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Ørsted Wind Power North America LLC

Project:

Ocean Wind II (OCW02) 2021 IHA

Geophysical Surveys

BOEM Leases OCS-A 0498 and OCS-A 0532

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EXECUTIVE SUMMARY

This report provides a summary of all protected species monitoring and mitigation activities for the Ocean Wind II (OCW02) and a portion of the Ocean Wind I (OCW01) geophysical surveys (hereafter referred to as the Project) conducted under the 2021 Ocean Wind LLC Incidental Harassment Authorization (IHA, (NMFS, 2021)) valid for one year from May-10-2021 to May-09-2022. The IHA covered all high-resolution geophysical (HRG) survey work for the development of the wind farms in New Jersey waters, within and near the Bureau of Ocean Energy Management (BOEM) Commercial Leases of Submerged Lands for Renewable Energy Development on the Outer Continental Shelf (OCS)-A 0498 and OCS-A 0532.

Protected species observers (PSOs) onboard four survey vessels completed 6058 hours and 50 minutes of monitoring effort, during 25836 miles of vessel track, on the Surveys. PSO effort was split approximately equally between Daylight versus Darkness.

During the Surveys, there were 264 detections of protected species composed of an estimated 933 individuals. Short-beaked common dolphin was the most abundant species encountered while humpback whale was the most frequently encountered. There were no North Atlantic right whale (NARW) individuals observed during the Surveys. Most protected species detections occurred while acoustic sources less than 200kHz were Inactive (74%), consistent with the proportion of PSO effort conducted during such conditions (72%).

The most frequent reaction behavior noted by the PSOs of these protected species was *none*, regardless of whether the sparker was active (77%), other acoustic sources <200kHz were active (92%) or all sources <200kHz were inactive (69%).

Where a reaction was observed, *dive* was the most frequently identified behavior when acoustic sources (<200kHz) were Inactive, accounting for 20% of encounters. When the sparker was active, only two behavioral reactions, other than *none*, were noted: *dive* and *change direction*. When acoustic sources <200kHz other than the sparker were Active, the only reaction besides *none* was *dive*, which was only recorded on one occasion.

Mitigation measures were implemented for 98 (37%) of the 264 protected species detections. *Detection delay* and *shutdown* were the most common mitigation measures implemented (13% of encounters each), with leatherback sea turtles being the primary cause of both mitigation measures.

A total of 18 encounters, comprising 23 individuals, were recorded within the Level B HZ of IHA-regulated equipment operating below 200kHz, accounting for 7% of encounters and 2% of the total number of individual protected species detected throughout the Surveys. Of these 18 encounters, 16 were sea turtles, there was a single encounter of unidentified dolphins totaling 6 individuals and another of a single humpback whale. In all cases a shutdown was requested and implemented with the exception of one of the turtle sightings as this individual was dead, and the sighting of unidentified dolphins which were deemed to be approaching voluntarily by the PSO on watch and did not enter the 100m EZ of the active equipment.

SERVICE WARRANTY

USE OF THIS REPORT

This report has been prepared with due care and diligence and with the skill reasonably expected of a reputable contractor experienced in the types of work carried out under the contract and as such the findings in this report are based on an interpretation of data which is a matter of opinion on which professionals may differ and unless clearly stated is not a recommendation of any course of action.

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LOCATION MAP

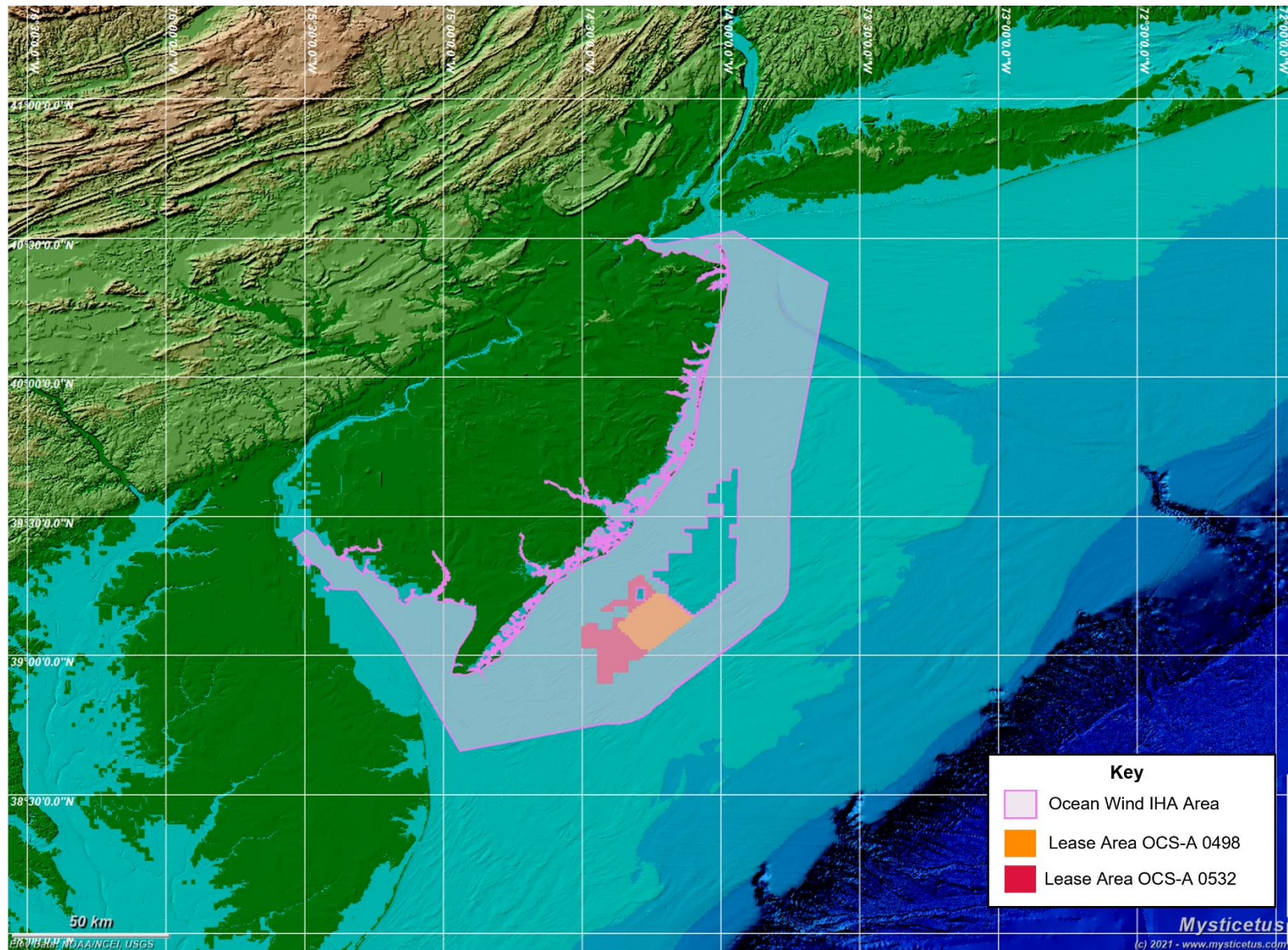


TABLE OF CONTENTS

REPORT AUTHORIZATION AND DISTRIBUTION	II
EXECUTIVE SUMMARY	III
SERVICE WARRANTY	IV
LOCATION MAP	V
TABLE OF CONTENTS	VI
LIST OF FIGURES	VII
LIST OF TABLES	VIII
GLOSSARY OF TERMS AND ABBREVIATIONS	IX
1 INTRODUCTION	1
1.1 Purpose	1
1.2 Background	1
1.3 Regulatory Documents	2
1.4 BOEM and NMFS Reporting Requirements	3
2 SUMMARY OF SURVEY ACTIVITIES	6
3 MONITORING AND MITIGATION METHODS	8
3.1 Protected Species Observers	8
3.2 PSO Recording Methods	9
3.3 Visual Monitoring Methods	9
3.4 Periods of Reduced Visibility	11
3.5 Mysticetus Observation Software	11
3.6 Mitigation Measures	12
3.7 Data Collection and Analysis Methods	18
3.8 Estimating Number of Exposures	19
4 EFFORT SUMMARY	21
4.1 Monitoring Effort	21
4.2 Weather Conditions During Monitoring	33
5 PROTECTED SPECIES DETECTION SUMMARY	36
5.1 Protected Species Detections	36
5.2 Protected Species Behavior	47
5.3 Closest Observed Point of Approach	54
5.4 Protected Species Potential Exposures	57
5.5 Summary of Mitigation Measures	58
5.6 Protected Species Incident Reports	59
6 MONITORING DEVICE EFFECTIVENESS	60
6.1 Monitoring Technique Overview	60
6.2 Initial Detection Distance	60
6.3 Comparison of Detection Method Effectiveness	61
7 BIBLIOGRAPHY	63
APPENDICES	
APPENDIX A MONITORING EQUIPMENT SPECIFICATIONS	
APPENDIX B PROTECTED SPECIES INCIDENT REPORTS	

LIST OF FIGURES

Figure 2.1	Summary of Survey Activities	7
Figure 4.1	Overview of Vessel Activity Hours Conducted during the Projects	22
Figure 4.2	Overview of Vessel Activity Miles Conducted during the Projects	22
Figure 4.3	Overview of Monitoring State Hours Conducted during the Projects	23
Figure 4.4	Overview of Monitoring State Miles Conducted during the Projects	23
Figure 4.5	Acoustic Source Activity on the MV <i>Ocean Observer</i> during the OCW01 Geophysical Survey conducted under the 2021 Ocean Wind IHA (NMFS, 2021)	25
Figure 4.6	Acoustic Source Activity on the MV <i>Ocean Observer</i> during the OCW02 Geophysical Survey	27
Figure 4.7	Acoustic Source Activity on the RV <i>Ocean Researcher</i> during the OCW01 Survey conducted under the OCW02 2021 Ocean Wind IHA (NMFS, 2021)	28
Figure 4.8	Acoustic Source Activity on the RV <i>Ocean Researcher</i> during the OCW02 Survey	30
Figure 4.9	Monitoring Effort by Beaufort Sea State	34
Figure 4.10	Percentage of Monitoring Effort by Atmospheric Conditions during Daylight and Darkness	34
Figure 4.11	Percentage of Monitoring Effort by Visibility Quality during Daylight and Darkness	35
Figure 5.1	Protected Species Encountered during the OCW01 and OCW02 Surveys	39
Figure 5.2	Protected Species Encountered on the MV <i>Ocean Observer</i>	40
Figure 5.3	Protected Species Encountered on the RV <i>Ocean Researcher</i>	41
Figure 5.4	Protected Species Encountered on the MV <i>Brasilis</i>	42
Figure 5.5	Protected Species Encountered on the RV <i>Substantial</i>	43
Figure 5.6	The Extent of the Two Mid-Atlantic Seasonal Management Areas Established Near the Project Areas from Nov-01 to Apr-30	44
Figure 5.7	Slow Zones Established Near or In the Project Area During the Geophysical Surveys	46
Figure 5.8	Closest Point of Approach of Mysticete Encounters to Active or Inactive Acoustic Sources <200kHz	54
Figure 5.9	Closest Point of Approach of Odontocete Encounters to Active and Inactive Acoustic Sources <200kHz	55
Figure 5.10	Closest Point of Approach of Testudines Encounters to Active and Inactive Acoustic Sources <200kHz	55
Figure 5.11	Box and Whisker plot of Closest Point of Approach of Protected Species Detections Observed when the Sparker was Active	56
Figure 5.12	Box and Whisker plot of Closest Point of Approach of Protected Species Detections Observed when Acoustic Sources <200kHz, other than the Sparker, were Active	56
Figure 5.13	Box and Whiskers plot of Closest Point of Approach of Protected Species Detections Observed when Acoustic Sources <200kHz were Inactive	57
Figure 6.1	Initial Detection Distance of Protected Species during the Project.	61

LIST OF TABLES

Table 1.1	Operational Overview	2
Table 1.2	Protected Species Reporting Requirements stipulated in BOEM Leases OCS-A 0498 and OCS-A 0532 and the 2021 Ocean Wind IHA	4
Table 2.1	Geophysical Survey Equipment Specifications for the Projects Conducted Under the 2021 Ocean Wind IHA (NMFS, 2021)	6
Table 3.1	Monitoring Devices Available on each Vessel	9
Table 3.2	Distance to the Horizon from Primary Observer Locations on each Vessel	10
Table 3.3	Summary of Exclusion Zones used for Protected Species Monitoring During Survey Activities	14
Table 3.4	Definitions of Data Collection and Analysis Terminology	18
Table 3.5	Applicable Level B Harassment Zones for Equipment Operating Below 200kHz	19
Table 3.6	Number of Level B Incidental Takes Authorized by the 2021 Ocean Wind IHA (NMFS, 2021)	20
Table 4.1	Summary of Monitoring Effort Conducted by each Vessel	21
Table 4.2	Vessel and Monitoring Activity on the MV <i>Ocean Observer</i> during the OCW01 Geophysical Survey conducted under the 2021 Ocean Wind IHA (NMFS, 2021)	24
Table 4.3	Vessel and Monitoring Activity on the MV <i>Ocean Observer</i> during the OCW02 Geophysical Survey	26
Table 4.4	Vessel and Monitoring Activity on RV <i>Ocean Researcher</i> during the OCW01 Geophysical Survey Conducted under the OCW02 2021 Ocean Wind IHA (NMFS, 2021)	27
Table 4.5	Vessel and Monitoring Activity on RV <i>Ocean Researcher</i> during the OCW02 Geophysical Survey	29
Table 4.6	Vessel and Monitoring Activity on the RV <i>Substantial</i> during the OCW02 Geophysical Survey	31
Table 4.7	Vessel and Monitoring Activity on the MV <i>Brasilis</i> during the OCW02 Geophysical Survey	32
Table 4.8	PSO Effort for each Monitoring Device used during Daylight and Darkness	33
Table 4.9	PSO Effort for each Monitoring Device when Acoustic Sources <200kHz Active or Inactive	33
Table 5.1	Protected Species Detected and the Estimated Number of Individuals during Daylight and Darkness	37
Table 5.2	Protected Species Detected and the Estimated Number of Individuals when Acoustic Sources (<200kHz) were Active and Inactive	38
Table 5.3	Slow Zones Established Near or In the Project Area During the Geophysical Survey	45
Table 5.4	Observed Initial Behaviors when Acoustic Sources (<200kHz) were Inactive for each Species Encounter during the Surveys	48
Table 5.5	Observed Initial Behaviors when the IHA regulated Sparker was Active for each Species Encounter during the Surveys	49
Table 5.6	Observed Initial Behaviors when Acoustic Sources (<200kHz) other than the Sparker were Active for each Species Encounter during the Surveys	50
Table 5.7	Reaction Behaviors for Protected Species when Acoustic Sources (<200kHz) were Inactive during the Surveys	51
Table 5.8	Reaction Behaviors for Protected Species when the Sparker was Active during the Surveys	52
Table 5.9	Reaction Behaviors for Protected Species when Acoustic Sources (<200kHz) other than the Sparker were Active during the Surveys	53
Table 5.10	Summary of Mitigation Measures Implemented during the Surveys	58

GLOSSARY OF TERMS AND ABBREVIATIONS

AMP	Alternative Monitoring Plan
BOEM	Bureau for Ocean Energy Management
CPA	Closest Point of Approach
Darkness	Between dusk and dawn, based on civil twilight
Daylight	Between dawn and dusk, based on civil twilight
DMA	Dynamic Management Area
DSLR	Digital Single Lens Reflex
ECR	Export Cable Route
eNGO	Environmental Non-Governmental Organization
ESA	Endangered Species Act
EZ	Exclusion Zone
GPS	Global Positioning System
HH IR	Handheld InfraRed
HRG	High Resolution Geophysical
HZ	Harassment Zone
IHA	Incidental Harassment Authorization
IR	InfraRed
kHz	Kilohertz
Leases	Commercial Lease of Submerged Lands for Renewable Energy Development on the Outer Continental Shelf OCS-A 0498, OCS-A 0532
MMPA	Marine Mammal Protection Act
MSRS	Mandatory Ship Recording System
MV	Motor Vessel
M-UHRS	Multichannel Ultra-High Resolution Seismic
NARW	North Atlantic Right Whale
NMFS	National Marine Fisheries Service
NOAA	National Oceanographic and Atmospheric Administration
NVD	Night Vision Device
NY	New York
OCS	Outer Continental Shelf
OCW02	Ocean Wind 02
Protected Species	Any listed marine mammals, sea turtles, Atlantic sturgeon or giant manta ray
PSO	Protected Species Observer
QA/QC	Quality Control/Quality Assurance
RB	Reticle Binoculars
RMS	Root Mean Square
RV	Research Vessel
SBP	Sub-Bottom Profiler
SMA	Seasonal Management Area
S-UHRS	Single Channel Ultra-High Resolution Seismic
UE	Unaided Eye
UHRS	Ultra-High Resolution Seismic
USBL	Ultra-Short Baseline positioning system
UTC	Coordinated Universal Time

1 INTRODUCTION

1.1 Purpose

The following Protected Species Observer (PSO) Report has been compiled by Gardline Limited (hereafter Gardline) for Ørsted Wind Power North America LLC (hereafter Ørsted). It summarizes PSO mitigation activity undertaken by all sub-contractors working on behalf of Ørsted conducting high resolution geophysical (HRG) surveys under the National Marine Fisheries Service (NMFS) issued Incidental Harassment Authorization (IHA; NMFS, 2021) across the proposed Ocean Wind Offshore Wind Farm II (Ocean Wind; OCW02) Lease Area, a portion of the Ocean Wind I (OCW01) Lease Area, and along the associated export cable routes (ECRs) to BL England and Oyster Creek interconnectors within the federal and New Jersey state waters (collectively the Project). Survey operations were conducted under Commercial Lease of Submerged Lands for Renewables Energy Development on the Outer Continental Shelf (OCS) Lease Areas OCS-A 0498 and OCS-A 0532 granted by the Bureau of Ocean Energy Management (BOEM, 2016; 2021c) and hereafter referred to as the Leases or Lease Areas.

The purpose of this report is to summarize information required by the 2021 Ocean Wind IHA for the period from May-10-2021 to May-09-2022.

1.2 Background

On May-10-2021, NMFS issued Ørsted a one-year IHA (hereafter 2021 Ocean Wind IHA), permitting high-resolution geophysical (HRG) surveys (the Surveys) in coastal waters off New Jersey for the purposes of site characterization prior to offshore windfarm development, including the requested Lease Areas and associated ECRs.

The Surveys were conducted from four vessels with PSOs supplied by three providers. Marine survey companies, survey vessels and PSO providers for each vessel are reported in Table 1.1.

The motor vessel (MV) *Ocean Observer* conducted operations from Jul-31-2021 to Dec-26-2021 predominantly along the ECR. During this period, the MV *Ocean Observer* conducted four days of operations for the Ocean Wind I survey scope from Nov-09-2021 to Nov-12-2021. Ocean Wind I operations conducted during this survey period were carried out under the OCW02 BOEM Lease (BOEM, 2016; 2021c) and complied with the same requirements of the Environmental Non-governmental Organization (eNGO) agreement (Grybowski *et al.*, 2012) and IHA (NMFS, 2021) as the OCW02 survey scope, with results detailed in this report.

The research vessel (RV) *Ocean Researcher* also undertook operations predominantly within the Lease Areas between Aug-20-2021 to Dec-15-2021. During this period, the RV *Ocean Researcher* also worked eighteen days: between Oct-18 and Nov-09, on a project under a different IHA and license, outside the scope of this report. The RV *Ocean Researcher* also conducted three days of operations on the Ocean Wind I (OCW01) survey scope from Nov-10-2021 to Nov-12-2021, these operations were carried out under the OCW02 BOEM Lease (BOEM, 2016; 2021c) and complied with the same requirements of the eNGO agreement (Grybowski *et al.*, 2012) and IHA (NMFS, 2021) as the OCW02 survey scope, with results detailed in this report.

Geodynamics Group LLC operated the RV *Substantial* with PSOs provided by AIS Inc. (hereafter Geodynamics and AIS, respectively). This vessel conducted predominantly nearshore operations around Asbury Park and Long Branch from Mar-10-2022 to the end of the 2021 Ocean Wind IHA period on May-09-2022, with work continuing under the renewed 2022 Ocean Wind IHA.

Fugro operated the MV *Brasilis* with PSOs provided by Smultea Environmental Sciences (hereafter Smultea). This vessel conducted operations predominantly within the Lease Areas from Apr-11-2022 to the end of the 2021 Ocean Wind IHA period on May-09-2022, with work continuing under the renewed 2022 Ocean Wind IHA.

Table 1.1 Operational Overview

Survey Vessel	Marine Survey Company	PSO Provider	Wind Farm/ ECR	Start date of IHA regulated survey	End date of IHA regulated survey
MV <i>Ocean Observer</i> (OCW02)	Gardline	Gardline	OCW02 Wind Farm Site and ECR	Jul-31-2021	Dec-26-2021
MV <i>Ocean Observer</i> (OCW01) ¹	Gardline	Gardline	OCW01 Wind Farm Site and ECR	Nov-09-2021	Nov-12-2021
RV <i>Ocean Researcher</i> (OCW02)	Gardline	Gardline	OCW02 Wind Farm Site	Aug-20-2021	Dec-15-2021
RV <i>Ocean Researcher</i> (OCW01)	Gardline	Gardline	OCW01 Wind Farm Site	Nov-09-2021	Nov-12-2021
RV <i>Substantial</i> (OCW02)	Geodynamics	AIS	OCW02 Nearshore Areas	Mar-10-2022	May-09-2022 ²
MV <i>Brasilis</i> (OCW02)	Fugro	Smultea	OCW02 Wind Farm Site	Apr-11-2022	May-09-2022 ²

MV Motor Vessel

RV Research Vessel

1 Geophysical survey operations for OCW01 and ECR were also conducted on the MV *Ocean Observer* between Apr-16-2021 and Jul-28-2021 (Gardline Project reference 11574), but no IHA regulated sources were used, therefore that survey data are not covered in this IHA report.

2 Survey operations on the RV *Substantial* and MV *Brasilis* continued after the end of the 2021 Ocean Wind IHA period and into the 2022 Ocean Wind IHA period which the is reported separately.

1.3 Regulatory Documents

Regulatory documents defining mitigation measures for the Projects were the 2021 Ocean Wind IHA, Lease agreements (BOEM, 2016; 2021c), North Atlantic right whale (NARW) eNGO Agreement (Grybowski *et al.*, 2012), the BOEM approved monitoring plans and associated Alternative Monitoring Plan (AMP: Ørsted, 2021b). Where different overlapping mitigation measures existed in the regulatory documents, the most conservative measure was typically adopted in the field.

The 2021 Ocean Wind IHA (NMFS, 2021) was issued on May-10-2021 and was in place for one year. This Report covers the period from May-10-2021 to May-09-2022 inclusive, during which HRG operations were conducted in the Lease Areas and along the ECRs, and limited incidental *takes* were authorized.

Ørsted worked under two BOEM Leases covered under the 2021 Ocean Wind IHA. The BOEM Lease OCS-A 0498 was issued to Ocean Wind, LLC on May-10-2016 (BOEM, 2016). On Mar-01-2017, BOEM Lease OCS-A 0498 was extended for a further year to Mar-01-2018. On Mar-26-2021, a portion of Lease OCS-A 0498 was assigned to Ørsted North America LLC with the new Lease number OCS-A 0532 (BOEM, 2021c), which remains subject to all terms and conditions of the original Lease. Both Leases have a five-year site assessment term which commenced on May-17-2018.

On Dec-12-2012, Deepwater Wind entered into a voluntary NARW Agreement (Grybowski *et al.*, 2012) with eNGOs to enhance mitigation measures to protect NARW during site assessments in the Mid-Atlantic wind energy area that was applicable to the Lease Areas covered in this report. Deepwater Wind was acquired by Ørsted in 2018 and with it the adherence to the NARW Agreement. The mitigation measures in the NARW Agreement were in addition to the NMFS minimum separation distance and seasonal operating requirements (NOAA Fisheries, 2021) and applied to the Surveys.

Mitigation measures were required for protected species during HRG operations utilizing survey equipment at frequencies below 200kHz. This equipment comprised a shallow penetration sub-bottom profiler (SBP; Innomar), ultra-short baseline (USBL) positioning system and a medium SBP (sparker).

As stipulated in Addendum C of the Leases, the Projects were run in accordance with specified mitigation measures which cover reducing the risk of disturbance and injury from geophysical survey operations. These measures included:

- vessel strike avoidance measures.
- enforcement of the NARW minimum separation distance and seasonal operating requirements (including speed restriction).
- maintenance of protected species exclusion zones (EZs).
- pre-clearance monitoring prior to operation of sound sources <200kHz.
- gradual ramp-up of equipment (where applicable).
- temporary delays and shutdown procedures of sound sources <200kHz implemented for protected species incursion within the relevant EZ.
- breaks in firing exceeding 20 minutes (not related to protected species) of sound sources <200kHz require a new pre-clearance.

Mitigation personnel also monitored the National Oceanic and Atmospheric Administration (NOAA) NARW reporting systems for the species' presence in the vicinity of all survey operations.

Full technical details of protected species monitoring can be found in the Leases (BOEM, 2016; 2021c) and 2021 Ocean Wind IH (NMFS, 2021) A.

1.4 [BOEM and NMFS Reporting Requirements](#)

This report is being submitted to fulfill the requirements of the Leases (BOEM, 2016; 2021c) and 2021 Ocean Wind IHA (NMFS, 2021) for the one-year period from May-10-May-2021 to May-09-2022 (Table 1.2). The Lead PSOs distributed a daily summary report to Ørsted, the marine survey companies and their PSO providers at the end of each coordinated universal time (UTC) calendar day. Assisted by Mysticetus observation reporting software (Mysticetus; see Section 3.5 for further details of software), daily reports detailed protected species observations, mitigation actions carried out and any potential *takes* which occurred within the Level B Harassment Zone (HZ). Incident reports, detailing occasions where an injured or dead protected species was observed during survey operations regardless of whether this was caused by survey activity, were also required.

