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OCS PERMIT L22-004
WESTERNGECO ENGAGEMENT III 3D OBN SURVEY
PROTECTED SPECIES OBSERVER FINAL REPORT

Final

29 June 2023

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REPORT

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Acronyms and Abbreviations

ADC	Analog Digital Converter
BO	Biological Opinion on the Federally Regulated Oil and Gas Program Activities in the Gulf of Mexico
BOEM	Bureau for Ocean Energy Management
BZ	Buffer Zone
CPA	Closest Point of Approach
DAQ	Data Acquisition
dB re 1 µPa (rms)	Decibel related to 1 micro pascal (root mean square)
EOL	End of Line
EPU	Electronic Processing Unit
ESA	Endangered Species Act
EZ	Exclusion Zone
FFT	Engine Noise Fast Fourier Transform
GOM	Gulf of Mexico
GPS	Global Positioning System
HF	High Frequency
Hz	hertz
kHz	Kilohertz
km	Kilometer
km^2	Square kilometers
LA	Louisiana
LF	Low Frequency
LOA	Letter of Authorization
m	Meters
MMPA	Marine Mammal Protection Act
NMFS	National Marine Fisheries Service
OBN	Ocean Bottom Node
OCS	Outer Continental Shelf
PAM	Passive Acoustic Monitoring
PSO	Protected Species Observer
s	Seconds
SOL	Start of Line
SW	Shearwater
TOAD	Time-of-Arrival-Distance
TX	Texas
US	United States
USB	Universal Serial Base
USFWS	United States Fish and Wildlife Service
UTC	Coordinated Universal Time

1 EXECUTIVE SUMMARY

The WesternGeco Engagement III 3D Ocean Bottom Node (OBN) survey was conducted by Shearwater GeoServices in United States (US) federal waters of the Gulf of Mexico (GOM), 110 nautical miles southwest of Port Fourchon, Louisiana (LA). The survey comprises the Garden Banks, Green Canyon, Keathley Canyon, and Walker Ridge protraction areas of the GOM. This report is the final protected species report for the survey, conducted under Bureau of Ocean Energy Management (BOEM) Lease L22-004 and covers the protected species monitoring and mitigation efforts on the two source vessels *Shearwater (SW) Gallien* and *SW Mikkelsen,* utilized for this survey.

The source vessels, *SW Gallien* and *SW Mikkelsen* towed two identical arrays on each vessel with a total of 28 airguns per array; each array was comprised of three sub arrays totaling a nominal source array volume of 5240 cubic inches. Both vessels conducted operations under Lease L22-004, for the *SW Mikkelsen* from 29 November 2022 to 06 April 2023 and for the *SW Gallien* from 21 November 2022 to 12 April 2023.

Protected Species Observers (PSOs) and Passive Acoustic Monitoring (PAM) Operators, provided through RPS, were assigned to each 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 National Marine Fisheries Service (NMFS) Biological Opinion on the Federally Regulated Oil and Gas Program Activities in the Gulf of Mexico (BO). Mitigation protocols for this survey included establishment of a buffer zone (BZ) and exclusion zone (EZ) for marine mammals and other protected species including sea turtles, visual and acoustic monitoring, and strike avoidance mitigation measures. Both the *SW Gallien* and *SW Mikkelsen* had three PSOs conducting visual monitoring per vessel, one local PAM Operator/Technician on board and three remote PAM Operators that connected to the vessel via a remote link from shoreside to preform acoustic watches.

For the portion of the survey conducted under Lease L22-004, the *SW Gallien* and the *SW Mikkelsen* were active for a total of 4,010 hours and seven minutes, of which 3,576 hours and 36 minutes were at full volume. PSOs conducted visual observations for a total of 3,186 hours and 55 minutes, and PAM Operators monitored for a total of 5,334 hours and 34 minutes.

A total of 132 detection events of protected species occurred during the survey, of which 111 were marine mammal detections, 19 sea turtle detections, and two ray detections.

Marine mammal detections consisted of 57 visual detections and 54 acoustic detections. Visual detections of cetaceans consisted of five identified delphinid species: bottlenose dolphin (*Tursiops truncates*), Spinner dolphin (*Stenella longirostris*), pantropical spotted dolphins (*Stenella attenuate*), Clymene dolphin (*Stenella clymene*) and Risso's dolphin (*Grampus griseus*). There were also 57 detections of unidentified delphinids, including eight visual sightings and 49 acoustic detections. There were seven detection events correlated between acoustic and visual detections, consisting of Clymene dolphins, pantropical spotted dolphins, and unidentified dolphins. There were two Odontocete whale species visually detected: sperm whale (*Physeter macrocephalus*) and dwarf sperm whale (*Kogia sima*). There were also six visual detections of unidentified whales.

Sea turtle detections consisted of 19 visual detections. There were 11 detections of two identified species: green sea turtle (*Chelonia mydas)* and loggerhead sea turtle (*Caretta caretta*). Additionally, there were eight visual detections of unidentified shelled sea turtles.

Giant manta ray (*Mobula birostris*) detections consisted of two visual detections.

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

In accordance with stipulations set forth under Lease L22-0004 and the BO and Letter of Authorization (LOA), a total of 29 mitigation actions were implemented for the sound sources, including six shutdowns of the source, 17 delays to activation of the source and six voluntary turtle pauses. There were 30 strike

avoidance mitigation actions for protected species implemented during the survey, however there were four instances where the visual detection was too brief to execute a strike avoidance mitigation action.

2 INTRODUCTION

The WesternGeco Engagement III 3D OBN survey was conducted by Shearwater GeoServices in federal waters of the GOM 110 nautical miles from Port Fourchon, LA. The survey comprised the Garden Banks, Green Canyon, Keathley Canyon, and Walker Ridge lease areas of the GOM. This report is the Final Protected Species Report for the WesternGeco Engagement III 2022/23 3D OBN survey, conducted under Bureau of Ocean Energy Management (BOEM) Lease L22-004 and covers the protected species monitoring and mitigation efforts on the two source vessels utilized by WesternGeco and Shearwater GeoSciences.

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 survey was conducted in accordance with BOEM and NMFS standards outlined in the BO and NMFS LOA.

WesternGeco was responsible for contracting Protected Species Observers (PSOs) through RPS, to conduct monitoring and mitigation for protected species, including marine mammals, sea turtles, Gulf sturgeon, oceanic whitetip sharks and giant manta rays during their activities. Monitoring and mitigation procedures that were implemented during the survey are described in Section 4 of this report.

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 H: Excel Data Sheets of Monitoring Effort, Source Operations and Detections of Protected Species During the Survey
The Marine Mammal Protection Act (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	BOEM Survey Permit L22-004	This technical report

Required Content	Source Reference	Location Addressed in Technical Report
Protected Species Observer Protocols found in the Biological Opinion issued by the National 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 L22-003	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

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 H: Excel Data Sheets of Monitoring Effort, Source Operations and Detections of Protected Species During the Survey
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 Coordinated Universal Time (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	GIS files are provided as a separate shapefile
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 L: Letters of Data Certification from Leads
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
In the event of a ship strike of a marine mammal by any vessel involved in the survey activities,	NMFS LOA,	7.4.2 Mitigation for strike

the LOA-holder must report the incident to OPR, NMFS and to the Southeast Regional Stranding Network as soon as feasible.	Section 6 (c) ii	avoidance

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 Engagement III survey area is located 235 kilometers (km) (110 nautical miles) south of Port Fourchon, LA, with the center of the survey area in the Garden Banks and Walker Ridge protraction areas, GOM. Water depths in this portion of the survey area ranged from 1700 to 2400 meters. The working prospect covers approximately 2400 square kilometers (km²) as detailed in Table 2.

Table 2: General survey parameters

Area Parameters	
General Location:	Gulf of Mexico – Garden Banks, Keathley Canyon, Green Canyon and Walker Ridge
Prospect Size:	2400 km²
Water depth	1700 to 2400 meters (m)
Port location	Port Fourchon, LA
Source Vessels	*SW Mikkelsen, SW Gallien*
Other Vessels Involved:	*Shelia Bordelon* (Node vessel), *Sarah Bordelon* (Support vessel)

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

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

Vessel Name	**Dates on Project**		**Area of Operation**
SW Gallien (source vessel)	21 November 2022	12 April 2023	Garden Banks, Green Canyon, Keathley Canyon, Walker Ridge
SW Mikkelsen (source vessel)	29 November 2022	06 April 2023	Garden Banks, Green Canyon, Keathley Canyon, Walker Ridge
Shelia Bordelon	28 November 2022	24 April 2023	Garden Banks, Green Canyon, Keathley Canyon, Walker Ridge
Sarah Bordelon	28 November 2022	24 April 2023	Garden Banks, Green Canyon, Keathley Canyon, Walker Ridge

Table 4: Summary of key survey events on the *SW Mikkelsen and SW Gallien*

Event	*SW Mikkelsen*	*SW Gallien*
PSO team mobilizes	24 November 2022	17 November 2022
Kick-off meetings	16 November 2022; 28 December 2022; 24 January 2023; 8 March 2023	16 November 2022; 17 January 2023; 04 March 2023
Vessel departs dock - PSO effort begins	29 November 2022	21 November 2022
Array testing begins	04 December 2022	22 November 2022
Data acquisition commences	10 December 2022	29 November 2022
Extended breaks in acquisition	18 December to 25 December 2022 – weather standby	24 November to 26 November 2022 – source maintenance
	30 December 2022 to 8 January 2023 – crew change and vessel repairs	15 December to 17 December 2022 – source repairs
		21 December to 25 December 2022 – weather downtime
Data acquisition complete	05 April 2023	05 April 2023
Vessel reaches dock - PSO effort complete	06 April 2023	12 April 2023

3.1 Vessel Summary

The survey was undertaken by the source vessels, *SW Mikkelsen* and *SW Gallien*, towing two identical arrays on each vessel with a total of 28 airguns per array. Each array was comprised of three sub arrays totaling a nominal source array volume of 5240 cubic inches. Both vessels conducted operations under Lease L22-004, from 21 November 2022 to 12 April 2023. Project vessels mobilized out of Port of Galveston, Texas (TX) and Port Fourchon, LA. The port of call for the duration of the survey was Port Fourchon, LA.

Specifications of each vessel are provided in Table 5 and photos 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)
SW Mikkelsen (source vessel)	Shearwater Invest AS	92	21	5.0	14.5
SW Gallien (source vessel)	Shearwater Invest AS	92	21	5.0	14.5
Shelia Bordelon	Bordelon Marine, LLC	78.33	15.8	0.2	12
Sarah Bordelon	Bordelon Marine, LLC	54.86	10.97	8	10.5

3.2 Summary of Survey Equipment Used

Both the *SW Mikkelsen* and *SW Gallien* towed an acoustic source comprised of two source arrays with three strings per array; the configuration is described in Table 6. Each array was activated in succession with the total operating source volume on the vessel at 5240 cubic inches. The survey design type while in acquisition was parallel: in the dense area, a “flip-flop-flap” pattern for a dual source with a shot point interval per vessel every 16 meters; a “flip-flip” or “flop-flop” pattern firing either the port or starboard source, one array per vessel, with a shot point interval every 16 meters. The maximum survey speed for each vessel was no more than 5 knots.

Table 6: Survey equipment operated by the survey vessels

SW Mikkelsen and SW Gallien	
Energy Source	**Frequency/Energy Specifications**
Bolt 1900 LLXT airguns Two towed source arrays Three strings per array 10-12 elements per string	Frequency: 0-200 Hertz Full volume: 5240 cubic inches Intensity: ~127.5 Decibel related to 1 micropascal (dB re 1µPa) at 1 m in water (Peak to peak)

4 MONITORING AND MITIGATION SURVEY

This section describes the protected species monitoring and mitigation measures established to meet the requirements of the BOEM permit and NMFS BO and LOA. Survey 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 on both source vessels to meet these objectives, and each are described in detail in a sub-section below:

SW Mikkelsen* and *SW Gallien

- 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 in place to be 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, Beaufort Sea State was at B3 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 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 *SW Mikkelsen* and *SW Gallien,* implemented when protected species were detected within these zones.

4.1 Monitoring: PSOs and PAM Operators

Trained and experienced PSOs, PAM Operators, were assigned to the *SW Mikkelsen* and *SW Gallien* 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 Atlantic Ocean or 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 were provided by RPS and WesternGeco 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 survey operations are listed in Appendix D.

4.2 Visual Monitoring: Protocols and Methods

A team of PSOs were deployed on the *SW Mikkelsen* and *SW Gallien* in sufficient numbers to meet the monitoring requirements of the vessel, as outlined in Appendix A. 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 PSO 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 or 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 source, such that the EZs around the sound source 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 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.).

Table 7: Visual monitoring methodology on the *SW Mikkelsen* and *SW Gallien*

	SW Mikkelsen	***SW Gallien***
Total Number of PSOs or PSO/PAMs	3	3
Number of PSOs on Watch - Day	2	2
Visual monitoring equipment- Day	Reticle binoculars 7x50 Big Eyes DSLR Cameras	Reticle binoculars 7x50 Big Eyes DSLR Cameras
Visual monitoring conducted at night	N/A	N/A
Range Estimation	Reticle binoculars Comparison to object of known distance	Reticle binoculars Comparison to object of known distance
Primary Monitoring Location	Bridge, Bridge Wings, Helideck	Bridge, Bridge Wings, Helideck

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, Beaufort 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 weekly 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 Onboard PAM

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.

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 technical troubleshooting of 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 systems were installed on the *SW Mikkelsen* and *SW Gallien* in locations 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 Remote PAM

On the *SW Mikkelsen* and *SW Gallien*, acoustic monitoring was predominantly conducted remotely from shore by three PAM Operators utilizing TeamViewer software to log into the vessel's PAM system and monitor for protected species. The PAM technician on board the *SW Mikkelsen* and *SW Gallien* were trained and experienced PAM operators, who were available to locally monitor the PAM system as

needed, provide help with troubleshooting any system issues, and oversee PAM cable deployments and retrievals.

For the *SW Mikkelsen* and *SW Gallien*, multiple methods of communication between the remote PAM Operators and the vessel's monitoring team were available, including Microsoft Teams audio calls, Microsoft Teams chat function, a WhatsApp group that includes all vessel observers, RPAM and PAM Technician and the vessel satellite phone system.

Remote PAM Operators accessed the onboard PAM system, for aural and visual monitoring, via TeamViewer software which was shared via onboard Starlink Satellite. On the *SW Mikkelsen* and *SW Gallien*, RPS deployed a Starlink system which utilized a satellite constellation in low Earth orbit to deliver broadband internet while offshore and in transit to redirect data to the land based RPAM Operators. This Starlink system was comprised of dual Flat High-Performance antennas to facilitate RPAM operations. The dual system ensured redundancy and obstruction mitigations. Specification for the equipment can be found in Appendix G.

4.3.3 PAM Parameters

Passive acoustic monitoring system designed to detect most species of marine mammals, were installed on the *SW Mikkelsen* and *SW Gallien*. The systems were 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 each vessel, 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 *SW Mikkelsen* and *SW Gallien*. Further PAM system specifications can be found in Appendix F.

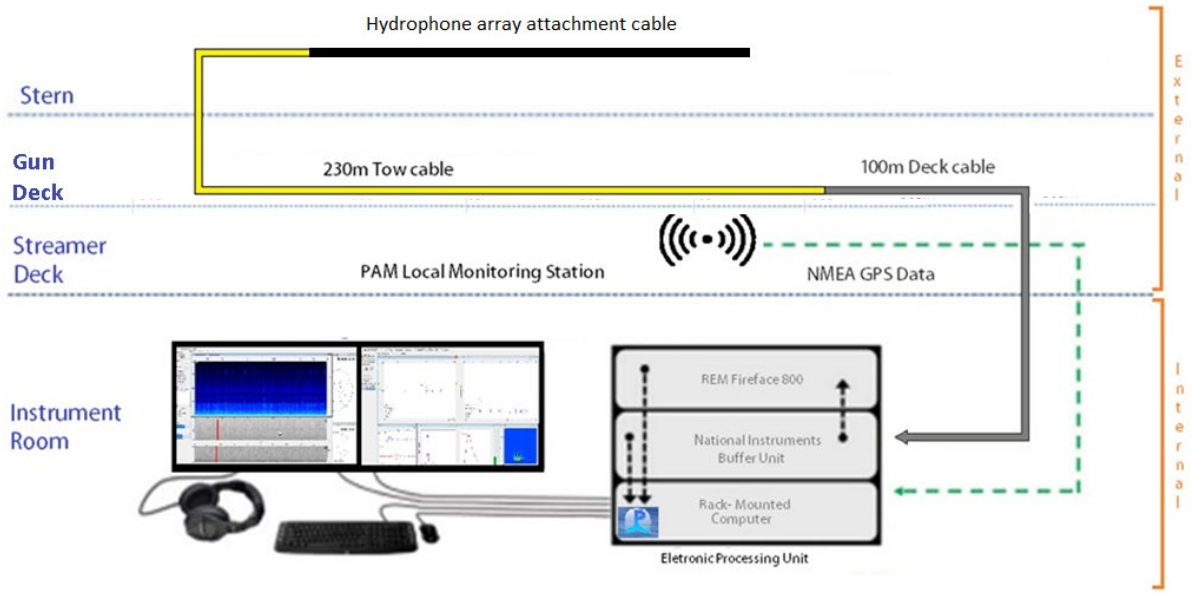


Figure 1: Simplified pathway of data through the PAM system onboard the survey vessels

The linear hydrophone array attachment cable on the *SW Mikkelsen* and *SW Gallien* 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 Hertz (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).

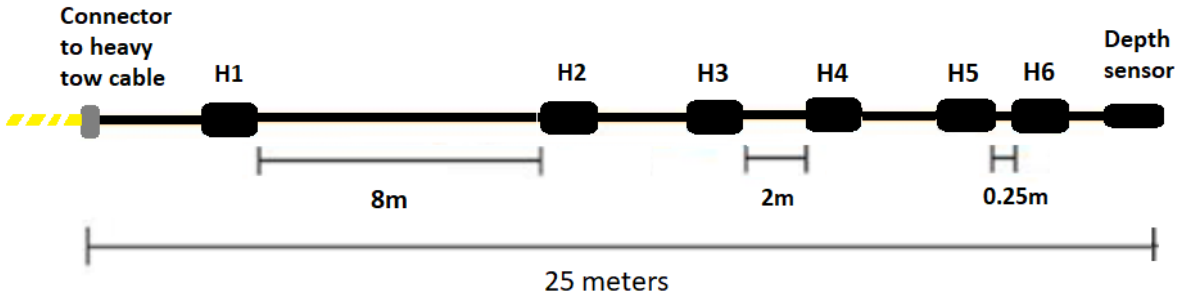


Figure 2: Diagram of 6-hydrophone element separation on 25m hydrophone array cable on the survey vessels

The hydrophone array section was attached to a 230-meter heavy duty tow cable installed on the back deck. The deck cable interfaced between the tow cable, and the Electronic Processing Unit (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 the 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 survey.

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 Kilohertz (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 800/802 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 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 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.

4.3.4 Hydrophone Deployment

On the *SW Mikkelsen*, the hydrophone cable was deployed from a winch on the streamer deck from the starboard stern of the vessel. When fully deployed the trailing end of the PAM cable was 200 meters astern of the vessel, the trailing pair of hydrophones were approximately 25 meters from the starboard source, and tow depths averaged 25 meters.

On the *SW Gallien*, the hydrophone cable was deployed from a winch on the streamer deck from the starboard stern of the vessel. When fully deployed the trailing end of the PAM cable was 150 meters astern of the vessel, the trailing pair of hydrophones were approximately 50 meters from the starboard source, and tow depths averaged 10 meters.

A more detailed description of the hydrophone deployment methods for the *SW Mikkelsen* and *SW Gallien* 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.

4.5 Mitigation Measures

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

- Establishment of Buffer Zone (BZ) around acoustic array
  - 1500-meter BZ for all true whales (Rice's whale, sperm whales, Kogia species and all beaked 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
  - 1500-meter EZ for all true whales (sperm whales, Kogia species and all beaked whales).
  - 500 meters for all other marine mammals
  - 100 meters: A 7-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 (WesternGeco voluntary enhanced mitigation measure for the *SW Mikkelsen* and *SW Gallien*)
- 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 source 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 source if any marine mammal or sea turtle enters into their respective EZ during ramp-up.
- 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 shutdown 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 survey 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 Endangered Species Act (ESA) listed fish species, such as Gulf sturgeon, oceanic whitetip 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 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. There were no instances of a PAM outage of more than 30 minutes for the duration of this survey.

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 *SW Mikkelsen* and *SW Gallien* were submitted on 01 December 2022, 01 January 2023, 01 February 2023, 01 March 2023, 01 April 2023 and 01 May 2023.

4.6.4 Final Report

RPS has prepared this technical report to meet the BOEM lease and NMFS BO and LAO 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.

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 *SW Mikkelsen* and *SW Gallien*.

The *SW Mikkelsen* and *SW Gallien* 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 in Table 8.

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 the *SW Mikkelsen* and *SW Gallien*. PSOs also recorded visibility during monitoring effort, in km, 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). Wind speed, 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 the *SW Mikkelsen* and *SW Gallien* throughout the 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 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 the *SW Mikkelsen* and *SW Gallien*, when 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.

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 vessel that conducted monitoring of the different sound sources utilized during the survey.

5.5 Mitigation Measures Implemented

Mitigation measures were implemented on the *SW Mikkelsen* and *SW Gallien* 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.

5.6 Data Quality Control

The RPS data analysts reviewed all of the PSO data sets received from the *SW Mikkelsen* and *SW Gallien* 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
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

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 Permit Area during source operation and source silence.

The monitoring effort, source operations and protected species detections for each vessel are also provided in excel datasets in Appendix H.

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, vessel to vessel transfer operations, 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 the *SW Mikkelsen* and *SW Gallien* are provided in Table 11.

Table 11: Summary of regulated sound source operations on the *SW Mikkelsen* and *SW Gallien*

Vessel	Dates of Operation	Total Days of Regulated Source Activity	Total Hours of Regulated Source Operations (hh.hh)
SW Mikkelsen	27 November 2022 –05 April 2023	81	1941.72
SW Gallien	21 November 2022 – 05 April 2023	87	2068.40

6.2 Monitoring Effort

Visual and acoustic monitoring effort for the *SW Mikkelsen* and *SW Gallien* during the survey is summarized in Table 12, shown 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	Acoustic	Visual	Acoustic
***SW Mikkelsen* Bolt 1900 LLXT**	974.42	1939.92	505.48	605.97
***SW Gallien* Bolt 1900 LLXT**	1044.17	2067.08	662.85	721.60

The combined total 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 *SW Mikkelsen* and *SW Gallien* in Table 13.

On 22 occasions the *SW Mikkelsen* and *SW Gallien* sound source was active while no acoustic monitoring was conducted, due to brief instances of PAM downtime, each of which was less than 30

minutes in duration. Table 13 summarizes the recorded duration of sound source activity, day and night, when no acoustic monitoring was conducted.

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

Monitoring Effort	Day (hh.hh)			Night (hh.hh)		
	Total	Source Active	Source Inactive	Total	Source Active	Source Inactive
Visual monitoring only	523.65	0.69	522.96	00.00	00.00	00.00
Visual and acoustic monitoring	2663.27	2017.90	645.37	00.00	00.00	00.00
Acoustic monitoring only	00.00	00.00	00.00	2671.30	1989.10	682.20
Total	3186.92	2018.59	1168.33	2671.30	1989.10	682.20

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 favorable to moderate.

Visibility was indicated in km 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 77.04 % was conducted in conditions where visibility extended to greater than 5 km, 20.41 % of monitoring effort occurred while visibility was between 0.5 and 5 km, and only 2.55 % of monitoring effort was conducted while visibility extended to less than 0.5 km. The duration of monitoring conducted at each visibility classification is provided in Table 14.

Table 14: Summary of visibility during visual monitoring effort on the *SW Mikkelsen* and *SW Gallien*.

Visibility (km)	*SW Mikkelsen*	*SW Gallien*	Percent of Total Project
	Duration (hh.hh)	Duration (hh.hh)	%
>5 km	1089.23	1365.83	77.04
2 to 5 km	284.25	205.35	15.36
1 to 2 km	51.93	55.04	3.36
0.5 to 1 km	20.03	33.98	1.69
0.3 to 0.5 km	16.14	26.28	1.33
0.1 to 0.3 km	07.98	15.22	0.73
0.05 to 0.1 km	09.12	04.10	0.41
>.05 km	01.22	01.22	0.08
Total	1479.90	1707.02	100.00

Monitoring effort for the *SW Mikkelsen* and *SW Gallien* was conducted in Beaufort Sea States ranging from Level 1 to Level 8, however, a majority of the monitoring effort 62.85 % accumulated in sea states at or below Level 3, which is considered favorable conditions for most protected species monitoring (Table 15). Visual observations at Level 4 Beaufort Sea State or higher accounted for 37.15 % of the total visual monitoring effort.

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

Beaufort Sea State	*SW Mikkelsen*	*SW Gallien*	Percent of Total Project
	Duration (hh.hh)	Duration (hh.hh)	%
B1	36.51	33.43	2.19
B2	420.27	413.18	26.15
B3	458.87	640.83	34.51
B1 through B3	915.65	1087.44	62.85
B4	286.00	300.00	18.39
B5	152.32	189.38	10.72
B6	99.67	84.72	5.79
Greater than B6	26.26	45.48	2.25
Total	1479.90	1707.02	100.00

Monitoring effort was conducted in swell heights greater than 4 m. However, most of the effort was conducted at swell heights below 2 meters (m), which accounted for 81.26 % of the total monitoring effort (Table 16).

Table 16. Summary of swell height during visual monitoring during the survey

Swell Height	*SW Mikkelsen*	*SW Gallien*	Percent of Total Project
	Duration (hh.hh)	Duration (hh.hh)	%
< 2 m	1075.63	1514.14	81.26
2 – 4 m	325.97	191.88	16.25
> 4 m	78.30	01.00	2.49
Total	1479.90	1707.02	100.00

Precipitation may also obscure visibility and sea surface. However, light rain, heavy rain, haze, and thin fog only attributed to 27.87 % of the total visual effort (Table 17). These conditions did not affect visibility to a point where operations had to be suspended.

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

Precipitation	*SW Mikkelsen*	*SW Gallien*	Percent of Total Project
	Duration (hh.hh)	Duration (hh.hh)	%
Clear	1094.78	1204.00	72.13
Light Rain	27.22	39.35	2.09
Heavy Rain	4.33	10.43	0.46
Thin Fog	34.24	20.70	1.73
Heavy Fog	17.65	14.30	1.00
Haze	301.68	418.24	22.59
Total	1479.90	1707.02	100.00

6.4 Ghost Net Initiative

During this survey, WesternGeco took part in a cooperative effort with EnerGeo Alliance's Ghost Net Initiative. Over the course of the permit Shearwater GeoServices on behalf of WesternGeco collected 114.6 kg of miscellaneous fishing nets and debris. These items were identified by the various vessels on the project and then removed by the *SW Mikkelsen, SW Gallien, FRC,* and *Workboat*. Once the debris was collected, it was delivered to port for disposal. Data was collected as the debris was picked up and can be seen in the table below.

Table 18: Summary of Ghost Net Initiative debris removed from the GOM during the Engagement III Survey

Date	Weight (kg)	Debris Recovered
06 January 2023	0.7	Fishing line
06 January 2023	5.0	Fishing net
26 Janaruy 2023	0.3	Finsing line
14 February 2023	0.1	Mooring ropes
14 February 2023	45.0	Fishing line; fishing net; styrofoam block
21 February 2023	2.5	Life jacket- not belonging to SW
21 Febraury 2023	100.0	*attempted but unsucsseful
17 March 2023	50.0	Mooring ropes
31 March 2023	5.0	FAD's with line
06 April 2023	5.0	Fishing ling; fishing net
04 May 2023	1.0	Life Jacket- not belonging to SW

7 PROTECTED SPECIES OBSERVATION RESULTS

7.1 Visual Sightings

This section of the report summarizes visual sightings of protected species made during the survey. There were 78 protected species detections, both inside and outside the lease area, including 36 dolphin detections, 21 whale detections, 19 sea turtle detections and two ray detections. Detections consisted of seven species of marine mammals observed in 43 detection events, as well as 8 sightings of unidentified dolphins. There were 19 detections of sea turtles.

Of the 78 visual detections, 82.05 % (64 detection events) were identified to the species level while the remaining 17.95% (14 detection events) were identified to family level or a higher taxonomic level (classified as unidentified delphinids, whale or turtle).

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

Table 19 shows the total number of detection records and the number of individuals detected for each protected species during the survey. The locations of these detections, by group, can be found in Appendix K.

Table 19: Detection records collected for each protected species visually during the survey

Species	Total Number of Visual Detection Records	Total Number of Animals
Pantropical spotted dolphin	10	104
Clymene dolphin	7	46
Spinner dolphin	2	22
Bottlenose dolphin	7	103
Risso's dolphin	2	18
Unidentified dolphin	8	60
Total dolphin	**36**	**353**
Dwarf spem whale	1	1
Sperm whale	14	31
Unidentified whale	6	10
Total whale	**21**	**42**
Loggerhead sea turtle	4	4
Green sea turtle	7	7
Unidentified shelled sea turtle	8	8
Total sea turtle	**19**	**19**
Giant manta ray	2	2
Total ray	**2**	**2**
Total protected species	**78**	**416**

7.1.1 Detection and Distance Summaries

The most commonly detected species was the sperm whale (14 detections of 31 estimated individuals), followed by pantropical spotted dolphins (ten detections of 104 estimated individuals). The number of detection events, approximate number of animals observed, range and median group sizes, range of distances from vessel at first detection, and detection rate for each species of marine mammals detected over the course of the survey is provided in Table 20.

Table 20 shows bottlenose dolphins accounted for the largest mean group size of 14.71.

Table 20: Detection summary of dolphins observed during the survey

Dolphins	Bottlenose dolphin	Pantropical spotted dolphin	Clymene dolphin	Spinner dolphin	Risso's dolphin	Unidentified dolphin
# of Detection Records	7	10	7	2	2	8
Estimated # of individuals detected	103	104	46	22	18	60
Mean Group Size	14.71	10.40	6.57	11.00	9.00	7.50
Mean Distance (m) at first detection	156.57	434.00	211.14	735.00	750.00	407.50
Detection rate	0.00212	0.00314	0.00220	0.00063	0.00063	0.00251

There were 14 visual sightings of sperm whales, and one sighting of a dwarf sperm whale. The mean observed group size for all whales was 2.00 as shown in Table 21.

Table 21: Detection summary of whales observed during the survey

Whales	Sperm whale	Dwarf sperm whale	Unidentified whale
# of Detection Records	14	1	6
Estimated # of individuals detected	31	1	10
Mean Group Size	2.21	1	1.67
Mean Distance (m) at first detection	1905.21	550.00	2466.67
Detection rate	0.00439	0.00031	0.00188

There were 19 visual sightings of sea turtles. The mean observed group size for sea turtles was 1.00 as shown in Table 22.

Table 22: Detection summary of sea turtles observed during the survey

Turtles	Loggerhead sea turtle	Green sea turtle	Unidentified shelled sea turtle
# of Detection Records	4	7	8
Estimated # of individuals detected	4	7	8
Mean Group Size	1.00	1.00	1.00
Mean Distance (m) at first detection	72.50	47.14	53.75
Detection rate	0.00001	0.00220	0.00251

The difference between the closest observed approach of marine mammals to active versus inactive sources were small, with distances generally closer for detections when the source was inactive Table 23.

Table 23: Average CPA of protected species to seismic sources or vessel, while active and inactive.

Species Detected	Source Active		Source Inactive	
	Number of detections	Mean closest observed approach to source (meters)	Number of detections	Mean closest observed approach to vessel (meters)
Pantropical spotted dolphins	6	604.17	4	306.25
Bottlenose dolphins	1	550.00	--	--
Clymene dolphins	1	400.00	4	293.25
Spinner dolphins	2	340.00	--	--
Risso's dolphins	2	640.00	--	--
Unidentified dolphin	5	688.80	1	110.00
Total dolphin	**17**	**587.00**	**9**	**278.67**
Sperm whale	4	1774.25	9	1764.11
Dwarf sperm whale	--	--	1	830.00
Unidentified whale	2	2900.00	3	2351.00
Total whale	**6**	**2149.50**	**13**	**1827.69**

7.2 Acoustic Detection Summary

There were 54 acoustic detections of marine mammals associated with the survey. 49 acoustic detections were of dolphins identified at the family level and five were identified to a species level (Clymene dolphins and pantropical spotted dolphins). There were seven correlated visual and acoustic detections consisted of Clymene dolphins, pantropical spotted dolphins, and unidentified dolphins.

Screenshots of acoustically detected protected species during the survey are provided in Appendix J.

Of the 54 acoustic detections for the survey, 18 occurred when the source was active and 36 occurred while the source was inactive (Table 24).

Table 24: Acoustic detections and source activity during the survey

	Dolphin detections for the *SW Mikkelsen* and *SW Gallien*
# of Detection Records	54
Number of detections while source was active	18
Number of detections while source was inactive	36
Detection Rate	0.01012

7.3 Protected species incident reporting

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

7.4 Summary of Mitigation Measures Implemented

7.4.1 Mitigation for sound exposure from survey equipment

Mitigation actions for protected species detected during the survey were requested by PSOs and PAM Operators. Source operators complied with those requests and implemented the actions. Combined for the *SW Mikkelsen* and *SW Gallien*, a total of 29 mitigation actions were requested and implemented. These actions included 17 delays to source activity and six shutdowns of the source. Mitigation actions were from both visual and acoustic detections. There were six voluntary turtle pauses implemented during this survey (Table 25).

Table 25: Summary of mitigation actions implemented on the *SW Mikkelsen* and *SW Gallien*

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	15	14.39	1	00.18	1	00.20	**17**	**14.77**
Voluntary turtle pause	--	--	--	--	6	00.13	**6**	**00.13**
Shutdown of active source	4	02.47	2	01.88	0	00.00	**6**	**04.35**
All Mitigation Actions	**19**	**16.86**	**3**	**02.06**	**7**	**00.33**	**29**	**19.25**

7.4.2 Mitigation for strike avoidance

There were 30 strike avoidance mitigation actions for a protected species implemented during the survey, however there were four instances where the visual detection was too brief to execute a strike avoidance mitigation action. The mitigation action is summarized below in Table 26.

Table 26: Summary of protected species detections occurring inside the species/species group specific separation distances in Appendix C of the BO and the LOA.

Detections from *SW Mikkelsen*

Date	Detection Number	Species	Number of Animals	CPA to Vessel (m)	Strike Avoidance Maneuver
02 December 2022	VD 01	Sperm whale	1	80	Reduced speed and altered course
08 December 2022	VD 03	Unidetified shelled sea turtle	1	20	Maintined course
13 December 2022	VD 09	Unidetified shelled sea turtle	1	50	Maintained course
01 January 2023	VD12	Bottlenose dolphin	8	5	Maintained course and speed
02 January 2023	VD 13	Unidentified dolphin	3	40	Maintained course and speed
12 February 2023	VD 21	Clymene dolphin	9	10	Maintained course
23 February 2023	VD 25 AD 18	Pantropical spotted dolphin	5	1	Maintained course
23 Febraury 2023	VD 26 AD 19	Pantropical spotted dolphin	15	1	Maintained course
28 Febraury 2023	VD 27	Giant manta ray	1	50	Maintained course
01 March 2023	VD 28	Unifenditfied shelled sea trutle	1	50	Maintained course and speed
02 March 2023	VD 29 AD 21	Pantropical spotted dolphin	15	1	Maintained course and speed
03 March 2023	VD 30 AD 22	Clymene dolphin	5	1	Maintained course and speed
03 March 2023	VD31	Pantropical spotted dolphin	12	1	Maintained course and speed
08 March 2023	VD 33	Unidentified shelled sea turtle	1	50	Maintained course and speed
28 March 2023	VD 38	Pantropical spotted dolphin	15	5	Maintained course and speed

Detections from *SW Gallien*

Date	Detection Number	Species	Number of Animals	CPA to Vessel (m)	Strike Avoidance Maneuver
22 November 2022	VD 02	Bottlenose dolphin	6	20	Maintained speed
06 January 2023	VD 17 AD 02	Clymene dolphin	5	5	Maintained course and speed
10 January 2023	VD 19	Unidentified shelled sea trutle	1	50	Maintained course and speed
31 January 2023	VD 21	Unidentified shelled sea trutle	1	30	Maintained course and speed
25 February 2023	VD 24	Unidentified shelled sea trutle	1	50	Maintained course and speed
26 February 2023	VD 26	Spinner dolphin	12	1	Maintained course and speed
31 March 2023	VD 28	Unidentifiable dolphin	20	10	Maintained course and speed
31 March 2023	VD 29	Clymene dolphin	3	20	Maintained course and speed
31 March 2023	VD 30	Clymene dolphin	1	8	Maintained course and speed
31 March 2023	VD 31	Bottlenose dolphin	11	1	Maintained course and speed
01 April 2023	VD 32	Bottlenose dolphin	33	2	Maintained course and speed
01 April 2023	VD 33	Giant manta ray	1	40	Maintained course and speed
05 April 2023	VD 35 AD 29	Clymene dolphin	8	10	Maintained course and speed
11 April 2023	VD 36	Bottlenose dolphin	10	1	Maintained course and speed
11 April 2023	VD 37	Pantropical spotted dolphin	2	20	Maintained course and speed

*There was one loggerhead sea turtle and three green sea turtle visual detections that were too brief to execute a VSA

8 SUMMARY

8.1 Interpretation of the Results

The marine mammal and sea turtle 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 all except pantropical spotted dolphins, the distance at initial detection and at closest approach was greater when the regulated sound sources were on, 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 Monitoring and Mitigation Methods

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 27: Monitoring effort, protected species detections and detection rate for each monitoring method used on 24-hour operation vessels

	Visual Monitoring	Acoustic Monitoring
Monitoring effort (hh.hh)	3186.92	5334.57
Number of marine mammal detections	57	54
Detection rate	0.01788	0.01012
Number of sea turtle detections	19	0
Detection rate	0.00596	0
Number of rays detections	2	0
Detection rate	0.00063	0

8.2.1 Effectiveness of PAM

PAM had lower detection rate compared to visual monitoring, which is not usual 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 mysticetes 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.

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.

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. Mitigation actions for sound sources were implemented successfully during 29 detections events. 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. Sound sources were initiated gradually, in ramp-up format whenever multiple airguns would be active simultaneously.

Strike avoidance maneuvering was conducted 30 times 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 132 protected species detections and included marine mammals, sea turtles and rays. 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 survey permit appear to have been an effective means to protecting the marine species encountered during survey 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 Survey Activities in the Gulf of Mexico. 2020. Appendix A & C.

Appendix A: BOEM Permit, NMFS Biological Opinion and LOA

United States Department of the Interior
BUREAU OF OCEAN ENERGY MANAGEMENT
Gulf of Mexico Regional Office
1201 Elmwood Park Blvd
New Orleans, Louisiana 70123-2394

ELECTRONIC MAIL – RETURN RECEIPT REQUESTED

October 25, 2022

WesternGeco LLC
Attention: Mr. Gary Poole
10001 Richmond Ave
Houston, TX 77042

Dear Mr. Poole:

Your request for the program modification for OCS Permit L22-004, received October 21, 2022, has been approved. Modification 01 approves the change of contractor from MagSeis-Fairfield to Shearwater Geoservices Norway AS. Modification 01 also approves the node model to be used from ZXPLR to OBX-90. The nodal locations will be the same as approved in the original OCS Permit L22-004 letter. In addition, modification 01 approves the following vessel changes:

Old Vessels:

Vessel Name	Registered Owner	Registry Number	Radio Call Sign	Vessel Type
Rem Saltire	E. Forland AS	9377016	5BYV4	ROV handler
Artemis Arctic	Maritim Management	9207510	LIZK3	Source
Sanco Spirit	Sanco Holdings	9429936	ZDJN3	Source
Victory G	Rederij Groen BV	9318838	3ECY4	Support

New Vessels:

Vessel Name	Registered Owner	Registry Number	Radio Call Sign	Vessel Type
SW Gallien	Shearwater Invest AS	9538139	C6XK4	Source
SW Mikkelsen	Shearwater Invest AS	9538098	C6XK5	Source
MV Shelia Bordelon	Bordelon Marine, LLC	9670638	WSHQ	Node handler
Sarah Bordelon	Bordelon Marine, LLC	9350367	WDJ4762	Supply

WesternGeco and its contractor are required to follow all requirements and mitigations as listed in Attachment A of the originally approved OCS Permit L22-004. Furthermore, any conditions stated in the applicable Letter of Authorization issued by the National Marine Fisheries Service must also be followed. **BOEM must be advised immediately upon the commencement and completion of the survey.**

If you have any questions, please call Goh Sakulpitakphon at (504) 736-5731 (tanaporn.sakulpitakphon@boem.gov) or the Office of Resource Evaluation, Data Acquisition and Special Projects Unit at (504) 736-3231 (GGPermitsGOMR@boem.gov).

Sincerely,

CARLOS ALONSO

Digitally signed by CARLOS ALONSO
Date: 2022.10.25 08:37:55 -05'00'

Carlos Alonso
Resource Studies Section Chief
Gulf of Mexico Office
Office of Resource Evaluation

10001 Richmond Ave.
Houston, Texas (77042-4299)
P.O. Box 2469 (77252-2469)
Tel: 713 789-9600
Fax: 713-789-0172

October 21, 2022

Bureau of Ocean Energy Management
Regional Supervisor for Resource Evaluation
1201 Elmwood Park Boulevard, Room 410
New Orleans, Louisiana 70123-2394

Attn: Teree Campbell, Goh Sakulpitakphon

REF: MODIFICATION #1 FOR PERMIT NUMBER L22-004

WesternGeco would like to make various modifications to permit number L22-004. The list of requested modification are as follows:

- Change of Contractor
- Change of vessels
- Change of node type

Contractor Change:
The original Contractor listed in the Permit is MagSeis-Fairfield. Due to timing constraints MagSeis-Fairfield are no longer able to supply WesternGeco with a crew. Hence, WesternGeco have awarded the contract to Shearwater instead. The official company name is **Shearwater Geoservices Norway AS**
The person in charge of Field Operations is:
Name: Scott Hudd
Email: shudd@shearwatergeo.com
Mobile: +44 7729 621226
Office: +44 1293 903210

Vessel Change:
The new vessels on the project are as follows:

	IMO	Call Sign	Owner	Vessel Type
SW Gallien	9538139	C6XK4	Shearwater Invest AS	Source
SW Mikkelsen	9538098	C6XK5	Shearwater Invest AS	Source
MV Shelia Bordelon	9670638	WSHQ	Bordelon Marine, LLC	Node handler
Sarah Bordelon	9350367	WDJ4762	Bordelon Marine, LLC	Supply

These replace all vessels listed in the original permit.
I attach vessel descriptions/specifications for all four vessels listed above.

Node Type Change:
The node type originally specified in the permit was the ZXPLR. Due to the change in Contractor the node type is also being replaced. The new node type is the OBX-90 which is of a similar size but is slightly lighter. A specification sheet of the OBX-90 node is attached.

Please let me know if any other information or any other actions are required on my part.

OBX Ocean Bottom Recorder

OBX-90

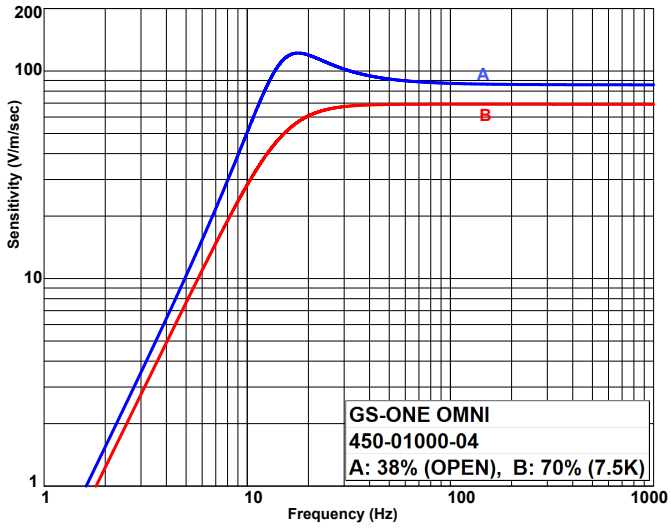
- Continuous cable-free 4C autonomous recording
- Battery module: 90 days operation
- Built-in full resolution test generator
- Solid-state flash memory: 16 GB per channel
- CSAC clock

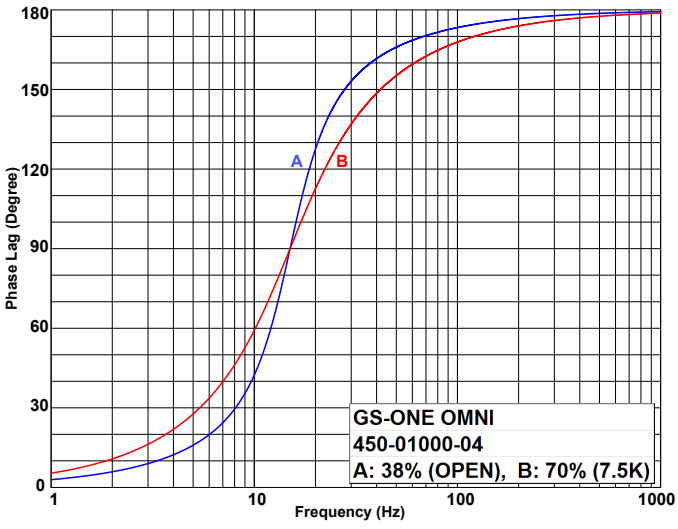
GEOSPACE® Technologies

GS-ONE OMNI GEOPHONE

PHYSICAL SPECIFICATIONS		
Moving Mass	13.2 g	0.466 oz
Maximum coil excursion p-p	4.06 mm	0.16 in.
Minimum coil excursion p-p	1.02 mm	0.04 in.
Diameter	30.5 mm	1.2 in.
Height	40.7 mm	1.6 in.
Weight	130 g	4.60 oz
Operating and Storage Temperature Range	–40°C to +100°C	–40°F to +212°F

ELECTRICAL SPECIFICATIONS	
All parameters are specified with 7.5 kΩ load at 25°C in all tilt positions unless otherwise stated.	
Frequency	15 Hz
Spurious Frequency	>160 Hz
Distortion at Horizontal	0.05% Typical
Coil Resistance	1450 Ω
Open-Circuit Sensitivity	69.2 V/m/s (1.75 V/i/s)
Sensitivity at 70% Damping	69.2 V/m/s (1.75 V/i/s)
Open-Circuit Damping	70%
Distortion at all tilt angles	<0.2% measured at 15 Hz with 0.2 in/s p-p





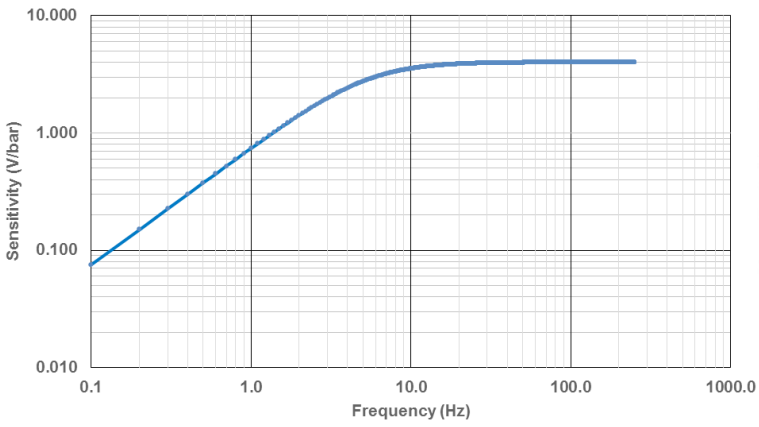
US Patent 8,098,546

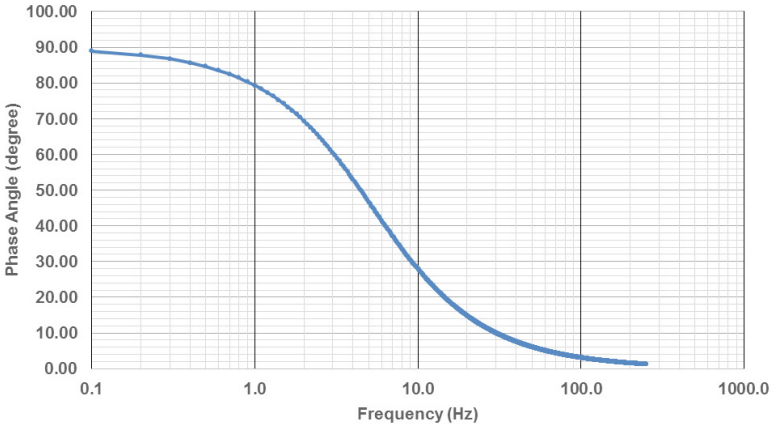
HYDROPHONE Deepender™ 5000-X

PHYSICAL SPECIFICATIONS	
Maximum Operating Pressure	34.5 MPa (5,000 psi)
Maximum Working Depth	3450 m (11,319 ft.)
Operating Temperature Range[1]	–10 to +75°C (+14 to 167°F)
Outside Diameter	50.8 mm (2.0 in.)
Length	38.1 mm (1.5 in.)

ELECTRICAL SPECIFICATIONS	
Nominal Capacitance (at 25°C 1atm)	20.0 nanofarads
Voltage Sensitivity[2]	4.0 µV/µBar
Sensitivity (dBv ref 1µPa @ 25°C)	–181.9 dB re 1nC/µPa
Frequency Response (into 2 MΩ load)	3 –15,000 Hz

1. Safe to be used slightly below 0°C as long as water is not frozen. Do not let hydrophone be frozen in ice, as this will cause irreversible damage to the crystals.
2. Voltage Sensitivity is specified when connected to OBX.





OBX-90

MECHANICAL SPECIFICATIONS (HOUSING)	*Metric*	*US*
Length	500 mm	19.7 in.
Width	215 mm	8.48 in.
Height	111 mm	4.38 in.
Weight in Air	17.0 kg	37.5 lbs.
Weight in Seawater	9.9 kg	21.8 lbs.
Maximum Operating Pressure	34.5 MPa/345 Bar	5,000 psi
Maximum Operating Depth	3,450 M	11,316 ft.
Operating Temperature Range	–5°C to +35°C	+23°F to +95°F
Storage Temperature Range	–10°C to +40°C	+14°F to +104°F

ELECTRICAL SPECIFICATIONS	
Digitized 4C Recording Station:	4 Channel, 24 Bit A/D Digitizer 3C Orthogonal oriented GS-One OMNI 15 Hz Geophones 1 DEEPENDER Hydrophone
Digitization	24-bit Delta-Sigma
Sample Interval	0.25, 0.5, 1, 2, 4 ms
Pre-amplifier Gains	0, 6, 12, 18, 24, 30, 36 dB
Maximum Input Signal	1.8 Vrms
Equivalent Input noise (@2ms sample interval)	0.17 µVrms
Gain Accuracy	Better than 1%
Anti-alias Filter	83% Nyquist
Instantaneous Dynamic Range	124dB @ 2 ms sample interval
THD	<0.2%
Distance Between Digitizer & Farthest Sensor	<18 cm
Distance Between All Sensors	<13 cm
Flash Memory	16 GB per channel
Frequency Response	1 Hz – 1650 Hz @ ¼ ms sample interval
Battery Module	90 days operation

Specifications subject to change at sole discretion of Geospace Technologies.

GEOSPACE® Technologies

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Bedfordshire LU3 4BU, England
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592-13010-02 Rev. A

SW Gallien

1 Vessel Maritime Specifications

Main Maritime Characteristics	
Vessel Name	SW Gallien
Vessel Owner	Shearwater Invest AS
Maritime operator	Shearwater
ISM Manager and ISM Manager Company	Reflection Marine UK LTD 2 City Place Beehive Ring Road Gatwick West Sussex RH6 0PA UK
Flag	Bahamas
Port of Registry	Nassau
Date of build and rebuild	2010
Classification (Include DP/RP Class)	CLEAN DESIGN, COMF-V (3), ICE-1A, NAUT-AW, HELDK, BWM-T, IMO code SPS-2008
Call Sign	C6XK4
IMO number	9538139
Any previous vessel names or owners?	Polarcus Alima, Polarcus
Helideck (Deck Size / Rating / Beacon Details / Max Weight / Max Heli Dimensions)	Sikorsky S-61N / S-92
Berths	60, including 32 single cabins
Available berths for 3rd party personnel	As required
Type of Fuel Used	MGO
Fuel Capacity / Endurance / Consumption (Transit, Standby, Operations)	1925m^3

Main Maritime Characteristics	
Fresh Water Maker Capacity	2x10 m3/24hr-AlfaLaval

Dimensions	
Length (m)	92.0m
Beam (m)	21.0m
Working Back Deck Dimensions (X x Y, m^2)	21.0m
Max Draft (m)	7.5m
Gross tonnage (mt)	7420t
Net tonnage (mt)	2369t

Propulsion & Power	
Maximum Speed (knot)	14.5knots
Cruising Speed (knot)	12.5knots
Bollard Pull (mt)	115t
Propulsion Principle (e.g. diesel, diesel electric, electric, hybrid)	Diesel Electric
Propulsion System (Controllable pitch propeller, fixed pick, retractable, etc.)	2 x Berg CP Propeller at 3750kW
Diesel Engines (Type/Number/Output)	Wartsila 4 x 9L20 + 2 x 9L26, 4 x 1800 kW and 2 x 2984 kW. Total 13,168 kW
Number of Generators / Rating (KW)	4x AvK 1933 kVA 2x AvK 3303kVA
Electrical System (Make/Power if applicable)	690V, 400V, 230V 50Hz
Number and type of propellers	2 x conventional CPP propellers at 3.75MW
Stern Thrusters	1 x Brunvoll tunnel thruster at 830kW
Bow Thrusters	1 x Brunvoll tunnel thruster at 1200kW 1 x retractable azimuth thruster at 850kW

Table 02.1 No Title

Communications	
Primary	GMDSS A4
Secondary	Inmarsat F Fleet-77
Communication	VSAT

Bridge Navigation Equipment	
Radar 1 (Make/Model/Radius)	1 ARPA Furuno FCR 2837 S-Band
Radar 2 (Make/Model/Radius)	1 ARPA Furuno FCR 2827 S-Band
Radar 3 (Make/Model/Radius)	1 Seahawk Ice tracking Radar
Auto pilot	1 Anschtz NautoPilot 2025-C
Gyro Compass (GPS heading equipment or MRU)	3 Anschutz Standard 22
Navigation	ECDIS chart system Furuno T-2136
Log	Furuno DS-80
Auto track/auto speed system (e.g. KPOS or MT)	Kongsberg K-Pos DP-21 DYNPOS AUTR DP-System (DP II)

Safety Equipment	
Life rafts (Type/Number/Capacity)	inflatable with MES,cap.for 200% of POB

Safety Equipment	
Lifejackets (Type/Number)	60
Survival suits (Type/Number)	60
MOB vessel (Type/Size/Capacity/Launching Method)	1ea. Norsafe Magnum 750

Fire Fighting Equipment	
Fire Detection Monitoring System	TYCO-T2000
Main Fire Pump	2 x Allweiler 50m³/hr
Emergency Fire Pump	1 x Allweiler 40m³/hr
Portable Fire extinguishers	as per SOLAS requirements

Additional Navigation Equipment	
Echosounder	Kongsberg EA600
Echosounder Frequencies	12KHz,38KHz,200KHz
Maximum Sounding Depth	6000mwith12KHz
Motion sensor (pitch, roll, heave)	KongsbergMRU
Current Profiler (Model/Depth Range)	Nortek

Auxiliary Boats	
Seismic Work Boat (Type/Size/Capacity)	Westplast WP950 SW
Number of Work Boats Available	2

2 Vessel Seismic Equipment Specifications

Streamer Specifications	
Streamer (Manufacturer/Type)	Sercel Sentinel
Solid or Gel	Solid
Streamer Jacket	Polyurethane
Group Length (m)	12.5m
Hydrophone Type	Sercel Flexible Hydrophone
Number of hydrophones in group and spacing	8
Group sensitivity (V/bar)	19.7V/Bar

Seismic Navigation System	
Main DGPS/dGNSS	
Name and provider of system	Fugro Starfix G2
Secondary DGPS	
Name and provider of system	Fugro Skyfix XP / Fugro Starfix HP
Tertiary DGPS	
Name and provider of system	Fugro Starfix L1
Online/Integrated Navigation System	
Type and Manufacturer (Version)	ION Concept System Orca
Online Binning System	
Type and Manufacturer (Version)	ION Reflex

RGPS/rGNSS	
Manufacturer/Type (Shipboard & in-water)	Seamap, Buoylink

Streamer Control & Positioning Specifications	
Streamer Depth Controller	
Manufacturer/Type/Number	Input/Output (Digicourse) DigiBird 5011
Streamer Lateral Controller	
Manufacturer/Type	ION (Digicourse) DigiFin 5120
Acoustic Positioning System	
Manufacturer/Type	ION Digirange 2
Streamer Compass	
Manufacturer/Type/Number	ION(Digicourse)5011

Source	
Manufacturer and Type	Bolt Air Guns
Number of sub-arrays per source	6
Nominal Source Operating Pressure (psi)	2000 psi typical
Firing sensor type	Solenoid
Timing resolution	0.1ms
Number and position of near field hydrophones	1 per gun/gun cluster position
Number and position of depth transducers	Each gun position
Source Controller / timing accuracy	Seamap GunLink 4000
Number and Type of Compressors	3 x LMF 1800 CFM

3 Instrument Room

Recording System	
Acquisition System	Sercel Seal 428 Marine Data Acquisition System
Recording System	Seal 428 Profocus Argus DUG Real Time QC
Maximum number of seismic channels	12 x 648 => 12 x 8100m streamers
Number of aux channels	10
Recording format	SEG-D rev 1.0 & 2.1
Tape drives (Type/Model/Number)	IBM 3592
Sampling rates (ms)	0.25ms, 0.5ms,1 ms, 2 ms, 4ms
Recording low cut filter, hydrophone (Hz, dB/oct)	Analog 2Hz

Note: Additional system, equipment, hardware and, software information may be available. Please refer to the appropriate specification sheets and/or manuals for more information.

