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3D Marine Seismic Survey

ACCOBAMS MMO & PAM Report

Marine Seismic Survey

EPI Report No. E1118

Client	HELLENIQ UPSTREAM IONIO S.A.
Area	Block Ionio
Survey	3D MSS
Regulatory Reference	ΥΠΕΝ/ΔΙΠΑ/107567/7189
Dates	01-13 December 2022
Contractor	PGS
Vessel	M/V *Ramform Hyperion*
MMO and PAM Team:	Manuel Garcia, Dimos Pipinis, Kasia Lisson, Marta Rimada, Panagiotis Kourouklis, Tena Sarcevic

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Marine Mammal Observer and Passive Acoustic Monitoring Operator

FINAL REPORT

MISSION AT SEA FROM 01 TO 13 DECEMBER 2022
TYPE OF MISSION: 3D MARINE SEISMIC SURVEY

EPI GROUP REPORT PREPARED ON 27 JANUARY 2023
AUTHOR: MANUEL GARCIA (EPI) AND BRITTINY BENNETT (EPI)

REGULATORY REFERENCE: ΥΠΕΝ/Δ ΙΠΑ/107567/7189
EXPLORATION BLOCK: IONIAN BLOCK

MARINE MAMMAL OBSERVERS AND PASSIVE ACOUSTIC MONITORING OPERATORS FINAL REPORT

Survey dates	01-13 December 2022
Survey type	3D Marine Seismic
Client	HELLENiQ Energy
Contractor / Vessel	Petroleum Geo-Services (PGS)/*Ramform Hyperion*

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SUMMARY

This report covers the Marine Mammal Observer (MMO) and Passive Acoustic Monitoring (PAM) mitigation measures undertaken during the 3D Marine Seismic Survey on the M/V *Ramform Hyperion* from 1 December to 13 December 2022. MMO and PAM watches commenced on 29 November 2022 for seismic source testing. The survey was performed in the Ionian Block, offshore of West Greece in the Ionian Sea.

The seismic data acquisition commenced on 01 December and was completed on 13 December 2022.

There were nine (9) soft-starts during daylight, 15 at night and four (4) during dusk or dawn. Seismic operations were conducted over 16 days, during which 24 primary acquisition lines were completed, three (3) re-run lines, and six (6) source tests were performed.

Weather conditions recorded by the MMO team during the survey consisted of southeast winds Beaufort 5 to 6 and sea states Beaufort 5 to 6 predominating, with low swell heights. The Client/vessel recorded sea states of Beaufort 8 to 9 and 5 to 6 m wave heights during this survey.

The survey applied the approved Environmental Action Plan, based on ACCOBAMS Guidelines to address the impact of anthropogenic noise on cetaceans in the ACCOBAMS area.

A team of six (6) dedicated Marine Mammal Observers (MMOs) and Passive Acoustic Monitoring (PAM) operators were present on board to implement mitigation measures as required.

Combined acoustic and visual pre-watches were implemented before the start of all operations.

During the survey, 24 hours of combined visual and acoustical monitoring was maintained. All of the survey operations were in deep water and preceded by an MMO and PAM pre-shooting search period of 120 minutes.

Visual monitoring for marine animals resulted in 287:24 (hh:mm) of observer effort during the survey period, where 141:29 (hh:mm) corresponds to day visual and 145:55 (hh:mm) corresponds to night visual monitoring.

Acoustic monitoring for marine mammals resulted in 328:58 (hh:mm) of monitoring effort during the course of the survey.

Overall, 65.6% of monitoring effort took place while the acoustic source was active, and 34.4% took place while the acoustic source was not active.

There were four (4) visual sightings and two (2) acoustic detections of marine mammals.

There were 23 combined visual and acoustic pre-shooting searches, and four (4) during night using only PAM.

During the survey there were no incidences where seismic operations were delayed/shutdown due to the presence of marine animals within the exclusion zone (EZ).

There were no instances of non-compliance with the EAP and ACCOBAMS guidelines during operations.

The communication with the Seismic Operators and the mitigation team was professional, efficient, and effective.

1 Introduction

1.1 Project Information

This report details the procedures and results of marine mammal and sea turtle monitoring conducted during the 3D seismic survey in the Ionian Block of the Ionian Sea in Greek waters. The survey company Petroleum Geo-Services (PGS) carried out survey operations on behalf of HELLENiQ Energy on board the M/V *Ramform Hyperion* from 29 November to 13 December 2022.

The survey was completed following the conditions outlined in the approval from the regulator with reference ID: ΥΠΕΝ/ΔΙΠΑ/107567/7189, issued on 15 November 2022 by the Greek Republic, Ministry of Environment & Energy, and using the mitigation procedures outlined in the Environmental Action Plan (EAP) for the geophysical research program in the sea area of the Ionian Block, based on the *ACCOBAMS-MOP7/2019/Doc31Rev1* and JNCC Guidelines to address the impact of anthropogenic noise on cetaceans in the ACCOBAMS area.

1.2 Survey area

The marine seismic survey area covered Block Ionio off the coast of NW Greece, south of the island of Corfu, at the northeastern edge of the Ionian Sea (Figure 1). The minimum distance between the boundaries of the Concession Area and the coasts of Corfu Island is approximately six (6) km. The survey area was located within Greek territorial waters in Western Greece, with water depths ranging from 100 m to approximately 2,800 m (Figure 1).

There are seven (7) areas of interest for the conservation of marine/coastal habitats and species overlapping with the Ionian Block, including one NATURA 2000 protected area. These are shown in Table 1 and Figure 1.

Table 1 Areas of Interest overlapping with the Ionian Block

	AREAS OF INTEREST SUMMARY
NATURA 2000	Nisoi Paxoi kai Antipaxoi kai Evryteri Thalassia Periochi_GR2230004. Special Area of Conservation (SAC).
	Ionian Archipielago. Important Marine Mammal Area (IMMA).
	Eastern Ionian Sea and Gulf of Corinth (Greece). ACCOBAMS Critical Cetacean Habitat (CCH)
Other areas of interest	North East Ionian Sea. Candidate Important Marine Mammal Area (cIMMA).
	North East Ionian Sea Coast and Islands. Candidate Important Marine Mammal Area (cIMMA)
	Hellenic Trench. Ecologically or Biologically Significant Area (EBSA)
	Southern Adriatic and Northern Ionian Sea. Area of interest (AoI)

A total of 3.5% of the seismic survey length was within the “Ionian Archipelago” IMMA and ACCOBAMS “Eastern Ionian Sea and Gulf of Corinth (Greece)” CCH (refer to Figure 1).

Table 2 Coordinates of the survey area.

Latitude (DDM)	Longitude (DDM)
37° 33.45’ N	20° 35.45’ E
37° 39.85’ N	20° 12.35’ E

