DocuSign Envelope ID: EFD94765-5E11-4ED4-8104-A0C65B976D1E

MAKING COMPLEX EASY

OCS PERMIT L21-038 & A-00006 DAS BOREHOLE PROTECTED SPECIES OBSERVER REPORT

Final

DocuSign Envelope ID: EFD94765-5E11-4ED4-8104-A0C65B976D1E

OCS PERMIT L21-038 & A-00006 DAS BOREHOLE PROTECTED SPECIES OBSERVER REPORT

Final

Report Reviewer	
Name	Date of Review
Chance Skinner	July 21, 2022
Katie Gideon	August 8, 2022

Final Report Approval	
Name	Stephanie Milne
Title	Senior Environmental Manager
Signature	DocuSigned by: Stephanie Milne 6312C0728E234BC...
Date	Sep 21, 2022

Prepared by:

RPS

Stephanie Milne

20 Park Plaza,
Suite 322,
Boston, Massachusetts 02116

T +1 281-589-7257
E Stephanie.Milne@rpsgroup.com

Prepared for:

BP

David Duke

501 Westlake, Park Boulevard
Houston, Texas 77079

T +1 832-734-5270
E David.duke2@bp.com

DocuSign Envelope ID: EFD94765-5E11-4ED4-8104-A0C65B976D1E

Contents

Acronyms and Abbreviations v

1 EXECUTIVE SUMMARY 5

2 INTRODUCTION 6
2.1 BOEM and NMFS Reporting Requirements 6

3 PROJECT OVERVIEW 9
3.1 Vessel Summary 10
3.2 Summary of Survey Equipment Used 11

4 MONITORING AND MITIGATION PROGRAM 12
4.1 Monitoring: PSOs and PAM Operators 12
4.2 Visual Monitoring: Protocols and Methods 13
4.2.1 Daylight Visual 14
4.3 Monitoring: PAM Protocols and Methods 14
4.3.1 PAM System 14
4.3.2 PAM Parameters 15
4.3.3 Hydrophone Deployment 17
4.4 Monitoring: Data Collection 17
4.4.1 Data Collection Requirements & Methods 17
4.5 Mitigation Measures 18
4.5.1 Strike Avoidance and Vessel Separation Distances 18
4.6 Reporting 19
4.6.1 Injured or Dead Protected Species 19
4.6.2 Non-functioning PAM System During Source Activity 19
4.6.3 Monthly Interim Reports 19
4.6.4 Final Report 19

5 DATA RECORDS AND ANALYSIS METHODS 20
5.1 Operation Activity 20
5.2 Monitoring Effort 20
5.2.1 Summary of Environmental Conditions 20
5.3 Visual Sightings of Protected Species 21
5.3.1 Closest point of approach 22
5.3.2 Detection rate 22
5.3.3 Behavior and behavior change 22
5.4 Monitoring Tools Efficacy and Comparisons Assessment 23
5.5 Mitigation Measures Implemented 23
5.6 Data Quality Control 24

6 RESULTS 25
6.1 Operation Activity 25
6.2 Monitoring Effort 25
6.3 Environmental Conditions 26

7 PROTECTED SPECIES OBSERVATION RESULTS 30
7.1 Visual Sightings 30
7.2 Acoustic Detection Summary 32
7.3 Protected species incident reporting 32
7.4 Summary of Mitigation Measures Implemented 32

DocuSign Envelope ID: EFD94765-5E11-4ED4-8104-A0C65B976D1E

7.4.1 Mitigation for sound exposure from survey equipment 32
7.4.2 Mitigation for strike avoidance 33

8 SUMMARY 34
8.1 Interpretation of the Results 34
8.2 Monitoring Efficacy and Comparison Assessment 34
8.2.1 Effectiveness of PAM 34
8.3 Effectiveness of Monitoring and Mitigation 35

9 LITERATURE CITED 36

Tables

Table 1: BOEM Reporting Requirements 5
Table 2: General program parameters 9
Table 3: Summary of dates in areas of operation by vessel 9
Table 4: Summary of key program events for *Sanco Spirit* 10
Table 5: Summary of project vessel specifications 10
Table 6: Survey equipment operated by each survey vessel 11
Table 7: Visual monitoring methodology on the *Sanco Spirit* 14
Table 8: Beaufort Sea state scale 21
Table 9: Change in behavior state analysis variables 23
Table 10: Quality control editing performed by RPS on PSO datasets by data field 24
Table 11: Summary of regulated sound source operations on each survey vessel 25
Table 12: Summary of monitoring effort, visual and acoustic, by vessel and by source activity status 25
Table 13: Total monitoring effort, visual and acoustic, during day and night by airgun source activity status on the *Sanco Spirit.* 26
Table 14: Summary of visibility during visual monitoring effort on the *R/V Sanco Spirit*. 27
Table 15. Summary of Beaufort Sea state during visual monitoring during the survey 28
Table 16. Summary of Swell Height during visual monitoring during the survey 28
Table 17. Summary of precipitation during visual monitoring during the survey 29
Table 18: Detection records collected for each protected species visually detected during the program 31
Table 19: Acoustic detections and source activity during the BP Atlantis OBN Survey 32
Table 20: Summary of mitigation actions implemented on the *Sanco Spirit* 33
Table 21: Monitoring effort, protected species detections, and detection rate for each monitoring method 34

Figures

Figure 1: Simplified pathway of data through the PAM system onboard the source vessel 15
Figure 2: Diagram of 6-hydrophone element separation on *Sanco Spirit* 25m hydrophone array cable 16
Figure 3: Detection map for all Visual and Acoustic detections for the survey, small pullout for detections made during transit in and out of Port Fourchon, Louisiana. 30

DocuSign Envelope ID: EFD94765-5E11-4ED4-8104-A0C65B976D1E

Appendices

APPENDIX A : BOEM PERMIT, NMFS BIOLOGICAL OPINION AND LOA

APPENDIX B : ENVIRONMENTAL MONITORING PLAN

APPENDIX C : SURVEY VESSEL PHOTOS

APPENDIX D : PSO AND PAM OPERATORS

APPENDIX E : RETICLE BINOCULAR CALIBRATION TABLE

APPENDIX F : VESSEL SPECIFIC PAM DEPLOYMENT PROCEDURES

APPENDIX G : EXCEL DATA SHEETS OF MONITORING EFFORT, SOURCE OPERATIONS AND DETECTIONS OF PROTECTED SPECIES DURING THE SURVEY

APPENDIX H : PHOTOS OF VISUAL DETECTIONS

APPENDIX I : SCREENSHOTS OF ACOUSTIC DETECTIONS

APPENDIX J : LETTER OF DATA CERTIFICATION FROM LEAD

DocuSign Envelope ID: EFD94765-5E11-4ED4-8104-A0C65B976D1E

Acronyms and Abbreviations

ADC	Analog Digital Converter
BO	Biological Opinion on the Federally Regulated Oil and Gas Program Activities in the GOM
BOEM	Bureau for Ocean Energy Management
BZ	Buffer Zone
CPA	Closest Point of Approach
DAQ	Data Acquisition Unit
dB	Decibel
dB re 1 µPa (rms)	Decibel related to 1 micropascal (root mean square)
EMP	Environmental Management Plan
EOL	End of Line
EPU	Electronic Processing Unit
EZ	Exclusion Zone
FFT	Engine Noise Fast Fourier Transform
GOM	Gulf of Mexico
GPS	Global Positioning System
G&G	Geological and Geophysical
HF	High Frequency
Hz	hertz
kHz	Kilohertz
km	Kilometer
LF	Low Frequency
m	Meters
MF	Mid Frequency
min	Minute/s
MMPA	Marine Mammal Protection Act
NMFS	National Marine Fisheries Service
OBN	Ocean Bottom Node
PAM	Passive Acoustic Monitoring
PSO	Protected Species Observer
s	Second/s
SOL	Start of Line
TOAD	Time-of-Arrival-Distance
USB	Universal Serial Base
USFWS	United States Fish and Wildlife Service
UTC	Coordinated Universal Time

DocuSign Envelope ID: EFD94765-5E11-4ED4-8104-A0C65B976D1E

1 EXECUTIVE SUMMARY

The BP Atlantis 4D Ocean Bottom Node (OBN) survey was conducted by Magseis Fairfield in federal waters of the Gulf of Mexico (GOM) off the coast of Louisiana. This report is the final protected species report for the Atlantis 4D OBN project, comprising of the Green Canyon and Atwater Valley areas, and operated under BOEM G&G Permit L21-038, as well as concurrent effort on A-00006 at DC213, DC214 and DC222 to have the DAS Borehole Seismic recorded simultaneously with the OBN Survey. While the OBN survey of L21-038 was acquired, DAS cables were turned on to listen and record only, the *Sanco Spirit* source seismic pulses created survey data that also provided energy for the recording of the 3D DAS Borehole Seismic. There was no additional energy created uniquely for the 3D DAS Borehole Seismic. This report covers the protected species monitoring and mitigation efforts on the source vessel utilized by BP and Magseis Fairfield for this program.

