OCS PERMIT L21-014 SURVEY 2021
PROTECTED SPECIES OBSERVER REPORT

Final

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15 December 2021

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Approval for issue

Stephanie Milne		15 December 2021

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Acronyms and Abbreviations

ADC	Analog Digital Converter
BO	Biological Opinion on the Federally Regulated Oil and Gas Survey 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)
EOL	End of Line
EOW	End of Watch
EPU	Electronic Processing Unit
EZ	Exclusion Zone
FFT	Engine Noise Fast Fourier Transform
FV	Full Volume
GOM	Gulf of Mexico
GPS	Global Positioning System
HF	High Frequency
Hz	hertz
kHz	Kilohertz
km	Kilometer
LF	Low Frequency
LISS	Low Impact Seismic Source
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
RPAM	Remote Passive Acoustic Monitoring
s	Second/s
SOL	Start of Line
SOW	Start of Watch
SS	Soft Start
TEAMS	Microsoft Teams (Remote Communication Platform)
TOAD	Time-of-Arrival-Distance
TPS	Turned Pulse Source
TV	Team Viewer (Remote Viewing Software)
UNID	Unidentified
USB	Universal Serial Base
USFWS	United States Fish and Wildlife Service
UTC	Coordinated Universal Time
VSAT	Very Small Aperture Terminal

1 EXECUTIVE SUMMARY

The Chevron *Big Foot* Distributed Acoustic Sensing (DAS) Vertical Seismic Profiling (VSP) Phase One was conducted by Chevron in federal waters of the Gulf of Mexico (GOM) off the coast of Texas. The *Big Foot* DAS VSP *1* site is located in the Green Canyon and Walker Ridge leasing areas, operating under the survey permit L21-014. This report is the first and final Protected Species Report for the *Big Foot* DAS VSP 1, covering the protected species monitoring and mitigation efforts on the source vessel *M/V Sanco Atlantic* utilized by Chevron for this survey.

The *M/V Sanco Atlantic* conducted operations under BOEM Lease L21-014 and a National Marine Fisheries Service (NMFS) Letter of Authorization (LOA) from 14 October 2021 to 08 November 2021.

Protected Species Observers (PSOs) and Passive Acoustic Monitoring (PAM) Operators, provided through RPS, were assigned to the vessel conducting 24-hour source 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 the establishment of buffer zones (BZ) and exclusion zones (EZ) for marine mammals and other protected species, including sea turtles, visual and acoustic monitoring, and strike avoidance mitigation measures. The *M/V Sanco Atlantic* had three PSOs for visual monitoring and four PAM Operators conducting acoustic monitoring onboard the vessel.

The *M/V Sanco Atlantic* was active for a total of 343 hours and 58 minutes, of which 309 hours and 17 minutes were at full volume. PSOs conducted visual observations for a total of 270 hours and 53 minutes, and PAM Operators monitored for a total of 421 hours and 40 minutes.

A total of two detection events of protected species occurred during the survey in the survey area, all of which were sea turtles. There were no visual or acoustic detections of marine mammals throughout the survey.

Sea turtle detections consisted of one loggerhead sea turtle (*Caretta caretta*) and one unidentified sea turtle.

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

In accordance with stipulations set forth under Lease L21-014 and the GOM BO, a total of two mitigation actions were implemented for the sound sources, which were both voluntary turtle pauses. No strike avoidance maneuvers for protected species were necessary during the program.

There were no instances of non-compliance during this survey.

2 INTRODUCTION

The Chevron *Big Foot* Distributed Acoustic Sensing (DAS) Vertical Seismic Profiling (VSP) Phase One was conducted by Chevron in federal waters of the US Gulf of Mexico (GOM), off the coast of Texas. The Big Foot DAS VSP 1 site is located in the Green Canyon and Walker Ridge leasing areas, operating under the survey permit L21-014. This report is the first and final Protected Species Report for the *Big Foot* DAS VSP 1, covering the protected species monitoring and mitigation efforts on the source vessel *M/V Sanco Atlantic* utilized by Chevron for this survey.

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 outlined in the 2020 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 monitor and mitigate protected species, including marine mammals, sea turtles, Gulf sturgeon, and oceanic white-tipped shark and giant manta rays, during their activities. Monitoring and mitigation procedures implemented during this survey 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 L21-014 and the BO, identified in **Table 1**. A copy of the BOEM permit (Appendix A) and an Environmental Management Plan (EMP) (Appendix B), documenting reporting requirements from the survey permit and NMFS BO.