37° 30.66‘ N	20° 33.66’ E
37° 55.50’ N	20° 31.00’ E
37° 26.75’ N	20° 35.61’ E
37° 27.15’ N	20° 35.28’ E

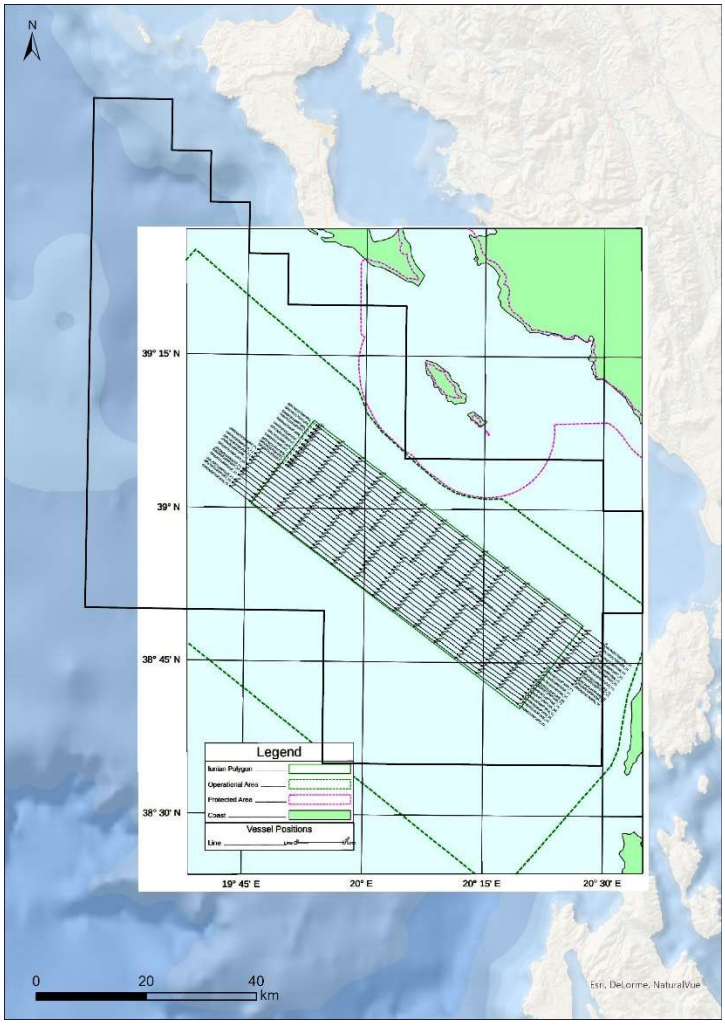

Figure 1 Location of the seismic survey.

1.3 Protected Species Occurrence

Several species likely to be present in the survey area are shown along with their IUCN status (IUCN, 2012) in Tables 2 and 3.

The waters of Ionian Sea are of key importance for Sperm and Cuvier’s beaked whales – cetacean species that typically prefer waters greater than 1000 metres deep (Frantzis et al., 2014), as well as for both Mediterranean marine turtle species: loggerhead (Caretta caretta) and green turtle (Chelonia mydas). Loggerheads use this area as a nursery ground for hatchlings (Casale & Mariani 2014), foraging grounds of juveniles (Camiñas et al., 2020, Mingozzi et al., 2016) and as a migratory corridor between western Greece and eastern Italy and Adriatic (Lazar et al., 2004, Casale et al., 2012). For green turtle, it is a developmental habitat (Camiñas et al., 2020) and a migratory route (Casale, 2018, Camiñas et al., 2020).

Table 3 Marine Mammals in the survey area

SPECIES GROUP	SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	IUCN STATUS (Mediterranean)
Baleen whales	Fin whale	*Balaenoptera physalus*	Endangered
Toothed whales	Sperm whale	*Physeter macrocephalus*	Endangered
	Cuvier's beaked whale	*Ziphius cavirostris*	Data Deficient
	Long-finned pilot whale	*Globicephala melas*	Data Deficient
	Risso's dolphin	*Grampus griseus*	Endangered
	Bottlenose dolphin	*Turisops truncatus*	Vulnerable
	Short-beaked common dolphin	*Delphinus delphis*	Endangered
	Striped dolphin	*Stenella coeruleoalba*	Least Concern
Seals	Monk seal	*Monachus monachus*	Critical Endangered

Table 4 Turtles in the survey area

SPECIES GROUP	SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	IUCN STATUS (Global)
Turtles	Loggerhead turtle	*Caretta caretta*	Least Concern*
	Green turtle	*Chelonia mydas*	Endangered
	Leatherback turtle	*Dermochelys coriacea*	Vulnerable

*IUCN Status for Mediterranean

2 Survey Equipment and Vessels Involved

2.1 Vessels

The seismic survey was undertaken from seismic vessel *Ramform Hyperion* (Figure 2), which was assisted by three support and chase vessels, the *Thor Omega (main support), the Vernicos Sifnos* and the *EDT Zenon* (Figure 3 and 4).

***RAMFORM HYPERION* SPECIFICATIONS**	
CALL SIGN	C6DB4
TYPE	SEISMIC Vessel
LENGTH	104.2m
BREADTH	70m
DRAFT	6.9 m (max)
GRT	20 637 t

Figure 2 Ramform Hyperion

***THOR OMEGA* SPECIFICATIONS**	
CALL SIGN	OZ2065
TYPE	SUPPORT VESSEL
LENGTH	55.10m
BREADTH	12.5m
DRAFT	4.85m
GRT	1153t

Figure 3 Thor Omega

***VERNICOS SIFNOS* SPECIFICATIONS**	
CALL SIGN	SVA7860
TYPE	SUPPORT VESSEL
LENGTH	38m
BREADTH	11.8m
DRAFT	5m
GRT	499t

Figure 4 Vernicos Sifnos

2.2 Survey Equipment

Details of the 3D equipment and configuration used to acquire data during the survey can be found in Table 5 and Figures 5 and 6.

Table 5: Survey equipment specifications

SOURCE	
Source type	Bolt
Number of sources	3
Air pressure [psi]	2000
Volume [cu in]	3280
Source separation [m]	50
Number of sub-arrays (per source)	2
Sub array separation [m]	8
Source length [m]	14
Source depth [m]	7
Shot point interval [m]	18.75
STREAMER	
Steamer type	GeoStreamer
Number of streamers	12
Length of streamers [m]	8100
Separation of streamers [m]	150
Depth of streamers [m]	25 PGS Standard front end
Group interval [m]	12.5
Acquisition bin size [m]	6.25 in-line

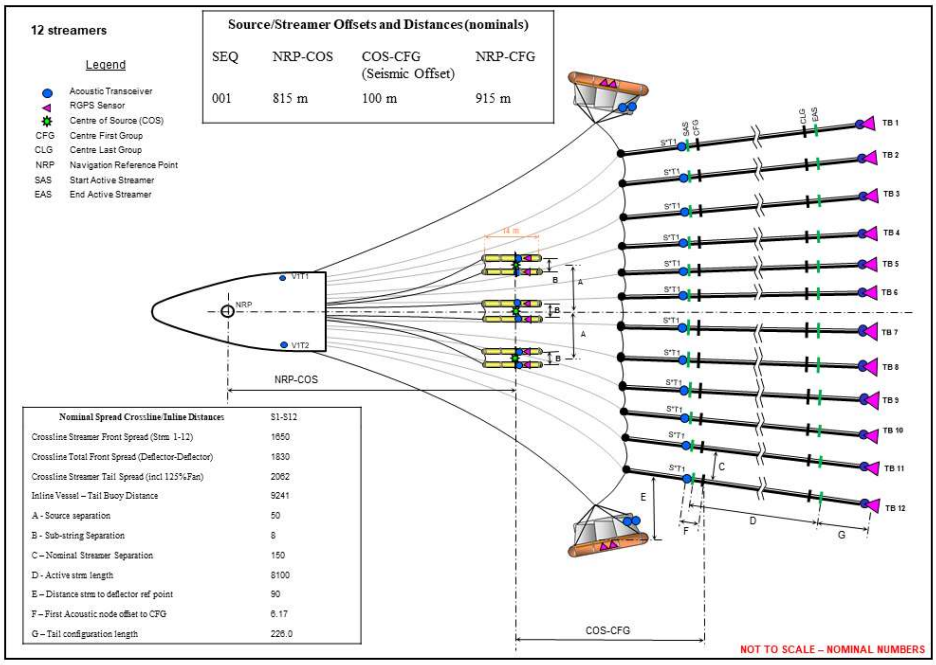

Figure 4: Survey equipment configuration (not in scale)

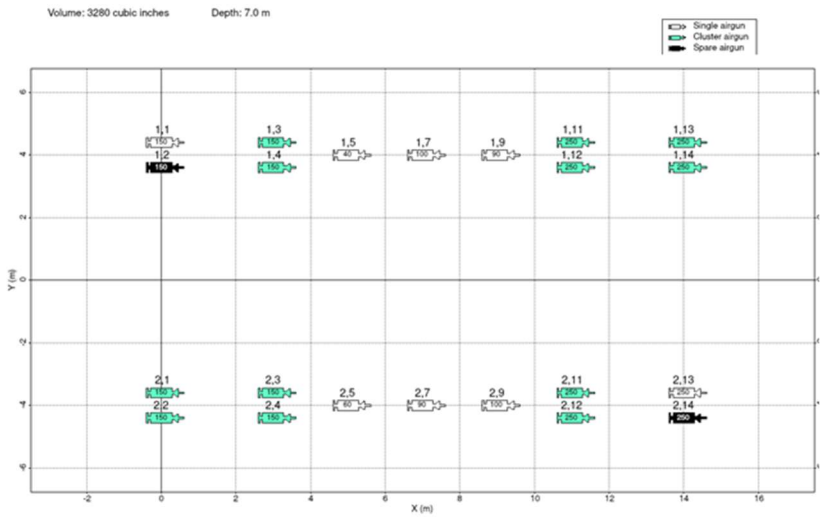

Figure 5: Air gun array.