The R/V *Sanco Spirit* towed airgun arrays and conducted operations under G&G Permit L21-038, from 12 April 2022 to 21 June 2022.

Protected Species Observers (PSOs) and Passive Acoustic Monitoring (PAM) Operators, provided through RPS, were assigned to the source vessel conducting 24-hour operations to undertake visual and acoustic observations and implement mitigation protocols, in accordance with the BOEM survey permit and the NMFS Biological Opinion on the Federally Regulated Oil and Gas Program Activities in the Gulf of Mexico (BO). Mitigation protocols for this survey included strike avoidance mitigation measures and the establishment of buffer zones (BZ) and exclusion zones (EZ) for marine mammals and other Endangered Species Act (ESA) protected species, including sea turtles. The R/V *Sanco Spirit* had three PSOs and four PAM operators onboard the vessel.

The R/V *Sanco Spirit* seismic source was active for a total of 1079 hours and 41 minutes, of which 890 hours and 08 minutes were at full volume. PSOs onboard conducted visual observations for a total of 1028 hours and 47 minutes, and PAM operators monitored acoustically for a total of 1447 hours and 57 minutes.

A total of 52 detection events of protected species occurred during the program with four of those being correlated detection in the Atlantis GoM area, 47 of which were marine mammal detections and five sea turtle detections.

Marine mammal detections consisted of 19 visual sightings and 28 acoustic detections. Visual detections of cetaceans consisted of six unidentified dolphins, 11 identified delphinid species, and two identified whale species: Pantropical spotted dolphin (*Stenella attenuate)*, rough-toothed dolphin (*Steno bredanensis),* short-finned pilot whale (*Globicephala macrorhynchus),* and sperm whale *(Physeter macrocephalus)*. For acoustic detections, there were four correlated detections of two rough-toothed dolphins, one of short-finned pilot whales and one of pantropical spotted dolphin. The remainder of acoustic detections were dolphins that were not identified at the species level.

Sea turtle detections consisted of five sightings of two identified species: loggerhead sea turtle (*Caretta caretta)* and green sea turtle *(Chelonia mydas)*.

There were no observations of dead/injured protected species during the program.

In accordance with stipulations set forth under G&G Permit L21-038, A-00006 and the GOM BO, a total of nine mitigation actions were implemented for the acoustic source, including three delays to activation of the source, two shutdowns of the active source and four voluntary turtle pauses.

No strike avoidance maneuvers for protected species were necessary during the program.

DocuSign Envelope ID: EFD94765-5E11-4ED4-8104-A0C65B976D1E

2 INTRODUCTION

The BP Atlantis 2022 4D OBN was conducted by Magseis Fairfield in federal waters of the Gulf of Mexico (GOM) off the coast of Louisiana. The Atlantis program comprises of the Green Canyon and Atwater Valley areas, operating under survey permits. This report is the final protected species report for the Atlantis OBN, conducted under BOEM G&G Permit L21-038 and A-00006 and covers the protected species monitoring and mitigation efforts on the source vessel R/V *Sanco Spirit* utilized by BP and Magseis Fairfield for this program.

National Marine Fisheries Service (NMFS) and BOEM have advised that sound-producing survey equipment operating in the hearing range of marine species has the potential to cause acoustic harassment, particularly to marine mammals. Protected species monitoring for the program was conducted in accordance with BOEM and NMFS standards as amended in the 2021 Biological Opinion on the Federally Regulated Oil and Gas Program Activities in the Gulf of Mexico (BO).

The survey company conducting operations was responsible for contracting Protected Species Observers (PSOs) through a provider to conduct monitoring and mitigation for protected species, including marine mammals, sea turtles, Gulf sturgeon, oceanic white-tipped shark and giant manta rays during their activities. Monitoring and mitigation procedures that were implemented during the 2022 program are described in Section 4 of this report.

2.1 BOEM and NMFS Reporting Requirements

This report summarizes the information required by the BOEM survey permit L21-038 and A-00006 and the BO, identified in Table 1. A copy of the BOEM permit is provided in Appendix A and an Environmental Management Plan (EMP) is provided in Appendix B, documenting reporting requirements from the survey permit and NMFS BO.

DocuSign Envelope ID: EFD94765-5E11-4ED4-8104-A0C65B976D1E

Table 1: BOEM Reporting Requirements

Required Content	Source Reference	Location Addressed in Technical Report
PSOs must use a standardized data collection form, whether hard copy or electronic. PSOs shall record detailed information about any implementation of mitigation requirements, including the distance of animals to the acoustic source and description of specific actions that ensued, the behavior of the animal(s), any observed changes in behavior before and after implementation of mitigation, and if shutdown was implemented, the length of time before any subsequent ramp-up of the acoustic source. If required mitigation was not implemented, PSOs should record a description of the circumstances.	NMFS BO Appendix A	Appendix G: Excel Data Sheet of Monitoring Effort, Source Operations and Detections of Protected Species
The MMPA authorization (as applicable) and BOEM Permit/Plan holder shall submit a draft comprehensive report to BOEM/BSEE (protectedspecies@boem.gov and protectedspecies@bsee.gov) and NMFS (nmfs.psoreview@noaa.gov) on all activities and monitoring results within 90 days of the completion of the survey or expiration of the MMPA authorization (as applicable) or BOEM Permit/Plan, whichever comes sooner, or if an issued MMPA authorization is valid for greater than one year, the summary report must be submitted on an annual basis,. The report must describe all activities conducted and sightings of protected species near the activities, must provide full documentation of methods, results, and interpretation pertaining to all monitoring, and must summarize the dates and locations of survey operations and all protected species sightings (dates, times, locations, activities, associated survey activities, and information regarding locations where the acoustic source was used). A final report must be submitted within 30 days following resolution of any comments on the draft report.	NMFS BO Appendix A	This Technical Report
The MMPA authorization (as applicable) and BOEM Permit/Plan holder must report sightings of any injured or dead aquatic protected species immediately, regardless of the cause of injury or death. For injured or dead non-marine mammal aquatic protected species, report incidents to the hotlines listed at https://www.fisheries.noaa.gov/report (phone numbers vary by state). For reporting dead or injured marine mammals, refer to the reporting requirements specified in the MMPA authorization (as applicable), associated with the activity being conducted.	NMFS BO Appendix A	7.3 Protected species incident reporting
SEISMIC SURVEY OPERATION, MONITORING, AND REPORTING GUIDELINES: The applicant will follow the guidance provided under Appendix A. Seismic Survey Mitigation and Protected Species Observer Protocols found in the Biological Opinion issued by the National	BOEM Survey Permit L21-038	This Technical Report

DocuSign Envelope ID: EFD94765-5E11-4ED4-8104-A0C65B976D1E

Required Content	Source Reference	Location Addressed in Technical Report
Marine Fisheries Service on March 13, 2020. The guidance can be accessed on NOAA Fisheries internet website at https://www.fisheries.noaa.gov/resource/document/appendices-biological-opinion-federallyregulated-oil-and-gas-survey-gulf-mexico.		
VESSEL-STRIKE AVOIDANCE/REPORTING: The applicant will follow the guidance provided under Appendix C. Gulf of Mexico Vessel Strike Avoidance and Injured/Dead Aquatic Protected Species Reporting Protocols found in the Biological Opinion issued by the National Marine Fisheries Service on March 13, 2020. The Appendix can be accessed on the NOAA Fisheries internet site at https://www.fisheries.noaa.gov/resource/document/appendicesbiological-opinion-federally-regulated-oil-and-gas-survey-gulf-mexico	BOEM Survey Permit L21-038	7.3 Protected species incident reporting 7.4.2 Mitigation for strike avoidance.
NMFS and BSEE must be notified via email (nmfs.psoreview@noaa.gov and protectedspecies@bsee.gov, respectively) as soon as practicable with the time and location off any operations conducted without an active PAM system. The notification will include the vessel name, the time and location (GIS position) in which the PAM system ceased function where seismic operations continued.	NMFS BO Appendix A	4.6.2 Non-functioning PAM System During Source Activity