Table 1.2 Protected Species Reporting Requirements stipulated in BOEM Leases OCS-A 0498 and OCS-A 0532 and the 2021 Ocean Wind IHA

Reporting Requirement	Source Reference		Location Addressed in Technical Report
	Leases (BOEM, 2016; 2021c) ¹	2021 Ocean Wind IHA (NMFS, 2021)	
The Lessee must ensure that sightings of any injured or dead protected species (e.g., marine mammal, sea turtle, sturgeon or giant manta ray) are reported to the Lessor, NMFS (by email nmfs.gar.stranding@noaa.gov and PR.ITP.MonitoringReports@noaa.gov) and the NMFS Northeast Region's Stranding Hotline (866-755-6622 or current) as soon as feasible within 24 hours of sighting, regardless of whether the injury or death is caused by a vessel. In addition, if the injury or death was caused by a collision with a project-related vessel, the Lessee must notify the Lessor, NMFS (by email nmfs.gar.stranding@noaa.gov and PR.ITP.MonitoringReports@noaa.gov) and the NMFS Northeast Region's Stranding Hotline (866-755-6622 or current) as soon as feasible within 24 hours. The Lessee must use the form provided in Appendix A to ADDENDUM "C" to report the sighting or incident. If the Lessee's activity is responsible for the injury or death, the Lessee must ensure that the vessel assists in any salvage effort as requested by NMFS.	Addendum C Section 4.5.1 ²	Section 6 (c)	Section 5.6 Protected Species Incident Reports
If a North Atlantic right whale is observed at any time by PSOs or personnel on any project vessels, during surveys or during vessel transit, Ocean Wind must immediately report sighting information to the NMFS North Atlantic Right Whale Sighting Advisory System: (866) 755-6622. North Atlantic right whale sightings in any location may also be reported to the U.S. Coast Guard via channel 16.	NA	Section 6 (b)	Section 5.1.1 North Atlantic Right Whale Monitoring and Section 5.1.2 North Atlantic Right Whale Detections
The Lessee must report any observed <i>takes</i> of listed marine mammal, sea turtle, sturgeon or giant manta ray (as defined in Addendum C Section 1.13) resulting in injury or mortality within 24 hours to the Lessor and NMFS. The Lessee must report any observations concerning any impacts on Endangered Species Act (ESA) listed marine mammal, sea turtle, sturgeon or giant manta ray to the Lessor and NMFS Northeast Region's Stranding Hotline within 48 hours. The Lessee must record injuries or mortalities using the form provided in Appendix A to ADDENDUM "C".	Addendum C Section 4.5.2 ²	Section 6 (c)	Section 5.4 Protected Species Potential Exposures

Reporting Requirement	Source Reference		Location Addressed in Technical Report
	Leases (BOEM, 2016; 2021c) ¹	2021 Ocean Wind IHA (NMFS, 2021)	
The Lessee must ensure that the protected species observer record all observations of protected species using standard marine mammal observer data collection protocols. The list of required data elements for these reports is provided in Appendix B to ADDENDUM “C”.	Addendum C Section 4.5.3	Section 5 (n, ix)	Section 5 Protected Species Detection Summary and Mysticetus data sets
The Lessee must provide BOEM and NMFS with a final technical report within 90 calendar days following the conclusion/demobilization of the HRG activities or expiration of the IHA, whichever comes sooner. Each report must include a summary of survey activities, all protected species observer and incident reports (See Appendices A and B to ADDENDUM “C”), and an estimate of the number of listed marine mammals and sea turtles observed and/or <i>taken</i> during these survey activities. The IHA report must fully document the methods and monitoring protocols, summarize the data recorded during monitoring, describe, assess, and compare the effectiveness of monitoring and mitigation measures. Any recommendations made by NMFS must be addressed in the final report prior to acceptance by NMFS. PSO datasheets or raw sightings data must also be provided with the draft and final monitoring report.	Addendum C Section 4.5.4 ³	Section 6 (a)	The entirety of this Technical Report and the Mysticetus data sets

1 BOEM Leases OCS-A 0498, OCS-A 0532 (BOEM, 2016; 2021c)

2 The giant manta ray was listed as ESA threatened in 2018 (83 FR 2916; Federal Register, 2018) and, in accordance with Appendix A2 of the PECP (Ørsted, 2021c), it was added to ESA reporting measures wherever sturgeon appears.

3 As per BOEM approved waiver (BOEM, 2021a)

2 SUMMARY OF SURVEY ACTIVITIES

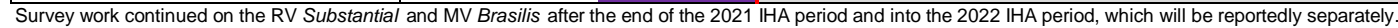
The Ocean Wind II project was mobilized on Jul-29-2021, with 24-hour HRG operations conducted from Jul-31-2021 to Dec-26-2021 on the MV *Ocean Observer*, from Aug-20-2021 to Dec-15-2021 on the RV *Ocean Researcher* and from Apr-11-2022 on the MV *Brasilis*. In addition, daylight-only nearshore operations were conducted on the RV *Substantial* from Mar-10-2022. Operations on the MV *Brasilis* and RV *Substantial* continued beyond the end of the IHA period (May-09-2022).

HRG survey equipment included a multibeam echosounder, side scan sonar, parametric SBP (Innomar), USBL beacons, gradiometer and sparkers. The sparkers, Innomar and USBL beacon all operated at frequencies below 200kHz and required mitigation for marine mammals. The specifications of the equipment operated at <200kHz are detailed in Table 2.1. A summary of the vessel activity throughout the Surveys is shown in Figure 2.1.

Table 2.1 Geophysical Survey Equipment Specifications for the Projects Conducted Under the 2021 Ocean Wind IHA (NMFS, 2021)

Equipment Type	Geophysical Equipment	Operating Frequency	Offshore Vessels			Nearshore Vessels
			RV <i>Ocean Researcher</i>	MV <i>Ocean Observer</i>	MV <i>Brasilis</i>	RV <i>Substantial</i>
Parametric SBP (Innomar)	Innomar SES-2000 Compact/Medium-100/Smart	Primary: 85 to 115kHz Secondary: 2 to 22kHz	X	X (10kHz)	X	X (5-15kHz)
USBL	Sonardyne Ranger 2 USBL	19 to 34kHz	X	X		
	Sonardyne Mini-Ranger2 and WSM6+	19 to 34kHz				X
	Kongsberg C-Node	20 to 30kHz			X	
Medium SBP (sparkers)	Dura-Spark S-UHRS	1.2 to 300kHz				X
	Geomarine Geosource S-UHRS, M-UHRS	0.1 to 5kHz			X	
	S-UHRS: Applied Acoustics Geo-Source 400 tip sparker with a single channel 8 element streamer	0.3 to 3.5kHz Peak at approx. 1.2kHz	X			
	M-UHRS: Applied Acoustics Geo-Source 400 tipped stacked sparker (800 tips total) with a 96 channel 1.0 m group μ seis streamer	0.5 to 3.5kHz Peak at approx. 0.5 to 0.7kHz	X			
	S-UHRS: Dual Catamaran (firing top bank only), 250J Applied Acoustics with 1.0m multi-element single channel hydrophone	0.4 to 6.0kHz		X		
	M-UHRS: Dual Catamaran (firing both top and bottom bank, flip-flop style) 750J Applied Acoustics with a 96 channel 1.0m group μ seis streamer	0.4 to 6.0kHz		X		

Figure 2.1 Summary of Survey Activities



3 MONITORING AND MITIGATION METHODS

The protected species monitoring and mitigation program for the surveys was established to satisfy requirements outlined in the regulatory documents, as detailed in Section 1.3. Ørsted adopted the following mitigation techniques to avoid harassment of marine species listed under the Endangered Species Act (ESA; US Congress, 1973) and the US Marine Mammal Protection Act (MMPA; Marine Mammal Commission, 1972) in accordance with the Leases (BOEM, 2016; 2021c). Specifically, the program focused on minimizing disturbance to protected species related to geophysical equipment operating below 200kHz and reducing the risk of vessel collision with protected species. To achieve this, the following monitoring and mitigation measures were implemented during the Surveys.

3.1 Protected Species Observers

During the Surveys, a minimum of six PSOs were on board the RV *Ocean Researcher* and MV *Ocean Observer*, four were onboard the MV *Brasilis* and two on board the RV *Substantial* owing to its smaller size and daylight-only operations. All PSOs were NMFS certified and BOEM approved to meet the minimum requirements outlined in the regulatory documents.

The PSO teams provided 24-hour monitoring during the surveys with the exception of the RV *Substantial* which worked predominantly during daylight hours. During daylight hours, a minimum of one PSO was required to be on watch during operations in order to provide visual mitigation for geophysical survey equipment. During operations undertaken in the hours of darkness or poor visibility, a minimum of two PSOs conducted visual watches with night vision devices (NVDs) and infrared (IR) devices. Under the eNGO agreement (Grybowski *et al.*, 2012) two PSOs were recommended to be on watch during all HRG operations between Nov-01 and Nov-22 and between Mar-22 to Apr-30 (Yellow Period) as NARWs were expected to be migrating through the survey area.

PSOs were to conduct a maximum of four hours continuous monitoring on any single discipline with a minimum 2-hour break following each 4-hour period. In addition, observers were only permitted to work a maximum of 12 hours within each 24-hour period.

PSOs monitored during all vessel operations whilst the vessel was surveying or underway as well as during equipment calibration, and periods when the vessel was maneuvering whilst waiting for favorable weather conditions. The exception to this was during periods of low visibility either caused by fog, precipitation or extreme sea state which reduced visibility so that the pre-agreed exclusion zone surrounding the work area was not visible. No survey operations could begin during these periods of impaired visibility. During periods of transit and survey operations not requiring mitigation, one PSO conducted watches to assist the marine crew in avoiding any potential vessel strike of a protected species.

PSOs always maintained clear and effective communications with the chain of command and surveying departments on the vessel. Onboard, the Lead PSO attended a daily health, safety and environmental meetings with key members of the vessel and survey crew. Any questions arising from survey operations were raised with survey suppliers and Ørsted in real time and relevant information fed back to the PSO team by the Lead PSO.

3.2 PSO Recording Methods

PSOs used Mysticetus to record all operational, environmental and sightings information. Mysticetus aims to reduce human error by enforcing data standardization across mitigation, collection, and reporting. The data recorded are automatically time stamped, encrypted and stored securely, allowing all changes made to be logged. Sightings can also be communicated across all vessels operating with Mysticetus in the wider area.

If software issues should arise during operations, Mysticetus provided a standardized Microsoft Excel version of the forms as a back-up for PSOs to complete manually.

3.3 Visual Monitoring Methods

During the Surveys, PSOs conducted visual monitoring using several different methods; the unaided eye (UE; which includes the use of reticle binoculars; RBs), handheld NVDs (HH NVD), handheld IR devices (HH IR), and vessel mounted IR camera systems. Monitoring equipment available on each vessel is presented in Table 3.1, whilst detailed specifications for each piece of monitoring equipment can be found in Appendix A. PSOs on all vessels also had access to a digital single lens reflex (DSLR) camera to document detections and allow for species verification where possible. Utilizing multiple complimentary monitoring methods, depending on the environmental and vessel conditions, allowed for effective monitoring for protected species to be implemented.

Table 3.1 Monitoring Devices Available on each Vessel

Survey Vessel	HH NVD			HH IR		Vessel Mounted IR		RB ¹
	Rongland GNVY-3	PVS-14	FLIR PVS-7	BHM-XR	FLIR Scout III 640	NVTS Reliant 640HD	Current Corps NN 30500VT	
MV <i>Ocean Observer</i>	X			X		X		X
RV <i>Ocean Researcher</i>	X			X		X		X
RV <i>Substantial</i>					X			
MV <i>Brasilis</i>		X	X				X	

1 Various models

Visual watches for PSOs during daylight were primarily from the bridge deck, either inside of the bridge wheelhouse or outside on the bridge wings. Additional visual watches were conducted from different areas when access to the bridge wasn't possible due to COVID-19 restrictions during the presence of a pilot. Visual monitoring using the NVTS was conducted from the instrument room onboard the MV *Ocean Observer* and RV *Ocean Researcher*.

Distance to the unobstructed horizon at sea can be calculated for each observation location on the vessels using known observer eye height and height above water of the observation position and applying trigonometry and corrections for the curvature of the earth (Table 3.2). All PSO eye heights and deck heights were confirmed prior to the Surveys and entered into Mysticetus which then automatically calculated the distance to visual detections using this information and displayed them on the map.

Table 3.2 Distance to the Horizon from Primary Observer Locations on each Vessel

Survey Vessels	Observer Location	Height of Deck (m)	Height of Deck (m) + 1.6m ¹	Distance to Horizon (km) ²
MV <i>Ocean Observer</i>	Bridge and Bridge Wings	11.10	12.70	12.7
RV <i>Ocean Researcher</i>	Bridge and Bridge Wings	10.50	12.10	12.4
RV <i>Substantial</i>	Fly Bridge (Upper Deck)	2.45	4.05	7.2
MV <i>Brasilis</i>	Bridge and Bridge Wings	10.70	12.30	12.5
	Forecastle Deck	8.01	9.61	11.1

1 Average eye height calculated on the assumption of the average male (5ft 10in., or 1.77m) and average female (5ft 4in. or 1.63m) height minus 4 inches (10cm).

2 Calculated using Pythagoras' theorem, trigonometry and curvature corrections.

3.3.1 Visual Monitoring During Daylight

Daylight for geophysical surveys was defined as the period between local civil twilight sunrise and sunset which is defined as when the sun's geometric center is higher than 6° below the horizon. The times for civil twilight were referenced from available almanac records. PSOs monitored 360° around the vessel with a particular focus on the EZ surrounding all geophysical survey equipment operating at frequencies below 200kHz. PSOs systematically scanned the water, primarily with the unaided eye (UE) and utilized RBs to focus on points of interest when necessary. While transiting, PSOs focused monitoring forward and approximately 90° either side of the vessel heading. Crew aboard each vessel also assisted with protected species monitoring, where possible, and alerted the PSOs in the event of a protected species detection. Selected methods of visual monitoring complement each other and allowed for the PSOs to effectively monitor the applicable EZ.

While on-watch, during daylight, PSOs systematically scanned waters surrounding the vessel in a sweeping pattern as described above, primarily with UE. Reticle binoculars were used to confirm species' identification, group size, behavior, and distance, and to scan for smaller or less-demonstrative species. Distances were primarily estimated using reticle binoculars; however, as a back-up PSOs constructed range-finder sticks (Heinemann, 1981) for measuring distances. Range-finder sticks are a useful tool to validate an observer's judgement of distance to an animal and therefore whether they have been detected within their relevant EZ. Distances can be calculated using trigonometry principles, taking into account the height of the observation platform and observer and how far away in relation to the horizon the animal(s) appear.

3.3.2 Visual Monitoring During Darkness

When operating in darkness, PSOs used NVDs and IR technology. One PSO undertook monitoring using night vision binoculars and the other used IR thermal imaging technology. PSOs interchanged between both monitoring methods and unaided eye (UE) to avoid eye fatigue.

When using the handheld NVDs, watches were conducted from the bridge wings, where feasible, to minimize any visual barriers that may affect visibility e.g., reflectivity from bridge windows. While on watch, the PSOs searched 360° around the vessel, with a focus on the EZ surrounding the geophysical equipment below 200kHz. Due to the equipment configuration, watches using the vessel mounted IR were conducted from the instrument room on the RV *Ocean Researcher* and from the bridge deck on the other three vessels.

3.4 Periods of Reduced Visibility

If visibility was reduced to less than the maximum EZ prior to the commencement of survey operations, then PSOs were not able to conduct pre-clearance search and survey operations were not permitted to begin. PSOs remained on visual watch to monitor the visibility and once the entire EZ could be visually monitored and confirmed free of protected species for the duration of the 60-minute pre-clearance, operations could commence with a ramp-up (when applicable).

If equipment below 200kHz were active (including during line turns, which Ørsted considered part of active survey) and the visibility was reduced meaning the EZ no longer visible, operations could continue if an alternative monitoring method was implemented.

Should an equipment shutdown occur due to protected species incursion or equipment failure, PSOs would have to wait until the entire EZ could be visually monitored again to conduct a 60-minute pre-clearance to confirm the EZ is clear before operations could recommence with a ramp-up (when applicable).

3.5 Mysticetus Observation Software

During the Projects, PSOs utilized Mysticetus observation software to record all visual monitoring effort, protected species visual detections details, mitigation actions required and operational and environmental conditions in real time. The use of Mysticetus aims to increase efficiency of data recording and to reduce human error by enforcing standardization across data collection and reporting. It also displays vessel position, protected species detections, seasonal management areas (SMAs), acoustic slow zones and dynamic management areas (DMAs) in real time using a global positioning system (GPS).

Data were recorded by PSOs using a standardized Ørsted Mysticetus data collection template. The template contained fields relating to BOEM and NMFS data requirements (see Section 1.4). At the end of each watch period, PSOs were required to review their data entry and at end of each day the Lead PSO reviewed all the data prior to submission for an onshore quality check. The onshore PSO project manager reviewed these data and performed the daily quality control/quality assurance (QA/QC) within 24 hours when feasible: the quality of internet connection onboard the vessel varied with the vessel location and environmental conditions which occasionally delayed the delivery of data to the onshore team. The purpose of the daily onshore QA/QC was to allow timely feedback to be provided to the PSO team to improve the overall data quality. The data would be signed-off within 72 hours when feasible. Mysticetus recorded and encrypted all original data entry and subsequent edits, allowing all changes made to be logged. Mysticetus also stored and backed up data securely in the Mysticetus cloud for retrieval to allow for QA/QC, data aggregation and further analysis in numerous file formats. Data were also backed up on an external hard drive.

In order to coordinate detections between PSOs working on different vessels, Mysticetus notified PSOs on other vessels using Mysticetus through an automated detection alert if vessels were within 20km of each other. This feature helped alert PSOs on nearby vessels of any known protected species in the area. Live communications between the PSOs on different vessels was possible via VHF radio when in range and by satellite telephone when the vessels are out of range should Mysticetus not be operational, or additional information was required to be relayed.

If software issues should arise during operations, Mysticetus provided a standardized Microsoft Excel version of the forms as a backup for PSOs to complete manually. All Mysticetus data was recorded in UTC.

3.6 Mitigation Measures

Mitigation measures for the Surveys are presented below. The HRG equipment operating at frequencies below 200kHz and therefore requiring mitigation measures were the Innomar, sparkers and USBL. Mitigation measures were identified in the regulatory documents and were implemented during the Surveys. Where regulations differed among documents the more conservative measure was implemented.

3.6.1 Vessel Strike Avoidance

The geophysical survey complied with the requirements for vessel strike avoidance as stipulated in the Leases (BOEM, 2016; 2021c) associated waivers (BOEM, 2021a) and 2021 Ocean Wind IHA (NMFS, 2021). In order to avoid causing injury or death to protected species, the following measures were implemented:

- A minimum of one PSO shall be on watch during transit during both daylight and hours of darkness.
- Vessel speed shall be reduced to 10 knots or less when any large whale species, mother/calf pairs, whale or dolphin pods, or larger assemblages of non-delphinoid cetaceans are observed near (within 100m) an underway vessel.
- Vessel shall comply with 10 knot or less speed restriction in any SMA or DMA per NMFS guidance, and within non-DMA slow zones as detailed in Section 1.3. In addition, all vessels >19.8m in overall length (*i.e.*, MV *Ocean Observer*, RV *Ocean Researcher* and MV *Brasilis*) operating from Nov-1 to April-30 must always operate at speeds of 10 knots or less.
- All vessels must maintain a separation distance of 500m (1,640ft) or greater from any sighted NARW. If a whale is observed but cannot be confirmed as a species other than a NARW, the vessel operator must assume that it is a NARW and take appropriate action.
- If the vessel is stationary, the vessel must not engage engines until the NARW has moved beyond 100 meters.

Underway vessel that is neither towing gear nor navigationally constrained – NARW:

- If a NARW is sighted within 500m, reduce speed to 10 knots or less and steer a course away from the NARW until the 500m minimum separation distance has been established.
- If a NARW is sighted in the vessels path or within 100m, the vessel must reduce speed and shift its engines into neutral.¹ Engines must not be engaged until the NARW has moved outside of the vessel's path and beyond 100m.

¹

Shifting to neutral: primary concern is safety of lives of all those at sea. Gear loss is not a safety risk if only associated with cost. If dropping gear would result in an action that could lose control of the vessel, and thus become a safety risk, then revert to the primary concern.

Underway vessel towing gear – NARW:

- If a NARW is spotted within 500m, but outside of the vessel's path. Steer away at 10 knots or less and shift to neutral.
If a NARW is detected in the vessels path or within 100m, reduce speed to 10 knots or less and shift to neutral. Engines must not be engaged until the NARW has moved outside of the vessel's path and beyond 100m.

Other Species:

- If any non-delphinoid cetaceans (other than the NARW) are sighted, a minimum 100m distance shall be maintained between the individuals and the vessel. If sighted within 100m, the vessel underway shall immediately reduce speed and shift the engine into neutral. Engines shall not be engaged until the animal has moved outside of the vessel's path and beyond 100m. If stationary, the vessel must not engage engines until animal(s) have moved out of the vessel's path and beyond 100m.
- If any delphinoid cetaceans or pinnipeds approach the vessel underway, the vessel must maintain a separation distance of 50m or more with an understanding that this may not always be possible e.g., for animals that approach the vessel.
- Any vessel underway should remain parallel to an observed delphinoid cetacean's course whenever possible and avoid excessive speed or abrupt changes in direction to avoid injury.
- All vessels underway will not divert or alter course in order to approach any whale, delphinoid cetacean or pinniped.
- If sea turtles are detected, a distance of 50m between the vessel and the individual/s shall be maintained.

To avoid vessel strikes, the Early Warning System (a network of observers that disseminates right whale location information to mariners via the typical marine communication channels), Sighting Advisory System (sighting locations can be checked at <http://www.nefsc.noaa.gov/psb/surveys/>) and the Mandatory Ship Recording System (MSRS) notifying mariners of NARW presence will be monitored regularly. Ørsted shall be notified of all NARW sightings immediately and these shall also be reported to the NMFS on 866-755-6622 or using the whale alert app where available. A follow up detailed report shall be provided to Ørsted within 24 hours. The monitoring team will consult NMFS NARW reporting systems for the presence of NARWs throughout survey operations (as outlined above) and can also report to the US Coast Guard on VHF Channel 16.

3.6.2 Exclusion Zone

As per the Leases (BOEM, 2016; 2021c), associated waivers (BOEM, 2021a; 2021b), 2021 Ocean Wind IHA Section 4 (NMFS, 2021), NARW Agreement (Grybowski *et al.*, 2012) and associated risk assessments (Ørsted, 2021a), PSOs established EZs around the active HRG equipment operating below 200kHz where mitigation measures would be implemented if required following an incursion of a protected species.

The 2021 Ocean Wind IHA (NMFS, 2021) considers the Innomar and USBL *de minimus* sources, and stipulated a 500m EZ for NARW when sparkers were active and a 100m EZ for all other marine mammals other than voluntarily approaching dolphins from the genera *Delphinus*, *Lagenorhynchus*, *Stenalla* (*frontalis* only), or *Tursiops*.

However, additional measures were required for SBPs (including sparker and Innomar) in the NARW Agreement (Grybowski *et al.*, 2012) and associated extensions. This included an expansion of the NARW EZ to 1000m when sparkers were active in the Lease Areas during the Yellow Period (Ørsted, 2021a). These more conservative measures were required as NARW presence in the Project area was considered a higher possibility during this time. See Section 3.6.7 for further details on the NARW mitigation.

These requirements, as well as those in the Leases (BOEM, 2016; 2021c) and associated waivers (BOEM, 2021a; 2021b), meant that the implemented EZ varied during the course of the Surveys depending on the equipment below 200kHz being utilized and the location of the survey operations relative to the Lease Areas (Table 3.3).

When the full suite of equipment requiring mitigation was in use, EZs defaulted to the most conservative size. The EZ was centered around the estimated output of the loudest sound source in operation, as was the closet point of approach (CPA) to the Active or Inactive HRG source. The EZ was continuously monitored by the PSOs to implement the appropriate mitigation measures as required.

Table 3.3 Summary of Exclusion Zones used for Protected Species Monitoring During Survey Activities

Protected Species	In Lease Area		Outside Lease Area	
	Sparker	No sparker	Sparker	No sparker
From Jul-31-2021				
NARW or unidentified whale	500m	500m	500m	500m
Turtles	500m	200m	200m	200m
Other marine mammals (except dolphins approaching voluntarily)	500m	100m	100m	100m
From Nov-01-2021 (NARW agreement Autumn Yellow Period, including extension to Dec-21-2021, inclusive)				
NARW or unidentified whale	1000m	500m	500m	500m
Turtles	500m	200m	200m	200m
Other marine mammals (except dolphins approaching voluntarily)	500m	100m	100m	100m
From 16-Dec-2021 (NARW agreement Red Period, no SBP permitted within Lease Area)				
NARW or unidentified whale	SBP not permitted	500m	500m	500m
Turtles		200m	200m	200m
Other marine mammals (except dolphins approaching voluntarily)		100m	100m	100m
From Mar-10-2021 (Recommencement of Surveys during NARW agreement Red Period)				
NARW or unidentified whale	SBP not permitted	500m	500m	500m
Turtles		200m	200m	200m
Dolphins		200m	200m	200m
Other cetaceans and pinnipeds		200m	500m	200m
From Mar-23-2021 (NARW agreement Spring Yellow Period and BOEM Waiver (BOEM, 2021b) received)				
NARW or unidentified whale	500m	500m	500m	500m
Turtles	500m	200m	500m	200m
Dolphins	100m	100m	100m	100m
Other cetaceans and pinnipeds	500m	100m	500m	100m

3.6.3 Pre-Clearance

A 60-minute pre-clearance monitoring period was required prior to commencing HRG operations using sources operating below 200kHz if such sources had been inactive for the preceding >20 minutes not related to protected species incursion. The PSOs were positioned onboard the survey vessel at a suitable location that allowed for a 360° view of the EZ, typically on the bridge wings. This enabled the PSOs to complete a 60-minute pre-clearance watch as required by Lease Stipulation 4.4.6.5 (BOEM, 2016; 2021c) associated waivers (BOEM, 2021a), to ensure that the entire EZ had been clear of protected species for the required period of time. The full extent of all EZs had to be visible for the entirety of pre-clearance in order for PSOs to be able to deem the area clear for HRG operations to commence.

If a protected species was observed within the EZ during a pre-clearance period, the PSO called a delay to the survey crew and the pre-clearance was paused. A Detection Delay was then implemented whilst the protected species was within the EZ. If the protected species was observed leaving the EZ, then the pre-clearance could continue unaffected and operations could commence once the remainder of the 60-minute pre-clearance was completed. If the protected species was not tracked leaving the EZ, then, as well as completing the remainder of the 60-minute pre-clearance, an additional delay period was required to ensure the EZ was clear of protected species:

- 60 minutes for sea turtles.
- 15 minutes for small odontocetes and pinnipeds.
- 30 minutes for all large whale species (all other marine mammals), extending to 60 minutes during the NARW Yellow Period (see Section 3.6.7).

It should be noted that the remaining pre-clearance and delay period could be run simultaneously. PSOs maintained clear communication with bridge and survey crews so that HRG operations using equipment below 200kHz could begin immediately following the completion of the pre-clearance.

Dedicated monitoring was also continued for 30 minutes after the use of survey equipment ceased in the form of a post-shooting search.

3.6.4 Ramp-Up Procedure

A ramp-up of all acoustic survey equipment (where technically feasible) was required at the start or restart of all survey activities as per Lease Stipulation 4.4.6.8 (BOEM, 2016; 2021c) and the 2021 Ocean Wind IHA 4(f) (NMFS, 2021). This allowed the regulated acoustic sources to be gradually introduced to the environment. The power started with the lowest output possible and was gradually increased and other acoustic sources added in such a way that the source level would increase in steps of 20%, where technically feasible. The Innomar, S-UHRS and M-UHRS sources could be ramped up during the HRG survey, but the USBL did not have ramp-up capabilities and so was activated after the Innomar and sparker were at full power.