3 Mitigation Measures

The survey followed the Environmental Action Plan (EAP) recommendations approved by the Directorate of Environmental Licensing in the Greek Ministry of Environment and Energy, under approval with reference ID: ΥΠΕΝ/Δ ΙΠΑ/107567/7189, the competent national regulator body, the Ministry of Environment and Energy, the General Directorate of Environmental Policy, and the Environmental Licensing Department. These recommendations were designed to minimize the risk of injury and disturbance to marine mammals and sea turtles from anthropogenic noise in the Concession Area of the Ionian Block in the Ionian Sea.

The EAP measures for the project were based on the Guidelines from the *Agreement on the Conservation of Cetaceans of the Black Sea, Mediterranean Sea and Contiguous Atlantic Area* (ACCOBAMS).

Table 6: Mitigation requirements summary

	MITIGATION PROCEDURES SUMMARY
Mitigation Team	At least two dedicated Visual Observers should be on continuous watch at the same time during all seismic operations (24h visual monitoring).
	24 hours PAM. At least one operator should be on watch and shifts should be organized to allow 24/24h monitoring, unless automatic detection/alerting systems with proven effectiveness are available.
Species covered	Marine mammals and sea turtles.
Exclusion zone	750 m for dolphin species and sea turtles.
	1500 m extended exclusion zone for sperm whales and beaked whales.
Pre-watch period	30 minutes in shallow waters (< 200 m).
	120 minutes in deep waters (> 200 m) due to the presence of deep diving species.
Soft-start length	Minimum 20 min.
	Maximum 40 min from soft-start to start acquisition line.

Soft-start	At least one soft-start should be recorded.
Soft-start delays	30 minutes after last sighting.
	Extended to 120 minutes after last sighting of Cuvier´s beaked whales and Sperm whales.
Shutdown during production	Immediate shutdown is required if marine mammals/sea turtles in Exclusion Zone.
	Distressed behaviour is observed anywhere in the monitoring area.
	Aggregations of vulnerable species (Cuvier's beaked whales, sperm whales) anywhere in the monitoring area.
Air-gun Testing	Pre-watch must be carried out before any gun testing.
	If testing a single gun, no soft-start required.
	If testing multiple guns, a soft-start (minimum 20 minutes) is required. Guns should be tested in order of volume, smallest first.
	40 minutes maximum from soft-start beginning to start of line
Operation suspended	Less than 10 min, ask MMO/PAM for clearance.
	More than 10 min, a new pre-watch must be undertaken.
Line Turns	Longer than 40 minutes, firing is to be terminated at the end of the survey line.
Additional requirements	**TWO VISUAL OBSERVERS**. At least two dedicated Visual Observers should be on continuous watch at the same time during all seismic operations.
	24 hours PAM OPERATOR. At least one operator should be on watch and shifts should be organized to allow 24/24h operation, unless automatic detection/alerting systems with proven effectiveness are available.
	NO SEISMIC ACQUISITION IN PROTECTED AREAS. The seismic vessel could enter Natura areas to perform turning maneuvers, however no seismic survey activities will take place within the NATURA 2000 protected areas and a buffer of 1000 m around them.
	TURTLE GUARD. Due to presence of sea turtles in the survey area, a turtle protection system (Turtle Guard) should be installed on the towed equipment to prevent any accidents.
	SEABIRDS. To mitigate the impact on the seabirds, the external lighting should be limited. Furthermore, all injure seabirds must be assisted to regain consciousness and released back into the environment following the appropriate instructions.

4 Monitoring Methodology

4.1 Marine Mammal Mitigation Team

The MMOs and PAM Operators' role was to monitor that the seismic operations were conducted in accordance with the permit, EAP and ACCOBAMS Guidelines to minimize the impact to marine mammals

and from anthropogenic noise. The Marine Mammal Mitigation Team (MMOs and PAM Operators) included six (6) trained and experienced MMO and/or PAM Operators per rotation.

During the survey, communication via UHF radios was established between the MMOs themselves and the seismic observers as well. UHF radios allowed the MMOs to track changes in source activity and to communicate effectively given the need to implement a mitigation procedure. Additionally, the Seismic Observers provided at least 120 minutes' notice to the MMOs prior to any source activation, as well as requesting for clearance for activating the sources and informing of timing on any change in air gun activity (such as soft-start commencement, full volume reaching, tests and source stopped), and maintained a log of source activity and soft-starts, which was made available to the MMOs whenever requested.

4.2 Visual Monitoring

MMOs carried out 24-hour coverage of continuous visual monitoring.

4.2.1 Day Visual Monitoring

Two (2) dedicated MMOs conducted continuous visual monitoring during daylight hours, from sunrise to sunset. Shifts were arranged to allow breaks each two hours or switching to PAM position.

The main platform of observation was located on the bridge, bridge-wings and monkey deck, which allowed 360-degrees of visibility at 20.27 m and 23.17 m elevation above sea level respectively. A front view lounge also available where the MMO station was located at 17.52 m high (Table 7 and Figures 7 and 8).

Figure 6 Observation Platforms.

Table 7: Observation Platforms.

PLATFORM	HIGH (m)	VISIVILITY
Deck Wings (A)	20.27	360°
Bridge (B)	20.27	360°
Front View Lounge (C)	17.52	180°
Monkey Deck (D)	23.17	360°

Figure 8 Long distances binoculars on 'Monkey Deck'

4.2.2 Night Visual Monitoring

One of the MMOs at the time switched to night visual monitoring after sunset until before the sunrise. Two (2) dedicated dual-role MMO/PAM Operators performed the main hours of the night-shift, conducting the visual monitoring at the time by combining with acoustic monitoring each two (2) hours. First and last hours of the dark were covered by day-shift personnel.

4.2.3 Visual Monitoring Equipment

Combined use of the naked eye with binoculars and long distance binoculars (*big-eyes*) in addition to night vision gear, during dark hours, was used to monitor the sea surface visually. The distance was estimated using a range-finder stick and reticle binoculars. Equipment is described below in Table 8. Several field guides were available to assist MMOs in species identification when necessary.

MMO effort, sightings, and operations of seismic activity were recorded following ACCOBAMS template forms to monitor compliance with the permit, Environmental Action Plan, and the ACCOBAMS guidelines.