SW Mikkelsen

1 Vessel Maritime Specifications

Main Maritime Characteristics	
Vessel Name	SW Mikkelsen
Vessel Owner	Shearwater Invest AS
Maritime operator	Shearwater
ISM Manager and ISM Manager Company	Reflection Marine UK LTD 2 City Place Beehive Ring Road Gatwick West Sussex RH6 0PA UK
Flag	Bahamas
Port of Registry	Nassau
Date of build and rebuild	2010
Classification (Include DP/RP Class)	DNV 1A1, SF, E0, DYNPOS-AUTR, CLEAN DESIGN, COMF-V (3), ICE-C, NAUT - AW HELDK
Call Sign	C6XK5
IMO number	9538098
Any previous vessel names or owners?	Polarcus Naila, Polarcus
Helideck (Deck Size / Rating / Beacon Details / Max Weight / Max Heli Dimensions)	Sikorsky S-61N / S-92
Berths	60, including 23 single cabins
Available berths for 3rd party personnel	As required
Type of Fuel Used	MGO
Fuel Capacity / Endurance / Consumption (Transit,	1925m^3

Main Maritime Characteristics	
Standby, Operations)	
Fresh Water Maker Capacity	2x10 m3/24hr-AlfaLaval

Dimensions	
Length (m)	92.0m
Beam (m)	21.0m
Working Back Deck Dimensions (X x Y, m^2)	21.0m
Max Draft (m)	7.5m
Gross tonnage (mt)	7894t
Net tonnage (mt)	2369t

Propulsion & Power	
Maximum Speed (knot)	14.5knots
Cruising Speed (knot)	12.5knots
Bollard Pull (mt)	115t
Propulsion Principle (e.g. diesel, diesel electric, electric, hybrid)	Diesel Electric
Propulsion System (Controllable pitch propeller, fixed pick, retractable, etc.)	2 x Berg CP Propeller at 3750kW
Diesel Engines (Type/Number/Output)	Wartsila 4 x 9L20 + 2 x 9L26, 4 x 1800 kW and 2 x 2984 kW. Total 13,168 kW
Number of Generators / Rating (KW)	4x AvK 1933 kVA 2x AvK 3303kVA
Electrical System (Make/Power if applicable)	690V, 400V, 230V 50Hz
Number and type of propellers	2 x conventional CPP propellers at 3.75MW
Stern Thrusters	1 x Brunvoll tunnel thruster at 830kW
Bow Thrusters	1 x Brunvoll tunnel thruster at 1200kW 1 x retractable azimuth thruster at 850kW

Communications	
Primary	GMDSS A4
Secondary	Inmarsat F Fleet-77
Communication	VSAT

Bridge Navigation Equipment	
Radar 1 (Make/Model/Radius)	1 ARPA Furuno FCR 2837 S-Band
Radar 2 (Make/Model/Radius)	1 ARPA Furuno FCR 2827 S-Band
Radar 3 (Make/Model/Radius)	1 Seahawk Ice tracking Radar
Auto pilot	1 Anschtz NautoPilot 2025-C
Gyro Compass (GPS heading equipment or MRU)	3 Anschutz Standard 22
Navigation	ECDIS chart system Furuno T-2136
Log	Furuno DS-80
Auto track/auto speed system (e.g. KPOS or MT)	Kongsberg K-Pos DP-21 DYNPOS AUTR DP-System (DP II)

Safety Equipment	
Life rafts (Type/Number/Capacity)	inflatable with MES,cap.for 200% of POB
Lifejackets (Type/Number)	60

Safety Equipment	
Survival suits (Type/Number)	60
MOB vessel (Type/Size/Capacity/Launching Method)	1ea. Norsafe Magnum 750

Fire Fighting Equipment	
Fire Detection Monitoring System	TYCO-T2000
Main Fire Pump	2 x Allweiler 50m³/hr
Emergency Fire Pump	1 x Allweiler 40m³/hr
Portable Fire extinguishers	as per SOLAS requirement

Additional Navigation Equipment	
Echosounder	Kongsberg EA600
Echosounder Frequencies	12KHz,38KHz,200KHz
Maximum Sounding Depth	6000mwith12KHz
Motion sensor (pitch, roll, heave)	KongsbergMRU
Current Profiler (Model/Depth Range)	Nortek

Auxiliary Boats	
Seismic Work Boat (Type/Size/Capacity)	Westplast WP950 SW
Number of Work Boats Available	2

2 Vessel Seismic Equipment Specifications

Streamer Specifications	
Streamer (Manufacturer/Type)	Sercel Sentinel
Solid or Gel	Solid
Streamer Jacket	Polyurethane
Group Length (m)	12.5m
Hydrophone Type	Sercel Flexible Hydrophone
Number of hydrophones in group and spacing	8
Group sensitivity (V/bar)	19.7V/Bar

Seismic Navigation System	
Main DGPS/dGNSS	
Name and provider of system	Fugro Starfix G2
Secondary DGPS	
Name and provider of system	Fugro Skyfix XP / Fugro Starfix HP
Tertiary DGPS	
Name and provider of system	Fugro Starfix L1
Online/Integrated Navigation System	
Type and Manufacturer (Version)	ION Concept System Orca
Online Binning System	
Type and Manufacturer (Version)	ION Reflex

RGPS/rGNSS	
Manufacturer/Type (Shipboard & in-water)	Seamap, Buoylink

Streamer Control & Positioning Specifications	
Streamer Depth Controller	

Streamer Control & Positioning Specifications	
Manufacturer/Type/Number	Input/Output (Digicourse) DigiBird 5011
Streamer Lateral Controller	
Manufacturer/Type	ION (Digicourse) DigiFin 5120
Acoustic Positioning System	
Manufacturer/Type	ION Digirange 2
Streamer Compass	
Manufacturer/Type/Number	ION(Digicourse)5011

Source	
Manufacturer and Type	Bolt Air Guns
Number of sub-arrays per source	6
Nominal Source Operating Pressure (psi)	2000 psi typical
Firing sensor type	Solenoid
Timing resolution	0.1ms
Number and position of near field hydrophones	1 per gun/gun cluster position
Number and position of depth transducers	Each gun position
Source Controller / timing accuracy	Seamap GunLink 4000
Number and Type of Compressors	3 x LMF 1800 CFM

3 Instrument Room

Recording System	
Acquisition System	Sercel Seal 428 Marine Data Acquisition System
Recording System	Seal 428 Profocus Argus DUG Real Time QC
Maximum number of seismic channels	12 x 648 => 12 x 8100m streamers
Number of aux channels	10
Recording format	SEG-D rev 1.0 & 2.1
Tape drives (Type/Model/Number)	IBM 3592
Recording high cut filter (Hz, dB/oct)	0.25ms, 0.5ms,1 ms, 2 ms, 4ms
Recording low cut filter, raw geosensor (Hz, dB/oct)	Analog 2Hz

Note: Additional system, equipment, hardware and, software information may be available. Please refer to the appropriate specification sheets and/or manuals for more information.

Shelia Bordelon Data Sheet

General Information

IMO No.	9670638
Owner/Manager	Bordelon Marine, LLC
Vessel Type	Ultra Light Intervention Vessel
Year Built	2015
Place Built / Builder	Bordelon Marine Shipbuilders
Flag State Authority	USA (Jones Act Compliant)
DP Classification	DP2
Classification	ABS / A1, AMS, +DPS-2, ACCU, USCG L&I, CRC
Official Number	1259393

Dimensions

Length	257 ft.	(78.33m)
Breadth	52 ft.	(15.8m)
Depth Molded	18 ft.	(5.5m)
Light Draft	12.5 ft.	(4.6m)
Loaded Draft	15 ft.	(4.6m)
Deadweight	3285 LT	

Main Work Deck

Main Deck Area	5,604 sq. ft.	(520.62m²)
Main Deck Dimensions	140 ft. x 45 ft.	(42.67m x 13.71m)
Strength	1080 lbs per sq. ft. = 5273 KG/M2	
Lars Deck Area	2912 sq. ft	
Lars Deck Dimensions	56 ft. x 52 ft.	
Strength	1080 lbs per sq. ft. = 5273 KG/M2 480v	
Electrical Power to Deck	(3) Phase, three locations	
Air Power to Deck	95 psi	

Capacities

Drill Water	178k gal	(674 m³)
Potable Water	69,126 gal	(262 m³)
Diesel Fuel	122k gal	(462m³)
Lube Oil	6190 gals | [2] tanks 3095 gals each	
Hydraulic Oil	3394 gals | [2] tanks 1697 gals each	
Water Maker	FCI Neptune series 8,000 gals per day | (1) tank	

Accomodations

Total Berths	60
Stateroom	19
Heads/ Showers	22
Laundry [2] Facility	8 units in each facility
Hospital	(1) 3 person capacity
Office	Offshore Manager | Conference Room | ROV Online Room | Project Office | Client | Survey Area | Shift Supervisor Deck | Dedicated PDU and Instrument Room|
Other	Lounges | Offices

Crane

Crane Description	NOV (50) ton AHC 20 tons @ 3000m single fall
Static Payload Capacity	50 ton
Wire Length	3070m
Wire Diameter	48mm
Maximum Boom Height	22M
Ship/ Rov Crane	1 ton Fixed Boom Support Crane
Certifications	ABS/DNV lifting notation 2015. Manride/handling certification 2015

**Power source to crane is fully redundant

Machinery

Main Propulsion	(2) Cummins QSK 60 Tier 3 (1641kW)
Main Generator	(4) Cummins QSK 38 Tier 2 (1044kW) (3) Cummins QSK 19 Tier 3 (563 kW)
Emergency Generators	(1) Cummins 6TA8 (201kW)
Azimuthing Thrusters	(2) Schottel 1215, 4400HP Total
Bow Thrusters	(2) STT2 FP 975 HP (708kW each) Continous Rating
Dive Support Capability	YES

Performance

Maximum Speed	12 knots	(200 USG/Hr.)
Service Speed	10 knots	(145 USG/Hr.)
Eco Speed	8.5 knots	(130 USG/Hr.)
Fuel Consumption at DP		(12-30 USG/Hr.)

Navigation snd Communication

Radars	(2) Furuno Ultra-High Def 6KW-12KWw/MT Bridge-mate display
ECDIS	(2) Nav-Suite 8700 Series, Bridge-mate integrated.
Gyros	(3) MT 6400 series, independent signal
Echo Sounder	(1) Skipper GDS102
Speed Log	(1) Skipper DL850
Auto Pilot	(3) MT Bridge-mate MTOS
GMDSS	(1) Sailor A3 150 W-SAT, C/SAT
Inmarsat C	(2) Sailor 6066, Dual Min-C

ROV Information

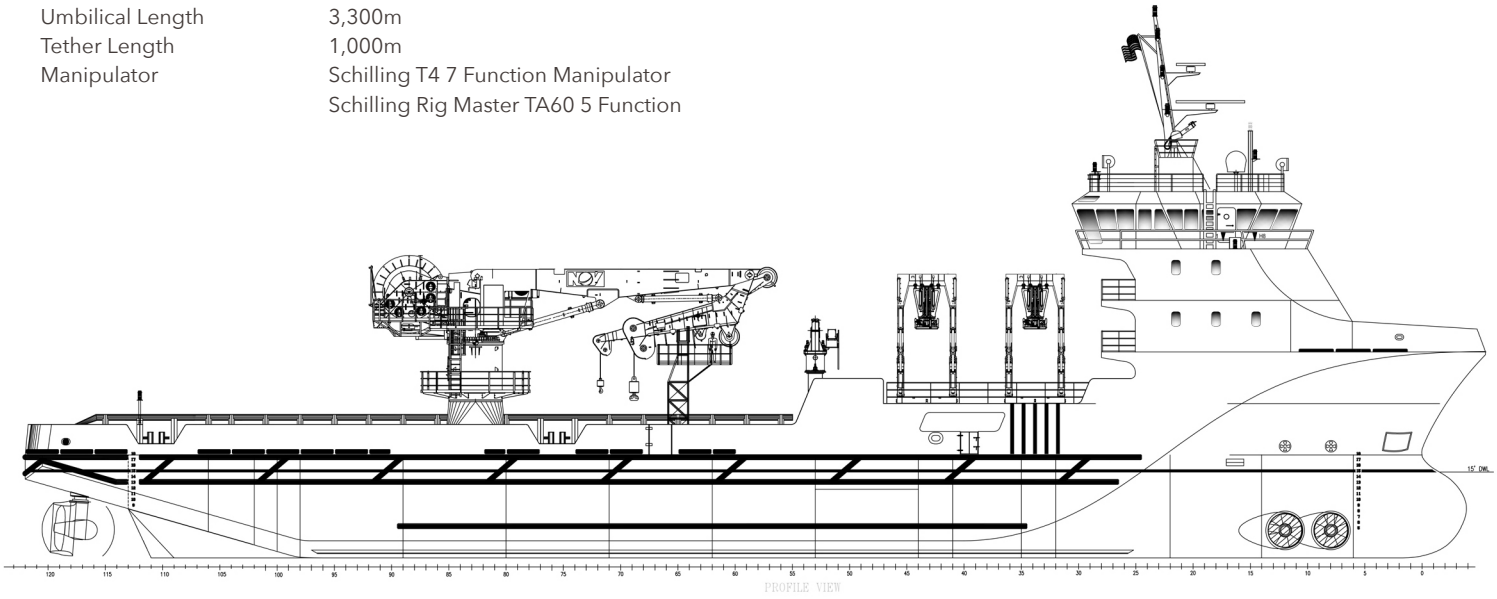
Type	Triton XLX 200 HP Work Class ROV
Number of systems	2
Depth Rating	3,000 msw
Umbilical Length	3,300m
Tether Length	1,000m
Manipulator	Schilling T4 7 Function Manipulator Schilling Rig Master TA60 5 Function

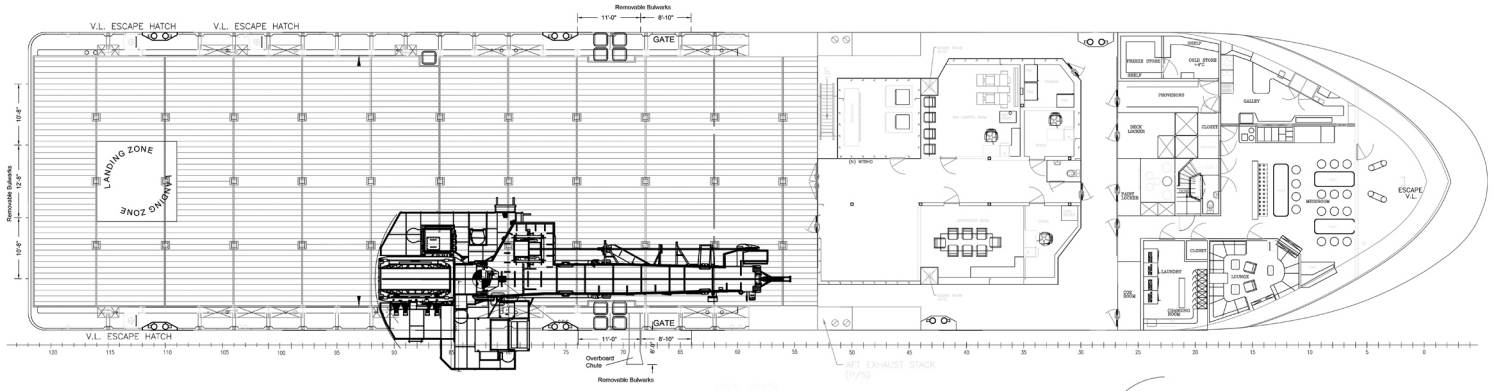
Safety

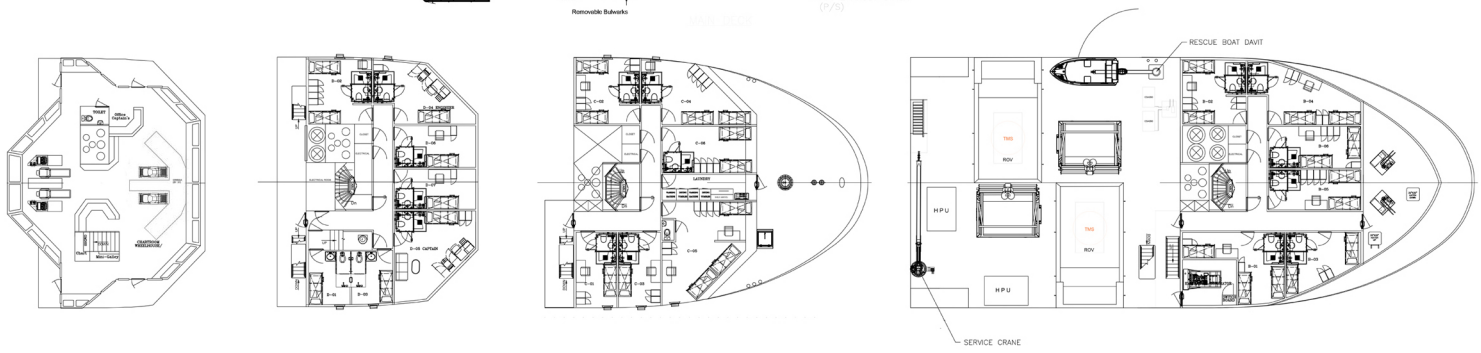
Life Rafts	6x 25-man USCG and ABS approved
Fast Rescue Craft	1 Schatt Harding with 40 HP Motor
Fire Fighting	Water and Foam capacity

DP & Referencing Systems

Marine Technology	DP2 w/ Full Bridge-mate integration, Independent consoles
DGPS	(2) CNAV 3050 Systems, with independent tracking
Cyscan	(1) MT Bridge-mate CyScan
RadaScan	(1) MT Bridge-mate RadaScan
USBL	(2) Ranger2 PRO Systems
	(2) Independent thru-hull deployment systems







Sarah Bordelon Data Sheet

General Information

Owner/Manager	Bordelon Marine, LLC
Vessel Type	Offshore Supply Vessel
Year Built	2006
Place Built / Builder	Bordelon Marine Shipbuilders
Flag State Authority	USA (Jones Act Compliant)
DP Classification	DP1
Classification	ABS / A1, USCG L
Official Number	1174839

Dimensions

Length	180 ft.	(54.86m)
Breadth	36 ft.	(10.97m)
Depth Molded	11.5 ft.	(3.50m)
Light Draft	8.5 ft.	(2.59m)
Loaded Draft	10 ft.	(3.04m)
Deadweight	440.92 LT	

Main Work Deck

Main Deck Area	3,840 sq. ft.	(356.55m²)
Main Deck Dimensions	32 ft. x 120 ft.	(9.75m x 36.57m)
Strength	785 lbs per sq. ft.	
Tonnage	390 LT	

Capacities

Drill Water	1,198 BBLS	(50,332 USG)
Fuel	57,200 USG	
Fuel, Transferable	52,000 USG	
Liquid Mud	1,200 BBLS	(50,400 USG)
Methanol	1,060 BBLS	(44,556 USG)
Potable Water	73,978 USG	

Accomodations

Total Berths	20
Crew	4
Passenger Berths	16
Lounge	6
Mess	10

Navigation & Communication

DP	IVCS2000-DP1
GPS	1-C-Nav 1000, 2-MX 420, and Furuno GP32
Radar	2-JRC2300
Gyro Compass	2-Yokogawa
SSB	Furuno FS-1503
Internet E-mail	VSAT System
Satellite Phone	VSAT System
Charting Program	Maptech, Offshore Navigator
VHF	2-Standard Matrix GX-128 OS
Autopilot	IVCS 2000
Depth Recorder	Furuno LS-6100
Computerized Alarms	Techsol
Tank Level Monitor	Techsol

Machinery

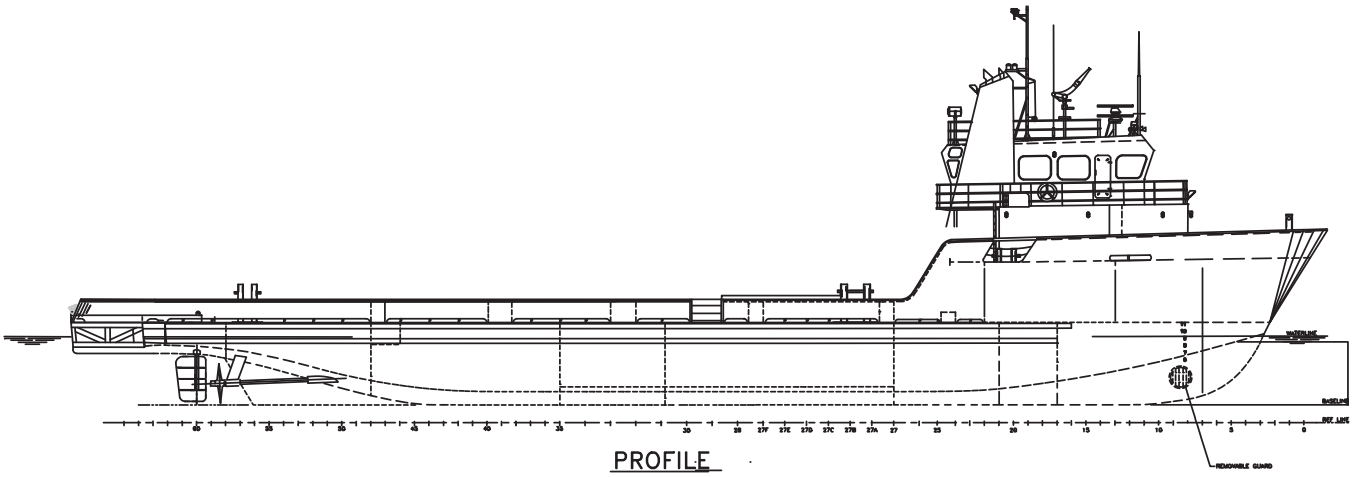
Main Engines	Cummins KTA 38MO
Brake Horsepower	1800
Gears	MG5301/4.96:1
Wheels	72x57
Generators	2-99KW/Cummins 6CTA
Generators-Mud	242 HP @ 1750 RPM | Mission Magnum
Bow Thrusters	Schottel STT 1 10LK/ Cummins M1 4TA
Fire Monitor	Crane Deming 5064

Performance

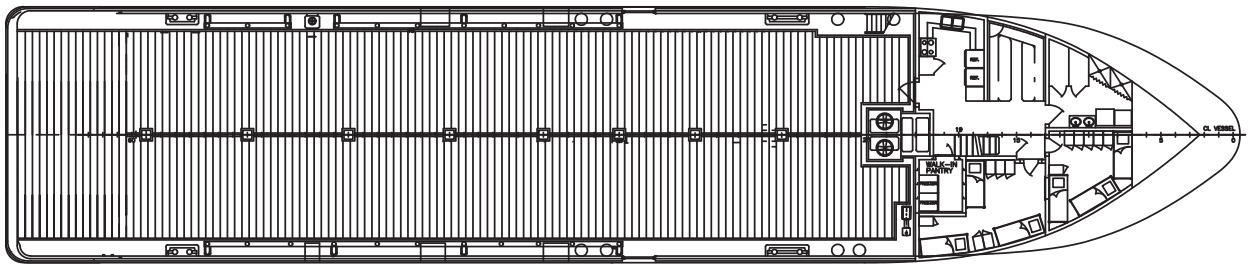
Maximum Speed	10.5 kts	82 USG/Hr.
Fuel Conservation Speed	8 knots	58 USG/Hr.
DP at 80% propulsion		50 USG/Hr.
Generator Consumption		60 USG/Day

Discharge Rates

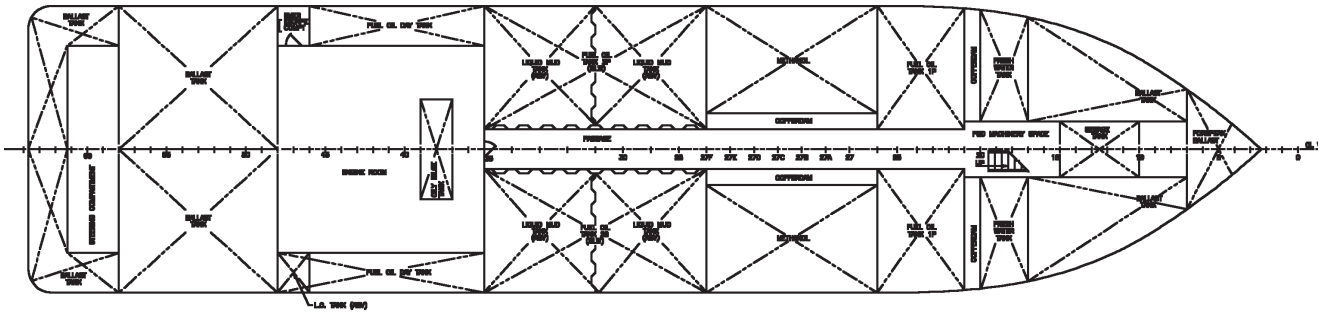
Drill Water	625 USG/min @150 ft
Potable Water	380 USG/min @100 ft
Fuel Oil	360 USG/min @100 ft
Liquid Mud at 22lbs Max	625 USG/min @150
Methanol	360 USG/min @100 ft
Fire Monitor	2,400 USG/min @380 ft



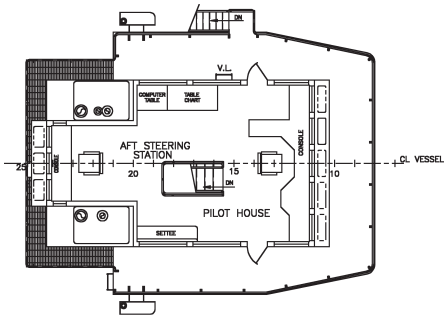
PROFILE



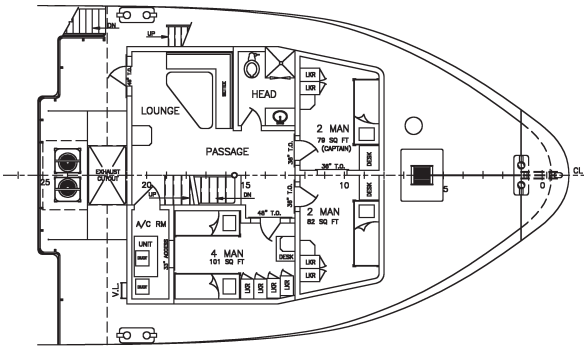
MAIN DECK PLAN



HOLD PLAN



PILOTHOUSE ARRANGEMENT



FOCSLE DECK ARRANGEMENT

Sincerely

Signature: 

Printed Name: __Gary Poole_____

Company: __WesternGeco_____

Title: __MultiClient New Ventures Lead____

Phone: ___(713) 689 6547_____

Email: ____GPoole@slb.com_____

Cc: Teree Campbell
Regional Supervisor
Bureau of Ocean Energy Management

Appendix A: Seismic Survey Mitigation and Protected Species Observer Protocols

This Appendix has been revised as of April 26, 2021, and replaces the original Appendix C (dated March 13, 2020). These protocols will be implemented by the Bureau of Ocean Energy Management (BOEM), the Bureau of Safety and Environmental Enforcement (BSEE), and provide guidelines to operators in complying with the Endangered Species Act (ESA; 16 U.S.C. §§ 1531-1544) and Marine Mammal Protection Act (MMPA; 16 U.S.C. §§1361-1423h). The measures contained herein apply to all seismic surveys approved by BOEM and associated with the federally regulated oil and gas program in the Gulf of Mexico.

Background

Geophysical surveys, including the use of airguns and airgun arrays may have an impact on marine wildlife. Many marine species are protected under the Endangered Species Act (ESA) and all marine mammals (including manatees) are protected under the Marine Mammal Protection Act (MMPA). The following Gulf of Mexico species are listed under the ESA:

ESA-listed Species common to the Gulf of Mexico
Gulf of Mexico Bryde's Whale (*Balaenoptera edeni*)
Sperm Whale (*Physeter macrocephalus*)
Green Turtle (*Chelonia mydas*) – North Atlantic DPS and South Atlantic DPS
Hawksbill Turtle (*Eretmochelys imbricata)*
Kemp's Ridley Turtle (*Lepidochelys kempii*)
Leatherback Turtle (*Dermochelys coriacea*) - Northwest Atlantic DPS
Loggerhead Turtle (*Caretta caretta*) – Northwest Atlantic Ocean DPS
Gulf Sturgeon (*Acipenser oxyrinchus desotoi*)
Oceanic Whitetip Shark (*Carcharhinus longimanus*)
Giant Manta Ray (*Manta birostris*)
West Indian Manatee (*Trichechus manatus*)*

**Managed by the US Fish and Wildlife Service*

Note that this list can change as other species are listed/delisted, and this protocol shall be applied to any ESA-listed protected species (and all marine mammals) that occur in the Gulf of Mexico, including rare and extralimital species.

BSEE and BOEM consult jointly with the National Marine Fisheries Service (NMFS) and the U.S. Fish and Wildlife Service (FWS) under Section 7 of the ESA to ensure that BOEM- or BSEE-authorized activities do not jeopardize the continued existence of ESA-listed species nor result in destruction or adverse modification of designated critical habitat. Incidental take of ESA-listed species is prohibited except as authorized pursuant to an Incidental Take Statement in the attached Biological Opinion. Incidental take of ESA-listed marine mammals cannot be exempted under the ESA unless also authorized under the MMPA. In this case, NMFS is

developing an incidental take regulation (ITR) to facilitate subsequent issuance of MMPA authorization (as applicable) to operators to authorize take incidental to seismic surveys. The proposed regulations would establish a framework for authorization of incidental take by Level A and Level B harassment through MMPA authorization (as applicable). Once an ITR and subsequent LOA is complete, the Biological Opinion and associated Incidental Take Statement may be amended to exempt take for Gulf of Mexico Bryde's whale and sperm whale, which are listed under the ESA. Following development of the ITRs, implementation could occur via issuance of MMPA authorization (as applicable and as Letters of Authorization [LOAs]) upon request from individual industry applicants planning specific seismic survey activities.

These protocols are the result of coordination between BOEM, BSEE, and NMFS and are based on: past and present mitigation measures; terms and conditions and reasonable and prudent measures identified in the attached Biological Opinion issued to the Bureaus; conditions, mitigation, monitoring, and reporting requirements identified in the MMPA ITR (50 CFR part 217 Subpart S); and NMFS' technical memorandum on standards for a protected species observer and data management program (Baker et al. 2013). BSEE is tasked as the lead agency for compiling lessee or operator reporting data required under current Biological Opinions applicable to both Bureaus. Therefore, while BOEM is issuing these protocols, all observer reports described herein must be submitted to BSEE as well as to NMFS where specified.

In order to protect ESA-listed species and marine mammals during seismic operations, seismic operators will be required to use protected species observers (PSOs) and follow specific seismic survey protocols when operating. These measures contained herein apply to all on-lease ancillary activity surveys conducted under 30 CFR Part 550 and all off-lease surveys conducted under 30 CFR Part 551, regardless of water depth. Operators must demonstrate your compliance with these requirements by submitting to BSEE and NMFS reports asdetailed below.

Definitions

Terms used in these protocols have the following meanings:

1. Protected species means any species listed under the ESA and/or protected by the MMPA. The requirements discussed herein focus on marine mammals and sea turtles since these species are the most likely to be observed during seismic surveys. However, other ESA-listed species (e.g., giant manta rays) are also protected and observations of them should be reported as detailed below.
2. Airgun means a device that releases compressed air into the water column, creating an acoustical energy pulse with the purpose of penetrating the seafloor.
3. Deep penetration surveys are defined as surveys using airgun arrays with total volume greater than 1,500 in^3.These surveys may in some cases collect return signals using sensors incorporated into ocean-bottom cables (OBC) or autonomous

ocean-bottom nodes (OBN) placed on the seafloor. These surveys are also referred to as high energy surveys.

4. Shallow penetration surveys are defined as surveys using airgun arrays with total volume equal to or less than 1,500 in^3, single airguns, boomers, or equivalent sources. These surveys are also referred to as low energy surveys.
5. Ramp-up (sometimes referred to as "soft start") means the gradual and systematic increase of emitted sound levels from an airgun array. Ramp-up begins by first activating a single airgun of the smallest volume, followed by doubling the number of active elements in stages until the full complement of an array's airguns are active. Each stage should be approximately the same duration, and the total duration should not be less than approximately 20 minutes for deep penetration surveys.
6. Shutdown of an airgun array means the immediate de-activation of all individual airgun elements of the array.
7. Exclusion zone means the area to be monitored for possible shutdown in order to reduce or eliminate the potential for injury of protected species. Two exclusion zonesare defined, depending on the species and context.
8. Buffer zone means an area beyond the exclusion zone to be monitored for the presence of protected species that may enter the exclusion zone. During pre-clearance monitoring (i.e., before ramp-up begins), the buffer zone also acts as an extension of the exclusion zone in that observations of marine mammals and sea turtles within the buffer zone would also prevent airgun operations from beginning (i.e. ramp-up). The buffer zone is not applicable for contexts that require an exclusion zone beyond 500 meters. The buffer zone encompasses the area at and below the sea surface from the edge of the 0– 500 meter exclusion zone, out to a radius of 1000 meters from the edges of the airgun array (500–1,000 meters) The buffer zone is not applicable when the exclusion zone is greater than 500 meters, *i.e.*, the observational focal zone is not increased beyond 1,500 meters.
9. Visual monitoring means the use of trained protected species observers (herein referred to as visual PSOs) to scan the ocean surface visually for the presence of protected species. These observers must have successfully completed a visual observer training program as described below. The area to be scanned visually includes primarily the exclusion zone, but also the buffer zone. Visual monitoring of the exclusion zones and adjacent waters is intended to establish and, when visual conditions allow, maintain zones around the sound source that are clear of marine mammals and sea turtles, thereby reducing or eliminating the potential for injury. Visual monitoring of the buffer zone is intended to (1) provide additional protection to marine mammals and sea turtles and awareness and potential protection of other visual protected species that may be in the area during pre-clearance, and (2) during airgun use, aid in establishing and maintaining the exclusion zone by alerting the visual observer and crew of marine mammals and sea turtles that are outside of, but may approach and enter, the exclusion zone.
10. Acoustic monitoring means the use of trained personnel (sometimes referred to as

passive acoustic monitoring (PAM) operators, herein referred to as acoustic PSOs) to operate PAM equipment to acoustically detect the presence of marine mammals. These observers must have successfully completed a passive acoustic observer training program as described below. Acoustic monitoring is intended to further support visual monitoring in maintaining an exclusion zone around the sound source that is clear of marine mammals, in part for the purpose of reducing or eliminating the potential for injury. In cases where visual monitoring is not effective (e.g., due to weather, nighttime), acoustic monitoring may be used to allow certain activities to occur, as further detailed below.

General Requirements

1. A copy of a MMPA incidental take authorization (as applicable) and BOEM-approved Permit/Plan must be in the possession of the vessel operator, other relevant personnel, the lead PSO (see description below), and any other relevant designees operating under the authority of the MMPA authorization (as applicable) and BOEM Permit/Plan.
2. The MMPA authorization holder (as applicable) and BOEM-approved Permit/Plan holder shall instruct relevant vessel personnel with regard to the authority of the protected species monitoring team (PSO team), and shall ensure that relevant vessel personnel and the PSO team participate in a joint onboard briefing (hereafter PSO briefing) led by the vessel operator and lead PSO to ensure that responsibilities, communication procedures, protected species monitoring protocols, operational procedures, and MMPA authorization (as applicable) and BOEM Permit/Plan requirements are clearly understood. This PSO briefing must be repeated when relevant new personnel join the survey operations before work commences.
3. The acoustic source must be deactivated when not acquiring data or preparing to acquire data, except as necessary for testing. Unnecessary use of the acoustic source must be avoided. For surveys using airgun arrays as the acoustic source notified operational capacity (not including redundant backup airguns) must not be exceeded during the survey, except where unavoidable for source testing and calibration purposes. All occasions where activated source volume exceeds notified operational capacity must be communicated to the PSO(s) on duty and fully documented. The lead PSO must be granted access to relevant instrumentation documenting acoustic source power and/or operational volume.

Protected Species Observers (PSOs, Visual and Acoustic)

Qualifications

1. The MMPA authorization (as applicable) and BOEM-approved Permit/Plan holder must use independent, dedicated, trained visual and acoustic PSOs, meaning that the PSOs must be employed by a third-party observer provider, may have no tasks other than to conduct observational effort (visual or acoustic), collect data, and communicate

with and instruct relevant vessel crew with regard to the presence of protected species and mitigation requirements (including brief alerts regarding maritime hazards), and must have successfully completed an approved PSO training course appropriate for their designated task (visual or acoustic). Acoustic PSOs are required to complete specialized training for operating PAM systems and are encouraged to have familiarity with the vessel with which they will be working. PSOs can act as acoustic or visual observers (but not at the same time) as long as they demonstrate to NMFS (nmfs.psoreview@noaa.gov) that their training and experience are sufficient to perform necessary tasks. NMFS must review and approve PSO resumes accompanied by a relevant training course information packet that includes the name and qualifications (i.e., experience, training completed, or educational background) of the instructor(s), the course outline or syllabus, and course reference material as well as a document stating successful completion of the course. NMFS shall have one week to approve PSOs from the time that the necessary information is submitted by the BOEM-approved Permit/Plan holder, after which PSOs meeting the minimum requirements shall automatically be considered approved.

2. At least one visual and two acoustic PSOs (when required) aboard the vessel must have a minimum of 90 days at-sea experience working in those roles, respectively, with no more than 18 months elapsed since the conclusion of the at-sea experience. One visual PSO with such experience shall be designated as the lead for the entire protected species observation team. The lead shall coordinate duty schedules and roles for the PSO team and serve as primary point of contact for the vessel operator (the responsibility of coordinating duty schedules and roles may instead be assigned to a shore-based, third-party monitoring coordinator). To the maximum extent practicable, the lead PSO shall devise the duty schedule such that experienced PSOs are on duty with those PSOs with appropriate training but who have not yet gained relevant experience.
    a. PSOs must successfully complete relevant training, including completion of all required coursework and passing (80 percent or greater) a written and/or oral examination developed for the training program. PSOs must have successfully attained a bachelor's degree from an accredited college or university with a major in one of the natural sciences, a minimum of 30 semester hours or

equivalent in the biological sciences, and at least one undergraduate course in math or statistics. The educational requirements may be waived if the PSO has acquired the relevant skills through alternate experience. Requests for such a waiver shall be submitted by the BOEM-approved Permit/Plan holder to NMFS (nmfs.psoreview@noaa.gov) and must include written justification. Requests shall be granted or denied (with justification) by NMFS within one week of receipt of submitted information. Alternate experience that may be considered includes, but is not limited to: (1) secondary education and/or experience comparable to PSO duties; (2) previous work experience conducting academic, commercial, or government-sponsored protected species surveys; or (3) previous work experience as a PSO; the PSO should demonstrate good standing and consistently good performance of PSO duties.

Equipment

The MMPA incidental take authorization (as applicable) and BOEM-approved Permit/Plan holder is required to:

1. Provide PSOs with bigeye binoculars (e.g., 25 x 150; 2.7 view angle; individual ocular focus; height control) of appropriate quality solely for PSO use. These shall be pedestal-mounted on the deck at the most appropriate vantage point that provides for optimal sea surface observation, PSO safety, and safe operation of the vessel.
2. Work with the selected third-party observer provider to ensure PSOs have all equipment (including backup equipment) needed to adequately perform necessary tasks, including accurate determination of distance and bearing to observed protected species. Such equipment, at a minimum, shall include:
    a. Each vessel requiring PAM will include a passive acoustic monitoring system that has been verified and tested by an experienced acoustic PSO that will be using it during the trip for which monitoring is required.
    b. Reticle binoculars (e.g., 7 x 50) of appropriate quality (at least one per PSO, plus backups)
    c. Global Positioning Units (GPS) (plus backup)
    d. Digital camera with a telephoto lens (the camera or lens should also have an image stabilization system) that is at least 300 mm or equivalent on a full-frame single lens reflex (SLR) (plus backup)
    e. Radios for communication among vessel crewand PSOs (at least one per PSO, plus backups)
    f. Any other tools necessary to adequately perform necessary PSO tasks.

    Equipment specified in (a) through (g) above may be provided by an individual PSO, the third-party observer provider, or the MMPA authorization (as applicable) and BOEM-approved Permit/Plan holder but the latter is responsible for ensuring PSOs have the proper equipment required to perform the duties specified within these protocols.

Data Collection

PSOs must use standardized data collection forms. PSOsshall record detailed information about any implementation of mitigation requirements, including the distance of animals to the acoustic source and description of specific actions thatensued, 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. At a minimum, the following information must be recorded:

1. BOEM Permit/Plan number;
2. Vessel names (source vessel and other vessels associated with survey), vessel size and type, maximum speed capability of vessel, port of origin, and call signs;
3. PSO names and affiliations;
4. Dates of departures and returns to port with port name;
5. Date and participants of PSO briefings (as discussed in General Requirements. 2);
6. Dates and times (Greenwich Mean Time) of survey effort and times corresponding with PSO effort;
7. Vessel location (latitude/longitude) when survey effort began and ended and vessel location at beginning and end of visual PSO duty shifts;
8. Vessel heading and speed at beginning and end of visual PSO duty shifts and upon any line change;
9. Environmental conditions while on visual survey (at beginning and end of PSO shift and whenever conditions changed significantly), including BSS and any other relevant weather conditions including cloud cover, fog, sun glare, and overall visibility to the horizon;
10. Factors that may have contributed to impaired observations during each PSO shift change or as needed as environmental conditions changed (e.g., vessel traffic, equipment malfunctions);
11. Survey activity information, such as acoustic source power output while in operation, number and volume of airguns operating in the array, tow depth of the array, and any other notes of significance (i.e., pre-clearance, ramp-up, shutdown, testing, shooting, ramp-up completion, end of operations, streamers, etc.); and
12. Upon visual observation of any protected species, the following information:
    a. Watch status (sighting made by PSO on/off effort, opportunistic, crew, alternate vessel/platform);
    b. PSO who sighted the animal;
    c. Time of sighting;
    d. Vessel location (coordinates) at time of sighting;
    e. Water depth;
    f. Direction of vessel's travel (compass direction);
    g. Direction of animal's travel relative to the vessel;
    h. Pace of the animal;

i. Estimated distance to the animal and its heading relative to vessel at initial sighting;

j. Identification of the animal (e.g., genus/species, lowest possible taxonomic level, or unidentified), PSO confidence in identification, and the composition of the group if there is a mix ofspecies;

k. Estimated number of animals (high/low/best);

l. Estimated number of animals by cohort (adults, juveniles, group composition, etc.);

m. Description (as many distinguishing features as possible of each individual seen, including length, shape, color, pattern, scars or markings, shape and size of dorsal fin, shape of head, and blow characteristics);

n. Detailed behavior observations (e.g., number of blows/breaths, number of surfaces, breaching, spyhopping, diving, feeding, traveling; as explicit and detailed as possible; note any observed changes in behavior), including an assessment of behavioral responses to survey activity;

o. Animal's closest point of approach (CPA) and/or closest distance from any element of the acoustic source;

p. Platform activity at time of sighting (e.g., deploying, recovering, testing, shooting, data acquisition, other); and

q. Description of any actions implemented in response to the sighting (e.g., delays, shutdown, ramp-up) and time and location of the action.

13. If a marine mammal is detected while using the PAM system, the following information should be recorded:
    a. An acoustic encounter identification number, and whether the detection was linked with a visual sighting;
    b. Date and time when first and last heard;
    c. Types and nature of sounds heard (e.g., clicks, whistles, creaks, burst pulses, continuous, sporadic, strength of signal);
    d. Any additional information recorded such as water depth of the hydrophone array, bearing of the animal to the vessel (if determinable), species or taxonomic group (if determinable), spectrogram screenshot, and any other notable information.

Deep Penetration Seismic Survey Protocols

Visual Monitoring

1. During survey operations (e.g., any day on which use of the acoustic source is planned to occur, and whenever the acoustic source is in the water, whether activated or not), a minimum of two visual PSOs must be on duty and conducting visual observations at all times during daylight hours (i.e., from 30 minutes prior to sunrise through 30 minutes following sunset).
2. Visual monitoring must begin no less than 30 minutes prior to ramp-up and must

continue until one hour after use of the acousticsource ceases or until 30 minutes past sunset.

3. Visual PSOs shall coordinate to ensure 360° visual coverage around the vessel from the most appropriate observation posts, and shall conduct visual observations using binoculars and the naked eye while free from distractions and in a consistent, systematic, and diligent manner.
4. PSOs shall establish and monitor applicable exclusion and buffer zones. These zones shall be based upon the radial distance from the edges of the airgun array (rather than being based on the center of the array or around the vessel itself). During use of the acoustic source (i.e., anytime the acoustic source is active, including ramp-up), occurrences of protected species within the buffer zone (but outside the exclusion zone) should be communicated to the operator to prepare for the potential shutdown for marine mammals (or voluntary pause for other non-marine mammal protected species [e.g., sea turtles] if being employed) of the acoustic source.
5. Visual PSOs shall immediately communicate all observations to the on duty acoustic PSO(s), including any determination by the PSO regarding species identification, distance, and bearing and the degree of confidence in the determination.
6. Any observations of protected species by crew members aboard any vessel associated with the survey shall be relayed to the PSO team.
7. During good conditions (e.g., daylight hours; Beaufort sea state (BSS) 3 or less), visual PSOs shall conduct observations when the acoustic source is not operating for comparison of sighting rates and behavior with and without use of the acoustic source and between acquisition periods, to the maximum extent practicable.
8. Visual PSOs may be on watch for a maximum of two consecutive hours followed by a break of at least one hour between watches and may conduct a maximum of 12 hours of observation per 24-hour period. Combined observational duties (visual and acoustic but not at same time) may not exceed 12 hours per 24-hour period for any individual PSO. NMFS may grant an exception for LOA applications that demonstrate such a "two hours on/one hour off" duty cycle is not practicable, in which case visual PSOs will be subject to a maximum of four consecutive hours on watch followed by a break of at least two hours between watches. Combined observational duties (visual and acousticbut not at the same time) must not exceed 12 hours per 24-hour period for any individual PSO

Acoustic Monitoring

1. Applicants must provide a PAM plan to NMFS according to the MMPA authorization including description of the hardware and software proposed for use prior to proceeding with any survey where PAM is required. The source vessel must use a towed PAM system at all times when operating in waters deeper than 100 m, which

must be monitored by at a minimum one on duty acoustic PSO beginning at least 30 minutes prior to ramp-up, at all times during use of the acoustic source, and until one hour after use of the acoustic source ceases. "PAM system" refers to calibrated hydrophone arrays with full system redundancy to detect,identify, and estimate distance and bearing to vocalizing cetaceans, coupled with appropriate software to aid monitoring and listening by a PAM operator skilled in bioacoustics analysis and computer system specifications capable of running appropriate software. The PAM system must have at least one calibrated hydrophone (per each deployed hydrophone type and/or set) sufficient for determining whether background noise levels on the towed PAM system are sufficiently low to meet performance expectations).

2. Acoustic PSOs shall immediately communicate all detections to visual PSOs, when visual PSOs are on duty, including any determination by the PSO regarding species identification, distance, and bearing and the degree of confidence in the determination.
3. Acoustic PSOs may be on watch for a maximum of four consecutive hours followed by a break of at least two hours between watches and may conduct a maximum of 12 hours of observation per 24-hour period. Combined observational duties (acoustic and visual but not at same time) may not exceed 12 hours per 24-hour period for any individual PSO.
4. Survey activity may continue for 30 minutes when the PAM system malfunctions or is damaged, while the PAM operator diagnoses the issue. If the diagnosis indicates that the PAM system must be repaired to solve the problem, operations may continue for an additional two hours without acoustic monitoring during daylight hours only under the following conditions:
    a. Sea state is less than or equal to BSS 4;
    b. No marine mammals (excluding delphinids) detected solely by PAM in the applicable exclusion zone in the previous two hours;
    c. NMFS and BSEE are notified via email (nmfs.psoreview@noaa.gov and protectedspecies@bsee.gov, respectively) as soon as practicable with the time and location in which operations began occurring without an active PAM system; and
    d. Operations with an active acoustic source, but without an operating PAM system, do not exceed a cumulative total of four hours in any 24-hour period.

Pre-clearance and Ramp-up

The intent of pre-clearance observation (30 minutes) is to ensure no protected species are observed within the exclusion zones, and buffer zone if applicable (i.e., only when the exclusion zone is equal to 500 meters, see Definitions section for details on when the buffer

zone is not applicable), prior to the beginning of ramp-up. During pre-clearance is the only time observations of protected species in the buffer zone would prevent operations (i.e., the beginning of ramp-up). The intent of ramp-up is to warn protected species of pending seismic operations and to allow sufficient time for those animals to leave the immediate vicinity. A ramp-up procedure, involving a step-wise increase in the number of airguns firing and total array volume until all operational airguns are activated and the full volume is achieved, is required at all times as part of the activation of the acoustic source. All operators must adhere to the following pre-clearance and ramp-up requirements, which are applicable to both marine mammals and sea turtles:

1. The operator must notify a designated PSO of the planned start of ramp-up as agreed upon with the lead PSO; the notification time should not be less than 60 minutes prior to the planned ramp-up.
2. Ramp-ups shall be scheduled so as to minimize the time spent with the source activated prior to reaching the designated run-in.
3. A designated PSO must be notified againimmediately prior to initiating ramp-up procedures and the operator must receive confirmation from the PSO to proceed.
4. Ramp-up may not be initiated if any marine mammal or sea turtle is within the applicable exclusion or buffer zone. If a marine mammal or sea turtle is observed within the applicable exclusion zone or the buffer zone during the 30 minute pre-clearance period, ramp-up may not begin until the animal(s) has been observed exiting the zones or until an additional time period has elapsed with no further sightings (15 minutes for small odontocetes and 30 minutes for all other species including sea turtles).
5. Ramp-up shall begin by activating a single airgun of the smallest volume in the array and shall continue in stages by doubling the number of active elements at the commencement of each stage, with each stage of approximately the same duration. Duration shall not be less than 20 minutes. The operator must provide information to the PSO documenting that appropriate procedures were followed.
6. PSOs must monitor the exclusion and buffer zones during ramp-up, and ramp-up must cease and the source must be shut down upon observation of a marine mammal or sea turtle within the applicable exclusion zone. Once ramp-up has begun, observations of marine mammals and sea turtles within the buffer zone do not require shutdown, or voluntarily pause for other non-marine mammal protected species (e.g., sea turtles) if being employed, but such observation shall be communicated to the operator to prepare for the potential shutdown, or voluntarily pause if being employed.
7. Ramp-up may occur at times of poor visibility, including nighttime, if appropriate acoustic monitoring has occurred with no detections in the 30 minutes prior to beginning ramp-up. Acoustic source activation may only occur at times of poor

visibility where operational planning cannot reasonably avoid such circumstances.

8. If the acoustic source is shut down for brief periods (i.e., less than 30 minutes) for reasons other than implementation of prescribed mitigation (*e.g.*, mechanical difficulty), it may be activated again without ramp-up if PSOs have maintained constant visual and/or acoustic observation and no visual detections of marine mammals or sea turtleshave occurred within the applicable exclusion zone and no acoustic detections of marine mammals have occurred. For any longer shutdown, pre-clearance observation and ramp-up are required. For any shutdown at night or in periods of poor visibility (e.g., BSS 4 or greater), ramp-up is required, but if the shutdown period was brief andconstant observation was maintained, pre-clearance watch of 30 min is not required.
9. Testing of the acoustic source involving all elements requires ramp-up. Testing limited to individual source elements or strings does not require ramp-up but does require pre-clearance observation period.

Shutdown

For non-marine mammal protected species (e.g., sea turtles), shutdowns are not required. However, the BOEM Permit or authorized Plan and MMPA authorization (as applicable) holder may employ a voluntary pause during which the visual PSO would request that the operator voluntarily pause the airgun array for six shots if a non-marine mammal protected species is observed within the exclusion zone (within 500 meters) during active airgun use, to let the animal float past the array while it is inactive. For marine mammals, all operators must adhere to the following shutdown requirements:

1. Any PSO on duty has the authority to delay the start of survey operations or to call for shutdown of the acoustic source if a marine mammal is detected within the applicable exclusion zone.
2. The operator must establish and maintain clear lines of communication directly between PSOs on duty and crew controlling the acoustic source to ensure that shutdown, and voluntary pause commands (optional for other protected species) are conveyed swiftly while allowing PSOs to maintain watch.
3. When both visual and acoustic PSOs are on duty, all detections must be immediately communicated to the remainder of the on-duty PSO team for potential verification of visual observations by the acoustic PSO or of acoustic detections by visual PSOs.
4. Two exclusion zones are defined, depending on the species and context. A standard exclusion zone encompassing the area at and below the sea surface out to a radius of 500 meters from the edges of the airgun array (0-500 m) is defined. An extended 1,500-m exclusion zone must be applied upon detection (visual or acoustic) of a baleen whale, sperm whale, beaked whale or *Kogia* spp. within the zone.
5. When the airgun array is active (i.e., any time one or more airguns is active, including during ramp-up) and (1) a marine mammal appears within or enters the applicable exclusion zone and/or (2) a marine mammal (excluding delphinids) is detected acoustically and localized within the applicable exclusion zone, the acoustic source must be shut down. When shutdown is called for by a PSO, the acoustic source must be

immediately deactivated and any dispute resolved only following deactivation.

6. The shutdown requirement is waived for dolphins of the following genera: *Steno*, *Tursiops*, *Stenella*, and *Lagenodelphis*.
    a. If a small delphinid (individual of the Family Delphinidae, which includes the aforementioned dolphin genera), is acoustically detected and localized within the exclusion zone, no shutdown is required unless the acoustic PSO or a visual PSO confirms the individual to be of a genera other than those listed above, in which case a shutdown is required.
7. If there is uncertainty regarding identification (i.e., whether the observed marine mammal(s) belongs to one of the delphinid genera for which shutdown is waived or one of the species with a larger exclusion zone), visual PSOs may use best professional judgment in making the decision to call for a shutdown.
8. Upon implementation of shutdown, the source may be reactivated after the marine mammal(s) has been observed exiting the applicable exclusion zone (i.e., animal is not required to fully exit the buffer zone where applicable) or following a 30-minute clearance period with no further observation of the marine mammal(s).