3.6.5 Shut-Down Procedures for Marine Animal Incursion

As per Lease Stipulation 4.4.6.9 (BOEM, 2016; 2021c) associated waivers (BOEM, 2021a), once HRG operations were underway, PSOs would request the immediate shutdown of equipment below 200kHz if a marine mammal or turtle was visually detected within, entering or approaching the EZ.

During the 2021 Ocean Wind IHA (NMFS, 2021) period delphinid species with IHA ‘take’ allowances (see Section Table 3.6) were exempt from triggering a shutdown when detected in the EZ should they be deemed by the PSO on watch to be voluntarily approaching the vessel or towed survey equipment. If the exempt delphinids were detected within the EZ but no voluntary approach was observed, then a shutdown was required. PSOs used their best professional judgment in making the decision to allow operations to continue or calling for the shutdown of equipment. Furthermore, if there was uncertainty regarding the identification of a marine mammal species (*i.e.*, whether the observed marine mammals belong to one of the delphinid genera for which shutdown is waived) then a shutdown was to be requested as a precautionary measure, regardless of the behavior observed. Immediate shutdown was also required if the species observed had reached its allocated Level B *take* allowance in the NMFS IHA or had no *take* allocated (see Section 3.8 for further details).

Subsequent restart of the survey equipment following a shutdown, survey equipment could either be restarted immediately if it was confirmed the protected species had left the EZ or following the required delay period from the last sighting within the EZ (or from when the animal dived):

- 60 minutes for sea turtles.
- 30 minutes for all large whales.
- 15 minutes for small odontocetes and pinnipeds.

Following a shutdown, HRG operations using the sparker and Innomar always required a ramp-up to be implemented before operations could recommence.

As per the 2021 Ocean Wind IHA (NMFS, 2021), there is no requirement to shut down operations involving the Innomar and/or USBL for marine mammals. Shutdown of the Innomar and USBL was still required for any turtles observed within the EZ as per initial survey requirements.

3.6.6 Breaks in Geophysical Survey Activity (not for Mitigation)

As per the Lease, Section 4.4.6.10.1 (BOEM, 2016; 2021c), if a break in HRG survey activity occurred due to reasons other than mitigation (*e.g.* mechanical or electrical failure and vessel transit) for 20 minutes or less, the acoustic sources could recommence at operational level as soon as practicable. This was on the condition that a PSO had been conducting continuous monitoring and no marine mammals or sea turtles were detected within the EZ during this time.

If the observers were not monitoring continuously during the break, then a full 60-minute pre-clearance watch and a ramp-up was required. Furthermore, if the break in HRG operations exceeded 20 minutes, a 60-minutes pre-clearance watch and a ramp-up of equipment was also required.

During short turns between HRG lines (typically <80 minutes), acoustic sources were activated at full power for 1 minute approximately every 15 minutes to allow for equipment settings to be checked and preparations made to continue survey operations for the next line. This procedure meant that HRG sources were not inactive for more than 20 minutes and therefore negated the need to conduct a 60-minute pre-clearance and ramp-up procedure in between each survey line.

3.6.7 North Atlantic Right Whale Mitigation Measures

Mitigation measures specific to NARWs were implemented during the Surveys. PSOs monitored online for the presence of any NMFS established DMAs or slow zones and/or the presence of NARWs in or near transit corridors and the Project area every 4 hours (NOAA Fisheries, 2021). A DMA is an area temporarily designated by NOAA and NMFS based on the visual sighting of three or more right whales within 2 to 3 miles of each other outside a designated SMA and are in place for a 15-day period (NOAA Fisheries, 2021). Each time a DMA check was undertaken by the PSO a column was marked in the *Mysticetus* data entry form and was automatically associated with a date, time, GPS position and any relevant comments. If a DMA was established in or near the Project area, the Lead PSO would immediately inform the Ørsted Offshore Supervisor and ensure that Ørsted were notified, as well as informing the PSO team and all relevant personnel onboard the vessel to ensure extra vigilance was maintained for NARWs. The DMA would be avoided where feasible or if operations necessitated the vessel to be within the DMA, then the required speed restriction of 10 knots was adhered to.

PSOs were also aware of any NARW SMAs within transit corridors or the Project area. All vessels more than 65ft long must not exceed 10 knots when within these areas to reduce the threat of ship collisions with NARWs and this restriction was adhered to.

Slow zones are a new designation by NMFS, these encompass DMAs (which are designated as a result of visual detections) and non-DMA Slow Zones (designated as a result of an acoustic detection). All DMAs are slow zones as previously mentioned, but not all Slow Zones are DMAs. All vessels working on the Project were to comply with 10 knot speed restriction, and exercise caution at all times within an acoustic slow zone but there was no requirement to cease HRG survey activities. The *Mysticetus* Software will differentiate what is a DMA and what is an acoustically triggered slow zone.

In addition, PSOs on the vessel were to prepare a summary of sighting details for any NARW detections, including photographs, in order that Ørsted could submit this information to NMFS. A NARW report template was available to PSOs on the vessels for this purpose. The Lead PSO also entered sighting data for any NARW sighting into the NMFS Whale Alert application where available, and *Mysticetus* automatically sent out an alert text and email notifications to the Project point of contact, Ørsted, and Gardline's onshore team notifying them of the time and location of the sighting.

The Projects were also required to be run in accordance with the additional measures stated in the NARW Agreement (Grybowski *et al.*, 2012) where these were more conservative. This included submitting a NARW Risk Assessment (Ørsted, 2021a) to eNGOs, NMFS, and BOEM, prior to surveying during the NARW Agreement 'Yellow Period' for sub-bottom profiling (from Mar-22 to Apr-30 and from Nov-01 to Nov-22). During this period, the 30-minute pre-clearance was extended to 60 minutes. Furthermore, all HRG operations using equipment below 200kHz that took place during the autumn 'Yellow Period' required that PSOs monitored an EZ of 1000m for NARWs due to the increased likelihood of their presence in the Project area. The 'Yellow Period' was extended until Dec-15 with approval from the eNGOs. From Dec-15-2021, the survey entered the NARW Agreement 'Red Period' for sub-bottom profiling which meant that the use of SBPs was prohibited in the Lease area until Mar-22-2022.

3.7 Data Collection and Analysis Methods

Data collection protocols were applied to all operations and analysis during the Surveys. PSOs documented all protected species detections, effort and survey activity throughout all Project operations. Required data, identified in the Regulatory Documents (Section 1.3), were collected in a pre-determined template on a laptop using Mysticetus. Restricted fields were used in data entry to reduce data variability between different PSO providers on other vessels. Specific terminology used for data collection and analysis is detailed in Table 3.4.

Effort data was generally recorded every 30 minutes or whenever operational or environmental monitoring conditions changed and during each protected species detection and mitigation action. Effort data can be categorized broadly into two categories: Monitoring Effort and PSO Effort.

Monitoring Effort was categorized as any period when at least one PSO was on watch. Monitoring Effort could not exceed 24 hours in a single day, regardless of how many PSOs were conducting monitoring. Monitoring Effort is presented across a range of environmental and operational conditions.

PSO Effort was categorized as the total number of PSO hours during the day across all monitoring methods. Therefore, PSO Effort could exceed 24 hours in a single day if two or more PSOs were conducting monitoring simultaneously. PSO effort is presented across different monitoring methods to compare the effectiveness of different detection methods. PSO Effort is also analyzed based on minutes conducted in Daylight versus Darkness, inside versus outside the Lease Area and acoustic sources (<200kHz) Active/On versus Inactive/Off.

Table 3.4 Definitions of Data Collection and Analysis Terminology

Term	Definition
Monitoring Effort	Active use of visual monitoring methods. Cannot exceed 24 hours in a day
PSO Effort	Total PSO person hours allocated to monitoring for protected species. Can exceed 24 hours in a day
Darkness	Period between civil twilight set and civil twilight rise
Daylight	Period between civil twilight rise and civil twilight set
Inside	Within BOEM Lease Areas OCS-A 0498, OCS-A 0532
Outside	Outside BOEM Lease Areas OCS-A 0498, OCS-A 0532
Active/On	Period of time when acoustic sources (<200kHz) are active
Inactive/Off	Period of time when regulated acoustic sources (<200kHz) are inactive
Detection	A protected species group observed by a PSO
Group	One or more protected species individuals seen close together or conducting similar behavior

For each detection, PSOs recorded the lowest taxonomic level of animal identification for which they were confident, down to species when possible. Detection distances, including CPA, were measured or estimated from the animal to the PSO and to sound sources (both active and/or inactive) for every detection. Protected species movements relative to the vessel, initial and secondary behaviors and any behavior reaction were recorded for each detection based on a pre-defined list.

PSOs recorded the observed behavior of species detected in Mysticetus. Behaviors included: *blow*, *bow ride*, *breach*, *chase fish*, *dead*, *feed*, *fluke up*, *look*, *mill*, *none*, *other* (defined in Mysticetus notes),

porpoise, rest, socialize, splash, surface-active mill, surface-active travel, swim, tail slap, travel and unknown (when behavior could not be determined). Any protected species observed change in behavior as a potential reaction to the vessel and/or survey operations was also recorded including *change direction, dive, look, none, slow down, speed up, splash and other* (defined in *Mysticetus* notes).

3.8 Estimating Number of Exposures

All marine mammals are protected under the MMPA, which requires that any operation which emits noise into the marine environment must consult with NMFS if sound levels produced by the activity may disturb or injure marine mammals by exceeding pre-determined sound exposure thresholds and frequencies that may result in an NMFS-determined level of 'take'.

NMFS defines a Level B harassment of marine mammals as any exposure that could potentially result in the temporary [hearing] threshold shift or behavioral disturbance (NMFS, 2022). NMFS considers a Level B 'take' to occur at $\geq 120\text{dB re } 1\mu\text{Pa}$ root mean square (RMS) for continuous and non-impulsive anthropogenic noise and at $\geq 160\text{dB re } 1\mu\text{Pa}$ RMS for impulsive noise (NOAA, 2016). To determine the potential for Level B 'take', the take criteria for impulsive noise was applied. Level A harassment is defined as injury or mortality to marine mammals that occurs as a result of exposure to high noise levels (NMFS, 2022). Level A harassment may result in permanent [hearing] threshold shift.

Ørsted assessed the Level A and Level B HZs for marine mammals for the equipment below 200kHz that was planned to be used during the Surveys as part of the IHA application. The maximum Level A HZ calculated was <5m for high-frequency cetaceans and therefore the risk of Level A harassment during the survey was considered unlikely. Level A 'take' is not typically granted by NMFS. The maximum Level B HZ calculated was 141m for the sparker (see Table 3.5). The Level B isopleth was therefore set at 141m for the sparker in the 2021 Ocean Wind IHA (NMFS, 2021), while the USBL and Innomar were considered exempt sources (Table 3.5).

Table 3.5 Applicable Level B Harassment Zones for Equipment Operating Below 200kHz

Survey Period (Local Date)	Level B Harassment Zone (m)		
	Sarker	SBP (Innomar)	USBL
Jul-31-2021 to Dec-15-2021 ²	141	N/A ¹	N/A ¹
Dec-16-2021 to Mar-21-2021 ³	141	N/A ¹	N/A ¹
Mar-22-2022 to May-09-2022	141	N/A ¹	N/A ¹

1 Aside from the 141m Level B for sparker, a 48m Level B harassment zone applied to non-impulsive, non-parametric SBPs, therefore the USBL and Innomar were exempt.

2 The NARW Agreement 'Yellow Period' was extended beyond Nov-22-2021 with approval from the eNGO.

3 Gray cells denote use of source no longer permitted within the Lease Area due to NARW Agreement 'Red Period'. HRG operations were, however, conducted outside the Lease areas up until Dec-25-2021 (MV *Ocean Observer*) and from Mar-10-2022 (RV *Substantial*).

The IHA grants permission for potential non-lethal 'take' of small numbers of marine mammal to allow for the incidental harassment resulting from HRG survey activities (Table 3.6), although it is assumed that mitigation measures implemented will protect marine mammals from the risk of Level A and Level B harassment. A potential exposure was considered to have occurred when a marine mammal was observed within the Level B HZ of equipment operating below 200kHz at that time, based on the direct

observations of the PSO. A tick box was available in Mysticetus to allow PSOs to flag and report when a potential exposure to an acoustic sound source below 200kHz had occurred. However, what is considered a Level B 'take' is assessed and determined by NMFS on a case-by-case basis.

Table 3.6 Number of Level B Incidental Takes Authorized by the 2021 Ocean Wind IHA (NMFS, 2021)

Common Name	Latin Name	Authorized 'Takes' by Level B Harassment
North Atlantic right whale	<i>Eubalaena glacialis</i>	9
Humpback whale	<i>Megaptera novaeangliae</i>	2
Fin whale	<i>Balaenoptera physalus</i>	6
Sei whale	<i>Balaenoptera borealis</i>	1
Minke whale	<i>Balaenoptera acutorostrata</i>	2
Sperm whale	<i>Physeter macrocephalus</i>	3
Short-finned pilot whale	<i>Globicephala macrorhynchus</i>	2
Long-finned pilot whale	<i>Globicephala melas</i>	2
Bottlenose dolphin (Offshore stock)	<i>Tursiops truncatus</i>	242
Bottlenose dolphin (Migratory stock)	<i>Tursiops truncatus</i>	1410
Common dolphin	<i>Delphinus delphis</i>	124
Atlantic white-sided dolphin	<i>Lagenorhynchus acutus</i>	16
Atlantic spotted dolphin	<i>Stenella frontalis</i>	3
Risso's dolphin	<i>Grampus griseus</i>	30
Harbor porpoise	<i>Phocoena phocoena</i>	91
Harbor seal	<i>Phoca vitulina</i>	11
Gray seal	<i>Halichoerus grypus</i>	11

4 EFFORT SUMMARY

Due to the various different vessels, PSOs, operators and reporting regimes implemented across the life of this project, the data are sometimes not directly comparable. The use of the Mysticetus software has enforced a good deal of uniformity across the majority of the datasets, but there are still occasions where observations have been recorded inconsistently. While efforts have been made where possible to compare the data as completely as possible, some inconsistencies may remain.

The monitoring effort and vessel activities were processed using the Mysticetus OnCloud service using the data provided by the various contractors taking part in the Surveys.

4.1 Monitoring Effort

Across vessels conducting geophysical work under the 2021 Ocean Wind IHA (NMFS, 2021), visual monitoring was carried out over 210 days between Jul-31-2021 and May-09-2022 inclusive. There were 6058 hours and 50 minutes of monitoring effort, during which time vessels covered approximately 25836 miles (see Table 4.1). During periods of data acquisition, one or more acoustic sources <200kHz were recorded as being active for a total of 1384 hours and 40 minutes during 6009 miles of vessel track.

During the Projects waiting on weather (WOW) and surveying were the most common survey activities, accounting for 40% and 18% of the total survey time, respectively (see Figure 4.1). Monitoring requiring no mitigation was the most common monitoring activity conducted by the PSOs (see Figure 4.3), accounting for 80% of the total survey time.

Table 4.1 Summary of Monitoring Effort Conducted by each Vessel

Vessel	Monitoring Effort (miles)				Monitoring Effort ([h]:mm)			
	Sparker On	Other Sources <200kHz On ¹	All Sources <200kHz Off	Total	Sparker On	Other Sources <200kHz On ¹	All Sources <200kHz Off	Total
OCW02								
MV <i>Ocean Observer</i>	1668	521	9830	12086	354:13	125:29	2613:16	3092:59
RV <i>Ocean Researcher</i>	1146	591	7425	9163	267:21	124:52	1527:33	1919:48
RV <i>Substantial</i>	396	201	1274	1871	102:42	53:10	192:03	347:56
MV <i>Brasilis</i>	1126	237	759	2122	263:09	66:27	223:35	553:12
OCW01								
MV <i>Ocean Observer</i> ²	57	23	266	347	14:27	2:34	78:58	96:00
RV <i>Ocean Researcher</i> ³	33	10	203	247	7:26	2:48	38:40	48:54
Total	4427	1583	19757	25836	1009:41	375:21	4674:08	6058:50

¹ Includes Monitoring Effort when the Innomar and/or USBL were Active and the sparker was Inactive.

² MV *Ocean Observer* operated under the OCW01 Project from 17:07:49.9 UTC, Nov-09-2021 to the end of Nov-12-2021 but this was recorded in the OCW02 project in Mysticetus. For Oncloud analysis the whole of Nov-09-2021 to Nov-12-2021 have been treated as OCW01.

³ RV *Ocean Researcher* operated under the OCW01 Project from 23:05:12.3 UTC, Nov-10-2021 to the end of Nov-12-2021 and this was recorded and analyzed under the OCW01 Project in Mysticetus.

Figure 4.1 Overview of Vessel Activity Hours Conducted during the Projects

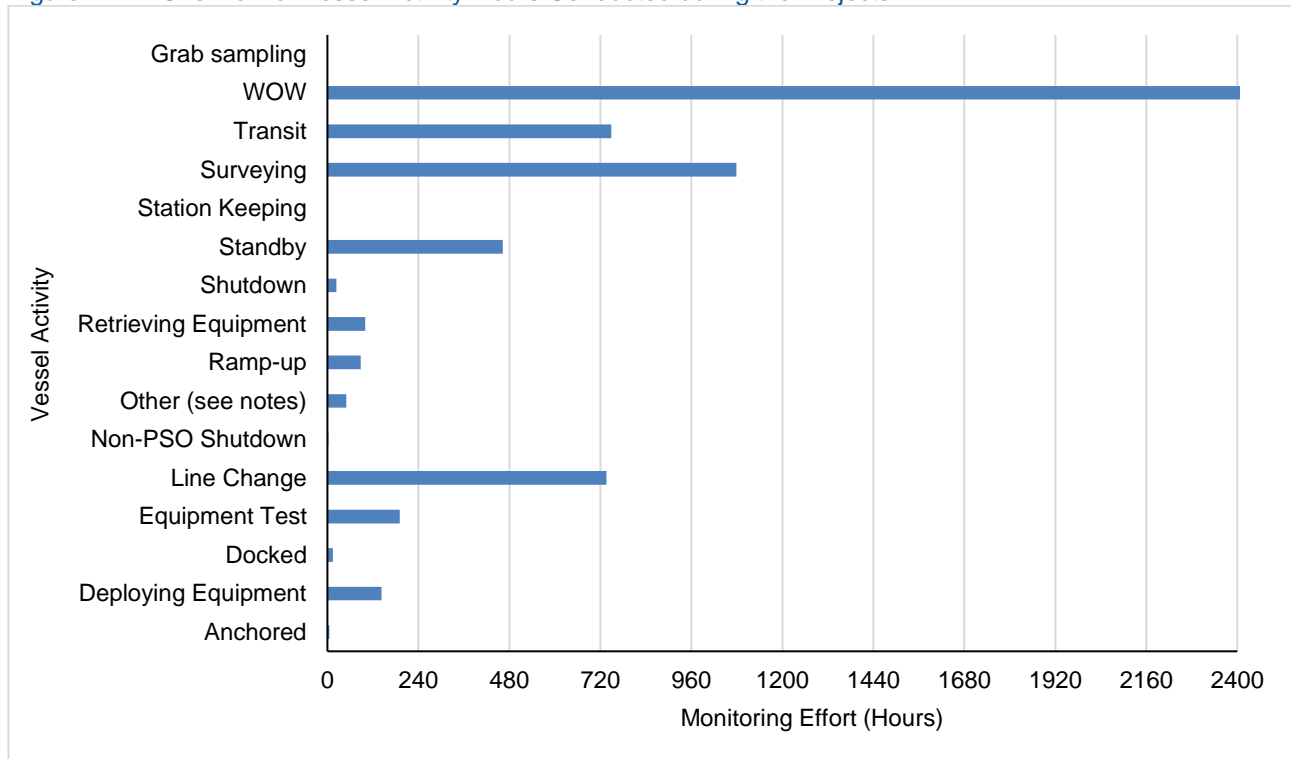


Figure 4.2 Overview of Vessel Activity Miles Conducted during the Projects

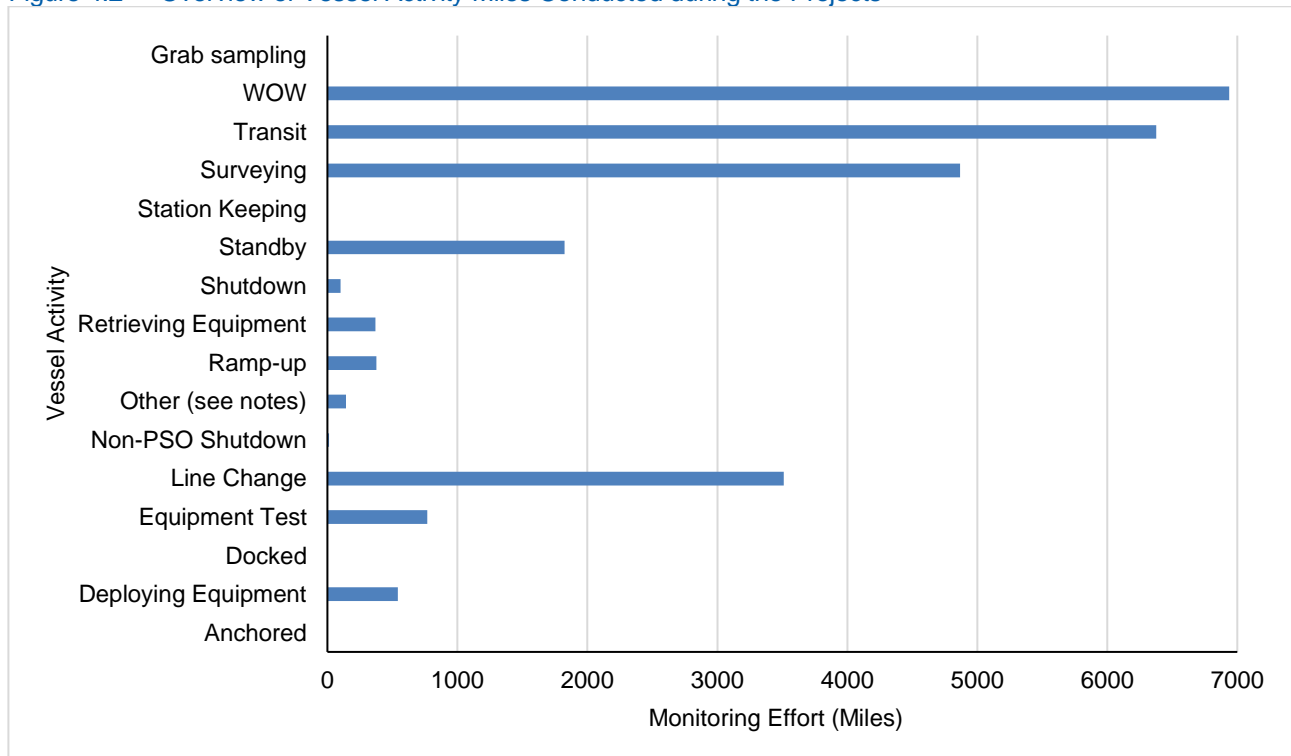


Figure 4.3 Overview of Monitoring State Hours Conducted during the Projects

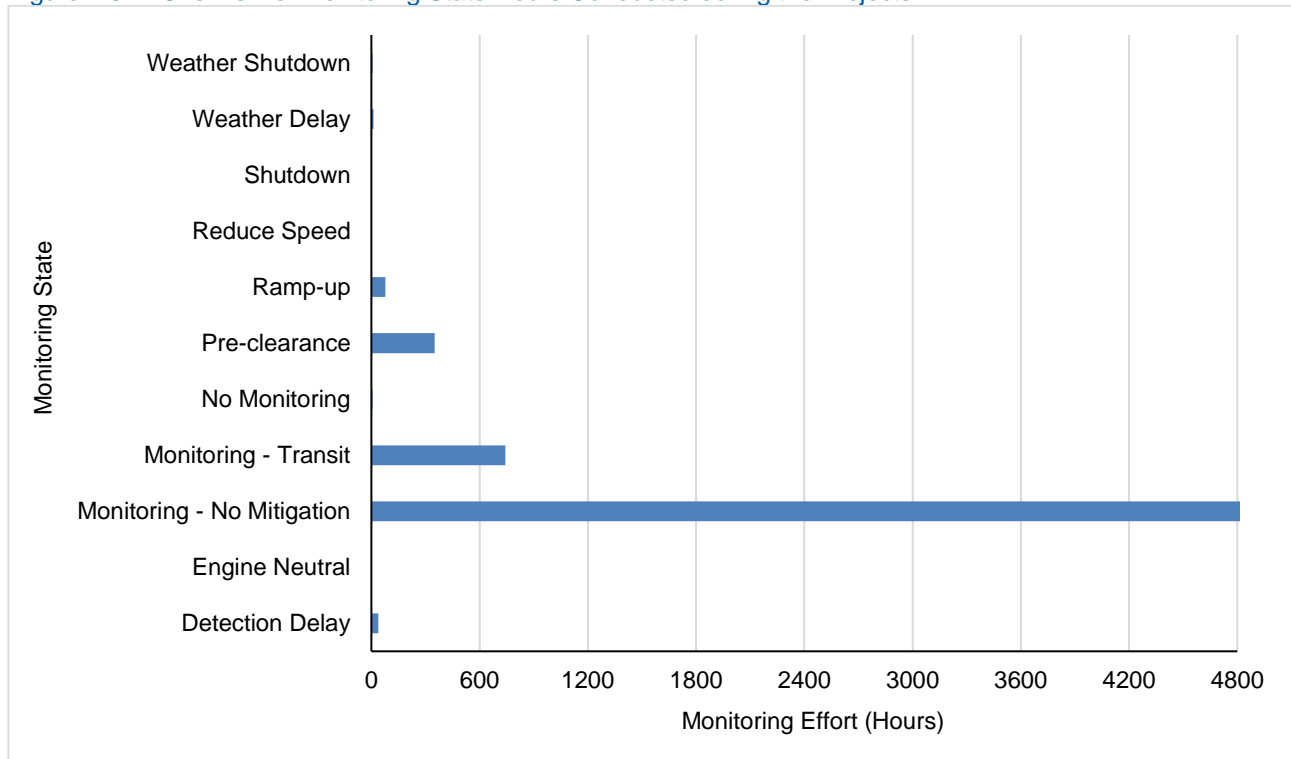
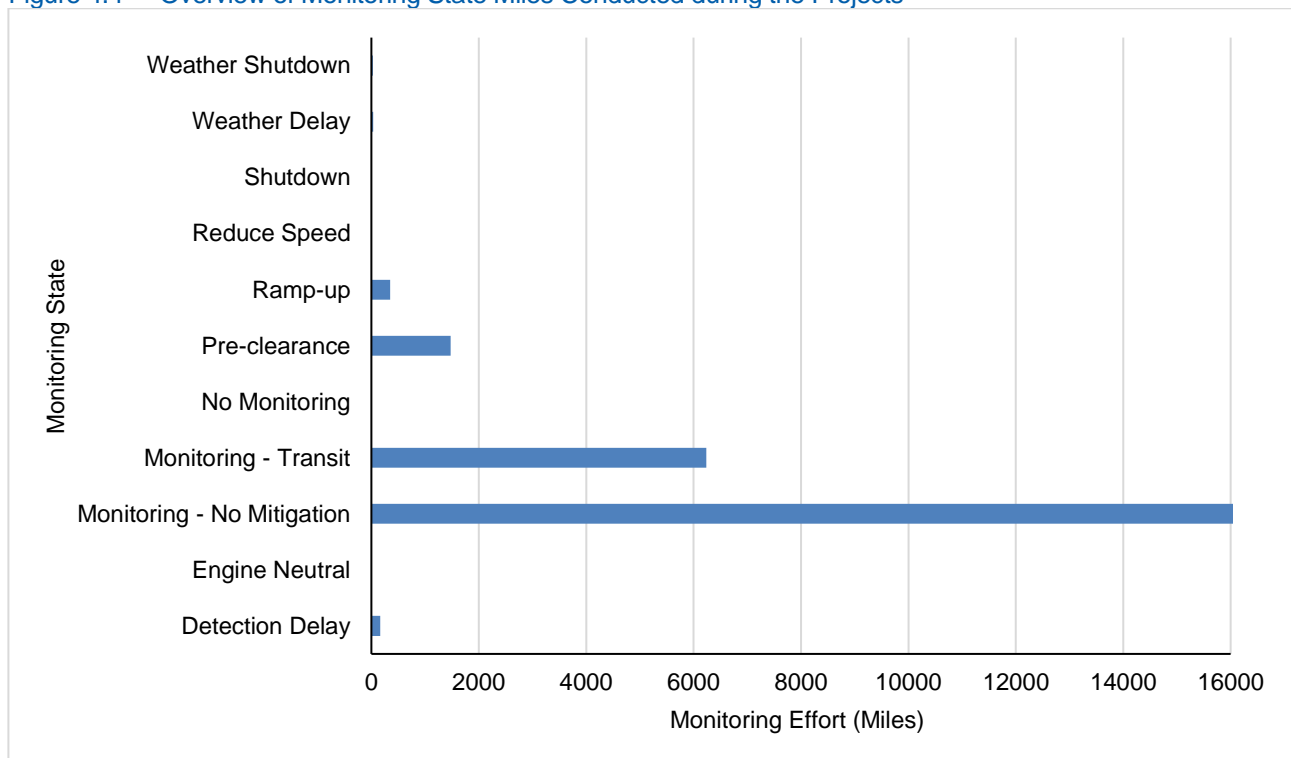


Figure 4.4 Overview of Monitoring State Miles Conducted during the Projects



4.1.1 Monitoring Effort by Project and Vessel

Monitoring effort whilst the HRG equipment was considered Active or Inactive, is presented by Project and vessel in Figure 4.7 to Figure 4.5. Vessel track lines show monitoring effort inside and outside the project specific Lease area(s), with the acoustic sources Active and Inactive. Periods where acoustic activity was Inactive predominantly relates to vessel transit; either between stations, sites or port calls, periods of time waiting on weather on site and periods of pre-clearance or shutdown due to protected species.