Table 1: BOEM and NMFS Reporting Requirements

Required Content	Source Reference	Location Addressed in Technical Report
BOEM		
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 Sheets of Monitoring Effort, Source Operations and Detections of Protected Species During the Program
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

Required Content	Source Reference	Location Addressed in Technical Report
BOEM		
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 Marine Fisheries Service on 13 March 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-program-gulf-mexico.	BOEM Survey Permit L21-014	This Technical Report
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 13 March 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-program-gulf-mexico.	BOEM Survey Permit L21-014	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 of 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
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 Sheets of Monitoring Effort, Source Operations, and Detections of Protected Species during the Survey

Required Content	Source Reference	Location Addressed in Technical Report
NMFS LOA		
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. This 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
For operations requiring the use of PAM, the report must include a validation document concerning the use of PAM, which should include necessary noise validation diagrams and demonstrate whether background noise levels on the PAM deployment limited achievement of the planned detection goals. Copies of any vessel self-noise assessment reports must be included with the report.	NMFS LOA, section 6 (a) iii	Appendix F: Vessel Specific PAM Deployment Procedures and PAM Validation Documents
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 data 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 H: Shapefiles of Vessel Position with Operational Source Status
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: Lead PSO Data Certification
A final report must be submitted within 30 days following resolution of any comments on the draft report.	NMFS LOA, Section 6 (a) vi	This technical report

Required Content	Source Reference	Location Addressed in Technical Report
NMFS LOA		
Reporting of injured or dead marine mammals: 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. 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) i-ii	**7.3** Protected species incident reporting

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 Big Foot area is located 495 kilometers (267 nautical miles) southeast of Port Galveston, in the Green Canyon and Walker Ridge block areas (Figure 1) US Gulf of Mexico. Water depths in this portion of the program area ranged from 1,130 to 3,332 meters. The operational area covers approximately 1,393 square kilometers, with the survey area covering approximately 387 square kilometers in the center of the operations area Table 2.

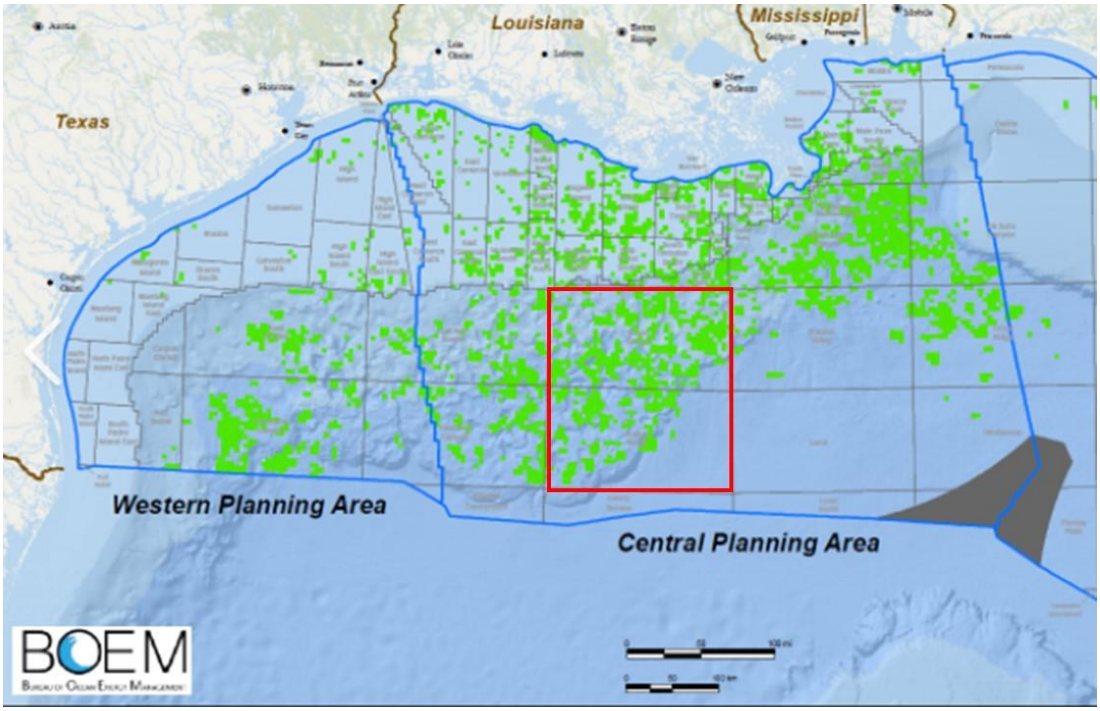

Figure 1: BOEM Lease area and survey location in the red box.