Time-area closure

From January 1 through May 31, no use of airguns may occur shoreward of the 20-m isobaths and between 90-84º W

Shallow penetration protocols

1. The requirements defined for deep penetration surveys shall be followed, with the following exceptions:
    a. PAM is not required for shallow penetration surveys.
    b. Ramp-up for small airgun arrays must follow the procedure described above for large airgun arrays, but may occur over an abbreviated period of time. Ramp-up is not required for surveys using only a single airgun. For sub-bottom profilers, power should be increased as feasible to effect a ramp-up.
    c. Two exclusion zones are defined, depending on the species and context. A standard exclusion zone encompassing the area at and below the sea surface out to a radius of 100 meters from the edges of the airgun array (if used) or from the acoustic source (0-100 m) is defined. An extended 500-m exclusion zone must be applied upon detection (visual or acoustic) of a baleen whale, sperm whale, beaked whale or *Kogia* spp. within the zone.
    d. The buffer zone encompasses the area at and below the sea surface from the edge of the 0-100 meter exclusion zone out to a radius of 200 meters from the edges of the airgun array (if used) or from the acoustic source (100-200 meters). The buffer zone is not applicable when the exclusion zone is greater than 100 meters.

Non-Airgun High-Resolution Geophysical (HRG) Protocol

Non-airgun HRG surveys are conducted in leases and along pipeline routes to evaluate the potential for geohazards, archaeological resources, and certain types of benthic communities. Non-airgun HRG sources include but are not limited to side-scan sonars, boomers, sparkers (in limited situations) and compressed high-intensity radiated pulse (CHIRP) sub bottom profilers (in limited situations), and single-beam or multibeam depth sounders.

Non-Airgun HRG Surveys with Frequencies ≥180 kHz

Acoustic sources do not require detailed analyses because the frequency is outside the general hearing range of marine mammals.

Non-Airgun HRG Surveys with Frequencies <180 kHz

For all non-airgun HRG surveys in which one or more active acoustic sound sources are operating at <180 kHz, the requirements defined for shallow penetration surveys shall be followed, with the following exceptions:

1. Pre-clearance watch is required for a period of 30 minutes and over a 200-m radius from the acoustic source.
2. When operating in waters deeper than 100-m, during survey operations (*e.g.*, any day on which use of the acoustic source is planned to occur, and whenever the acoustic source is in the water, whether activated or not), a minimum of one trained and experienced independent PSO must be on duty and conducting visual observations at all times during daylight hours (*i.e.*, from 30 minutes prior to sunrise through 30 minutes following sunset).
3. When operating in waters shallower than 100-m, a minimum of one trained visual PSO, which may be a crew member, must be employed. PSOs employed during shallow-water HRG surveys are only required during the pre-clearance period.
4. PSOs are not required during survey operations in which the active acousticsource(s) are deployed on an autonomous underwater vehicle.
5. PAM is not required for HRG surveys. Shutdowns are not required for HRG surveys.

Entanglement and Entrainment Risk Reduction

Nodal Survey Requirements

To avoid the risk of entanglement, lessees and operators conducting surveys using ocean-bottom nodes or similar gear must:

1. Use negatively buoyant coated wire-core tether cable;
2. Ensure any cables/lines are designed to be rigid;

3. Retrieve all lines immediately following completion of the survey; and
4. Attach acoustic pingers directly to the coated tether cable; acoustic releases should not be used.

Reporting

1. The BOEM Permit/Plan holder shall submit interim reports (see Data Collection section for details) on the 1st of each month to BSEE (protectedspecies@bsee.gov) detailing all protected species observations with closest approach distance. 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). 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 diagramsand demonstrate whether background noise levels on the PAM deployment limited achievement. The draft report shall also include geo-referenced time-stamped vessel track lines for all time periods during which airguns were operating. Track lines should include points recording any change in airgun status (e.g., when the airguns began operating, when they were turned off, or when they changed from full array to single gun or vice versa). GIS files shall beprovided in ESRI shapefile format and include the UTC date and time, latitude in decimal degrees, and longitude in decimal degrees. All coordinates shall be referenced to the WGS84 geographic coordinate system. In addition to the report, all raw observational data shall be made available to BOEM/BSEE and NMFS. The report must summarize the information submitted in interim monthly reports as well as additional data collected as described above in *Data Collection* and the MMPA authorization (as applicable). 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 BOEM/BSEE and NMFS a statement concerning implementation and effectiveness of the required mitigation and monitoring. A final report must be submitted within 30 days following resolution of any comments on the draft report.
2. Reporting injured or dead protected species:
   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 reporting dead or injured marine mammals, refer to the reporting requirements specified in the MMPA authorization (as applicable), associated with the activity being conducted, and Appendix C

References

Baker, K., D. Epperson, G. Gitschlag, H. Goldstein, J. Lewandowski, K. Skrupky, B. Smith, and T. Turk. 2013. National standards for a protected species observer and data management program: A model using geological and geophysical surveys. Technical Memorandum NMFS-OPR-49, Office of Protected Resources, National Marine Fisheries Service, National Oceanic and Atmospheric Administration; Bureau of Ocean Energy Management, U.S. Department of the Interior; Bureau of Safety and Environmental Enforcement, U.S. Department of the Interior, Silver Spring, Maryland.

Appendix C. Vessel Strike Avoidance and Injured/Dead Aquatic Protected Species Reporting Protocols

This Appendix has been revised as of April 26, 2021 and replaces the original Appendix C (dated March 13, 2020). These protocols will be implemented by the Bureau of Ocean Energy Management (BOEM) and the Bureau of Safety and Environmental Enforcement (BSEE) through non-discretionary conditions of approval (COA) applied programmatically to BOEM/BSEE permitted activities (see Attachment 1 to the amended Incidental Take Statement), and provide guidelines to operators in complying with the Endangered Species Act (ESA; 16 U.S.C. §§ 1531-1544) and Marine Mammal Protection Act (MMPA; 16 U.S.C. §§1361- 1423h). The measures contained herein apply to all seismic surveys approved by BOEM and associated with the federally regulated oil and gas program in the Gulf of Mexico.

Aquatic Protected Species Identification

Crew and supply vessel personnel should use a Gulf of Mexico reference guide that includes identifying information on marine mammals, sea turtles, and other marine protected species (i.e., Endangered Species Act listed species such as Gulf sturgeon, giant manta ray, or oceanic whitetip shark; hereafter collectively termed "other aquatic protected species") that may be encountered in the Gulf of Mexico Outer Continental Shelf (OCS). Vessel operators must comply with the below measures except under extraordinary circumstances when the **safety of the vessel or crew is in doubt or the safety of life at sea is in question**.

Vessel Strike Avoidance

1. Vessel operators and crews must maintain a vigilant watch for all aquatic protected species and slow down, stop their vessel, or alter course, as appropriate and regardless of vessel size, to avoid striking any protected species. A single aquatic protected species at the surface may indicate the presence of submerged animals in the vicinity of the vessel; therefore, precautionary measures should always be exercised. A visual observer aboard the vessel must monitor a vessel strike avoidance zone (species-specific distances detailed below) around the vessel according to the parameters stated below, to ensure the potential for strike is minimized. Visual observers monitoring the vessel strike avoidance zone can be either third-party observers or crew members (e.g., captain), but crew members responsible for these duties must be provided sufficient training to distinguish aquatic protected species to broad taxonomic groups, as well as those specific species detailed further below.
2. Vessel speeds must also be reduced to 10 knots or less when mother/calf pairs, pods, or large assemblages (greater than three) of any marine mammal are observed near a vessel.

3. All vessels must maintain a minimum separation distance of 100 meters (m) from sperm whales, and 500 m from any baleen whale to specifically protect the Gulf of Mexico Bryde's whale.
4. All vessels must, to the maximum extent practicable, attempt to maintain a minimum separation distance of 50 meters from all "other aquatic protected species" including sea turtles, with an exception made for those animals that approach the vessel.
5. When aquatic protected species are sighted while a vessel is underway, the vessel should take action as necessary to avoid violating the relevant separation distance (e.g., attempt to remain parallel to the animal's course, avoid excessive speed or abrupt changes in direction until the animal has left the area). If aquatic protected species are sighted within the relevant separation distance, the vessel should reduce speed and shift the engine to neutral, not engaging the engines until animals are clear of the area. This does not apply to any vessel towing gear (e.g., source towed array and site clearance trawling).
6. Any BOEM/BSEE-authorized or -permitted activity occurring within the Eastern Planning Area will be subject to a step-down review with NMFS under the attached 2020 biological opinion on BOEM Oil and Gas Program Activities in the Gulf of Mexico.

The above requirements do not apply in any case where compliance would create an imminent and serious threat to a person or vessel or to the extent that a vessel is restricted in its ability to maneuver and, because of that restriction, is unable to comply.

Injured/Dead Protected Species Reporting

The measures below have been revised from the original measures (contained in the Appendices to the biological opinion dated March 13, 2020) in accordance with the revised proposed action (see Attachments 1 and 2 to the amended ITS).

At all times, vessel operators must report sightings of any injured or dead aquatic protected species immediately, regardless of whether the injury or death was caused by the operator's vessel. If the injury or death was caused by a collision with the operator's vessel, the operator must immediately report the incident to NMFS by email at nmfs.psoreview@noaa.gov and must also immediately report the incident to the appropriate NMFS contact below for 24 hour response. The operator must further notify BOEM and BSEE within 24 hours of the strike by email to protectedspecies@boem.gov and protectedspecies@bsee.gov. The report must include the following information:

1. Time, date, and location (latitude/longitude) of the incident;
2. Species identification (if known) or description of the animal(s) involved;
3. Vessel's speed during and leading up to the incident;
4. Vessel's course/heading and what operations were being conducted (if applicable);
5. Status of all sound sources in use;

6. Description of avoidance measures/requirements that were in place at the time of the strike and what additional measures were taken, if any, to avoid strike;
7. Environmental conditions (*e.g.*, wind speed and direction, Beaufort sea state, cloud cover, visibility) immediately preceding the strike;
8. Estimated size and length of animal that was struck;
9. Description of the behavior of the marine mammal immediately preceding and following the strike;
10. If available, description of the presence and behavior of any other marine mammals immediately preceding the strike;
11. Estimated fate of the animal (*e.g.*, dead, injured but alive, injured and moving, bloodor tissue observed in the water, status unknown, disappeared); and
12. To the extent practicable, photographs or video footage of the animal(s).

In the event that any of the following occur at any time, immediate reporting of the incident is required, after personnel and/or diver safety is ensured:

- Entanglement or entrapment of a protected species (i.e., an animal is entangled in a line or cannot or does not leave a moon pool of its own volition).
- Injury of a protected species (e.g., the animal appears injured or lethargic).
- Interaction or contact with equipment by a protected species.
- Any observation of a leatherback sea turtle within a moon pool (regardless of whether it appears injured, or an interaction with equipment or entanglement/entrapment is observed).

As soon as personnel and/or diver safety is ensured, any of the incidents listed above must be reported to NMFS by contacting the appropriate expert for 24-hr response. If an immediate response is not received, the operator must keep trying until contact is made. Any failed attempts should be documented. Contact information for reporting is as follows:

- Marine mammals: contact Southeast Region's Marine Mammal Stranding Hotline at 1-877-433-8299.
- Sea turtles: contact NMFS Veterinary Medical Officer at 352-283-3370. If no answer, contact (301) 301-3061. This includes the immediate reporting of any observation of a leatherback sea turtle within a moon pool.
- Other protected species (e.g., giant manta ray, oceanic whitetip shark, or Gulf sturgeon): contact the ESA Section 7 biologist at 301-427-8413.

The report must include the following information:

1. Time, date, water depth and location (latitude/longitude) of the first discovery (and updated location information if known and applicable);
2. Name, type, and call sign of the vessel in which the event occurred;
3. Equipment being utilized at time of observation;
4. Species identification (if known) or description of the animal(s) involved;
5. Approximate size of animal;
6. Condition of the animal(s) during the event and any observed injury / behavior;
7. photographs or video footage of the animal(s), if able; and
8. General narrative and timeline describing events that took place.

After the appropriate contact(s) have been made for guidance/assistance as described above, the operator may call BSEE at 985-722-7902 (24 hours/day) for questions or additional guidance on recovery assistance needs (if still required) and continued monitoring requirements. The operator may also contact this number if a timely response from the appropriate contact(s) listed above were not received.

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
1315 East-West Highway
Silver Spring, Maryland 20910

LETTER OF AUTHORIZATION

WesternGeco and its designees are hereby authorized under section 101(a)(5)(A) of the Marine Mammal Protection Act (MMPA; 16 U.S.C. 1371(a)(5)(A)) to take marine mammals incidental to geophysical survey activities in the Gulf of Mexico, subject to the provisions of the MMPA and the Regulations Governing Taking Marine Mammals Incidental to Geophysical Survey Activities in the Gulf of Mexico (50 CFR Part 217, Subpart S) (Regulations).

1. This Letter of Authorization (LOA) is valid from the date of issuance to April 18, 2023.

2. This LOA authorizes take incidental to the specified geophysical survey activities (3D ocean bottom node survey of approximately 322 lease blocks in the Green Canyon and Walker Ridge areas) described in the LOA request.

3. General Conditions

(a) A copy of this LOA must be in the possession of the Holder of the Authorization (Holder), vessel operator, other relevant personnel, the lead protected species observer (PSO), and any other relevant designees operating under the authority of the LOA.

(b) The species and/or stocks authorized for taking are listed in Table 1. Authorized take, by Level A and Level B harassment only, is limited to the species and numbers listed in Table 1.

(c) The taking by serious injury or death of any of the species listed in Table 1 or any taking of any other species of marine mammal is prohibited and may result in the modification, suspension, or revocation of this LOA. Any taking exceeding the authorized amounts listed in Table 1 is prohibited and may result in the modification, suspension, or revocation of this LOA.

(d) The Holder must instruct relevant vessel personnel with regard to the authority of the protected species monitoring team (PSO team), and must ensure that relevant vessel personnel and PSO team participate in a joint onboard briefing, led by the vessel operator and lead PSO, prior to beginning work to ensure that responsibilities, communication procedures, protected species monitoring protocols, operational procedures, and LOA requirements are clearly understood. This briefing must be repeated when relevant new personnel join the survey operations before work involving those personnel commences.

(e) The acoustic source must be deactivated when not acquiring data or preparing to acquire data, except as necessary for testing. Unnecessary use of the acoustic source must be avoided. Notified operational capacity (i.e., total array volume) (not including redundant backup airguns) must not be exceeded during the survey,

except where unavoidable for source testing and calibration purposes. All occasions where activated source volume exceeds notified operational capacity must be communicated to the PSO(s) on duty and fully documented. The lead PSO must be granted access to relevant instrumentation documenting acoustic source power and/or operational volume.

(f) PSO requirements:

i. LOA-holders must use independent, dedicated, qualified PSOs, meaning that the PSOs must be employed by a third-party observer provider, must have no tasks other than to conduct observational effort, collect data, and communicate with and instruct relevant vessel crew with regard to the presence of protected species and mitigation requirements (including brief alerts regarding maritime hazards), and must be qualified pursuant to section 5(a) of this LOA. Acoustic PSOs are required to complete specialized training for operating passive acoustic monitoring (PAM) systems and are encouraged to have familiarity with the vessel on which they will be working. PSOs may act as both acoustic and visual observers (but not simultaneously), so long as they demonstrate that their training and experience are sufficient to perform each task.

ii. The Holder must submit PSO resumes for NMFS review and approval prior to commencement of the survey (submit to nmfs.psoreview@noaa.gov). Resumes should include dates of training and any prior NMFS approval, as well as dates and description of last experience, and must be accompanied by information documenting successful completion of an acceptable training course. NMFS is allowed one week to approve PSOs from the time that the necessary information is received by NMFS, after which PSOs meeting the minimum requirements will automatically be considered approved.

iii. At least one visual PSO and two acoustic PSOs aboard each acoustic source vessel must have a minimum of 90 days at-sea experience working in those roles, respectively, with no more than eighteen months elapsed since the conclusion of the at-sea experience. One visual PSO with such experience must be designated as the lead for the entire PSO team. The lead must coordinate duty schedules and roles for the PSO team and serve as the primary point of contact for the vessel operator. (Note that the responsibility of coordinating duty schedules and roles may instead be assigned to a shore-based, third-party monitoring coordinator.) To the maximum extent practicable, the lead PSO must devise the duty schedule such that experienced PSOs are on duty with those PSOs with appropriate training but who have not yet gained relevant experience.

4. Mitigation Requirements

(a) Visual monitoring requirements:

i. During survey operations (i.e., any day on which use of the acoustic source is planned to occur, and whenever the acoustic source is in the water, whether activated or not), a minimum of two PSOs must be on duty and conducting visual observations at all times during daylight hours (i.e., from 30 minutes prior to sunrise through 30 minutes following sunset).

ii. Visual monitoring must begin not less than 30 minutes prior to ramp-up and must continue until one hour after use of the acoustic source ceases or until 30 minutes past sunset.

iii. Visual PSOs must coordinate to ensure 360° visual coverage around the vessel from the most appropriate observation posts, and must conduct visual observations using binoculars and the naked eye while free from distractions and in a consistent, systematic, and diligent manner.

iv. Visual PSOs must immediately communicate all observations of marine mammals to the on-duty acoustic PSO, including any determination by the PSO regarding species identification, distance, and bearing and the degree of confidence in the determination.

v. Any observations of marine mammals by crew members aboard any vessel associated with the survey must be relayed to the PSO team.

vi. During good conditions (e.g., daylight hours; Beaufort sea state (BSS) 3 or less), visual PSOs must conduct observations when the acoustic source is not operating for comparison of sighting rates and behavior with and without use of the acoustic source and between acquisition periods, to the maximum extent practicable.

vii. Visual PSOs may be on watch for a maximum of two consecutive hours followed by a break of at least one hour between watches and may conduct a maximum of 12 hours of observation per 24-hour period. NMFS may grant an exception for LOA applicants that demonstrate such a “two hours on/one hour off” duty cycle is not practicable, in which case visual PSOs will be subject to a maximum of four consecutive hours on watch followed by a break of at least two hours between watches. Combined observational duties (visual and acoustic but not at the same time) must not exceed 12 hours per 24-hour period for any individual PSO.

(b) Acoustic monitoring requirements:

i. All source vessels must use a towed PAM system at all times when operating in waters deeper than 100 m, which must be monitored by a minimum of one acoustic PSO beginning at least 30 minutes prior to

ramp-up, at all times during use of the acoustic source, and until one hour after use of the acoustic source ceases. “PAM system” refers to calibrated hydrophone arrays with full system redundancy to detect, identify, and estimate distance and bearing to vocalizing cetaceans, coupled with appropriate software to aid monitoring and listening by a PAM operator skilled in bioacoustics analysis and computer system specifications capable of running appropriate software. The PAM system must have at least one calibrated hydrophone (per each deployed hydrophone type and/or set) sufficient for determining whether background noise levels on the towed PAM system are sufficiently low to meet performance expectations. Applicants must provide a PAM plan including description of the hardware and software proposed for use prior to proceeding with any survey where PAM is required.

ii. Acoustic PSOs must immediately communicate all detections of marine mammals to visual PSOs (when visual PSOs are on duty), including any determination by the PSO regarding species identification, distance, and bearing, and the degree of confidence in the determination.

iii. Acoustic PSOs may be on watch for a maximum of four consecutive hours followed by a break of at least two hours between watches, and may conduct a maximum of 12 hours of observation per 24-hour period. Combined observational duties (visual and acoustic but not at the same time) must not exceed 12 hours per 24-hour period for any individual PSO.

iv. Survey activity may continue for 30 minutes when the PAM system malfunctions or is damaged, while the PAM operator diagnoses the issue. If the diagnosis indicates that the PAM system must be repaired to solve the problem, operations may continue for an additional two hours without acoustic monitoring during daylight hours only under the following conditions:

(A) Sea state is less than or equal to BSS 4;

(B) No marine mammals (excluding delphinids) detected solely by PAM in the applicable exclusion zone in the previous two hours;

(C) NMFS is notified via email as soon as practicable with the time and location in which operations began occurring without an active PAM system; and

(D) Operations with an active acoustic source, but without an operating PAM system, do not exceed a cumulative total of four hours in any 24-hour period.

(c) PSOs must establish and monitor applicable exclusion and buffer zones. These zones must be based upon the radial distance from the edges of the airgun array (rather than being based on the center of the array or around the vessel itself). During use of the acoustic source (i.e., anytime the acoustic source is active, including ramp-up), occurrence of marine mammals within the relevant buffer zone (but outside the exclusion zone) should be communicated to the operator to prepare for the potential shutdown of the acoustic source.

i. Two exclusion zones are defined, depending on the species and context. A standard exclusion zone encompassing the area at and below the sea surface out to a radius of 500 meters from the edges of the airgun array (0-500 m) is defined. For special circumstances (defined at 4(e)(v) of this LOA), the exclusion zone encompasses an extended distance of 1,500 meters (0-1,500 m).

ii. During pre-start clearance monitoring (i.e., before ramp-up begins), the buffer zone acts as an extension of the exclusion zone in that observations of marine mammals within the buffer zone would also preclude airgun operations from beginning (i.e., ramp-up). For all marine mammals (except where superseded by the extended 1,500-m exclusion zone), the buffer zone encompasses the area at and below the sea surface from the edge of the 0-500 meter exclusion zone out to a radius of 1,000 meters from the edges of the airgun array (500-1,000 m). The buffer zone is not applicable when the exclusion zone is greater than 500 meters, i.e., the observational focal zone is not increased beyond 1,500 meters.

(d) A ramp-up procedure, involving a step-wise increase in the number of airguns firing and total active array volume until all operational airguns are activated and the full volume is achieved, is required at all times as part of the activation of the acoustic source. A 30-minute pre-start clearance observation period must occur prior to the start of ramp-up. The Holder must adhere to the following pre-start clearance and ramp-up requirements:

i. The operator must notify a designated PSO of the planned start of ramp-up as agreed upon with the lead PSO; the notification time should not be less than 60 minutes prior to the planned ramp-up.

ii. Ramp-ups must be scheduled so as to minimize the time spent with source activated prior to reaching the designated run-in.

iii. A designated PSO must be notified again immediately prior to initiating ramp-up procedures and the operator must receive confirmation from the PSO to proceed.

iv. Ramp-up must not be initiated if any marine mammal is within the applicable exclusion or buffer zone. If a marine mammal is observed

within the exclusion zone or the buffer zone during the 30-minute pre-start clearance period, ramp-up must not begin until the animal(s) has been observed exiting the zones or until an additional time period has elapsed with no further sightings (15 minutes for small delphinids and 30 minutes for all other species).

v. Ramp-up must begin by activating a single airgun of the smallest volume in the array and shall continue in stages by doubling the number of active elements at the commencement of each stage, with each stage of approximately the same duration. Total duration must not be less than 20 minutes. The operator must provide information to the PSO documenting that appropriate procedures were followed.

vi. Ramp-up must cease and the source shut down upon observation of marine mammals within the applicable exclusion zone. Once ramp-up has begun, observations of marine mammals within the buffer zone do not require shutdown.

vii. Ramp-up may occur at times of poor visibility, including nighttime, if appropriate acoustic monitoring has occurred with no detections of a marine mammal other than delphinids in the 30 minutes prior to beginning ramp-up. Acoustic source activation may only occur at night where operational planning cannot reasonably avoid such circumstances.

viii. If the acoustic source is shut down for brief periods (i.e., less than 30 minutes) for reasons other than implementation of prescribed mitigation (e.g., mechanical difficulty), it may be activated again without ramp-up if PSOs have maintained constant visual and/or acoustic observation and no visual or acoustic detections of any marine mammal have occurred within the applicable exclusion zone. For any longer shutdown, pre-start clearance observation and ramp-up are required. For any shutdown at night or in periods of poor visibility (e.g., BSS 4 or greater), ramp-up is required, but if the shutdown period was brief and constant observation maintained, pre-start clearance watch is not required.

ix. Testing of the acoustic source involving all elements requires ramp-up. Testing limited to individual source elements or strings does not require ramp-up but does require the pre-start clearance observation period.

(e) Shutdown requirements:

i. Any PSO on duty has the authority to delay the start of survey operations or to call for shutdown of the acoustic source pursuant to the requirements of this subpart.

ii. The operator must establish and maintain clear lines of communication

directly between PSOs on duty and crew controlling the acoustic source to ensure that shutdown commands are conveyed swiftly while allowing PSOs to maintain watch.

iii. When both visual and acoustic PSOs are on duty, all detections must be immediately communicated to the remainder of the on-duty PSO team for potential verification of visual observations by the acoustic PSO or of acoustic detections by visual PSOs.

iv. When the airgun array is active (i.e., anytime one or more airguns is active, including during ramp-up) and (1) a marine mammal appears within or enters the applicable exclusion zone and/or (2) a marine mammal (excluding delphinids) is detected acoustically and localized within the applicable exclusion zone, the acoustic source must be shut down. When shutdown is called for by a PSO, the acoustic source must be immediately deactivated and any dispute resolved only following deactivation.

v. The extended 1,500-m exclusion zone must be applied upon detection (visual or acoustic) of a baleen whale, sperm whale, beaked whale, or *Kogia* spp. within the zone.

vi. Shutdown requirements are waived for dolphins of the following genera: *Tursiops*, *Stenella*, *Steno*, and *Lagenodelphis*. If a delphinid is visually detected within the exclusion zone, no shutdown is required unless the PSO confirms the individual to be of a genus other than those listed above, in which case a shutdown is required. Acoustic detection of delphinids does not require shutdown.

vii. If there is uncertainty regarding identification or localization, PSOs may use best professional judgment in making the decision to call for a shutdown.

viii. Upon implementation of shutdown, the source may be reactivated after the marine mammal(s) has been observed exiting the applicable exclusion zone or following a 30-minute clearance period with no further detection of the marine mammal(s).

(f) *Entanglement avoidance*. To avoid the risk of entanglement, if conducting surveys using ocean-bottom nodes or similar gear the Holder must:

i. Use negatively buoyant coated wire-core tether cable;

ii. Retrieve all lines immediately following completion of the survey; and

iii. Attach acoustic pingers directly to the coated tether cable; acoustic

releases should not be used.

(g) *Vessel strike avoidance*. The Holder must adhere to the following requirements:

i. Vessel operators and crews must maintain a vigilant watch for all marine mammals and must slow down, stop their vessel, or alter course, as appropriate and regardless of vessel size, to avoid striking any marine mammal. A visual observer aboard the vessel must monitor a vessel strike avoidance zone around the vessel, which shall be defined according to the parameters stated in this subsection. Visual observers monitoring the vessel strike avoidance zone may be third-party observers (i.e., PSOs) or crew members, but crew members responsible for these duties must be provided sufficient training to distinguish marine mammals from other phenomena and broadly to identify a marine mammal as a baleen whale, sperm whale, or other marine mammal;

ii. Vessel speeds must be reduced to 10 kn or less when mother/calf pairs, pods, or large assemblages of marine mammals are observed near a vessel;

iii. All vessels must maintain a minimum separation distance of 500 m from baleen whales;

iv. All vessels must maintain a minimum separation distance of 100 m from sperm whales;

v. All vessels must, to the maximum extent practicable, attempt to maintain a minimum separation distance of 50 m from all other marine mammals, with an exception made for those animals that approach the vessel; and

vi. When marine mammals are sighted while a vessel is underway, the vessel must take action as necessary to avoid violating the relevant separation distance, e.g., attempt to remain parallel to the animal's course, avoid excessive speed or abrupt changes in direction until the animal has left the area. If marine mammals are sighted within the relevant separation distance, the vessel must reduce speed and shift the engine to neutral, not engaging the engines until animals are clear of the area. This does not apply to any vessel towing gear or any vessel that is navigationally constrained.

vii. These requirements do not apply in any case where compliance would create an imminent and serious threat to a person or vessel or to the extent that a vessel is restricted in its ability to maneuver and, because of the restriction, cannot comply.

5. Monitoring Requirements

(a) PSO qualifications:

i. PSOs must successfully complete relevant, acceptable training, including completion of all required coursework and passing (80 percent or greater) a written and/or oral examination developed for the training program.

ii. PSOs must have successfully attained a bachelor's degree from an accredited college or university with a major in one of the natural sciences, a minimum of 30 semester hours or equivalent in the biological sciences, and at least one undergraduate course in math or statistics. The educational requirements may be waived if the PSO has acquired the relevant skills through alternate experience. Requests for such a waiver must be submitted to NMFS and shall include written justification. Requests will be granted or denied (with justification) by NMFS within one week of receipt of submitted information. Alternate experience that may be considered includes, but is not limited to:

(A) secondary education and/or experience comparable to PSO duties;

(B) previous work experience conducting academic, commercial, or government-sponsored marine mammal surveys; or

(C) previous work experience as a PSO; the PSO should demonstrate good standing and consistently good performance of PSO duties.

(b) *Equipment*. The Holder is required to:

i. Provide PSOs with bigeye binoculars (e.g., 25 x 150; 2.7 view angle; individual ocular focus; height control) of appropriate quality solely for PSO use. These must be pedestal-mounted on the deck at the most appropriate vantage point that provides for optimal sea surface observation, PSO safety, and safe operation of the vessel.

ii. For each vessel required to use a PAM system, provide a PAM system that has been verified and tested by an experienced acoustic PSO who will be using it during the trip for which monitoring is required;

iii. Work with the selected third-party observer provider to ensure PSOs have all equipment (including backup equipment) needed to adequately perform necessary tasks, including accurate determination of distance and bearing to observed marine mammals. (Equipment specified in A. through G. below may be provided by an individual PSO, the third-party observer provider, or the LOA-holder, but the LOA-holder is responsible for ensuring PSOs have the proper equipment required to perform the duties specified herein.) Such equipment, at a minimum, must include:

(A) Reticle binoculars (e.g., 7 x 50) of appropriate quality (at least one per PSO, plus backups);

(B) Global Positioning Unit (GPS) (plus backup);

(C) Digital camera with a telephoto lens (the camera or lens should also have an image stabilization system) that is at least 300 mm or equivalent on a full-frame single lens reflex (SLR) (plus backup);

(D) Compass (plus backup);

(E) Radios for communication among vessel crew and PSOs (at least one per PSO, plus backups); and

(F) Any other tools necessary to adequately perform necessary PSO tasks.

(c) *Data collection*. 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. At a minimum, the following information should be recorded:

i. Vessel names (source vessel and other vessels associated with survey), vessel size and type, maximum speed capability of vessel, port of origin, and call signs;

ii. PSO names and affiliations;

iii. Dates of departures and returns to port with port name;

iv. Dates of and participants in PSO briefings;

v. Dates and times (Greenwich Mean Time) of survey effort and times corresponding with PSO effort;

vi. Vessel location (latitude/longitude) when survey effort began and ended and vessel location at beginning and end of visual PSO duty shifts;

vii. Vessel location at 30-second intervals (if software capability allows) or 5-minute intervals (if location must be manually recorded);

viii. Vessel heading and speed at beginning and end of visual PSO duty shifts and upon any line change;

ix. Environmental conditions while on visual survey (at beginning and end of PSO shift and whenever conditions changed significantly), including Beaufort sea state and any other relevant weather conditions including cloud cover, fog, sun glare, and overall visibility to the horizon;

x. Vessel location when environmental conditions change significantly;

xi. Factors that may have contributed to impaired observations during each PSO shift change or as needed as environmental conditions change (e.g., vessel traffic, equipment malfunctions);

xii. Survey activity information, such as acoustic source power output while in operation, number and volume of airguns operating in an array, tow depth of an acoustic source, and any other notes of significance (i.e., pre-start clearance, ramp-up, shutdown, testing, shooting, ramp-up completion, end of operations, streamers, etc.); and

xiii. Upon visual observation of a marine mammal, the following information:

(A) Watch status (sighting made by PSO on/off effort, opportunistic, crew, alternate vessel/platform);

(B) PSO who sighted the animal and PSO location (including height above water) at time of sighting;

(C) Time of sighting;

(D) Vessel coordinates at time of sighting;

(E) Water depth;

(F) Direction of vessel's travel (compass direction);

(G) Speed of the vessel(s) from which the observation was made;

(H) Direction of animal's travel relative to the vessel;

(I) Pace of the animal;

(J) Estimated distance to the animal (and method of estimating distance) and its heading relative to vessel at initial sighting;

(K) Identification of the animal (e.g., genus/species, lowest possible

taxonomic level, or unidentified), PSO confidence in identification, and the composition of the group if there is a mix of species;

(L) Estimated number of animals (high/low/best);

(M) Estimated number of animals by cohort (adults, juveniles, group composition, etc.);

(N) Description (as many distinguishing features as possible of each individual seen, including length, shape, color, pattern, scars or markings, shape and size of dorsal fin, shape of head, and blow characteristics);

(O) Detailed behavior observations (e.g., number of blows/breaths, number of surfaces, breaching, spyhopping, diving, feeding, traveling; as explicit and detailed as possible; note any observed changes in behavior), including an assessment of behavioral responses to survey activity;

(P) Animal's closest point of approach (CPA) and/or closest distance from any element of the acoustic source;

(Q) Platform activity at time of sighting (e.g., deploying, recovering, testing, shooting, data acquisition, other); and

(R) Description of any actions implemented in response to the sighting (e.g., delays, shutdown, ramp-up) and time and location of the action.

xiv. Upon acoustic detection of a marine mammal using a PAM system, the following information:

(A) An acoustic encounter identification number, and whether the detection was linked with a visual sighting;

(B) Date and time when first and last heard;

(C) Types and nature of sounds heard (e.g., clicks, whistles, creaks, burst pulses, continuous, sporadic, strength of signal); and

(D) Any additional information recorded such as water depth of the hydrophone array, bearing of the animal to the vessel (if determinable), species or taxonomic group (if determinable), spectrogram screenshot, and any other notable information.

6. Reporting Requirements

(a) Annual reporting:

i. 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.

ii. 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.

iii. 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.

iv. The Holder must provide geo-referenced time-stamped vessel tracklines for all time periods in which airguns (full array or single) were operating. Tracklines 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.

v. 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.

vi. A final report must be submitted within 30 days following resolution of any comments on the draft report.

(b) *Comprehensive reporting*. The Holder must contribute to the compilation and analysis of data for inclusion in an annual synthesis report addressing all data collected and reported through annual reporting in each calendar year. The

synthesis period shall include all annual reports deemed to be final by NMFS in a given one-year reporting period. The report must be submitted to NMFS within 90 days following the end of a given one-year reporting period.

(c) Reporting of injured or dead marine mammals:

i. 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 NMFS Office of Protected Resources (OPR) (*PR.ITP.MonitoringReports@noaa.gov*) and to the Southeast Regional Stranding Network (877-942-5343) as soon as feasible. The report must include the following information:

(A) Time, date, and location (latitude/longitude) of the first discovery (and updated location information if known and applicable);

(B) Species identification (if known) or description of the animal(s) involved;

(C) Condition of the animal(s) (including carcass condition if the animal is dead);

(D) Observed behaviors of the animal(s), if alive;

(E) If available, photographs or video footage of the animal(s); and

(F) General circumstances under which the animal was discovered.

ii. 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 NMFS Office of Protected Resources (OPR) (*PR.ITP.MonitoringReports@noaa.gov*) and to the Southeast Regional Stranding Network (877-942-5343) as soon as feasible. The report must include the following information:

(A) Time, date, and location (latitude/longitude) of the incident;

(B) Species identification (if known) or description of the animal(s) involved;

(C) Vessel's speed during and leading up to the incident;

(D) Vessel's course/heading and what operations were being conducted (if applicable);

(E) Status of all sound sources in use;

(F) Description of avoidance measures/requirements that were in place at the time of the strike and what additional measures were taken, if any, to avoid strike;

(G) Environmental conditions (e.g., wind speed and direction, Beaufort sea state, cloud cover, visibility) immediately preceding the strike;

(H) Estimated size and length of animal that was struck;

(I) Description of the behavior of the marine mammal immediately preceding and following the strike;

(J) If available, description of the presence and behavior of any other marine mammals immediately preceding the strike;

(K) Estimated fate of the animal (e.g., dead, injured but alive, injured and moving, blood or tissue observed in the water, status unknown, disappeared); and

(L) To the extent practicable, photographs or video footage of the animal(s).

7. Actions to Minimize Additional Harm to Live-Stranded (or Milling) Marine Mammals

(a) In the event of a live stranding (or near-shore atypical milling) event within 50 km of the survey operations, where the NMFS stranding network is engaged in herding or other interventions to return animals to the water, the Director of OPR (or designee) will advise the Holder of the need to implement shutdown procedures for all active acoustic sources operating within 50 km of the stranding. Shutdown procedures for live stranding or milling marine mammals include the following:

i. If at any time, the marine mammal(s) die or are euthanized, or if herding/intervention efforts are stopped, the Director of OPR (or designee) will advise the LOA-holder that the shutdown around the animals' location is no longer needed.

ii. Otherwise, shutdown procedures will remain in effect until the Director of OPR (or designee) determines and advises the LOA-holder that all live animals involved have left the area (either of their own volition or following an intervention).

iii. If further observations of the marine mammals indicate the potential for re-stranding, additional coordination with the LOA-holder will be required to determine what measures are necessary to minimize that likelihood

(e.g., extending the shutdown or moving operations farther away) and to implement those measures as appropriate.

(b) If NMFS determines that the circumstances of any marine mammal stranding found in the vicinity of the activity suggest investigation of the association with survey activities is warranted, and an investigation into the stranding is being pursued, NMFS will submit a written request to the LOA-holder indicating that the following initial available information must be provided as soon as possible, but no later than 7 business days after the request for information. In the event that the investigation is still inconclusive, the investigation of the association of the survey activities is still warranted, and the investigation is still being pursued, NMFS may provide additional information requests, in writing, regarding the nature and location of survey operations prior to the time period above.

i. Status of all sound source use in the 48 hours preceding the estimated time of stranding and within 50 km of the discovery/notification of the stranding by NMFS; and

ii. If available, description of the behavior of any marine mammal(s) observed preceding (i.e., within 48 hours and 50 km) and immediately after the discovery of the stranding.

8. This Authorization may be modified, suspended or revoked if the Holder fails to abide by the conditions prescribed herein (including, but not limited to, failure to comply with monitoring or reporting requirements), or if NMFS determines: (1) the authorized taking is likely to have or is having more than a negligible impact on the species or stocks of affected marine mammals, or (2) the prescribed measures are likely not or are not effecting the least practicable adverse impact on the affected species or stocks and their habitat.

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Kimberly Damon-Randall
Director,
Office of Protected Resources,
National Marine Fisheries Service.

Table 1. Authorized Incidental Take.

Common name	Scientific name	Level A harassment	Level B harassment
Rice's whale	*Balaenoptera ricei*	0	0
Sperm whale	*Physeter microcephalus*	0	1,500
Pygmy/Dwarf sperm whale	*Kogia* spp.	32	550
Beaked whales	*Ziphius cavirostris*/ *Mesoplodon* spp.	0	6,970
Rough-toothed dolphin	*Steno bredanensis*	0	1,208
Bottlenose dolphin	*Tursiops truncatus*	0	5,111
Clymene dolphin	*Stenella clymene*	0	3,377
Atlantic spotted dolphin	*Stenella frontalis*	0	2,040
Pantropical spotted dolphin	*Stenella attenuata*	0	17,180
Spinner dolphin	*Stenella longirostris*	0	3,768
Striped dolphin	*Stenella coeruleoalba*	0	1,363
Fraser's dolphin	*Lagenodelphis hosei*	0	397
Risso's dolphin	*Grampus griseus*	0	947
Melon-headed whale	*Peponocephala electra*	0	2,215
Pygmy killer whale	*Feresa attenuata*	0	577
False killer whale	*Pseudorca crassidens*	0	868
Killer whale	*Orcinus orca*	0	7
Short-finned pilot whale	*Globicephala macrorhynchus*	0	594

Appendix B: Environmental Management Plan

WESTERN GECO 3D OBN SURVEY – L22-004

Environmental Management Plan: Marine Mammal and Sea Turtle Monitoring, Mitigation, and Reporting

October 27, 2022

WESTERN GECO 3D OBN SURVEY – L22-004

Environmental Management Plan: Marine Mammal and Sea Turtle Monitoring, Mitigation, and Reporting

With reference to the Biological Opinion (BO) issued by the National Marine Fisheries Service on March 13, 2020 & BOEM Permit L22-004.

Revision		
Date	**Version**	**Revision made**
27 October 2022	1	First Draft issued to WesternGeco
14 November 2022	2	V2 submitted to WesternGeco – additions made to Section 7 as well as several small adjustments
2 February 2023	3	Minor adjustments to formatting – Section 8.3
6 February 2023	4	Amendments to section 5.1
	5	

Approval for issue	
Name	Signature

Contents

1 INTRODUCTION

Western Geco has contracted TGS to conduct a 3D OBN seismic survey within the Gulf of Mexico. The details of the survey activities are provided in the survey plan application.

In an effort to minimize the potential impacts of seismic operations on certain protected species, including marine mammals and sea turtles, the Bureau of Ocean Energy Management (BOEM), the National Marine Fisheries Service (NMFS), and the Bureau of Safety and Environmental Enforcement (BSEE), have outlined monitoring, mitigation, and reporting procedures that survey operators and permit holders are expected to implement during their seismic survey operations.

1.1 Applicable Regulatory Documents and Permits

Protected species monitoring, mitigation and reporting procedures that are applicable to the 3D OBN survey are contained in the following regulatory documents:

1. The Biological Opinion (BO) issued by the NMFS on March 13, 2020, where Protected Species Observer (PSO) procedures are outlined in detail in Appendix A

2. The survey permit issued by BOEM, permit L22-004

This document, the Environmental Management Plan (EMP), prepared by RPS on behalf of Western Geco, describes how monitoring, mitigation, and reporting measures for protected species will be executed during the 3D OBN program to maintain compliance with the regulatory requirements in the 2020 Gulf of Mexico Biological Opinion and its appendices and the BOEM survey permit L22-004.

2 MARINE PROTECTED SPECIES

Marine protected species or protected species refers to any marine species for which dedicated monitoring and mitigation procedures will be implemented, including:

- All marine mammals
- All sea turtles
- Gulf sturgeon, oceanic white-tipped shark, giant manta ray*

*Note that strike avoidance procedures apply to these ESA listed species, but monitoring and sound source mitigation procedures do not need to be implemented.

3 PROTECTED SPECIES OBSERVERS AND PASSIVE ACOUSTIC MONITORING OPERATORS

3.1 Staffing Plan

A team of three Protected Species Observers (PSOs), supplied by RPS, will be onboard each source vessel to undertake day-time visual watches, implement mitigations, conduct data collection and reporting in accordance with the BO and the survey permit.

A team of four Passive Acoustic Monitoring (PAM) Operators will conduct 24-hour PAM monitoring, implement mitigations, and conduct data collection and reporting in accordance with the BO and the survey permit, with three working remotely from shore and one onboard the vessel.

3.2 Roles and Responsibilities

Lead PSO

- Coordinate and oversee PAM and PSO Operations and ensure compliance with monitoring requirements
- Visually monitor, detect, and identify protected species, as well as determine distance from source.
- Record and report protected species sightings, survey activities, and environmental conditions, per regulations
- Monitor and advise on sound source and vessel operations for compliance with the environmental requirements for the survey
- Communicate with the crew to implement mitigation actions as required by environmental protocols
- Participate in daily operation meeting with crew when appropriate

PAM Tech

- Oversee all deployments and retrievals of the hydrophone cable
- Maintain and troubleshoot the PAM system hardware and software
- Acoustically monitor, detect, and identify protected species, as well as determine distance from source, as needed during remote PAM downtime.

PSO

- Visually monitor, detect, and identify protected species
- Record and report according to survey plan
- Monitor and advise on sound source and vessel operations for compliance with the environmental requirements for the survey plan
- Communicate with the crew to implement mitigation actions as required by environmental protocols
- Participate in daily operation meeting with crew when appropriate

Remote PAM Operator

- Acoustically monitor, detect, and identify marine mammals and determine distance to source
- Record and report marine mammal sightings, survey activities and environmental conditions, per regulations
- Monitor and advise on sound source and vessel operations for compliance with the environmental requirements for the survey
- Assist onboard PAM tech in maintaining and troubleshooting the PAM system hardware and software
- Communicate with the crew to implement mitigation actions as required by environmental protocols, including delays to initiation of survey equipment

3.3 PSO and PAM Operator Requirements

- All Protected Species Observers (PSOs) and PAM Operators will have completed a protected species observer training program as described in the BO.
- PAM Operators will have completed a PAM training course as described in the BO.
- PSOs' and PAM Operators' CVs will be submitted to NMFS for approval prior to deployment on the project.
- PSOs will have completed HUET / Sea Survival training.
- PSOs and PAM Operators' will be equipped with Personnel Protective Equipment (PPE), including hard hat, steel-toe boots, fire-retardant coveralls, work gloves, and safety glasses.

4 MONITORING EQUIPMENT

4.1 Visual Monitoring Equipment

The PSOs on duty will monitor for marine protected species using the naked eye, hand-held reticle binoculars, and big-eye binoculars as described in BO.

Digital single-lens reflex camera equipment, including zoom lens, will be used to record sightings and verify species identification.

4.2 Acoustic Monitoring Equipment

4.2.1 Passive Acoustic Monitoring (PAM) System

The PAM system is designed to provide a flexible approach to the monitoring for marine mammals using a towed hydrophone system. The system uses PAMGUARD software modules such that the optimum system can be configured for the application, vessel, and deployment method. PAM software modules will be configured for the application, vessel, and deployment method.

The source vessel will have two acoustic monitoring systems, a primary system and a secondary system available as back-up should any issues be encountered with the main system.

Remote PAM operators will have access to an onshore remote monitoring station connected to the electronics installed on each vessel via satellite using the RPS dedicated Starlink system with a bandwidth of 2-20MB uplink, 20-150MB downlink, and 25-50 millisecond response time. The onshore remote monitoring station PAM Operators will be able to fully manipulate software settings and stream audio from their location. Communications between PAM Operator and survey crew will be conducted by satellite phone.

NOTE: the bandwidth numbers seen above are after land based testing. Once we are installed and offshore we will have a better indicator of the true performance metrics.

The PAM system has been designed to monitor for most cetacean species found in the Gulf of Mexico, covering a broad range of frequencies up to 200kHz. The predominant vessel noise (propellers) will automatically be filtered out because the hydrophone will only begin to pick up frequencies at 2 kHz. Some propeller and engine noise will still dominate the lower frequencies, but the species of concern should all be detectable above the noise as their dominant frequencies are around the 8 to 20 kHz ranges.

Mid and high frequency marine mammal vocalizations are processed by the laptop internal sound card. Mid frequency vocalizations include sperm whale click trains and codas and delphinid whistles in the frequency range of approximately 2 kHz to 24 kHz. Kogia species, beaked whales, and delphinid echolocation clicks that are emitted at very high frequencies in excess of 80kHz are processed by a specialized sound card in the buffer unit, an external National Instruments sound card, capable of sampling audio at 500kHz. PAM equipment specifications are provided in Appendix A.

4.2.2 PAM JSA and PAM deployment and retrieval procedure

A job safety analysis (JSA) will be completed prior to hydrophone deployment. The Lead PSO/PAM Operator will develop, in cooperation with the vessel crew, a vessel-specific deployment and retrieval procedure that considers both the minimization of entanglement risks with other towed equipment while maximizing the acoustic range of the system.

4.2.3 Distance estimation of acoustic detections

There are a variety of methods that can be used to estimate the distance to vocalizing marine mammals using the acoustic detection software, PAMGuard. When the distance to a vocalizing animal cannot be determined by PAMGuard, the experienced PAM Operator can make a distance estimation assisted by the noise or detection score system developed by Gannier et al. (2002). Gannier et al. monitored sperm whales in the Mediterranean both visually and acoustically. A scale was developed based upon the strength or intensity of the sperm whale clicks at various distances that were then measured when the sperm whales

surfaced and were visually observed. Although the scale is subjective, and sounds produced in marine environments will vary according to local conditions, the scale provides a measure for approximating distances when using a single, linear hydrophone array.

5 VISUAL AND ACOUSTIC MONITORING PROCEDURES

5.1 Visual Monitoring Watches

There will be **at least two PSOs on visual watch** during:

- All seismic source activity in daylight hours, including testing
- During search periods prior to activating the seismic source
- For the duration of any day when there is planned acoustic source activity, regardless of whether the source is deployed

There will be **at least one PSO on visual watch when**:

- Acoustic source is not operating and no plans of operating during the day
  AND
- Monitoring condition is “poor” (poor conditions are defined in the BO as Beaufort sea state of 5 or more)

****NOTE – No ancillary watch should be conducted without RPS PM approval.**

Visual monitoring will begin 30 minutes before sunrise and continue until 30 minutes after sunset.

The following guidelines will apply to these watch periods:

- No additional duties may be assigned to the PSO during his/her visual observation watch
- No PSO will be allowed more than **two consecutive hours on watch** before being allocated a one-hour break from visual monitoring
- No PSO will be assigned a combined watch schedule of more than 12 hours in a 24-hour period

The PSOs will stand watch in a suitable location that will not interfere with the navigation or operation of the vessel and affords an optimal view of the sea surface. PSOs will maintain 360° coverage surrounding the vessel and the seismic source.

If a protected species is observed, the PSO should first take care of any necessary mitigation actions, or if no mitigation actions are required, they will note and monitor the position (including latitude/longitude of the vessel and relative bearing and estimated range to the animal) until the animal dives or moves out of visual range of the observer.

5.2 Passive Acoustic Monitoring Watches

There will be a local PAM Operator on the vessel, whose responsibilities will include any technical onboard tasks with the PAM system. However, monitoring and data collection will be primarily conducted remotely by PAM Operators based on land.

Remote PAM Operators will conduct acoustic monitoring from monitoring stations set up in their homes. The monitoring station location will be selected to provide a quiet environment from which to monitor and the station will be configured to be ergonomically comfortable for the Operator.

Remote PAM monitoring will be conducted with the remote access software TeamViewer. The remote PAM Operators will monitor the acoustic software for indications of a failing or insufficient remote connection. The Operator will monitor for marine mammals aurally using the headphones as well as visually monitoring the spectrogram and click detectors. Remote Operators will be able to monitor the same acoustic monitoring software modules at the same level of quality as they would from a vessel-based monitoring station.

Passive acoustic monitoring will be conducted, day and night, during all uses of the seismic sources AND during the search periods prior to activation of the seismic sources.

During acoustic monitoring watches, the following guidelines shall be followed:

- No additional duties may be assigned to the PAM Operator during their acoustic monitoring watch
- No PAM Operator will be allowed more than **four consecutive hours of acoustic monitoring** before they will be allocated a break of two hours
- No person on watch as a PSO or PAM Operator will be assigned a combined watch schedule of more than 12 hours in a 24-hour period

Acoustic monitoring must be consistent, diligent, and free of distractions for the duration of the watch.

5.2.1 Communications between Vessel and Remote PAM Operators

Each remote monitoring station will be equipped with multiple methods of communications with the vessel for which they are conducting acoustic monitoring:

1. A satellite phone linked through the dedicated satellite bandwidth for PAM monitoring.
2. A computer chat program connecting via the internet will be installed on each remote PAM computer and on the computer used by the personnel controlling the sound source.
3. In the event that the previous communications methods fail, a call to the ship's satellite phone system will be employed.

5.2.2 Procedures for PAM System Malfunction

In the event that a PAM system is not functional for the purposes of mitigation monitoring, whether because of malfunction with the cables, electronics, monitoring software or another issue, the PAM Operator is permitted **30 mins to diagnose the issue** without the need to shut down the source array.

During daylight when PSOs are also on watch, an additional 2 hours is permitted to conduct repairs, where seismic operations can continue during that time **if all the following conditions are met:**

1. The sea state at the time of the malfunction is B4 or less. AND
2. There were no acoustic-ONLY detections of marine mammals other than delphinids inside the applicable EZ in the 2 hours preceding the malfunction.

Operations conducted without ongoing acoustic monitoring **may not exceed a total of 4 hours in a 24-hour period**.

NMFS and BSEE must be notified as soon as is practicable of any PAM system malfunctions exceeding 30 minutes in duration that occur while acoustic source operations are ongoing. Reporting procedures are outlined in the Reporting section of this EMP.

6 PROJECT BRIEFING

The vessel crew and PSO team should participate in a project briefing that includes communication procedures, monitoring requirements and operating protocols.

The briefing should be repeated every time relevant new personnel join the vessel before operations begins.

7 MITIGATION PROCEDURES: STRIKE AVOIDANCE

7.1 Strike Avoidance Monitoring and Vessel Maneuvering

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:

- All marine mammals
- All sea turtles
- Gulf sturgeon, oceanic white-tipped shark, giant manta ray

These procedures apply to physical interactions involving vessels and the towed equipment.

7.2 Vessel Speed Restrictions

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

7.3 Separation Distances

When protected species are sighted while a vessel is underway, the vessel should take action as necessary to avoid violating the relevant separation distance (e.g., attempt to remain parallel to the animal's course, avoid excessive speed or abrupt changes in direction until the animal has left the area).

If marine protected species are sighted within the relevant separation distance, the vessel should reduce speed and shift the engine to neutral, not engaging the engines until animals are clear of the area. While Appendix C of the BiOp states that this does not apply to any vessel that is towing gear, an effort should still be made by the vessel, as is operationally feasible to maintain a separation distance. PSOs should always provide the suggestion for VSA and allow the vessel crew to make determination on whether that procedure can be executed without risk to the safety of the vessel and crew.

NOTE: Vessels are not required to shift into neutral for animals that approach the vessel.

500 m: All baleen whales including the Rice's whale (formerly known as the Bryde's whale)

100 m: Sperm whales

50 m: All other marine mammals (including manatees), and sea turtles, and the ESA-listed fish species referenced in Section 7.1.

NOTE: Any large whale for which species can't be identified should be mitigated for as a baleen whale.

7.4 Rice's Whale Area

In accordance with the new language in the BOEM permit, operators or their recognized representatives must notify BOEM or BSEE as appropriate of their intention to transit through the Rice's Whale Area (from 100- to 400- meter isobaths from 87.5° W to 27.5° N as described in the species' status review plus an additional 10 km around that area) Figure 1 below.

For this survey the Rice's Whale Area should not be a consideration as the survey area and transit path in and out of the survey area does not approach the Rice's Whale Area.

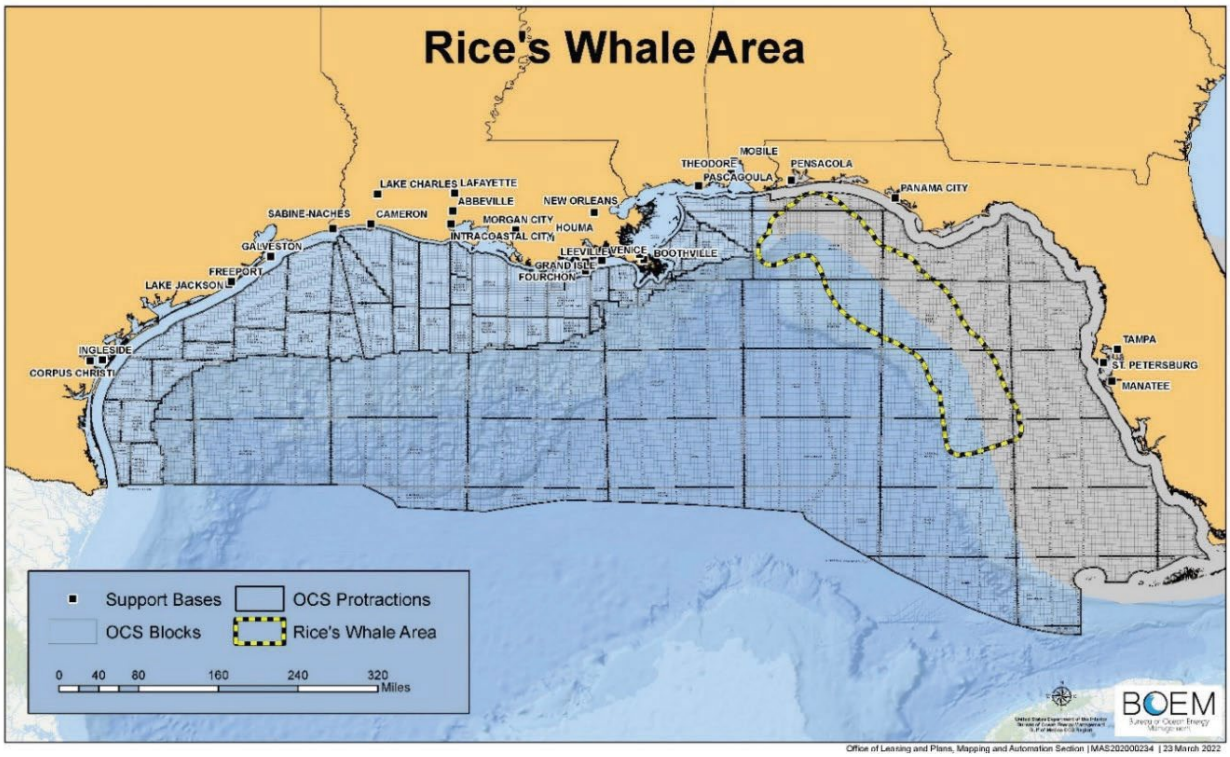


Figure 1: Rice's Whale Area as described in BOEM Permit.