Table 8: MMO equipment specifications

MMO EQUIPMENT	
CAMERA	Olympus SP-1000EE Dot Frame
	Nikon D300s 80-200 f.20.8
	Canon SX50 HS 35mm equv.
	Olympus E-510 (Lens 40-150 mm 1:4-5.6)
BINOCULARS	Bernard Optic 8x32
	Nikon Sporter 10x50
	Bushnell Marine 7x50 with compass and Reticles
	Bushnell Marine 7x50 with compass and Reticles
LONG DISTANCE BINOCULARS	Fujinon Binoculars LR-150 25x150 MT
THERMAL CAMERA	Pulsar Axion LRF XQ35 35mmx2-8
NIGHT VISION MONOCULAR	Falcon Digital NV 007 32mmx5

4.3 Acoustic Monitoring

Passive Acoustic Monitoring (PAM) was conducted 24-hours per day during the entire project. The PAM system used was Seiche. A technician from Seiche Ltd. carried out the installation at Algeciras, Spain on 11 and 12 November 2022, prior to the start of operations. The system used conventional towed array cables, and the on board PAM electronics were located in the rack room. The PAM Operator was monitoring and controlling the system over a local area network, from a local monitoring station (mini-PC) located in the common area just outside the Instrument Room.

The PAM equipment and software were fully tested. Seiche provided full support during the survey. The vessel carried a total of four (4) identical tow cables, two (2) deck ‘jumper’ cables and a complete backup set of electronics.

There were four (4) dual-role MMO/PAM operators on board covering 24-hours continuous acoustic monitoring. All pre-shooting searches during night hours were covered both by the PAM Operator and the MMO conducting night visual monitoring.

4.3.1 Hydrophone Array

The towed hydrophone array consisted of four (4) hydrophones and pre-amplifiers, and a 10-bar rated depth sensor. The front two (2) hydrophones (H1, H2) are spherical elements with a broad band response (nominally 0.2-200 kHz, -3 dB points); the rear two (2) hydrophones (H3, H4) are also spherical elements, with a higher frequency response (nominally 2-200 kHz). The hydrophones are mounted on a 250 m, 14 mm diameter cable. Broadband channel sensitivity (at the output from the pre-amplifier) is -155 dB re 1 V/µPa (Hydrophone sensitivity is -195 dB re 1 V/µPa and preamplifier gain is -40 Db). Spacing between H1 and H2 is 2.0 m; there is 13 m between H2 and H3, and 0.25 m between H3 and H4. A 20 m rope drogue is fastened to the end of each cable to promote a 'flat' tow through the water.

4.3.2 Electronic Processing System

The electronic processing system consisted of the following parts (Figure 9):

- Buffer box interface unit
- RME Fireface 800 analogue-digital converter (ADC)
- National Instruments USB-6251 data-acquisition device.
- Measurements Computing PMD 1208LS ADC (depth data for the backup tow system).
- Windows 10 PC.
- JTS SIEM 11-R Wireless Audio Transmitter and Receiver.

Buffer box circuitry splits each hydrophone input into low frequency (LF) and high frequency (HF) band outputs. All four (4) LF channels are input to an RME Fireface 800 sound card. In standard configuration, two (2) channels (H1, H2) are digitized at 48 kHz, 24bit. The Fireface is connected to PC via a firewire 800 cable. RME software allows the PAM operator to control which hydrophone signals are monitored over headphones. The headphone mix typically consists of either the raw hydrophone signals or the processed playback signals from the PC. The playback output is subject to a veto (PAMGuard software module) that removes the sound of the airgun shots ('seismic veto'). The HF output of the buffer box is digitized at the buffer box by the National Instruments data acquisition card at 500 kHz, 16 bit (H3, H4) and sent to the PC via USB. The PC was custom-built by Seiche and runs on Microsoft Windows 10 64 bit.

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Figure 7 PAM electronics

4.3.3 Local Monitoring Station

The Local Monitoring Station (LMS) was set-up in the common area close to the instrument room (Figure 10). The LMS consisted of a mini 'net-top' PC, two wide-screen display monitors and a pair of headphones. A remote desktop connection to the base station was patched through from the rack room. The software NetSupport Manager is used to control the base station systems. A stereo audio stream was broadcast from the Fireface sound card over the local area network connection to the LMS. The audio stream consists of either the H1+H2 hydrophone signals, H3+H4, or the Veto playback channels, as selected by the PAM

operator. An Unreal software suite is used to control the audio broadcast (Unreal Live Server, Media Server and Media Player).

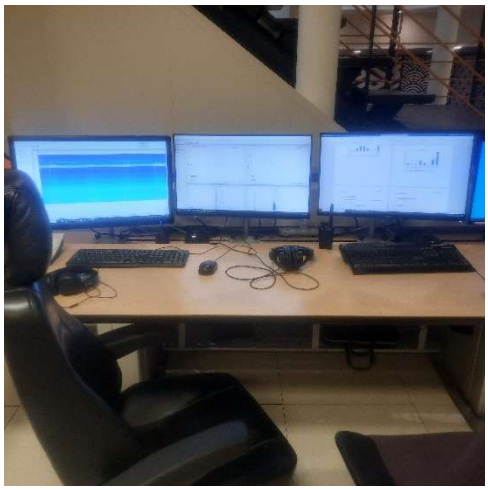

Figure 8 Local monitoring station

4.3.4 GPS

The vessel navigation department provided the NMEA string $GP GGA, at 9600 baud, from the Starfix system. This was delivered to the PC base station.

4.3.5 Deployment

A sliding collar on a 12th lead-in on the port side was the towing point for the 90 m free end of the PAM cable that incorporates the hydrophone array (20 m). The cable between the collar and the stern of the vessel (120 m) was coupled with a rope to relieve the cable from towing forces (taped every 4-5 m on the cable) and both were suspended below the lead-in using a second sliding collar and four (4) large quick-links ('p-links'). The loop end of this rope on the stern end was used as the towing point of the PAM cable on the stern (using a large quick-link attached to rope running on an overhead winch on deck). Both sliding collars and four (4) quick-links were attached to the cable via double rope eyes and using cable grips, which distribute the tension over the sheath of the cable when it is being towed and when the cable and collar are winched back onboard. The last 40 m of PAM cable from the stern towing point to the deck connector were laid on deck in a figure 8 arrangement close to the deck connector.

Both sliding collars and all four (4) quick-links were submerged after deployment. A chain weight of 3 kg was attached with tape to the PAM cable at 15 m distance from hydrophone array. The depth of the hydrophone array was between 20 – 30 meters approximately during the survey, with variability depending on the vessel speed. The cable was loaded onto a mechanical winch, which was utilized to facilitate cable deployment and retrieval.

The PAM tow cable was deployed and recovered to spur-line winches, once the seismic streamers and paravanes had been fully deployed. The end of the cable was connected to the deck cable that was installed between the streamer deck and the rack room when *Ramform Hyperion* was rigged.

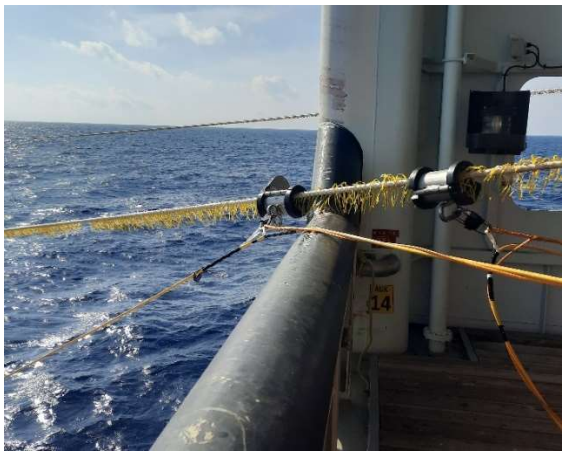

Figure 9. Slide collar over the lead-in (during deployment).

Figure 10. Cable deployed on lead-in 12.

4.4 PAM monitoring techniques

4.4.1 Software

The primary PAM software used was PAMGuard version 2.02.03 (64 bit). PAMGuard was configured to acquire data from both the Fireface 800 (LF) and the National Instruments USB-6251 data-acquisition device (HF). The data model includes a 1024 pt FFT and spectrogram displays, LF and HF click detectors, whistle and moan detectors, a map display, LF and HF sound recorders, a seismic veto and a sound output module. An SQLite database interface was included in the model to receive outputs from the detector modules, GPS data, user input on PAM effort and detections, and information on PAMGuard configuration settings and status. The map display plots the vessel track, the location of animal detections, and shows the marine mammal exclusion zone around the vessel and projected for 20 min ahead of the ship. Bearing lines to marine mammal detections can also be displayed on the map. A regional base map was provided, generated from the GEBCO Digital Bathymetric Atlas.