Table 2: General program parameters

Area Parameters	
General Location:	Green Canyon & Walker Ridge, Gulf of Mexico
Prospect Size (km²):	1,393
Water depth (m)	1,130 to 3,332
Port location	Galveston, Texas.
Source Vessel	*M/V Sanco Atlantic*
Other Vessels Involved:	*N/A*

3.1 Vessel Summary

The *M/V Sanco Atlantic* conducted data acquisition for the survey area from 16 October 2021 to 08 November 2021. The vessel mobilized out of Galveston, Texas, which was the port of call for the duration of this project. A summary of key survey events for the vessel is found in Table 3.

Table 3: Summary of key survey events for the *M/V Sanco Atlantic*

Event	Date
PSO team mobilizes	13 October 2021
Kick-off meetings	14 October 2021
Vessel departs dock - PSO effort begins	14 October 2021
Array testing begins	16 October 2021
Data acquisition commences	16 October 2021
Extended breaks in acquisition	16 October 2021 18 October 2021 19 October 2021 23 October 2021 24 October 2021 27 October 2021 28 October 2021 29 October 2021 30 October 2021 31 October 2021 04 November 2021
Data acquisition complete	08 November 2021
Vessel reaches dock - PSO effort complete	09 November 2021

Vessel specifications are provided in Table 4, and photos of the *M/V Sanco Atlantic* are included in Appendix C.

Table 4: Summary of project vessel specifications

Vessel Name	Vessel Operator	Length meters (m)	Width meters (m)	Production Speed knots (kts)	Max Speed knots (kts)
M/V Sanco Atlantic	Sanco Shipping AS	91.3	17.4	2.1-7.8	10

3.2 Summary of Survey Equipment Used

The *M/V Sanco Atlantic* acoustic source comprised six sub-arrays; the configuration is described in Table 5. Each array was activated in succession with a total operating source volume of 5,040 cubic inches. The design while in acquisition was a “flip flop flap” pattern for a double source, with the shot point interval every 50 meters at survey speeds of no more than seven knots.

Table 5: Survey equipment operated by the vessel

***Sanco Atlantic* acoustic source specifications**	
Energy Source	Airgun array
Manufacturer	Sercel
Model	G-source II
Number of Source Arrays	2 arrays / 6 sub arrays
Array Volume	5,040 in^3 per array
Frequency	5-50Hz
Source Level	237 dB re 1µPa
Array Length	15.0 m
Array Width	16.0 m (8 m between sub-arrays)
Array Depth	12.0 m

4 MONITORING AND MITIGATION PROGRAM

This section describes the protected species monitoring and mitigation measures established to meet the requirements of BOEM permit 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 is described in detail in a sub-section below:

- 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 PAM 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, the 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, the 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 *M/V Sanco Atlantic*, 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 the vessel during survey activities to monitor protected species, record and report detections, and request mitigation actions according to the established regulatory requirements and monitoring plan.

The PSO contractor 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 Atlantic Ocean or the Gulf of Mexico.

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

The PSO contractor was responsible for providing the PSOs and PAM Operators with vessel-specific and survey contractor-specific training; RPS and Chevron provided environmental Project Inductions during project kick-off meetings conducted prior to the start of survey operations.

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

4.2 Visual Monitoring: Protocols and Methods

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 PSO during transit and two PSOs during source operations monitored at a time. 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 the vessel was 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 the vessel, equipment operators, and the PAM Operator.

PSOs conducted their visual monitoring by actively scanning with the naked eye 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 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.). Visual monitoring methodologies used during the survey are summarized in Table 6.

Table 6: Visual monitoring methodology

M/V Sanco Atlantic	
Total Number of PSOs	3
Number of PSOs on Watch	2
Visual monitoring equipment	Handheld binoculars, big eyes, digital single-lens reflex (DSLR) cameras
Range Estimation	By naked eye, reticle binoculars
Primary Monitoring Location	Topdeck

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 and 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 handheld reticle binoculars, big eyes binoculars, and digital single-lens reflex (DSLR) cameras with zoom lenses to aid 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 and with reticle binoculars. Reticle binoculars were calibrated whenever possible to ensure the accuracy of distance data. These reticle calibration tables are provided in Appendix E.

4.3 Monitoring: PAM Protocols and Methods

4.3.1 Onboard PAM

Acoustic monitoring was used to augment visual monitoring efforts in detecting, identifying, and locating 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.