8 MITIGATION PROCEDURES: SOUND SOURCES

8.1 Survey Equipment Subject to Monitoring and Mitigation Procedures

All of the survey equipment that produces sound below 200kHz is subject to the following monitoring and mitigation protocols with the exception of the USBL, which is considered to be navigational equipment.

Equipment	Array or Airgun Size (cu. In.)	Frequency	Subject to Monitoring and Mitigation Requirements
Bolt Air Gun Array	5240	0-128 Hz	Yes
Pressure Inverted Echo-Sounder (PIES)	--	--	No
Ocean Bottom Nodes	--	--	No

8.2 Sound Source Exclusion Zones and Buffer Zones

Two types of zones will be established around the seismic sources, both radii that extend from the outer edge of the airgun array.

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 it's applicable BZ during the search will result in a delay to activating the source

- **1500 meters:** All true whale species (Rice's whale, sperm whales, Kogia species and all beaked whales)
- **1000 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 it's applicable EZ will result in a shutdown of the sound source.

- **1500 meters:** All true whale species (sperm whales, Kogia species and all beaked whales)
- **500 meters**: All other marine mammals
- 100 meters: A 07 shot turtle pause shall be implemented for any turtles within 100 meters of the ship, such that the turtle is greater than 200m from array upon resumption of source activity

8.3 Visual and Acoustic Pre-clearance Search Periods

To activate the sound source, a minimum of a 30-minute search period must be conducted.

During the daytime, the search will be conducted visually by the PSOs and acoustically by the PAM Operator.

During nighttime, the search will be conducted acoustically by the PAM Operator.

PSO and PAM on watch should be notified of the intent to turn on the source from silence, either to conduct a ramp-up or for testing, at least 60 minutes prior to the planned start,

8.4 Delays to Initiation of the Seismic Source

If any marine mammal or sea turtle was detected inside its respective Buffer Zone during the 30-minute search period, initiation of the seismic source must be delayed until:

- When all marine protected species that were observed inside the relevant Buffer Zone have been confirmed by the visual observer to have exited the relevant Buffer Zone.
- 15 minutes from last detection for small odontocetes if not observed exiting the BZ
- 30 minutes from last detection for all other protected species, including sea turtles, if not observed exiting the BZ
- 30 minutes from last detection for acoustic-only detections

NOTE: 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, but 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 turned on when the delay period is completed.

8.5 Ramp Up Procedure and Testing

The intent of ramp-up is to warn marine mammals and sea turtles of pending seismic operations and to allow sufficient time for those animals to leave the immediate vicinity.

For all acoustic source activity, including source testing involving more than one airgun element, ramp-up procedures must be conducted to allow marine mammals and sea turtles to depart the exclusion zone before surveying begins.

- The vessels can test a single gun or cluster without Ramp Up regardless of volume, If going beyond a single cluster- Ramp Up is required from smallest volume to gun size needed for testing.
- Ramp-up should be planned in an effort to minimize time that the source is active on the run in to the start of the survey line.
- Acoustic source activation may only occur at times of poor visibility (including night) where operational planning cannot reasonably avoid such circumstances.

Ramp-up procedures are as follows:

- Visually and acoustically (day) or acoustically (night) monitor the buffer zone and adjacent waters for the absence of marine mammals and sea turtles for at least 30 minutes before initiating ramp-up procedures.
- If no protected species are visually or acoustically detected inside their respective BZs, ramp-up procedures may begin. If animals are detected, refer to Procedures to clear the BZs prior to start of source operations.
- Seismic personnel confirm with PSOs on watch (daytime) and/or PAM Operator (day and night) that the BZs are clear of protected species.
- Ramp-up begins by activating a single airgun of the smallest volume in the array.
- Continue ramp-up in stages by doubling the number of active elements at the commencement of each stage, with each stage of approximately the same duration.
- Total duration of the ramp-up should not be less than 20 minutes.

NOTE: Please review Section 8.5.1 below for shutdown requirements for protected species detected inside the EZ during a ramp up.

8.6 Protected Species Shutdown Procedures

8.6.1 Shutdown During Ramp Up

If **any marine mammal or sea turtle** is visually or acoustically detected within its EZ, an immediate shutdown of the seismic source in ramp up is required. This shutdown also applies for the four "non-shutdown" species listed in Section 8.5.2 below.

1. No shutdown of the ramp up is required for marine mammals or sea turtles detected inside the BZ during ramp up, however, notification should be made that a shut down could be called for if those animals move into the EZ.
2. No shutdown of the ramp up is required for acoustic only detections (day or night) unless those acoustic only detections can be localized inside the appropriate EZ. Notification should still be made that a shutdown could be called for if animals are able to be localized.

8.6.2 Shutdown During Full-Volume Operations

If any **marine mammal** is detected visually or acoustically within its EZ, an immediate shutdown of the seismic source is required.

The shutdown requirement is waived under the following circumstances:

1. Shut down is not required for dolphins of the following genera: *Steno, Tursiops, Stenella,* and *Lagenodelphis.*
2. Shut down is not required for acoustic detections of delphinids inside the EZ unless the PSO or PAM Operator can confirm that the dolphin(s) present are from a different genus than those listed above.

If there is uncertainty regarding identification (i.e., whether the observed marine mammal(s) belongs to one of the delphinid genera for which shutdown is waived or one of the species with a larger exclusion zone), visual PSOs should use best professional judgment in making the decision to call for a shutdown.

The vessel operator must comply immediately with any shut-down request made by a PSO or PAM Operator. Any discussion can occur only after the shutdown has been implemented.

Subsequent restart of seismic source may only occur following clearance of the EZ of all marine protected species under the following conditions:

- When all other marine mammals have been confirmed by the visual observer to have been seen exiting the relevant EZ (not BZ)
  OR
  When a marine mammal was not observed exiting the EZ, an additional 30 minutes has elapsed following the last detection inside the EZ.

NOTE: All resumptions of source activity following a protected species shutdown must begin with a ramp-up

8.7 Short Breaks in Source Operations

8.7.1 Daylight

In recognition of occasional short periods of silence for a variety of reasons other than for mitigation, during daylight operations, the seismic source may be silenced for periods of time not exceeding **30 minutes in duration** and may be restarted at the same volume for operations without a ramp-up if:

1. Visual and acoustic monitoring (daytime) is continued diligently through the silent period

   AND

2. No marine protected species are visually observed in their respective EZ during the silent period, and no acoustic detections made **at any distance**

NOTE: Procedures for returning to full volume without ramp up after silent periods also apply to returning to full volume from reduced volume.

However, if the source were operating at that reduced volume for more than 30 minutes, **a ramp up would be required to return to full volume.**

8.7.2 Night-time

In recognition of occasional short periods of silence for a variety of reasons other than for mitigation**,** the seismic source may be silenced for periods of time not exceeding **10 minutes in duration** and may be restarted at the same volume for operations without a ramp-up if:

1. Acoustic monitoring (nighttime) is continued diligently through the silent period

   AND

2. No acoustic detections have been made **at any distance**

NOTE: Procedures for returning to full volume without ramp up after silent periods also apply to returning to full volume from reduced volume.

For example, if two of three strings were silenced from full volume for the purpose of testing single strings, and testing was completed in less than 30 minutes, the array could return to full volume without a ramp-up provided that the conditions described above were met.

However, if the source were operating at that reduced volume for more than 30 minutes, **a ramp up would be required to return to full volume.**

8.8 Non-acquisition and Non-Testing Source Activity

The acoustic source should be deactivated when not acquiring data or preparing to acquire data, except as necessary for testing. Unnecessary use of the acoustic source shall be avoided.

9 REPORTING

9.1 Incident Reporting

9.1.1 Potential Non-Compliance Incidents

The Lead PSO or Lead PAM Operator verbally informs Party Manager and on-board Client Representative of any potential compliance related issues immediately. The Lead PSO/PAM Operator also informs the RPS Project Manager immediately of all potential non-compliance events.

If the issue can be resolved between the Lead PSO/PAM Operator, Client Representative and Party Manager, the lead PSO/PAM Operator will document in writing the compliance issue and the agreed-upon practices for minimizing future non-compliance incidents of the same nature. The party manager and QC Representative review and approve, and the statement is submitted to the following distribution list:

rmcgowan1@slb.com
fealys@slb.com
gpoole@slb.com

The representatives listed above will distribute any pertinent information resulting from the incident to their respective crews as deemed necessary and appropriate.

If the issue cannot be resolved at the vessel level, Western Geco and RPS will discuss and determine the appropriate future actions to be taken. When a common position is reached, notification of the agreed procedures will be distributed by Western Geco to vessel crew and by RPS to the PSOs and PAM Operators.

If an agreement cannot be reached at the office level, a Western Geco representative will contact BOEM/NMFS/BSEE for clarification. Results from the clarification will be distributed by Western Geco**.**

9.1.2 Reporting A Non-functioning PAM System During Seismic Operations

The PAM Operator on duty will notify the RPS Project Manager as soon as possible. The RPS PM will email NMFS (nmfs.psoreview@noaa.gov) and BSEE (protectedspecies@bsee.gov) as soon as is practicable of any PAM system malfunctions exceeding 30 minutes in duration that occur while acoustic source operations are ongoing.

The notification will include the vessel name, the time and location (GIS position) in which the PAM system ceased function where seismic operations continued. The template for this email will be provided by the RPS PM.

The PAM Operator will also notify by email:

- The vessel Party Chief
- The Client Representative
- The RPS PM should also be copied on this

9.1.3 Injured or Dead Protected Species Reporting

1. The PSO on watch will report the sightings of a dead and/or injured marine species to the Lead PSO, the RPS project manager, on board client representative and vessel Party Chief as soon as possible after the sighting.
2. The RPS PM will report the sighting to the NMFS stranding hotline. This will occur as soon as practicably possible but no more than 24 hours of the detection.
3. A written report will be prepared including any photos taken of the animal and sent to RPS as soon as possible.

4. The RPS office will submit the written report to the following distribution list within 12 hours of the detection for review:

   On-board:
   - Onboard Party Chief
   - Client Representative

   On-shore:
   - Western Geco Project Manager

RPS will provide the written report, once the draft has been reviewed and approved per above, to NOAA, NMFS, and BOEM with Western Geco included in copy.

NOTE: Unless otherwise directed by BOEM, NOAA Fisheries, or NOAA, the dead or injured marine mammal or sea turtle SHOULD NOT be touched! Dead and injured marine mammals and sea turtles are still protected by the ESA and the MMPA and touching the animals in any manner is considered harassment and is punishable by law.

9.2 Daily Progress, Interim and Final Reporting

9.2.1 Daily Progress Reports

A daily report will be completed and submitted to the Party chief, onboard client representative and RPS project manager.

The template will be provided by RPS and Western Geco will be provided opportunity to review and provide comments.

9.2.2 Interim Reports

RPS will submit interim reports in the format of an excel spreadsheet for each vessel containing the required information listed in the BO.

RPS will submit interim reports (a dataset in a format approved by NMFS and BSEE) on the 1st of each month to BSEE (protectedspecies@bsee.gov).

9.2.3 Final Report

RPS will develop a final report summarizing the survey activities and all PAM / PSO observations. The report will contain all the data required to meet the requirements of the BO.

The RPS Project Manager will provide the draft final report to the Western Geco Project Manager within 45 days of project completion and then the final submission of the report will be submitted to BOEM, BSEE, NMFS within 90 days of project completion.

A.1 Passive Acoustic Monitoring (PAM) Equipment

The PAM equipment comprises the following items:

- 250m Hydrophone Array Cable containing 2 Low Frequency hydrophones (10Hz to 24kHz), 2 Ultra Broadband hydrophones (200Hz to 200kHz), and 2 Broadband hydrophones (2kHz to 200kHz)
- 100m deck cable
- Electronic data capture and processing unit including:
  - Headphones RF transmitter
  - Fireface audio interface
  - Rackmount PC
  - Buffer interface unit
- Integral screen and keyboard
- Backup System

A.2 6 Hydrophone Array

The array includes six hydrophones arranged in three pairs of identical specification with appropriate physical separation to provide direction0finding (bearings) to marine mammals and localization using Target Motion Analysis (TMA).

- The front pair (H1 and H2, 8m separation) consists of two “Low Frequency” hydrophones with a response of 10 Hz to 24 KHz.
- The middle pair (H3 and H4, 2m separation) consists of two “Broadband” hydrophones with a response of 200 Hz to 200 kHz.
- The rear pair (H5 and H6, 0.25m separation) consists of two “Standard” hydrophones with a response of 2 kHz to 200 kHz.

The “Low Frequency” hydrophones are configured to detect very low frequency vocalizations while the “Broadband” and “Standard” hydrophones are configured to detect low-mid frequency and mid-high vocalizations respectively. These three pairs of hydrophones provide the capability to detect the full range of marine mammal vocalizations anticipated to be encountered.

Appendix C: Survey Vessel Photos

Survey Vessel Photos

Figure 1: Source Vessel SW Mikkelsen

Figure 2: Source Vessel SW Gallien

Figure 3: Node Vessel Shelia Bordelon

Figure 4: Support Vessel Sarah Bordelon

Appendix D: PSOs and PAM Operators

RPS PSOs Deployed *SW Gallien*
Avinash Maharajh
Celine Ramsarran
Chelsea Twohy
Daniela Durazo
Edgar Alvarado
Eren Penfield
Heber Huizar
Jill Nace
Jimena Ortega
Jordan Boliver
Laura Danos
Leticia Lili
Mario Reyes
Michelle Klein
Neftali Bonfil
Pamela Parnell
Yessica Vincencio

RPS PSOs Deployed *SW Mikkelsen*
Andrea Aguilar
Anna Turano
Cassandra Frey
Daniella Cuevas
Katie Douglas
Kelsey Gibbons
Maritza Martinez
Monica Arancibia
Neil Roper
Omar Salgado
Sancy Santiago
Sara Davis
Sean Bogle
Shauna Mohler
Sofia Juarez
Valeria Pena
Victoria Schaefer
Yessica Vicencio

Appendix E: Reticle Binocular Calibration Table

Reticle Binocular Calibrations – *SW Mikkelsen*

Week #	Date	Observer Name	Reticle Binocular Estimated Distance (m)	True Distance from Radar (m)	Sea State (Beaufort)	Wind Force (knots)	Swell (m)
1	2-Dec-22	Andrea Aguilar	2610	2463	2	13	<2
1	2-Dec-22	Shauna Mohler	5808	5000	2	11	<2
1	2-Dec-22	Omar Salgado	1088	1037	2	9	<2
2	7-Dec-22	Andrea Aguilar	2610	2077	2	11	<2
2	7-Dec-22	Shauna Mohler	2604	2018	2	11	<2
2	7-Dec-22	Omar Salgado	1460	1296	2	13	<2
3	12-Dec-22	Andrea Aguilar	1740	1814	2	11	<2
3	12-Dec-22	Shauna Mohler	2604	3129	3	12	<2
4	19-Dec-22	Daniela Cuevas	3089	4014	4	20	<2
4	21-Dec-22	Andrea Aguilar	1740	1981	6	28	>4
4	21-Dec-22	Shauna Mohler	1736	1807	6	30	>4
5	26-Dec-22	Andrea Aguilar	2610	2407	2	8	<2
5	26-Dec-22	Shauna Mohler	1432	1181	3	12	<2
5	25-Dec-22	Daniela Cuevas	958	1181	3	12	<2
6	8-Jan-23	Andrea Aguilar	5100	5074	3	3	<2
6	8-Jan-23	Shauna Mohler	3906	3648	3	3	<2
6	8-Jan-23	Daniela Cuevas	2596	2967	2	4	<2
7	14-Jan-23	Andrea Aguilar	746	777	4	18	2-4
7	14-Jan-23	Shauna Mohler	864	1124	4	24	2-4
7	14-Jan-23	Daniela Cuevas	1426	1384	4	16	2-4
8	21-Jan-23	Andrea Aguilar	580	550	3	20	<2
8	21-Jan-23	Shauna Mohler	1736	1666	3	12	<2
9	25-Jan-23	Andrea Aguilar	2610	2694	6	22	2-4
9	25-Jan-23	Shauna Mohler	2592	2694	6	22	2-4
9	25-Jan-23	Daniela Cuevas	1731	1624	6	18	2-4
9	29-Jan-23	Valeria Pena	1093	1138	3	15	<2
9	29-Jan-23	Anna Turano	868	900	3	12	<2
9	29-Jan-23	Sean Bogle	1001	997	3	8	<2
10a	31-Jan-23	Valeria Pena	870	877	2	10	<2
10a	31-Jan-23	Sean Bogle	396	312	2	11	<2
10a	31-Jan-23	Anna Turano	234	230	2	11	<2
10b	1-Feb-23	Valeria Pena	2710	2592	2	11	<2
10b	2-Feb-23	Sean Bogle	3222	3200	2	10	<2
10b	2-Feb-23	Anna Turano	868	900	2	10	<2
11	6-Feb-23	Valeria Pena	1900	2037	2	6	<2
11	6-Feb-23	Sean Bogle	3960	4000	2	11	<2
11	6-Feb-23	Anna Turano	1973	2037	2	6	<2
12	14-Feb-23	Valeria Pena	1190	1200	5	22	<2
12	14-Feb-23	Sean Bogle	2260	2129	2	8	<2

Week #	Date	Observer Name	Reticle Binocular Estimated Distance (m)	True Distance from Radar (m)	Sea State (Beaufort)	Wind Force (knots)	Swell (m)
12	15-Feb-23	Anna Turano	1953	2037	3	11	<2
13	20-Feb-23	Valeria Pena	870	926	3	8	<2
13	20-Feb-23	Sean Bogle	2200	2130	3	6	<2
13	20-Feb-23	Anna Turano	2200	1900	3	11	<2
14a	27-Feb-23	Valeria Pena	4000	4352	4	10	<2
14a	27-Feb-23	Sean Bogle	3704	3501	3	9	<2
14a	27-Feb-23	Anna Turano	289	295	2	8	<2
14b	1-Mar-23	Valeria Pena	1900	1924	4	17	<2
14b	1-Mar-23	Sean Bogle	2740	3000	4	14	<2
14b	1-Mar-23	Anna Turano	2800	3000	4	12	<2
15	6-Mar-23	Valeria Pena	770	809	2	8	<2
15	6-Mar-23	Sean Bogle	2260	2222	3	11	<2
15	6-Mar-23	Anna Turano	521	696	2	11	<2
15	12-Mar-23	Kelsey Gibbons	330	309	4	27	<2
15	12-Mar-23	Shauna Mohler	261	309	4	27	<2
15	12-Mar-23	Sofia Juarez	343	309	4	27	<2
16	13-Mar-23	Kelsey Gibbons	1420	1563	5	28	<2
16	13-Mar-23	Sofia Juarez	1292	1563	5	28	<2
16	15-Mar-23	Shauna Mohler	736	796	4	12	<2
17	21-Mar-23	Shauna Mohler	2604	3889	5	17	2-4
17	24-Mar-23	Sofia Juarez	2840	3889	5	17	2-4
17	26-Mar-23	Kelsey Gibons	1420	1981	3	13	<2
18	28-Mar-23	Shauna Mohler	654	700	3	6	<2
18	28-Mar-23	Sofia Juarez	1852	1416	3	5	<2
18	28-Mar-23	Kelsey Gibons	1852	1620	3	5	<2
18c	1-Apr-23	Shauna Mohler	1220	1307	3	17	<2
18c	1-Apr-23	Sofia Juarez	723	661	3	17	<2
18c	1-Apr-23	Kelsey Gibons	568	770	3	20	<2
19	5-Apr-23	Shauna Mohler	2614	2963	5	29	<5
19	6-Apr-23	Kelsey Gibons	330	309	4	16	2-4
19	6-Apr-23	Sofia Juarez	343	309	4	16	2-4

Reticle Binocular Calibrations – *SW Gallien*

Week #	Date	Observer Name	Reticle Binocular Estimated Distance (m)	True Distance from Radar (m)	Sea State (Beaufort)	Wind Force (knots)	Swell (m)
1	26-Nov-22	Avinash Maharajh	3937	4120	3	15	<2
1	27-Nov-22	Heber Huizar	3126	2296	2	8	<2
1	27-Nov-22	Leticia Lili	2786	2950	3	11	<2
2	29-Nov-22	Heber Huizar	284	225	4	21	<2
2	30-Nov-22	Leticia Lili	265	225	4	23	<2
2	30-Nov-22	Avinash Maharajh	280	225	4	25	<2
2	3-Dec-22	Heber Huizar	782	741	2	8	<2
2	2-Dec-22	Avinash Maharajh	8220	8334	2	14	<2
2	3-Dec-22	Leticia Lili	797	741	2	23	<2
3	3-Dec-22	Heber Huizar	782	741	2	8	<2
3	2-Dec-22	Avinash Maharajh	8220	8334	2	14	<2
3	3-Dec-22	Leticia Lili	797	741	2	23	<2
3	5-Dec-22	Heber Huizar	1900	1666	2	7	<2
3	7-Dec-22	Avinash Maharajh	5340	5556	2	9	<2
4	16-Dec-22	Heber Huizar	3126	3889	4	12	<2
4	16-Dec-22	Mario Reyes	3136	3889	4	12	<2
4	16-Dec-22	Leticia Lili	946	1022	3	13	<2
4	16-Dec-22	Mario Reyes	1296	1568	4	16	<2
4	16-Dec-22	Heber Huizar	1296	1563	4	16	<2
5	25-Dec-22	Mario Reyes	1363	1568	3	13	<2
5	25-Dec-22	Heber Huizar	1363	1563	3	3	<2
6a	26-Dec-22	Leticia Lili	610	645	2	3	<2
6a	26-Dec-22	Heber Huizar	1040	1200	2	5	<2
6a	31-Dec-22	Mario Reyes	285	225	4	11	<2
6b	1-Jan-23	Mario Reyes	1045	1000	3	12	<2
7	1-Jan-23	Leticia Lili	541	610	2	5	<2
7	6-Jan-23	Heber Huizar	2826	2593	3	10	<2
7	6-Jan-23	Mario Reyes	2836	2222	3	11	<2
8	9-Jan-23	Heber Huizar	1563	1372	3	10	<2
8	9-Jan-23	Leticia Lili	1372	1402	3	10	<2
8	15-Jan-23	Mario Reyes	945	852	2	15	<2
9	20-Jan-23	Heber Huizar	1042	987	5	24	<2
10	25-Jan-23	Chelsea Twohy	1800	1700	5	24	<2
10	25-Jan-23	Celine Ramsarran	1800	2000	5	24	<2
10	26-Jan-23	Daniela Durazo	540	517	3	17	<2
10	28-Jan-23	Pamela Parnell	1450	1400	3	23	<2
11a	31-Jan-23	Daniela Durazo	1033	996	2	11	<2
11a	31-Jan-23	Pamela Parnell	1033	996	2	11	<2
11a	31-Jan-23	Chelsea Twohy	210	204	3	7	<2

Week #	Date	Observer Name	Reticle Binocular Estimated Distance (m)	True Distance from Radar (m)	Sea State (Beaufort)	Wind Force (knots)	Swell (m)
11b	4-Feb-23	Chelsea Twohy	1722	1700	3	7	<2
11b	4-Feb-23	Pamela Parnell	1722	1700	3	7	<2
11b	5-Feb-23	Daniela Durazo	517	500	2	8	<2
12	6-Feb-23	Daniela Durazo	2800	2770	3	13	<2
12	10-Feb-23	Chelsea Twohy	1550	1518	2	5	<2
12	10-Feb-23	Daniela Durazo	1550	1518	2	5	<2
12	10-Feb-23	Pamela Parnell	675	620	2	5	<2
13	13-Feb-23	Chelsea Twohy	674	690	2	3	<2
13	13-Feb-23	Daniela Durazo	674	690	2	3	<2
13	19-Feb-23	Pamela Parnell	2300	2400	3	9	<2
13	19-Feb-23	Chelsea Twohy	2335	2100	3	9	<2
14	24-Feb-23	Chelsea Twohy	861	900	3	13	<2
14	24-Feb-23	Daniela Durazo	861	900	3	13	<2
14	25-Feb-23	Pamela Parnell	1107	1180	3	8	<2
15	5-Mar-23	Jordan Boliber	310	314	3	15	<2
15	5-Mar-23	Laura Danos	320	314	3	15	<2
15	5-Mar-23	Eren Penfield-Espinosa	300	314	3	16	<2
16	9-Mar-23	Jordan Bolivar	1722	1500	2	13	<2
16	8-Mar-23	Eren Penfield-Espinosa	1300	1111	2	13	<2
16	12-Mar-23	Laura Danos	1700	1550	4	19	<2
17	17-Mar-23	Jordan Bolivar	3000	5167	3	21	<2
17	17-Mar-23	Eren Penfield-Espinosa	5000	5556	3	20	<2
17	19-Mar-23	Laura Danos	1762	2000	5	30	2-4
18	26-Mar-23	Laura Danos	2214	3463	2	10	<2
18	24-Mar-23	Eren Penfield-Espinosa	2000	1852	3	16	<2
18	24-Mar-23	Jordan Bolivar	3100	3219	2	9	<2
19	30-Mar-23	Jordan Bolivar	258	227	2	8	<2
19B	31-Mar-23	Eren Penfield-Espinosa	1132	1483	2	10	<2
19B	31-Mar-23	Jordan Bolivar	1550	1482	2	10	<2
19C	1-Apr-23	Eren Penfield-Espinosa	3100	2963	2	14	<2
20	3-Apr-23	Laura Danos	1000	926	3	16	<2
21	10-Apr-23	Eren Penfield-Espinosa	3100	2222	2	15	<2

Appendix F: Vessel Specific PAM Deployment Procedures

SW Mikkelsen PAM Hydrophone Deployment Procedures

03 December 2022

The hydrophone deployment procedure is a draft document and may be altered at any time to reflect changes in the deployment over time. The deployment requires the PAM operator and one additional person to operate the winch.

Overview

A 230-meter heavy tow cable; a 25-meter hydrophone array cable containing six hydrophone elements with a depth gauge, and a 100-meter deck cable were supplied for the survey. Also, an electronic data capture and processing until (DPU) was provided and included a rack mounted PC; two integral screens; keyboard and mouse; one fireface audio interface; a buffer interface unit, and headphones RF transmitter. A backup system is also onboard in case of any failures in the main system.

The six hydrophones on the array cable are arranged in three pairs of identical specification with appropriate physical separation to provide direction-finding (bearings) and localization. The front pair consists of two low frequency hydrophones (with a response of 10Hz to 24kHz); the middle pair consists of two broadband hydrophones (200Hz to 200kHz response), and the rear pair consists of two standard hydrophones (2kHz to 200kHz response) (Figure 1).

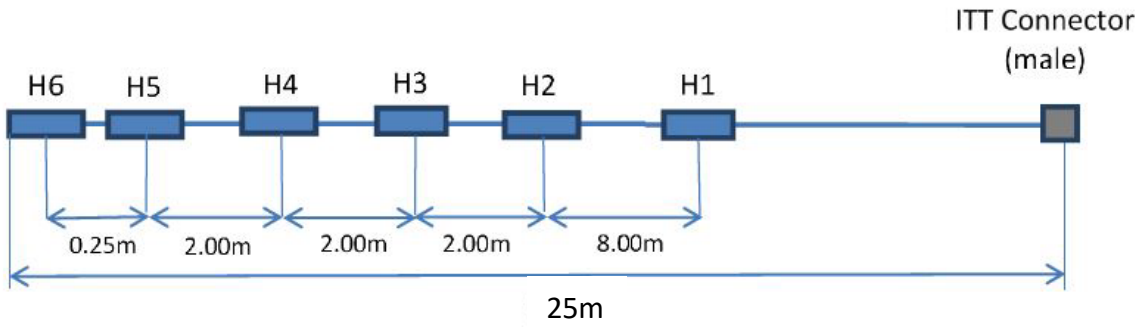


Figure 1: Schematic diagram of the hydrophone array cable indicating the position and separation of individual hydrophone elements and hydrophone pairs.

The “Low Frequency” hydrophones are configured to detect very low frequency vocalizations while the “Broadband” and “Standard” hydrophones are configured to detect low-mid frequency and mid-high vocalizations respectively. These three pairs of hydrophones provide the capability to detect the full range of marine mammal vocalizations anticipated to be encountered.

The PAM DPU, laptop, and monitors were set up in the instrument room (Figure 2). A GPS feed (GNGGA string) was provided from a *GlobalSat* GPS antenna. From it, the sound and screen were sent via TeamViewer to the remote PAM operators.

The 100-meter deck cable is connected to the PAM DPU located in the instrument room and is also connected to the hydrophone tow cable via a SD-16 connector. Both sets of tow and hydrophone array cables were spooled onto a mechanical winch located on the port stern side of the vessel for the deployment/retrieval process into the water (Figure 3).

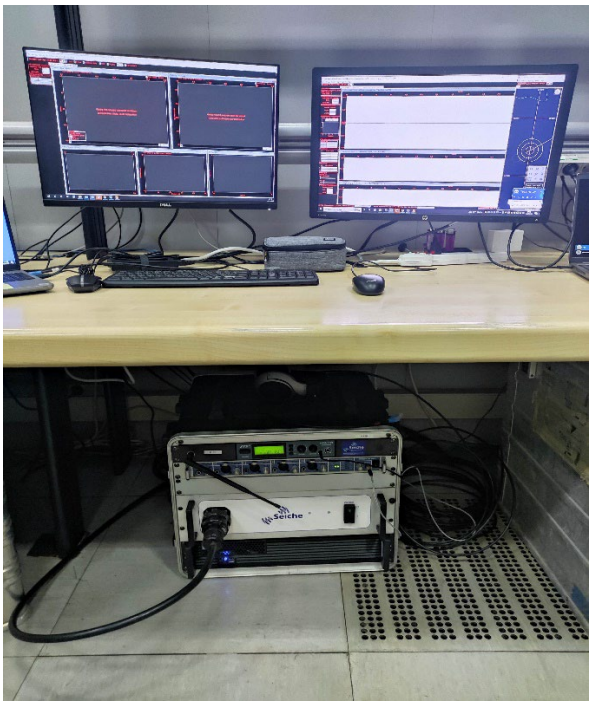


Figure 2: Passive acoustic monitoring station located in the instrument room.

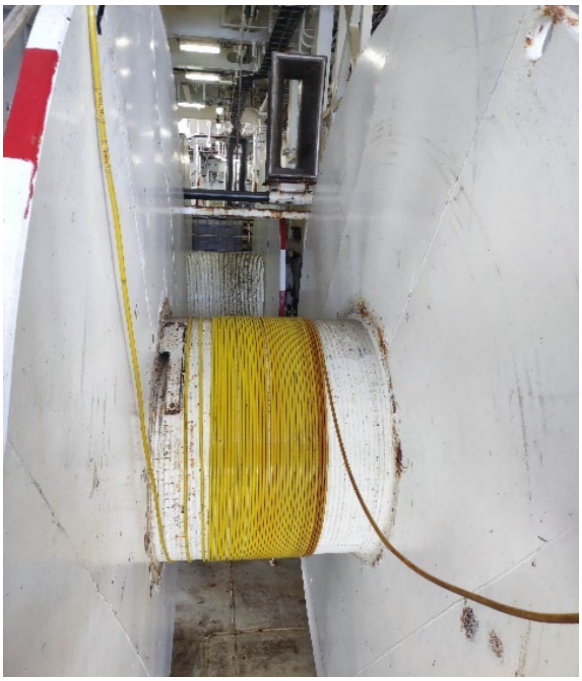


Figure 3. Hydrophone and tow cables mounted on the port stern winch.

Two set of chains of approximately nine kilograms and four kilograms were securely attached onto the tow cable, at approximately five meters and 100 meters, respectively, from the tow cable connection point with

the hydrophone array section (Figure 4). The weight was added to aid in proper towing depth and to decrease the likelihood of entanglement.

Figure 4. Chains added to the tow cable to increase depth.

A Chinese finger was also attached to the tow cable at approximately 180 meters from the connection point with the hydrophone array section to help secure the cable on the stern side of the vessel after being deployed (Figure 5).

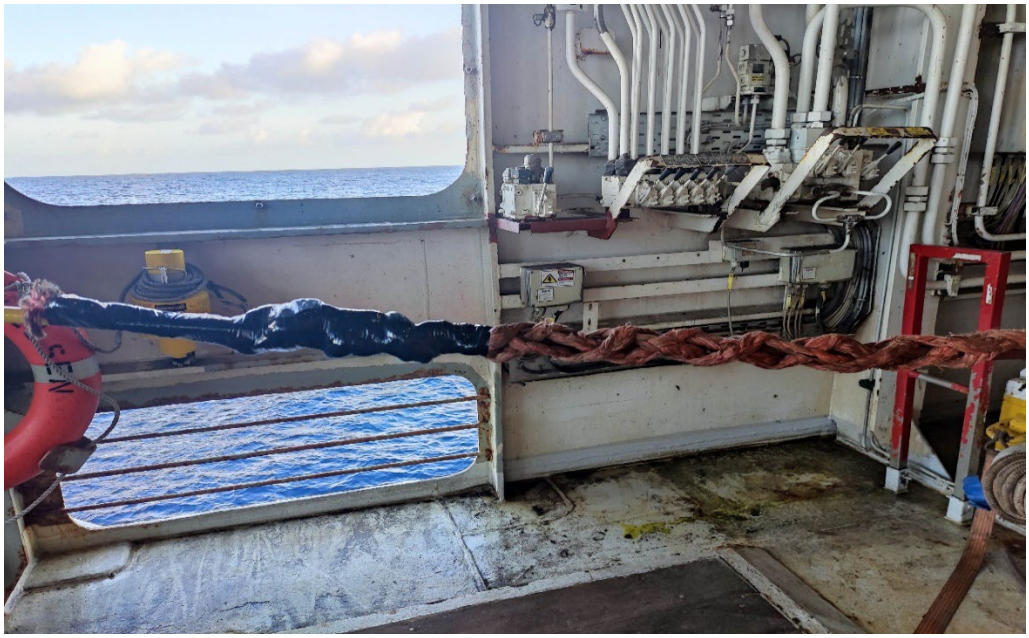


Figure 5. Chinese finger added to the tow cable to help secure it after deployed.

Deployment

When ready to deploy, the operator first ensures that the deck cable is disconnected from the tow cable on the winch and that the electronics in the instrument room are powered off. Then, the mechanic opens the local hydraulic valves to activate and run the winch to deploy the cable to the desired towing length. From the winch, the cable is guided through a fairlead block located over the port stern of the *SW Mikkelsen* to the sea (Figure 6).

Figure 6. Cable guided through a fairlead block to the port stern of the vessel.

Once deployed, the Chinese finger on the tow cable is secured with a metallic hook to an anchor rope located on the edge of the port stern (Figure 7). The winch is finally turned off and disconnected, and the deck cable is connected to the tow cable on the winch before returning to the instrument room.

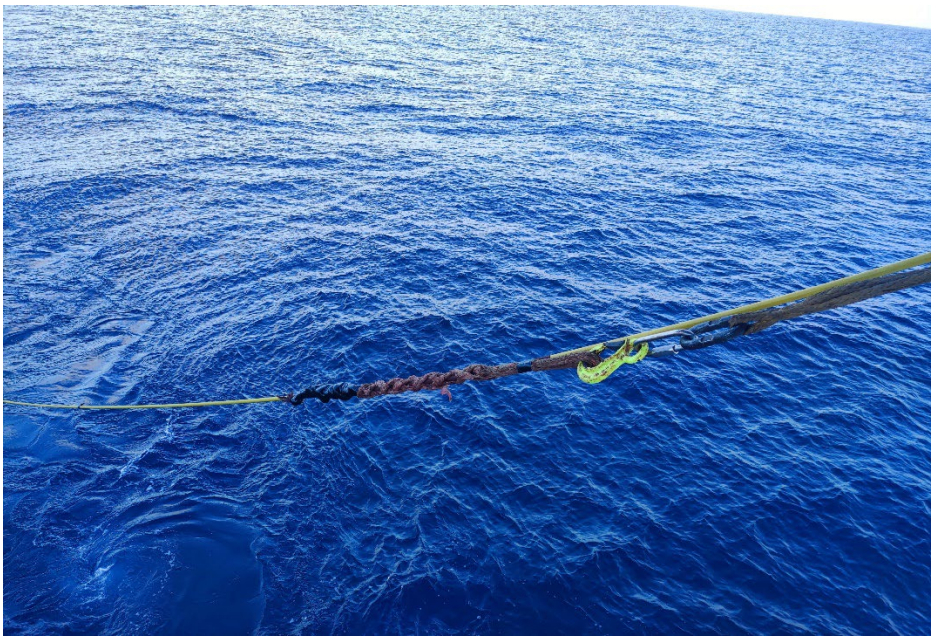


Figure 7. PAM cable fully deployed off the port stern.

When the PAM cable is fully deployed, approximately 200 meters of the cable is towed freely astern of the vessel (Figure 8). The end of the cable tows at an average depth of 30 meters, depending on the sea current and vessel's speed. The center of the acoustic source is located approximately 25 meters from the hydrophone array cable.

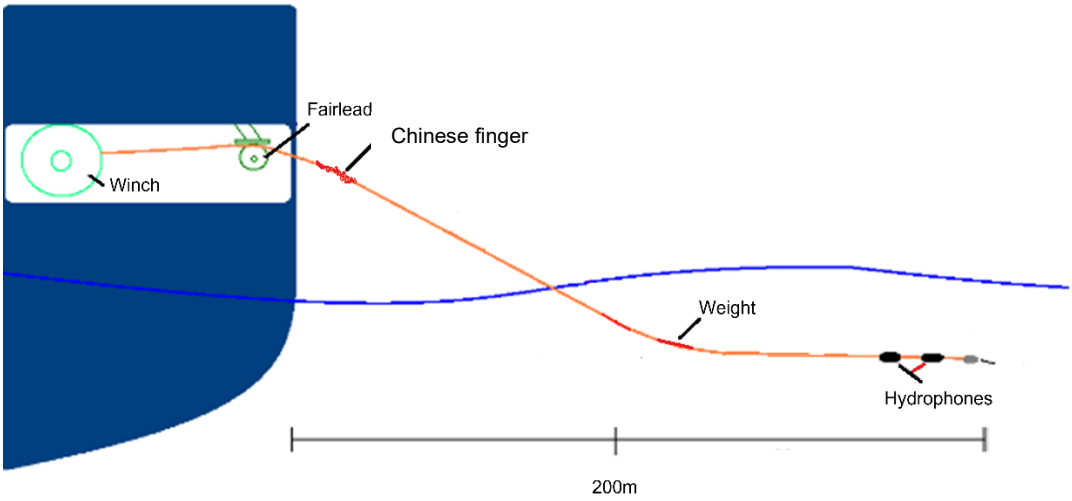


Figure 8: Sketch of the hydrophone deployment on the *SW Mikkelsen*.

Retrieval

During retrieval, the electronics in the instrument room are powered off; the tow cable is disconnected from the deck cable, and the Chinese finger is dis-attached from the anchor rope. Then, the mechanic opens the local hydraulic valves to activate and run the winch. The tow cable is slowly loaded onto the winch while making sure that the first weight section is carefully retrieved and placed. When the second weight section attached at 30 meters from the depth gauge is onboard, the rest of the tow cable and the hydrophone cable are manually retrieved, coiled, and placed on deck. The connectors are then protected with a tape or plastic bag to prevent corrosion.

Pre-Deployment Tasks

- Ensure the system has been tested and calibrated
- Chief mechanic / SL mechanic / PAM assess the environmental conditions.

Deployment

- Ensure that the PAM electronic unit is powered down.
- Toolbox meeting alerting instrument room of pending hydrophone deployment.
- Ensure the deck cable is disconnected from the hydrophone tow cable (tape both connectors to prevent corrosion).
- Open hydraulics for the spreader rope winch.
- Manually deploy the first 30 meters of the cable on the port stern side.
- Pay out the rest of the tow cable from the lead-in winch until a total length of 200 meters has been deployed, where the Chinese finger is attached.
- Secure the PAM cable by attaching the metallic hook of the anchor rope to the hydrophone cable via the Chinese finger.
- Release a little more cable to reduce tension.

- Close the hydraulics for the spreader rope winch.
- Connect the deck cable to the hydrophone cable.
- Power up electronics in the PAM station.

Retrieval

- Power down electronics in the PAM station of the instrument room.
- Toolbox meeting alerting instrument room of pending hydrophone retrieval.
- Ensure the deck cable is disconnected from the hydrophone cable (tape both connectors to prevent corrosion).
- Open hydraulics for spreader rope winch.
- Pull the cable until the Chinese finger is on deck.
- Disconnect the Chinese finger from the metallic hook on the anchor rope.
- Retrieve the tow cable onto the winch (until the weight section is closer to the hydrophone cable).
- Manually retrieved the remaining 45 meters of cable and coiled it on deck.
- Close the hydraulics for the spreader rope winch.
- Protect the connectors to avoid moisture and corrosion.

Always ensure the deck cable is disconnected from the tow cable before operating the winch.

HSE

Normal working deck PPE is required (hard hat, boots, gloves, eye protection, and coveralls). The procedure takes place on the streamer deck, so a life vest is also required. This operation carries a relatively low risk. Hazards include working close to the side of the vessel, trip hazards, and pinch points at the winch, shackles, and collar.

A Job Safety Analysis (JSA) has been completed for this task. The JSA will also require further review for any additional modifications.

Daniela Cuevas Miranda

12/03/2022

SW Gallien PAM Hydrophone Deployment Procedures

01/05/2023

The hydrophone deployment procedure is a draft document and may be altered at any time to reflect changes in the deployment over time. The deployment requires the PAM operator and one additional person to complete.

Overview

A 200 m heavy tow cable and 25 m hydrophone array cable containing two Low Frequency hydrophones (10Hz to 24kHz), two ultra broadband hydrophones (200Hz to 200kHz), and two broadband hydrophones (2kHz to 200kHz) was supplied for the survey. The six hydrophones are arranged in three pairs of identical specification with appropriate physical separation to provide direction-finding and localization (Figure 1).

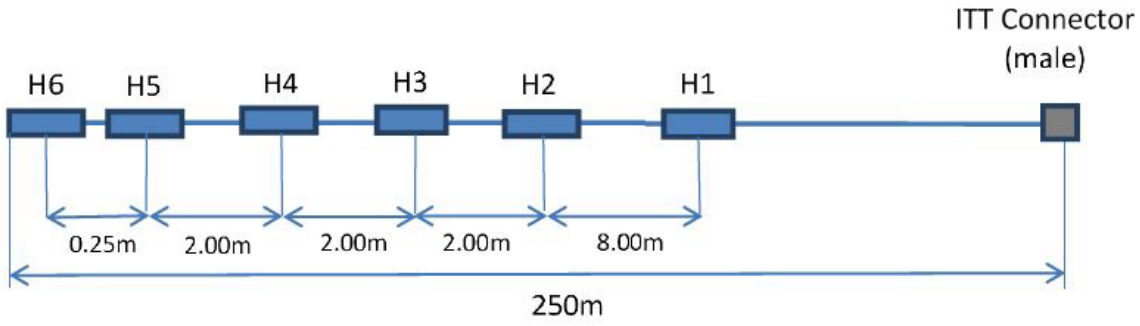


Figure 1: Schematic diagram of the hydrophone array cable indicating the position and separation of individual hydrophone elements and hydrophone pairs.

Both sets of tow and hydrophone cables were spooled onto a mechanical winch for easy deployment/retrieval. The cables of the starboard winch were designated as the main cables, and the cables from the port winch were designated as the spare (Figure 2).

Figure 2. Hydrophone and tow cable on the hydraulic winch.

Two set of chains of approximately 14 kilograms and eight kilograms were securely attached onto the tow cable at approximately five meters and 100 meters respectively, from the tow cable connection point with the hydrophone array section (Figure 3-4). The weight was added to aid in proper towing depth and decrease the likelihood of entanglement.

Figure 3-4. Weight added to the tow cable to increase depth.

When ready to deploy, the mechanic opens the local hydraulic valves to activate and runs the winch to deploy the cable to the desired tow length. From the winch, the cable is guided through a fairlead block over the starboard stern of the *SW Gallien* to the sea (Figure 5-6). There is a Chinese finger approximately 157 meters from the depth sensor of the hydrophone cable. Once deployed, the cable is secured to an anchor rope by a metallic hook and connected to the Chinese finger (Figure 7-8).

Figure 5-6. Cable guided through a fairlead block.

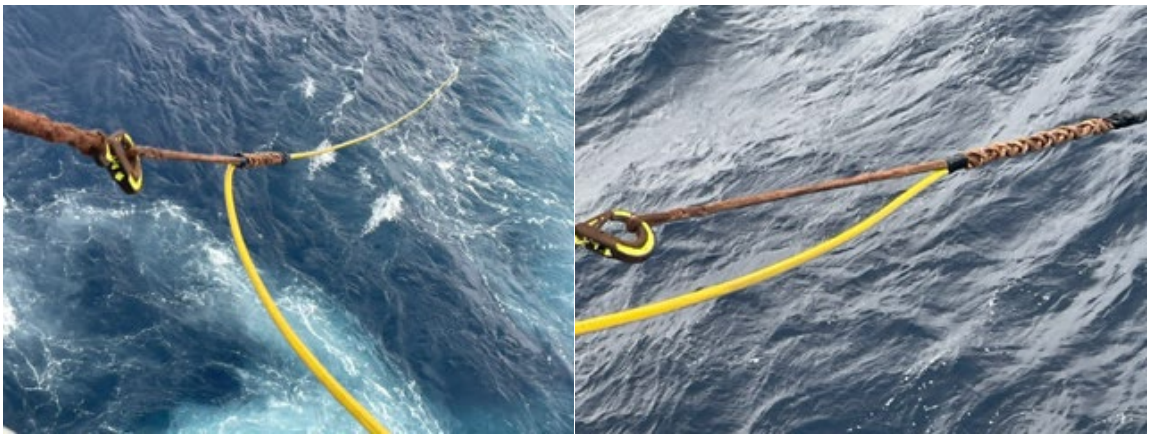


Figure 6-7. Chinese finger attached to the tow cable.

When fully deployed, approximately 150m of the hydrophone cable is towed freely behind the stern of the vessel (Figure 8-9). On average, the end of the cable tows at a depth of 10.5m. The center of source is located approximately 50m from the hydrophones.

Figure 8. PAM cable deployed off the starboard stern.

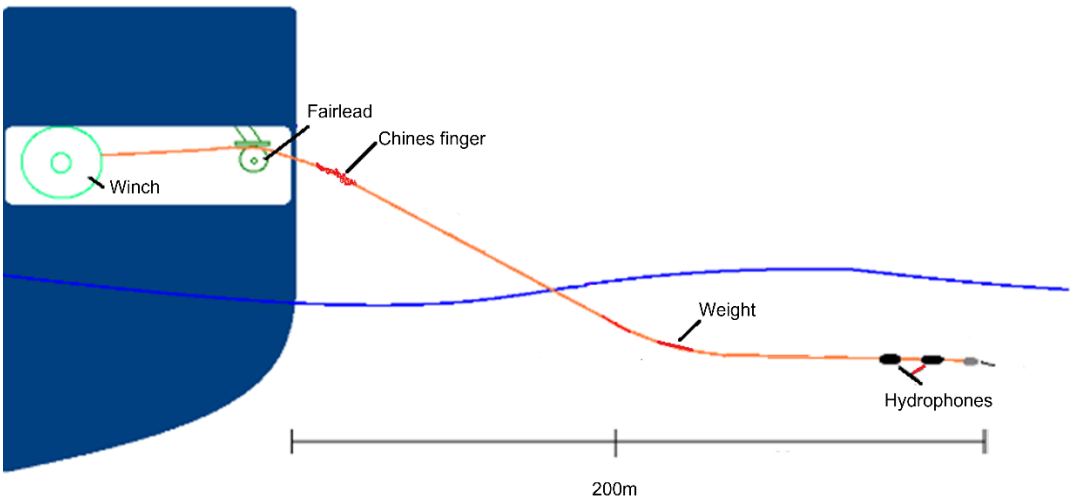


Figure 9: Sketch of the hydrophone deployment on the *SW Gallien*.

During retrieval, the hydrophone cable is disconnected, and the Chinese finger is dis-attached. Then, the cable is slowly loaded into the winch, making sure the first weight section is carefully placed on the winch. When the weight section attached 45 meters from the depth gauge is onboard, the rest of the tow cable and the hydrophone cable are manually retrieved and coiled on the deck. The connectors are then protected with a tape or plastic bag to avoid any moisture getting in them.

Update

On January 05, 2023, as the PAM cable was being recovered for source maintenance, it was notice that the towing cable was damage with some internal wiring exposed due to entanglement with some fishing gear. Since that day, the spare cable, already mounted on the port side's winch, was use as the main hydrophone cable.

Two sets of chains of approximately 14 kilograms and eight kilograms were securely attached onto the tow cable at approximately five meters and 80 meters respectively, from the tow cable connection point with the hydrophone array section (Figure 10-11). The weight was added to aid in proper towing depth and decrease the likelihood of entanglement.

Figure 10-11. Weight added to the tow cable to increase depth.

When ready to deploy, the mechanic opens the local hydraulic valves to activate and runs the winch to deploy the cable to the desired tow length. From the winch, the cable is guided through a fairlead block over the port stern of the *SW Gallien* to the sea (Figure 12). There is a Chinese finger approximately 171 meters from the depth sensor of the hydrophone cable. Once deployed, the cable is secured to an anchor rope by a metallic hook and connected to the Chinese finger (Figure 13).

Figure 12. Cable guided through a fairlead block.

Figure 13. Chinese finger attached to the tow cable and the metallic hook

When fully deployed, approximately 170m of the hydrophone cable is towed freely behind the stern of the vessel (Figure 14). On average, the end of the cable tows at a depth of 17.5m. The center of source is located approximately 30m from the hydrophones.

Figure 14. PAM cable deployed off the port stern.

On January 07, the spare hydrophone cable was received, and it was mounted on the starboard side winch. The cable was set up with chains and a Chinese finger at the same distances that the port side cable, so both deployments would be identical. Nonetheless, this starboard side cable was weighted with chains of 5.5 kilograms and 4.2 kilograms, five and 80 meters, respectively, after the connection point between the tow and hydrophone cable.

Since that day (January 07), both cables were used indistinctively depending on the retrievals of the acoustic source for maintenance. If the port side PAM cable was deployed and strings 4-6 needed to be recovered, the PAM cable was retrieved and immediately after, the starboard side PAM cable was deployed. If strings 1-3 needed to be recovered, the PAM cable was recovered and the cable on the port side was then deployed. This so acoustic monitoring could continue, and downtime could be reduced.

Pre-Deployment Tasks

The PAM data processing unit, laptop, and monitor were set up on the instrument room (Figure 10). A GPS feed (GNGGA string) was provided from a *GlobalSat* GPS antenna. From it, the sound and screen were sent via TeamViewer to the remote PAM operators.

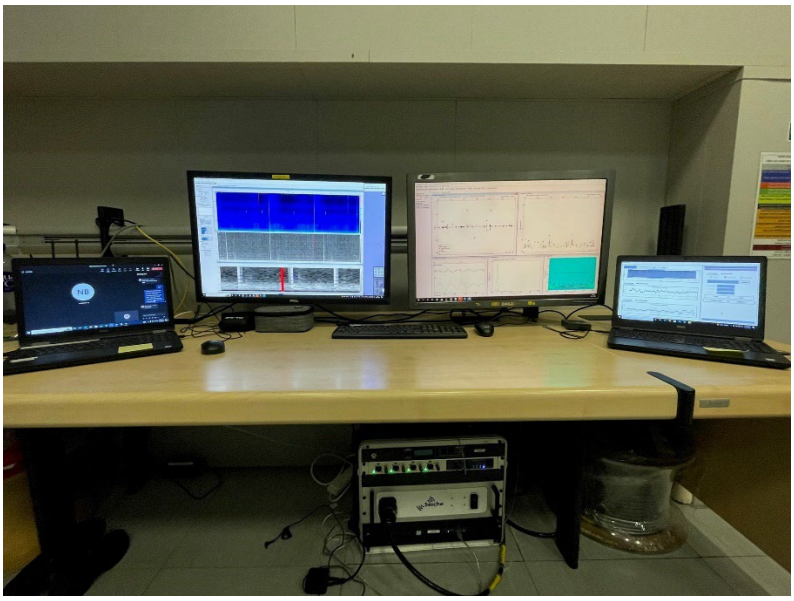


Figure 10: Passive acoustic monitoring station on the bridge.

Deployment

- Ensure that the PAM electronics unit is powered down.
- Toolbox meeting alerting instrument room of pending hydrophone deployment.
- Ensure the deck cable is disconnected from the hydrophone tow cable (tape both connectors to prevent corrosion).
- Open hydraulics for spreader rope winch.
- Deployed the first 45 meters of cable by hand.
- Pay out the rest of the hydrophone cable from the lead-in winch.
- Attach the shackle for the collar to the hydrophone cable via the Chinese finger.
- Released a little more cable to reduce tension.
- Close the hydraulics for the spreader rope winch.
- Connect the deck cable to the hydrophone cable.
- Power up electronics on bridge.

Retrieval

- Power down electronics on the PAM desk.
- Toolbox meeting alerting instrument room of pending hydrophone deployment.
- Ensure the deck cable is disconnected from the hydrophone cable (tape both connectors to prevent corrosion).
- Open hydraulics for spreader rope winch.
- Pull the cable until the Chines finger is on deck.
- Disconnect Chinese finger from the collar.
- Retrieve the first 155m of hydrophone cable using the winch (until the weight section closer to the hydrophone cable).
- Manually retrieved the remaining 45 meters of cable and coiled it on deck.
- Close the hydraulics for the spreader rope winch.
- Protect the connectors to avoid moisture.

Always ensure the deck cable is disconnected from the tow cable before operating the winch.

HSE

Normal working deck PPE is required (hard hat, boots, gloves, eye protection, and coveralls). The operation carries a relatively low risk. Hazards include working close to the side of the vessel, trip hazards, and pinch points at the winch, shackles, and collar.

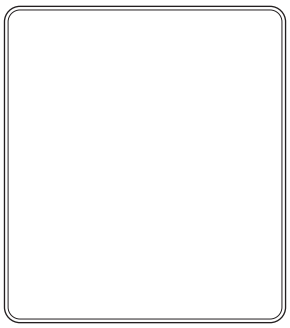
A Job Safety Analysis (JSA) has been completed for this task. The JSA will also require further review of any additional modifications.