Throughout the survey the echosounders signals were displayed on the spectrogram screen at a frequency of 12 kHz and 38 kHz respectively.

5 Results

The following results are based on the data collected throughout the duration of this project onboard the survey vessel *Ramform Hyperion* from 29 November to 13 December 2022.

5.1 Operations summary

From the first day of operations on 29 November to 13 December 2022, when the project was completed, a total number of 30 active source sequences occurred, consisting of three (3) test lines, 21 primary lines, three (3) re-run lines and three (3) source tests.

Of the total active source sequences (including tests and acquisition lines), 13 were initiated during daylight hours and 17 during hours of darkness. In total, 255 hours 42 minutes of active source were recorded throughout, comprising soft-starts, gun tests and production lines.

On one (1) occasion, the active source was stopped due to technical issues while on an acquisition line.

An automated system allowed the soft-start to be set at a 21-minute duration. There were 11 soft-starts which took place during daytime and 17 during dark hours. There was an average time of 33 minutes between the beginning of soft-start and the start of the acquisition line and no approach exceeded the 40-minute maximum referenced in the EAP. The source was never active within protected areas.

Table 9 shows the operations summary and a sample of a recorded soft-start can be found in Table 10.

Table 9 Seismic Operation Summary

OPERATIONS SUMMARY (29th February to 13th December 2022)		
SOURCE ACTIVITY TIME	Total Source Active (hh:mm)	207:42
	Total Soft-Start to SOL (hh:mm)	15:46
	Total Full Volume Source Time (hh:mm)	193:56
	Total Source Test time (hh:mm)	03:41
	Minimum Soft-Start Time (hh:mm)	00:21
	Maximum Soft-Start Time (hh:mm)	00:21
SOURCE ACTIVITY NUMBER	Total N° of Lines (including re-runs)	24
	Total N° of Soft-Starts	28
	Total N° of Source Test	6
	Total N° of Source Test followed by a Line	0
	Total N° of Source Test during dawn/day	3
	Total N° of Source Tests during night/dusk	3
	Total Nº of Soft-Starts during dawn/day	11
	Total Nº of Soft-Starts during night/dusk	13
MITIGATION ACTION	Nº of mitigation actions initiated	0
NON-COPLIANCE	Nº of incidences of non-compliance	0

Table 10 Outline of the soft-start procedure

STEP	DATE	TIME (UTC)	NUMBER OF AIRGUNS	VOLUME (cu. in.)	Pressure (psi.)	Volume %
1	04/12/2022	14:15:00	1	40	2020	1,2
2	04/12/2022	14:16:00	2	100	2020	3,0
3	04/12/2022	14:16:00	3	190	2020	5,8
4	04/12/2022	14:17:00	4	280	2020	8,5
5	04/12/2022	14:18:00	5	380	2020	11,6
6	04/12/2022	14:18:00	6	480	2020	14,6
7	04/12/2022	14:19:00	7	630	2020	19,2
8	04/12/2022	14:20:00	8	780	2020	23,8
9	04/12/2022	14:21:00	9	930	2020	28,4
10	04/12/2022	14:22:00	10	1080	2020	32,9
11	04/12/2022	14:23:00	11	1230	2020	37,5
12	04/12/2022	14:24:00	12	1380	2020	42,1
13	04/12/2022	15:25:00	13	1530	2020	46,6
14	04/12/2022	14:27:00	14	1780	2020	54,3
15	04/12/2022	14:28:00	15	2030	2020	61,9
16	04/12/2022	14:30:00	16	2280	2020	69,5
17	04/12/2022	14:32:00	17	2530	2020	77,1
18	04/12/2022	14:33:00	18	2780	2020	84,8
19	04/12/2022	14:35:00	19	3030	2020	92,4
20	04/12/2022	14:36:00	20	3280	2020	100,0

5.2 Weather conditions

The weather can affect the probability of detecting marine animals, with increasing sea state, swell height and wind speeds, and decreasing visibility, reducing the probability of visually detecting marine mammals (Forney, 2000). This is particularly true of species with inconspicuous surfacing behavior (Palka, 1996).

As environmental conditions heavily influence the likelihood of observing marine mammals, several weather-related variables were recorded during MMO watches. These variables and the percentage of time spent observing during different states are illustrated below (Figure 12). Weather conditions were recorded when visual monitoring was conducted during the daylight hours.

The sea state was predominantly Beaufort 5 and 6 during visual monitoring (29.4% and 26.3% respectively) and the swell height was predominantly low (<2 m) at 62.2%, but 37.8% of the time was moderate (2-4m) and high (>4m). The Client/vessel recorded sea states of Beaufort 8 to 9 and 5 to 6 m wave heights during this survey.

Wind speeds between Beaufort force 1 and 8 were recorded with the most dominant wind speed being Beaufort force 5 and 6 (29.0% and 26.3% respectively). Wind direction was predominantly from the southeast (47.1%).

There was mainly no rain (80.7%) with some periods of precipitation and visibility was good (>5 km) for 74.8% of the monitoring time, with periods of haze and rain. Predominantly, there was no sun glare (42.6%).

Weather conditions on watch were good for 54.4% (Figure 13) of the monitoring time with a sea state less than Beaufort 4, swell less than 2 m, and visibility greater than 5 km. When one or more of these variables

were different, sighting conditions were considered as moderate/poor, accounting for 45.6% of the monitoring time.