Trained and experienced PAM Operators undertook acoustic monitoring. Each of them had completed a BOEM-accepted PSO training course and an RPS in-house PAM training course, which includes using the PAM systems onboard 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 that provided space for the system and 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 signals. The map module within *PAMGuard* could be utilized to localize 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

The passive acoustic monitoring system, designed to detect most species of marine mammals, was installed on the vessel. Seiche Measurements Limited developed the system, which consisted of the following components: a tow cable with hydrophone array attachment, a deck cable, sound cards, a computer, and a suite of analysis software. A spare system was also present onboard if the main system components became damaged or inoperable. The diagram in Figure 2 is a simplified depiction of the PAM system installed on the vessel. Further PAM system specifications can be found in Appendix F.

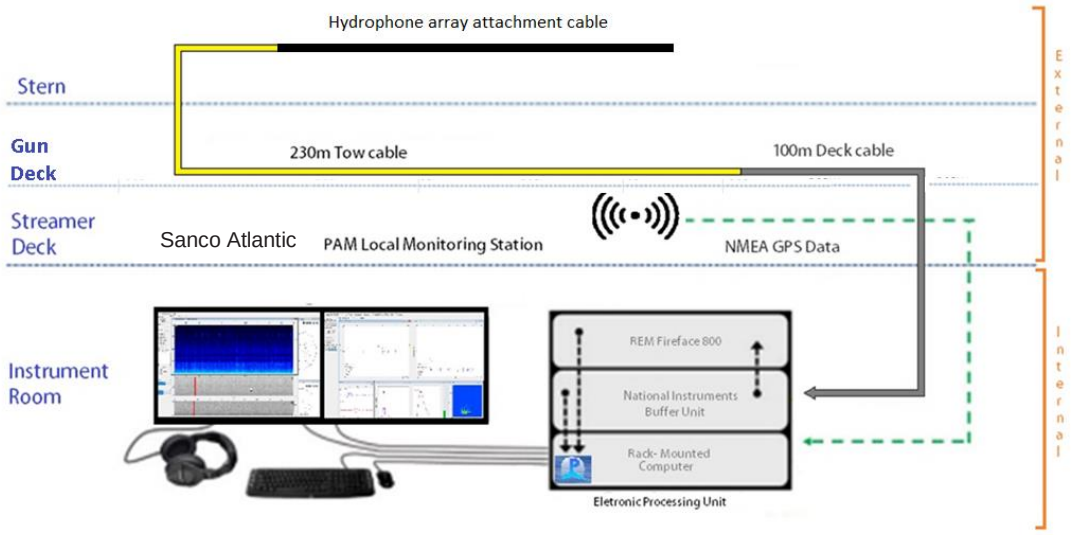

Figure 2: Simplified pathway of data through the PAM system onboard

The linear hydrophone array attachment cable on the *M/V Sanco Atlantic* contained six individual hydrophone elements and a depth transducer, with spacing as shown in Figure 3. 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).

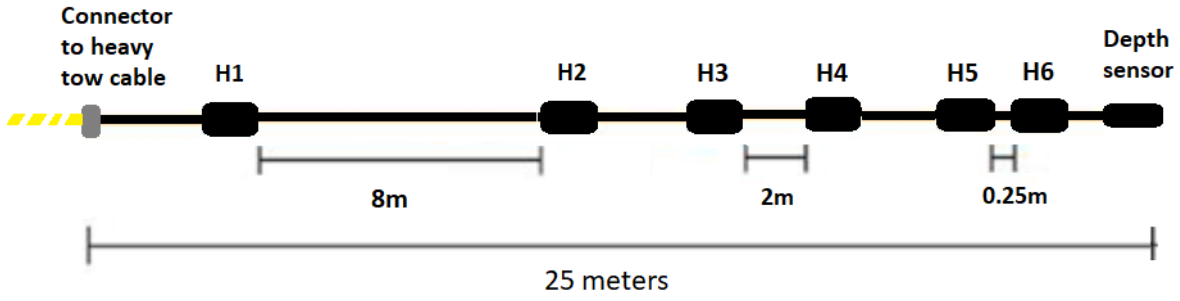

Figure 3: Diagram of 6-hydrophone element separation on 25 m hydrophone array cable.