DocuSign Envelope ID: EFD94765-5E11-4ED4-8104-A0C65B976D1E

NMFS LOA		
PSOs must use standardized electronic data forms. PSOs must record detailed information about any implementation of mitigation requirements, including the distance of marine mammals to the acoustic source and description of specific actions that ensued, the behavior of the animal(s), any observed changes in behavior before and after implementation of mitigation, and if shutdown was implemented, the length of time before any subsequent ramp-up or activation of the acoustic source. If required mitigation was not implemented, PSOs must record a description of the circumstances.	NMFS LOA, Section 5 (c)	Appendix G: Excel Data Sheet of Monitoring Effort, Source Operations and Detections of Protected Species
The Holder must submit a summary report to NMFS on all activities and monitoring results within 90 days of the completion of the survey or expiration of the LOA, whichever comes sooner, and must include all information described above under section 5(c) of this LOA. If an issued LOA is valid for greater than one year, the summary report must be submitted on an annual basis. The report must describe activities conducted and sightings of marine mammals, must provide full documentation of methods, results, and interpretation pertaining to all monitoring, and must summarize the dates and locations of survey operations and all marine mammal sightings (dates, times, locations, activities, associated survey activities, and information regarding locations where the acoustic source was used). In addition to the report, all raw observational data must be made available to NMFS.	NMFS LOA, Section 6 (a) i-ii	This Technical Report
The Holder must provide geo-referenced time-stamped vessel track lines for all time periods in which airguns (full array or single) were operating. Track lines must include points recording any change in airgun status (e.g., when the airguns began operating, when they were turned off). GIS files must be provided in ESRI shapefile format and include the UTC date and time, latitude in decimal degrees, and longitude in decimal degrees. All coordinates must be referenced to the WGS84 geographic coordinate system.	NMFS LOA, Section 6 (a) iv	Appendix G: Excel Data Sheet of Monitoring Effort, Source Operations and Detections of Protected Species
The draft report must be accompanied by a certification from the lead PSO as to the accuracy of the report, and the lead PSO may submit directly to NMFS a statement concerning implementation and effectiveness of the required mitigation and monitoring	NMFS LOA, Section 6 (a) v	Appendix J
In the event that personnel involved in the survey activities discover an injured or dead marine mammal, the Holder must report the incident to the Office of Protected Resources (OPR), NMFS and to the Southeast Regional Stranding Network as soon as feasible.	NMFS LOA, Section 6 (c) i	7.3 Protected species incident reporting

DocuSign Envelope ID: EFD94765-5E11-4ED4-8104-A0C65B976D1E

In the event of a ship strike of a marine mammal by any vessel involved in the survey activities, the LOA-holder must report the incident to OPR, NMFS and to the Southeast Regional Stranding Network as soon as feasible.	NMFS LOA, Section 6 (c) ii	7.4.2 Mitigation for strike avoidance.

DocuSign Envelope ID: EFD94765-5E11-4ED4-8104-A0C65B976D1E

3 PROJECT OVERVIEW

The objectives of this survey were to collect data to support: site characterization, development of a ground model, ensure the seabed is clear of obstructions, and identification of buried archaeological features in compliance with BOEM regulations and guidelines.

The Atlantis area is located 215 kilometers (116 nautical miles) south of Port Fourchon, Louisiana, in the Green Canyon and Atwater Valley protraction area of the US Gulf of Mexico. Water depths in this portion of the program area ranged from 1295 to 2345 meters. The working prospect covers approximately 676 square kilometers, with the node patch covering approximately 196 square kilometers in the center of the survey area Table 2.

Table 2: General program parameters

Area Parameters	
General Location:	US GoM, Green Canyon and Atwater Valley protraction area
Prospect Size (km²):	676km^2
Water depth	1295 – 2345 m
Port location	Fourchon
Source Vessel	*R/V Sanco Spirit*
Other Vessels Involved:	*Victory G (*Support Vessel), *REM Saltire* (Node Vessel)

Table **3** outlines the dates each vessel was in the portion of the program area covered in this permit and Table 4 outlines the key program events.

Table 3: Summary of dates in areas of operation by vessel

Vessel Name	Dates on Project		Area of Operation
R/V Sanco Spirit	12 April 2022	22 June 2022	Atlantis
REM Saltire	02 April 2022	10 June 2022	Atlantis
Victory G	12 Aril 2022	22 June 2022	Atlantis

DocuSign Envelope ID: EFD94765-5E11-4ED4-8104-A0C65B976D1E

Table 4: Summary of key program events for *Sanco Spirit*

Event	*R/V Sanco Spirit*
PSO team mobilizes	06 April 2022
Kick-off meetings	09-10 April 2022
Vessel departs dock - PSO effort begins	12 April 2022
Vessel arrives to prospect area	13 April 2022
Array testing begins	15 April 2022
Data acquisition commences	19 April 2022
Standby, awaiting node deployment	27 April – 05 May 2022
Port call for crew change	17-18 May 2022
Data acquisition complete	21 June 2022
Vessel reaches dock - PSO effort complete	23 June 2022

3.1 Vessel Summary

The Atlantis OBN program was undertaken by the *Sanco Spirit*. The *Sanco Spirit* conducted data acquisition for the survey area from 12 April 2022 to 21 June 2022. All project vessels mobilized out of Port Fourchon which was the port of call for the duration of this project.

Specifications of each vessel are provided in Table 5 and photos of each vessel are included in Appendix C.

Table 5: Summary of project vessel specifications

Vessel Name	Vessel Operator	Length meters (m)	Width meters (m)	Production Speed knots (kts)	Max Speed knots (kts)
R/V Sanco Spirit	Sanco Shipping AS	86.5	16	4.4	17
REM Saltire	Sanco Shipping AS	111	24	4.0	11.6
Victory G	Groen	53.80	13.80	3.9	13.0

DocuSign Envelope ID: EFD94765-5E11-4ED4-8104-A0C65B976D1E

3.2 Summary of Survey Equipment Used

The *Sanco Spirit* towed an acoustic source comprised of six source arrays; the configuration is described in Table 6. Each array was activated in succession with the total operating source volume on vessel of 5110 cubic inches. The design while in acquisition was a “flip flop” pattern for a triple source, with the shot point interval per vessel every 53.7 meters at survey speeds of no more than 5.5 knots.

Table 6: Survey equipment operated by each survey vessel

R/V Sanco Spirit	
Energy Source	Bolt 1900 LLXT airguns
Number of Source Arrays	Two towed arrays
Number of Strings per Array	Three
Number of Elements per String	10-12-10
Frequency	0 – 200 Hertz
Intensity	~267 dB re 1 µPa
Full Volume	5110 cubic inches
Full Volume Activity	Simultaneous activation of the 32 elements in one source array

DocuSign Envelope ID: EFD94765-5E11-4ED4-8104-A0C65B976D1E

4 MONITORING AND MITIGATION PROGRAM

This section describes the protected species monitoring and mitigation measures established to meet the requirements of BOEM permit L21-038 and A-00006 and NMFS BO. Program mitigation measures were designed to minimize potential impacts of the survey activities on marine mammals, sea turtles, and other protected species of interest.

The following monitoring protocols were implemented to meet these objectives, and each are described in detail in a sub-section below:

Sanco Spirit

- Visual observations were required to be conducted from port to port during daytime hours, to provide real-time sighting data, allowing for the implementation of mitigation procedures as necessary.
- A PAM system was deployed with operators to conduct continuous acoustic monitoring, day and night, during source activity or when source activity was anticipated, to augment visual observations, implement mitigation measures, and provide additional marine mammal detection data.
  - In recognition of brief periods of PAM malfunction/downtime, the NMFS BO allowed for the sound source to remain active for 30 minutes without acoustic monitoring, both day and night. It also allowed for an additional two hours of no acoustic monitoring during the day if visual observations were continuous, sea state was at B4 or below, and there had been no acoustic detections in the past two hours.
  - Outages over 30 minutes were reported to NMFS directly, describing the date, time, duration, location, source activity, reason for outage, resolution and follow up.
- Protected species buffer and exclusion zones (EZs) were established around the regulated sound source, with delays to initiation and shutdowns of the active source, as well as voluntary turtle pauses on the *Sanco Spirit*, implemented when protected species were detected within these zones.

4.1 Monitoring: PSOs and PAM Operators

Trained and experienced PSOs and PAM Operators were assigned to each vessel during survey activities to conduct the monitoring for protected species, record and report detections, and request mitigation actions in accordance with the established regulatory requirements and monitoring plan.

RPS was responsible for ensuring that each PSO and PAM Operator met the minimum requirements set forth by BOEM in Lease Area stipulations and by NMFS. BOEM and NMFS PSO requirements include training in protected species identification and behavior, in addition to field experience in protected species observation in the Gulf of Mexico.

RPS was responsible for the provision of training certifications and resumes to be reviewed and approved by BOEM prior to deployment on the vessel.

RPS was responsible for providing the PSOs and PAM Operators with vessel-specific and survey contractor-specific training and Environmental Project Inductions during project kick-off meetings, conducted prior to the start of survey operations and prior to scheduled crew changes.

All certified PSOs and PAM Operators who were deployed during the program operations are listed in Appendix D.

DocuSign Envelope ID: EFD94765-5E11-4ED4-8104-A0C65B976D1E

4.2 Visual Monitoring: Protocols and Methods

A team of PSOs was deployed on the *Sanco Spirit* in sufficient numbers to meet the monitoring requirements of that vessel, as outlined in Table 7. PSOs monitored while the vessel was in transit and prior to and during all sound source operations conducted by the vessel. Visual monitoring was also conducted during all periods between sound source activities to collect additional protected species data. One or two PSOs monitored at a time and PSOs rotated monitoring shifts as needed to maximize concentration and to meet the watch requirements of the Lease Area (watch periods not to exceed two hours without a minimum one-hour break, and a maximum duration of 12 hours in a 24-hour period).

Visual monitoring locations on each vessel were selected in consideration of the following factors:

1. To afford PSOs a 360-degree viewpoint around the vessel and acoustic sources, such that the exclusion zones (EZ) around the sound sources and the strike avoidance separation distances could be simultaneously monitored,
2. Provide the highest vantage point possible to allow for monitoring out to the greatest distances ahead of, and around, the vessel,
3. Provide shelter from inclement weather, as needed,
4. Provide real-time communication with vessel, equipment operators, and remote PAM operator.