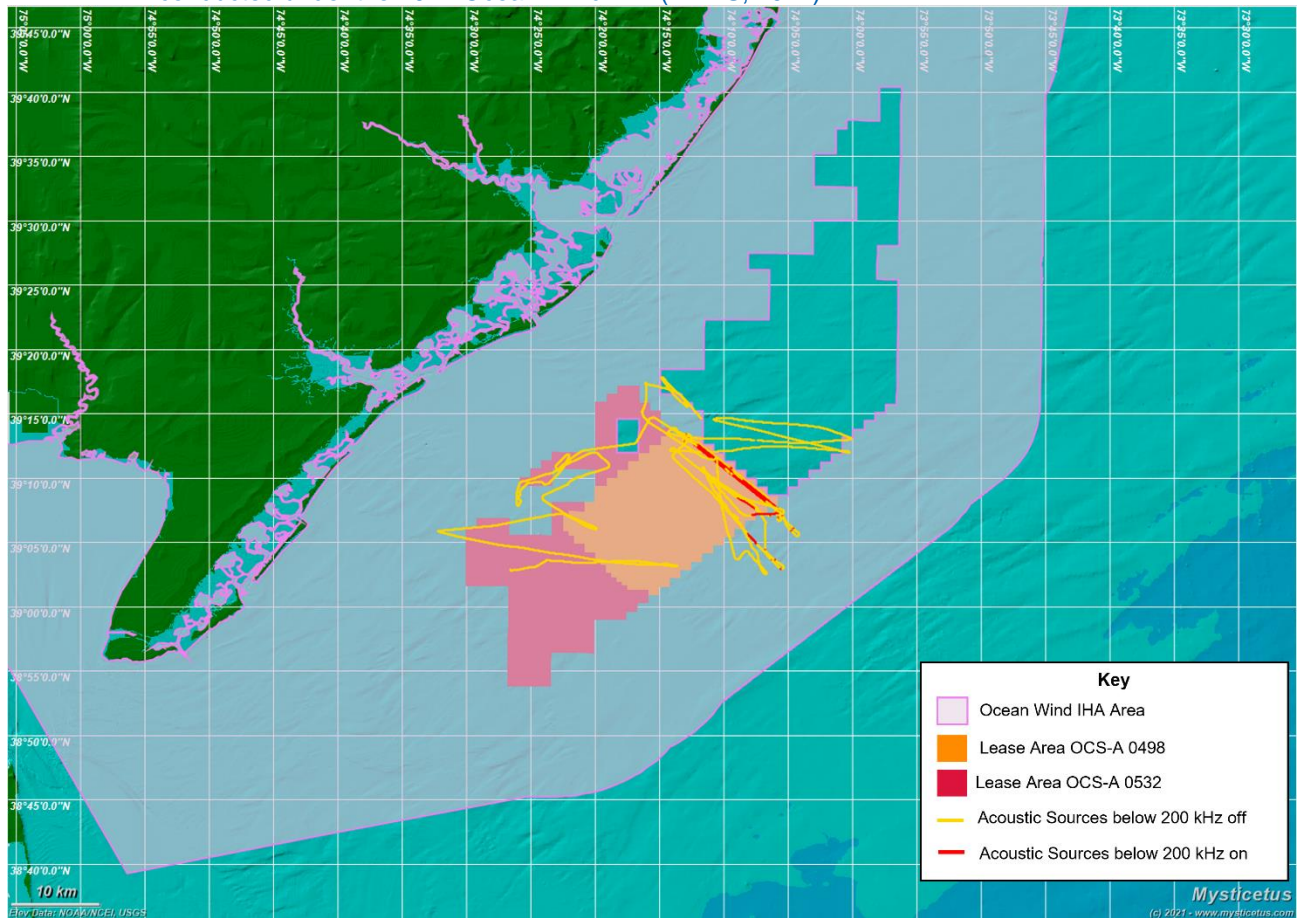
OCW01 on the MV Ocean Observer

Visual monitoring was carried out on 4 days of survey operations on the MV *Ocean Observer*, with a total of 96 hours of monitoring effort, during approximately 347 miles of vessel track (Table 4.5). This included 11 hours and 23 minutes of pre-clearance, almost all of which most was within the Ocean Wind IHA Area.

Table 4.2 Vessel and Monitoring Activity on the MV *Ocean Observer* during the OCW01 Geophysical Survey conducted under the 2021 Ocean Wind IHA (NMFS, 2021)

Vessel Activity	OCS-A 0498		OCS-A 0532		Ocean Wind IHA Area		Overall	
	Time	Miles	Time	Miles	Time	Miles	Time	Miles
Deploying Equipment	1:07	5	0:00	0	1:07	5	1:07	5
Equipment Test	0:05	0	0:00	0	0:24	2	0:24	2
Line Change	1:45	8	0:00	0	6:08	29	6:20	29
Ramp-up	0:23	2	0:00	0	1:00	4	1:00	4
Retrieving Equipment	0:18	1	0:00	0	0:30	2	0:30	2
Standby	8:28	31	0:00	0	10:40	39	27:32	77
Surveying	15:19	73	0:00	0	15:38	74	15:37	74
Transit	3:25	20	3:21	23	9:30	61	9:42	62
WOW	13:57	34	6:54	23	30:29	83	33:48	90
Total	44:47	175	10:15	46	75:26	300	96:00	347
Monitoring State	OCS-A 0498		OCS-A 0532		Ocean Wind IHA Area		Overall	
	Time	Miles	Time	Miles	Time	Miles	Time	Miles
Detection Delay	0:00	0	<0:01	<1	<0:01	<1	<0:01	<1
Engine Neutral	0:18	1	0:00	0	0:18	1	0:18	1
Monitoring - No Mitigation	35:28	131	6:54	23	58:34	208	78:56	253
Monitoring - Transit	2:30	17	0:52	8	4:11	30	4:22	32
Pre-clearance	6:08	25	2:28	15	11:23	56	11:23	56
Ramp-up	0:23	2	0:00	0	1:00	4	1:00	4
Total	44:47	175	10:15	46	75:26	300	96:00	347

Figure 4.5 Acoustic Source Activity on the MV Ocean Observer during the OCW01 Geophysical Survey conducted under the 2021 Ocean Wind IHA (NMFS, 2021)



OCW02 on the MV Ocean Observer

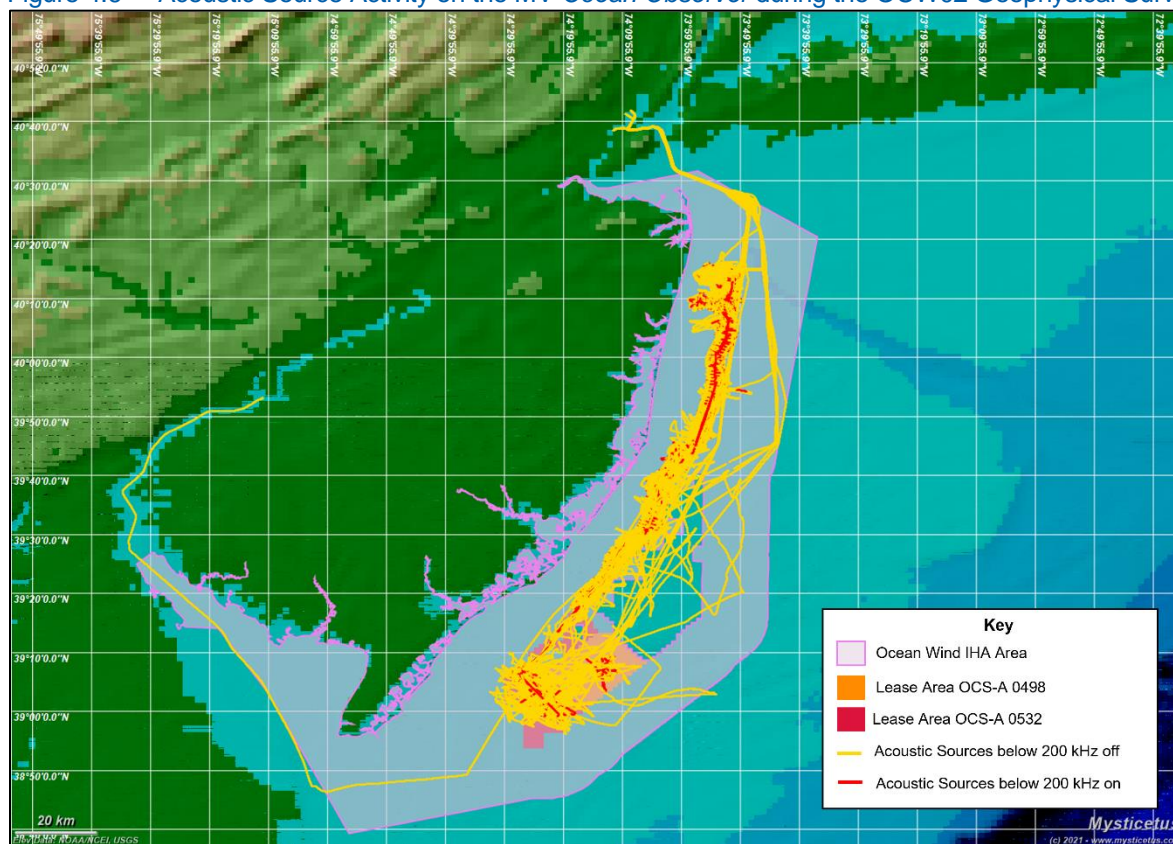
Visual monitoring was carried out on 129 days of survey operations on the MV *Ocean Observer*, with a total of 3092 hours and 59 minutes of monitoring effort, during approximately 12086 miles of vessel track (Table 4.5). This included 144 hours and 34 minutes of pre-clearance, of which most (139 hours 49 minutes) was within the Ocean Wind IHA Area.

Table 4.3 Vessel and Monitoring Activity on the MV Ocean Observer during the OCW02 Geophysical Survey

Vessel Activity	OCS-A 0498		OCS-A 0532		Ocean Wind IHA Area		Overall	
	Time	Miles	Time	Miles	Time	Miles	Time	Miles
Deploying Equipment	1:37	7	23:49	99	66:58	273	67:09	273
Docked	0:00	0	0:00	0	0:00	0	2:17	0
Equipment Test	21:59	103	25:45	123	70:48	338	77:02	338
Line Change	0:00	0	76:36	367	467:11	2257	470:00	2260
Non-PSO Shutdown	0:00	0	0:00	0	2:22	11	2:22	11
Other (see notes)	0:00	0	2:12:	13	42:03	128	49:29	140
Ramp-up	0:22	2	10:29	50	34:04	162	35:55	162
Retrieving Equipment	2:17	10	14:48	62	46:30	189	48:01	190
Shutdown	0:00	0	0:01	0	4:45	21	4:45	21
Standby	23:01	95	59:13	258	197:39 0	806	207:50	832
Surveying	0:00	0	50:54	245	346:15	1666	347:44	1666
Transit	8:36	85	20:44	115	224:38	1789	292:54	2403
WOW	73:11	217	341:21	832	1420:17	3633	1487:30 :	3789
Total	131:03	519	625:52	2166	2923:30	11273	3092:59	12086
Monitoring State	OCS-A 0498		OCS-A 0532		Ocean Wind IHA Area		Overall	
	Time	Miles	Time	Miles	Time	Miles	Time	Miles
Detection Delay	0:00	0	3:06	14	13:07	59	13:07	59
Engine Neutral	0:00	0	0:00	0	0:00	0	0:00	0
Monitoring - No Mitigation	113:19	392	545:50	1793	2486:09	8565	2575:15	8741
Monitoring - Transit	8:45	86	26:49	138	238:30	1846	313:39	2480
No Monitoring	0:00	0	0:00	0	0:00	0	0:03	0
Pre-clearance	8:36	39	39:33	171	139:50	600	144:35	603
Ramp-up	0:22	2	10:33	51	34:14	162	34:41	162
Reduce Speed	0:00	0	0:00	0	0:04:	0	0:04	0
Shutdown	0:00	0	0:00	0	0:22	2	0:23	2
Weather Delay	0:00	0	0:00	0	4:55	12	4:55	12
Weather Shutdown	0:00	0	0:00	0	6:18	27	6:18	27
Total	131:03	519	625:52	2166	2923:30	11273	3092:59	12086

Includes all HRG surveying operations regardless of source frequency

Figure 4.6 Acoustic Source Activity on the MV *Ocean Observer* during the OCW02 Geophysical Survey



OCW01 Survey on the RV *Ocean Researcher*

Visual monitoring was carried across 3 days of survey operations on the RV *Ocean Researcher*, with a total of 48 hours and 54 minutes of effort, during approximately 247 miles of vessel track (Table 4.4). This included 5 hours and 33 minutes of pre-clearance, of which most (4 hours 42 minutes) was within the Ocean Wind IHA Area.

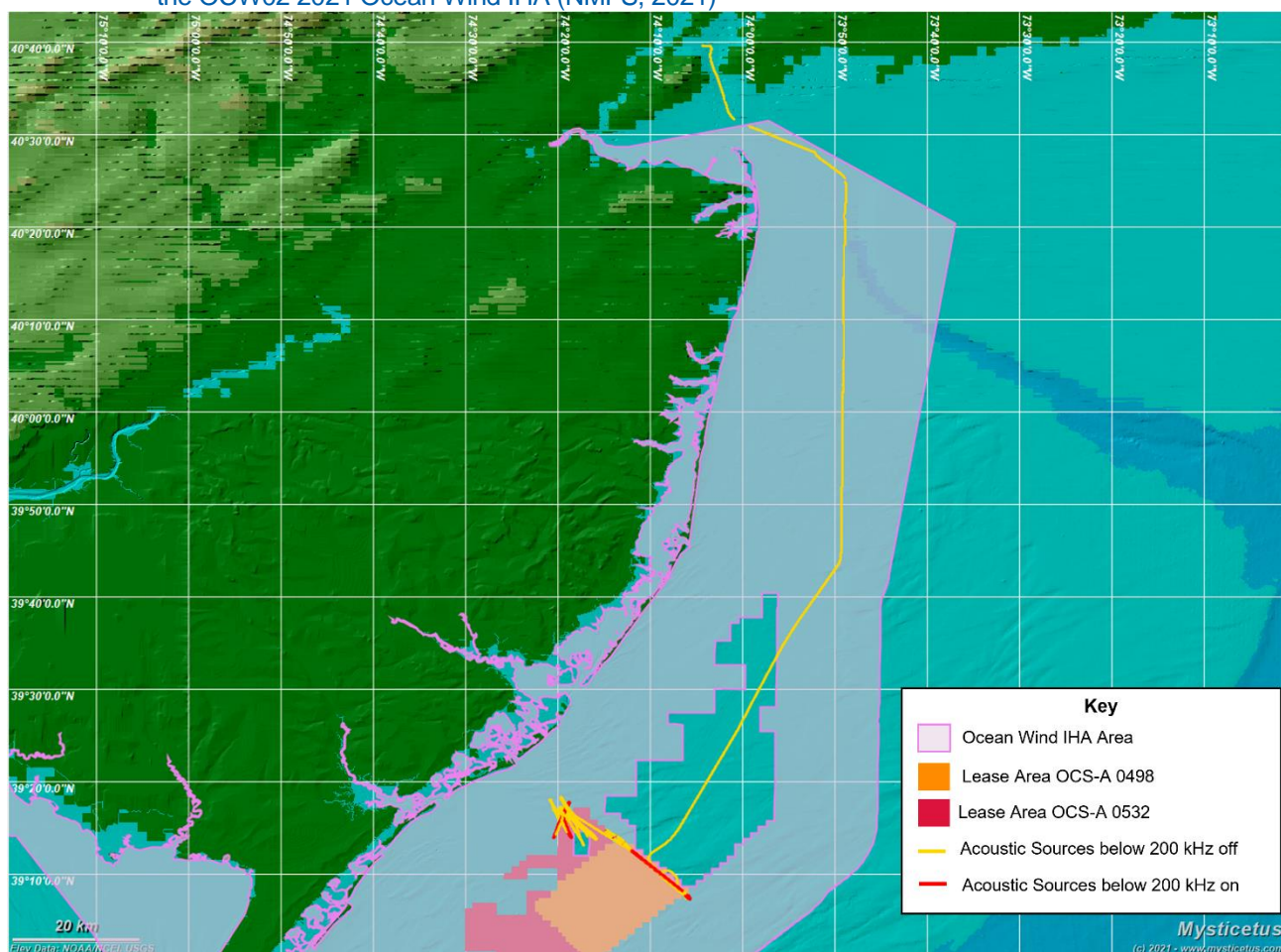
Table 4.4 Vessel and Monitoring Activity on RV *Ocean Researcher* during the OCW01 Geophysical Survey Conducted under the OCW02 2021 Ocean Wind IHA (NMFS, 2021)

Vessel Activity	OCS-A 0498		OCS-A 0532		Ocean Wind IHA Area		Overall	
	Time	Miles	Time	Miles	Time	Miles	Time	Miles
Deploying Equipment	0:59	4	0:00	0	0:58	4	1:03	4
Equipment Test	0:02	<1	0:23	2	1:45	7	1:45	7
Line Change	1:23	6	0:00	0	3:07	14	3:07	14
Ramp-up	0:00	0	0:19	1	0:59	4	1:00	4
Retrieving Equipment	0:00	0	0:05	<1	0:30	2	0:30	2
Standby	2:32	11	1:14	3	4:37	18	5:23	21
Surveying	6:32	29	0:00	0	6:31	29	6:39	29
Transit	0:00	0	0:00	0	6:42	72	10:24	109
WOW	0:00	0	10:12	30	17:18	51	19:00	56
Total	11:28	51	12:15	37	42:32	201	48:54	247

Vessel Activity	OCS-A 0498		OCS-A 0532		Ocean Wind IHA Area		Overall	
	Time	Miles	Time	Miles	Time	Miles	Time	Miles
Monitoring - No Mitigation	7:57	35	11:01	34	30:08	107	31:57	112
Monitoring - Transit	0:00	0	0:00	0	6:42	72	10:25	109
Pre-clearance	3:31	15	0:54	2	4:42	18	5:33	22
Ramp-up	0:00	0	0:20	1	1:00	4	1:00	4
Total	11:28	51	12:15	37	42:32	201	48:54	247

Includes all HRG surveying operations regardless of source frequency

Figure 4.7 Acoustic Source Activity on the RV *Ocean Researcher* during the OCV01 Survey conducted under the OCV02 2021 Ocean Wind IHA (NMFS, 2021)



OCW02 Survey on the RV Ocean Researcher

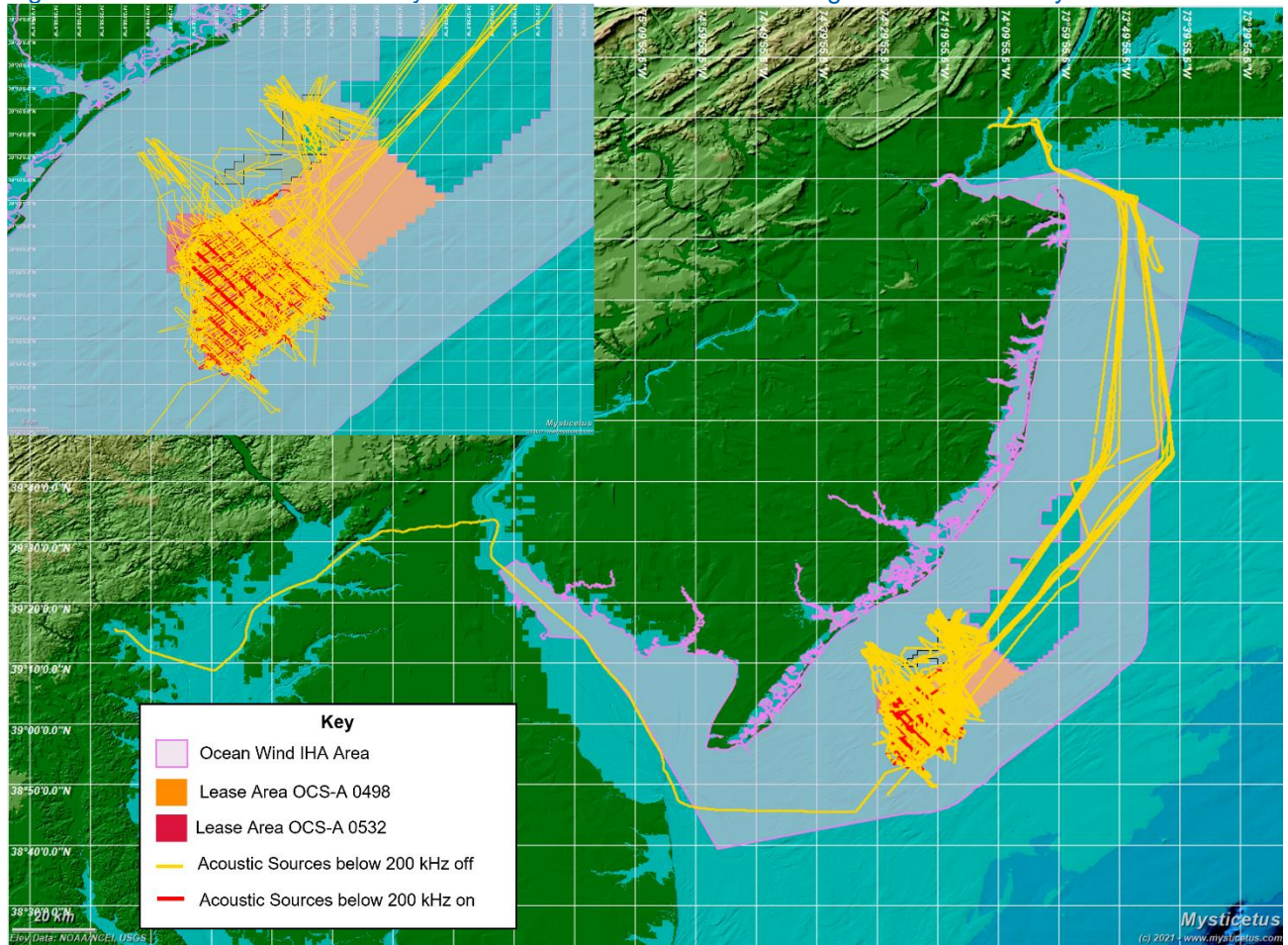
Visual monitoring was carried out across 88 days of survey operations on the RV *Ocean Researcher*, with a total of 1919 hours and 48 minutes of monitoring effort, during approximately 9163 miles of vessel track (Table 4.5). This included 134 hours and 43 minutes of pre-clearance, of which most (132 hours 15 minutes) was within the Ocean Wind IHA Area.