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 towed 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 analog-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 signal source. 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 two spectrograms, one displaying two-channel feeds at frequency ranges of three to 24 kHz and another displaying one channel feed at a frequency range of 0 to 3 kHz. 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 is interfaced with GPS data from the vessel to display its location and determine the range and bearing estimates of clicks tracked with 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 relatively stationary animals, such as humpback whales. The mathematical function 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 *M/V Sanco Atlantic*, the hydrophone cable was deployed from the port stern using a winch on the top deck. When fully deployed, the trailing end of the PAM cable was 115 meters astern of the vessel, the trailing pair of hydrophones were approximately 75 meters from the port source, and tow depths averaged 10 meters.

A more detailed description of the hydrophone deployment method for the 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 data sheet 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 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 equipped with 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 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; when multiple click trains occur simultaneously or in close succession, and from different bearings,

the PAM Operator knows they originated 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 laptops and backed up on portable hard drives.

4.5 Mitigation Measures

The following mitigation actions were required for visual and acoustic detections of marine mammals and sea turtles, including Chevron voluntary enhanced mitigation measures, on the *Big Foot* DAS VSP *1*:

- **Buffer Zones (BZ):** Applicable during the pre-clearance search periods conducted prior to initiating the sound source from silence, where detections of a protected species inside its applicable BZ during the search will result in a delay in activating the source
  - **1,500 meters:** All true whale species (Bryde's whale, sperm whales, Kogia species, and all beaked whales)
  - **1,000 meters:** All other marine mammals and sea turtles
- **Exclusion Zones (EZ):** Applicable once the source has been activated, where detections of a protected species inside its applicable EZ will result in a shutdown of the sound source.
  - **1,500 meters:** All true whale species (sperm whales, Kogia species, and all beaked whales).
  - **500 meters:** All other marine mammals
  - **100 meters:** A 10 shot turtle pause shall be implemented for any turtles within 100 meters of the vessel, such that the turtle is greater than 200 meters from the arrays upon resumption of source activity.
- **Visual and Acoustic pre-clearance search periods:** 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 arrays 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.
  - Both the 30-minute pre-clearance search period and the mandatory delay for animals not seen exiting the buffer zone must be completed before source initiation. However, the pre-clearance search and delays can be implemented concurrently (they overlap). For a delay period that ends BEFORE the clearance search period is completed, the BZ will be cleared when the clearance search is completed. For a delay period that ends AFTER the standard

clearance search period is completed, the source can be active when the delay period is completed.

- 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 and 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 action to avoid violating the relevant minimum separation distances listed below. If protected species 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 approached. For vessels limited in maneuverability, maintaining separation distances were not required if doing so would put the safety of the crew or vessel at risk. The minimum separation distances are:
  - 500 m: All baleen whales, including the Bryde's whale
  - 100 m: Sperm whales
  - 50 m: All other marine mammals (including manatees), 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 program 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 to 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 the Lead PSO or shore-based PSO Provider, 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

There were no PAM outage reports for the *M/V Sanco Atlantic* during the program.

4.6.3 Monthly Interim Reports

RPS has prepared monthly interim reports to meet the BOEM lease and NMFS Biological Opinion report requirements outlined in Table 1 of this report. Interim reports for the *M/V Sanco Atlantic* were submitted on 01 November 2021 and 01 December 2021.

4.6.4 Final Report

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

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 start of line (SOL) and end of line (EOL) times for the equipment during acquisition. The vessels 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 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 7).

Table 7: 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 m) and recorded for the 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 km). Windspeed, wind direction, percentage of cloud cover, glare intensity, and presence of/type of precipitation were other environmental conditions recorded during visual monitoring efforts.

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 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 already documented. A standard duration of time was applied between observations: 15 minutes for 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; standardized categories for each were provided as controlled fields in the data form.

5.3.1 Closest point of approach

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

5.3.2 Detection rate

The detection rate was calculated using the number of protected species events per hour of monitoring effort, both visual and acoustic for the *M/V Sanco Atlantic*. On the *M/V Sanco Atlantic,* when more than one PSO was on watch simultaneously, an effort was not duplicated: one hour of monitoring effort by two PSOs consisted of one hour of effort for detection rate calculations purposes.

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, direction of travel at final detection, and other behaviors documented throughout the event. When 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 the change in behavior state are provided in Table 8.

Table 8: 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 none 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 be classified as moving away or approaching
	Pace change	• Any change in pace

5.4 Mitigation Measures Implemented

Mitigation measures were implemented on the *M/V Sanco Atlantic* as previously described. The onboard PSO team communicated and 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 the operations activity logs.

The mitigation downtime associated with that action was calculated for each mitigation action. 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 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.

