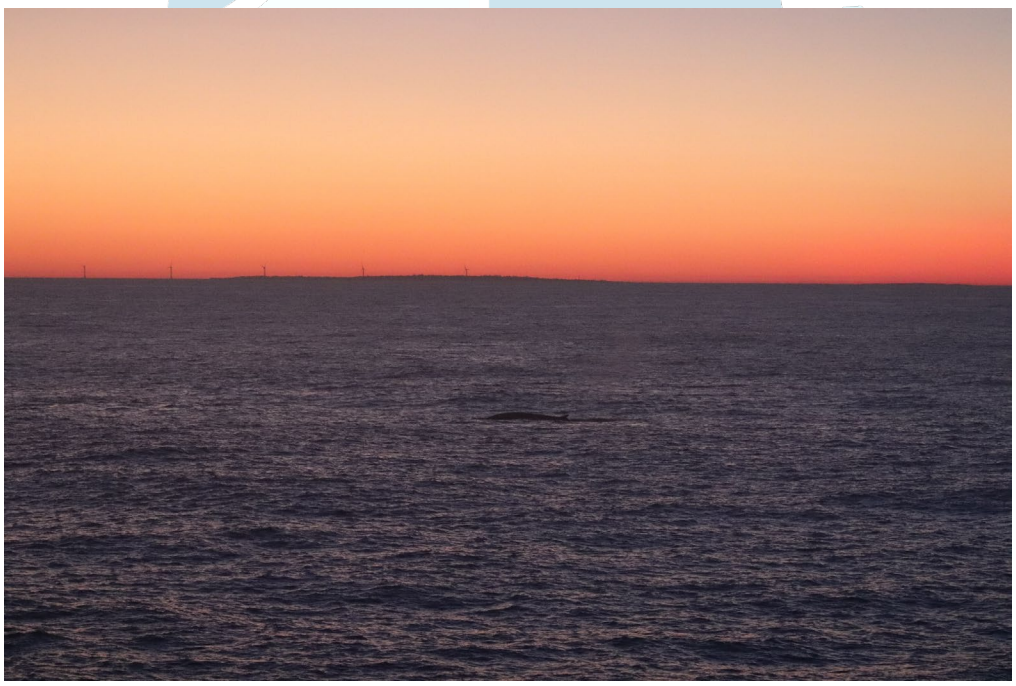

Figure 36. Unidentified mysticete whale observed on 04 July 2022 from the *Deep Helder*. Photo credit: Shemar Blakeney.

Figure 37. Short-beaked common dolphin (*Delphinus delphis*) observed on 13 July 2022 from the *Fugro Brasilis*. Photo credit: Chris Werre.

Figure 38. Unidentified sea turtle observed on 13 July 2022 from the *Fugro Brasilis*. Photo credit: Jason Hale.

Figure 39. Short-beaked common dolphin (*Delphinus delphis*) observed on 13 July 2022 from the *Fugro Brasilis*. Photo credit: Jason Hale.

Figure 40. Short-beaked common dolphin (*Delphinus delphis*) observed on 13 July 2022 from the *Fugro Brasilis*. Photo credit: Chris Werre.

Figure 41. Humpback whale (*Megaptera novaeangliae*) observed on 13 July 2022 from the *Fugro Brasilis*. Photo credit: Neil Roper.

Figure 42. Humpback whale (*Megaptera novaeangliae*) with calf observed on 13 July 2022 from the *Fugro Brasilis*. Photo credit: Neil Roper.

Figure 43. Minke whale (*Balaenoptera acutorostrata*) observed on 13 July 2022 from the *Fugro Brasilis*. Photo credit: Chris Werre.

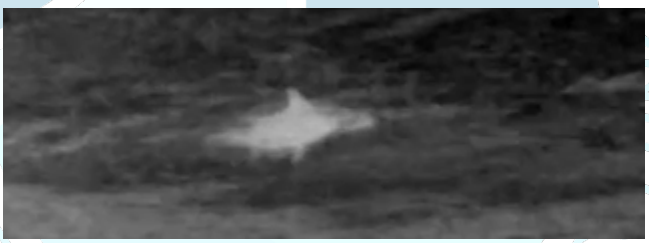

Figure 44. Short-beaked common dolphin (*Delphinus delphis*) observed with IR on 14 July 2022 from the *Fugro Brasilis*. Photo credit: Gregory Zmirak.

Figure 45. Short-beaked common dolphin (*Delphinus delphis*) observed with IR on 14 July 2022 from the *Fugro Brasilis*. Photo credit: Gregory Zmirak.

Figure 46. Short-beaked common dolphin (*Delphinus delphis*) observed on 15 July 2022 from the *Fugro Brasilis*. Photo credit: Jason Hale.

Figure 47. Loggerhead sea turtle (*Caretta caretta*) observed with IR on 16 July 2022 from the *Fugro Brasilis*. Photo credit: Jason Hale.