Table 4.5 Vessel and Monitoring Activity on RV Ocean Researcher during the OCW02 Geophysical Survey

Vessel Activity	OCS-A 0498		OCS-A 0532		Ocean Wind IHA Area		Overall	
	Time	Miles	Time	Miles	Time	Miles	Time	Miles
Anchored	0:00	0	0:00	0	0:00	0	0:17	0
Deploying Equipment	3:43	15	23:38	93	39:17	158	39:39	158
Docked	0:00	0	0:00	0	0:00	0	3:41	0
Equipment Test	0:44	3	9:00	41	15:02	69	15:09	69
Line Change	10:14	52	123:25	614	236:05	1133	237:07	1133
Non-PSO Shutdown	0:00	0	0:29	2	0:29	2	0:29	2
Other (see notes)	0:00	0	0:11	2	0:26	4	0:49	4
Ramp-up	2:08	9	14:12	67	30:26	139	30:27	139
Retrieving Equipment	1:36	6	19:48	77	28:03	109	28:17	109
Shutdown	0:42	3	13:54	59	17:50	75	17:53	75
Standby	3:46	25	89:24	379	137:55	596	139:08	596
Surveying	0:04	0	388:20	1745	406:54	1830	409:07	1830
Transit	16:47	156	10:45	97	152:38	1354	243:09	2164
WOW	59:49	276	467:18	1793	731:55	2826	754:36	2884
Total	99:32	545	1160:24	4969	1797:00	8294	1919:48	9163
Monitoring State	OCS-A 0498		OCS-A 0532		Ocean Wind IHA Area		Overall	
	Time	Miles	Time	Miles	Time	Miles	Time	Miles
Detection Delay	0:36	3	15:49	67	24:54	104	25:11	104
Engine Neutral	0:00	0	0:00	0	0:00	0	0:40	<1
Monitoring - No Mitigation	72:57	341	1034:37	4364	1455:30	6120	1483:37	6178
Monitoring - Transit	16:48	156	11:03	99	152:58	1356	243:44	2166
No Monitoring	0:00	0	0:00	0	0:00	0	0:27	0
Pre-clearance	6:58	36	83:54	369	132:15	571	134:43	571
Ramp-up	2:08	9	14:12	67	30:26	139	30:27	139
Shutdown	0:05	<1	0:48	4	0:56	4	0:58	4
Total	99:32	545	1160:24	4969	1797:00	8294	1919:48	9163

Includes all HRG surveying operations regardless of source frequency

Figure 4.8 Acoustic Source Activity on the RV *Ocean Researcher* during the OCW02 Survey



OCW02 on the RV *Substantial*

Visual monitoring was carried out across 42 days of survey operations on the MV *Substantial*, with a total of 347 hours and 56 minutes of monitoring effort, during approximately 1871 miles of vessel track (Table 4.6). This included 35 hours and 10 minutes of pre-clearance, of which most (30 hours 27 minutes) was within the Ocean Wind IHA Area. The RV *Substantial* did not operate within the OCS-A 0498 Lease area.

Table 4.6 Vessel and Monitoring Activity on the RV *Substantial* during the OCW02 Geophysical Survey

Vessel Activity	OCS-A 0498		OCS-A 0532		Ocean Wind IHA Area		Overall	
	Time	Miles	Time	Miles	Time	Miles	Time	Miles
Deploying Equipment	0:00	0	0:00	0	18:14	60	19:35	62
Docked	0:00	0	0:00	0	0:03	<1	7:52	<1
Equipment Test	0:00	0	0:00	0	57:44	243	65:55	244
Line Change	0:00	0	0:00	0	17:49	77	17:49	77
Grab Sampling	0:00	0	0:00	0	1:17	1	1:17	1
Ramp-up	0:00	0	0:00	0	12:10	44	13:21	44
Retrieving Equipment	0:00	0	0:00	0	12:13	42	12:14	42
Shutdown	0:00	0	0:00	0	1:18	5	1:18	5
Standby	0:00	0	0:00	0	25:06	132	28:43	135
Surveying	0:00	0	0:00	0	56:26	246	56:26	246
Transit	0:00	0	0:24	4	80:31	642	123:28	1016
Total	0:00	0	0:24	4	282:50	1492	347:56	1871
Monitoring State	OCS-A 0498		OCS-A 0532		Ocean Wind IHA Area		Overall	
	Time	Miles	Time	Miles	Time	Miles	Time	Miles
Detection Delay	0:00	0	0:00	0	0:06	<1	0:06	<1
Monitoring - No Mitigation	0:00	0	0:00	0	187:33	838	197:51	840
Monitoring - Transit	0:00	0	0:24	4	59:13	475	100:55	846
No Monitoring	0:00	0	0:00	0	0:03	<1	6:56	<1
Pre-clearance	0:00	0	0:00	0	30:27	158	35:10	163
Ramp-up	0:00	0	0:00	0	3:41	13	5:10	13
Reduce Speed	0:00	0	0:00	0	0:24	3	0:24	3
Shutdown	0:00	0	0:00	0	1:22	4	1:22	4
Total	0:00	0	0:24	4	282:50	1492	347:56	1871

OCW02 on the MV *Brasilis*

Visual monitoring was carried out across 29 days of survey operations on the MV *Brasilis* with a total of 553 hours and 12 minutes of monitoring effort, during approximately 2122 miles of vessel track (Table 4.7). This included 19 hours and 39 minutes of pre-clearance, of which most (18 hours and 30 minutes) was within the Ocean Wind IHA Area.

Table 4.7 Vessel and Monitoring Activity on the MV *Brasilis* during the OCW02 Geophysical Survey

Vessel Activity	OCS-A 0498		OCS-A 0532		Ocean Wind IHA Area		Overall	
	Time	Miles	Time	Miles	Time	Miles	Time	Miles
Anchored	0:00	0	0:00	0	0:00	0	4:49	2
Deploying Equipment	0:00	0	0:00	0	12:43	40	13:06	40
Docked	0:00	0	0:00	0	0:00	0	0:15	<1
Equipment Test	0:00	0	1:21	6	28:18	108	29:52	108
Non-PSO Shutdown	0:00	0	0:00	0	0:00	<1	0:00	<1
Ramp-up	0:00	0	0:57	4	5:40	24	6:00	24
Retrieving Equipment	0:00	0	0:12	1	9:39	25	10:01	25
Shutdown	0:00	0	0:00	0	0:00	<1	0:00	<1
Standby	0:00	0	1:42	7	47:02	163	51:19	164
Station Keeping	0:00	0	0:00	0	0:07	<1	0:07	<1
Surveying	0:00	0	16:03	70	236:38	1021	236:38	1021
Transit	2:41	26	0:36	3	56:55	485	72:49	622
WOW	0:00	0	0:00	0	128:16	116	128:16	116
Total	2:41	26	20:51	90	525:19	1982	553:12	2122
Monitoring State	OCS-A 0498		OCS-A 0532		Ocean Wind IHA Area		Overall	
	Time	Miles	Time	Miles	Time	Miles	Time	Miles
Detection Delay	0:00	0	0:00	0	0:30	2	0:30	2
Monitoring - No Mitigation	0:00	0	18:43	81	438:34	1401	449:03	1405
Monitoring - Transit	2:41	26	0:04	1	54:21	469	70:15	606
Pre-clearance	0:00	0	1:07	4	18:30	62	19:39	63
Ramp-up	0:00	0	0:57	4	5:40	24	6:00	24
Shutdown	0:00	0	0:00	0	0:00	<1	0:00	<1
Weather Delay	0:00	0	0:00	0	7:44	23	7:44	23
Weather Shutdown	0:00	0	0:00	0	0:00	<1	0:00	<1
Total	2:41	26	20:51	90	525:19	1982	553:12	2122

Includes all HRG surveying operations regardless of source frequency

4.1.2 PSO Effort

PSO effort using each piece of monitoring equipment, during operations conducted in Daylight and Darkness is presented in Table 4.8 and by geophysical acoustic sources <200kHz being Active and Inactive in Table 4.9. This activity reflects each PSO's effort individually and therefore can exceed 24 hours within any given day.

A total of 8734 hours and 58 minutes of PSO effort were conducted by designated PSOs during the Surveys, generally split equally between Daylight and Darkness. The dominant method of assessment during daylight operations was UE, accounting for 99.6% of Daylight PSO Effort. In Daylight, all other equipment was used for brief periods of lower visibility to enable monitoring to continue. During hours of darkness, the vessel mounted IR and NVD were the most used detection methods accounting for 52% and 46%, respectively to the total PSO Effort conducted in the Darkness.

Approximately three quarters (72%) of the PSO Effort was conducted whilst the acoustic sources <200kHz were Inactive. Furthermore, only 20% of the PSO Effort was conducted whilst the sparker was Active.

Table 4.8 PSO Effort for each Monitoring Device used during Daylight and Darkness

Condition	UE	IR - Handheld	IR - Mounted	NVD	Total PSO Effort
Daylight	4616:45	0:44	15:52	4:03	4637:26
Darkness	30:34	40:28	2138:26	1888:03	4097:32
Total	4647:19	41:13	2154:18	1892:06	8734:58

Table 4.9 PSO Effort for each Monitoring Device when Acoustic Sources <200kHz Active or Inactive

Source Activity	UE	IR - Handheld	IR - Mounted	NVD	Total PSO Effort
Sarker On	881:25	11:12	437:33	427:47	1757:58
Other Acoustic Sources <200kHz On	369:17	2:46	142:57	142:33	657:34
All Acoustic Sources <200kHz Off	3396:36	27:14	1573:48	1321:45	6319:25
Total	4647:19	41:13	2154:18	1892:06	8734:58

4.2 Weather Conditions During Monitoring

As would be expected with survey operations spanning nine different months, environmental conditions varied throughout the Surveys. Beaufort Sea state was commonly favorable throughout the Surveys; with 73% of Monitoring Effort conducted during periods in Beaufort 4 or less (Figure 4.9). The Beaufort scale is an empirical measurement that accounts for several environmental factors, one of which, and that with the most influence on PSO mitigation activities, is wave height. Swell height for most of the Surveys (62%) was less than 2m and considered low.

Atmospheric conditions were considered favorable for PSO observations during most of the survey activities. Periods of fog or precipitation, where visibility was generally reduced, accounted for 6% of all Daylight Monitoring Effort and 6% of all Monitoring Effort during Darkness (Figure 4.10).

Figure 4.9 Monitoring Effort by Beaufort Sea State

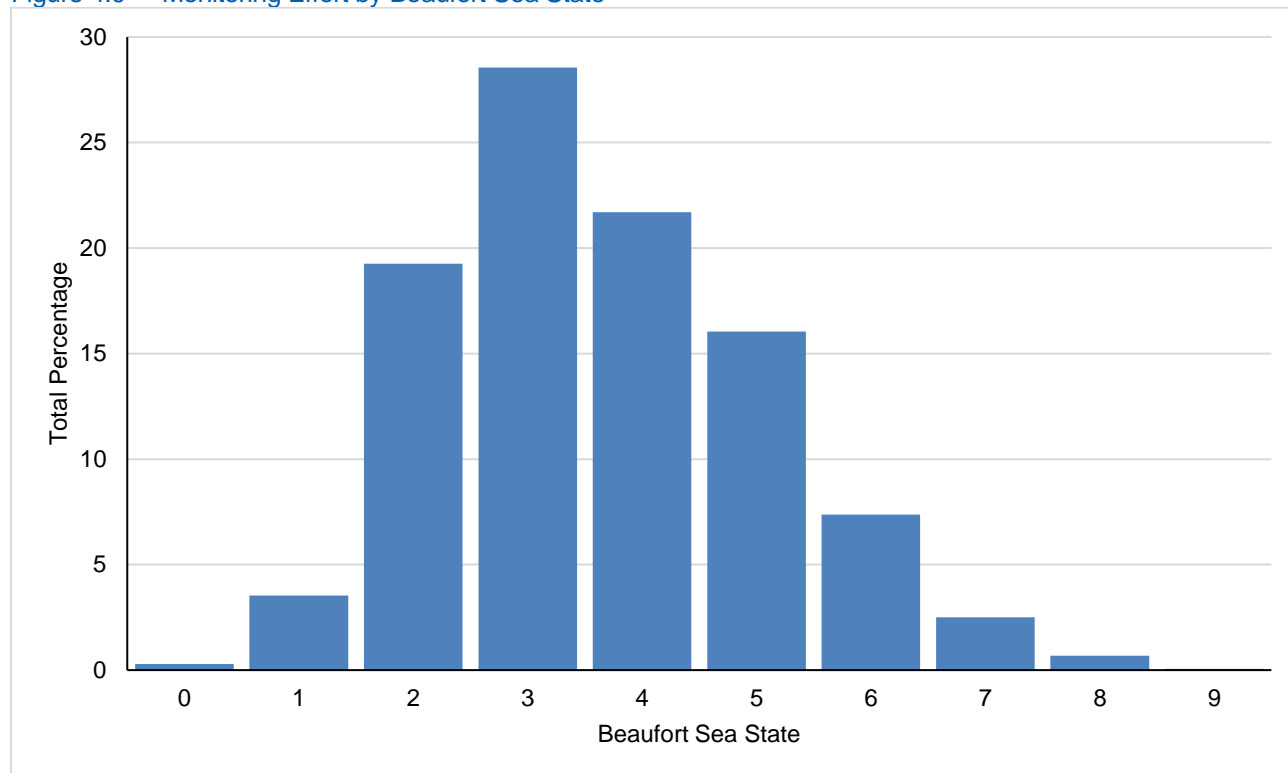
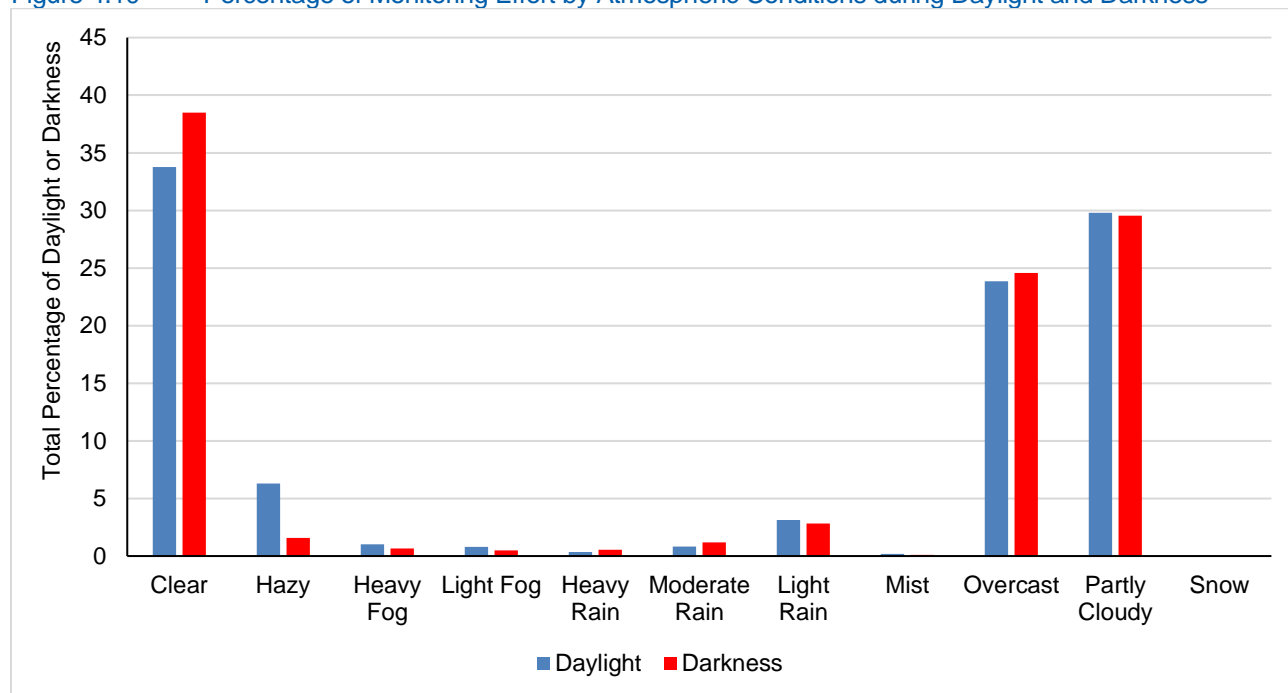


Figure 4.10 Percentage of Monitoring Effort by Atmospheric Conditions during Daylight and Darkness

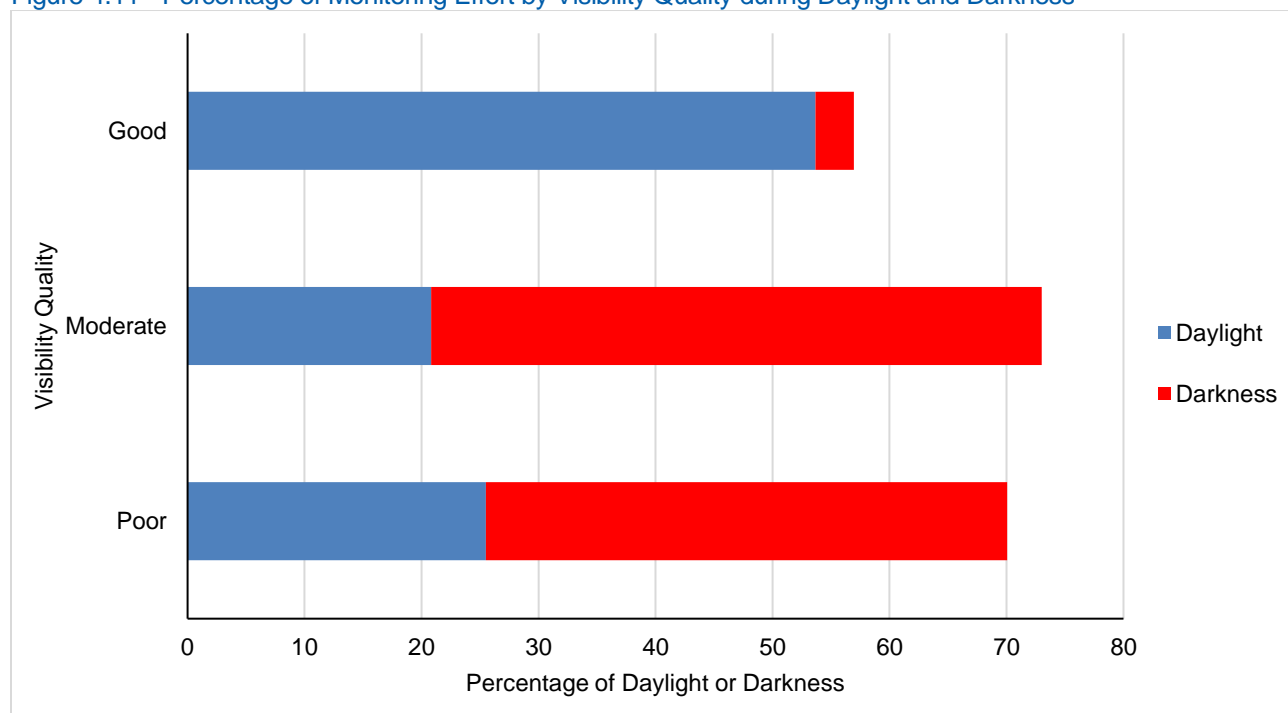


The visibility quality during Monitoring Effort is presented in Figure 4.11 and was defined by Mysticetus as follows:

- Good: Beaufort sea state ≤ 3 and visibility distance $> 1\text{km}$
- Moderate: Beaufort sea state 4 and/or visibility distance 0.5-1km
- Poor: Beaufort sea state > 4 and/or visibility distance $< 0.5\text{km}$

Visibility quality was considered *good* or *moderate* during the majority (65%) of Monitoring Effort. *Good* visibility was much more common during Daylight (54%) than during Darkness (3%). *Poor* visibility quality was more likely during Darkness than Daylight (45% and 25%, respectively).

Figure 4.11 Percentage of Monitoring Effort by Visibility Quality during Daylight and Darkness



5 PROTECTED SPECIES DETECTION SUMMARY

5.1 Protected Species Detections

PSOs recorded the necessary data elements for all protected species observations using *Mysticetus*.

Throughout the 192 days on which Monitoring Effort was conducted during the Surveys, there were a total of 260 initial detections of protected species, comprising an estimated 929 individuals. An additional 4 encounters were considered subsequent sightings of previously encountered individuals, giving an overall total of 264 encounters, comprising 933 individuals, during the survey.

Of the 264 encounters, 152 (58%, representing 561 individuals) were identified to species level, while the remaining 42% (representing 372 individuals) encounters were identified to taxonomic family level with the exception of one sighting representing one individual that could only be identified as a mammal. Of the protected species identified to species level, short-beaked common dolphin was most abundant (27 detections of approximately 271 individuals) while humpback whales were the most frequently encountered (46 detections of 79 individuals).

Of the 264 encounters, 93% occurred during Daylight, whilst 7% occurred during Darkness (Table 5.1). Daylight encounters were initially detected visually, using UE or RB. Darkness encounters were initially detected by UE, NVD, Mounted IR or aurally.

The majority of encounters (68%) occurred outside the Lease areas, during transit to, from or between Lease areas. The remaining encounters occurring during survey operations within the Lease areas. Of the 264 detections overall (including initial and subsequent), 74% occurred while the geophysical acoustic sources <200kHz were Inactive (Table 5.2). As this is consistent with the proportion of PSO effort conducted during such conditions (72%) it does not suggest any impact on the likelihood of detection overall based on geophysical source activity. In fact, the detection rate (initial detections per 1000 hours of PSO Effort) was actually higher when the sparker was active (55 initial detections per 1000 hours of PSO Effort) compared with when sources <200kHz were Inactive (42 initial detections per 1000 hours of PSO Effort), although this could reflect a greater degree of vigilance during such conditions.

A summary of all detections is tabulated in Table 5.1 and Table 5.2 and a map of the sightings from each vessel is presented in Figure 5.1 to Figure 5.5.

Table 5.1 Protected Species Detected and the Estimated Number of Individuals during Daylight and Darkness

Species	Scientific Name	Daylight		Darkness		Total	
		Estimated number of encounters	Estimated number of individuals	Estimated number of encounters	Estimated number of individuals	Estimated number of encounters	Estimated number of individuals
Odontocete							
Bottlenose Dolphin	<i>Tursiops truncatus</i>	16	147	0	0	16	147
Short-beaked Common Dolphin	<i>Delphinus delphis</i>	19	221	8	50	27	271
Unidentified Dolphin	NA	27	156	8	32	35	188
Unidentified Dolphin or Porpoise	NA	1	100	0	0	1	100
Total for group		63	624	16	82	79	706
Mysticete							
Fin Whale	<i>Balaenoptera physalus</i>	2	3	0	0	2	3
Humpback Whale	<i>Megaptera novaeangliae</i>	45	78	1	1	46	79
Minke Whale	<i>Balaenoptera acutorostrata</i>	6	6	0	0	6	6
Unidentified Mysticete Whale	NA	44	51	0	0	44	51
Total for group		97	138	1	1	98	139
Testudines							
Leatherback Sea Turtle	<i>Dermochelys coriacea</i>	40	40	0	0	40	40
Loggerhead Sea Turtle	<i>Caretta caretta</i>	14	14	0	0	14	14
Green Sea Turtle	<i>Chelonia mydas</i>	1	1	0	0	1	1
Unidentified Sea Turtle	NA	29	30	2	2	31	32
Total for group		84	85	2	2	86	87
Other							
Unidentified Marine Mammal	NA	1	1	0	0	1	1
Total		245	848	19	85	264	933

¹ Best estimated count of individuals.

Table data includes initial and subsequent encounters

Table 5.2 Protected Species Detected and the Estimated Number of Individuals when Acoustic Sources (<200kHz) were Active and Inactive

Species	Scientific Name	Sources Inactive		Sparker Active		Other <200kHz Sources Active		Total	
		Number of Encounters	Estimated Number of Individuals ¹	Number of Encounters	Estimated Number of Individuals ¹	Number of Encounters	Estimated Number of Individuals ¹	Number of Encounters	Estimated Number of Individuals ¹
Odontocete									
Short-beaked Common Dolphin	<i>Delphinus delphis</i>	24	249	0	0	3	22	27	271
Bottlenose Dolphin	<i>Tursiops truncatus</i>	13	112	3	35	0	0	16	147
Unidentified Dolphin	NA	31	170	3	14	1	4	35	188
Unidentified Dolphin or Porpoise	NA	1	100	0	0	0	0	1	100
Total for group		69	631	6	49	4	26	79	706
Mysticete									
Fin Whale	<i>Balaenoptera physalus</i>	1	2	1	1	0	0	2	3
Humpback Whale	<i>Megaptera novaeangliae</i>	31	50	14	28	1	1	46	79
Minke Whale	<i>Balaenoptera acutorostrata</i>	3	3	0	0	3	3	6	6
Unidentified Mysticete Whale	NA	31	36	11	13	2	2	44	51
Total for group		66	91	26	42	6	6	98	139
Testudines									
Leatherback Sea Turtle	<i>Dermochelys coriacea</i>	26	26	13	13	1	1	40	40
Loggerhead Sea Turtle	<i>Caretta caretta</i>	8	8	6	6	0	0	14	14
Green Sea Turtle	<i>Chelonia mydas</i>	0	0	1	1	0	0	1	1
Unidentified Sea Turtle	NA	27	28	4	4	0	0	31	32
Total for group		61	62	24	24	1	1	86	87
Other									
Unidentified Marine Mammal	NA	0	0	0	0	1	1	1	1
Total for group		0	0	0	0	1	1	1	1
Totals		196	784	56	115	12	34	264	933
Totals (%)		74	84	21	12	5	4	100	100

¹ Best estimated count of individuals.