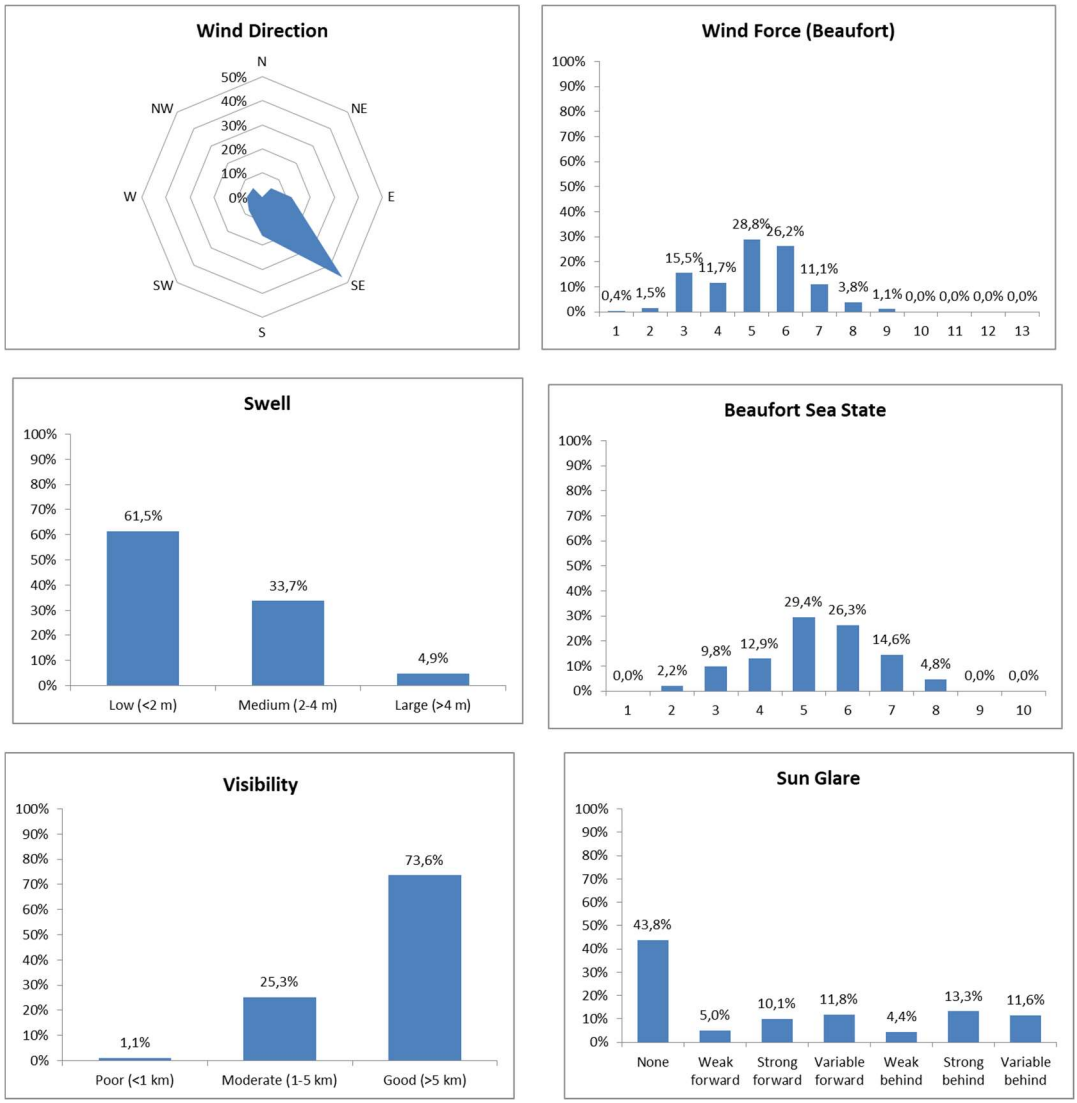

Figure 11: Weather condition during visual monitoring

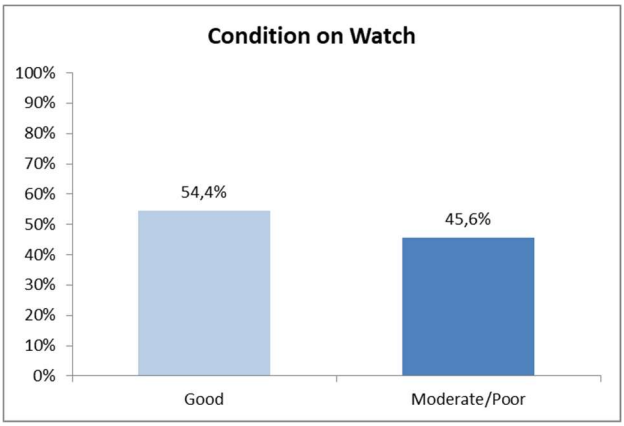

Figure 12: Weather conditions on watch

5.3 Visual and acoustic monitoring effort

From the first day of the 3D seismic survey operations on 29 November through 13 December 2022, when the project was completed, a total number of 27 pre-shooting searches were conducted, including 23 combined visual and acoustic pre-shooting searches. All pre-shooting searches were conducted in deep waters (> 200 m) with 120 minutes duration each.

Table 11 Marine mammal mitigation summary

EFFORT MONITORING SUMMARY (29 November to 13 December 2022)		
MONITORING EFFORT	Total visual observation (hrs/min)	287:24
	Day visual Observation (hrs/min)	141:29
	Night visual observation	145:55
	Total acoustic monitoring (hrs/min)	328:58
	Total monitoring (hrs/min)	616:22
MONITORING EFFORT & SOURCE ACTIVITY	Total effort whilst source was inactive	212:15
	Total effort whilst source was active	379:06
PRE-SHOOTING SEARCH EFFORT	Total Nº of Pre-shooting searches	27
	Nº of Pre-shooting searches in shallow	0
	Nº of Pre-shooting searches in deep	27
SIGHTINGS & DETECTIONS	Nº of cetacean sightings	4
	Nº of seals sightings	0
	Nº of turtle sightings	0
	Nº of acoustic detections	2
MITIGATION	Nº of mitigation actions initiated	0
NON-COMPLIANCE	Nº of incidences of non-compliance	0

A total of 287:24 (hh:mm) of dedicated marine mammal watches were carried out by the MMOs, 141:29 (hh:mm) took place during daytime and 145:55 (hh:mm) were during the night. A total of 328:58 (hh:mm) of dedicated marine mammal acoustic monitoring was carried out by the PAM Operator from 29 November to 13 December 2022. Out of the total 616:22 (hh:mm) of monitoring effort, 404:07 (hh:mm) (65.6%) were completed while the acoustic sources were active and 212:15 (hh:mm) (34.4%) were completed while the acoustic sources were silent (Figure 16).

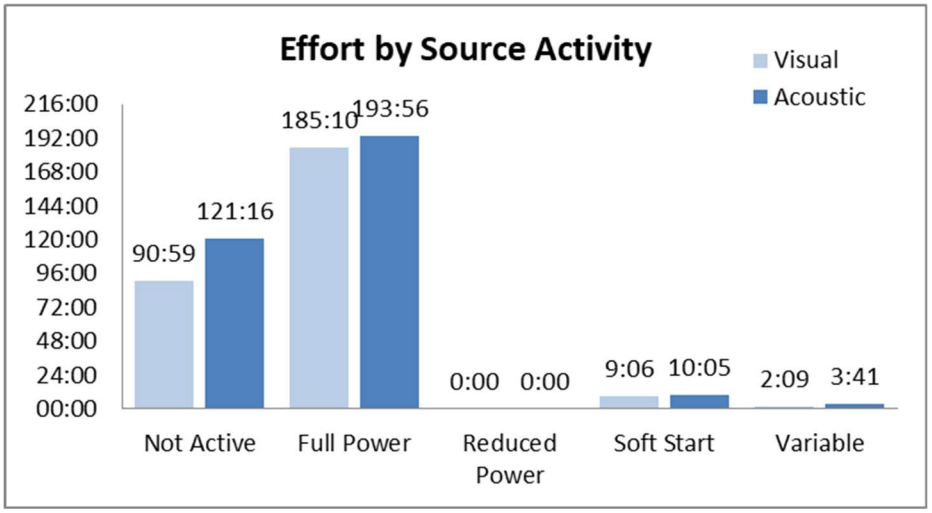

Figure 13 Time in hh:mm of visual and acoustic effort by source activity.

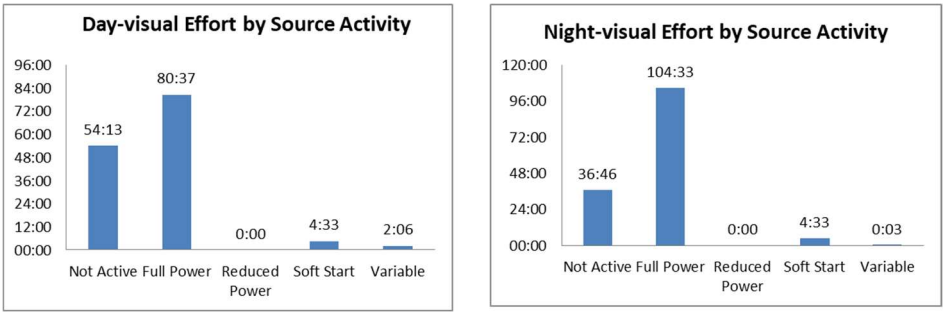

Figure 14 Day and night visual effort by source activity

5.4 Visual sighting

The survey was conducted in the Ionian Sea, West coast of Greece, where depths varied between 91 m and over 2759 m, allowing for the possibility of encountering both deep-water and shallow-water species.

In total, there were four (4) marine mammal sightings, all of them positively identified as common dolphins (*Delphinus delphis*). This dolphin species was recorded previously in the area. Species identification was also confirmed by reference to a field guide (Svensson et al. 1999).