5.5 Data Quality Control

The RPS data analysts reviewed all the PSO data sets received from the *M/V Sanco Atlantic* and conducted quality control as described in Table 9.

Table 9: 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
Source operations	Testing	• Testing status was not used as a separate category. Based on the survey days and monitoring effort times, testing was either added to the “on” status or not added to operations totals at all.
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
	Combining Unidentified categories	• Unidentified mysticetes was combined with the Unidentified whale category for data analysis • Unidentified cetacean was combined with the unidentified whales due to initial visual detection cue for data analysis

6 RESULTS

This section of the report details sound source operations, protected species monitoring efforts, environmental conditions during monitoring efforts, detection data and distribution inside and outside the lease area during source operations, and source silence.

The monitoring effort, source operations, and protected species detections for the *M/V Sanco Atlantic* are also provided in excel datasets in Appendix G. Shapefiles of vessel position with operational status of the source are included in Appendix H.

6.1 Operation Activity

Survey operations with the *M/V Sanco Atlantic* comprised the Green Canyon and Walker Ridge areas, operating under the survey permit. 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 10.

Table 10: Summary of regulated sound source operations on the vessel

Vessel	Dates of Operation	Total Days of Regulated Source Activity	Total Hours of Regulated Source Operations (HH.HH)
M/V Sanco Atlantic	14 October 2021 – 09 November 2021	27	343.97

6.2 Monitoring Effort

Visual and acoustic monitoring during the survey program broken down based on when the airguns were active or inactive is summarized in Table 11.

Table 11: Summary of monitoring effort, visual and acoustic by source activity status

Type of source utilized	Source Equipment Active		Source Equipment Inactive	
	Duration (HH.HH)		Duration (HH.HH)	
	Visual	PAM	Visual	PAM
Airguns	177.27	343.97	93.62	77.70

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 *M/V Sanco Atlantic* in Table 12.

Table 12: Total monitoring effort, visual and acoustic, during day and night by airgun source activity status

Monitoring Effort	Day (HH.HH)			Night (HH.HH)		
	Total	Source Active	Source Inactive	Total	Source Active	Source Inactive
Visual monitoring only	52.75	0.00	52.75	0.00	0.00	0.00
Visual and acoustic monitoring	218.13	177.27	40.87	0.00	0.00	0.00
Acoustic monitoring only	0.00	0.00	0.00	203.53	166.70	36.83
Total	**270.88**	**177.27**	**93.62**	**203.53**	**166.70**	**36.83**

There were no instances in which the *M/V Sanco Atlantic* sound source was active while no acoustic monitoring was conducted due to PAM downtime.

6.3 Environmental Conditions

Environmental conditions can impact the probability of detecting protected species in the survey area and during transit. The environmental conditions present during visual observations undertaken in the Bigfoot Survey were mild to moderate.

Visibility was indicated in kilometers and recorded in one of eight categories (>5, 2-5, 1-2, <1 km). A majority of monitoring effort (96.13%) was conducted in conditions where visibility extended to greater than 5 kilometers, 3.53% of monitoring effort occurred while visibility was between 2 and 5 kilometers, and only 0.34% of monitoring effort was conducted while visibility extended to between 1 and 2 kilometers. During the project, visibility was never below 1 kilometer. The duration of monitoring conducted at each visibility classification is provided in Table 13.

Table 13: Summary of visibility during visual monitoring effort

Visibility (km)	Duration (HH.HH)	% of Overall Monitoring Effort
>5km	260.40	96.13%
2 to 5 km	9.57	3.53%
1 to 2 km	0.92	0.34%
<1 km	0.00	0.00%
Total	**270.88**	**100.00%**

Monitoring effort was conducted in Beaufort Sea states ranging from Level 0 to Level 8 (Table 14). However, most monitoring efforts occurred when sea states were at or below Level 4, which is generally

considered favorable conditions for most protected species monitoring. Visual observations at Level 4 Beaufort Sea states or below accounted for (75.8%) of the total visual monitoring effort.

Table 14. Summary of Beaufort Sea state during visual monitoring during the program.

Beaufort Sea State	Duration (HH.HH)	% of Overall Monitoring Effort
B0	0.00	0.00
B1	5.18	1.9%
B2	53.60	19.8%
B3	74.20	27.4%
B4	72.25	26.7%
B0 through B4	**205.23**	**75.8%**
B5	35.32	13.0%
B6	25.68	9.5%
B7	4.08	1.5%
B8	0.57	0.2%
Total	**270.88**	**100.0%**

Precipitation may also obscure visibility and sea surface. However, a cumulative percentage of less than 5% accounted for these types of precipitation conditions (Table 15). These conditions still did not affect visibility to a point where operations had to be suspended.