PSOs conducted their visual monitoring by actively scanning with the naked eye out to the furthest observation points visible, methodically sweeping areas closer to the vessel and focusing on the EZs and ahead of the vessel. PSOs conducted regular sweeps of the surrounding areas using magnification devices as described below. PSOs monitored for cues that might indicate the presence of protected species including but not limited to splashing, footprints, blows, and presence of other marine species (diving seabirds, fish feeding activity, etc.).

DocuSign Envelope ID: EFD94765-5E11-4ED4-8104-A0C65B976D1E

Table 7: Visual monitoring methodology on the *Sanco Spirit*

	R/V Sanco Spirit
Total Number of PSOs	3
Number of PSOs on Watch - Day	2
Visual monitoring equipment- Day	Big eyes, Digital single lens reflex camera, reticule binoculars
Visual monitoring conducted at night	N/A
Visual monitoring equipment (Night)	N/A
Range Estimation	Reticule binocular Comparison to object of known distance
Primary Monitoring Location	Bridge, Bridge wings

Displays inside the bridge showed current information about the vessel (e.g. position, speed, heading, etc.), sea conditions (e.g. water depth, sea temperature, etc.), and weather (e.g. wind speed and direction, air temperature, etc.). Environmental conditions, along with vessel and acoustic source activity, were recorded at least once an hour, or every time there was a change of one or more of the variables (for example, visibility, sea state, etc.).

4.2.1 Daylight Visual

The PSOs on board were equipped with hand-held reticle binoculars, big eyes binoculars, and digital single lens reflex (DSLR) cameras with zoom lens to aid in visual watches conducted during the day. PSO teams used field notebooks to record data while on watch and laptops were used to enter data.

Range estimates were made by comparison to object of known distance, as well as with reticle binoculars. Reticle binoculars were calibrated whenever possible to ensure accuracy of distance data. These reticle calibration tables are provided in Appendix E.

4.3 Monitoring: PAM Protocols and Methods

4.3.1 PAM System

Acoustic monitoring was used to augment visual monitoring efforts in the detection, identification and locating of marine mammals. Acoustic monitoring was required to be conducted continuously, day and night, during all source operations and on any day that production was expected.

DocuSign Envelope ID: EFD94765-5E11-4ED4-8104-A0C65B976D1E

Acoustic monitoring was undertaken by trained and experienced PAM Operators, each of whom had completed a BOEM-accepted PSO training course and an RPS in-house PAM training course, which includes use of the PAM systems on board a vessel. PAM monitoring shifts were no longer than four hours in duration followed by at least a two-hour break.

The PAM system was installed in a location which provided space for the system, allowed for quick communication with the navigation team and source operators. Information about the vessel (including position, heading, and speed), water depth, source activity, and PAM system status (including cable deployments/retrievals, changes to the system) were recorded at least once every shift or whenever any of the parameters changed.

Acoustic monitoring for marine mammals was conducted aurally and visually, utilizing PAMGuard software installed on the PAM system. Low to mid-frequency delphinid whistles, clicks, and burst pulses, as well as sperm whale clicks and baleen whale vocalizations, could be visualized in PAMGuard's spectrogram modules. Odontocete clicks could also be visualized in low frequency (LF) and high frequency (HF) click detector modules. Settings adjustments to amplitude range, amplitude triggers, and spectral content filters, among others, could be made in PAMGuard's spectrogram. Click detector modules were utilized to maximize the distinction between cetacean vocalizations and ambient signal. The map module within PAMGuard could be utilized to attempt localizing the position and range of vocalizing marine mammals. Sound recordings could be made using the HF and LF sound recording modules when potential marine mammal vocalizations were detected, or when the operator noted unknown or unusual sound sources.

4.3.2 PAM Parameters

Passive acoustic monitoring systems, designed to detect most species of marine mammals, was installed on the source vessel. The system was developed by Seiche Measurements Limited and consisted of the following main components: a tow cable with hydrophone array attachment, a deck cable, sounds cards, a computer and a suite of analysis software. Spare systems were also present on board, in the event the main system components became damaged or inoperable. The diagram in Figure 1 is a simplified depiction of the PAM system installed on the source vessel. Further PAM system specifications can be found in Appendix F.

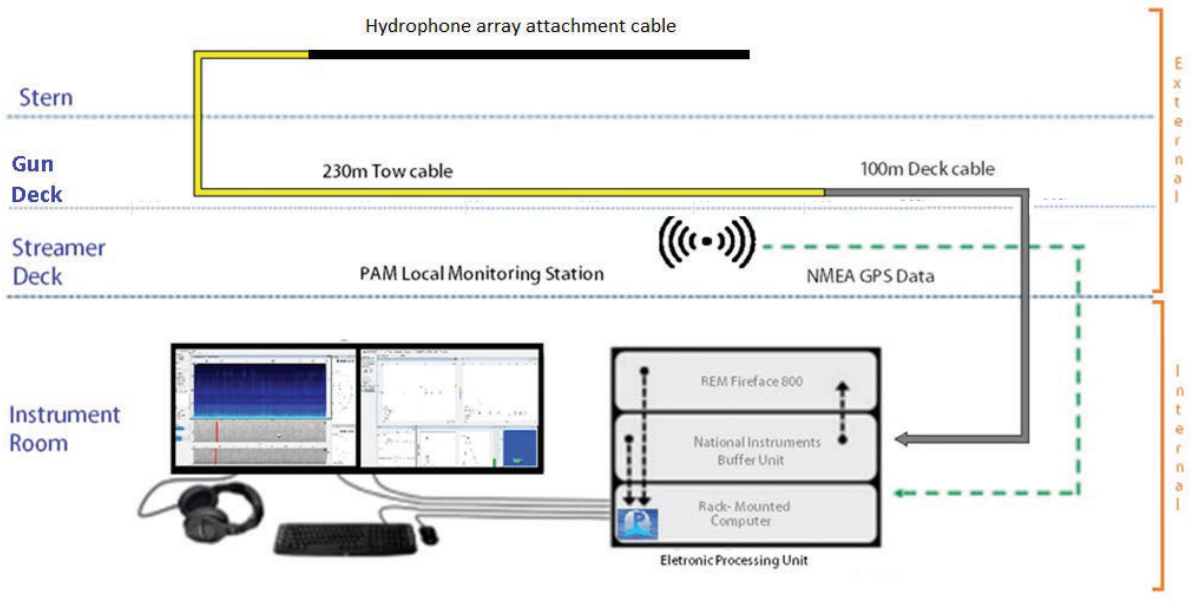

Figure 1: Simplified pathway of data through the PAM system onboard the source vessel

DocuSign Envelope ID: EFD94765-5E11-4ED4-8104-A0C65B976D1E

The linear hydrophone array attachment cable on the *Sanco Spirit* contained six individual hydrophone elements and a depth transducer, with spacing as shown in Figure 2. The forward hydrophone pair (H1, H2) was used to analyze and record LF sound (10 through 24,000 Hz); the middle hydrophone pair (H3, H4) was used to analyze and record middle frequencies (200 through 200,000 Hz), and the trailing hydrophone pair (H5, H6) was used to analyze and record HF sound (2,000 through 200,000 Hz).

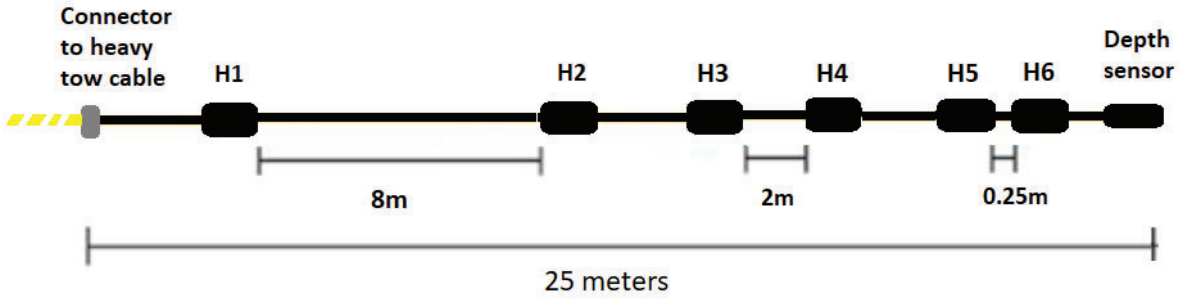

Figure 2: Diagram of 6-hydrophone element separation on *Sanco Spirit* 25m hydrophone array cable

The hydrophone array section was attached to a 230-meter heavy duty tow cable installed on the back deck of each vessel. The deck cable interfaced between the tow cable, and the EPU located at the monitoring station. The EPU contained a buffer unit with Universal Serial Base (USB) output, an RME Fireface 800 Analog Digital Converter (ADC) unit with firewire output, and a rack-mounted computer. A Global Positioning System (GPS) feed was supplied by each vessel's navigation system and connected to the PAM system using a USB port. Data from the hydrophone cable's depth transducer was routed through the buffer unit to the computer, via USB connection. The acoustic monitoring software PAMGuard was utilized for monitoring during the program.