Table data includes initial and subsequent encounters

Figure 5.1 Protected Species Encountered during the OCW01 and OCW02 Surveys

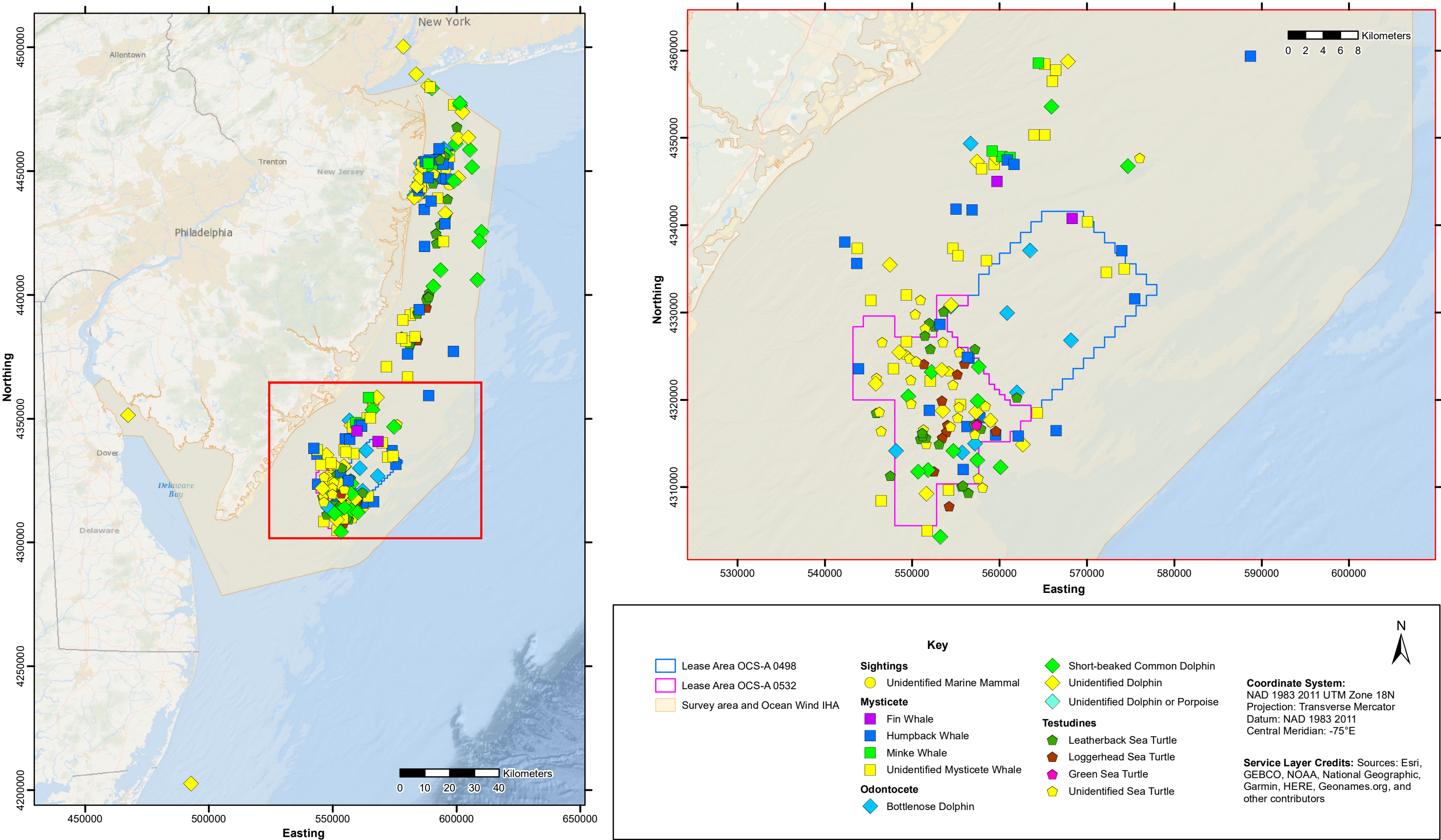


Figure 5.2 Protected Species Encountered on the MV *Ocean Observer*

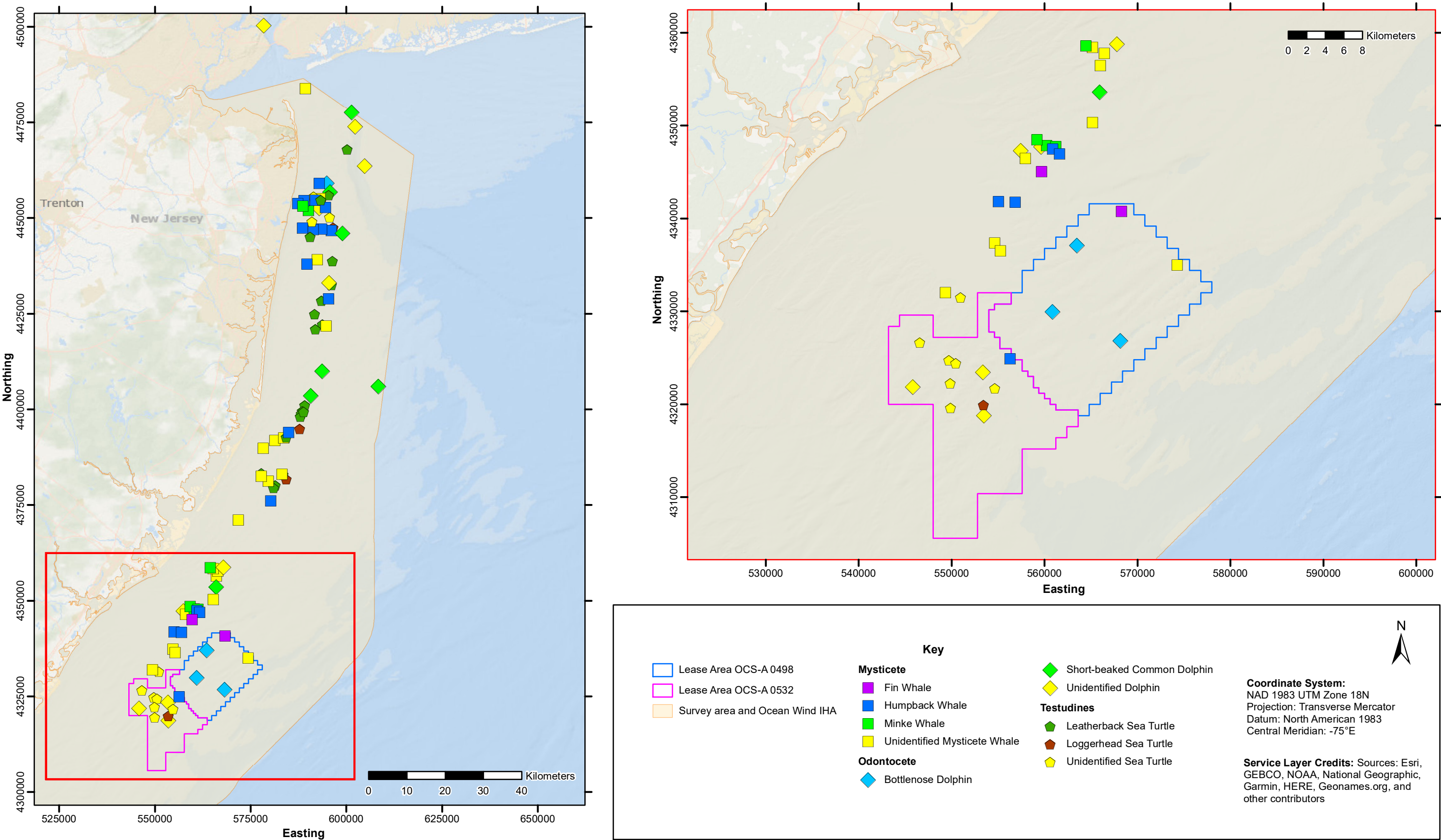


Figure 5.3 Protected Species Encountered on the RV *Ocean Researcher*

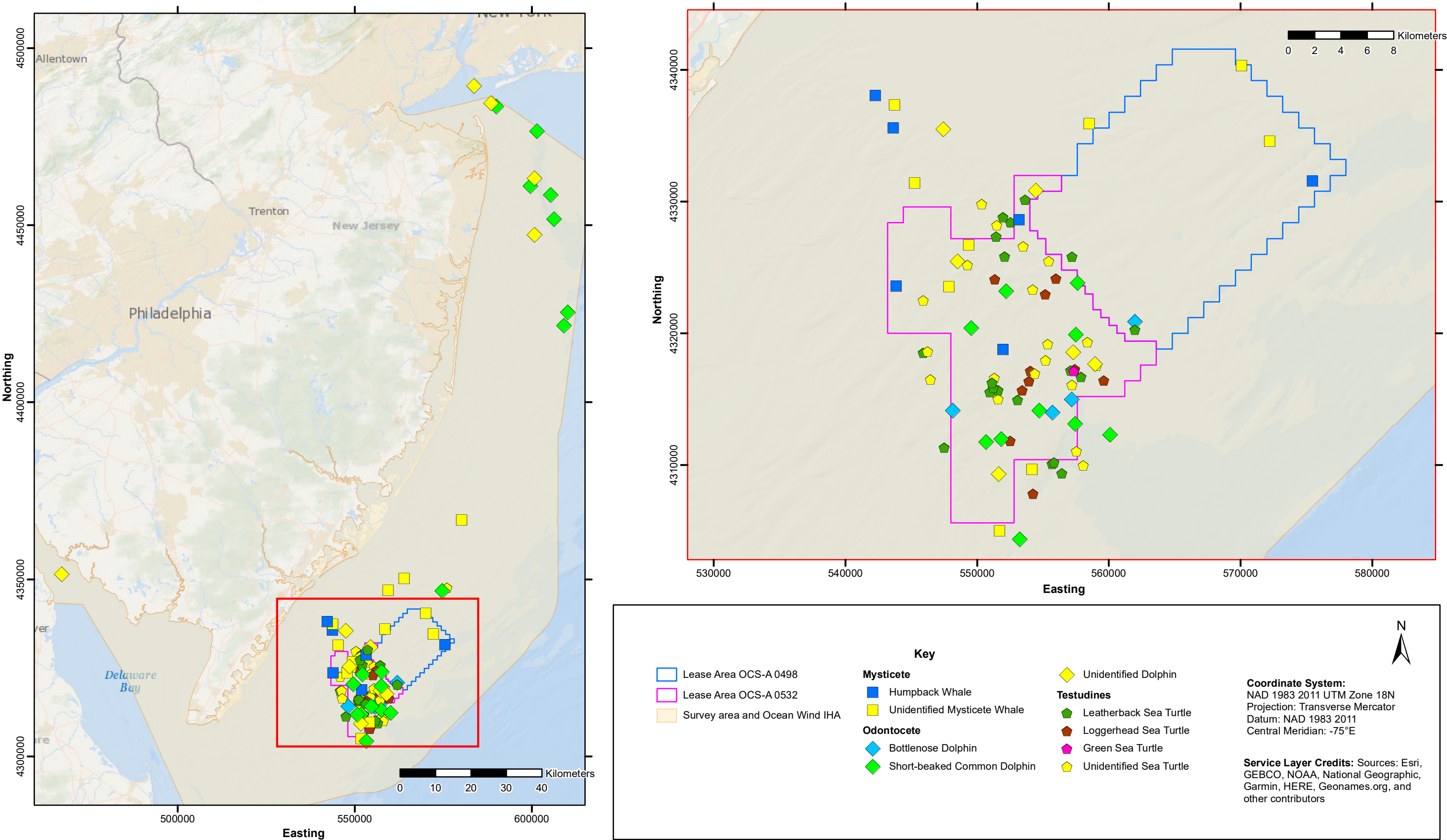


Figure 5.4 Protected Species Encountered on the MV *Brasilis*

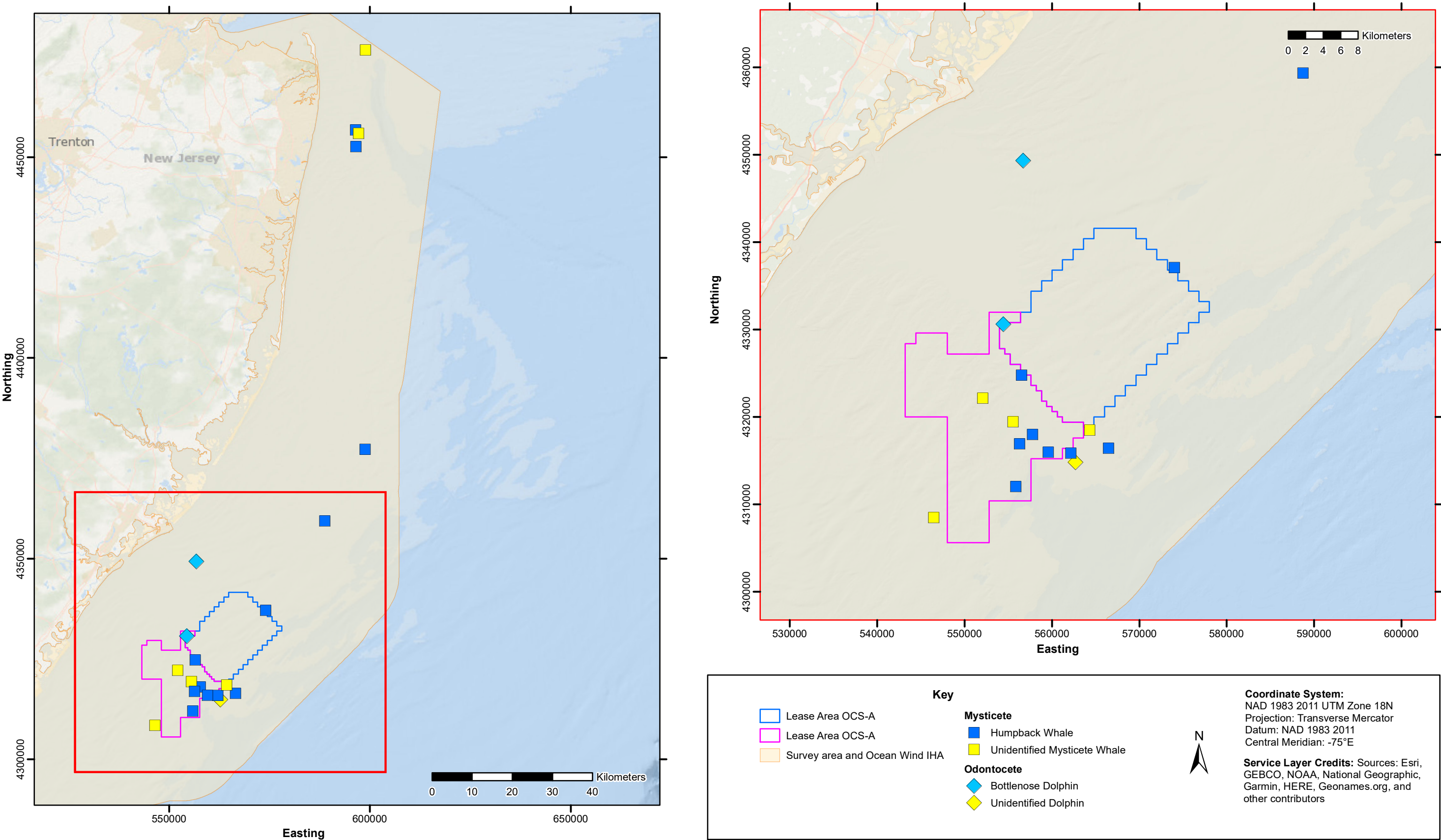
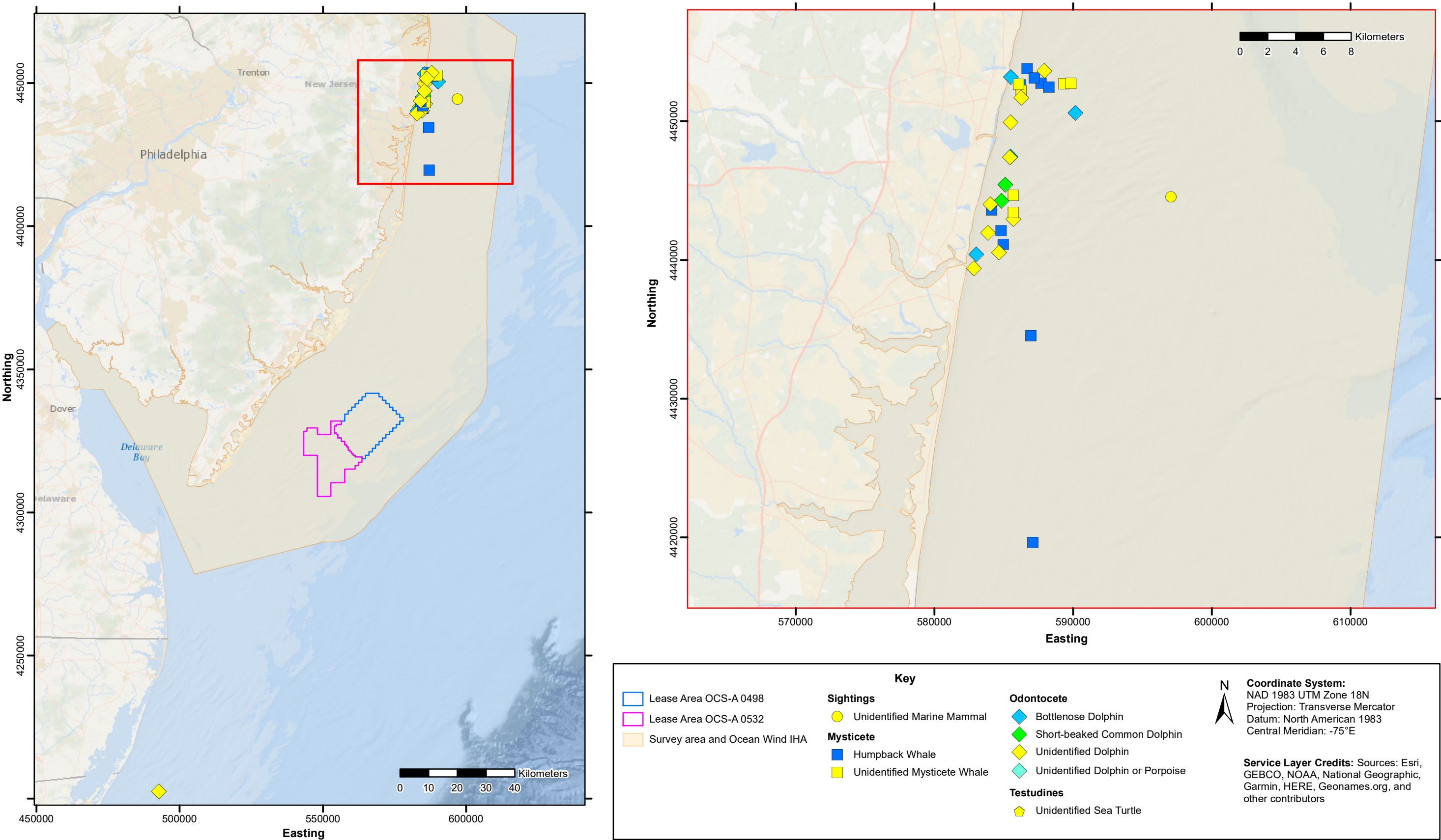


Figure 5.5 Protected Species Encountered on the RV *Substantial*

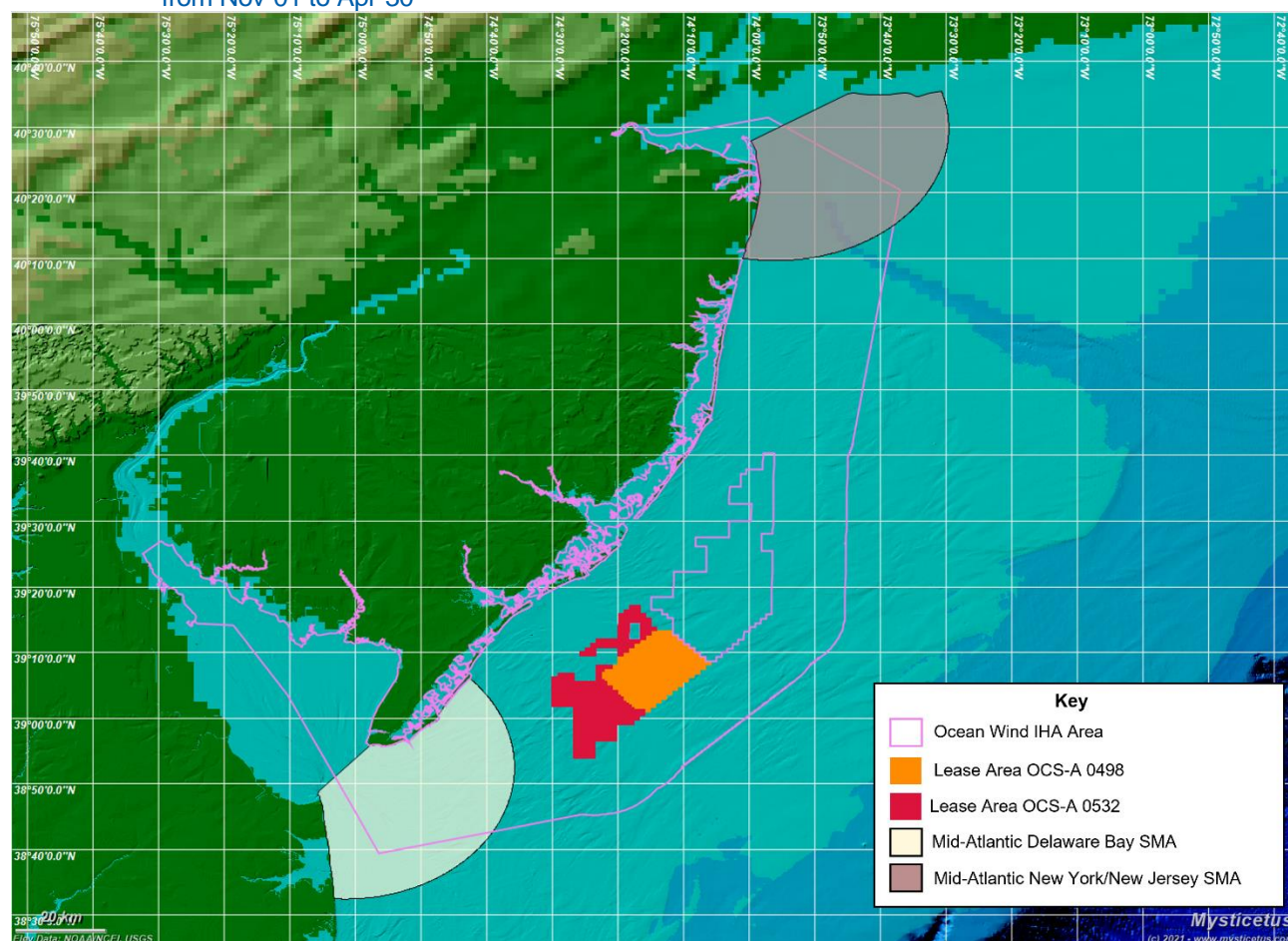


5.1.1 North Atlantic Right Whale Monitoring

From Nov-01 to Apr-30, two Mid-Atlantic SMAs were in effect in the vicinity of the Lease Areas; the Delaware Bay SMA and New York/New Jersey SMA (Figure 5.6). PSOs kept the crew informed of speed restrictions in SMAs.

PSOs maintained monitoring of the NMFS NARW Reporting Systems (the Mandatory Ship Reporting system, the Whale Alert app and the Interactive NARW Sightings Map (available at <https://www.nefsc.noaa.gov/psb/surveys/>), checking every 4 hours where able to monitor the presence of any NARWs in the area and to be aware of the establishment of a DMA.

Figure 5.6 The Extent of the Two Mid-Atlantic Seasonal Management Areas Established Near the Project Areas from Nov-01 to Apr-30



During the Surveys, several slow zones were established covering five areas within or near the IHA area in New York/New Jersey, each with several renewals throughout the Surveys. The 10-knot speed restriction per NOAA guidance was adhered to when the vessel was within a slow zone, but no cessation of survey activities was required when the slow zones were established within the Lease areas. See Table 5.3 and Figure 5.7 for details of the slow zones.

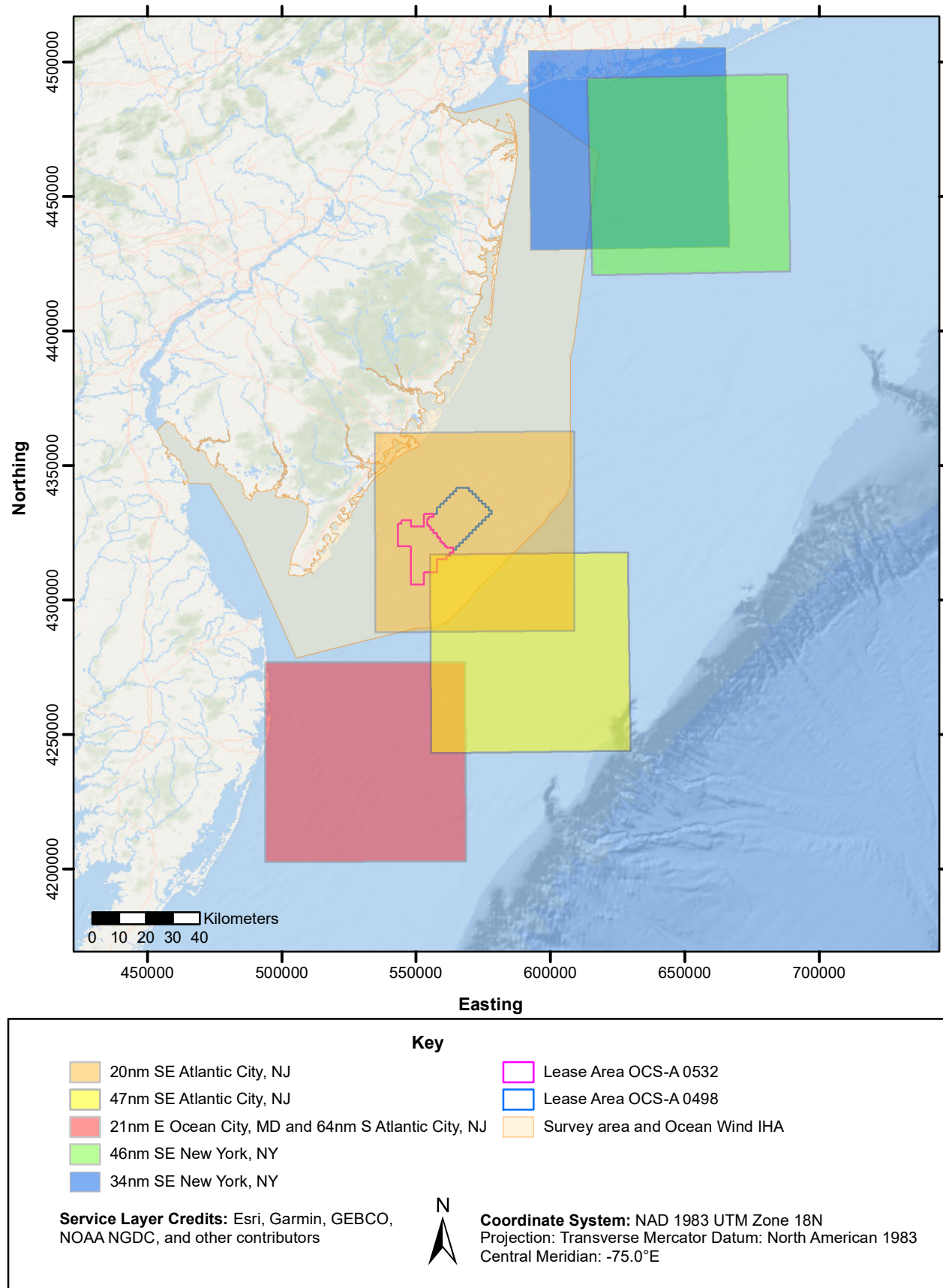
5.1.2 North Atlantic Right Whale Detections

During the Project activities, there were no detections of NARW.

Table 5.3 Slow Zones Established Near or In the Project Area During the Geophysical Survey

Location	ID(s)	Start Date	Expiry Date
46nm SE New York NY	3487	Nov-21-2021	Dec-06-2021
	3489	Nov-30-2021	Dec-15-2021
	3491	Dec-12-2021	Dec-27-2021
	3496	Dec-22-2021	Jan-06-2022
	NA	Feb-07-2022	Feb-22-2022
	NA	Mar-09-2022	Mar-25-2022
	NA	Mar-28-2022	Apr-12-2022
34nm SE New York NY	NA	Jan-09-2022	Jan-24-2022
	NA	Jan-18-2022	Feb-02-2022
20nm SE Atlantic City NJ	3488	Nov-24-2021	Dec-09-2021
	3490	Dec-03-2021	Dec-18-2021
	3492	Dec-12-2021	Dec-27-2021
	3494	Dec-21-2021	Jan-05-2022
	3499	Dec-30-2021	Jan-14-2022
	3501	Jan-09-2022	Jan-24-2022
	NA	Jan-20-2022	Feb-04-2022
	NA	Feb-01-2022	Feb-16-2022
	NA	Feb-12-2022	Feb-27-2022
	NA	Feb-21-2022	Mar-08-2022
	NA	Mar-05-2022	Mar-20-2022
	NA	Mar-25-2022	Apr-09-2022
47nm SE Atlantic City NJ	NA	Mar-01-2022	Mar-16-2022
21nm E Ocean City MD (Includes 64nm S Atlantic City NJ)	3478	Sep-30-2021	Oct-15-2021
	3485	Nov-12-2021	Nov-27-2021
	3493	Dec-12-2021	Dec-27-2021
	3495	Dec-21-2021	Jan-05-2022
	3500	Jan-01-2022	Jan-16-2022
	NA	Jan-10-2022	Jan-25-2022
	NA	Feb-09-2022	Feb-24-2022
	NA	Feb-24-2022	Mar-11-2022
	NA	Mar-17-2022	Apr-01-2022

Figure 5.7 Slow Zones Established Near or In the Project Area During the Geophysical Surveys



5.2 Protected Species Behavior

The difficulty associated with vessel-based observations of marine mammal and sea turtle behaviors should be noted, particularly when behavioral study is not a 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 implemented, where needed, do PSOs dedicate additional observation effort to assess animal behavior and potential reactions to the vessel or operations.