Table 15. Summary of Precipitation during visual monitoring during the survey

Precipitation	Duration (HH.HH)	% of Overall Monitoring Effort
Clear	257.70	95.13%
Light Rain	9.57	3.53%
Heavy Rain	3.62	1.34%
Total	**270.88**	**100.0%**

Swell height during visual monitoring remained below two meters (93.1%) for most of the monitoring campaign, which is optimal for detecting protected species (Table 16).

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

Swell Height	Duration (HH.HH)	% of Overall Monitoring Effort
<2 m	252.23	93.1%
2-4 m	18.65	6.9%

>4 m	0.00	0.0%
Total	**270.88**	**100.0%**

7 PROTECTED SPECIES OBSERVATION RESULTS

7.1 Visual Sightings

This report section summarizes visual sightings of protected species during the *Big Foot DAS VSP 1* area survey. The two detections occurred within the survey area; both were sea turtles, with one being identified to the species level and the other identified only to the family or higher taxonomic level (classified as unidentified sea turtle).

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 I The distribution of protected species detections inside the permit area is provided in Figure 4

Table 17 shows the total number of detection records and the number of individuals detected for each protected species during the program.

Table 17: Detection records collected for each protected species visually detected during the survey.

Species	Total Number of Visual Detection Records	Total Number of Animals
Loggerhead sea turtle	1	1
Unidentifiable shelled sea turtle	1	1
Total protected species	**2**	**2**