Raw feed from the two designated HF hydrophone elements was digitized in the buffer unit using an analogue-digital National Instruments data acquisition (DAQ) soundcard at a sampling rate of 500 kHz. The output was filtered for HF content and visualized using the PAMGuard software. PAM Operators configured settings for digital pre-filter and trigger filters to optimize the detection capabilities of their vessels' system. PAMGuard used the difference between the time that a signal arrived at each of the two hydrophones to calculate and display the bearing to the source of the signal. A scrolling bearing/time module displayed the filtered data in real time, allowing for the detection and directional mapping of click trains. Additional components of the HF click detector system in PAMGuard were an amplitude/time display that registered click intensity data in real time, as well as click waveform, click spectrum, and Wigner plot displays, providing the PAM Operator immediate review of individual click characteristics in the identification process.

Raw feed from the designated LF hydrophone elements was routed from the buffer unit to the RME Fireface 800 unit, where it was digitized at a sampling rate of 48 kHz. The relatively LF output was further processed within PAMGuard by applying Engine Noise Fast Fourier Transform (FFT) filters, including click suppression and spectral noise removal filters (e.g. median filter, average subtraction, Gaussian kernel smoothing and thresholding). Filtered LF content was visualized in three spectrograms, one displaying two channel feeds at frequency ranges of zero to 24 kHz, and another displaying one channel feed at a frequency range of 0 to 6 kHz and the third display of 0 to 1kHz. LF click detector modules allowed for review of individual click characteristics as well as the detection and tracking of click trains.

A map module on the LF system interfaced with GPS data provided by the vessel to display the vessel location and could be used to determine range and bearing estimates based on clicks tracked in the click detector module. PAMGuard contains a function for calculating the range to vocalizing marine mammals based upon the least squares fit test. This method is most effective with animals that are relatively stationary in comparison to the moving vessel, such as humpback whales. The mathematical function

DocuSign Envelope ID: EFD94765-5E11-4ED4-8104-A0C65B976D1E

estimates the range to vocalizing marine mammals by calculating the most likely crossing of a series of bearing lines generated from tracked clicks or whistles and plotted on a map display. Additionally, the bearings of detected whistles and moans were calculated using a Time-of-Arrival-Distance (TOAD) method (the signal time delay between the arrival of a signal on each hydrophone is compared), and presented on a radar display, along with amplitude information for the detected signal as a proxy for range.

4.3.3 Hydrophone Deployment

On the *Sanco Spirit*, the hydrophone cable was deployed from a winch on the streamer deck from the center stern of the vessel. When fully deployed the trailing end of the PAM cable was 105 meters astern of the vessel, between the port and starboard arrays, the trailing pair of hydrophones were approximately 60 meters from the front of the nearest source, and tow depths averaged nine meters.

A more detailed description of the hydrophone deployment methods for each vessel can be found in Appendix F.

4.4 Monitoring: Data Collection

During or immediately after each detection event, the PSOs and PAM Operators recorded the detection details in a standardized datasheet provided to them by RPS. Excel data forms included tabs for project data, monitoring effort data, source operations data, and protected species detection data. RPS supplied a set of standardized variables for specific data fields that were on the data form provided to their PSOs.

Each detection event was linked to an entry on an effort datasheet where specific environmental conditions and vessel activity were logged.

Species identifications were made for visual detections whenever the distance of the animal(s), length of the sighting, and visual observation conditions allowed. Whenever possible during detections, photographs were taken with DSLR cameras that had telephoto lenses. Marine mammal identification manuals were consulted, and photos were examined during observation breaks to confirm identifications.

While acoustic monitoring does not allow assessment of group size with the same level of precision as by visual observation, the LF and HF click detector modules in PAMGuard allow PAM Operators to identify when multiple animals are vocalizing simultaneously or in very close succession. Click detectors present cetacean click trains on computer displays, spatially differentiated by relative bearings to the hydrophone array, so when multiple click trains occur simultaneously or in close succession, and the click trains come from different bearings, the PAM Operator knows the click trains originate from different animals. While this does not allow the PAM Operator to estimate a total group size, it does provide the PAM Operator an estimate for the minimum group size.

4.4.1 Data Collection Requirements & Methods

Data was collected to meet the requirements of BOEM and NMFS as summarized in Table 1 of this report.

PSOs and PAM Operators collected data in handwritten notepads and/or on portable tablet devices during watches. During watch breaks and at the end of daylight hours, data was compiled in proprietary data forms on laptop computers and backed up on portable hard drives.

DocuSign Envelope ID: EFD94765-5E11-4ED4-8104-A0C65B976D1E

4.5 Mitigation Measures

The following mitigation actions were required for visual and acoustic detections of marine mammals and sea turtles, including BP voluntary enhanced mitigation measures, on the Atlantis OBN Survey:

- Establishment of Buffer Zone (BZ) around acoustic array
  - Any distance for Rice's whales (BP voluntary enhanced mitigation measure for the *Sanco Spirit* only)
  - 1500-meter BZ for all true whales
  - 1000-meter BZ for all other marine mammals and sea turtles
- Establishment of Exclusion Zone (EZ) around energy sources with operating frequencies below 200 kHz for operations
  - Any distance for Rice's whales (BP voluntary enhanced mitigation measure for the *Sanco Spirit* only)
  - 1500-meter EZ for all true whales
  - 500 meters for all other marine mammals
  - 200 meters: A 6-shot turtle pause shall be implemented for any turtles within 100 meters of the source, such that the turtle is greater than 200m from the array upon resumption of source activity (BP voluntary enhanced mitigation measure for the *Sanco Spirit* only)
- Search periods of 30 minutes, conducted visually and acoustically (daytime) or acoustically (all periods of reduced visibility, including night) prior to the initiation of the acoustic array from silence.
- If marine mammals or sea turtles were detected inside their respective BZ during the search period prior to the initiation of the source, delays to the initiation of the sound sources were implemented until all animals had been observed exiting the BZ, or when the animals were not observed exiting, 15 minutes for small odontocetes and 30 minutes for all other marine mammals and sea turtles were implemented. All delays for acoustic-only detections were for 30 minutes.
- Shutdown of the active source upon detection of marine mammals inside their respective EZ. Shutdown was not required for dolphins of the genera *Steno, Tursiops, Stenella, and Lagenodelphis*. In the event of an acoustic detection of dolphins inside the EZ, unless a visual observer or PAM Operator could confirm that the animals detected were not of one of the four shutdown-exempted genera listed above, the detection was assumed to have been of one of those genera, and no shutdown was required.
- Once the sound source had been shut down for a protected species detection, operations would resume with ramp up following at least either all animals were observed exiting the exclusion zone, or when they were not observed exiting, 30 minutes had passed.

4.5.1 Strike Avoidance and Vessel Separation Distances

The following strike avoidance procedures were implemented for detections of protected species in the program area.

- Vessel operators must maintain a vigilant watch for all aquatic protected species. Vessels must slow down, stop their vessel, or alter course, as appropriate and regardless of vessel size, to avoid striking any protected species, including marine mammals, sea turtles, and ESA-listed fish species such as Gulf sturgeon, oceanic white-tipped shark and giant manta ray.
- When protected species are sighted while a vessel is underway, the vessel should take act to avoid violating the relevant minimum separation distances listed below. If protected species

DocuSign Envelope ID: EFD94765-5E11-4ED4-8104-A0C65B976D1E

are sighted within their relevant separation distance, the vessel should reduce speed and/or shift the engine to neutral, not engaging the engines until animals are clear of the area. Vessels were not required to shift into neutral for animals that voluntarily approach. For vessels limited in maneuverability, maintaining separation distances were not required if doing so would put the safety of crew or vessel at risk. The minimum separation distances are:

  - 500 m: All baleen whales including the Rice's whale
  - 100 m: Sperm whales
  - 50 m: All other marine mammals (including manatees), and sea turtles, and the ESA-listed fish species.

- Vessel speeds must be reduced to 10 knots or less when mother/calf pairs, pods, or large assemblages of any marine mammal are observed near a vessel.

4.6 Reporting

Reporting requirements of the BOEM Lease Area are outlined in Table 1. Both BOEM and NMFS require that monthly interim reports and a final survey report be prepared, detailing source operations, PSO/PAM effort, detection of protected species and any mitigation measures taken.

4.6.1 Injured or Dead Protected Species

Any injured or dead marine mammal or sea turtle observed either by a PSO on watch or by a crew member was required be reported to BOEM and NMFS as described in Table 1.Reporting requirements included a phone notification to the NMFS Regional Stranding hotline as soon as practicably possible, made by either the Lead PSO or shore based RPS Project Manager, as communications permitted from the vessel.

In the event of an injured or dead protected species detection, the Lead PSO would also prepare a written report in accordance with NMFS standard reporting guidelines, using the template provided by BOEM in the lease, which would be submitted to the agencies.

4.6.2 Non-functioning PAM System During Source Activity

RPS has prepared reports for each PAM outage event during source activity to meet the BO report requirements outlined in Table 1 of this report. PAM outage reports for the *Sanco Spirit* were submitted to NMFS and BOEM on the day of the event.