The observed initial behavior as recorded by PSOs varied between species group and were generally consistent with known behavior of broad species groups:

- non-delphinoid cetaceans were predominantly observed exhibiting *blow*, *swim* and *travel* behavior.
- delphinoid cetaceans predominantly exhibited *swim*, *porpoise*, *surface-active travel*, splash, *bow ride* or *travel* or behavior.
- sea turtles were mainly noted to exhibit *swim* behavior.

Details of noted initial behavior is tabulated for periods when acoustic sources (<200kHz) were considered Inactive in Table 5.4, for periods when the IHA regulated sparker was Active in Table 5.5 and for periods when other acoustic sources (<200kHz) were considered Active in Table 5.6.

The PSOs also recorded any behavioral reactions where these were noted for each encounter. Behavioral reactions are defined as perceived changes in protected species behavior as a result of the vessel or its operations, relative to the initial or secondary observed behaviors. Details of noted reaction behavior is tabulated for periods when acoustic sources (<200kHz) were considered Inactive in Table 5.7, for periods where the IHA regulated sparker was Active in Table 5.8 and for periods when other acoustic sources (<200kHz) were considered Active in Table 5.9.

The most frequently noted behavior reaction of protected species was *none*, regardless of whether the sparker was active (77%), other acoustic sources <200kHz were active (92%) or all sources <200kHz were inactive (69%). Where a reaction was observed, *dive* was the most frequently identified behavior when acoustic sources <200kHz were Inactive, accounting for 20% of encounters. When the sparker was active, only two behavioral reactions, other than *None*, were noted: *dive* (20%) and *change direction* (4%). When acoustic sources (<200kHz) other than the sparker were Active, the only other reaction noted besides *none* was *dive* which was only recorded on one occasion (8%).

Table 5.4 Observed Initial Behaviors when Acoustic Sources (<200kHz) were Inactive for each Species Encounter during the Surveys

Species	Scientific Name	Sources <200kHz Inactive																
		Blow	Bow Ride	Breach	Dead	Feed	Fluke Up	Look	Mill	None	Other (see notes)	Porpoise	Rest	Splash	Surface-active Mill	Surface-active Travel	Swim	Travel
Odontocete																		
Bottlenose Dolphin	<i>Tursiops truncatus</i>	0	0	0	0	0	0	0	0	0	0	2	0	3	3	1	1	3
Short-beaked Common Dolphin	<i>Delphinus delphis</i>	0	3	0	0	0	0	0	1	0	0	7	0	1	1	4	6	1
Unidentified Dolphin	NA	0	3	2	0	0	0	0	0	0	0	6	0	3	1	4	12	0
Unidentified Dolphin or Porpoise	NA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Total for group		0	6	2	0	0	0	0	1	0	0	15	0	7	5	9	19	5
Mysticete																		
Fin Whale	<i>Balaenoptera physalus</i>	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Humpback Whale	<i>Megaptera novaeangliae</i>	15	0	1	0	2	1	0	0	0	0	0	0	2	0	5	2	3
Minke Whale	<i>Balaenoptera acutorostrata</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0
Unidentified Mysticete Whale	NA	21	0	1	0	0	0	0	0	1	0	0	0	0	0	2	2	4
Total for group		37	0	2	0	2	1	0	0	1	0	0	0	2	0	7	7	7
Testudines																		
Leatherback Sea Turtle	<i>Dermochelys coriacea</i>	0	0	0	0	0	0	0	0	0	1	0	4	1	6	1	13	0
Loggerhead Sea Turtle	<i>Caretta caretta</i>	0	0	0	0	0	0	0	1	0	0	0	1	0	1	0	4	1
Green Sea Turtle	<i>Chelonia mydas</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Unidentified Sea Turtle	NA	0	0	0	0	0	0	1	1	0	1	0	4	0	1	0	19	0
Total for group		0	0	0	0	0	0	1	2	0	2	0	9	1	8	1	36	1
Other																		
Unidentified Marine Mammal	NA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total		37	6	4	0	2	1	1	3	1	2	15	9	10	13	17	62	13

Behaviors include initial and subsequent encounters.

Table 5.5 Observed Initial Behaviors when the IHA regulated Sparker was Active for each Species Encounter during the Surveys

Species	Scientific Name	IHA-regulated sources Active																
		Blow	Bow Ride	Breach	Dead	Feed	Fluke Up	Look	Mill	None	Other (see notes)	Porpoise	Rest	Splash	Surface-active Mill	Surface-active Travel	Swim	Travel
Odontocete																		
Bottlenose Dolphin	<i>Tursiops truncatus</i>	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	1
Short-beaked Common Dolphin	<i>Delphinus delphis</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Unidentified Dolphin	NA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	0
Unidentified Dolphin or Porpoise	NA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total for group		0	0	0	0	1	0	0	0	0	0	0	0	0	0	2	2	1
Mysticete																		
Fin Whale	<i>Balaenoptera physalus</i>	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Humpback Whale	<i>Megaptera novaeangliae</i>	11	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1	0
Minke Whale	<i>Balaenoptera acutorostrata</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Unidentified Mysticete Whale	NA	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Total for group		21	0	0	0	0	0	0	0	0	0	0	0	1	0	2	1	1
Testudines																		
Leatherback Sea Turtle	<i>Dermochelys coriacea</i>	0	0	1	1	0	0	0	0	0	0	0	4	0	1	0	6	0
Loggerhead Sea Turtle	<i>Caretta caretta</i>	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	4	0
Green Sea Turtle	<i>Chelonia mydas</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Unidentified Sea Turtle	NA	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	3	0
Total for group		0	0	1	2	0	0	0	0	0	0	0	6	0	1	0	14	0
Other																		
Unidentified Marine Mammal	NA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total		21	0	1	2	1	0	0	0	0	0	0	6	1	1	4	17	2

Behaviors include initial and subsequent encounters.

Table 5.6 Observed Initial Behaviors when Acoustic Sources (<200kHz) other than the Sparker were Active for each Species Encounter during the Surveys

Species	Scientific Name	Other sources <200kHz active																
		Blow	Bow Ride	Breach	Dead	Feed	Fluke Up	Look	Mill	None	Other (see notes)	Porpoise	Rest	Splash	Surface-active Mill	Surface-active Travel	Swim	Travel
Odontocete																		
Bottlenose Dolphin	<i>Tursiops truncatus</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Short-beaked Common Dolphin	<i>Delphinus delphis</i>	0	0	0	0	0	0	0	0	0	0	0	0	1	0	2	0	0
Unidentified Dolphin	NA	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Unidentified Dolphin or Porpoise	NA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total for group		0	0	0	0	0	0	0	0	0	0	0	0	2	0	2	0	0
Mysticete																		
Fin Whale	<i>Balaenoptera physalus</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Humpback Whale	<i>Megaptera novaeangliae</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Minke Whale	<i>Balaenoptera acutorostrata</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
Unidentified Mysticete Whale	NA	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total for group		2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	3
Testudines																		
Leatherback Sea Turtle	<i>Dermochelys coriacea</i>	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Loggerhead Sea Turtle	<i>Caretta caretta</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Green Sea Turtle	<i>Chelonia mydas</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Unidentified Sea Turtle	NA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total for group		0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Other																		
Unidentified Marine Mammal	NA	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total		3	0	0	0	0	0	0	1	0	0	0	0	2	0	2	1	3

Behaviors include initial and subsequent encounters.

Table 5.7 Reaction Behaviors for Protected Species when Acoustic Sources (<200kHz) were Inactive during the Surveys

Surveys

Species	Scientific Name	Sources <200kHz Inactive						
		None	Change Direction	Dive	Look	Slow Down	Speed Up	Splash
Odontocete								
Bottlenose Dolphin	<i>Tursiops truncatus</i>	9	1	2	0	0	0	1
Short-beaked Common Dolphin	<i>Delphinus delphis</i>	18	3	0	2	1	0	0
Unidentified Dolphin	NA	26	2	1	2	0	0	0
Unidentified Dolphin or Porpoise	NA	1	0	0	0	0	0	0
Total for group		54	6	3	4	1	0	1
Mysticete								
Fin Whale	<i>Balaenoptera physalus</i>	1	0	0	0	0	0	0
Humpback Whale	<i>Megaptera novaeangliae</i>	30	1	0	0	0	0	0
Minke Whale	<i>Balaenoptera acutorostrata</i>	3	0	0	0	0	0	0
Unidentified Mysticete Whale	NA	29	0	2	0	0	0	0
Total for group		63	1	2	0	0	0	0
Testudines								
Leatherback Sea Turtle	<i>Dermochelys coriacea</i>	6	1	18	0	0	1	0
Loggerhead Sea Turtle	<i>Caretta caretta</i>	3	0	3	0	0	1	1
Green Sea Turtle	<i>Chelonia mydas</i>	0	0	0	0	0	0	0
Unidentified Sea Turtle	NA	10	1	14	0	0	2	0
Total for group		19	2	35	0	0	4	1
Other								
Unidentified Marine Mammal	NA	0	0	0	0	0	0	0
Total		136	9	40	4	1	4	2

Reaction behaviors include initial and subsequent encounters

Table 5.8 Reaction Behaviors for Protected Species when the Sparker was Active during the Surveys

Species	Scientific Name	IHA-regulated sources active						
		None	Change Direction	Dive	Look	Slow Down	Speed Up	Splash
Odontocete								
Bottlenose Dolphin	<i>Tursiops truncatus</i>	2	1	0	0	0	0	0
Short-beaked Common Dolphin	<i>Delphinus delphis</i>	0	0	0	0	0	0	0
Unidentified Dolphin	NA	3	0	0	0	0	0	0
Unidentified Dolphin or Porpoise	NA	0	0	0	0	0	0	0
Total for group		5	1	0	0	0	0	0
Mysticete								
Fin Whale	<i>Balaenoptera physalus</i>	1	0	0	0	0	0	0
Humpback Whale	<i>Megaptera novaeangliae</i>	13	0	1	0	0	0	0
Minke Whale	<i>Balaenoptera acutorostrata</i>	0	0	0	0	0	0	0
Unidentified Mysticete Whale	NA	11	0	0	0	0	0	0
Total for group		25	0	1	0	0	0	0
Testudines								
Leatherback Sea Turtle	<i>Dermochelys coriacea</i>	7	1	5	0	0	0	0
Loggerhead Sea Turtle	<i>Caretta caretta</i>	3	0	3	0	0	0	0
Green Sea Turtle	<i>Chelonia mydas</i>	1	0	0	0	0	0	0
Unidentified Sea Turtle	NA	2	0	2	0	0	0	0
Total for group		13	1	10	0	0	0	0
Other								
Unidentified Marine Mammal	NA	0	0	0	0	0	0	0
Total		43	2	11	0	0	0	0

Reaction behaviors include initial and subsequent encounters

Table 5.9 Reaction Behaviors for Protected Species when Acoustic Sources (<200kHz) other than the Sparker were Active during the Surveys

Species	Scientific Name	Other sources <200kHz Active						
		None	Change Direction	Dive	Look	Slow Down	Speed Up	Splash
Odontocete								
Bottlenose Dolphin	<i>Tursiops truncatus</i>	0	0	0	0	0	0	0
Short-beaked Common Dolphin	<i>Delphinus delphis</i>	3	0	0	0	0	0	0
Unidentified Dolphin	NA	1	0	0	0	0	0	0
Unidentified Dolphin or Porpoise	NA	0	0	0	0	0	0	0
Total for group		4	0	0	0	0	0	0
Mysticete								
Fin Whale	<i>Balaenoptera physalus</i>	0	0	0	0	0	0	0
Humpback Whale	<i>Megaptera novaeangliae</i>	1	0	0	0	0	0	0
Minke Whale	<i>Balaenoptera acutorostrata</i>	3	0	0	0	0	0	0
Unidentified Mysticete Whale	NA	2	0	0	0	0	0	0
Total for group		6	0	0	0	0	0	0
Testudines								
Leatherback Sea Turtle	<i>Dermochelys coriacea</i>	0	0	1	0	0	0	0
Loggerhead Sea Turtle	<i>Caretta caretta</i>	0	0	0	0	0	0	0
Green Sea Turtle	<i>Chelonia mydas</i>	0	0	0	0	0	0	0
Unidentified Sea Turtle	NA	0	0	0	0	0	0	0
Total for group		0	0	1	0	0	0	0
Other								
Unidentified Marine Mammal	NA	1	0	0	0	0	0	0
Total		11	0	1	0	0	0	0

Reaction behaviors include initial and subsequent encounters

5.3 Closest Observed Point of Approach

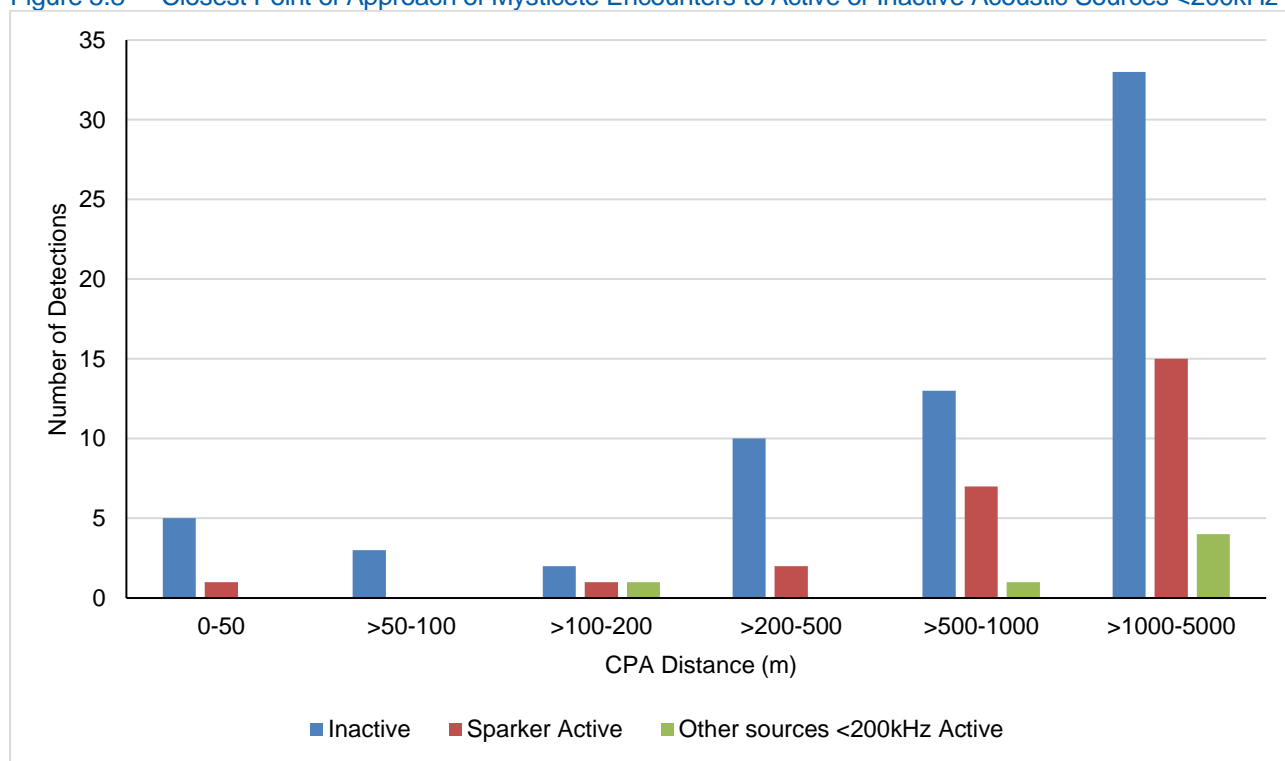
The CPA was estimated by PSOs for all visual detections. Mysticete rarely approached the vessel within 500m; with 53% of all CPAs at a distance greater than 1km. As shown in Figure 5.8, of the Mysticete encounters, only four were recorded within 500m of the Active Sparker, at which point a shutdown occurred immediately.

Conversely, the majority of Odontocete encounters approached the vessel within 50m (50%; Figure 5.9), particularly when the acoustics sources <200kHz were Inactive.

Similarly, over a third of Testudines encounters recorded a CPA distance of less than 50m (33%) and most occurred within 500m (97%; Figure 5.10), whether sources were Active or Inactive.

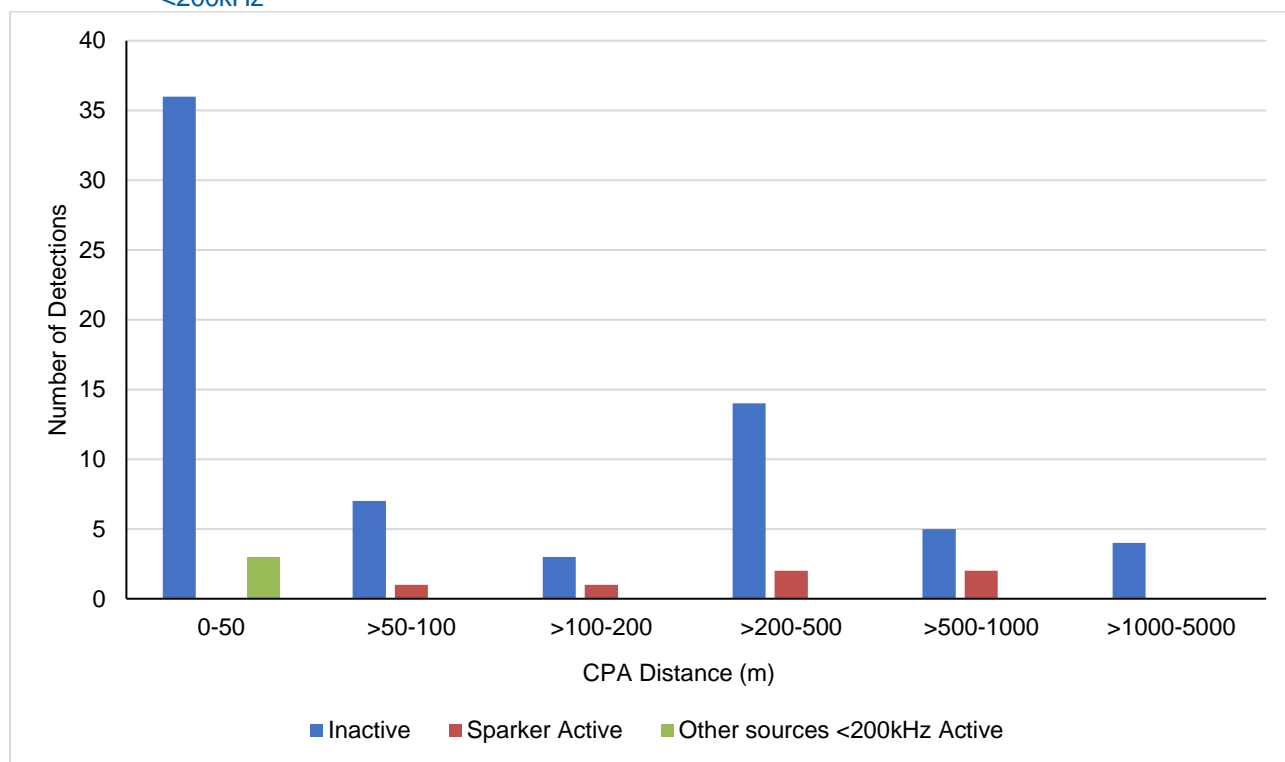
Figure 5.11 to Figure 5.13 further indicate that the median CPA differs by species group, most notably Mysticete and Odontocete. The single sighting of an unidentified mammal has been excluded from this analysis and following charts other than where mentioned.

Figure 5.8 Closest Point of Approach of Mysticete Encounters to Active or Inactive Acoustic Sources <200kHz



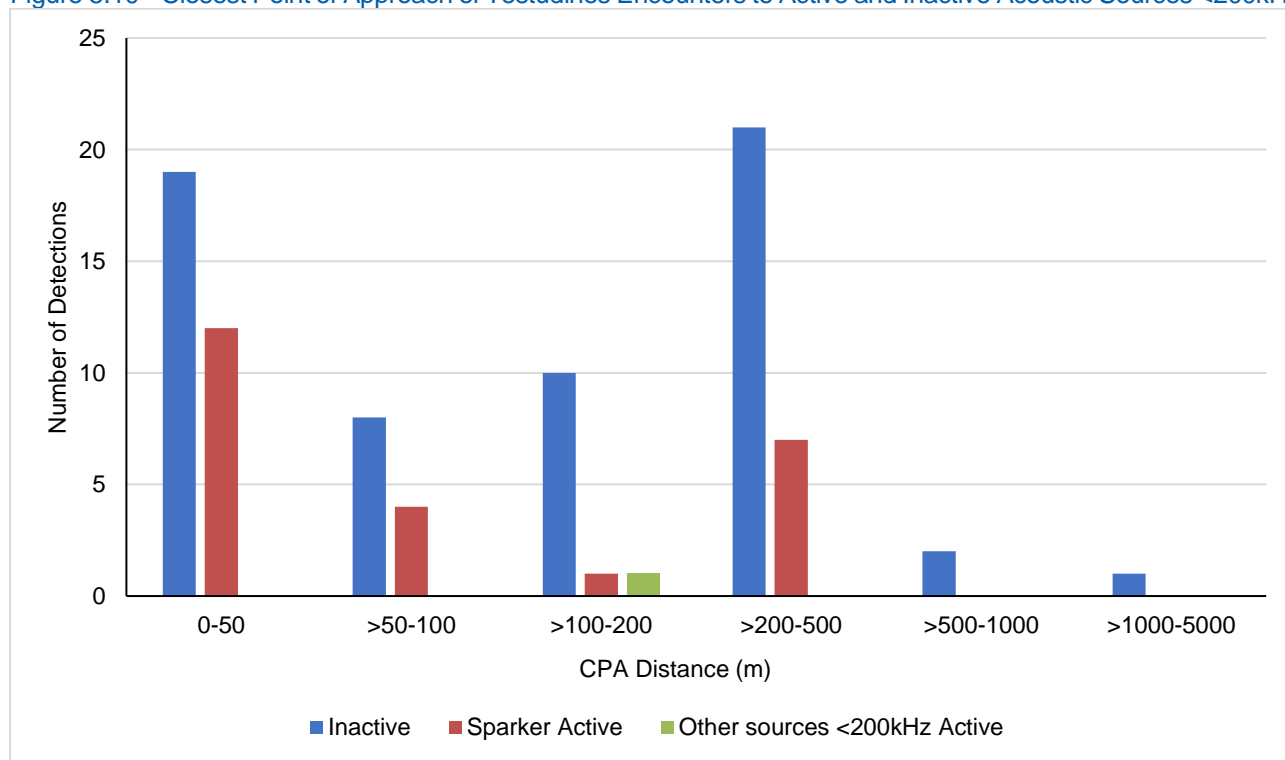
Geophysical acoustic sources operating at <200kHz include the USBL and Innomar.

Figure 5.9 Closest Point of Approach of Odontocete Encounters to Active and Inactive Acoustic Sources <200kHz



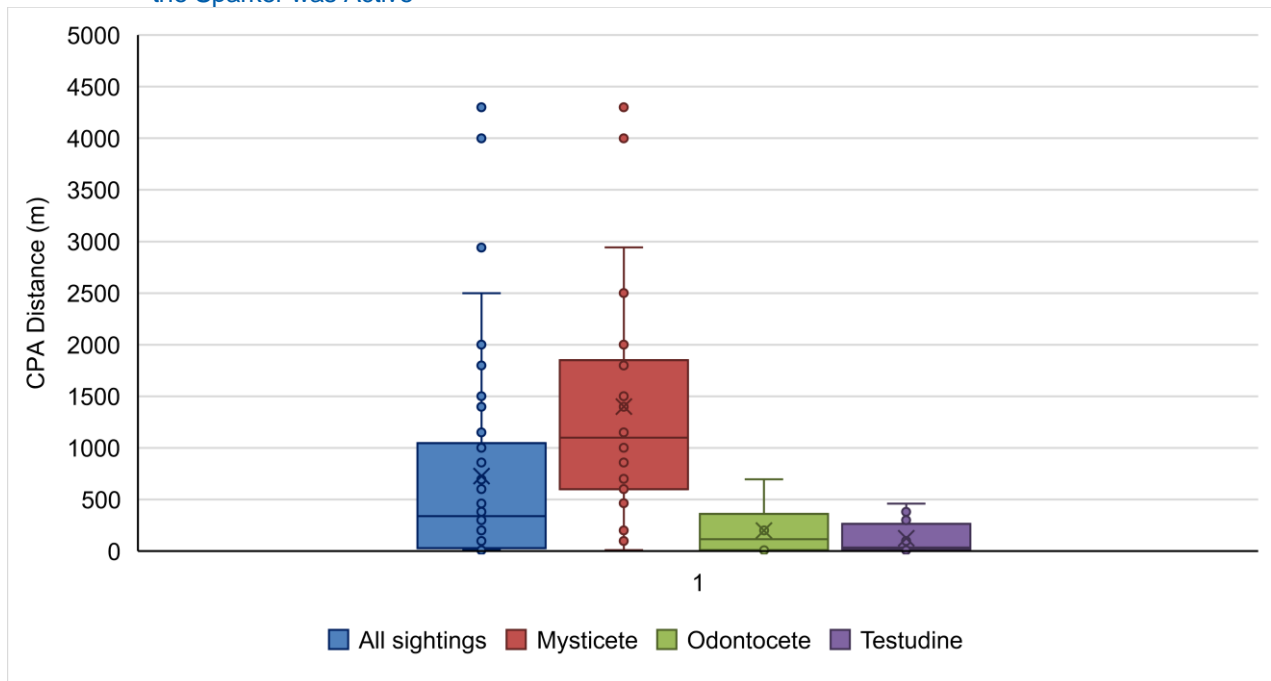
Geophysical acoustic sources operating at <200kHz include the USBL and Innomar.