Yessica Vicencio Murillo

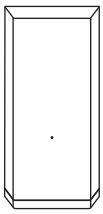
11/22/2022

Appendix G: StarLink System Specifications

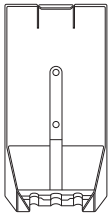
FLAT HIGH PERFORMANCE KIT



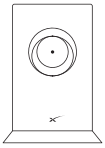
Dish



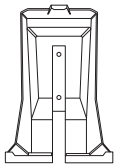
Power Supply



Power Supply Mount



Router



Router Mount

Starlink Cable
8 m
(26.2 ft)

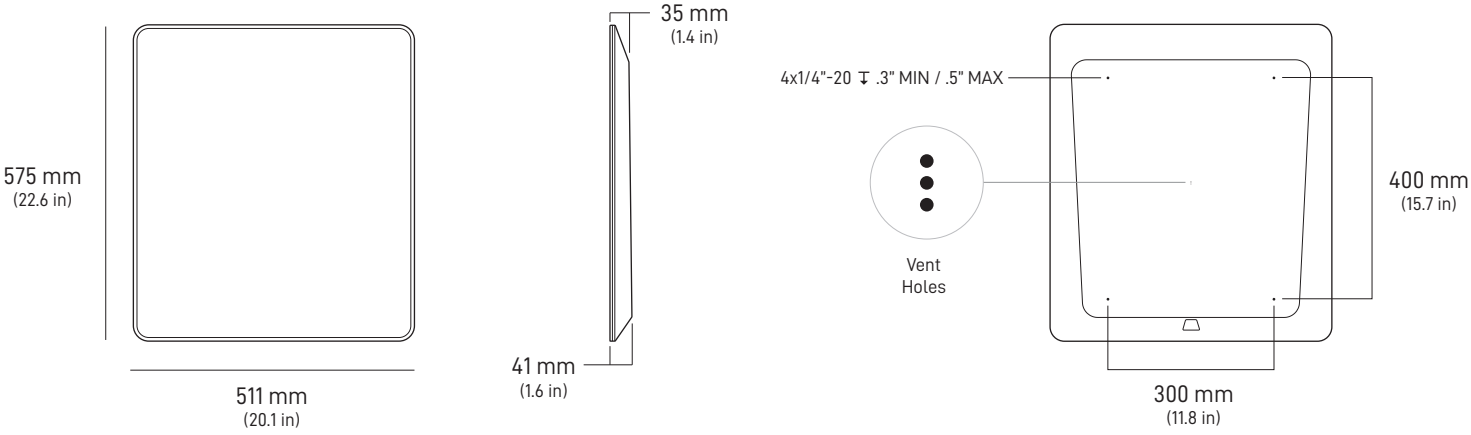
Ethernet Cable
5 m
(16.5 ft)

Router Cable
2 m
(6.5 ft)

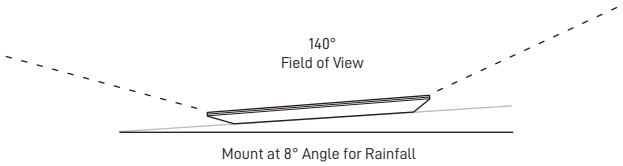
AC Cable (Power Supply)
1.8 m
(6 ft)

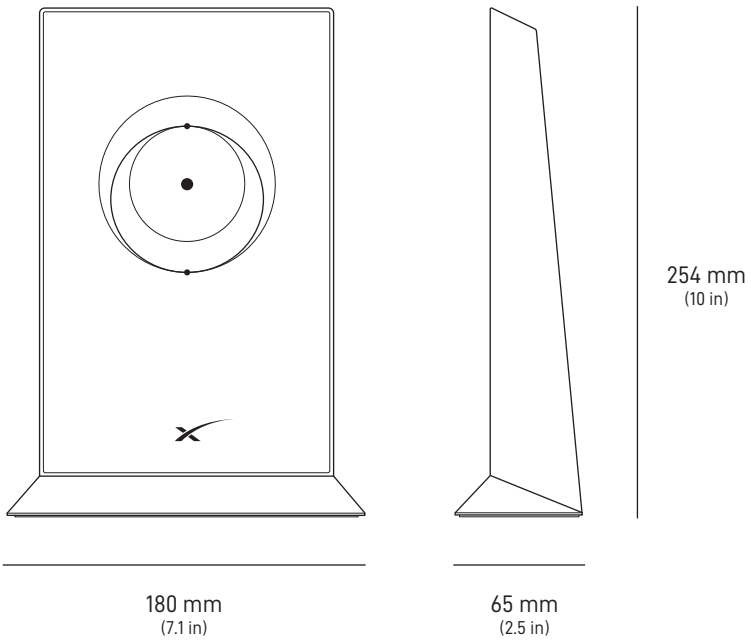
AC Cable (Router)
1.8 m
(6 ft)

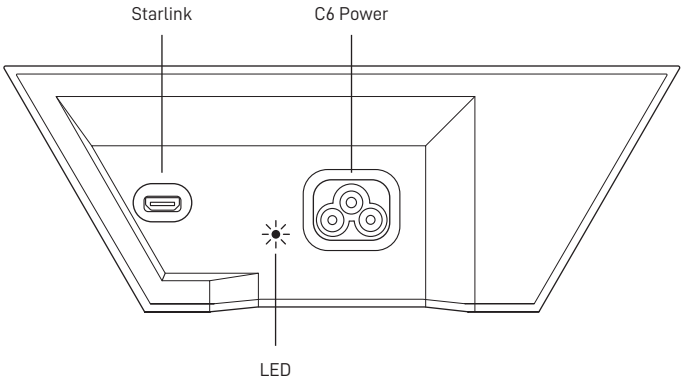
FLAT HIGH PERFORMANCE



Antenna	Electronic Phased Array
Field of View	140°
Orientation	Fixed
Dish Weight	5.9 kg / 13 lbs without Cable 6.7 kg / 15 lbs with 8 m / 26.2 ft Cable
Environmental Rating	IP56
Operating Temperature	-30°C to 50°C (-22°F to 122°F)
Wind Speed	Survivable: 280 kph+ (174 mph+)
Snow Melt Capability	Up to 75 mm / hour (3 in / hour)
Power Consumption	Average: 110-150 W
Wi-Fi	Dual Band Wi-Fi 5 - 3x3 MIMO
User LAN	RJ45 Cable

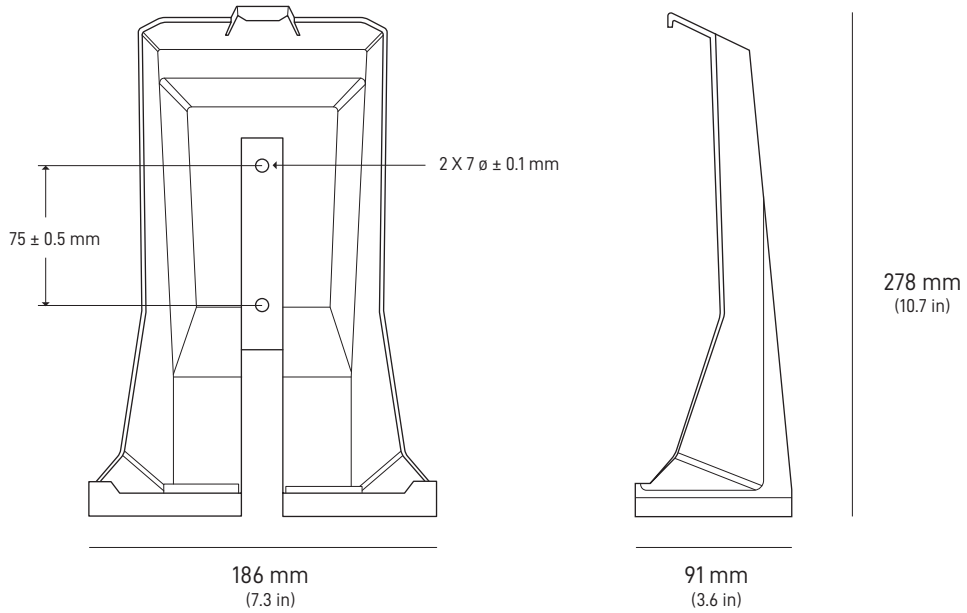




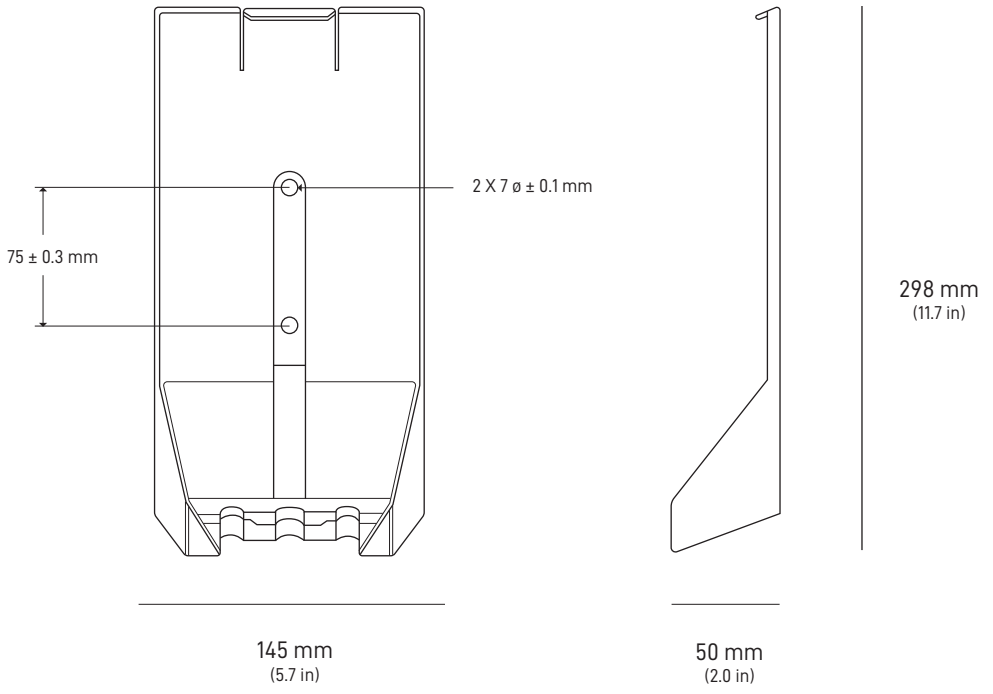


Wi-Fi Technology	802.11ac Dual Band
Generation	Wi-Fi 5
Radio	Dual Band -3 x 3 MIMO
Operating Temperature	-30°C to 50°C (-22°F to 122°F)
Weight	1 kg (2.2 lbs)
Security	WPA2
Range	Up to 185 m^2 (2000 ft^2) *Varies on placement, interference, and materials
Environmental Rating	IP54 - Configured for Indoor Use
Power Indicator	White LED | Base of Router
Mesh Compatibility	Compatible with up to 12 Starlink Nodes
Devices	Connect up to 128 devices

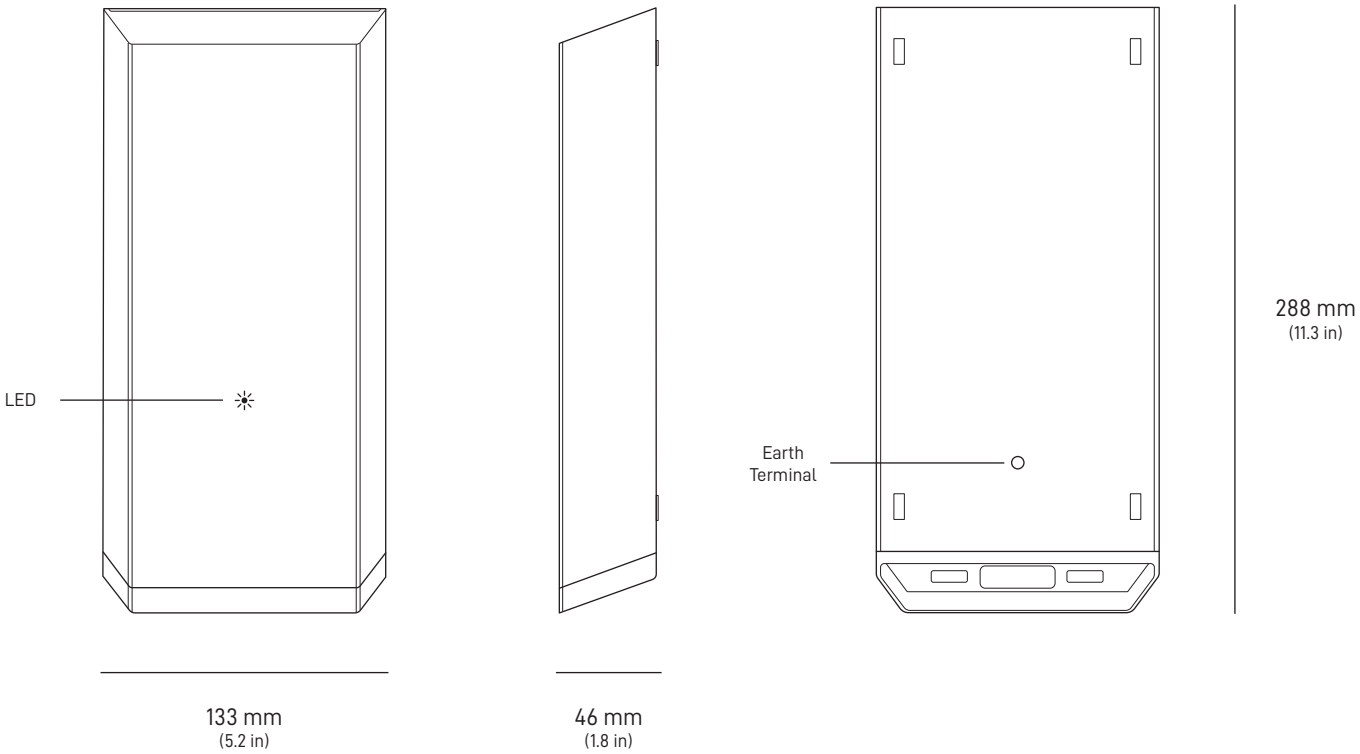
ROUTER MOUNT

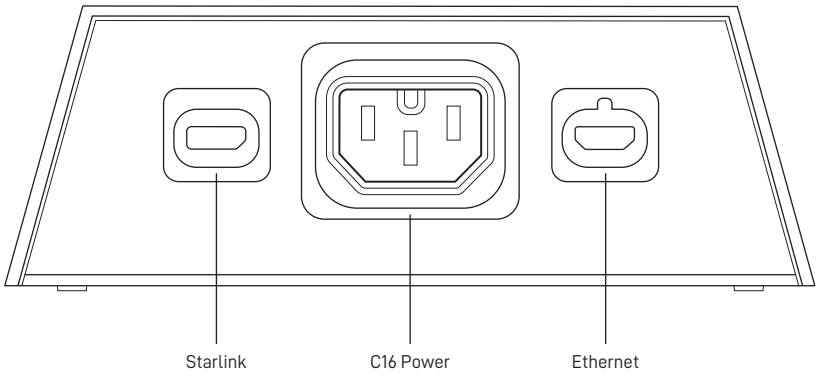


POWER SUPPLY MOUNT



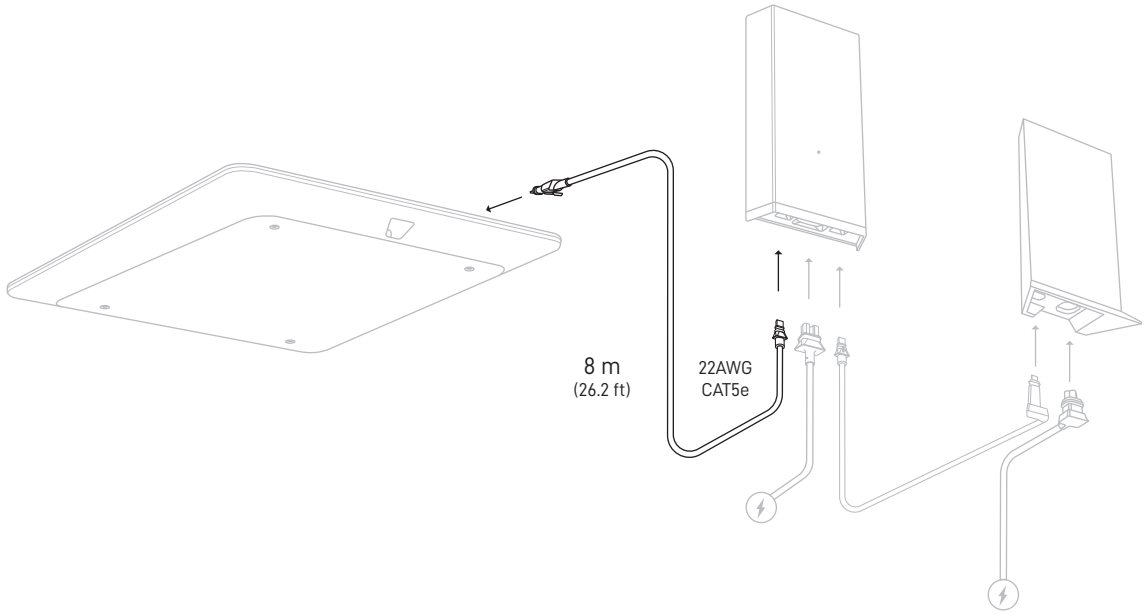
POWER SUPPLY UNIT

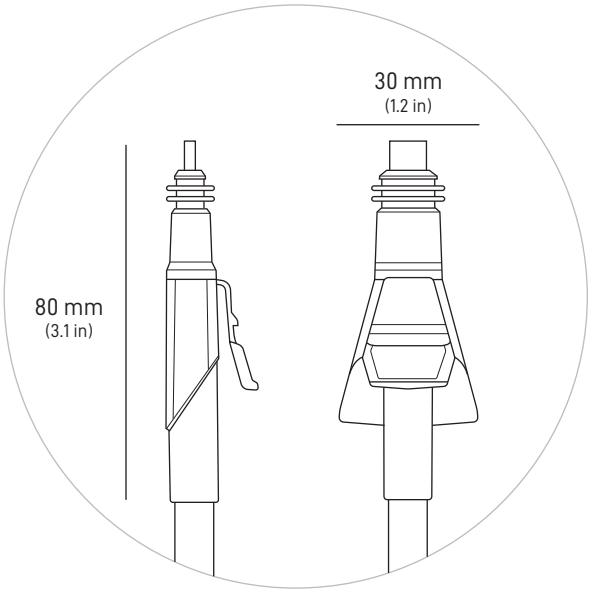


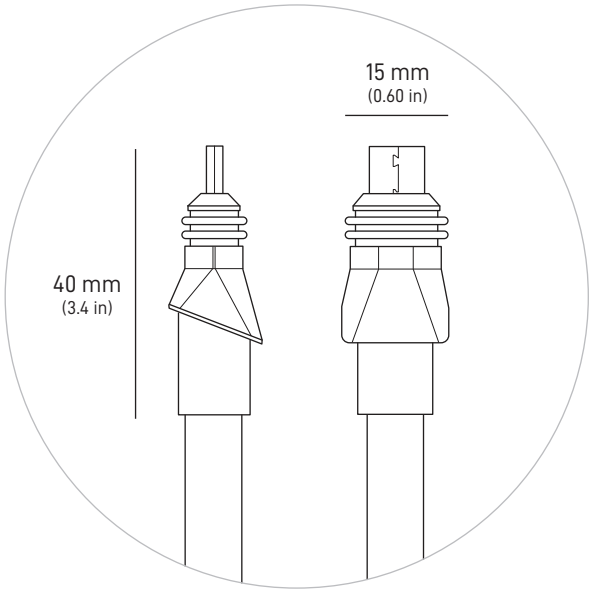


Environmental Rating	IP56
Operating Temperature	-30°C to 50°C (-22 to 122°F)
Weight	1.5kg (3lbs)
Grounding	Dedicated Earth Terminal
Power Specifications	100-240V - 6.3A 50 - 60 Hz
Mounting	Included Wall Mount

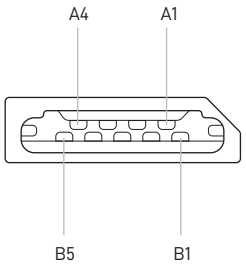
HIGH PERFORMANCE STARLINK CABLE



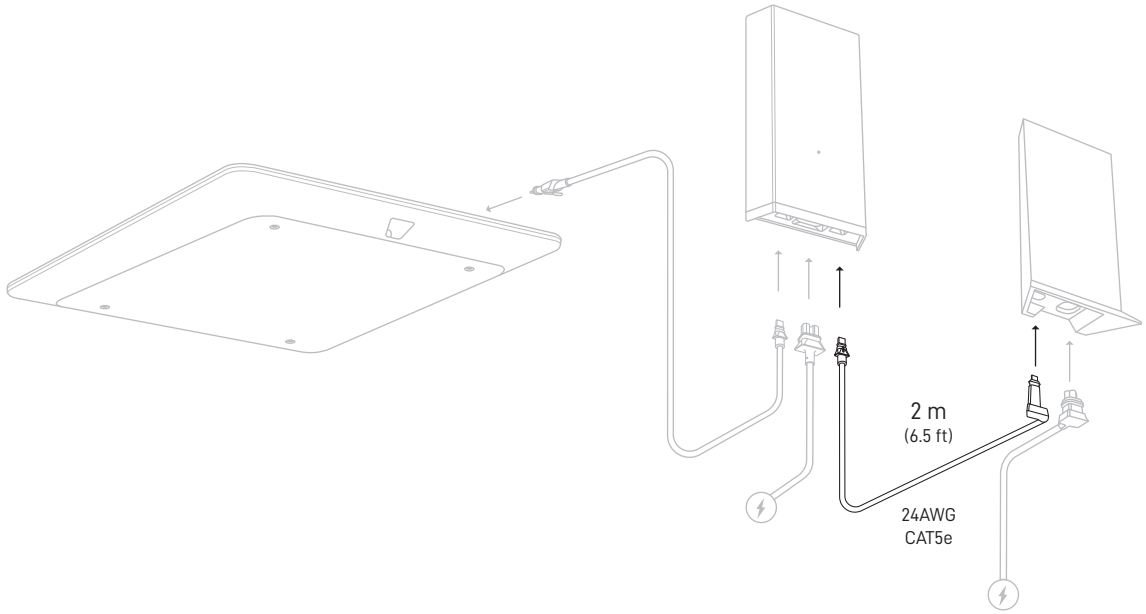


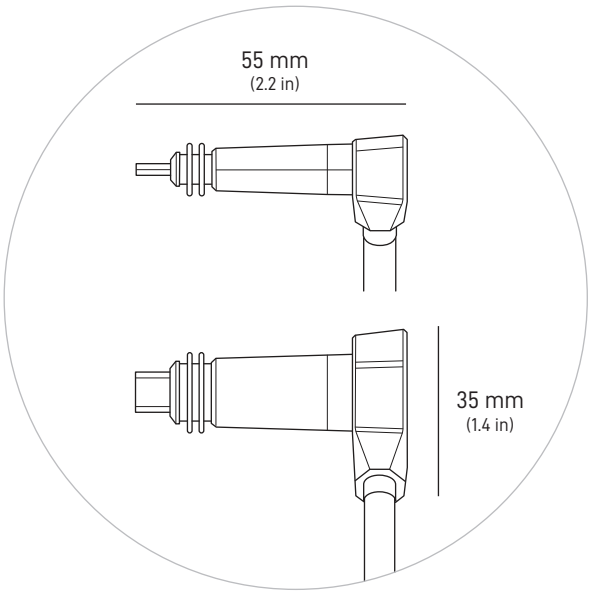


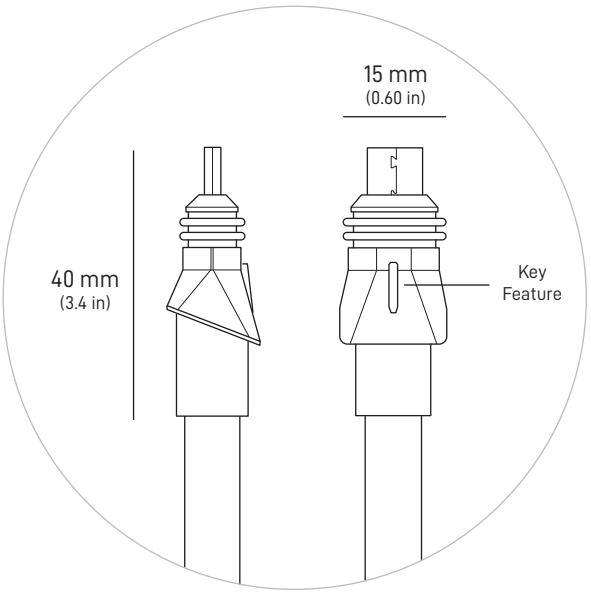
End	Pin	Wire Color	Pin	End
Dish	A1	Green	A1	Power Supply
	A2	Yellow	A2	
	A3	Blue	A3	
	A4	White	A4	
	B1	Orange	B1	
	B2	Purple	B2	
	B3	Brown	B3	
	B4	Gray	B4	
	B5	Shield / Shell	B5	



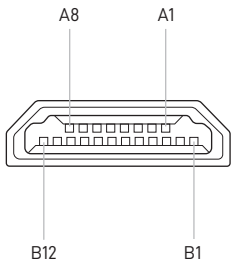
HIGH PERFORMANCE ROUTER CABLE



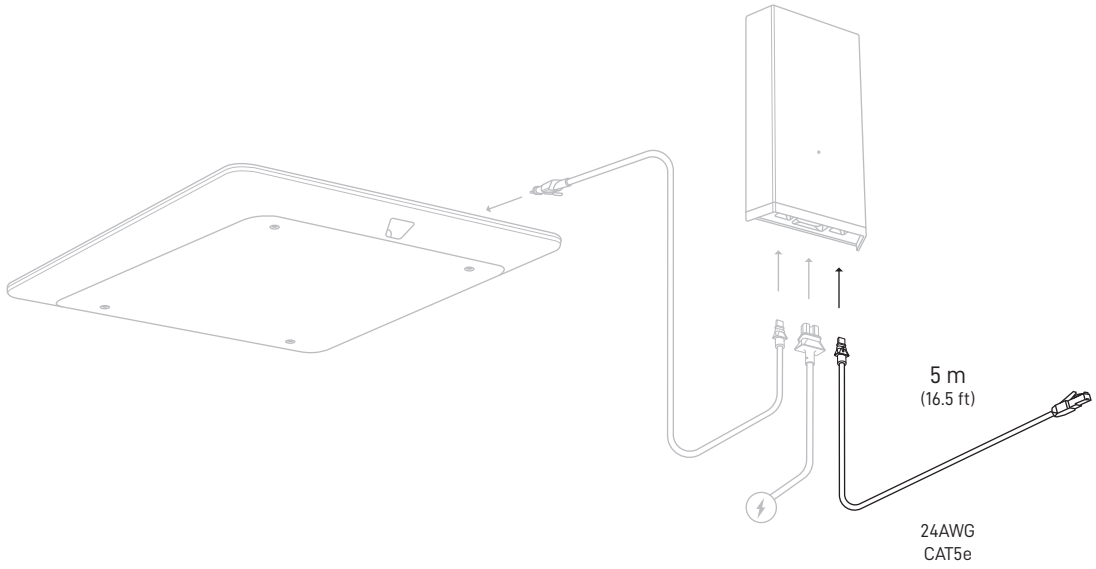


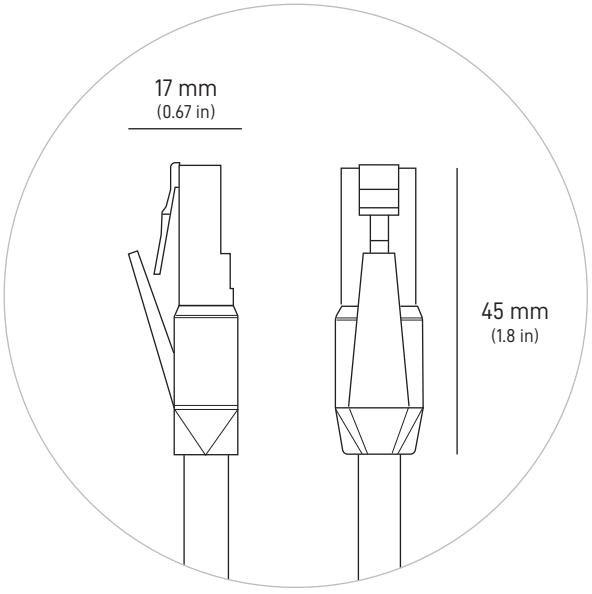


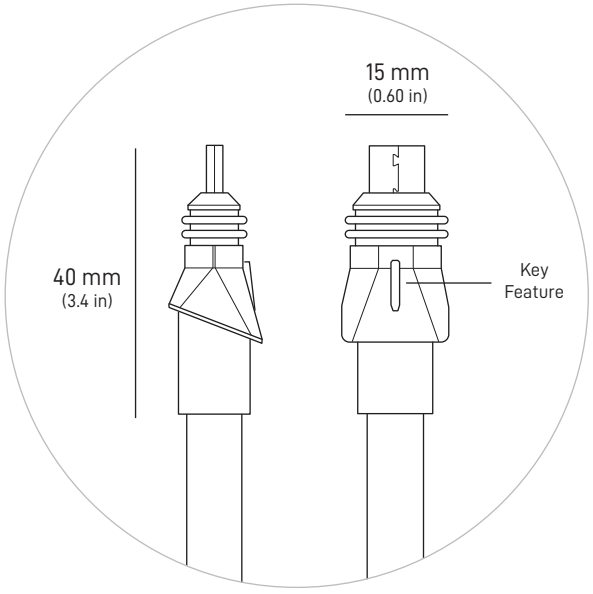
End	Pin	Ethernet Pin	Wire Color	Pin	End
	A1, A2	B+	Orange White	A1, A2	
	A3, A4	B-	Orange	A3, A4	
	A5, A6	A+	Green White	A5, A6	
	A7, A8	A-	Green	A7, A8	
	B1, B2	--	N / C	B1, B2	
	B3, B4	--	N / C	B3, B4	
Wi-Fi	B5	D+	Brown White	B5	Power Supply
	B6	D-	Brown	B6	
	B7	C-	Blue White	B7	
	B8	C+	Blue	B8	
	B9, B10	--	N / C	B9, B10	
	B11, B12	--	N / C	B11, B12	
	Shield Can		Drain Wire	Shell	



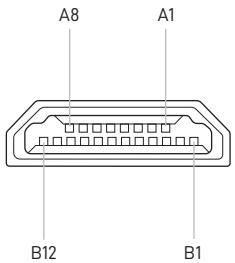
HIGH PERFORMANCE ETHERNET CABLE







End	Pin	Ethernet Pin	Wire Color	Pin	End
	A1, A2	B+	Orange White	A1, A2	
	A3, A4	B-	Orange	A3, A4	
	A5, A6	A+	Green White	A5, A6	
	A7, A8	A-	Green	A7, A8	
	B1, B2	--	N / C	B1, B2	
	B3, B4	--	N / C	B3, B4	
RJ45	B5	D+	Brown White	B5	Power Supply
	B6	D-	Brown	B6	
	B7	C-	Blue White	B7	
	B8	C+	Blue	B8	
	B9, B10	--	N / C	B9, B10	
	B11, B12	--	N / C	B11, B12	
	Shield Can		Drain Wire	Shell	



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

Appendix I: Photos of Visual Detections

PHOTOS OF PROTECTED SPECIES *SW MIKKELSEN*

Figure 1. VD #01 – Sperm whale – SW Mikkelsen

Figure 2. VD #01 – Sperm whale – SW Mikkelsen

Figure 3. VD #02 – Unidentified whale – SW Mikkelsen

Figure 4. VD #02 – Unidentified whale – SW Mikkelsen

Figure 5. VD#03 – Unidentified shelled Sea turtle – SW Mikkelsen

Figure 6. VD#04 – Dwarf sperm whales – SW Mikkelsen

Figure 7. VD#04 – Dwarf sperm whales – SW Mikkelsen

Figure 8. VD#06 – Sperm whale – SW Mikkelsen

Figure 9. VD#07 – Unidentifiable whale – SW Mikkelsen

Figure 10. VD#08 - Sperm whale – SW Mikkelsen

Figure 11. VD#10 - Sperm whale – SW Mikkelsen

Figure 12. VD#12 - Bottlenose dolphins – SW Mikkelsen

Figure 13. VD#13 - Unidentified dolphins - SW Mikkelsen

Figure 14: VD#14 - Sperm whales - SW Mikkelsen

Figure 15: VD#14 - Sperm whales - SW Mikkelsen

Figure 16: VD#15 - Clymene dolphins - SW Mikkelsen

Figure 17:VD#16 - Sperm whale - SW Mikkelsen

Figure 18: VD#16 - Sperm whale - SW Mikkelsen

Figure 19: VD#16 - Sperm whale - SW Mikkelsen

Figure 20: VD#20 - Bottlenose dolphins - SW Mikkelsen

Figure 21: VD#22 - Loggerhead sea turtle - SW Mikkelsen

Figure 22: VD#22 - Loggerhead sea turtle - SW Mikkelsen

Figure 23: VD#23 - Loggerhead sea turtle - SW Mikkelsen

Figure 24: VD#24 -Pantropical spotted dolphins - SW Mikkelsen

Figure 25: VD#25 -Pantropical spotted dolphins - SW Mikkelsen

Figure 26: VD#26 -Pantropical spotted dolphins - SW Mikkelsen

Figure 27: VD#27 - Giant Manta Ray - SW Mikkelsen

Figure 28:VD#28 Unidentifiable shelled sea turtle - SW Mikkelsen

Figure 29:VD#29 -Pantropical spotted dolphins - SW Mikkelsen

Figure 30: VD#30 - Clymene dolphins - SW Mikkelsen

Figure 31: VD#30 - Clymene dolphins - SW Mikkelsen

Figure 32: VD#31 - Pantropic spotted dolphins - SW Mikkelsen

Figure 33: VD#32 - Risso's dolphins - SW Mikkelsen

Figure 34: VD#34 - Pantropical spotted dolphins - SW Mikkelsen

Figure 35: VD#35 - Risso's dolphins - SW Mikkelsen

Figure 36: VD#36 - Pantropical spotted dolphins - SW Mikkelsen

Figure 37: VD#38 - Pantropical spotted dolphins - SW Mikkelsen

Figure 38: VD#39 - Green sea turtle - SW Mikkelsen

PHOTOS OF PROTECTED SPECIES *SW GALLIEN*

Figure 39: VD#1 – Common bottlenose dolphins– SW Gallien

Figure 40: VD#4 – Sperm whales– SW Gallien

Figure 41: VD#7 - Sperm whale– SW Gallien

Figure 42: VD#10 – Green sea turtle– SW Gallien

Figure 43: VD#11 – Green sea turtle– SW Gallien

Figure 44: VD#13 – Unidentifiable dolphins– SW Gallien

Figure 45: VD#14 – Green sea turtle - SW Gallien

Figure 46: VD#15 – Green sea turtle– SW Gallien

Figure 47: VD#16 – Green sea turtle– SW Gallien

Figure 48: VD#17 – Clymene dolphins– SW Gallien

Figure 49: VD#18 – Sperm whales– SW Gallien

Figure 50: VD#19 – Unidentifiable shelled sea turtle – SW Gallien

Figure 51: VD#20 – Unidentifiable dolphins – SW Gallien

Figure 52: VD#21 -Loggerhead Sea turtle – SW Gallien

Figure 53: VD#23 – Sperm whale – SW Gallien

Figure 54: VD#24 – Unidentified shelled turtle– SW Gallien

Figure 55: VD#27 – Unidentified dolphin– SW Gallien

Figure 56: VD#31 – Common bottlenose dolphins– SW Gallien

Figure 57: VD#32 – Common bottlenose dolphins– SW Gallien

Figure 58: VD#33 – Giant Manta Ray – SW Gallien

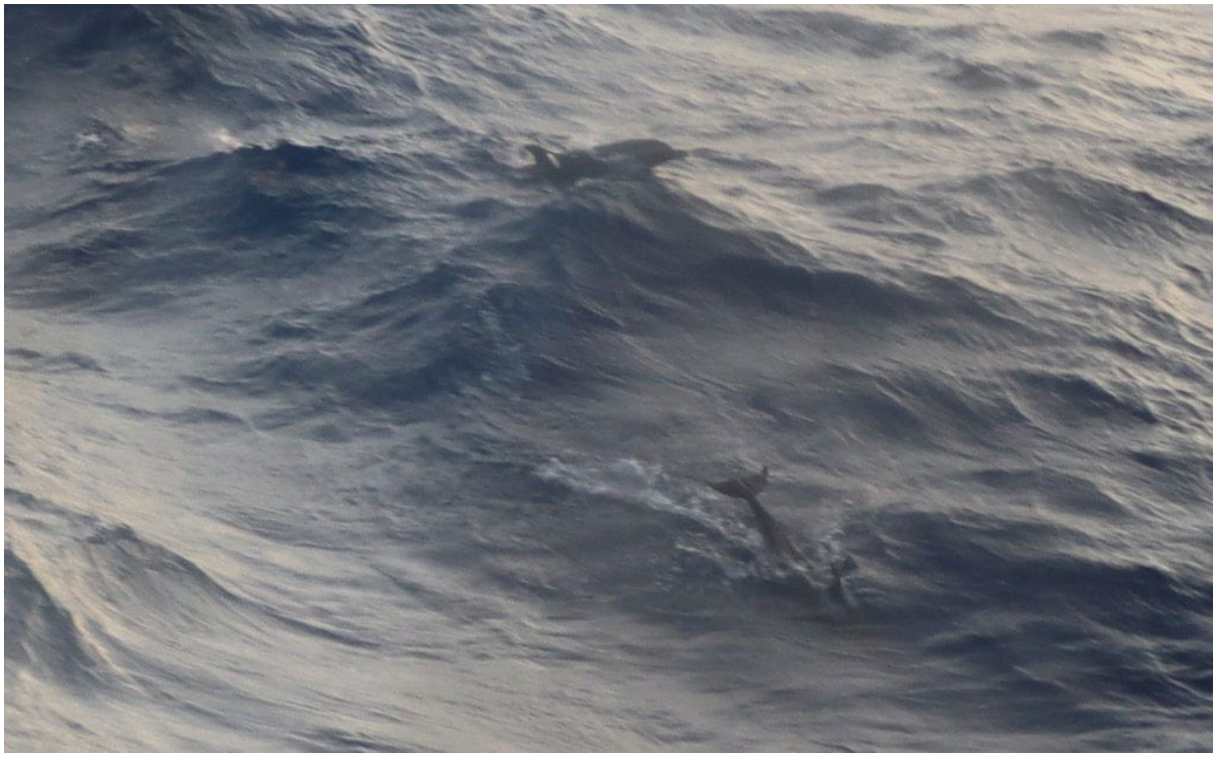


Figure 59: VD#35 – Clymene dolphins – SW Gallien

Appendix J: Screenshots of Acoustic Detections

SCREENSHOTS OF ACOUSTIC DETECTIONS ON *SW MIKKELSEN*

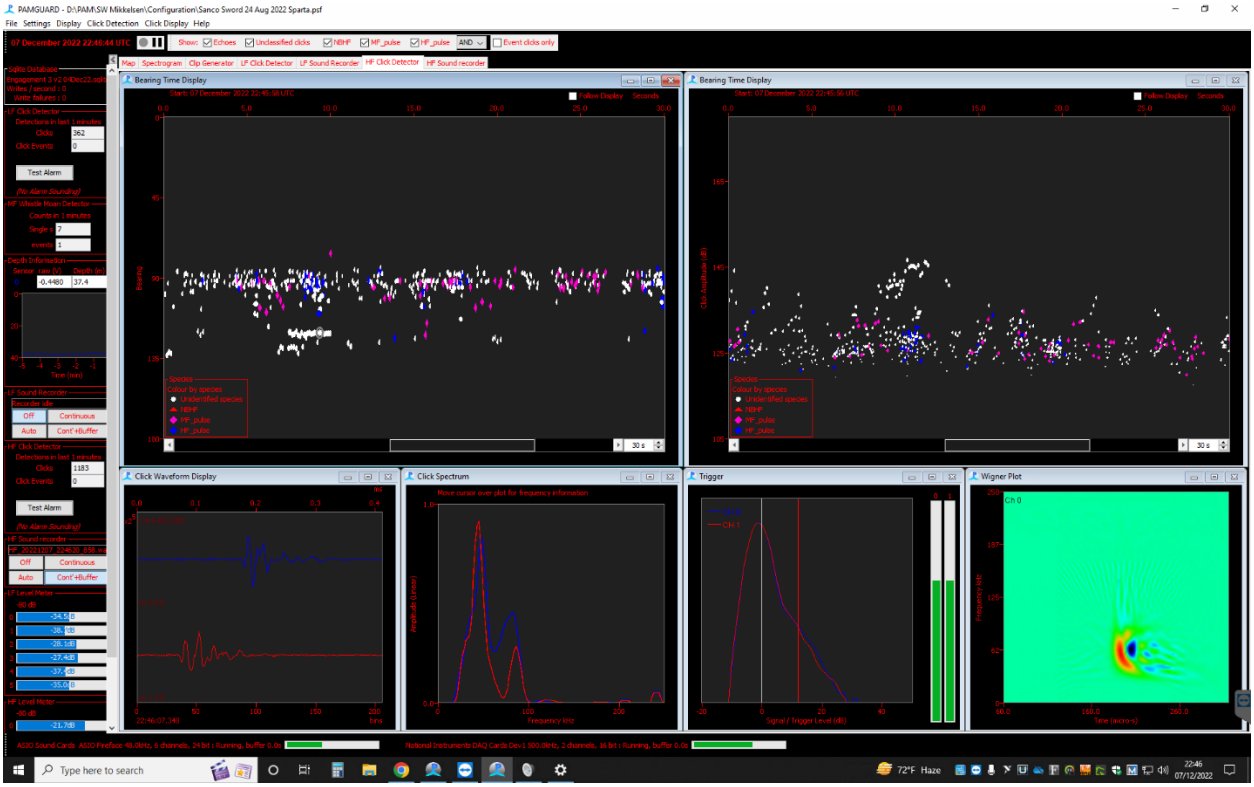


Figure 1. SWMAD#01 – Click trains of unidentifiable dolphins on PAMGuard's HF click detector

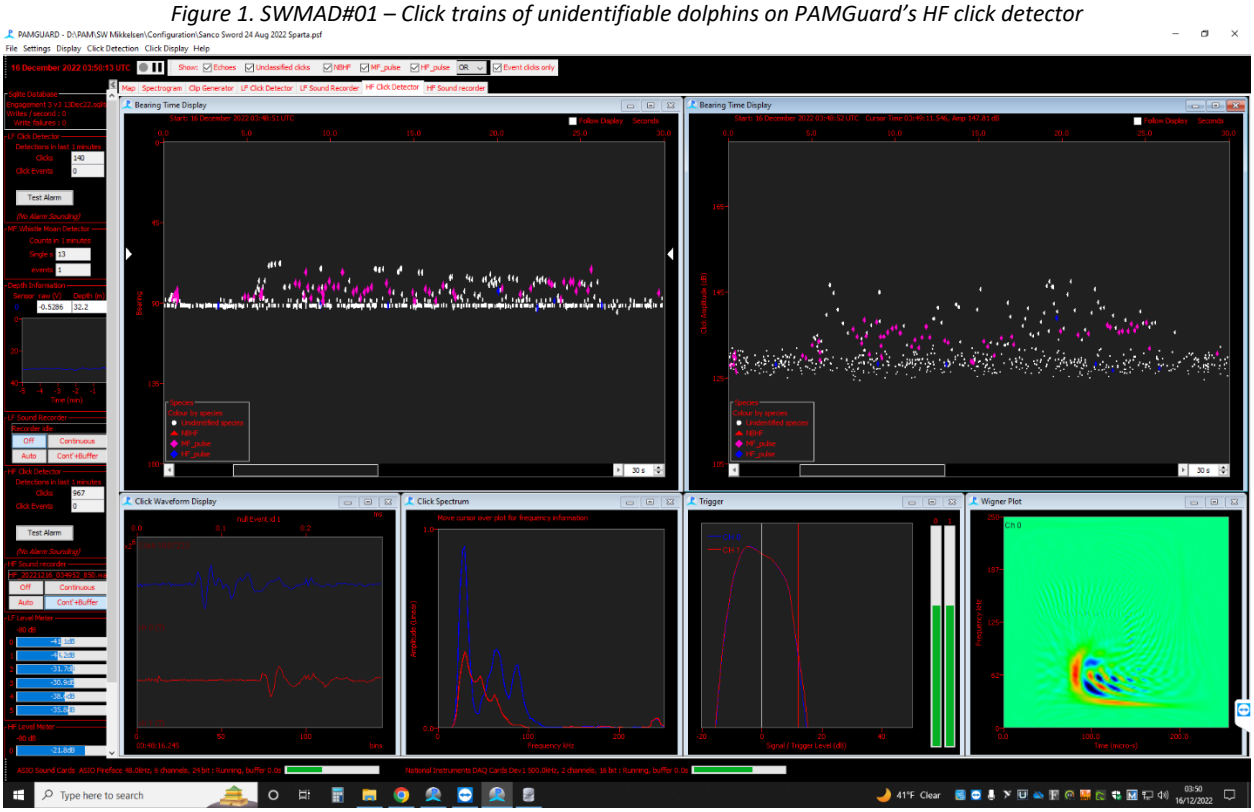


Figure 2. SWMAD#02 – Click trains of unidentifiable dolphins on PAMGuard's HF click detector

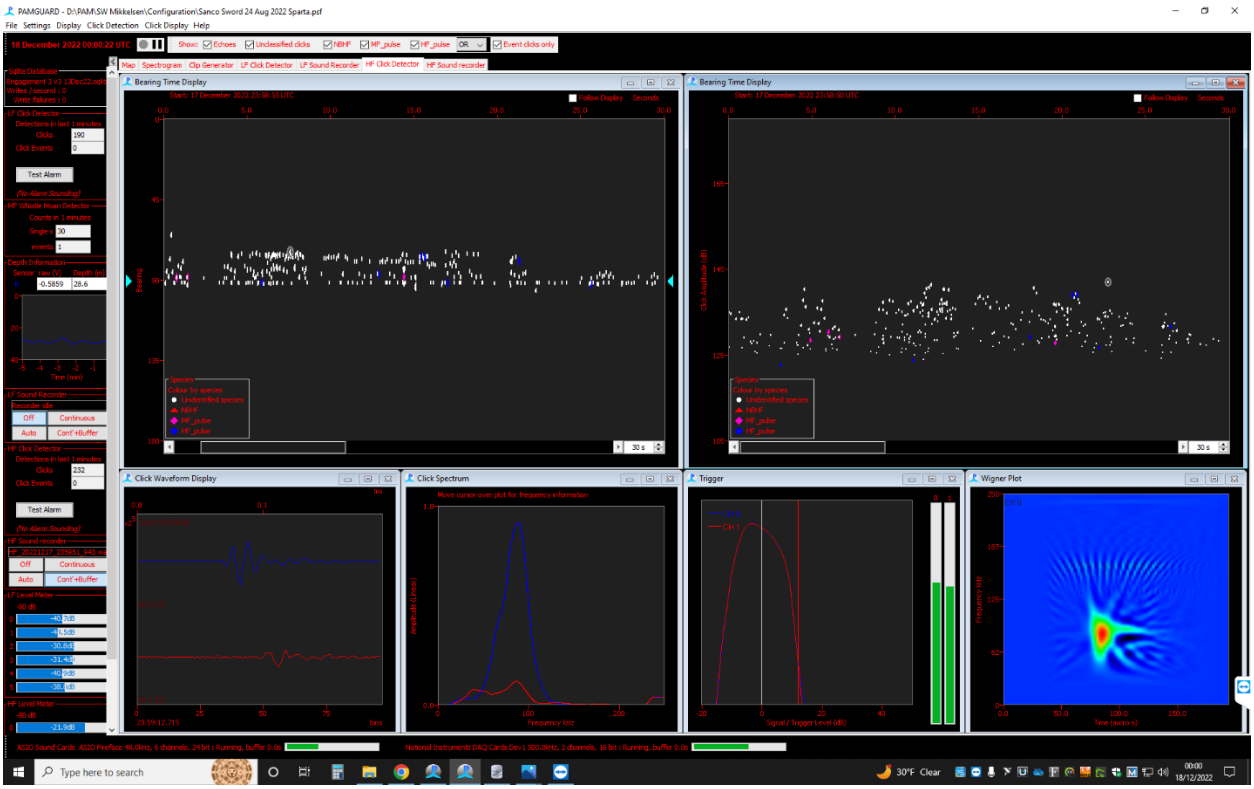


Figure 3. SWMAD#03 – Click trains of unidentifiable dolphins on PAMGuard's HF click detector

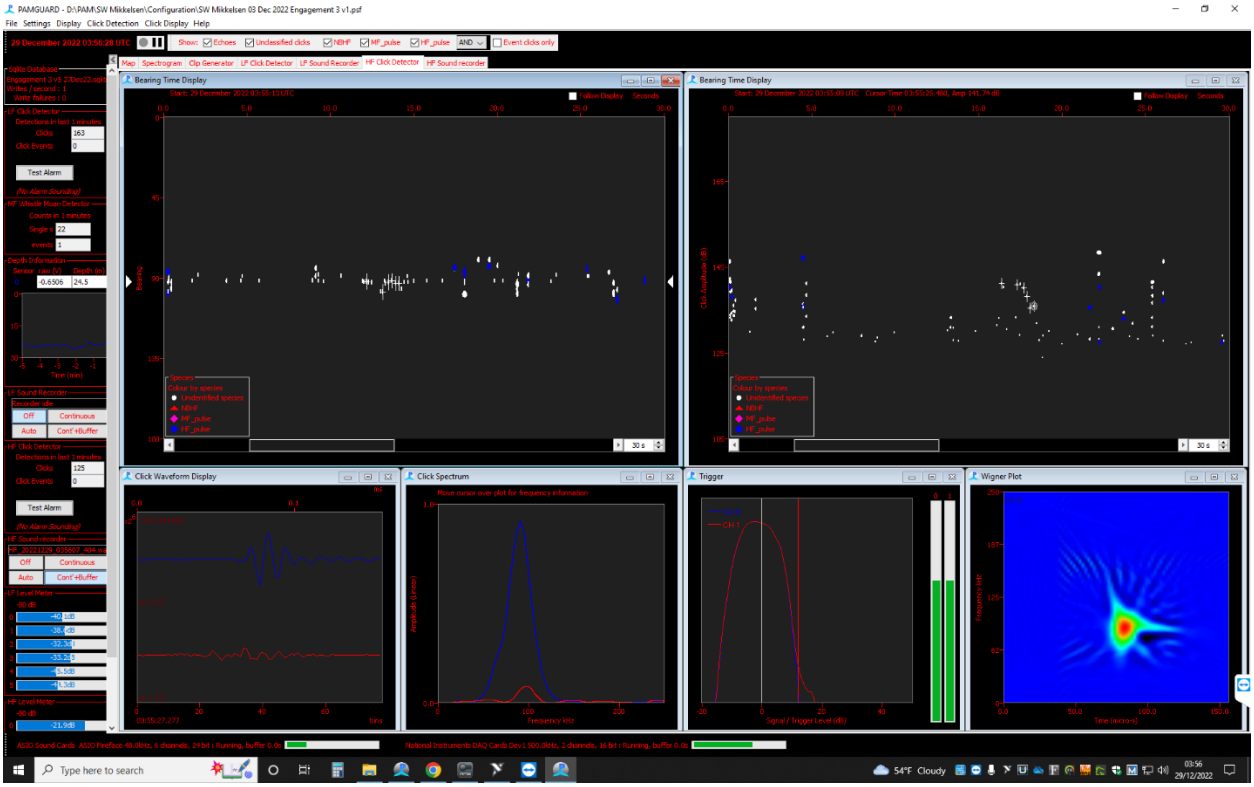


Figure 4. SWMAD#04 – Click trains of unidentifiable dolphins on PAMGuard's HF click detector

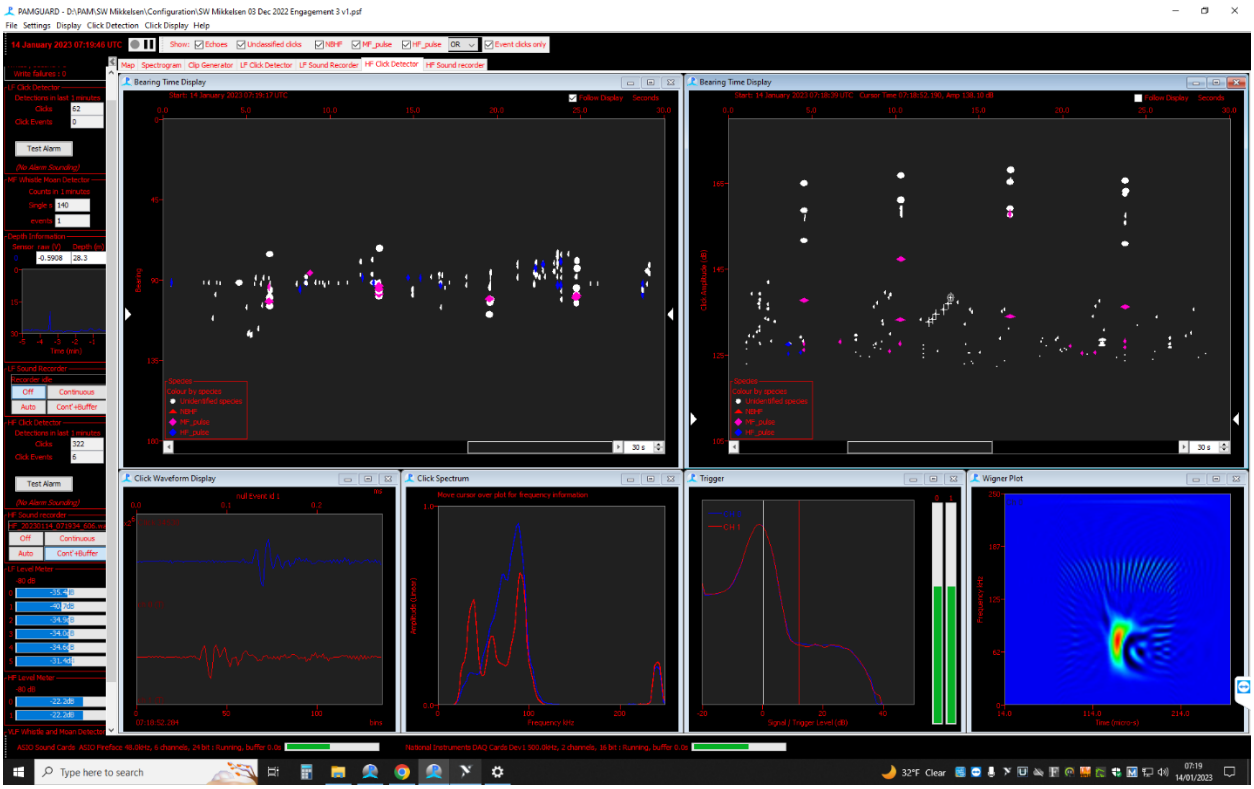


Figure 5: SWMAD#05 – Click trains of unidentifiable dolphins on PAMGuard's HF click detector

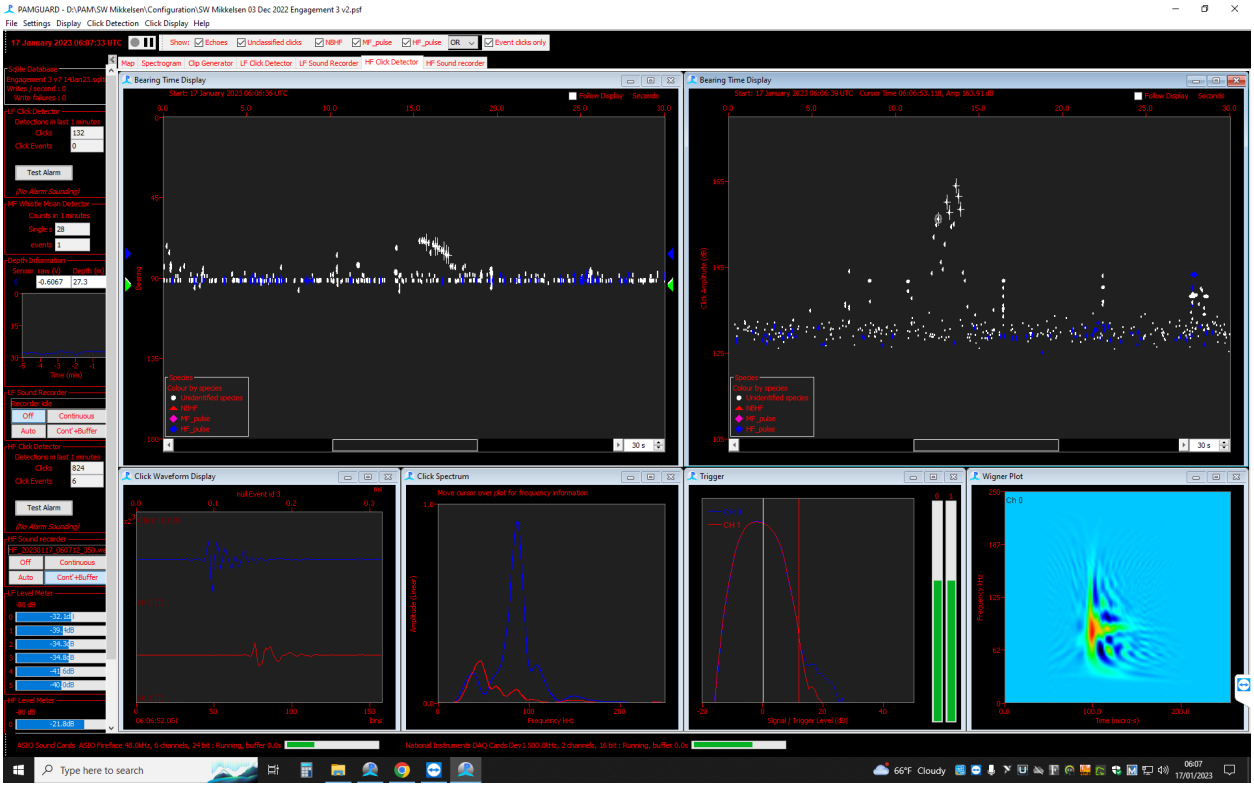


Figure 6: SWMAD#06 – Click trains of unidentifiable dolphins on PAMGuard's HF click detector