4.6.3 Monthly Interim Reports

RPS has prepared monthly interim reports to meet the BOEM lease and BO report requirements outlined in Table 1 of this report. Interim reports for the *Sanco Spirit* were submitted on 01 April 2022, 01 May 2022 and 01 June 2022.

4.6.4 Final Report

RPS has prepared this technical report to meet the BOEM lease and BO final report requirements outlined in Table 1 of this report. Each of the elements of the required final PSO report is provided in Table 1, referencing the section in this technical report where the element is addressed.

DocuSign Envelope ID: EFD94765-5E11-4ED4-8104-A0C65B976D1E

5 DATA RECORDS AND ANALYSIS METHODS

5.1 Operation Activity

PSOs and PAM Operators collected the operational status of regulated equipment each day that the equipment was deployed on the vessel.

Each vessel recorded the start of line (SOL) times and the end of line (EOL) times for the equipment during acquisition. The vessel also recorded the status of the equipment while acquisition occurred by noting full power or shutdowns due to mitigation actions.

5.2 Monitoring Effort

PSOs and PAM Operators recorded monitoring effort by entering start of watch and end of watch times into data sheets where the vessel position and environmental data was also documented for that duration.

Total monitoring effort was calculated by summing the durations of each watch period. Where the monitoring effort entry did not also indicate the source status for that monitoring period, source data was cross referenced during analysis to calculate the duration of monitoring conducted while regulated sources were on and off.

Acoustic monitoring while the acoustic source was silent included monitoring during transit between survey sites and other recorded silent periods in which the PAM cable could remain deployed without interfering with operations.

Visual monitoring while the acoustic source was silent included monitoring conducted during transit to/from survey sites and any other recorded silent periods (extended line changes, brief sequence changes, mitigation action, equipment downtime, or weather standby time).

5.2.1 Summary of Environmental Conditions

Each PSO monitoring effort data form included environmental conditions present during that watch period. Environmental variables were recorded every 60 minutes, or when conditions changed. Beaufort Sea state was recorded for each monitoring period using the accepted scale Table 8.

DocuSign Envelope ID: EFD94765-5E11-4ED4-8104-A0C65B976D1E

Table 8: Beaufort Sea state scale

Beaufort Number	Description	Wave Height	Sea Conditions
0	Calm	0 m	Sea like a mirror
1	Light air	0–0.3 m	Ripples with appearance of scales are formed, without foam crests
2	Light breeze	0.3–0.6 m	Small wavelets still short but more pronounced; crests have a glassy appearance but do not break
3	Gentle breeze	0.6–1.2 m	Large wavelets; crests begin to break; foam of glassy appearance; perhaps scattered white horses
4	Moderate breeze	1–2 m	Small waves becoming longer; fairly frequent white horses
5	Fresh breeze	2–3 m	Moderate waves taking a more pronounced long form; many white horses are formed; chance of some spray
6	Strong breeze	3–4 m	Large waves begin to form; the white foam crests are more extensive everywhere; probably some spray
7	High wind	4–5.5 m	Sea heaps up and white foam from breaking waves begins to be blown in streaks along the direction of the wind; spindrift begins to be seen
8	Gale	5.5–7.5 m	Moderately high waves of greater length; edges of crests break into spindrift; foam is blown in well-marked streaks along the direction of the wind
9	Severe gale	7–10 m	High waves; dense streaks of foam along the direction of the wind; sea begins to roll; spray affects visibility
10	Storm	9–12.5 m	Very high waves with long overhanging crests; resulting foam in great patches is blown in dense white streaks along the direction of the wind; on the whole the surface of the sea takes on a white appearance; rolling of the sea becomes heavy; visibility affected
11	Violent storm	11.5–16 m	Exceptionally high waves; small- and medium-sized ships might be for a long time lost to view behind the waves; sea is covered with long white patches of foam; everywhere the edges of the wave crests are blown into foam; visibility affected
12	Hurricane force	>14 m	The air is filled with foam and spray; sea is completely white with driving spray; visibility very seriously affected

Sea swell heights observed during visual monitoring were gauged by PSOs in meters, assigned to one of three swell height categories (<2, 2-4, >4) and recorded for each vessel. PSOs also recorded visibility during monitoring effort, in kilometers, where recorded values were selected from categories (>5, 2-5, 1-2, 0.5-1, 0.3-0.5, 0.1-0.3, 0.05-0.1, <0.05). Windspeed, wind direction, percentage of cloud cover, glare intensity and presence of/type of precipitation were other environmental conditions recorded during visual monitoring effort.

5.3 Visual Sightings of Protected Species

PSOs used standardized reporting forms provided by RPS to record all detections of marine mammals and sea turtles made during survey operations. These records were completed any time a sighting was made, regardless of distance, not just for detections where mitigation was implemented.

Sighting identification or detection event numbers were assigned chronologically for all protected species observed on a vessel throughout that vessel's survey activity. A new detection number was assigned for a new species sighting or when enough time had passed between observations of animals of the same species such that PSOs could not be certain that they were observing the same animals previously documented. A standard duration of time was to be applied between observations: 15 minutes for

DocuSign Envelope ID: EFD94765-5E11-4ED4-8104-A0C65B976D1E

delphinid and pinniped detections and 30 minutes for large whales. If there were multiple species in a single detection, the same sighting identification or detection event was used.

Protected species movement relative to the vessel, pace, and initial and subsequent behavior states were recorded for each protected species sighting where standardized categories for each were provided as controlled fields in the provided data form.

5.3.1 Closest point of approach

All PSOs recorded closest point of approach (CPA) and the source status at the CPA.

5.3.2 Detection rate

Detection rate was calculated using the number of protected species events per hour of monitoring effort, both visual and acoustic for all vessels. On a vessel where more than one PSO was on watch simultaneously, effort was not duplicated: one hour of monitoring effort by two PSOs consisted of one hour of effort for the purpose of detection rate calculations.

5.3.3 Behavior and behavior change

The PSO protected species detection template included an initial behavior and initial pace field for the detection. It included the direction of travel relative to the vessel at initial detection, pace, and direction of travel at final detection and other behaviors documented throughout the event. Where these data points were not included as specific entries in the data form, the information was sometimes available in a detection summary.

Protected species detection events were reviewed and categorized as having exhibited a change in behavior state or no observed change in behavior state.

The variables utilized to analyze change in behavior state are provided in Table 9.

DocuSign Envelope ID: EFD94765-5E11-4ED4-8104-A0C65B976D1E

Table 9: Change in behavior state analysis variables

Data Field	Variables	Analysis Method
Change in Behavior	Yes	• A detection narrative was provided that described a change • Initial and final pace were provided and were different • Initial and final direction of travel relative to vessel were provided and were different
	No	• If of the above criteria for an observed behavior change were satisfied, 'No change' was selected and detection data was then evaluated to determine whether no change was in fact observed or whether there was insufficient data provided to indicate whether a behavior change had been observed
Behavior change description	Insufficient data	• Initial and final pace data fields were empty • Initial and final direction of travel relative fields were empty • No detection narrative was provided • No subsequent behaviors after initial behavior state were provided • Detection duration (difference between initial and final detection time) suggested that observations may have occurred that were not documented in the data form
	Other direction change	• Any direction change that could not classified as moving away or approaching
	Pace change	• Any change in pace

5.4 Monitoring Tools Efficacy and Comparisons Assessment

Visual monitoring was mostly conducted by unaided eye, where handheld reticle binoculars, big eye binoculars and DSLR cameras with zoom lenses were also used to confirm a sighting or assist in making a species identification. The comparison of the monitoring tools efficacy will be limited to the one vessel that conducted monitoring of the different sound sources utilized during the Atlantis 4D seismic survey.

5.5 Mitigation Measures Implemented

Mitigation measures were implemented on the survey vessel as previously described. The onboard PSO team communicated requested mitigation in real time to survey operators that controlled the operation of the regulated sound sources or to the vessel crew operating the vessel, depending on the type of action required. Communications were conducted over handheld radios or in person.

Implemented mitigation actions were recorded on PSO data sheets in the detection data form and in the operations activity logs.

For each mitigation action, the mitigation downtime associated with that action was calculated. Mitigation downtime was the duration of the break in regulated source operations as required by the regulatory protocols: the duration of time that an animal was observed inside an EZ and any additional clearance time required before regulated sources could be activated. Mitigation downtime did not include any additional downtime that a survey operator needed to resume acquisition: additional vessel maneuvering time, time to deploy or calibrate equipment etc. Some detections included this additional downtime as a different field, production loss, but this variable was not recorded for every mitigation action taken.

DocuSign Envelope ID: EFD94765-5E11-4ED4-8104-A0C65B976D1E

5.6 Data Quality Control

RPS Project Manager reviewed all of the PSO data sets received from the vessel and conducted quality control as described in Table 10.