Figure 5.10 Closest Point of Approach of Testudines Encounters to Active and Inactive Acoustic Sources <200kHz



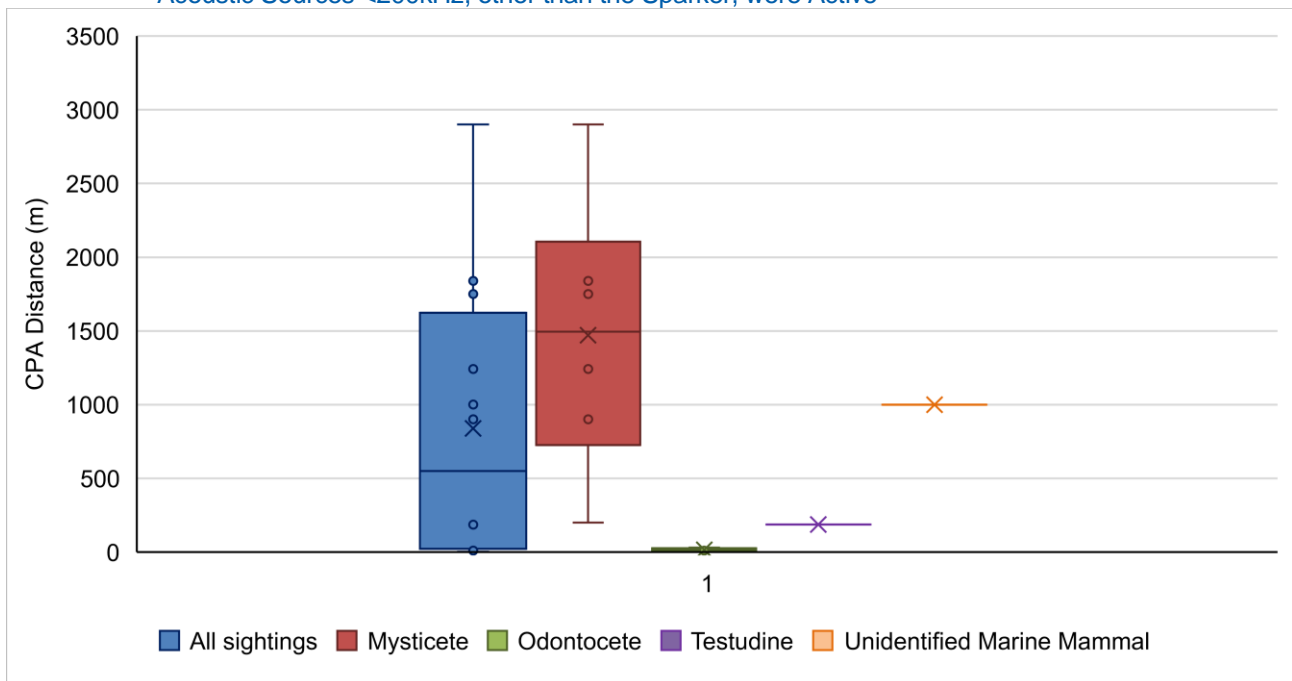
Geophysical acoustic sources operating at <200kHz include the USBL and Innomar.

Figure 5.11 Box and Whisker plot of Closest Point of Approach of Protected Species Detections Observed when the Sparker was Active



The horizontal line within the box indicates the median, the "X" within the box indicates the mean, the boundaries of the box indicate the 25th and 75th quartiles, the whiskers indicate the full range of the results, and a spot indicates an outlier.

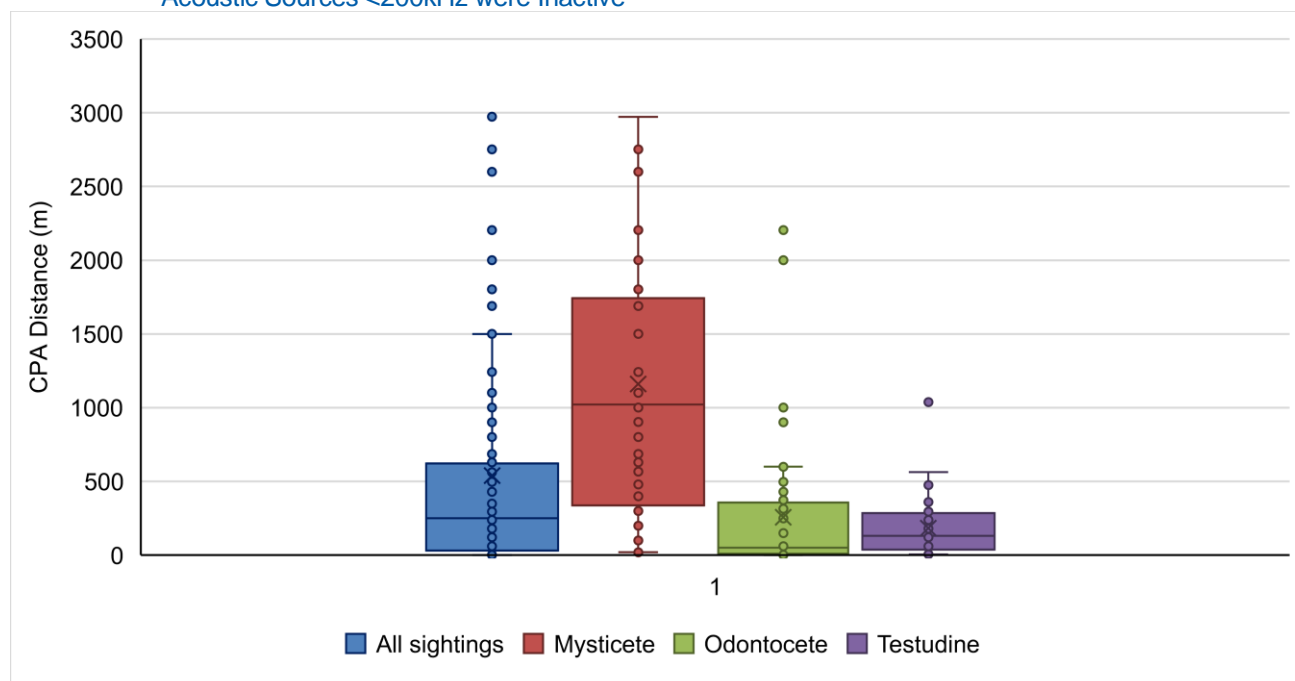
Figure 5.12 Box and Whisker plot of Closest Point of Approach of Protected Species Detections Observed when Acoustic Sources <200kHz, other than the Sparker, were Active



The horizontal line within the box indicates the median, the "X" within the box indicates the mean, the boundaries of the box indicate the 25th and 75th quartiles, the whiskers indicate the full range of the results, and a spot indicates an outlier.

Geophysical acoustic sources operating at <200kHz include the USBL and Innomar

Figure 5.13 Box and Whiskers plot of Closest Point of Approach of Protected Species Detections Observed when Acoustic Sources <200kHz were Inactive



The horizontal line within the box indicates the median, the "X" within the box indicates the mean, the boundaries of the box indicate the 25th and 75th quartiles, the whiskers indicate the full range of the results, and a spot indicates an outlier.

Geophysical acoustic sources operating at <200kHz include the USBL and Innomar.

5.4 Protected Species Potential Exposures

A potential exposure was considered to have occurred when a marine mammal was observed within the Level B HZ of an Active acoustic source operating at <200kHz, based on the direct observations of the PSO. In accordance with the 2021 Ocean Wind IHA (NMFS, 2021), HRG sound sources with the potential to result in Level B exposures to marine mammals from the Survey was the sparker SBP. Although there was not a requirement to shut down operations involving the Innomar and/or USBL for marine mammals, shutdown of this equipment was still required for any turtles observed within the EZ as per initial survey requirements.

The requirement to shut down operations when a marine mammal was observed within the Level B HZ of Active acoustic sources <200kHz did not apply to short-beaked common dolphins, if the PSO on watch deemed their approach to be voluntary. A total of 18 encounters, comprising 23 individuals, were recorded within the Level B HZ of IHA-regulated equipment operating below 200kHz, accounting for 7% of encounters and 2% of the total number of individual protected species detected throughout the Surveys.

Of these 18 encounters, 16 were sea turtles accounting for 19% of this group's encounters. A single encounter of unidentified dolphins totaling 6 individuals (1% total odontocete encounters) and another of a single humpback whale (1% total mysticete encounters) occurred within an Active Level B HZ. In all cases a shutdown was requested and implemented with the exception of one of the turtle sightings as this individual was dead, and the sighting of unidentified dolphins which were deemed to be approaching voluntarily by the PSO on watch and did not enter the 100m EZ of the active equipment.

5.5 Summary of Mitigation Measures

Mitigation measures were implemented for 98 (37%) of the 264 protected species encounters. *Detection delay* and *shutdown* were the most common mitigation measures implemented, each accounting for 13% of all encounters and around a third of mitigation measures taken. Leatherback sea turtles were the primary cause of these mitigation measures, accounting for 29% of the overall mitigation actions. A summary of the mitigation measures that occurred during the Surveys is given in Table 5.10.

Table 5.10 Summary of Mitigation Measures Implemented during the Surveys

Species	Scientific Name	Mitigation Request						Total	None
		Alter Course	Detection Delay	Engine Neutral	Other	Reduce Speed	Shutdown		
Odontocete									
Bottlenose Dolphin	<i>Tursiops truncatus</i>	0	0	0	0	0	3	3	13
Short-beaked Common Dolphin	<i>Delphinus delphis</i>	0	2	0	13	1	0	16	11
Unidentified Dolphin	NA	1	0	0	5	0	1	7	28
Unidentified Dolphin or Porpoise	NA	0	0	0	0	0	0	0	1
Total for group		1	2	0	18	1	4	26	53
Mysticete									
Fin Whale	<i>Balaenoptera physalus</i>	0	0	1	0	0	0	1	1
Humpback Whale	<i>Megaptera novaeangliae</i>	0	2	1	0	2	5	10	36
Minke Whale	<i>Balaenoptera acutorostrata</i>	0	0	0	0	1	0	1	5
Unidentified Mysticete Whale	NA	0	1	0	1	2	1	5	39
Total for group		0	3	2	1	5	6	17	81
Testudines									
Leatherback Sea Turtle	<i>Dermochelys coriacea</i>	1	14	0	0	0	13	28	12
Loggerhead Sea Turtle	<i>Caretta caretta</i>	0	5	0	0	0	6	11	3
Green Sea Turtle	<i>Chelonia mydas</i>	0	0	0	0	0	1	1	0
Unidentified Sea Turtle	NA	0	9	0	1	0	5	15	16
Total for group		1	28	0	1	0	25	55	31
Other									
Unidentified Marine Mammal	NA	0	0	0	0	0	0	0	1
Total		2	33	2	20	6	35	98	166

Mitigation measures include initial and subsequent encounters.

5.6 Protected Species Incident Reports

During the Surveys there were two protected species incident reports for injury or mortality as per Appendix A to Addendum C of the Leases (BOEM, 2016; 2021c).

On Sep-06-2021, a dead loggerhead sea turtle was sighted 400m from the MV *Ocean Observer* when conducting operations. Upon the initial sighting, a shutdown was requested and implemented, however, it was later determined that the animal was dead due to visible degradation of appendages. The dead turtle was seen to float out of the EZ after approximately seven minutes at which point a ramp-up of the equipment began.

The second was a report of a dead leatherback sea turtle on Oct-08-2021 whilst the MV *Ocean Observer* was conducting operations. PSOs at the time took no action as it was evident that this sighting was a decomposing carcass.

6 MONITORING DEVICE EFFECTIVENESS

It should be noted that detections took place over an eight-month period and therefore across multiple seasons with different environmental conditions which may have influenced the effectiveness of the detection method used. All results presented below should be interpreted as a relative assessment of the effectiveness of each monitoring device, as required by regulatory reporting stipulations.

6.1 Monitoring Technique Overview

During the offshore surveys, four complementary methods were used to monitor for protected species, some of which were used simultaneously (see Section 3 for monitoring methods):

- Unaided Eye
 - During daylight: UE (with systematic use of reticle binoculars)
 - During darkness: UE via artificial illumination from vessel light
- Handheld NVD during darkness, occasionally continuing into the first hour of daylight. Use of this equipment was regularly alternated with IR to avoid eye strain without it necessarily being reported as such in *Mysticetus*.
- HH IR devices during darkness, occasionally continuing into the first hour of daylight or during periods of reduced visibility. Use of this equipment was regularly alternated with NVD to avoid eye strain without it necessarily being reported as such in *Mysticetus*.
- Vessel mounted IR device (NVTs IR) during darkness, occasionally continuing into the first hour of daylight or during periods of reduced visibility.

The monitoring method in use when a marine mammal was first detected was recorded by PSOs, as well as any subsequent methods used to confirm the initial detection. All detection rates presented are based on the initial monitoring method used at the time of the initial detection.

6.2 Initial Detection Distance

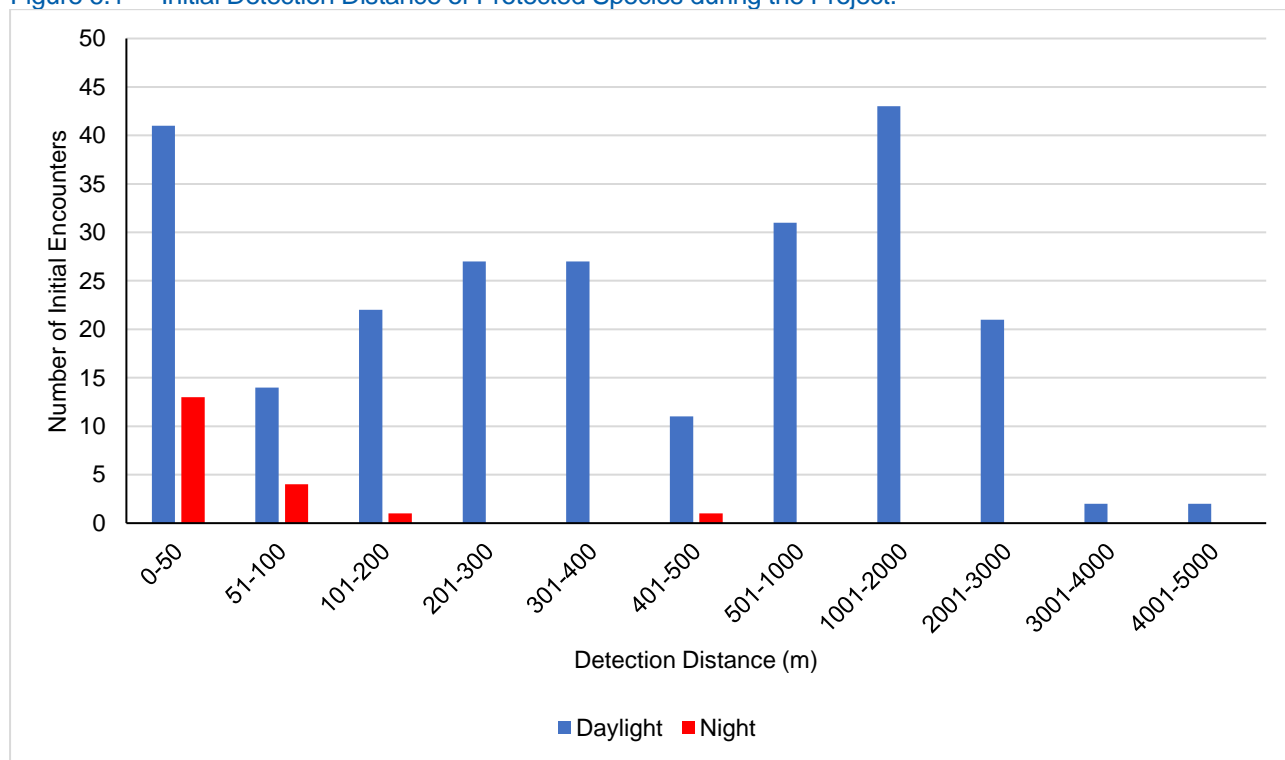
A wide range of factors are known to influence the 'detectability' of, and distance from which, a marine mammal is most likely to be detected. These include environmental and operational variables, animal behavior and the type of monitoring method.

Most initial encounters (94%) were detected with a combination of UE and RB. This is consistent with UE being the most widely used technique, accounting for 53% of all PSO Effort and reflects the fact that visibility quality was generally greater during daylight hours, increasing the likelihood of detection. It therefore follows, that when combining all detection methods, the mean distance at which marine mammals were initially detected was lower (56m) during darkness, compared with daylight (724m, Figure 6.1).

Initial detection distances of protected species groups are illustrated in Figure 6.1 and ranged from 5m to 4357m. Detections within 500m (n=161) of the PSO accounted for 62% of detections. A third of delphinoid cetacean encounters were initially detected within 50m of the vessel (32%, n=25). Almost all sea turtles (97%, n=83) were observed within 500m. More than half (63%, n=59) of the non-delphinoid cetaceans were detected >1km from the vessel, possibly reflecting the relative ease with which these mammals can

be detected, even at greater distances. One encounter was initially detected by incidental auditory means (PSOs heard the animals blow or splashing) and then confirmed by an IR device.

Figure 6.1 Initial Detection Distance of Protected Species during the Project.



6.3 Comparison of Detection Method Effectiveness

A wide range of factors are known to influence the 'detectability' of and distance from which protected species are most likely to be detected. These include environmental and operational variables, animal behavior and the type of monitoring method.

UE was the most effective monitoring method overall, with an average of 41 initial detections per 1000 hours of PSO Effort (based on UE and RB combined and the assumption that a third of NVD and IR PSA Effort during darkness involved UE as the AMP (Ørsted, 2021b) to minimize potential eye strain). UE was particularly effective during Daylight (52 initial detections per 1000 hours of PSO Effort), but less effective during Darkness (4 initial detections per 1000 hours of PSO Effort). Within this category there were 11 occasions where RB was the initial detection method, often used for scanning large areas or investigating unusual ripples or splashes in the water in the distance. RBs were more often used as a subsequent detection method (44%, n=115) after initially detecting a sighting using UE, due to the usefulness of RBs for obtaining more detail on detections, including taxonomic identification, group size and behavior, as well as providing an accurate method of calculating distance.

Both NVDs and HH IR devices were compromised by adverse weather conditions (moisture in the air). The larger field of view of the NVDs was considered more effective than the narrower field of view of the HH IR devices and this is reflected in the detection rates with the NVD averaging 6 initial detections per

1000 hours of PSO Effort in Darkness, whereas there were no detections attributed to the HH IR. The HH IR worked better than the NVDs in areas lit by the vessel's floodlights, where the ambient lights rendered the NVDs ineffective. Therefore, for optimal use of the NVDs bridge and deck lights were preferred to be switched off. The HH IR only worked outside due to heat sensitivity, whereas the NVDs did work inside but were dependent on the amount of reflection from the window; however, they were most effective when used outside. It was also reported that NVDs work most effectively during clear skies with no or minimal clouds and with a full moon, whereas overcast skies were considered less suitable conditions. IR cameras were considered useful for supplementing NVDs to account for vessel lights or extreme darkness.

The HH IR device was used for just over 41 hours (<0.5% of PSO Effort) during the Surveys. This limited effort may have been due to the PSOs choosing other monitoring methods due to the limitations discussed above.

Although these Surveys highlighted the effectiveness of UE, previous surveys have shown vessel mounted IR camera to be effective to monitor marine animals in darkness (Gauthier-Barette *et al.*, 2019) with effective monitoring of marine animals at much farther distances than other methods.

Unfortunately, distances cannot be accurately determined using RB at night; therefore, it is recommended that night vision range finders be required on future projects and evaluated for effectiveness. In addition, it is recommended that further development into the thermal imaging distance estimation and auto-detection software be pursued in order to increase the effectiveness of detections using thermal imaging.

In general, a combination of detection methods would be advisable during HRG surveys to effectively monitor the EZ in order to cope with varying survey conditions and distances of protected species from the vessel.

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APPENDICES

APPENDIX A MONITORING EQUIPMENT SPECIFICATIONS

A.1.1 Night Vision Device Specifications

Model	GNVY-3 (Rongland)	PVS-7 (Armasight/FLIR)	PVS-14 Monocular
Generation Image Intensifier Tube	3	3P	
Resolution (lp/mm)	57 - 64	-	
Optical magnification	1x	1x	1x
FOV	40°	40°	40°
Lens system	26.8mm: F 1.2	27mm, F 1.2	26mm: F 1.2
Detection quarter moon	up to 275m	-	
Detection cloud cover	up to 240m	-	
Recognition quarter moon	up to 225m	-	
Recognition cloud cover	up to 150m	-	
Identification	up to 90m	-	
Weight	510g	680g	307g
Eye relief	15mm	15mm	25mm
Dimensions	160x150x75mm	162x152x76mm	114x64x70mm
Focus range, m	0.25 to ∞	0.20 to ∞	0.25 to ∞
Diopter Adjustment	-6 to +5	-	-6 to +2
Signal to Noise	>23	-	
Supply voltage, V (CR123A)	3	-	
Automatic Brightness Control	Yes	Yes	
Automatic Light Cut-Off	Yes	Yes	
Automatic Shut-off System	Yes	Yes	
IR effective distance (m)	30	-	
Interpupillary Adjustment, mm	57÷73	-	
Output pupil diameter, mm	15	-	
Operating resource, hours	10000	-	
Operating Temperature Range °C	-40 to 55	-40 to 50	
Shock resistance	5g	-	

A.1.2 Vessel Mounted IR Specifications

Model	NVTS Reliant 640HD	Current Corp NN3050
Sensor type	Uncooled LWIR FPA	MWIR (inSb FPA)
Working band	8µm~14µm	3µm~5µm
Resolution	640 x 480	640 x 512
Sensor	17µm	-
NETD (300K)	≤60mK	-
FOV	40mm: 15.5 x 11.6°	28° to 2°
Image enhancement	Support	-
Video display	Black Hot/White Hot	-
Digital zoom	1x, 2x, 4x	12x
Video sensor	Full HD 1920 x 1080/60p (2.14MP)	1/28" CMOS
Signal system (NET)	1080P/30, 1080P/25, 720P/60, 720P/50, 720P/30, 720P/25	1080P/30
Signal system (SDI)	1080P30, 1080I60, 720P60, 720P30, 1080P25, 1080I50, 720P50m 720P25	1080P/30
Zoom	30x optical zoom (12x digital)	30x
Lens	4.3mm to 129mm F1.6 to F4.7	-
HFOV	65,0° (wide) to 2.3° (tele)	63,0° (wide) to 2.2° (tele)
Min illumination	Color: 0.0013Lux; Mono: 0.0008Lux	Color: 0.0008Lux; Mono: 0.0015Lux
WB	Auto	Auto
Focus	Auto/Manual	Auto/Manual
S/N Ratio	Not less than 50dB	-
WDR	Yes	-
BLC	On/Off	-
Image stabilization	On/Off	On/Off
DNR	1-5 Steps/Off	-
Day/Night	Auto/Manual	Auto/Manual
Pan range	360° continuous	360° continuous
Pan speed	Control speed: 0.04°~100°/s adjustable. Preset speed: 100°/s	-
Tilt range	-15°~90° (auto flip)	90°
Tilt speed	Control speed: 0.04°~90°/s adjustable. Preset speed: 90°/s	-
Preset	256	-
Preset precision	±0.2°	-
Stabilization	Gyro and Digital	Gyro
Image resolution	1920 x 1080@30fps	-
Image compression	H.264	-
Audio compression	AAC	-

Model	NVTS Reliant 640HD	Current Corp NN3050
Protocols	HTTP, RTSP, TCP, UDP, ONVIF	SDI
Simultaneous Live View	Up to 10	-
Dual stream	Yes	Yes
Ethernet interface	10/100M	10/100M
Control interface	RS-485	IP
Address	0~255	-
Common protocol	PELCO-P/PELCO-D (self-adaptive)	-
Baud rate	2400bps, 4800bps, 9600bps, 19200bps (self-adaptive)	-
Voltage	DC 10.8~28V	24 to 36 VDC
Power	35W/50W (heater on)	320W
Working temperature	-35°C~+55°C	-20°C~+55°C
IP Index	IP67	-
Dimension	Ø190mm x 275mm (7.48" x 10.83")	240mm x 432mm
Weight	6.3±0.1kg (13.89±0.22lb)	<20kg

A.1.3 Hand-held IR Specifications

System	BHM-XR (35mm)	BHM-XR (65mm)	Scout III 640 (FLIR)
FOV	18° x 13° NTSC	10° x 8° NTSC	10° x 14° NTSC
Start-up from Standby	< 1.5 seconds	< 1.5 seconds	< 1.5 seconds
Waveband	7.5 - 13.5µm	7.5 - 13.5µm	-
Thermal Sensitivity	<50mK @ f/1.0	<50mK @ f/1.0	-
Detector Type	640 x 480 VOx Microbolometer	640 x 480 VOx Microbolometer	640 x 512 VOx Microbolometer
Image Processing	FLIR Proprietary Digital Detail Enhancement	FLIR Proprietary Digital Detail Enhancement	FLIR Proprietary Digital Detail Enhancement
Power Button	On/Off/Standby	On/Off/Standby	On/Off/Standby
Picture Button	Still & Video image capture to SD card	Still & Video image capture to SD card	Still & Video image capture to SD card
Zoom Button	2x & 4x E-zoom	2x & 4x E-zoom	2x & 4x Zoom
Brightness	Adjusts Display Brightness	Adjusts Display Brightness	Adjusts Display Brightness
Built-In Display	LCD Display	LCD Display	LCD Display
Video Output	NTSC or PAL composite video; RCA jack	NTSC or PAL composite video; RCA jack	NTSC
Video Refresh Rate	<9Hz or 30Hz (NTSC and PAL)	<9Hz or 30Hz (NTSC and PAL)	30Hz NTSC
Image Polarity	White Hot/Black Hot/Marine Red/InstAlert; Selectable	White Hot/Black Hot/Marine Red/InstAlert; Selectable	Black Hot/White Hot/Graded Fire/InstAlert
On-Screen Symbology	Standard	Standard	-
SD Card	Stores still images and video	Stores still images and video	-
Battery Type	4 AA Batteries; NiMH, Li-Ion, or Alkaline	4 AA Batteries; NiMH, Li-Ion, or Alkaline	Li-Ion
Battery Life (Operating)	>5 hours on NiMH batteries	>5 hours on NiMH batteries	>5 hours on NiMH batteries
Battery Life (Stand-By)	120 hours on NiMH batteries	120 hours on NiMH batteries	-
Rating	IP-67, Submersible	IP-67, Submersible	IP-67, Submersible
Operating Temp.	-4°F to +140°F (-20°C to +50°C)	-4°F to +140°F (-20°C to +50°C)	-4°F to +122°F (-20°C to +50°C)
Drop	1m drop (camera body only)	1m drop (camera body only)	-
Physical Dimensions	10.5" x 6.5" x 2.6"	11.5" x 6.5" x 2.6"	8.7" x 2.3" x 2.4"
Weight (incl. lens)	2.84lb (1290g) with batteries	3.05lb (1380g) with batteries	12oz (340g)

APPENDIX B PROTECTED SPECIES INCIDENT REPORTS