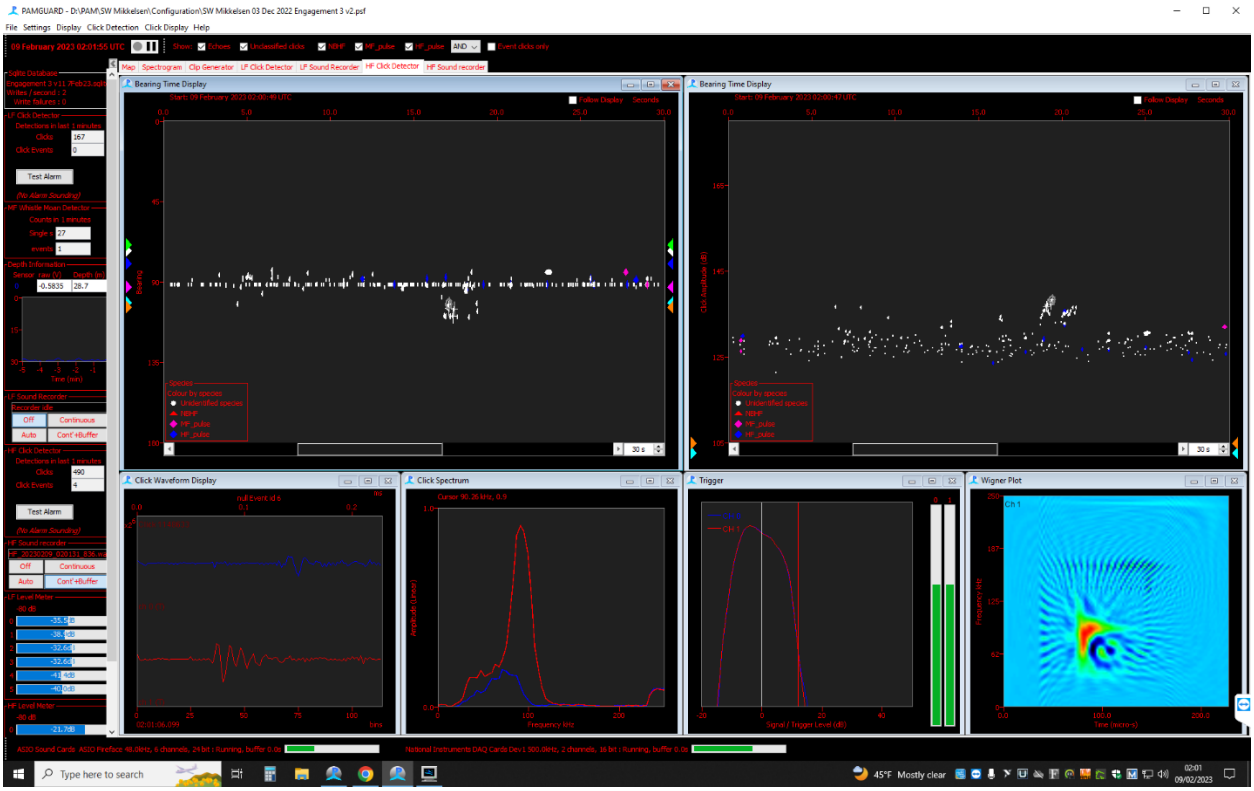


Figure 7: SWMAD#07 – Click trains of unidentifiable dolphins on PAMGuard's HF click detector

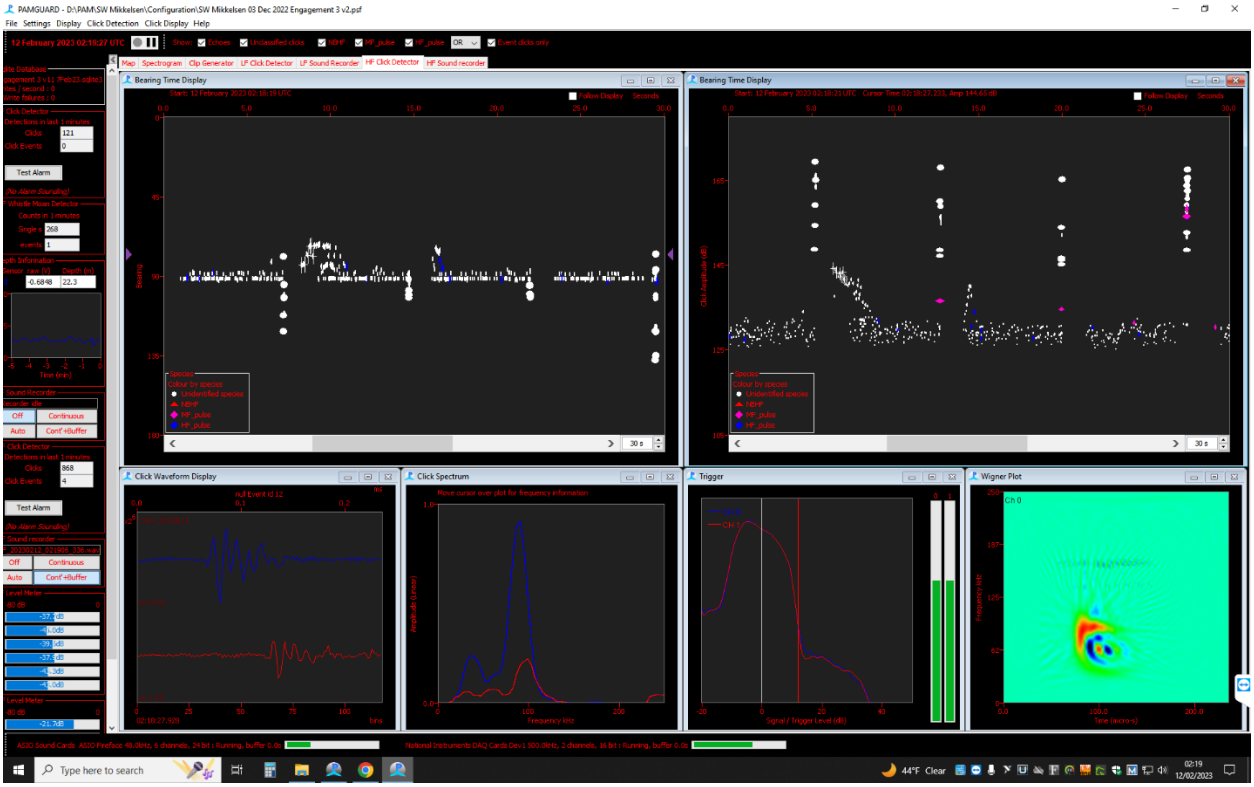


Figure 8: SWMAD#08 – Click trains of unidentifiable dolphins on PAMGuard's HF click detector

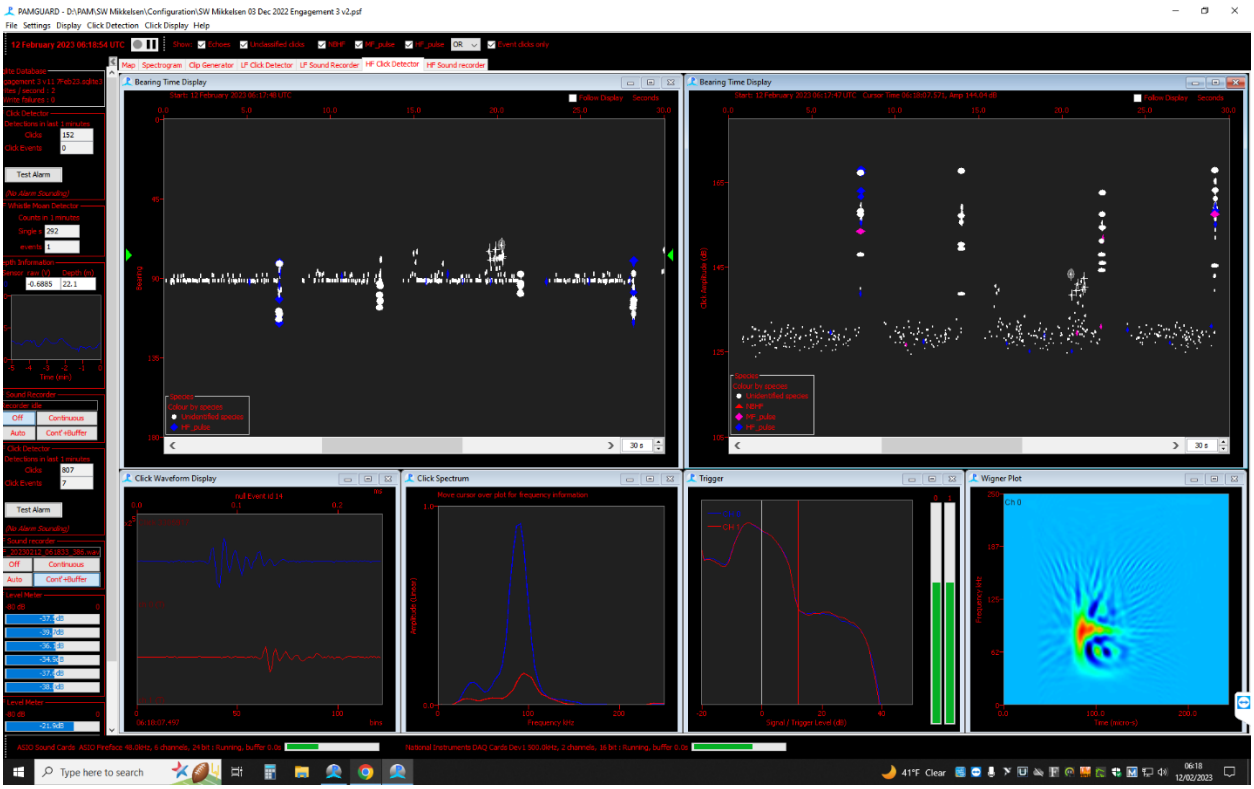


Figure 9:SWMAD#09 – Click trains of unidentifiable dolphins on PAMGuard's HF click detector

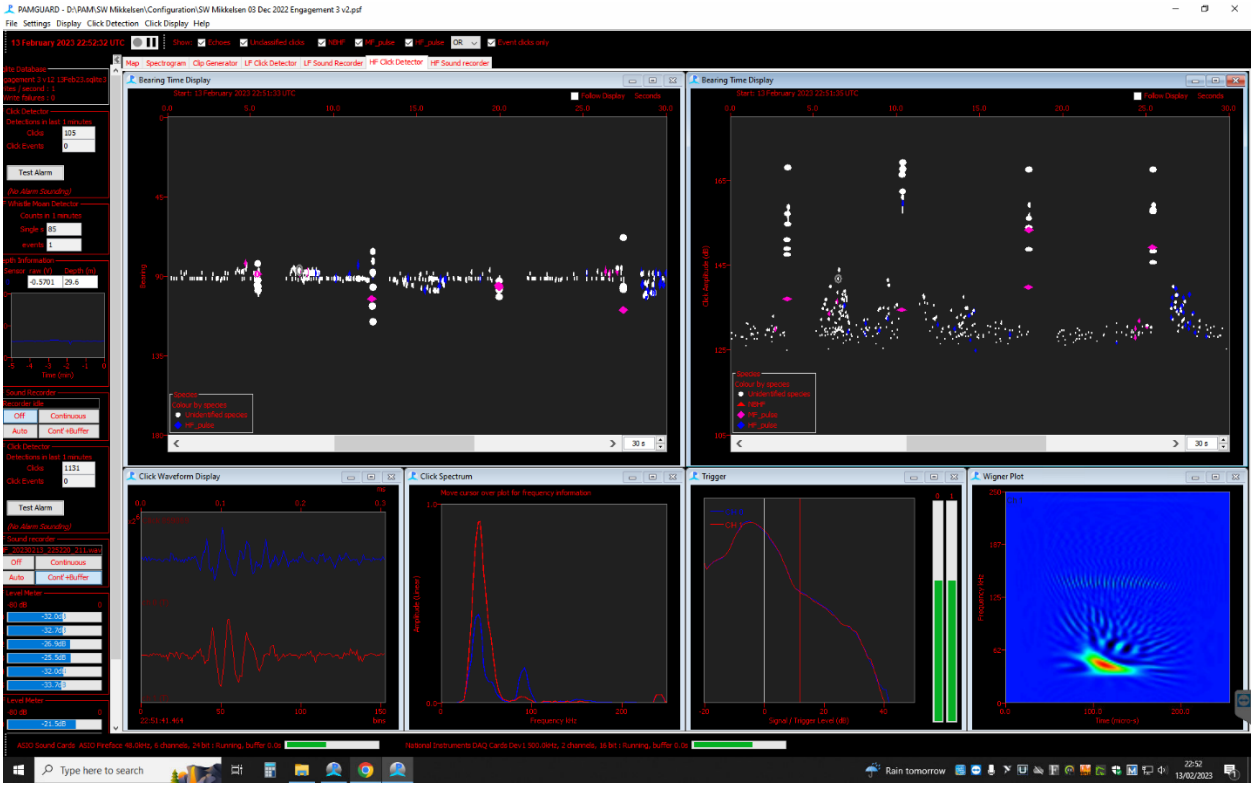


Figure 10: SWMAD#10 – Click trains of unidentifiable dolphins on PAMGuard's HF click detector

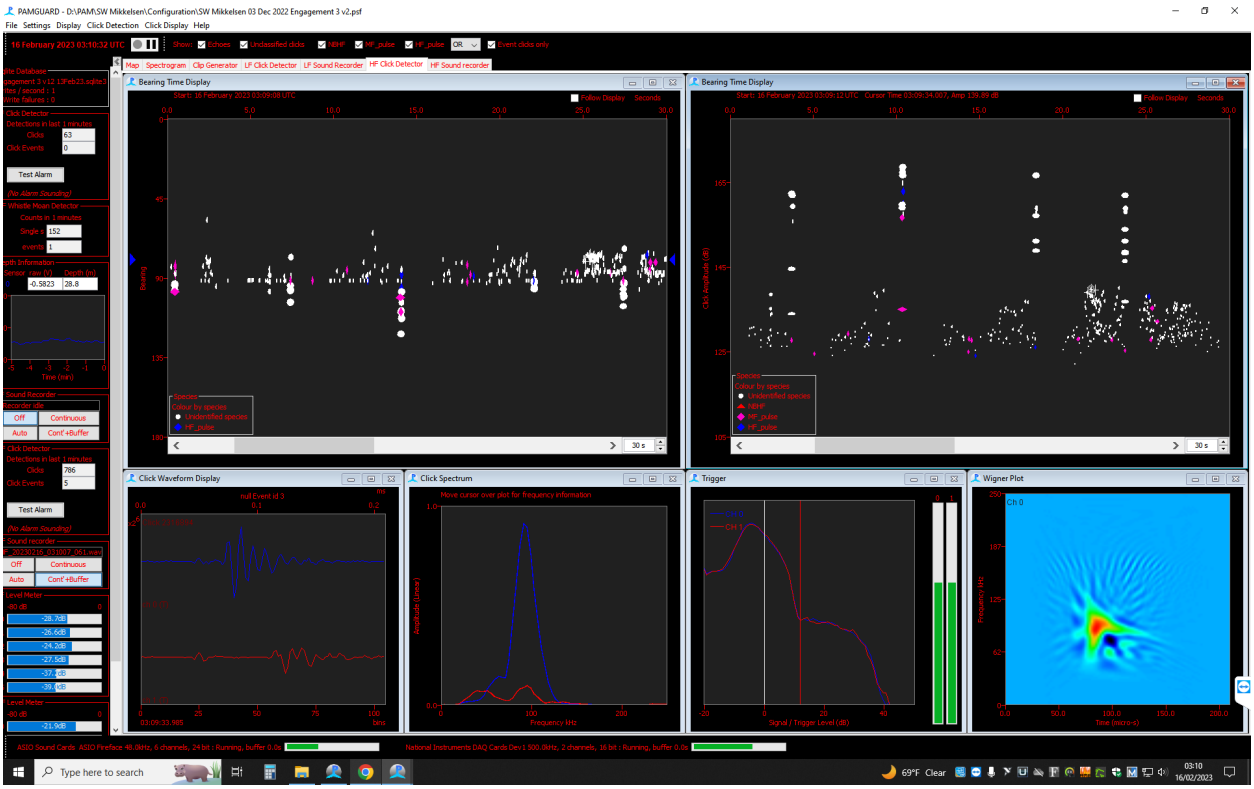


Figure 11: SWMAD#11 – Click trains of unidentifiable dolphins on PAMGuard's HF click detector

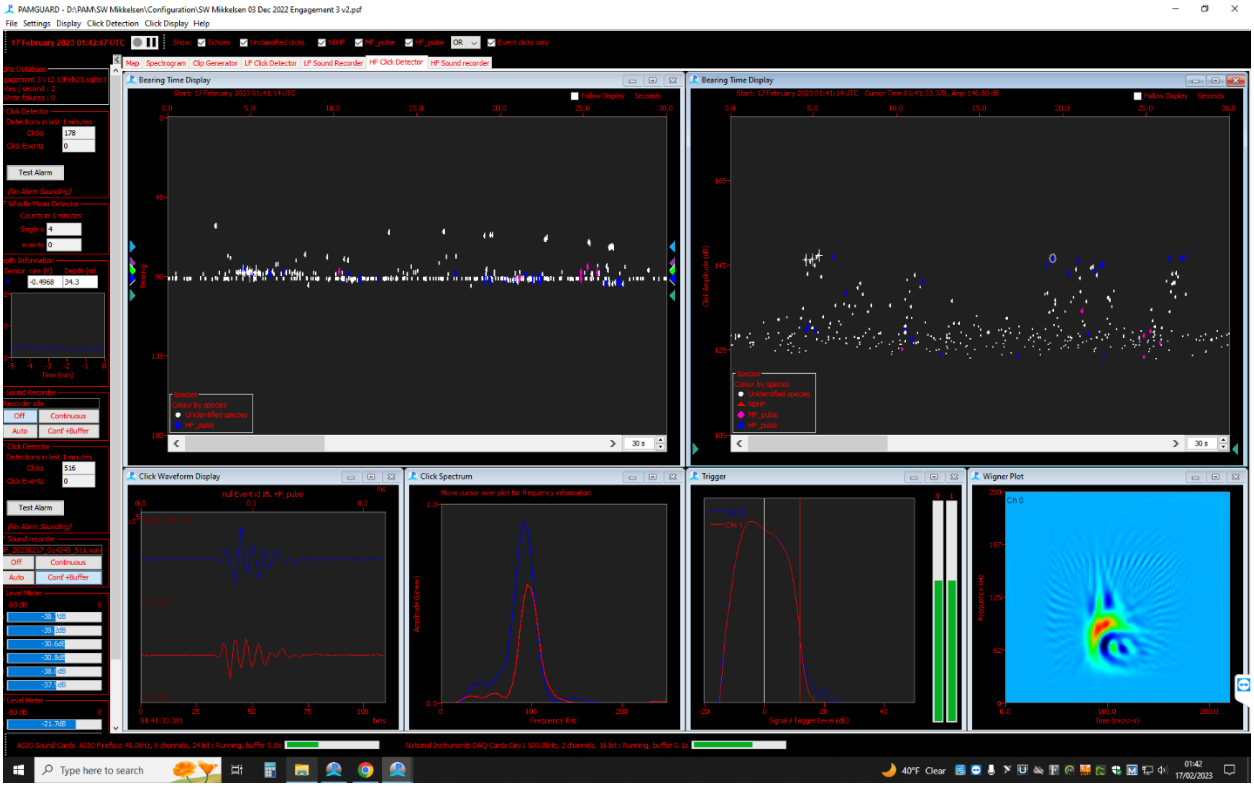


Figure 12: SWMAD#12 – Click trains of unidentifiable dolphins on PAMGuard's HF click detector

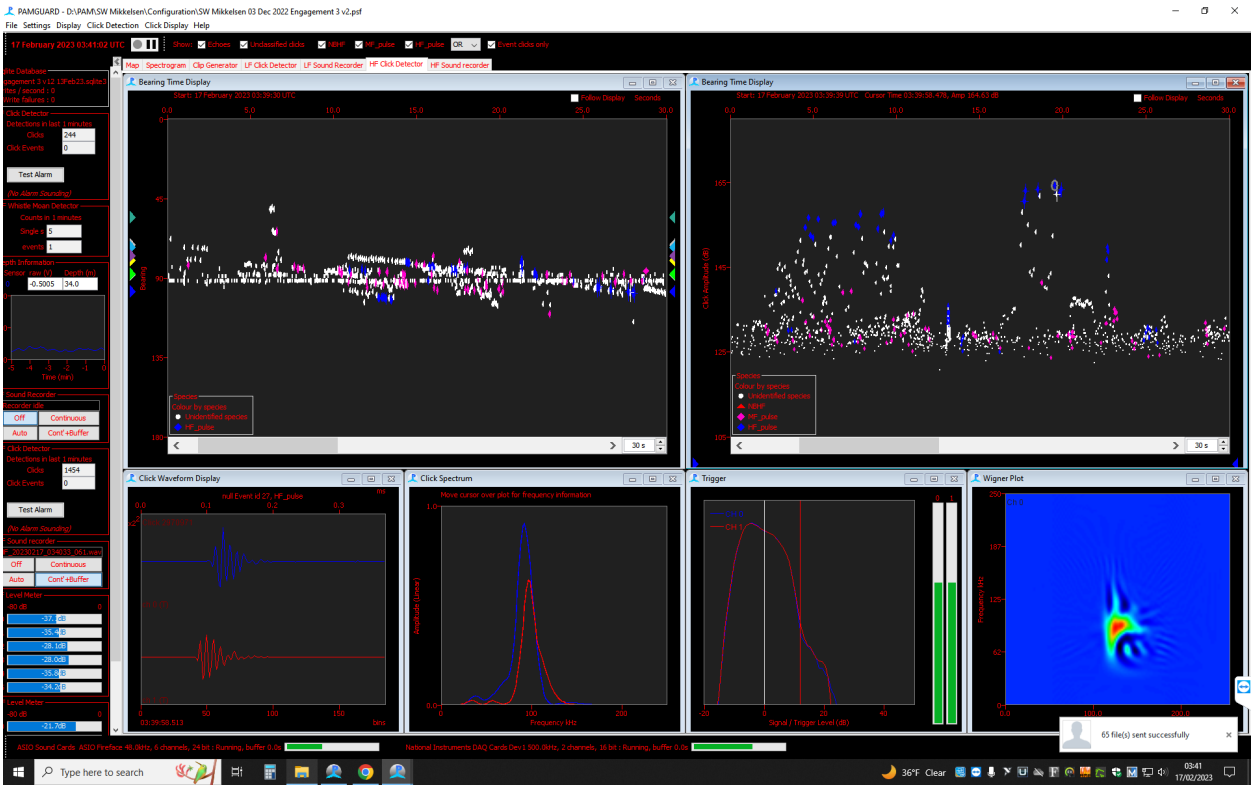


Figure 13: SWMAD#13 – Click trains of unidentifiable dolphins on PAMGuard's HF click detector

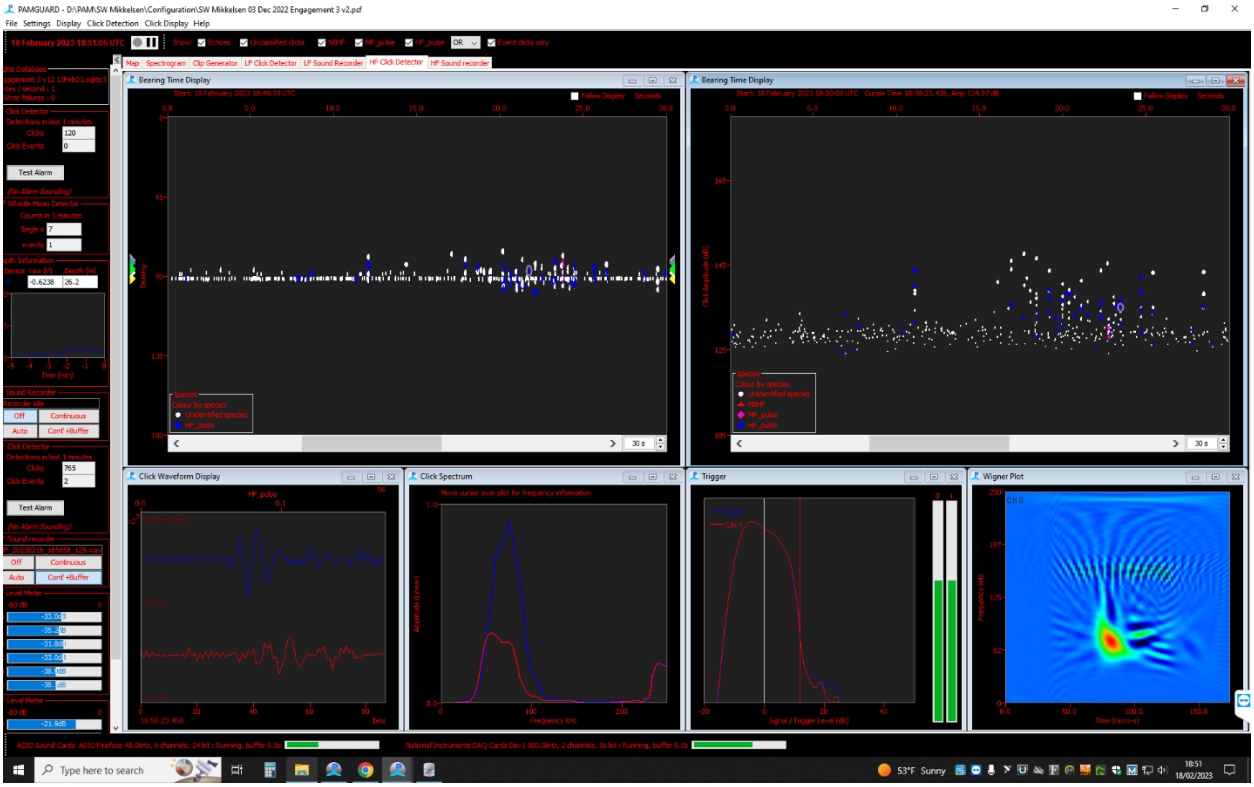


Figure 14: SWMAD#14 – Click trains of unidentifiable dolphins on PAMGuard's HF click detector

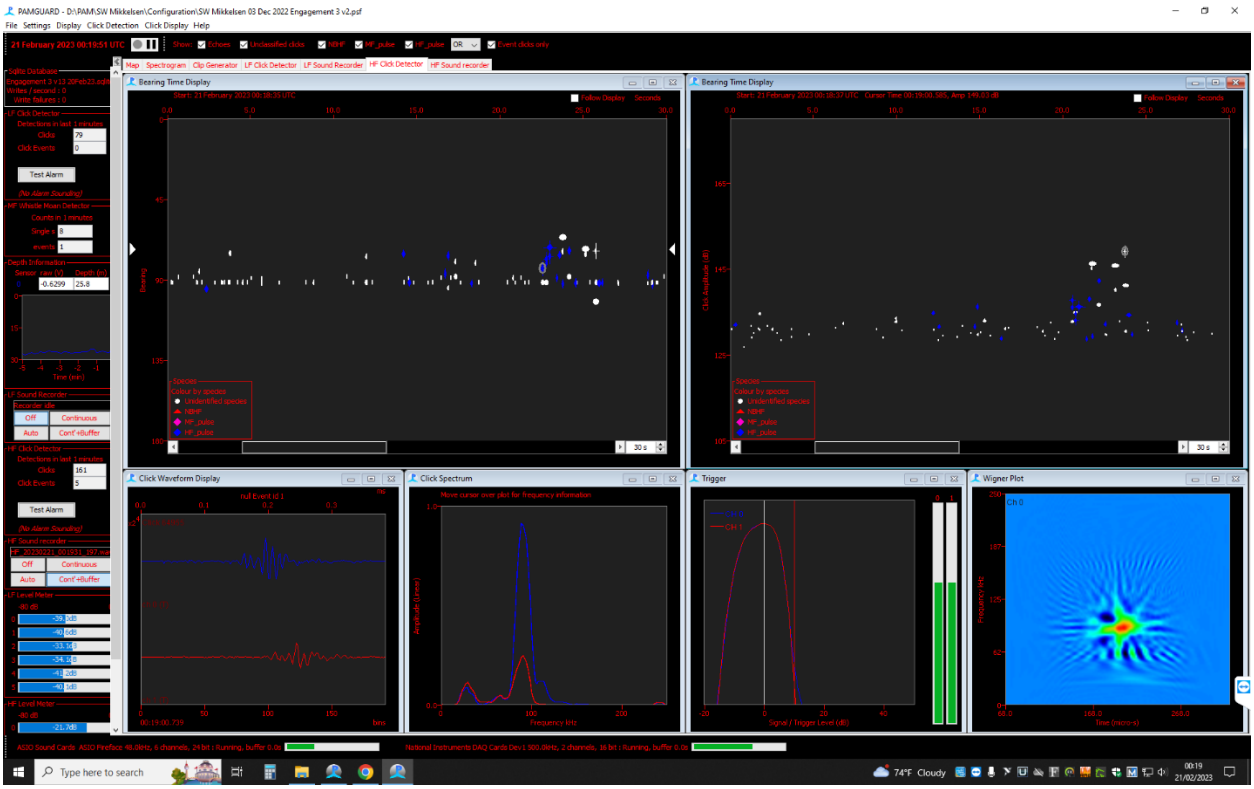


Figure 15:SWMAD#15 – Click trains of unidentifiable dolphins on PAMGuard's HF click detector

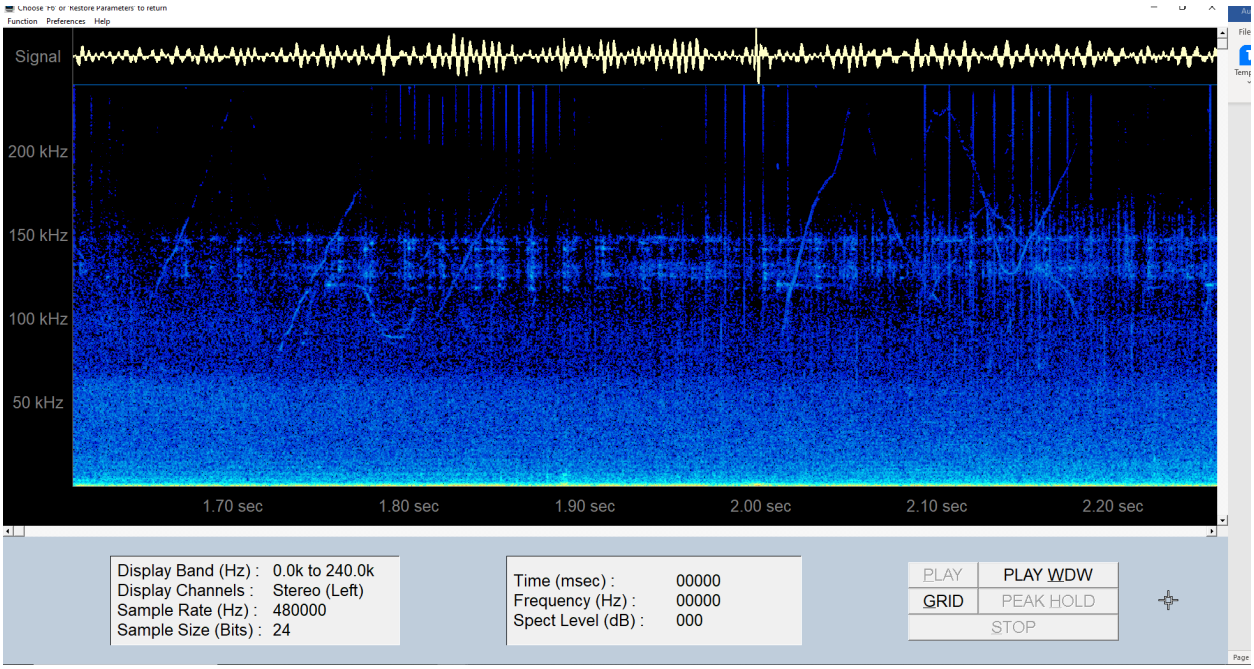


Figure 16: SWMAD#16 LF multi-classified whistles and click of unidentified dolphins on Spectrogram 16

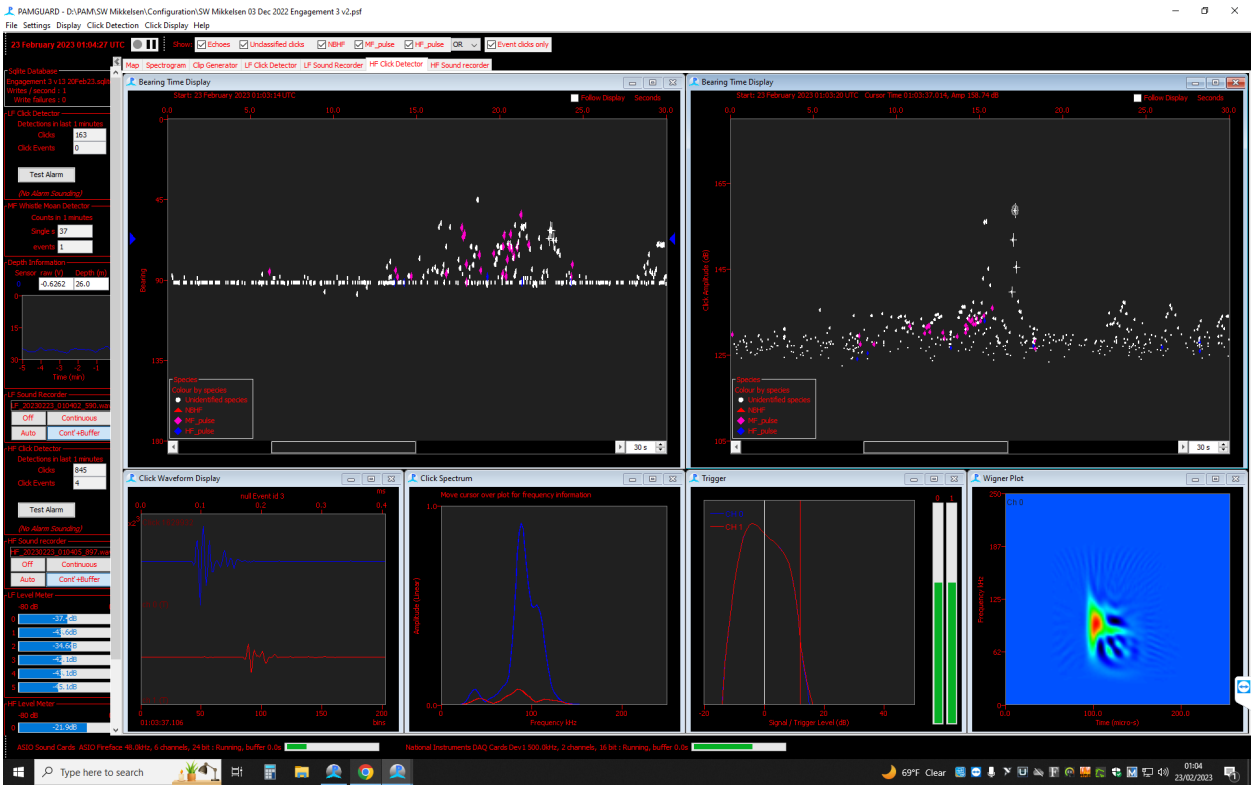


Figure 17: SWMAD#16 – Click trains of unidentifiable dolphins on PAMGuard's HF click detector

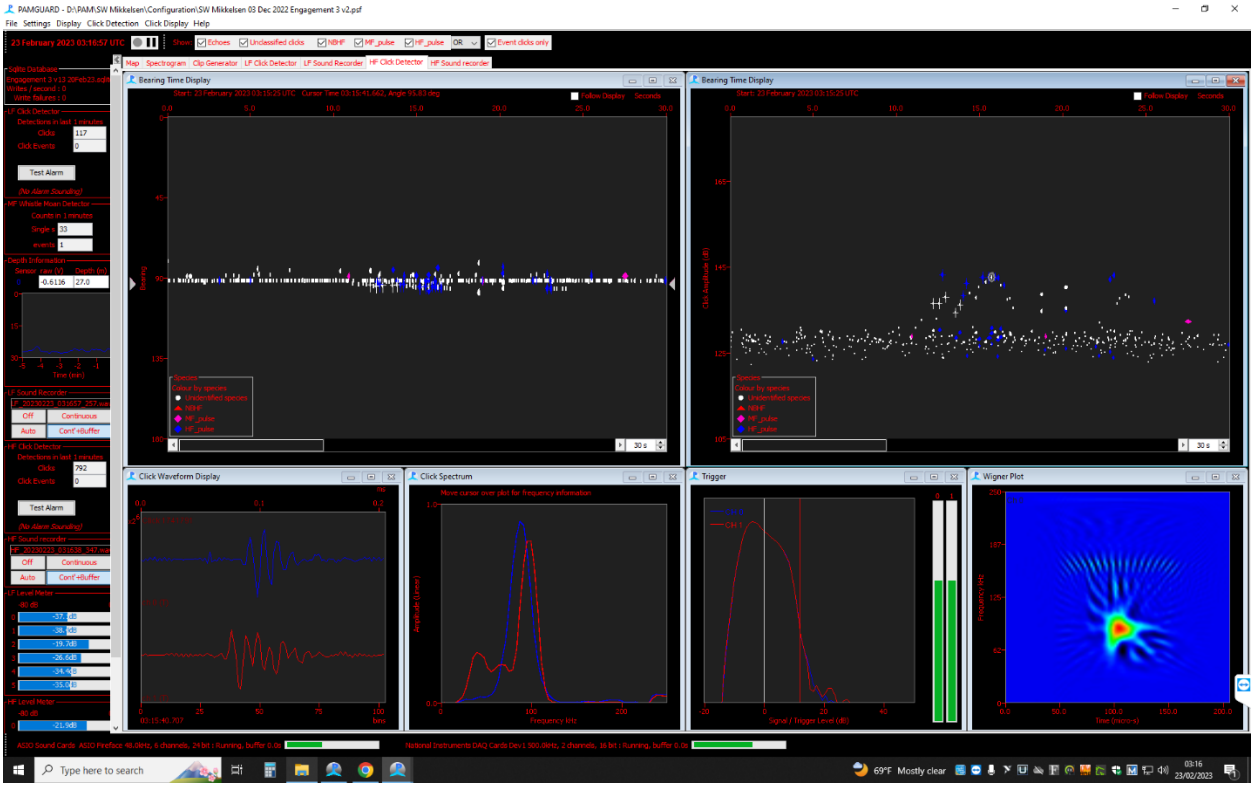


Figure 18: SWMAD#17 – Click trains of unidentifiable dolphins on PAMGuard's HF click detector

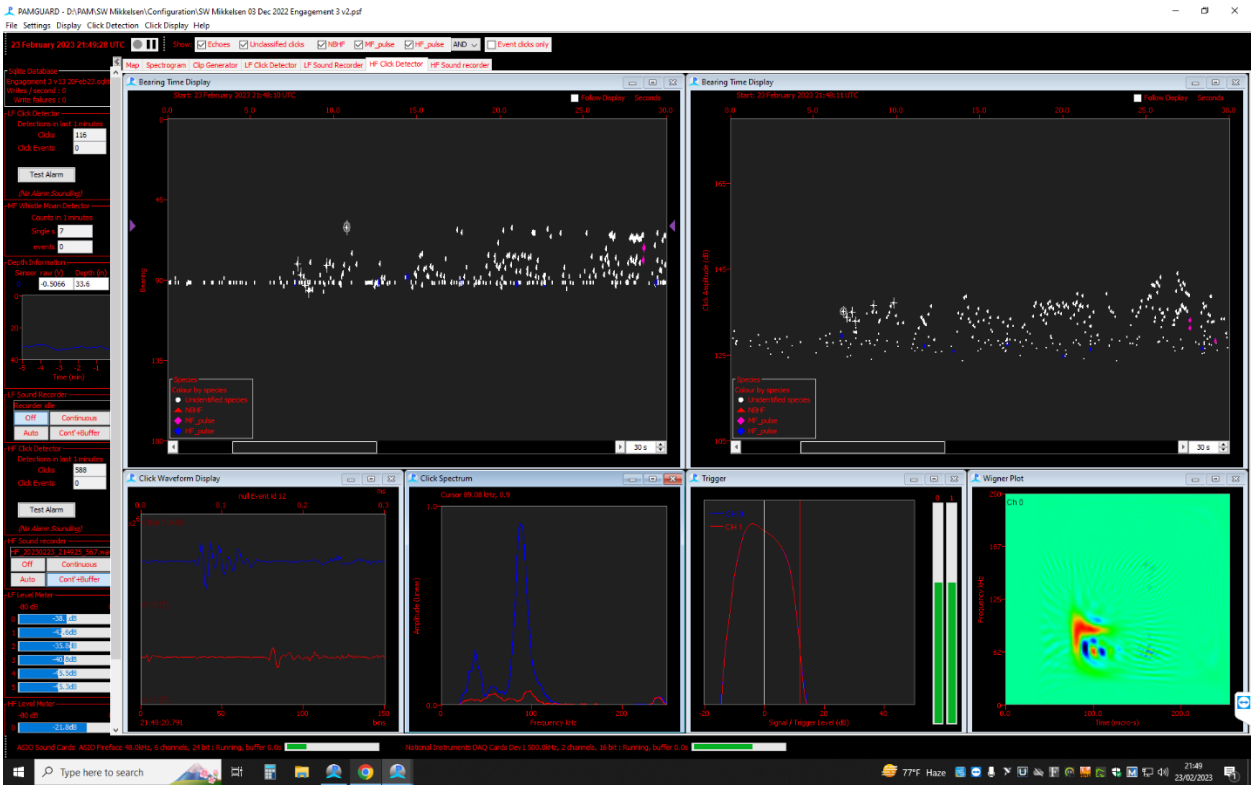


Figure 19: SWMAD#18 – Click trains of unidentifiable dolphins on PAMGuard's HF click detector

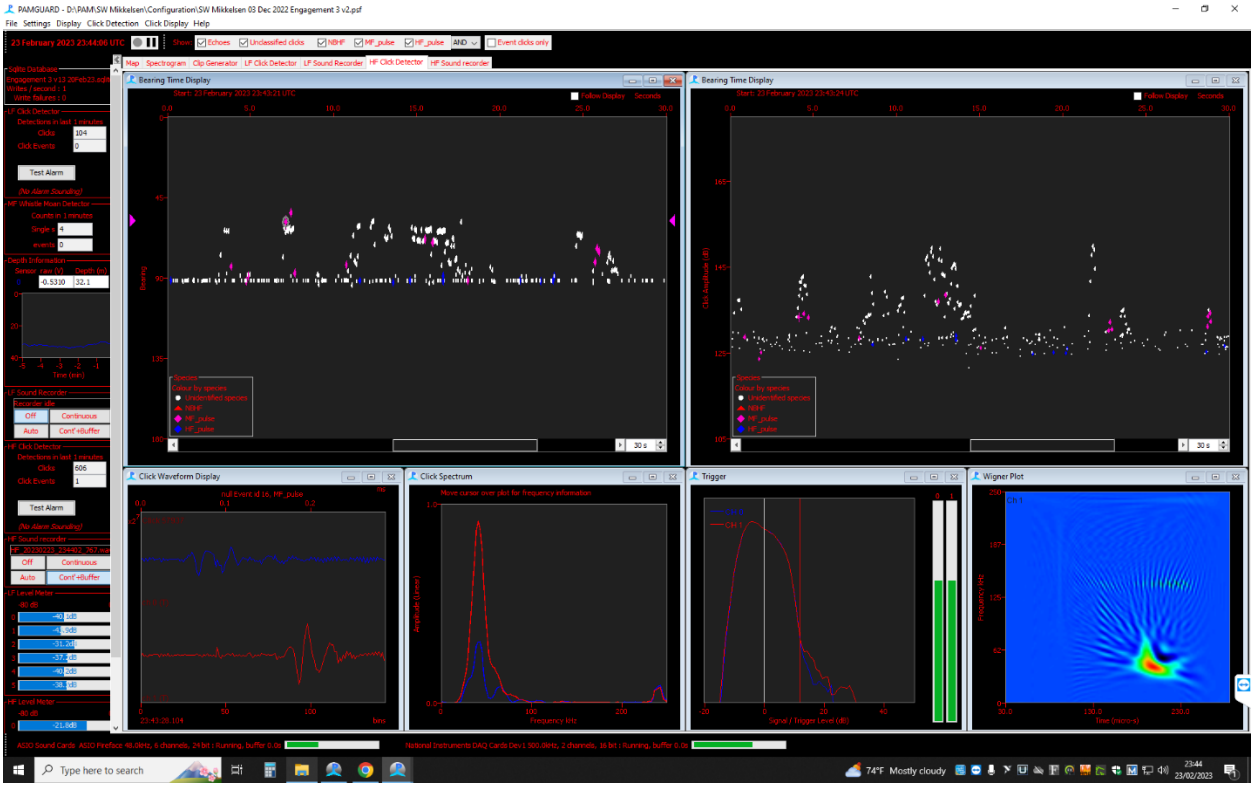


Figure 20: SWMAD#19 – Click trains of unidentifiable dolphins on PAMGuard's HF click detector

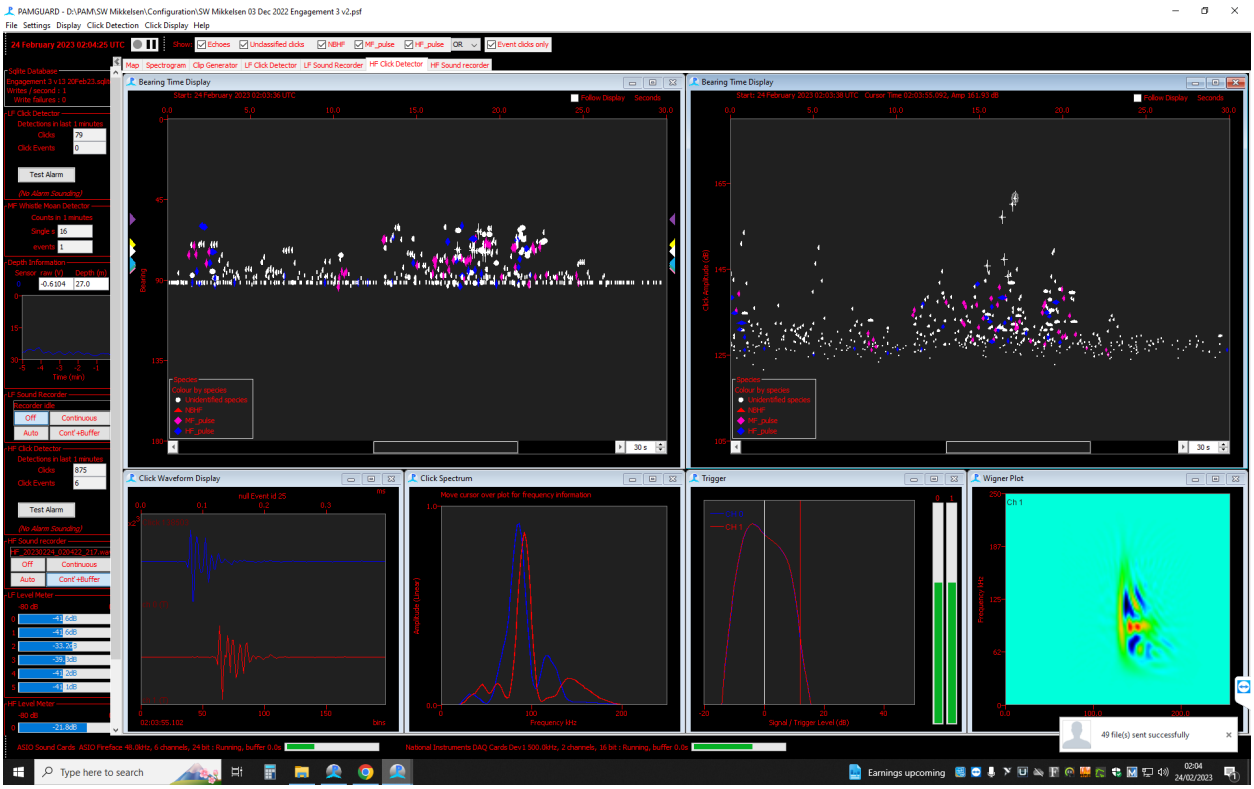


Figure 21: SWMAD#20 – Click trains of unidentifiable dolphins on PAMGuard's HF click detector

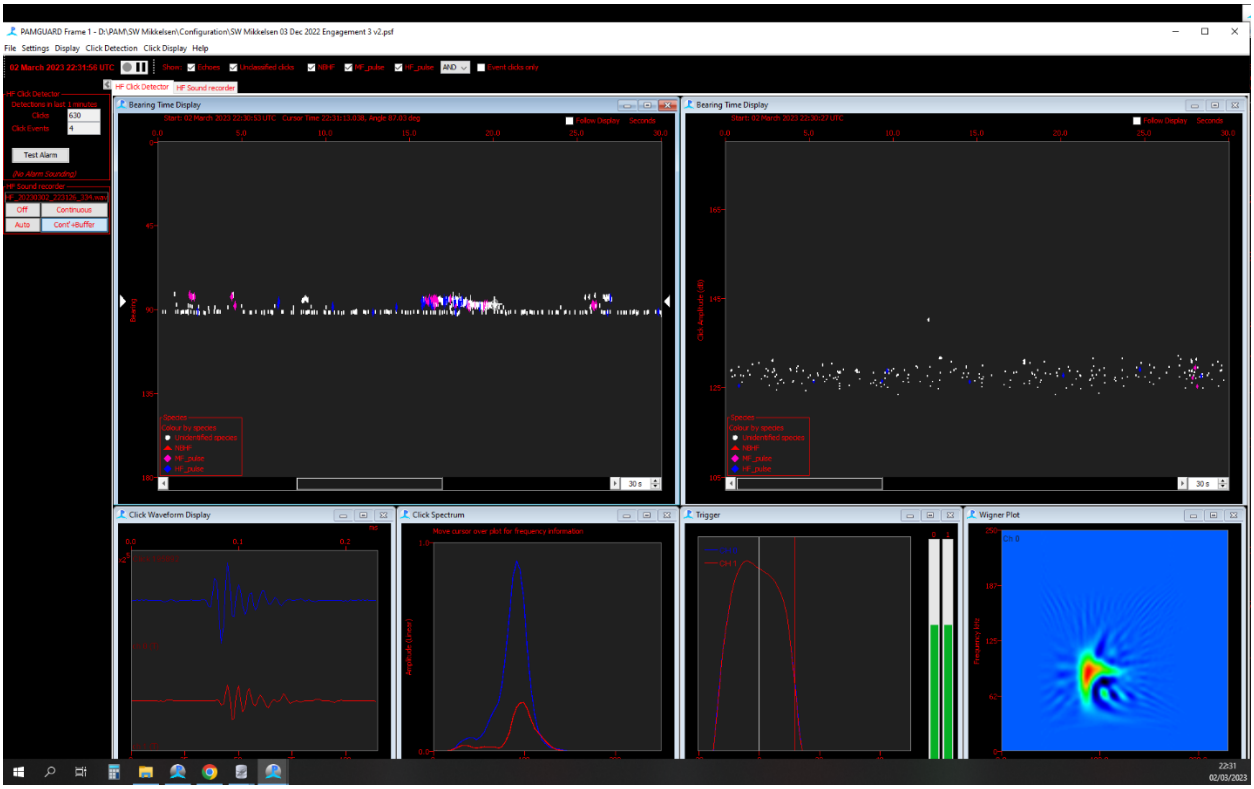


Figure 22: SWMAD#21 – Click trains of unidentifiable dolphins on PAMGuard's HF click detector

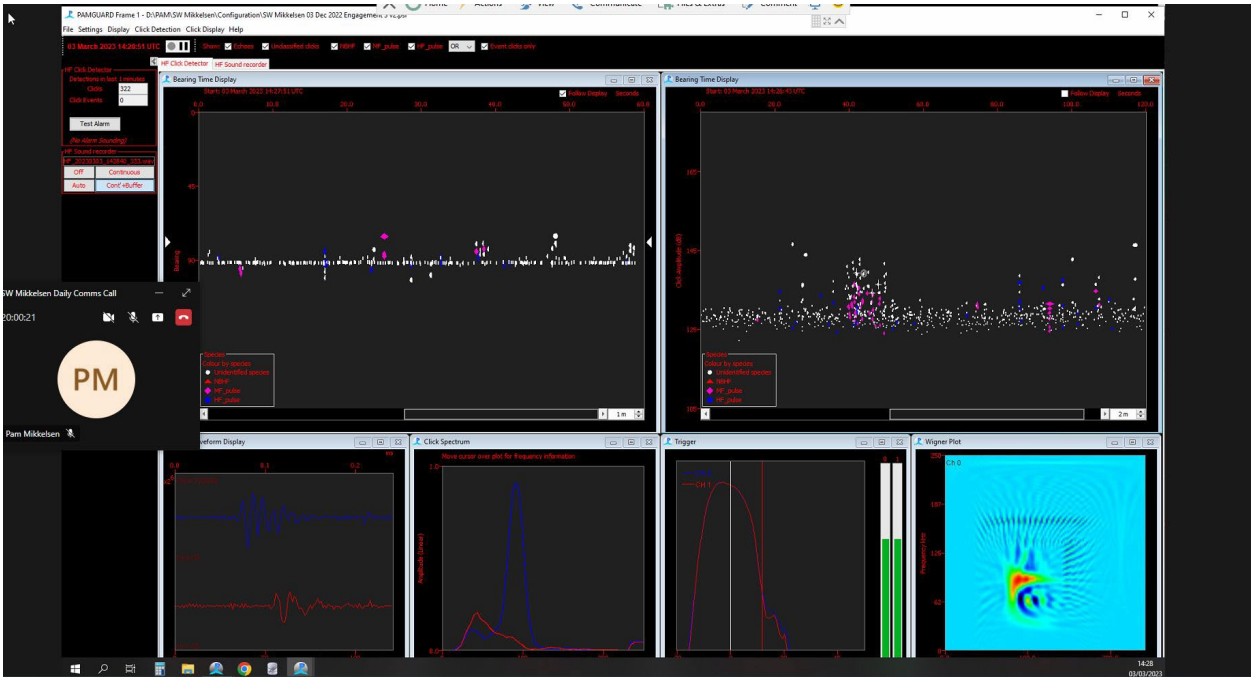


Figure 23:SWMAD#22 – Click trains of Clymene dolphins on PAMGuard's HF click detector