Table 10: Quality control editing performed by RPS on PSO datasets by data field

Data Type	Data Field	Corrections Made
Monitoring effort	Start of watch / End of watch	• Times were corrected or added where error was evident, typically by inconsistency with adjacent times
	Day time vs. Nighttime	• Failures to adjust time to Coordinated Universal Time (UTC) were corrected. • Times were corrected when end of effort overlapped with start of subsequent effort
Protected species detections	Position	• Positions that plotted out of place were corrected using effort positions of corresponding times, where available • When positions could not be corrected and position was on land, detection was removed from detection plots

DocuSign Envelope ID: EFD94765-5E11-4ED4-8104-A0C65B976D1E

6 RESULTS

This section of the report details sound source operations, protected species monitoring effort, environmental conditions during monitoring effort, detection data and distribution inside and outside the Lease Area during source operation and source silence.

The monitoring effort, source operations and protected species detections for the *Sanco Spirit* are also provided in excel datasets in Appendix G.

6.1 Operation Activity

The survey operations began with each vessel conducting source calibrations in the survey area before proceeding to acquisition, according to the survey plan. Survey operations were briefly suspended when necessary for weather, equipment maintenance, or port calls for provisions and crew change.

The dates of operation, total days of regulated source activity and hours of regulated source operations (shown in decimal hours [HH.HH]) by survey vessel are provided in Table 11.

Table 11: Summary of regulated sound source operations on each survey vessel

Vessel	Dates of Operation	Total Days of Regulated Source Activity	Total Hours of Regulated Source Operations (HH.HH)
R/V Sanco Spirit	12 April – 21 June 2022	70	1079.68

6.2 Monitoring Effort

Visual and acoustic (PAM) monitoring effort for all survey vessels during the survey is summarized in Table 12, shown by survey vessel and by activity of the seismic source and by the type of source utilized.

Table 12: Summary of monitoring effort, visual and acoustic, by vessel and by source activity status

Vessel and Type of Source Utilized	Source Equipment Active		Source Equipment Inactive	
	Duration (HH.HH)		Duration (HH.HH)	
	Visual	PAM	Visual	PAM
R/V Sanco Spirit	638.55	1079.68	390.23	368.27

The breakdown for visual only monitoring effort and concurrent visual and acoustic monitoring effort undertaken during day and night, according to source activity status, is provided for the *Sanco Spirit* in Table 13.

The *Sanco Spirit* did not have any instances of PAM downtime during this project. Table 13 summarizes the recorded duration of sound source activity, day and night, when no acoustic monitoring was conducted.

DocuSign Envelope ID: EFD94765-5E11-4ED4-8104-A0C65B976D1E

Table 13: Total monitoring effort, visual and acoustic, during day and night by airgun source activity status on the *Sanco Spirit.*

Monitoring Effort	Day (HH.HH)			Night (HH.HH)		
	Total	Source Active	Source Inactive	Total	Source Active	Source Inactive
Visual monitoring only	180.75	00.00	180.75	00.00	00.00	00.00
Visual and acoustic monitoring	848.03	638.55	209.48	00.00	00.00	00.00
Acoustic monitoring only	00.00	00.00	00.00	599.92	441.13	158.79
Total	**1028.78**	**638.55**	**390.23**	**599.92**	**441.13**	**158.79**

6.3 Environmental Conditions

Environmental conditions can have an impact on the probability of detecting protected species in a survey area. The environmental conditions present during visual observations undertaken the survey were moderate to severe.

Visibility was indicated in kilometers and recorded in one of eight categories (>5, 2-5, 1-2, 0.5-1, 0.3-0.5, 0.1-0.3, 0.05 to 0.1, and <0.05). The majority of monitoring effort (91.83%) was conducted in conditions where visibility extended to greater than 5 kilometers, 7.6% of monitoring effort occurred while visibility was between 0.5 and 5 kilometers, and 0.57% of monitoring effort was conducted while visibility extended to less than 0.5 kilometers. The duration of monitoring conducted at each visibility classification is provided in Table 14.

DocuSign Envelope ID: EFD94765-5E11-4ED4-8104-A0C65B976D1E

Table 14: Summary of visibility during visual monitoring effort on the *R/V Sanco Spirit*.

Visibility (km)	*R/V Sanco Spirit*	*Percent of Total Project*
	Duration (HH.HH)	**%**
<.05	5.82	0.57
0.05-0.1	0.75	0.07
0.1-0.3	2.73	0.27
0.3-0.5	9.80	0.95
0.5-1	7.30	0.71
1-2	25.70	2.50
2-5	32.00	3.11
>5	944.68	91.83
Total	**1028.78**	**100.00**

Monitoring effort for the *Sanco Spirit* was conducted in Beaufort Sea states ranging from Level 1 to Level 9, however, a majority of the monitoring effort accumulated in sea states at or below Level 4, which is generally considered favorable conditions for most protected species monitoring Table 15. Visual observations at Level 4 Beaufort Sea states or lower accounted for 98.38% of the total visual monitoring effort. There were no visual monitoring effort during Level 6 or higher during this survey.

DocuSign Envelope ID: EFD94765-5E11-4ED4-8104-A0C65B976D1E

Table 15. Summary of Beaufort Sea state during visual monitoring during the survey

Beaufort Sea State	*R/V Sanco Spirit*	Percent of Total Project
	Duration (HH.HH)	%
B0	18.35	1.78
B1	87.37	8.49
B2	440.57	42.82
B3	297.55	28.92
B4	168.43	16.37
B0 through B4	**1012.27**	**98.38**
B5	16.51	1.62
Total	**1028.78**	**100.00**

Monitoring effort was conducted in swell heights up to an in excess of 4 meters (m). However, most of the effort was conducted at swell heights below 2 m, which accounted for 95.71% of the total monitoring effort Table 16.

Table 16. Summary of Swell Height during visual monitoring during the survey

Swell Height (m)	*R/V Sanco Spirit*	Percent of Total Project
	Duration (HH.HH)	%
<2 m	1003.87	97.58
2 – 4 m	24.91	2.42
>4 m	0.00	0.00
Total	**1028.78**	**100**

Precipitation may also obscure visibility and sea surface. However, light rain, heavy rain and thin fog only attributed to 2.47% of the total visual effort Table 17. These conditions did not affect visibility to a point where operations had to be suspended.

DocuSign Envelope ID: EFD94765-5E11-4ED4-8104-A0C65B976D1E

Table 17. Summary of precipitation during visual monitoring during the survey

Precipitation	*R/V Sanco Spirit*	Percent of Total Project
	Duration (HH.HH)	%
Clear	925.88	90.00
Light Rain	20.03	1.95
Heavy Rain	5.37	0.52
Haze	77.50	7.53
Total	**1028.78**	**100.00**

DocuSign Envelope ID: EFD94765-5E11-4ED4-8104-A0C65B976D1E

7 PROTECTED SPECIES OBSERVATION RESULTS

7.1 Visual Sightings

This section of the report summarizes visual sightings of protected species made during the Atlantis OBN Survey. There were 24 protected species detections, both inside and outside the lease area, (n= 17 delphinid detections, n = 2 whale detections, n = 5 sea turtle detections). Detections consisted of five species of marine mammal species, two species of sea turtle, as well as unidentified dolphins.

Of the 24 visual detections, 75% (18 detection events) were identified to the species level while the remaining six detection events were identified to family level or a higher taxonomic level (classified as unidentified delphinids, unidentified beaked whale, unidentified cetacean or unidentified sea turtles).

A table of all protected species sightings is provided as part of an excel datasheet attachment in Appendix G. Photographs of the identified protected species visually detected during the program are provided in Appendix H. The distribution of protected species detections both inside and outside the permit area is provided in Figure 3.