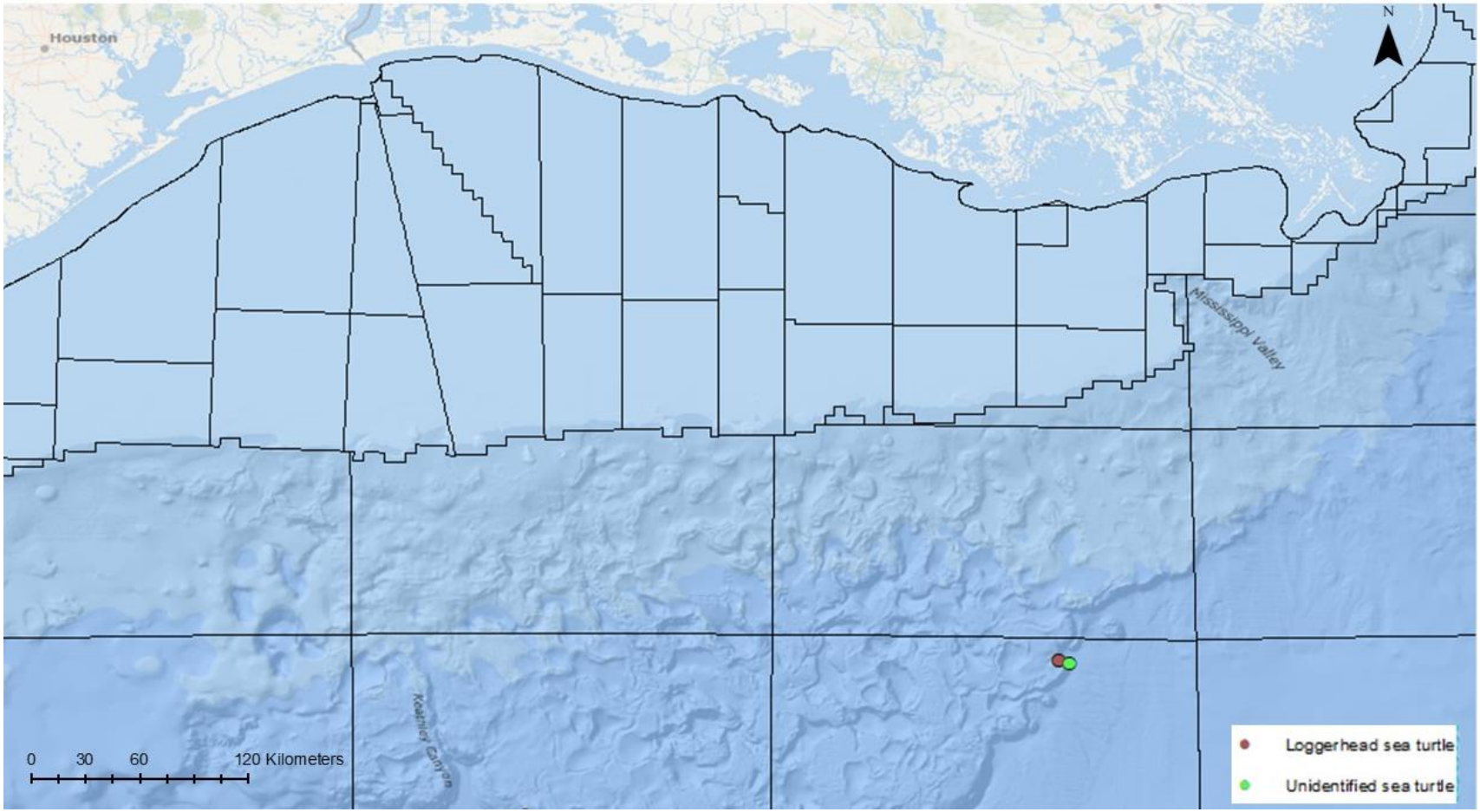

Figure 4: Map of protected species detections during the survey

7.1.1 Detection and Distance Summaries

All sea turtle detections consisted of one animal, with initial detection distances ranging from 10 to 100 meters from the vessel (Table 18). Generally, group sizes and initial detection distances tend to be smaller for sea turtle detections than marine mammals. There were too few turtle sightings events to conduct a behavioral analysis.

Table 18: Detection summary for turtles observed during program

Turtles	Loggerhead sea turtle	Unidentified shelled sea turtle
# of Detection Records	1	1
Estimated # of individuals detected	1	1
Group Size	1	1
Mean distance (m) at first detection	100	10
Detection rate	0.00369	0.00369

7.2 Acoustic Detection Summary

There were no acoustic observations made during the survey program.

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. Two voluntary turtle pauses were implemented, resulting in mitigation downtime totaling 0.08 hours for the entirety of the survey campaign aboard the *M/V Sanco Atlantic* (Table 19).

Table 19: Summary of mitigation actions implemented on the *M/V Sanco Atlantic*

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	0	0.00	0	0.0	0	0.00	0	**0.00**
Voluntary turtle pause	0	0.00	0	0.0	2	0.08	**0**	**0.08**
Shutdown of active source	0	0.00	0	0.00	0	0.00	**0**	**0.00**
All Mitigation Actions	**0**	**0.00**	**0**	**0.00**	**2**	**0.08**	**2**	**0.08**

7.4.2 Mitigation for strike avoidance

There was no strike avoidance mitigation for vessel or towed equipment interactions with protected species required during this survey.

8 SUMMARY

8.1 Interpretation of the Results

The sea turtles detected during the survey commonly occur in the Gulf of Mexico and are regularly observed by PSOs and PAM Operators during survey activities. Each detected species was observed within its predicted range, with no species encounters occurring outside its normal range. 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 due to the survey activities undertaken.

8.2 Effectiveness of Monitoring and Mitigation

In order to minimize the potential impacts to marine mammals and sea turtles, PSOs and PAM Operators assigned to the *M/V Sanco Atlantic* were prepared to implement mitigation measures whenever protected species were detected approaching, entering, or within the designated exclusion/buffer zones. PSOs and PAM Operators searched the exclusion zones prior to activation of sound sources, and the survey crew confirmed that exclusion zones were clear prior to initiating operations. The acoustic source was initiated gradually, in ramp-up format, whenever multiple sources would be active simultaneously.

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

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

Visual and acoustic observations yielded a total of two protected species detections, both of which were sea turtles. 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. During monitoring, the environmental conditions were generally good for detecting protected species, especially inside the exclusion and buffer zones.

The monitoring and mitigation measures required by the GOM Biological Opinion and the survey permit appear to have effectively protected the marine species encountered during program operations.

9 LITERATURE CITED

Bureau of Ocean Energy Management (BOEM) Lease

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

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

Appendix A: BOEM Permit, NMFS Biological Opinion, and NMFS Letter of Authorization

Appendix B: Environmental Monitoring Plan

Appendix C: Survey Vessel Photos

Appendix D: PSOs and PAM Operators

Appendix E: Reticle Binocular Calibration Table

Appendix F: Vessel Specific PAM Deployment Procedures and PAM Validation Documents

Appendix G: Excel Data Sheets of Monitoring Effort, Source Operations, and Detections of Protected Species during the Survey

Appendix H: Shapefiles of Vessel Position with Operational Source Status

Appendix I: Photographs of Identified Protected Species Visually Detected During the Survey

Appendix J: Lead PSO Data Certification