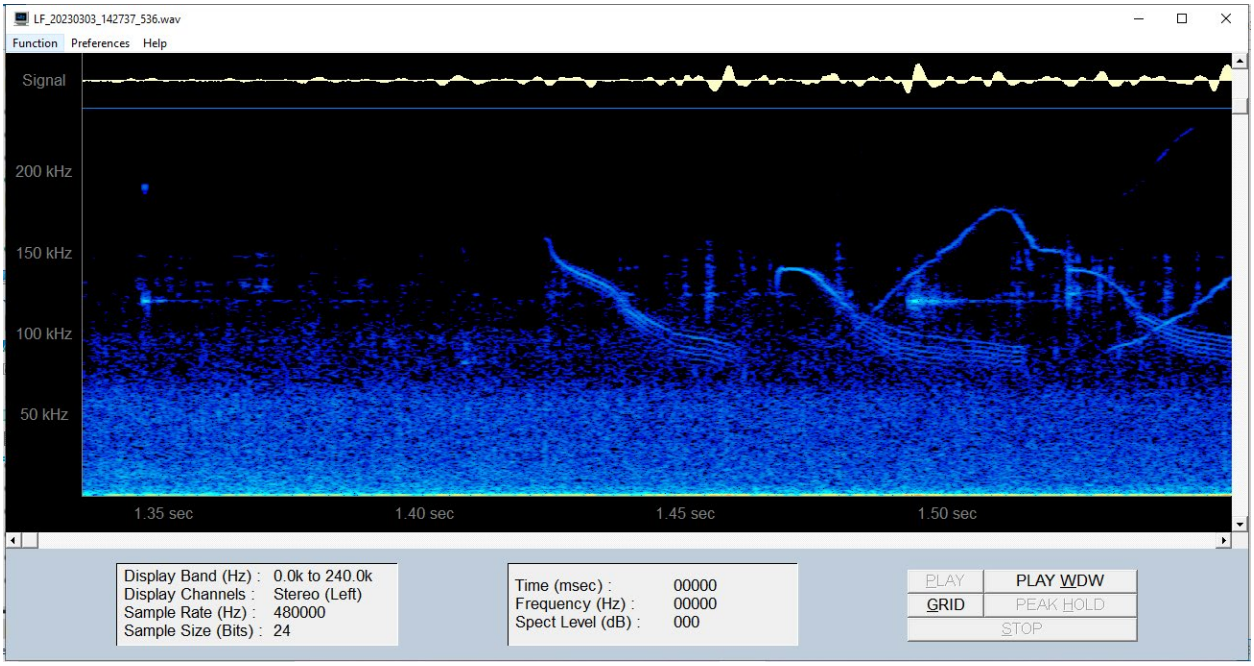


Figure 24: SWMAD#22 – Multi-classified LF whistles from Clymene dolphins on Spectrogram16

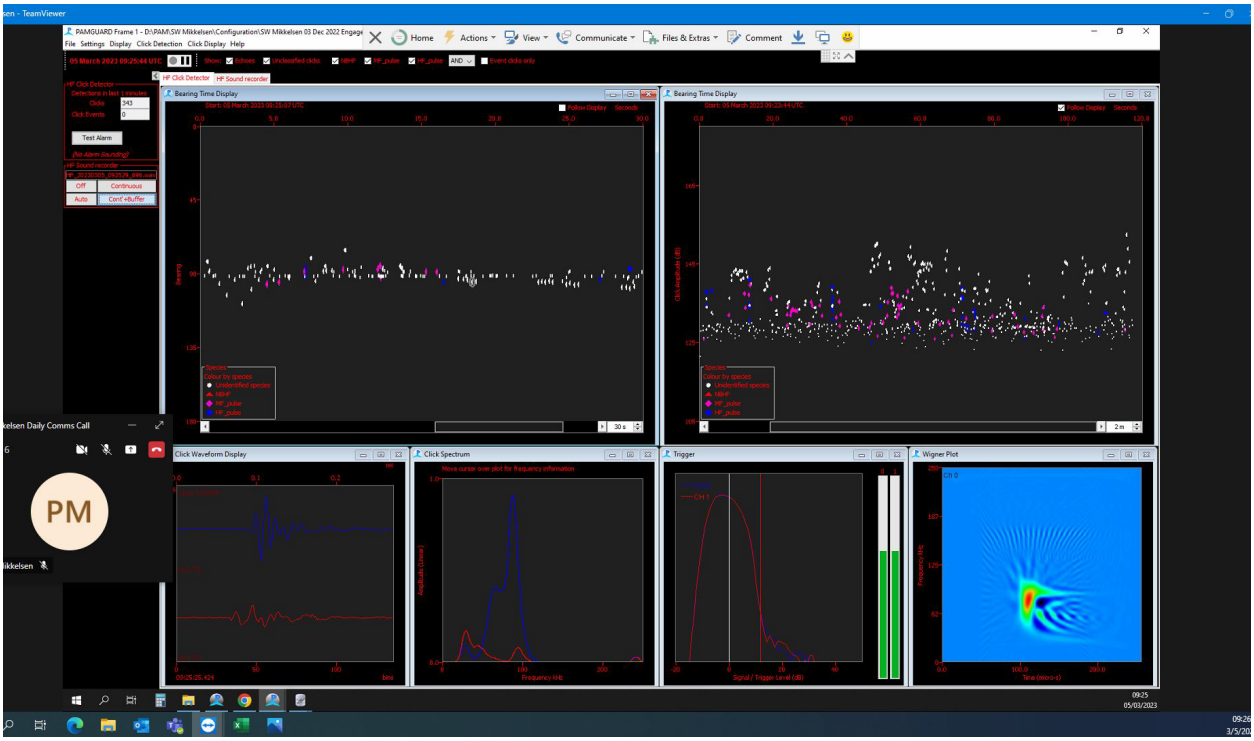


Figure 25: SWMAD#23 – Click trains of unidentifiable dolphins on PAMGuard's HF click detector

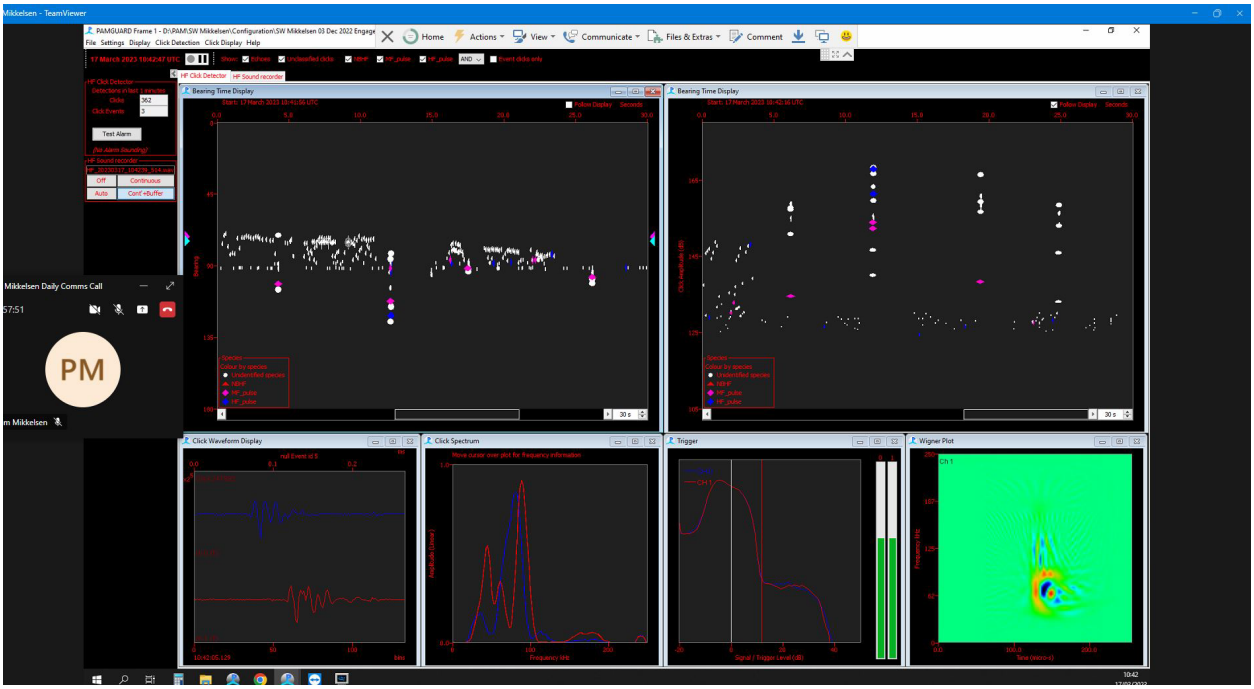


Figure 26: SWMAD#24 – Click trains of unidentifiable dolphins on PAMGuard's HF click detector

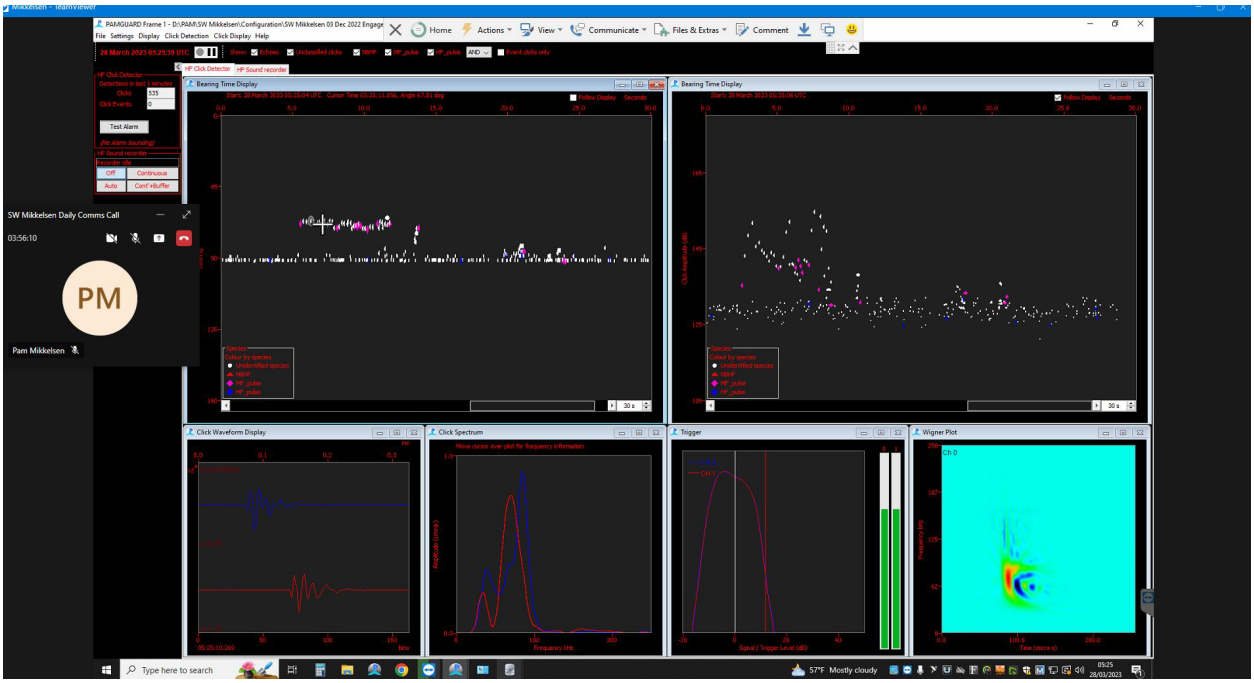


Figure 27: SWMAD#25 – Click trains of unidentifiable dolphins on PAMGuard's HF click detector

SCREENSHOTS OF ACOUSTIC DETECTIONS ON *SW GALLIEN*

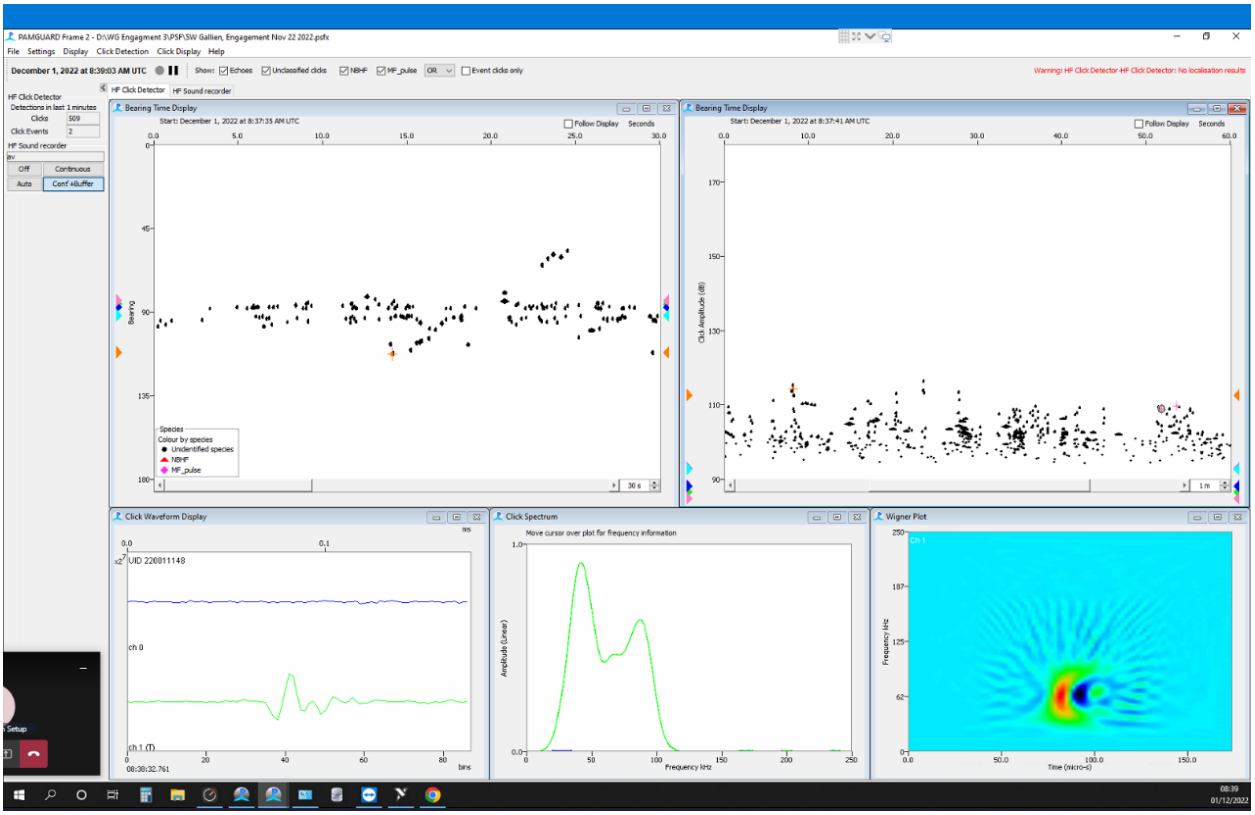


Figure 28: SWGAD#01 – Click trains of unidentifiable dolphins on PAMGuard's HF click detector

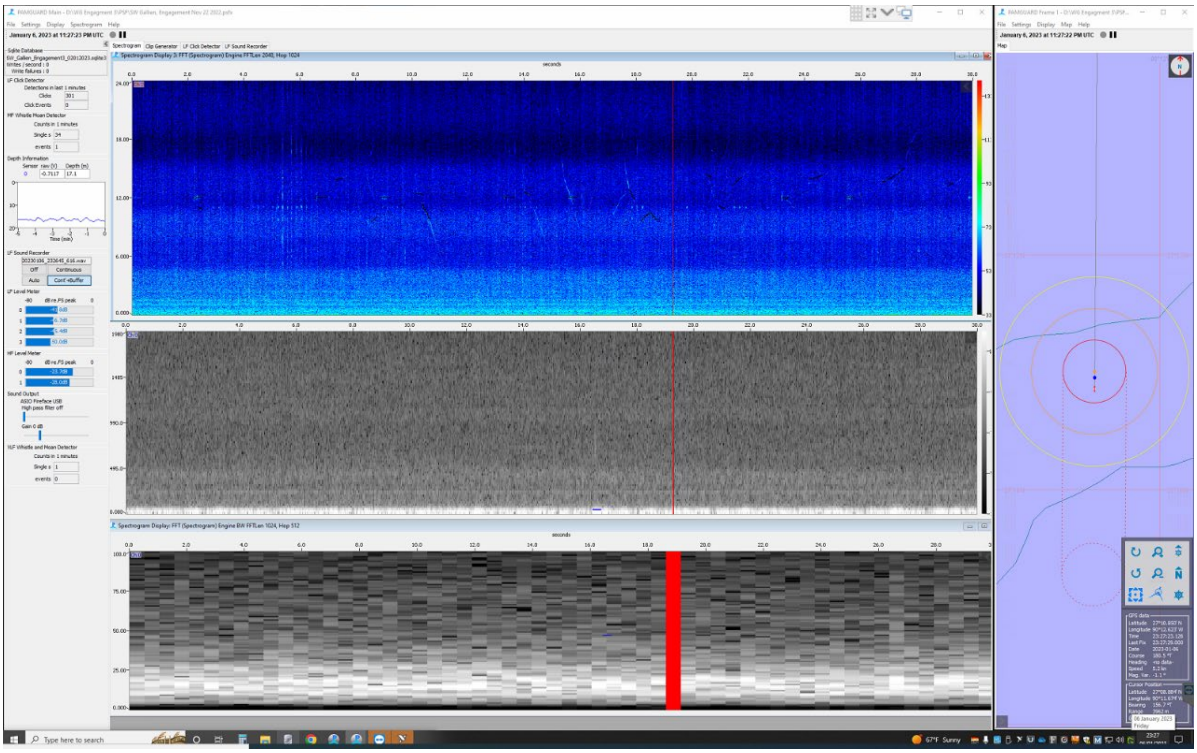


Figure 29: SWGAD#02 - LF whistles from Clymene dolphins on PAMGuard's Spectrogram

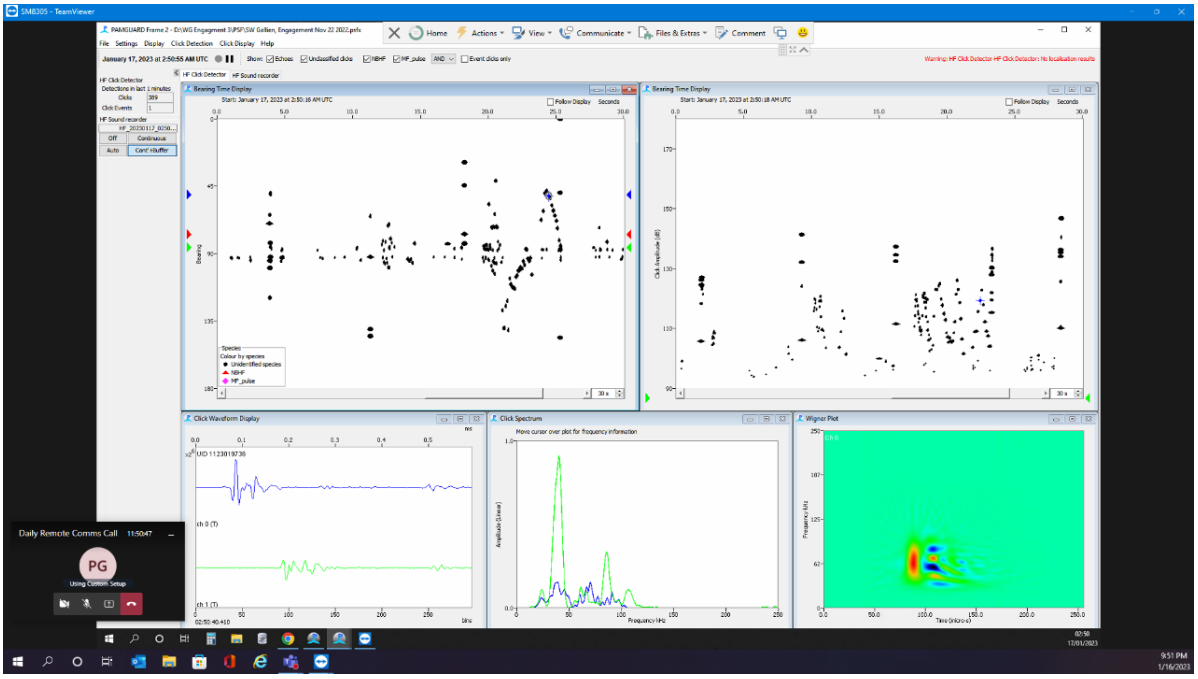


Figure 30: SWGAD#03 - Click trains of unidentifiable dolphins on PAMGuard's HF click detector

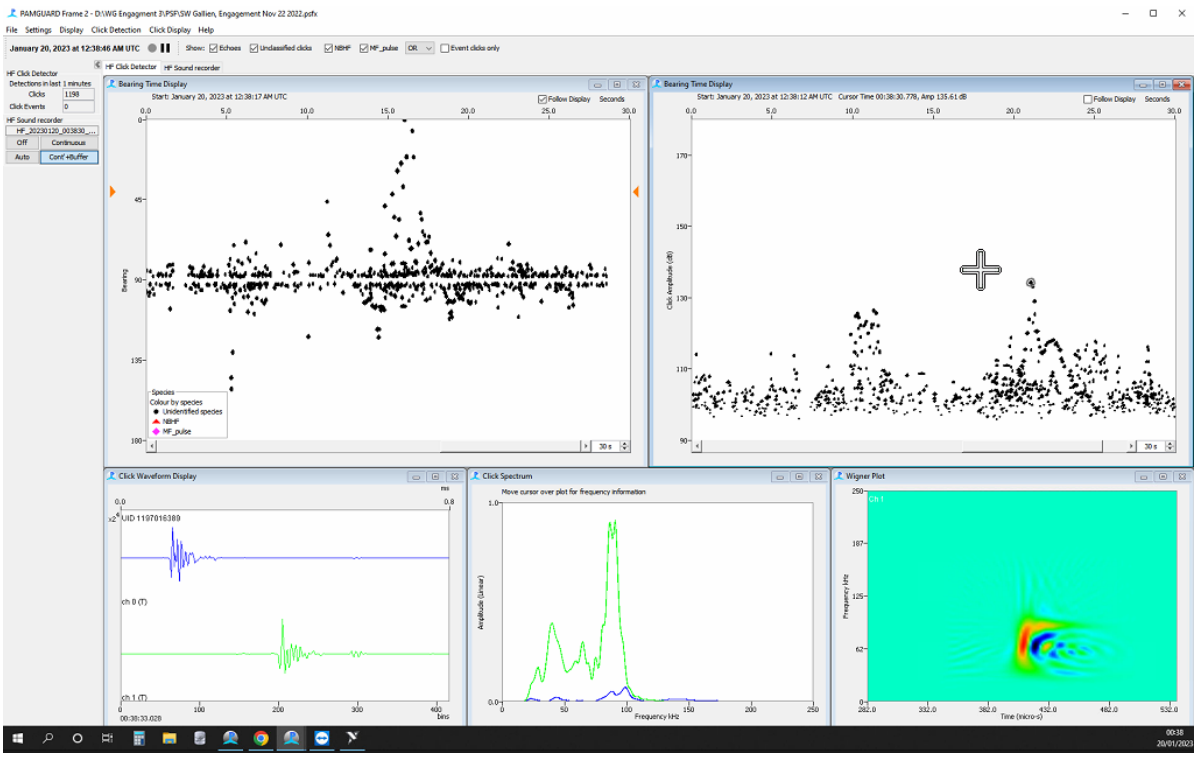


Figure 31:SWGAD#04 - Click trains of unidentifiable dolphins on PAMGuard's HF click detector

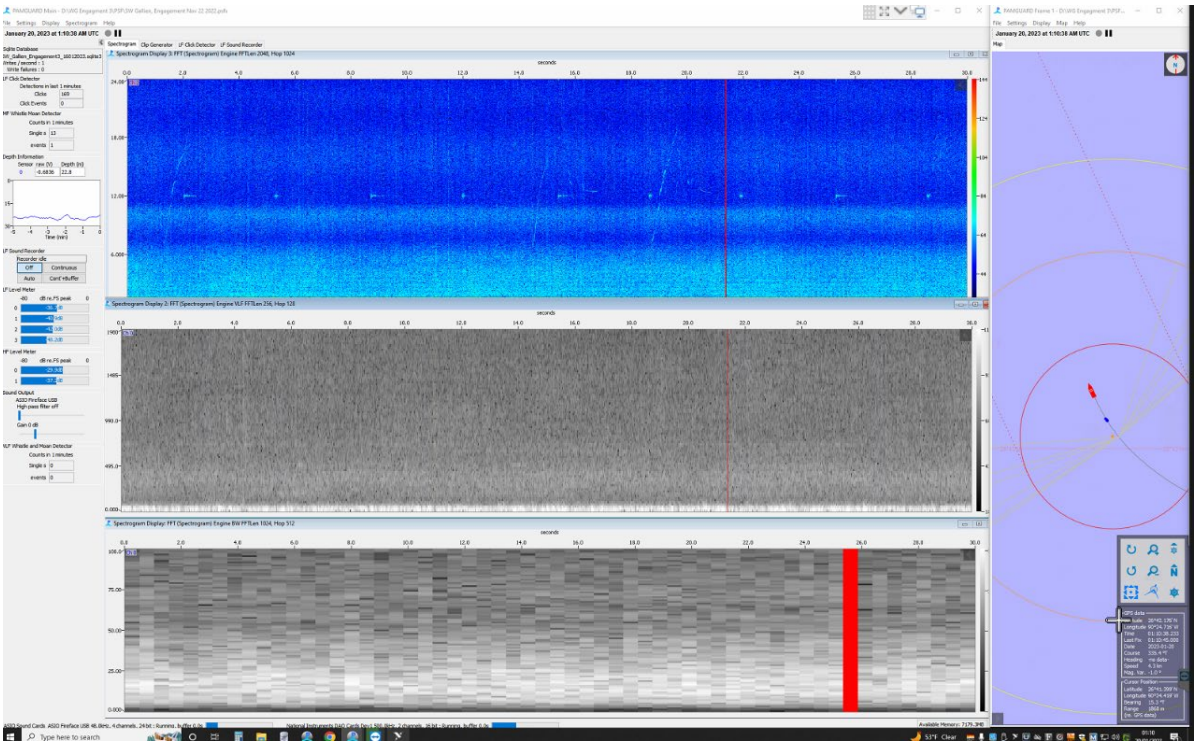


Figure 32: SWGAD#05 – LF whistles from unidentifiable dolphins on PAMGuard's LF Spectrogram

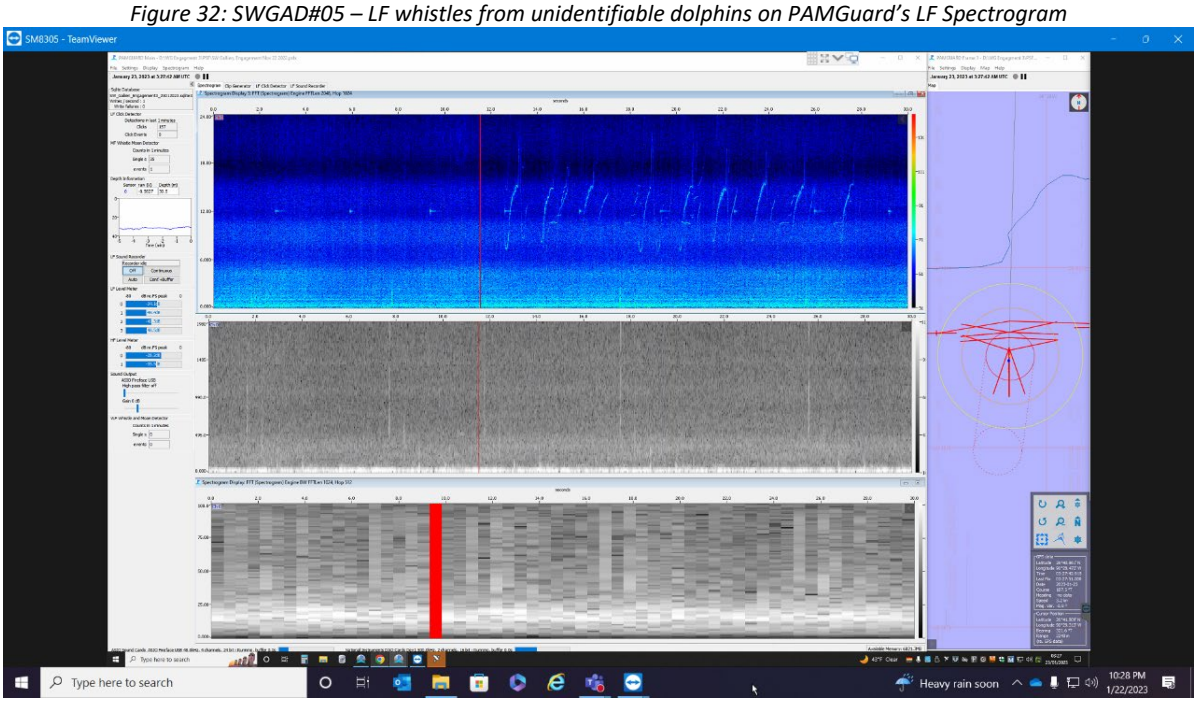


Figure 33: SWGAD#06 - LF whistles from unidentifiable dolphins on PAMGuard's LF Spectrogram

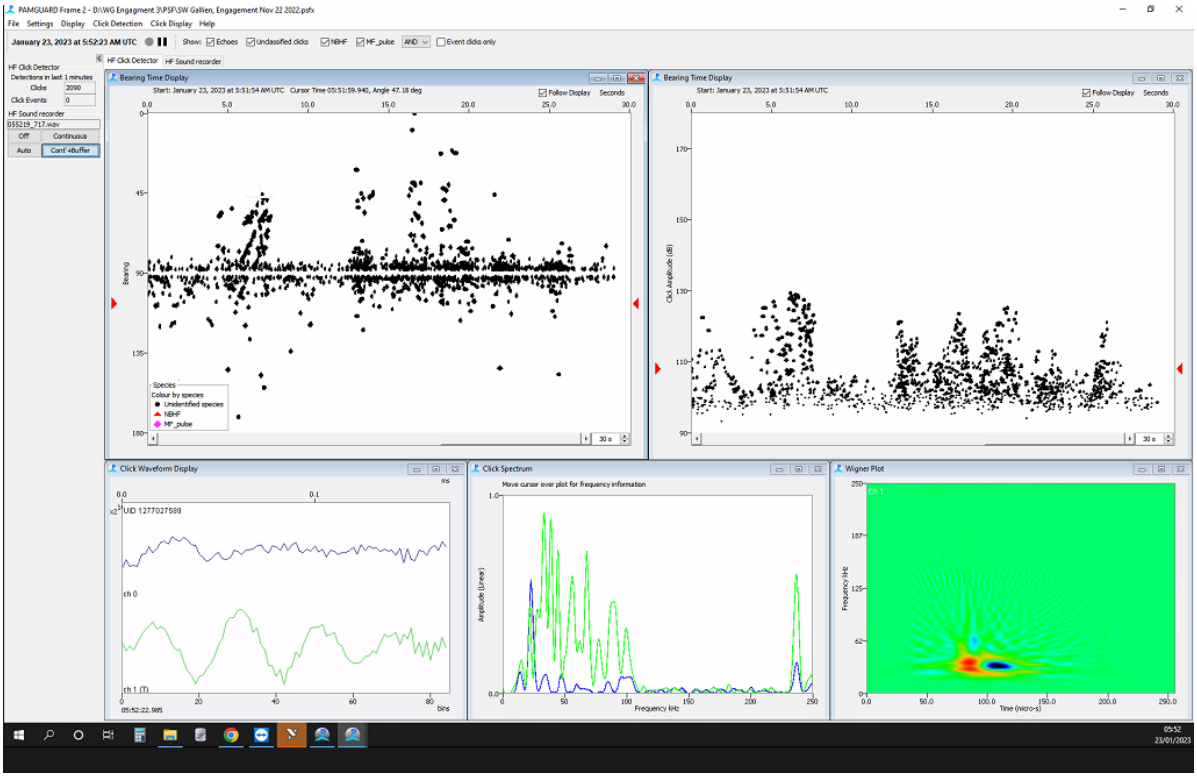


Figure 34: SWGAD#07 - Click trains of unidentifiable dolphins on PAMGuard's HF click detector

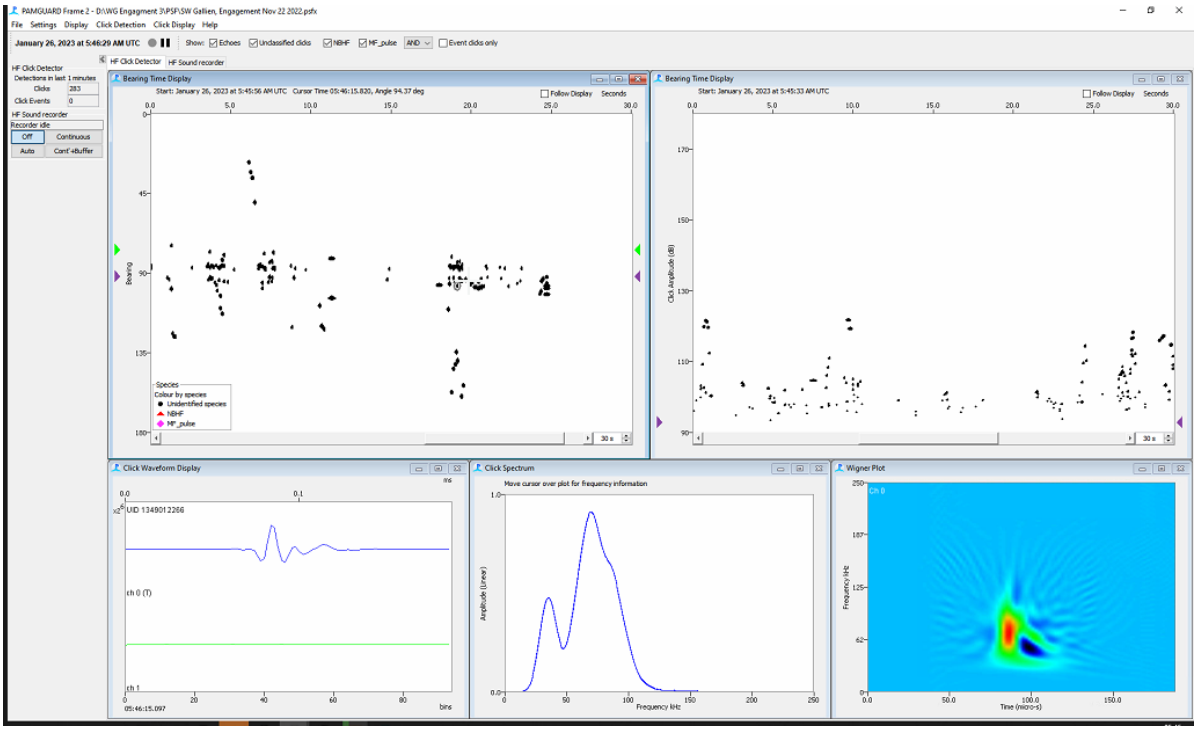


Figure 35: SWGAD#08 - Click trains of unidentifiable dolphins on PAMGuard's HF click detector

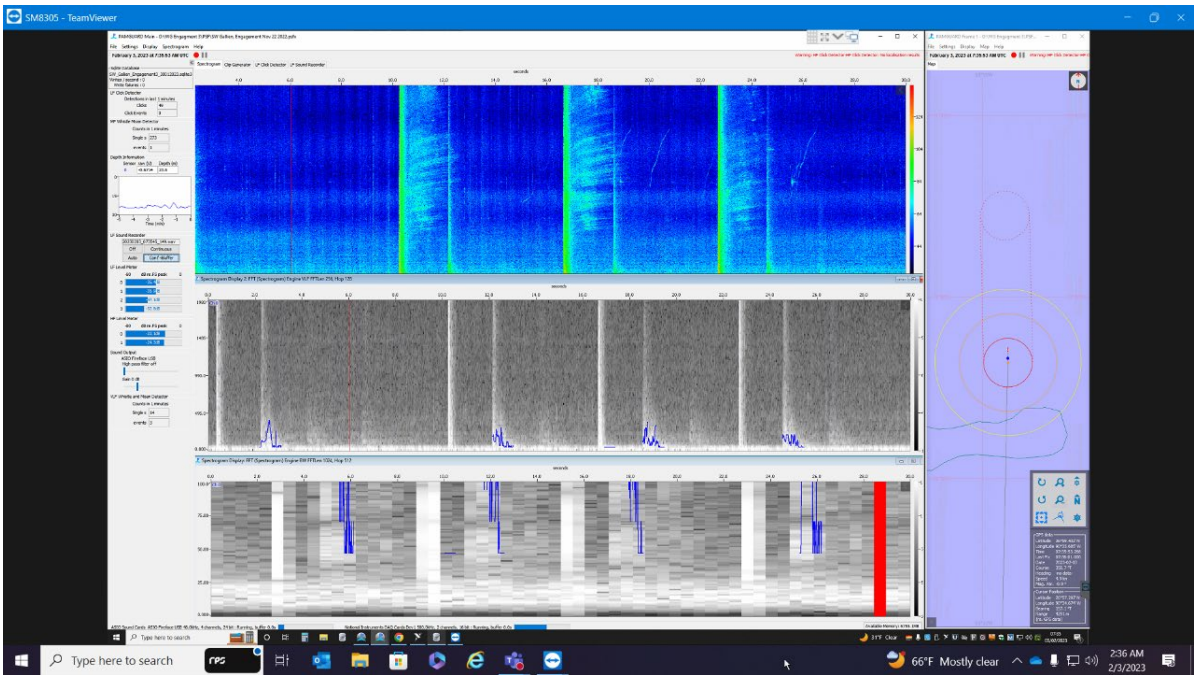


Figure 36: SWGAD#09 - LF whistles from unidentifiable dolphins on PAMGuard's LF Spectrogram

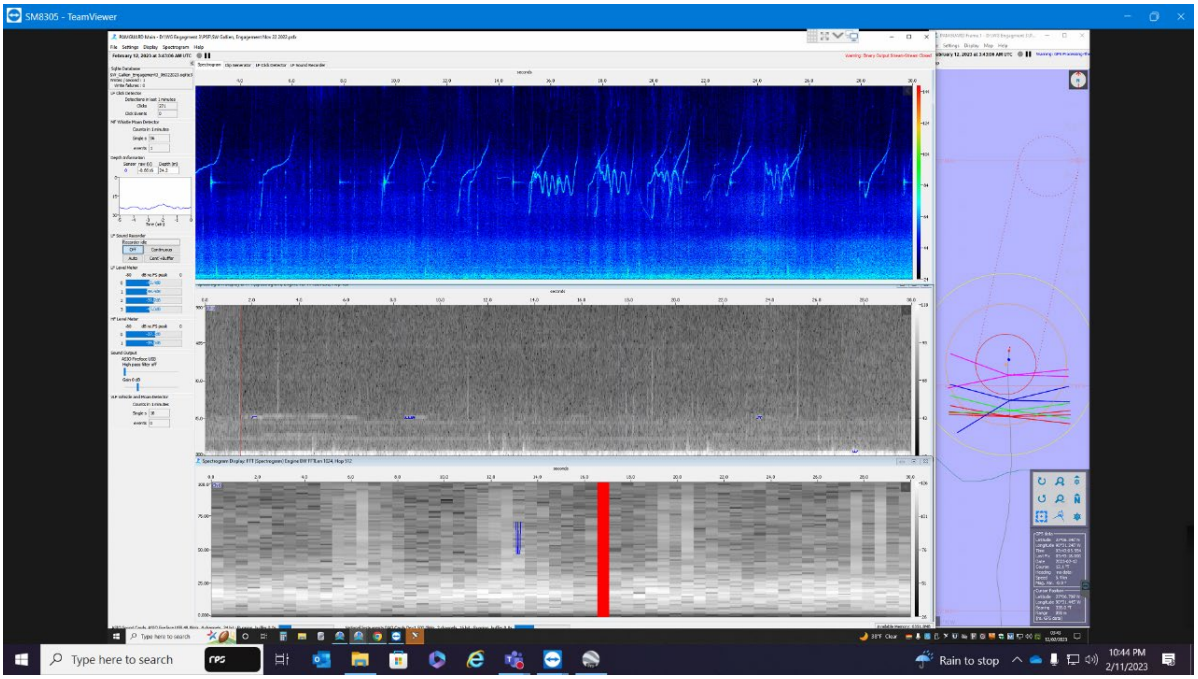


Figure 37: SWGAD#10 - LF whistles from unidentifiable dolphins on PAMGuard's LF Spectrogram

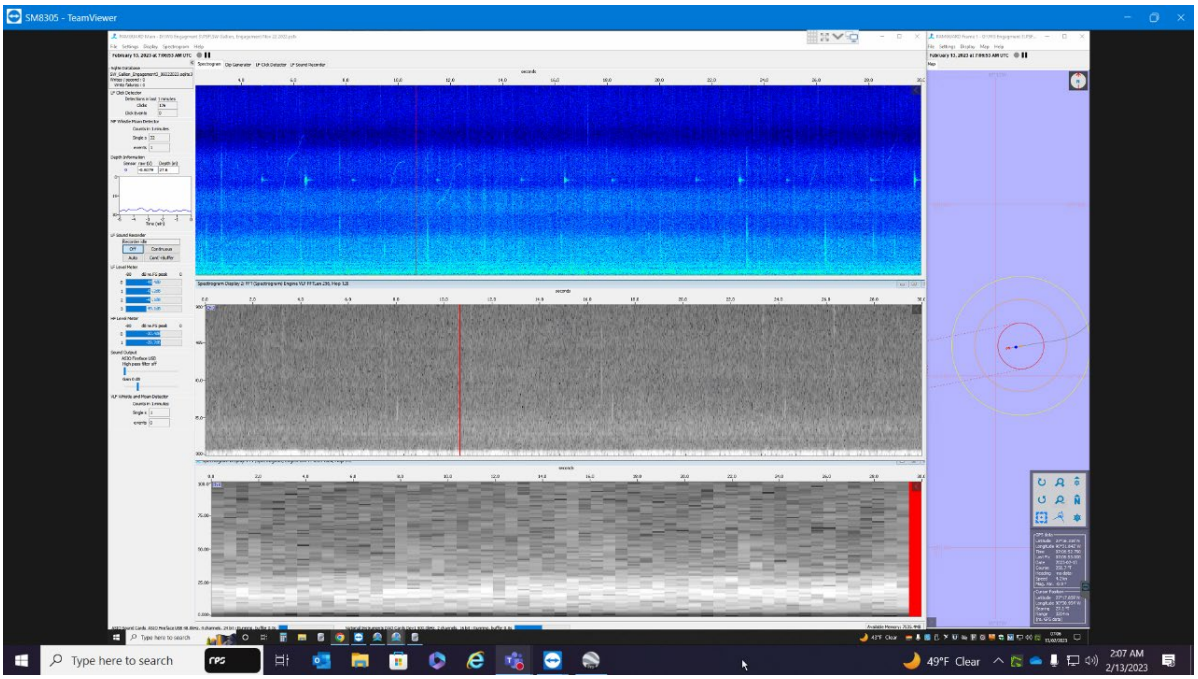


Figure 38: SWGAD#11 - LF whistles from unidentifiable dolphins on PAMGuard's LF Spectrogram

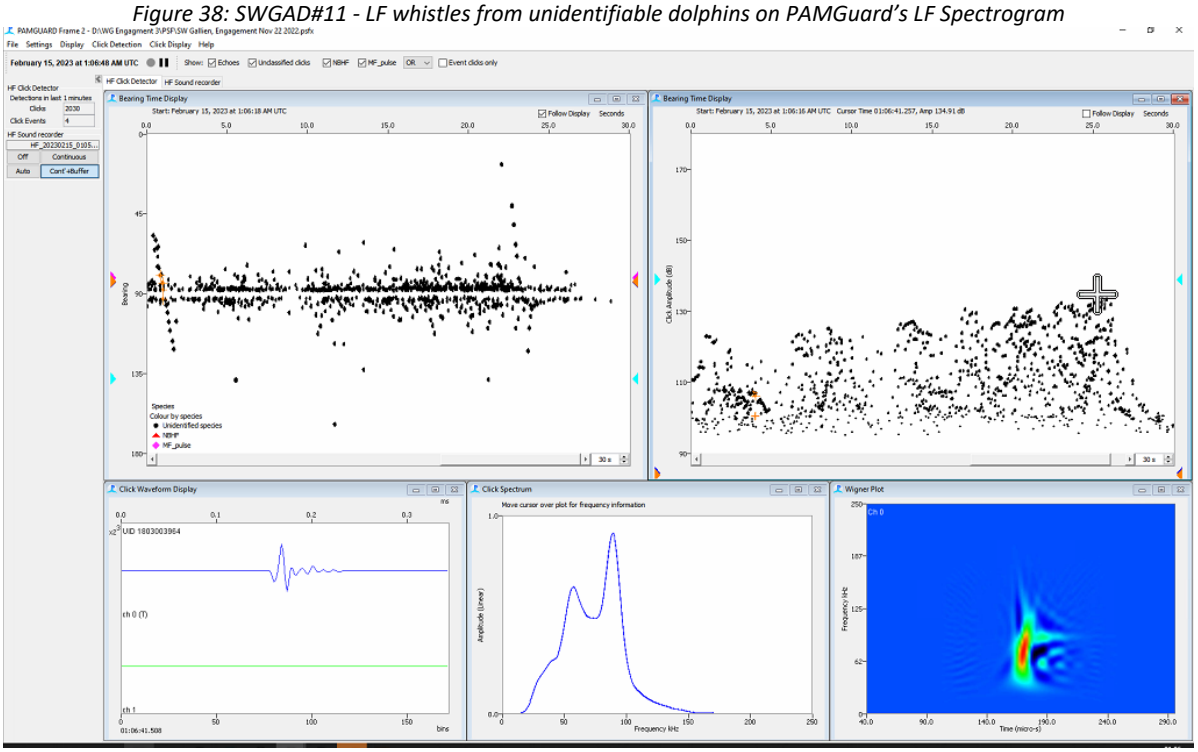


Figure 39: SWGAD#12 - Click trains of unidentifiable dolphins on PAMGuard's HF click detector

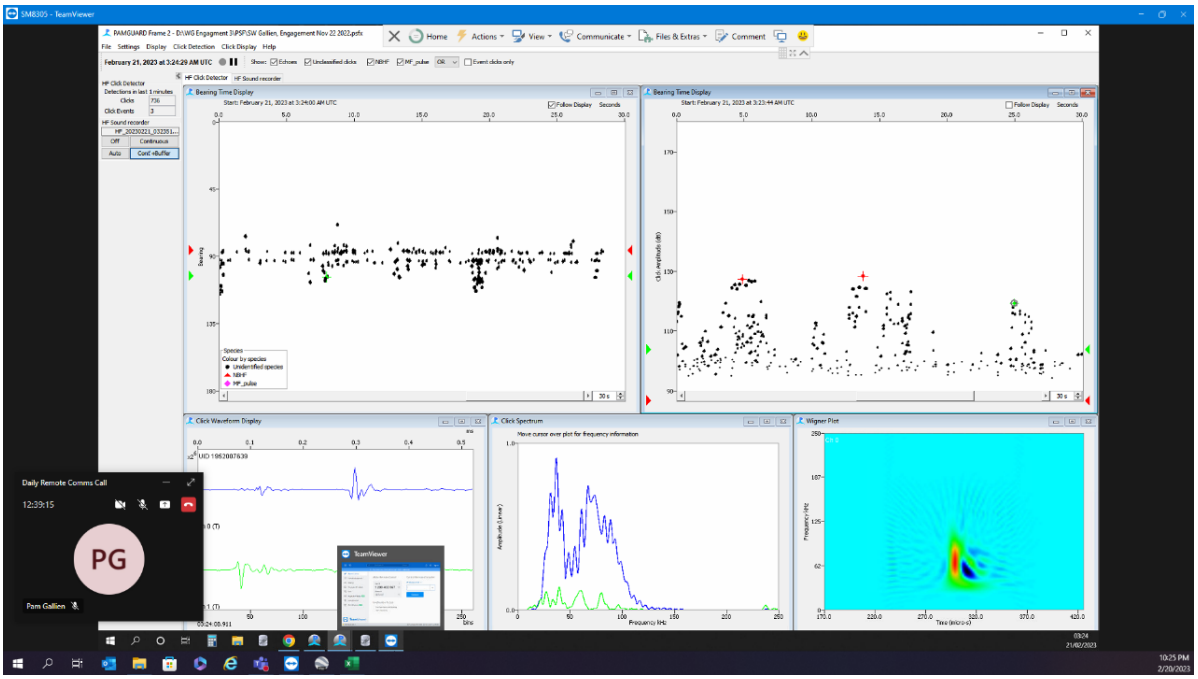


Figure 40: SWGAD#13 – Click trains of unidentifiable dolphins on PAMGuard's HF click detector

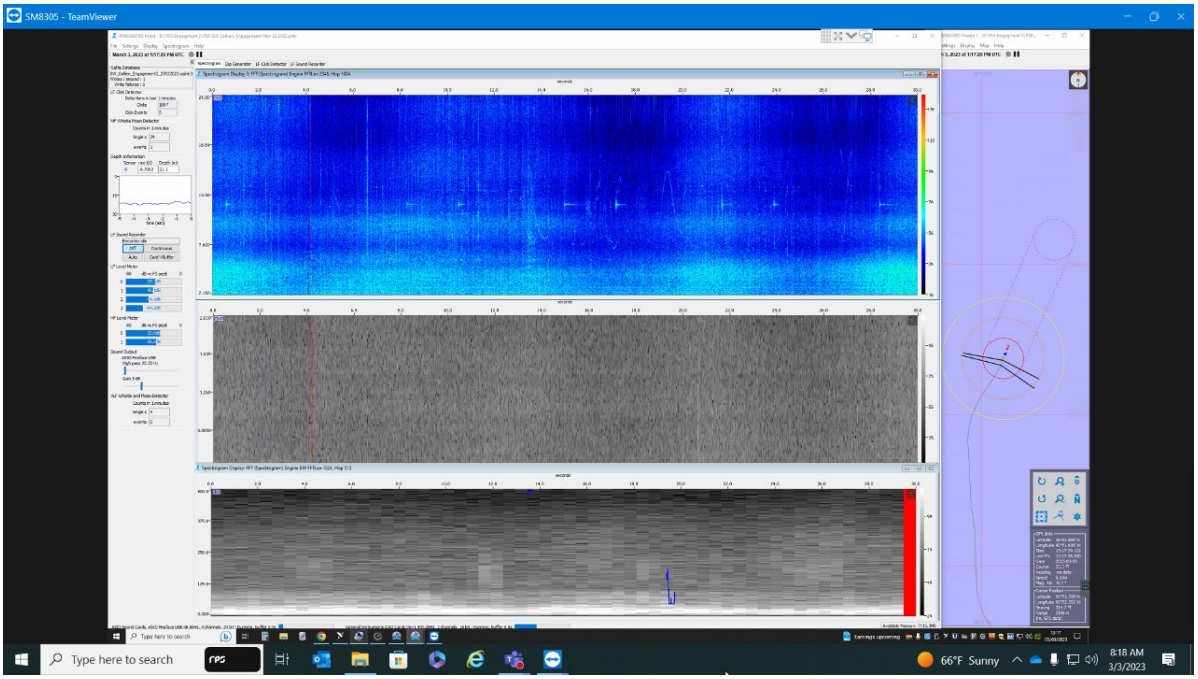


Figure 41: SWGAD#14 – LF whistles from unidentifiable dolphins on PAMGuard's LF Spectrogram

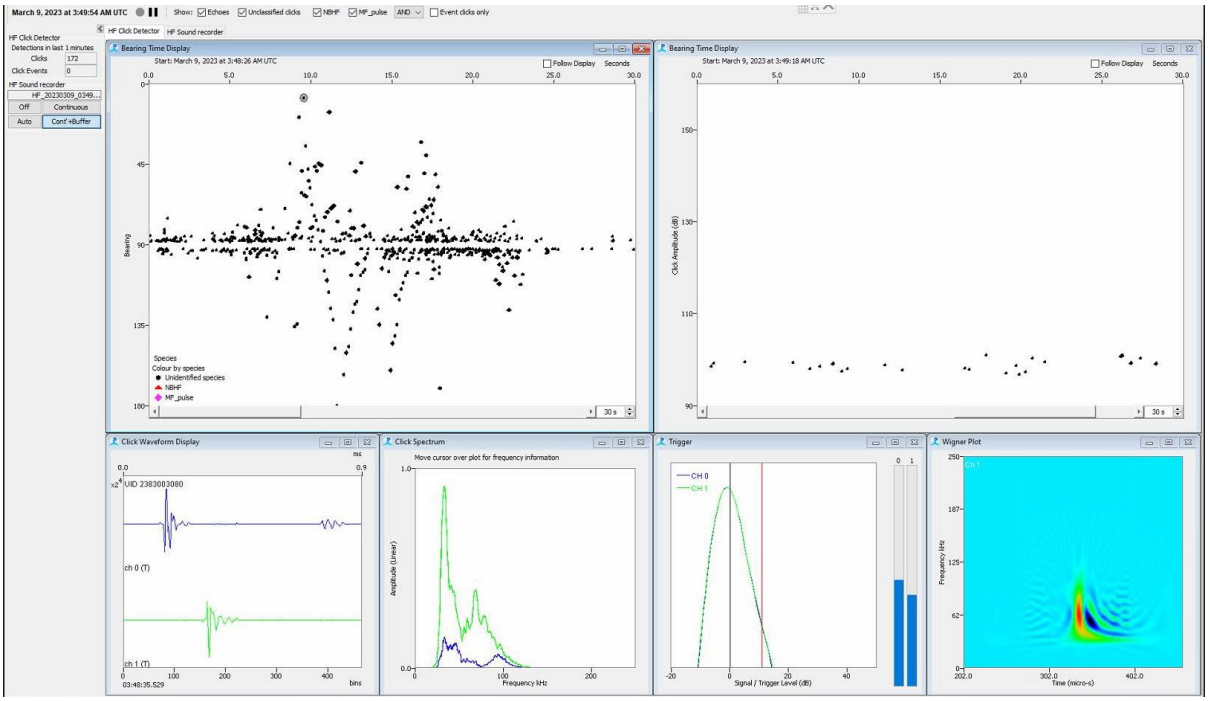


Figure 42: SWGAD#15 – Click trains of unidentifiable dolphins on PAMGuard's HF click detector

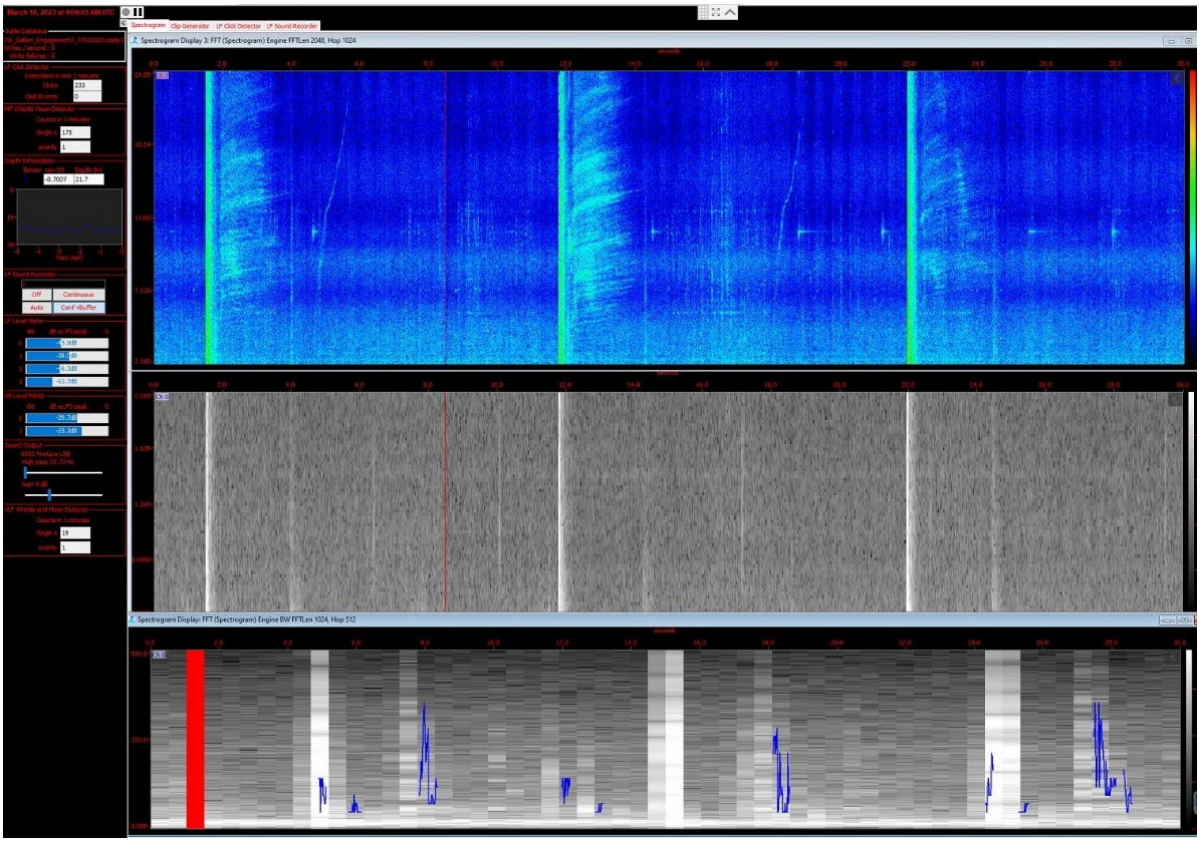


Figure 43: SWGAD#16 – LF whistles from unidentifiable dolphins on PAMGuard's LF Spectrogram