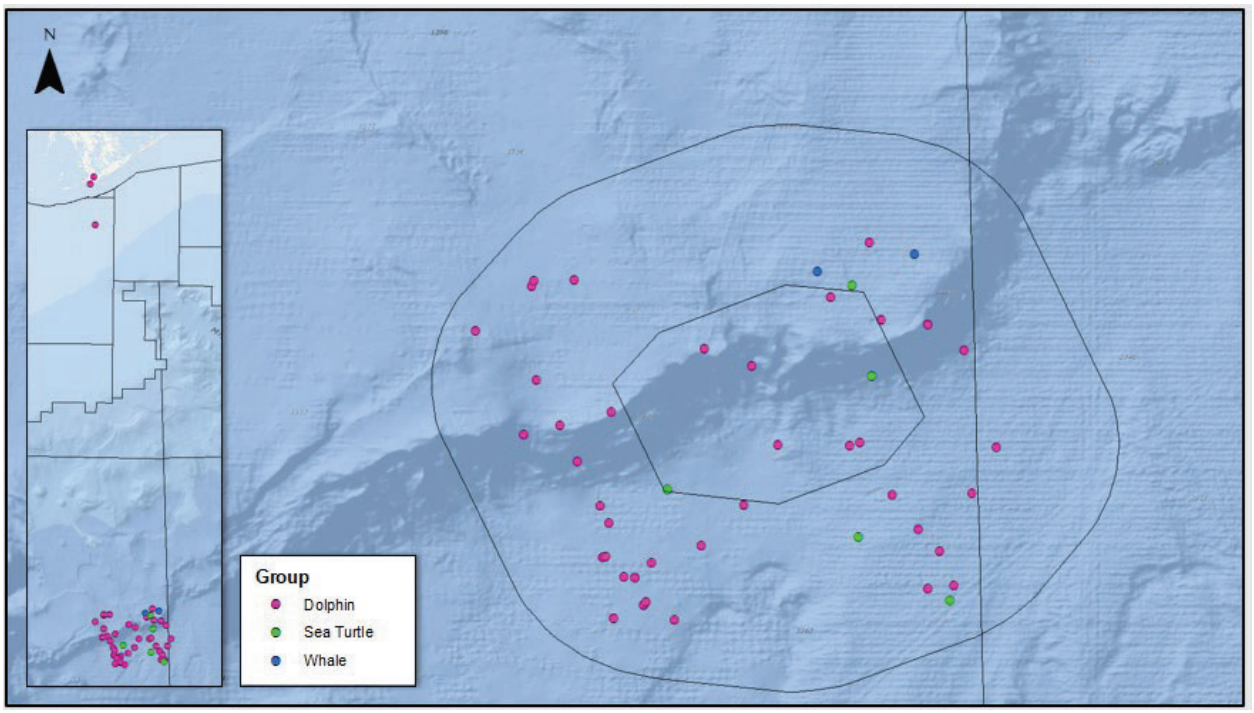

Figure 3: Detection map for all Visual and Acoustic detections for the survey, small pullout for detections made during transit in and out of Port Fourchon, Louisiana.

Table 18 shows the total number of detection records and the number of individuals detected for each protected species during the program. The locations of these detections, by group, can be found in Figure 3.

DocuSign Envelope ID: EFD94765-5E11-4ED4-8104-A0C65B976D1E

Table 18: Detection records collected for each protected species visually detected during the program

Species	Total Number of Visual Detection Records	Total Number of Animals
Sperm whale	2	5
Total whale	2	5
Unidentified dolphin	6	31
Short-finned pilot whale	3	33
Rough-toothed dolphin	2	30
Pantropical spotted dolphin	3	99
Bottlenose dolphin	3	10
Total dolphin	17	203
Loggerhead sea turtle	2	2
Green sea turtle	3	3
Total sea turtle	5	5
Total protected species		

DocuSign Envelope ID: EFD94765-5E11-4ED4-8104-A0C65B976D1E

7.2 Acoustic Detection Summary

There were 28 only acoustic detections of marine mammals associated with the Atlantis OBN program. 24 of the acoustic detections were of dolphins identified at the family level. There were four correlated visual and acoustic detections.

Screenshots of acoustically detected protected species during the program are provided in Appendix I.

For all acoustic detections, the initial indication of detection was by visual detection of clicks on the HF click detector.

Of the 28 acoustic detections for the program, 13 occurred when the source was active and 15 occurred while the source was inactive Table 19.

Table 19: Acoustic detections and source activity during the BP Atlantis OBN Survey

Detections for the R/V *Sanco Spirit*	**Unidentified dolphin detections**	**Short-finned pilot whale detections**	**Rough-toothed dolphin detections**	**Pantropical spotted dolphin detections**
# of Detection Records	24	1	2	1
Number of detections while source was inactive	10	0	0	1
Number of detections while source was active	14	1	2	0

7.3 Protected species incident reporting

There were no observations of dead or injured protected species during the program.

7.4 Summary of Mitigation Measures Implemented

7.4.1 Mitigation for sound exposure from survey equipment

Requisite mitigation actions for protected species detected during the program were requested by PSOs/PAM Operators and implemented by source operators. There were three delays to source activity for protected species detections, there were four voluntary turtle pauses implemented, and there were two shutdowns.

DocuSign Envelope ID: EFD94765-5E11-4ED4-8104-A0C65B976D1E

Table 20: Summary of mitigation actions implemented on the *Sanco Spirit*

Mitigation Action	Dolphins		Whales		Sea Turtles		All Species	
	No.	Mitigation Downtime (HH.HH)	No.	Mitigation Downtime (HH.HH)	No.	Mitigation Downtime (HH.HH)	No.	Mitigation Downtime (HH.HH)
Delay to initiation of source	3	1.40	0	0.00	0	0.00	3	1.40
Voluntary turtle pause	0	0.00	0	0.00	4	0.05	**4**	**0.05**
Shutdown of active source	0	0.00	2	1.32	0	0.00	**2**	**1.32**
All Mitigation Actions	**3**	**1.40**	**2**	**1.32**	**4**	**0.05**	**9**	**2.77**

7.4.2 Mitigation for strike avoidance.

There were no strike avoidance mitigations for vessel or towed equipment interactions with protected species required during this program.

DocuSign Envelope ID: EFD94765-5E11-4ED4-8104-A0C65B976D1E

8 SUMMARY

8.1 Interpretation of the Results

Most of the marine mammal species that were detected during the survey were species that occur commonly in the Gulf of Mexico and that are regularly observed by PSOs and PAM Operators during survey activities. Each species detected was observed within its predicted range with no species encounters occurring outside of that species normal range.

For the marine mammal species groups, the distance at initial detection and at closest approach was closer when the regulated sound sources were off, but the sample sizes were still too small to be statistically significant. No behaviors were documented that suggested adverse impacts had occurred to any protected species encountered as a result of the survey activities undertaken.

8.2 Monitoring Efficacy and Comparison Assessment

During the survey, two different monitoring methods were used to detect protected species. Each method is discussed in Section 4.

1. Daytime unaided eye where PSOs made regular and frequent sweeps of the surrounding area with reticle binoculars and/or big-eye reticle binoculars.
2. PAM, which was used both day and night.

Table 21: Monitoring effort, protected species detections, and detection rate for each monitoring method

	Visual Monitoring (HH.H)	PAM (HH.HH)
Monitoring effort	1023.78	1447.95
Number of marine mammal detections	19	28
Detection rate	0.0518	0.0193
Number of sea turtle detections	5	--
Detection rate	0.0049	--

8.2.1 Effectiveness of PAM

PAM had a lower detection rate compared to visual monitoring, which is not unusual for PAM systems deployed on industry vessels where many factors can limit the efficacy of the system.

- The deployment configuration of a towed hydrophone cable is limited by vessel specific features such as the presence of thrusters and propeller because the PAM Operator must identify a safe location for deployment of the cable where entanglement risk for the cable is low.
- Vessel noise from the propellers occurs in the low-frequency range and at high decibel levels and has the potential to mask marine mammal vocalizations, especially those of large mysticete whales that produce calls that overlap in frequency with this vessel noise. Additional masking may occur from the vessel itself, especially for animals like dolphins that will frequently approach the front of the vessel and ride at the surface, where their highly directional vocalizations can be blocked by the hull.

DocuSign Envelope ID: EFD94765-5E11-4ED4-8104-A0C65B976D1E

Additionally, PAM detections are limited to vocalizing marine mammals where many species exhibit highly variable vocalizing behavior that changes depending on behavior state, social structure factors and age and gender. Environmental conditions can also limit the efficacy of PAM where increased background noise could result in masking of vocalizations that overlap in frequency with the noise.

Despite the limitations that exist with PAM systems, there was six acoustic only detections (three during daytime, three at night) made during the survey that were not accompanied by a visual sighting of the marine mammals, so this monitoring method enabled the detection of marine mammals that would otherwise not have been detected visually.

8.3 Effectiveness of Monitoring and Mitigation

In order to minimize the potential impacts to marine mammals and sea turtles, PSOs and PAM Operators assigned to all the survey vessels were prepared to implement mitigation measures whenever protected species were detected approaching, entering, or within the designated exclusion/buffer zones. No shutdown actions for the seismic sources were implemented during the project survey. PSOs and PAM Operators searched the exclusion zones prior to activation of sound sources and survey crew confirmed that exclusion zones were clear prior to initiating operations. Seismic sources were initiated gradually, in ramp-up format whenever multiple airguns would be active simultaneously.

Strike avoidance maneuvering was not necessary at any point during the survey.

There were no sightings of injured or dead protected at any point during the survey.

Visual and acoustic observations yielded a total 52 protected species detections and included marine mammals. PSOs and PAM Operators likely did not detect all animals present; however, it is highly unlikely that protected species were not detected inside the exclusion and buffer zones while the sources were active, especially since zones were relatively small and PSOs were equipped with multiple tools to augment visual monitoring. The environmental conditions present during monitoring were generally good for detecting protected species, especially inside the exclusion and buffer zones.

The monitoring and mitigation measures required by the BO and the lease area appear to have been an effective means to protecting the marine species encountered during survey operations.

DocuSign Envelope ID: EFD94765-5E11-4ED4-8104-A0C65B976D1E

9 LITERATURE CITED

Bureau of Ocean Energy Management (BOEM) Lease

National Marine Fisheries Service (NMFS) Endangered Species Act Section 7 Biological Opinion. Biological Opinion of the Federally Regulated Oil and Gas Survey Activities in the Gulf of Mexico. 2020. Appendix A & C.

United States Fish and Wildlife Service (USFWS). 2019. Marine Mammal Protection Act (MMPA). 16 U.S.C.