Tables 12 and 13 provide a selection of the data collected during each sighting and acoustic detections, including species, range to source, and source status at the time of the sightings/detections.

Table 12 MMO sightings records

ID #	Common Name	Species	Individuals#	Latitude (DDM)	Longitude (DDM)	Time (UTC)	Source Activity at Initial Detection	Closest Approach to Source (m)	Mitigation Action
001	Common dolphin	*Delphinus delphis*	8	39° 08,03 'N	19° 43,02' E	14:49	Not Active	2407	None Required
002	Common dolphin	*Delphinus delphis*	3	39° 09,40' N	19° 43,00' E	15:08	Not Active	765	None Required
003	Common dolphin	*Delphinus delphis*	2	38° 37,63' N	20° 25,24' E	5:50	Not Active	836	None Required
004	Common dolphin	*Delphinus delphis*	115	38° 55,74' N	19° 53,91' E	12:39	Full Volume	856	None Required

Sighting ID# 001: On 2 December 2022 at 14:49 UTC, a group of eight (8) common dolphins (*Delphinus delphis*) (four (4) adults, one (1) juvenile, three (3) calves) was seen at 4000 m in front of the vessel, heading in opposite parallel direction, then changed their direction perpendicular of the vessel heading. The closest distance to the vessel was 1800 m. The sighting lasted from 14:49 UTC to 14:57 UTC. The dolphins were seen travelling and head slapping. No seismic activity occurred during the encounter.

Sighting ID# 002: On 2 December 2022 at 15:08 UTC, a group of three (3) individual common dolphins (*Delphinus delphis*) was seen surfacing once at 15:08 UTC, 700 m from the vessel, heading parallel opposite direction. At 15:17 UTC, individuals were seen further away, at 3000m, surfacing a few times and travelling parallel with the vessel. It is possible that this smaller pod is related to the scattered dolphin family from the previous sighting.

Sighting ID# 003: On 12 December 2022 at 5:05 UTC, two (2) individual common dolphins (*Delphinus delphis*) were sighted. Only three (3) jumps were seen, including full body leaps above the surface at a high speed and in various directions. No seismic activity occurred during the encounter.

Sighting ID# 004: On 12 December 2022, 15 individual common dolphins (*Delphinus delphis*) were sighted in a synchronized group, displaying full body leaps above surface while in fast speed travel. The group was seen once while acquisition was in full volume.

5.5 Acoustic detections

Table 13 PAM operator acoustic detection records

ID #	Common Name	Species or Lowest Classification	Individuals#	Latitude (DDM)	Longitude (DDM)	Time (UTC)	Source Activity at Initial Detection	Closest Approach to Source (m)	Mitigation Action
500	Unidentified dolphin	Delphinidae	1	38° 44,73 ' N	20° 12,07' E	15:38	Not Active	Not Located	None Required
501	Unidentified dolphin	Delphinidae	1	38° 53,07' N	20° 09,59' E	23:47	Full Volume	<750	None Required

Acoustic detection ID# 500: On the 30 November 2022 at 15:38 UTC, there was one (1) detection of an unidentified dolphin at an initial bearing of 65°/295° from the vessel heading. Echolocation click trains were detected on the mid-frequency (MF) spectrogram and the high frequency (HF) click detector, displaying a frequency range of 18-65 kHz and low amplitude, below 120 dB re 1µPa. At 15:43 UTC, four (4) upsweep whistles, each with 7 to 11 kHz frequency, were aurally detected and identified on the spectrogram during the post-analysis. Echolocation click trains started reaching higher amplitudes with a peak of 137 dB re 1µPa until the last signal was detected at 15:46 UTC. The clicks were not localized on the map. However, the signal was very faint so the Operator confirmed the detection was outside of the exclusion zone. Since the vessel was in stand-by and sources were non active, no mitigation action was required, as per protocol.

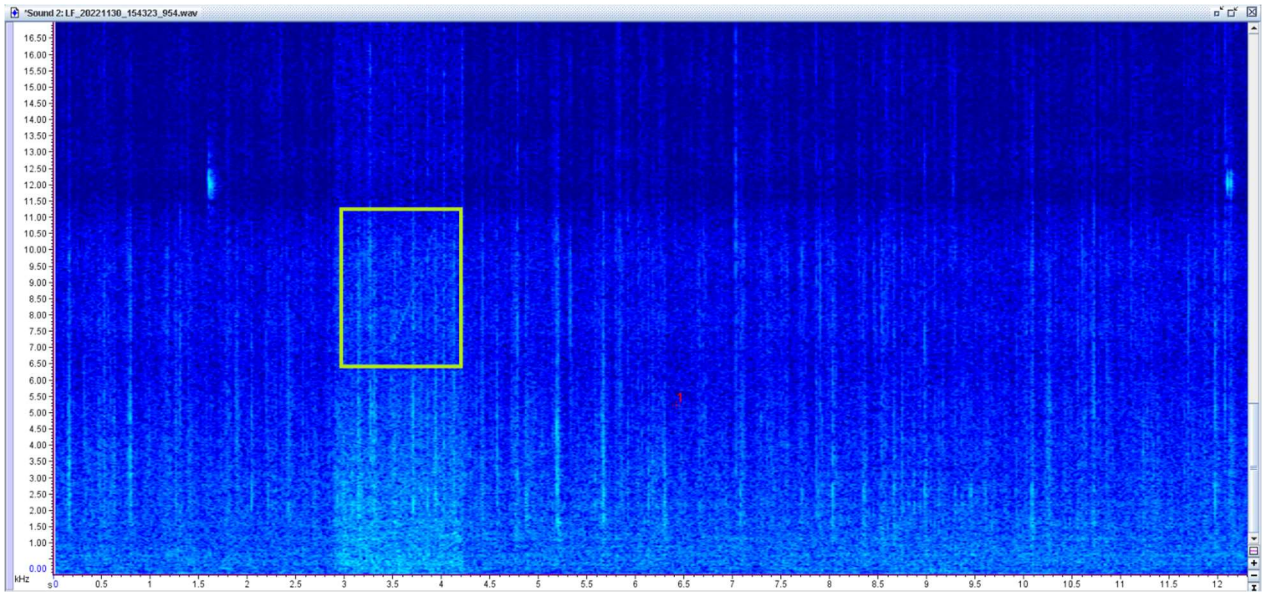

Figure 15: Acoustic detection ID#500. Upsweep whistle (post-analysis with Raven).

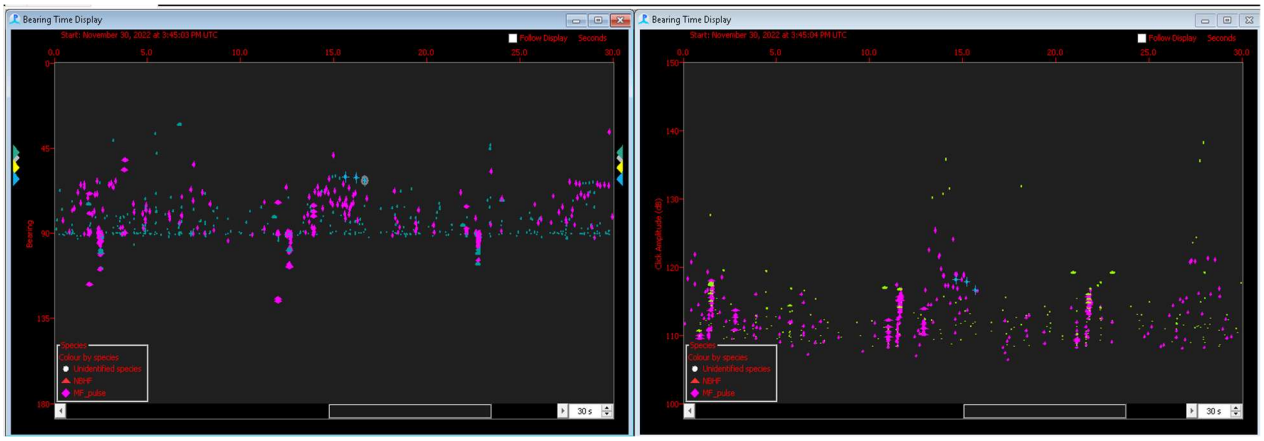

Figure 16: Acoustic Detection ID#500. Echolocation click trains.