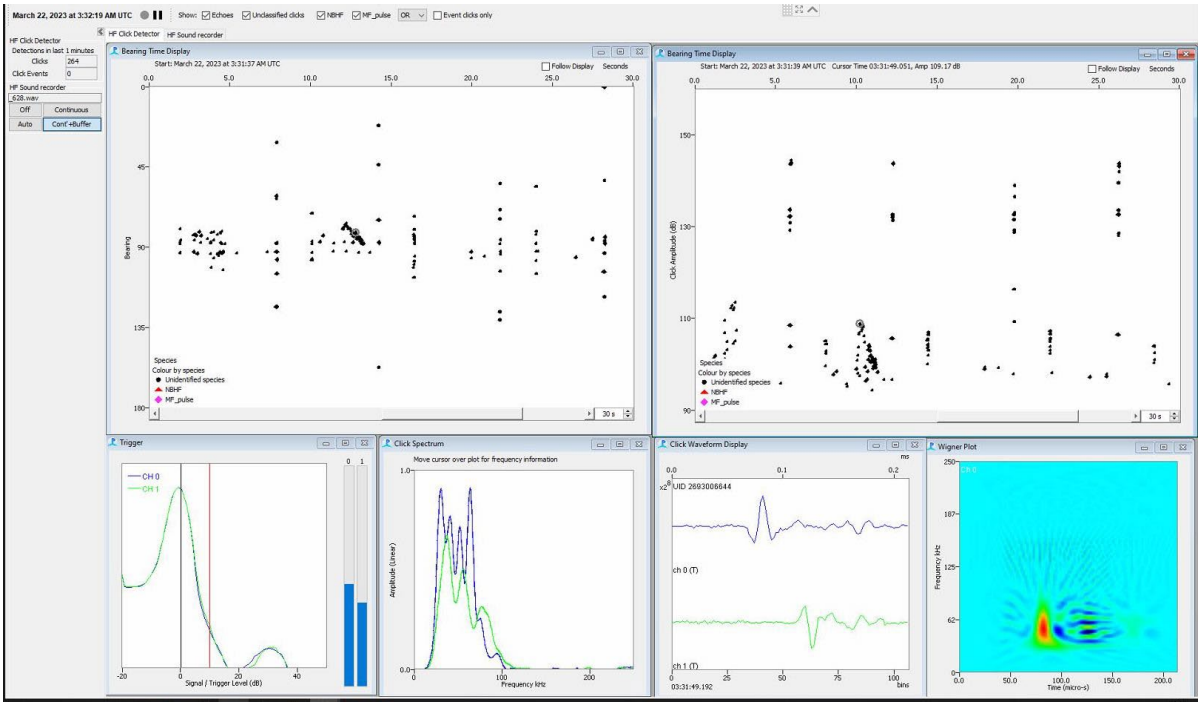


Figure 44: SWGAD#17 – Click trains of unidentifiable dolphins on PAMGuard's HF click detector

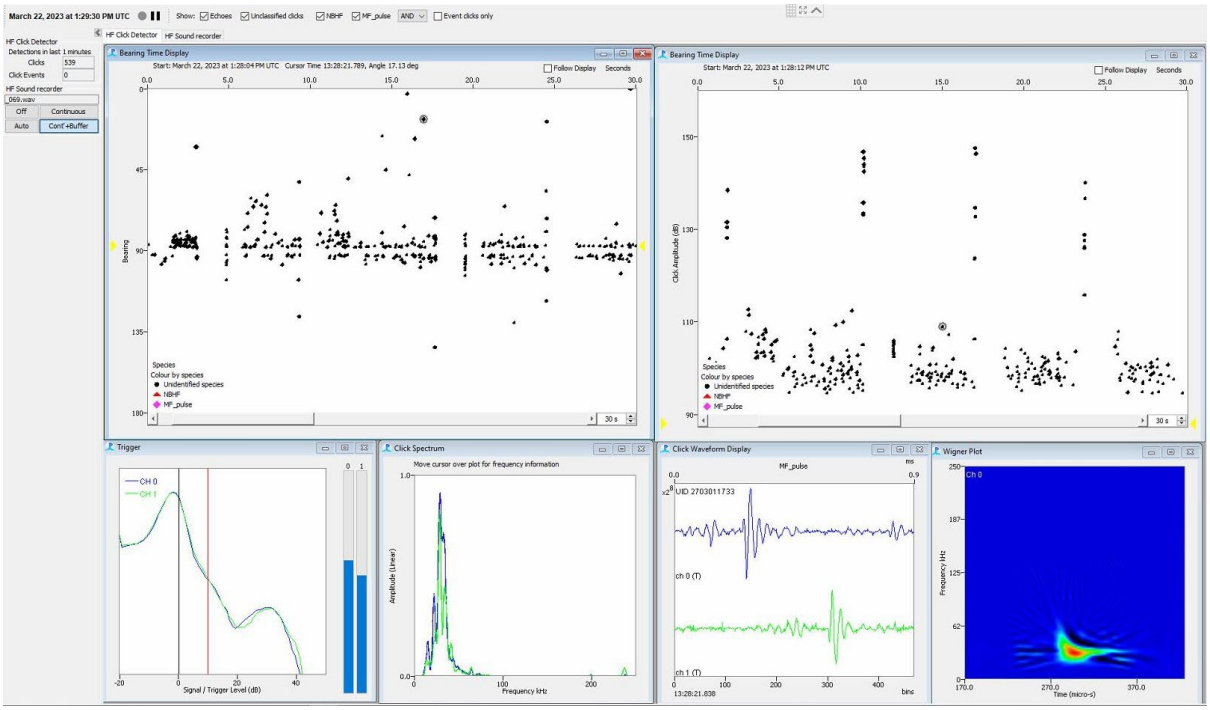


Figure 45: SWGAD#18 – Click trains of unidentifiable dolphins on PAMGuard's HF click detector

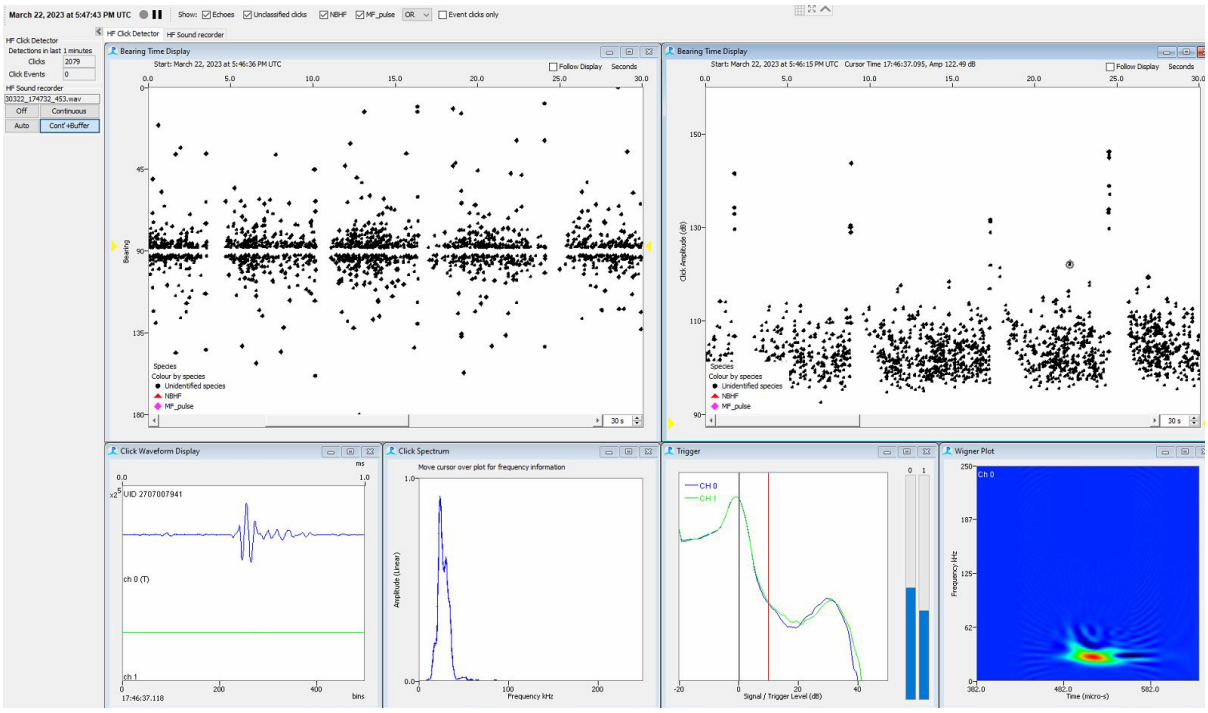


Figure 46: SWGAD#19 – Click trains of unidentifiable dolphins on PAMGuard's HF click detector

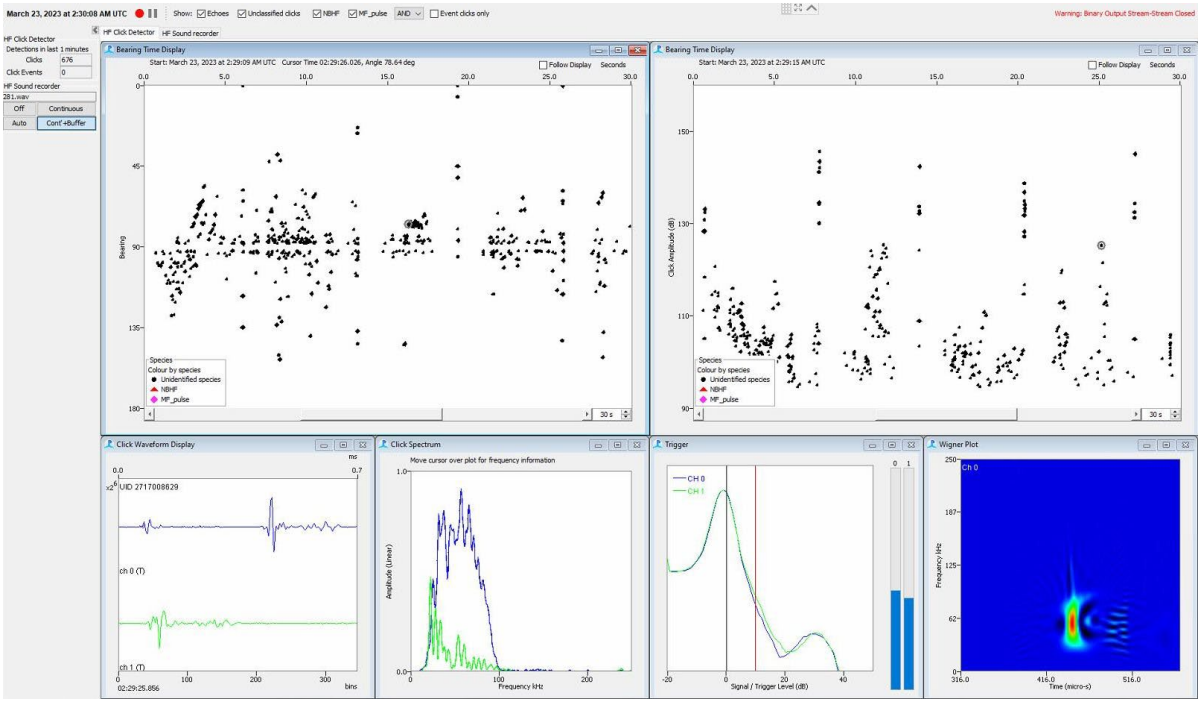


Figure 47: SWGAD#20 – Click trains of unidentifiable dolphins on PAMGuard's HF click detector

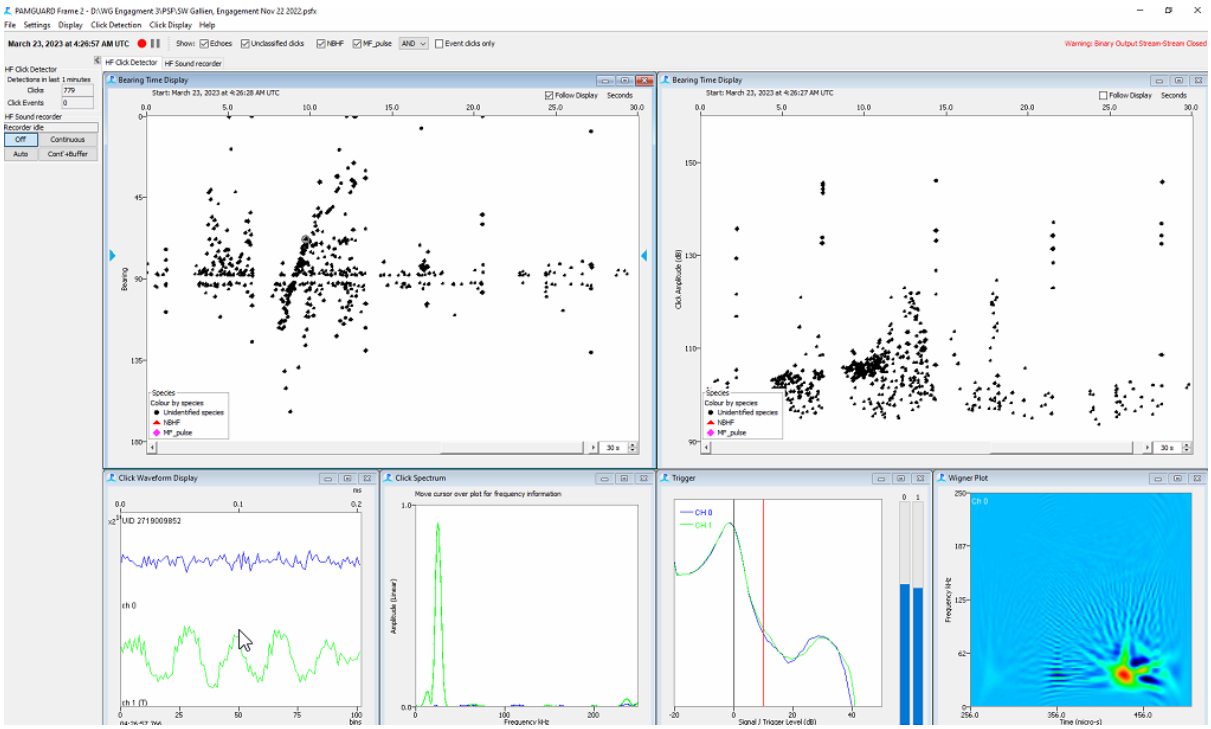


Figure 48: SWGAD#21 – Click trains of unidentifiable dolphins on PAMGuard's HF click detector

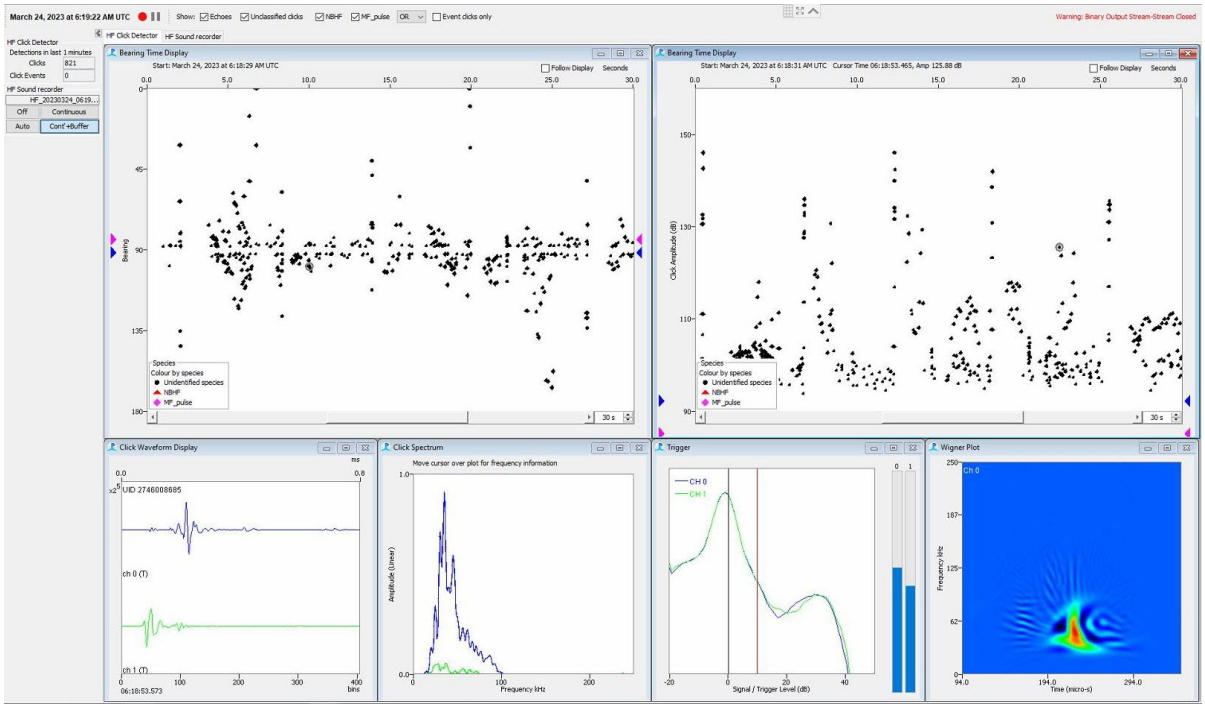


Figure 49: SWGAD#22 – Click trains of unidentifiable dolphins on PAMGuard's HF click detector

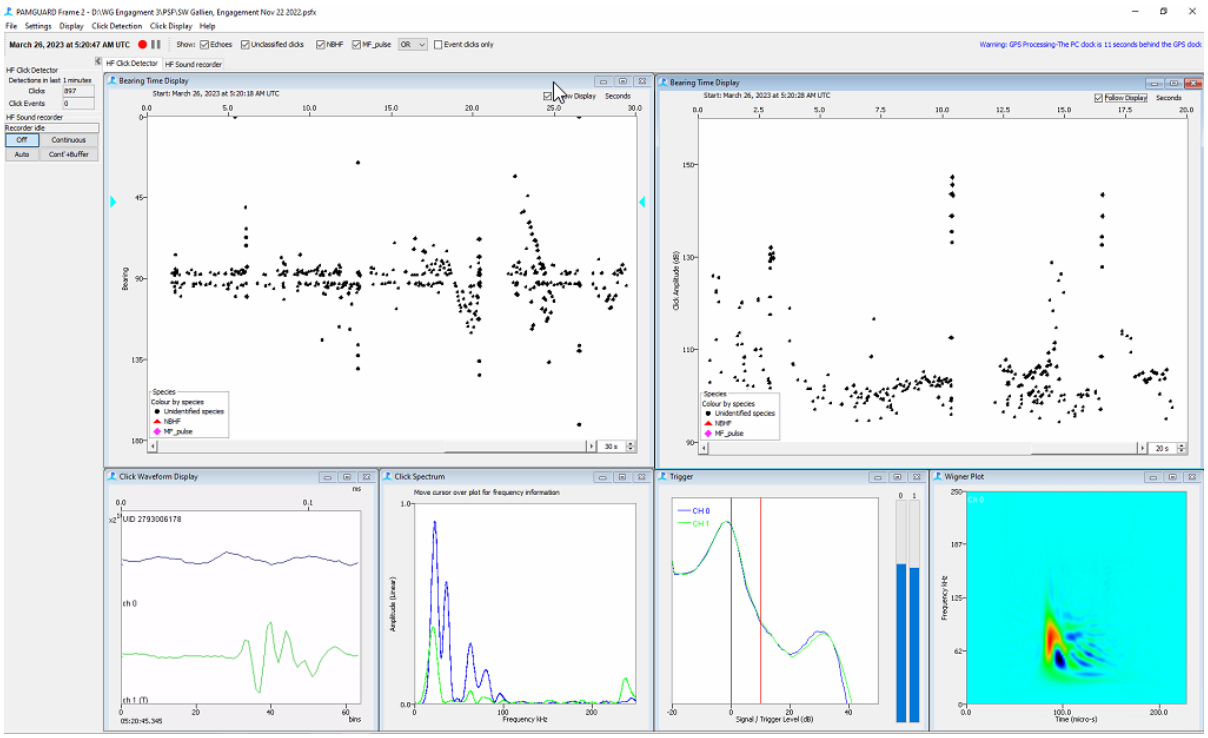


Figure 50: SWGAD#23 – Click trains of unidentifiable dolphins on PAMGuard's HF click detector

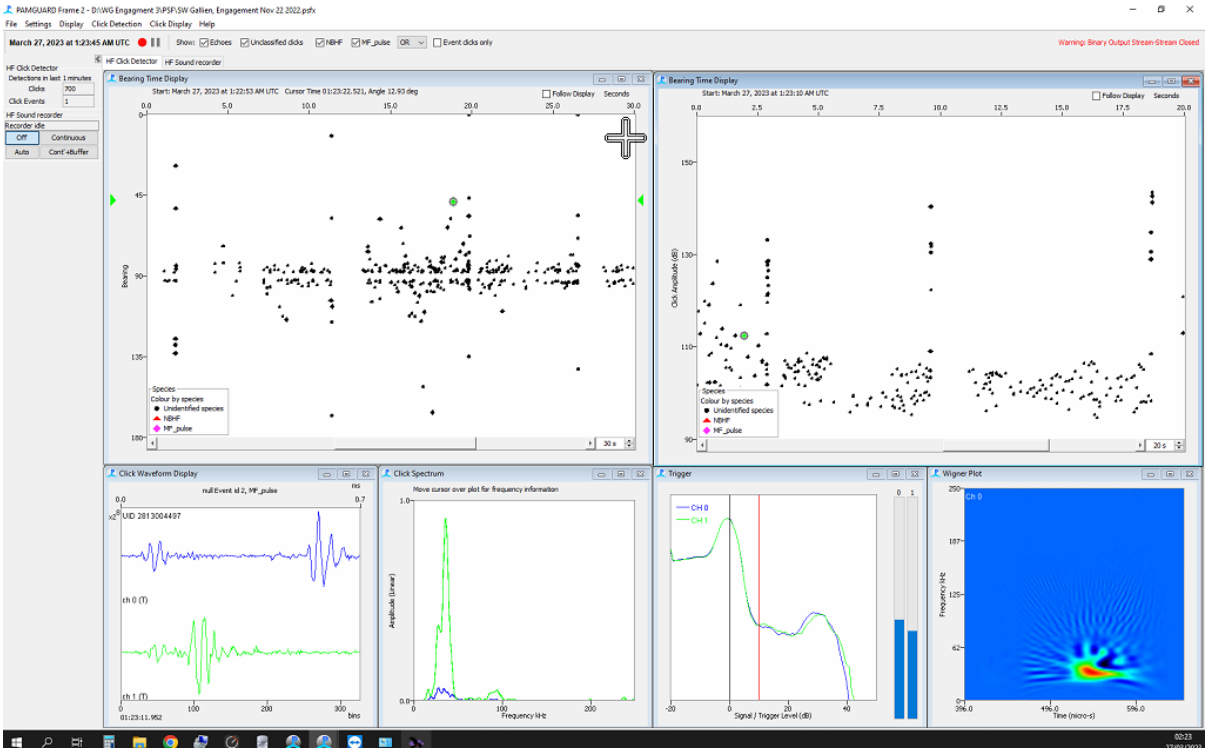


Figure 51: SWGAD#24 – Click trains of unidentifiable dolphins on PAMGuard's HF click detector

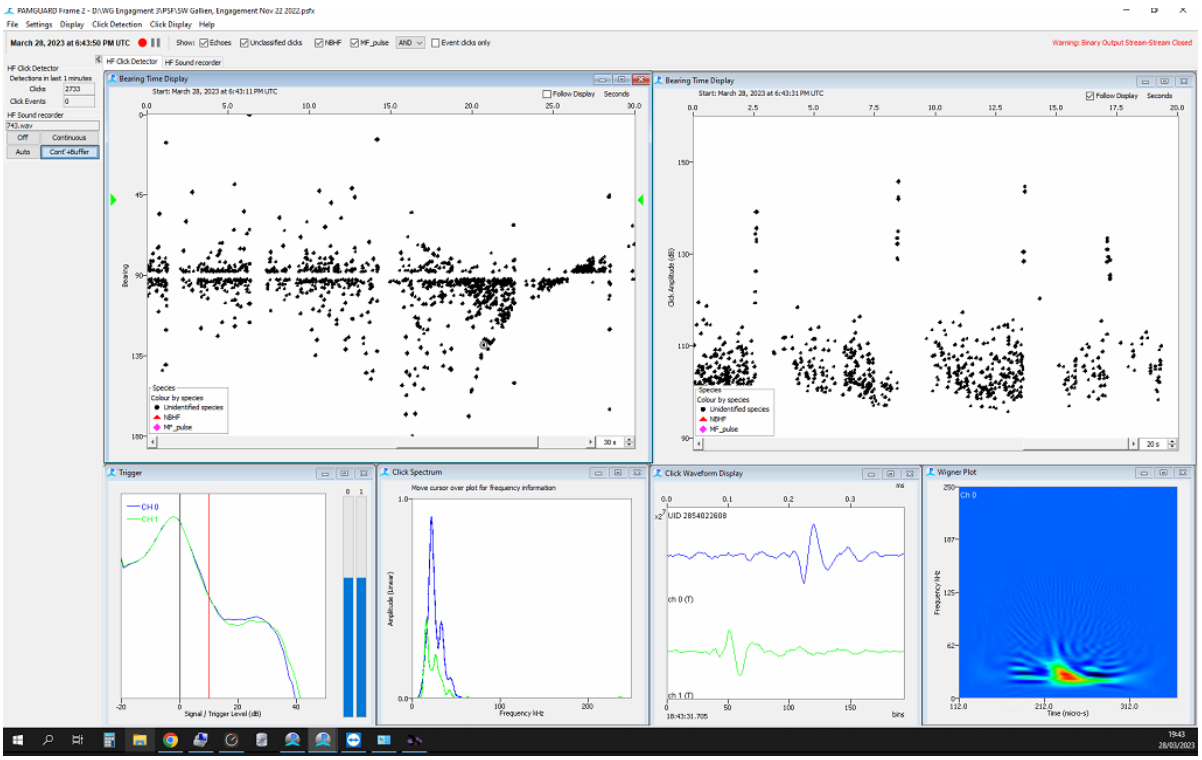


Figure 52: SWGAD#25 – Click trains of unidentifiable dolphins on PAMGuard's HF click detector

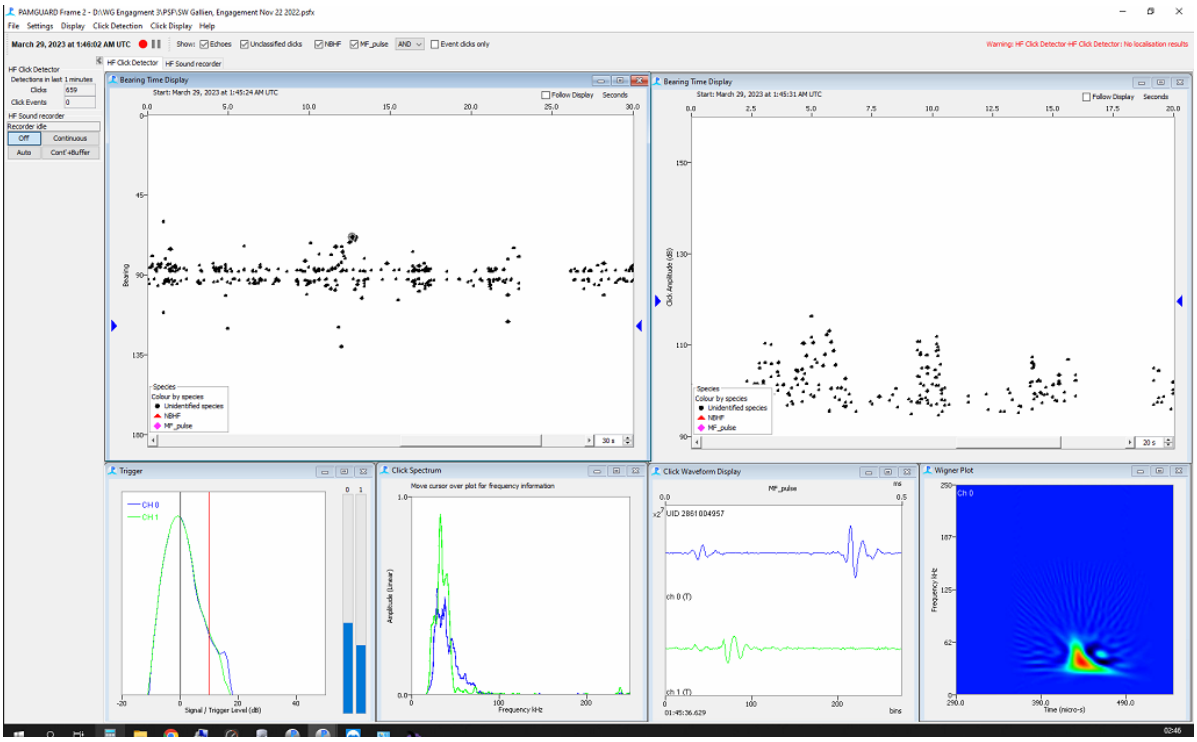


Figure 53: SWGAD#26 – Click trains of unidentifiable dolphins on PAMGuard's HF click detector

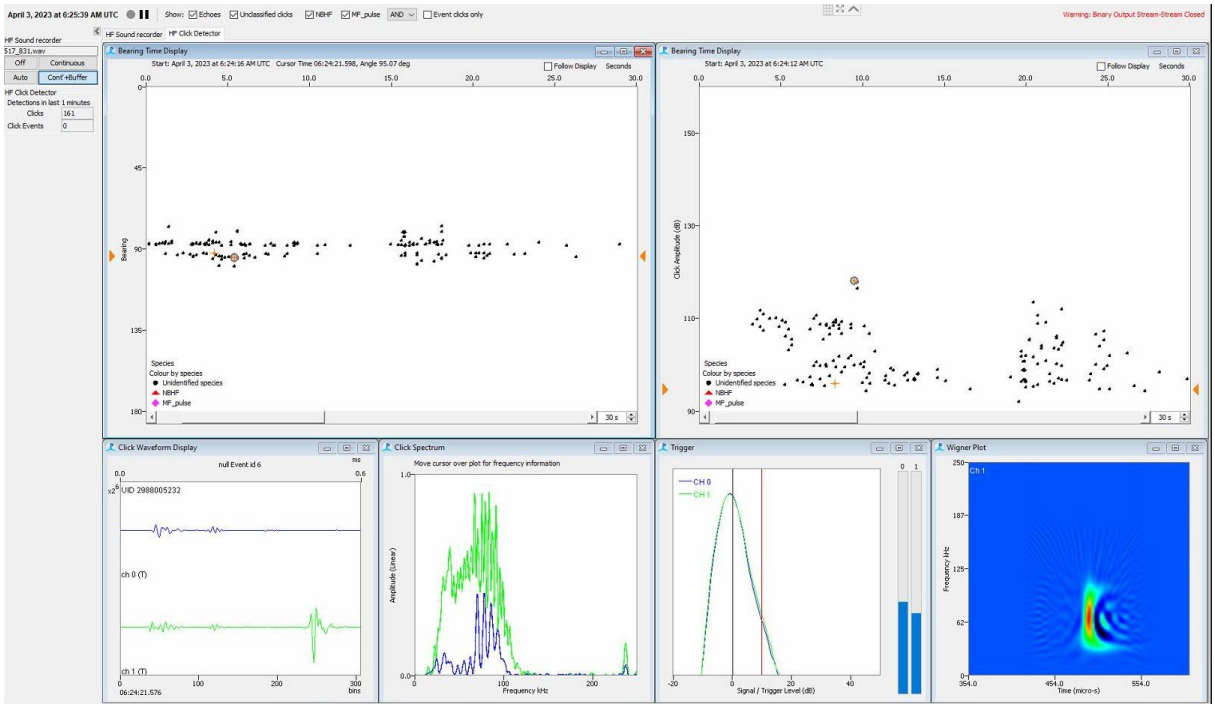


Figure 54: SWGAD#27 – Click trains of unidentifiable dolphins on PAMGuard's HF click detector

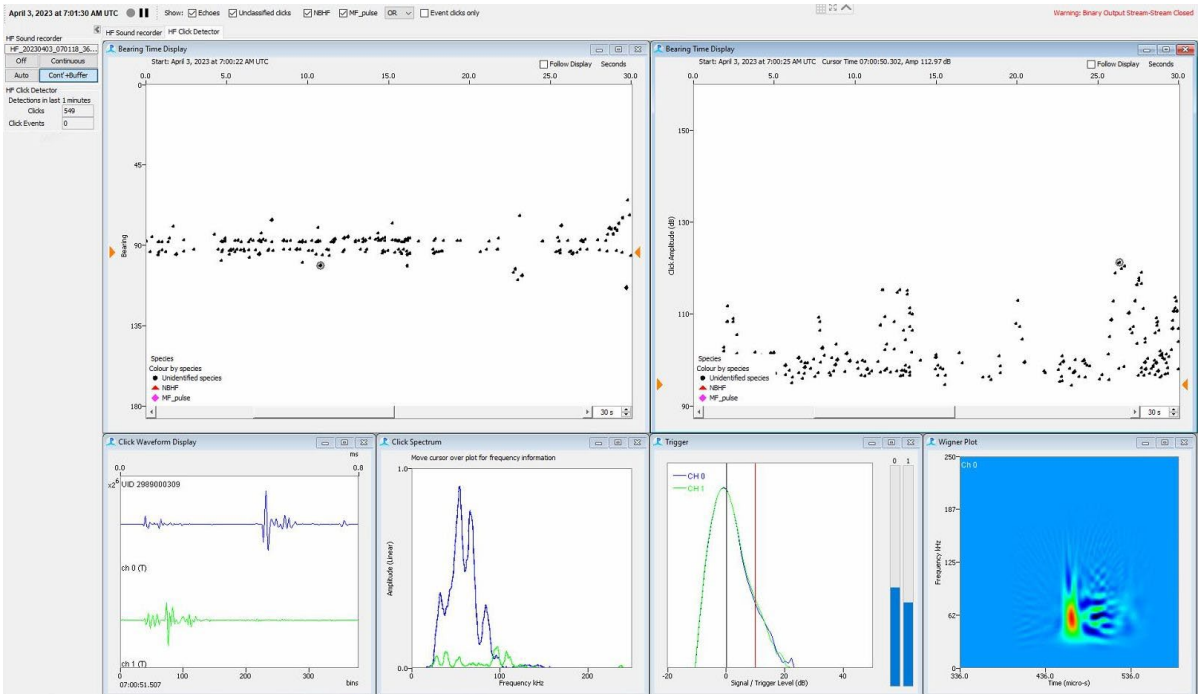


Figure 55: SWGAD#28 – Click trains of unidentifiable dolphins on PAMGuard's HF click detector

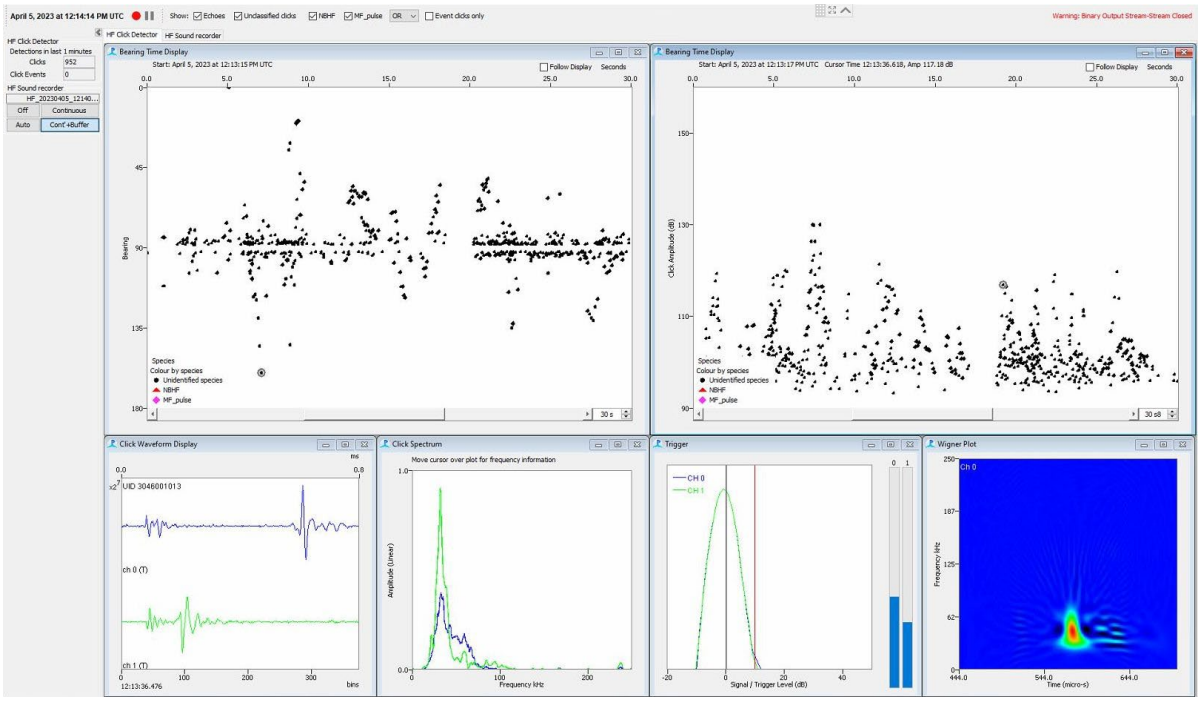


Figure 56: SWGAD#29 – Click trains of Clymene dolphins on PAMGuard's HF click detector

Appendix K: Detection Distribution Maps

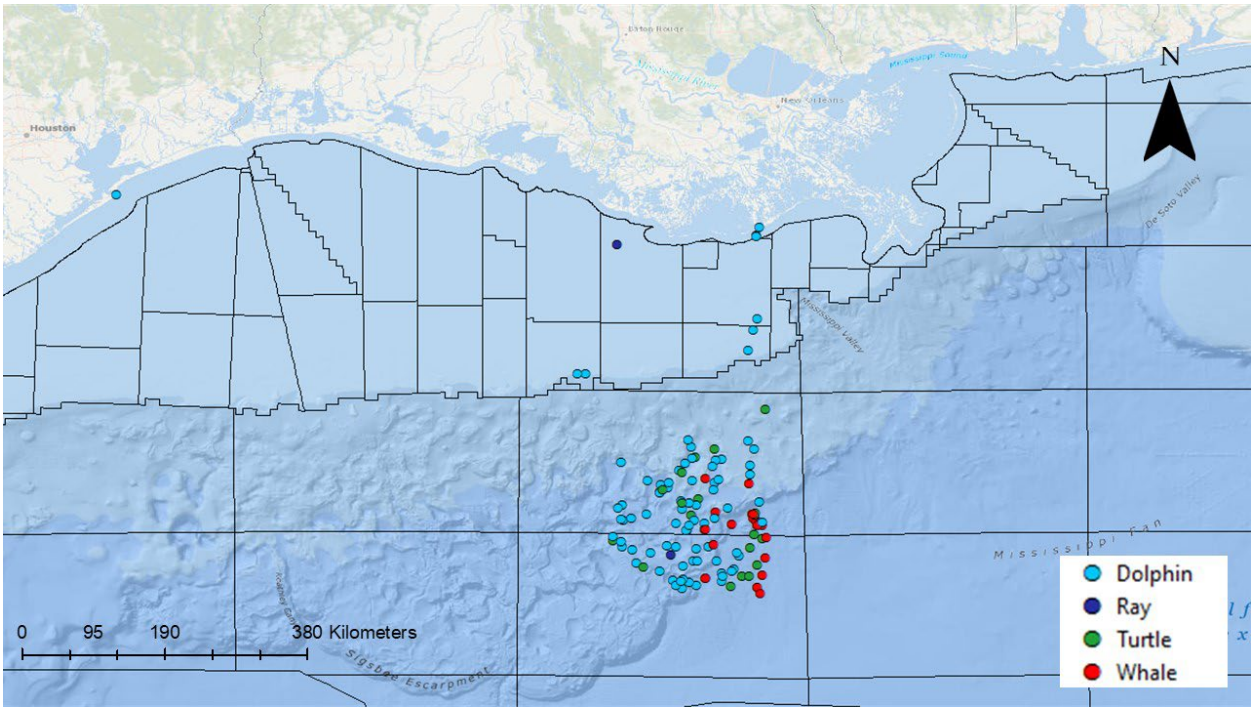


Figure 1: Detection distribution map for all species

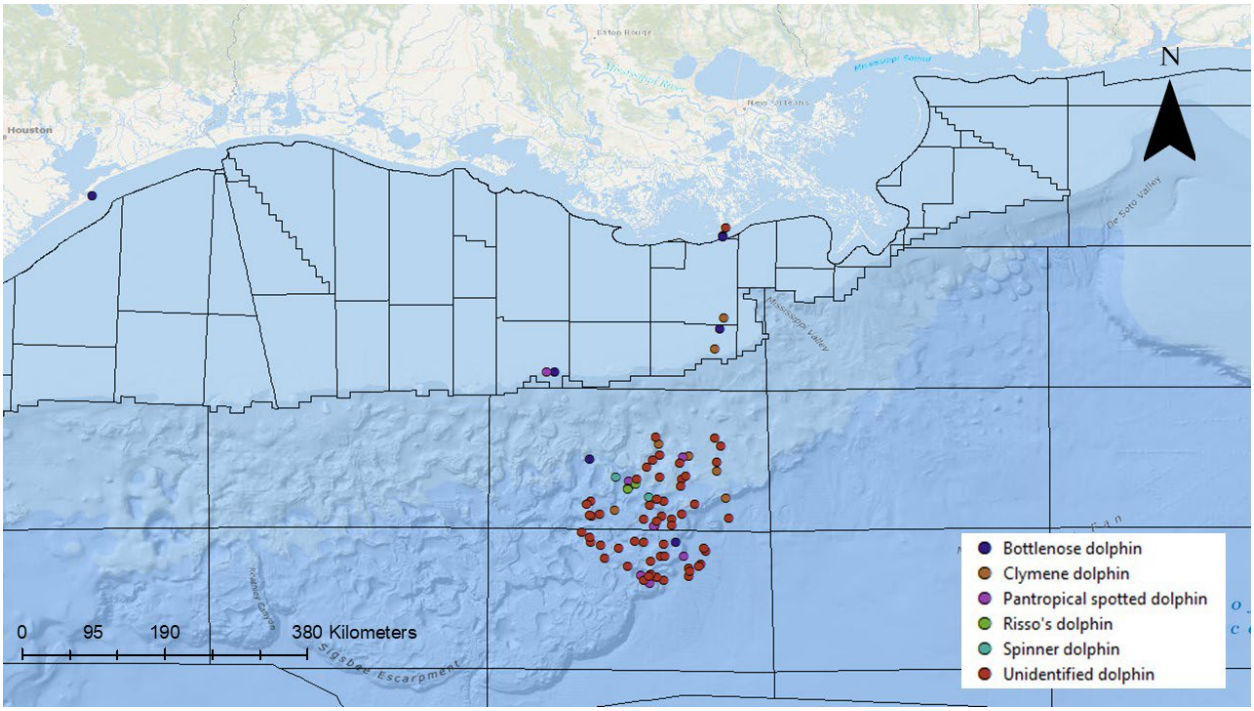


Figure 2: Distribution map for dolphins

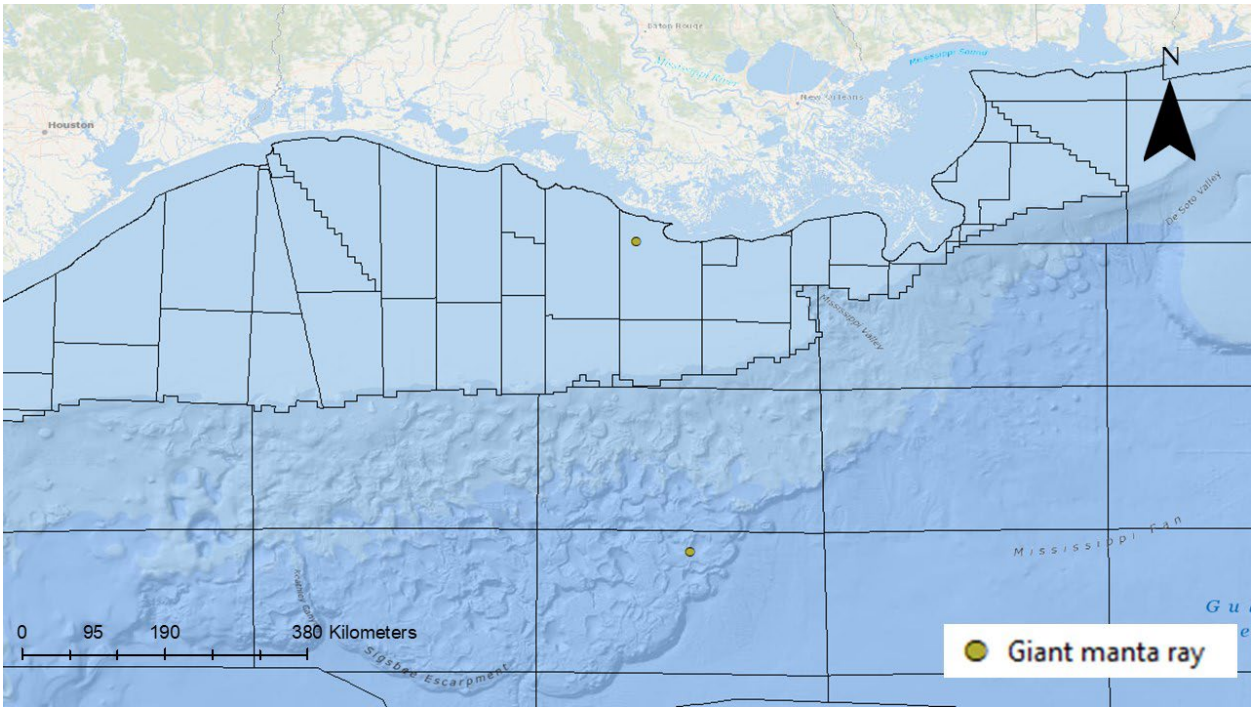


Figure 3: Distribution map for Giant manta ray

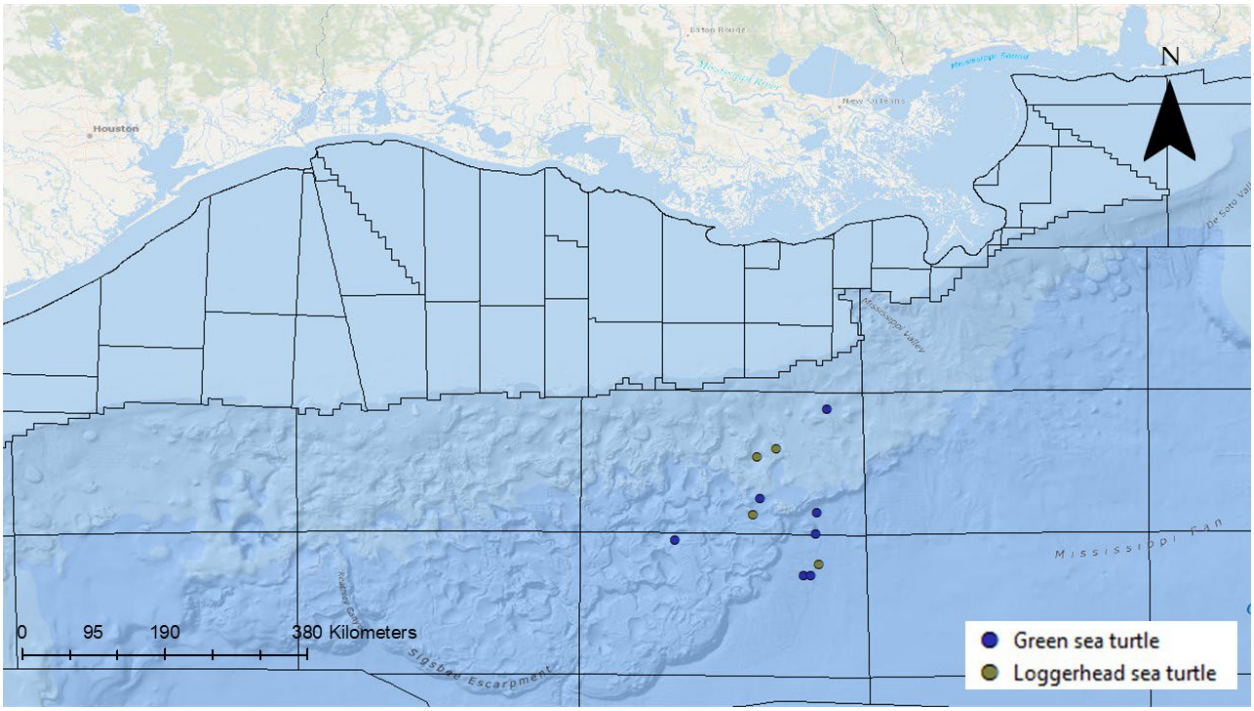


Figure 4: Distribution map for sea turtles

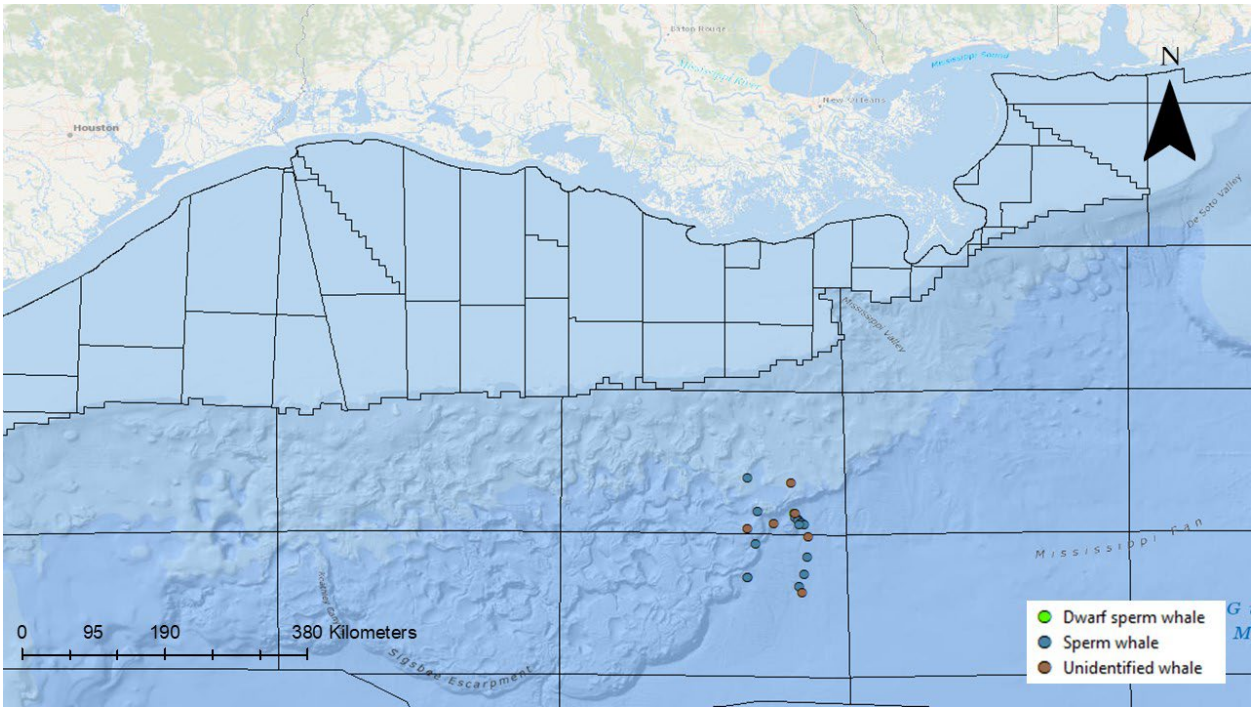


Figure 5: Distribution map for whales

Appendix L: Letters of Data Certification from Leads

Report Certification Statement

I, Sofia Juarez Sanchez, am familiar with the protocols outlined in Appendix A: Seismic Survey Mitigation and Protected Species Observer Protocols, implemented by the Bureau of Ocean Energy Management (BOEM) and Bureau of Safety and Environmental Enforcement (BSEE), which provide guidelines to operators in complying with the Endangered Species Act (ESA; 16 U.S.C. §§ 1531-1544) and Marine Mammal Protection Act (MMPA; 16 U.S.C. §§1361- 1423h).

I hereby certify that, to the best of my knowledge, the data collected by the Protected Species Observer (PSOs) offshore and the information that was provided to RPS by the PSO team for our vessel to compile this report is accurate.

Name: Sofia Juarez Sanchez

Position: Lead PSO

Date: jun. 7, 2023

Signed DocuSigned by: 38D5803F2CCA441...

I, Anna Williams, am familiar with the protocols outlined in Appendix A: Seismic Survey Mitigation and Protected Species Observer Protocols, implemented by the Bureau of Ocean Energy Management (BOEM) and the Bureau of Safety and Environmental Enforcement (BSEE), which provide guidelines to operators in complying with the Endangered Species Act (ESA; 16 U.S.C. §§ 1531-1544) and Marine Mammal Protection Act (MMPA; 16 U.S.C. §§1361- 1423h).

I hereby certify that, to the best of my knowledge, the information provided in this report that was compiled by the RPS Project Support Manager is accurate.

Name: Anna Williams

Position: Environmental Project Support

Date: Jun 8, 2023

Signed DocuSigned by: Anna Williams 3AEB4A1548B54FF...

Report Certification Statement

I, Erendira-Elizabeth Penfield-Espinosa, am familiar with the protocols outlined in Appendix A: Seismic Survey Mitigation and Protected Species Observer Protocols, implemented by the Bureau of Ocean Energy Management (BOEM) and Bureau of Safety and Environmental Enforcement (BSEE), which provide guidelines to operators in complying with the Endangered Species Act (ESA; 16 U.S.C. §§ 1531-1544) and Marine Mammal Protection Act (MMPA; 16 U.S.C. §§1361- 1423h).

I hereby certify that, to the best of my knowledge, the data collected by the Protected Species Observer (PSOs) offshore and the information that was provided to RPS by the PSO team for our vessel to compile this report is accurate.

Name: Erendira-Elizabeth Penfield-Espinosa

Position: Lead PSO

Date: Jun 21, 2023

Signed DocuSigned by: Eren Penfield E9D449891EBA43F...

I, Anna Williams, am familiar with the protocols outlined in Appendix A: Seismic Survey Mitigation and Protected Species Observer Protocols, implemented by the Bureau of Ocean Energy Management (BOEM) and the Bureau of Safety and Environmental Enforcement (BSEE), which provide guidelines to operators in complying with the Endangered Species Act (ESA; 16 U.S.C. §§ 1531-1544) and Marine Mammal Protection Act (MMPA; 16 U.S.C. §§1361- 1423h).

I hereby certify that, to the best of my knowledge, the information provided in this report that was compiled by the RPS Project Support Manager is accurate.

Name: Anna Williams

Position: Environmental Project Support

Date: Jun 21, 2023

Signed DocuSigned by: Anna Williams 3AEB4A1548B54FF...