Acoustic detection ID# 501: An unidentified dolphin was registered on 11 December 2022 from 23:47 to 23:58 UTC when sources were active on full power. There were echolocation click trains detected on the spectrogram and the HF click detector with an initial bearing of 43°/317° from the vessel heading. The detection was not able to be localized on the map. Whistles of 9 to 19kHz frequency and amplitude 142 dB re 1 µPa were shown in the spectrogram and the radar display. Contours detected, 15 whistles in total, were mostly upsweep with inflections and harmonics present in some of them. The whistles started during full power at 23:51 UTC and ended at 23:58 UTC. Since the signals were very faint, the estimated distance to the source was determined to be outside of the EZ.

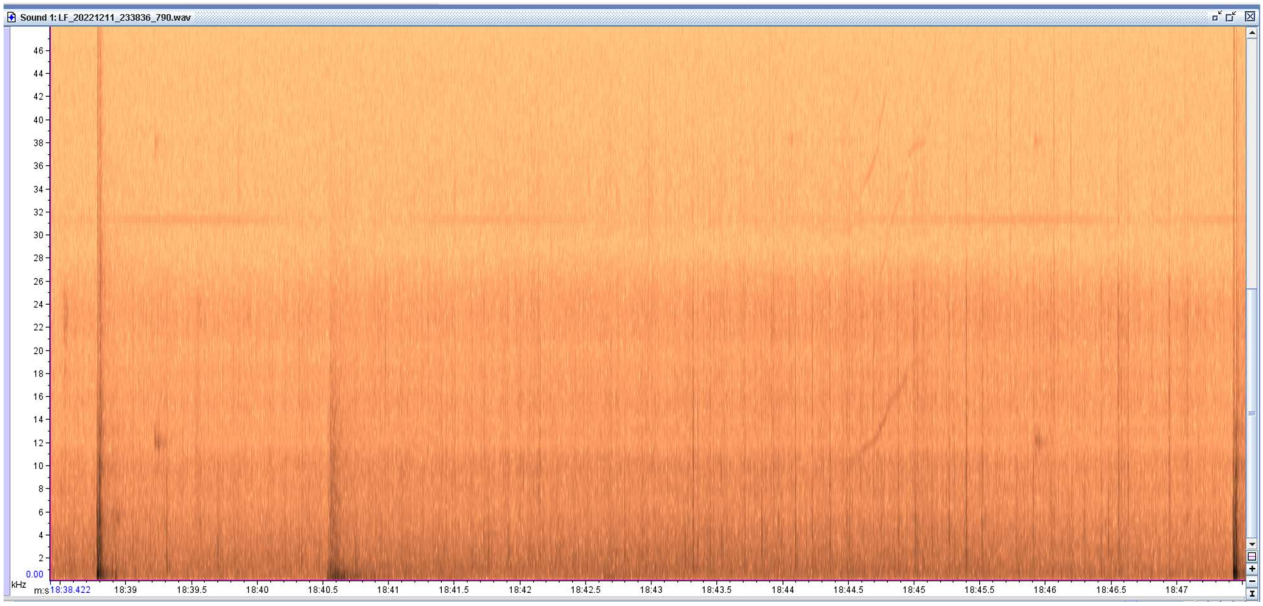

Figure 17: Acoustic Detection ID #501 Whistle with harmonics (post-analysis in Raven)

Figure 20 shows the location of all visual sightings and acoustic detections. More details are included in the ACCOBAMS recording form.

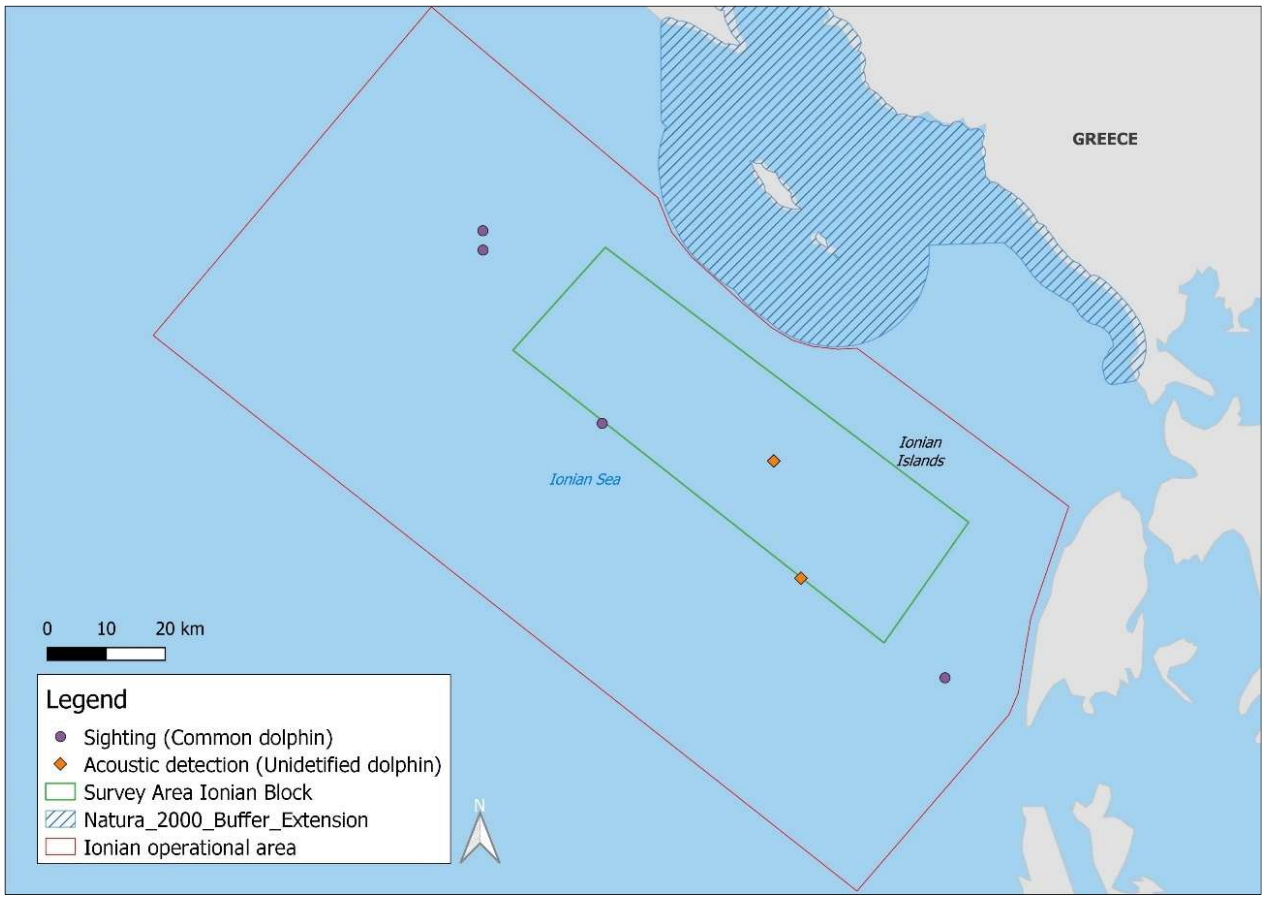

Figure: 18 Map of MMO sightings and PAM detections.

5.6 Mitigation incidences

No mitigation incidences occurred and no unexpected breaks, delays or shutdowns occurred due to the presence of marine animals within the Exclusion Zone.

5.7 Environmental Action Plan Compliance

The Marine Fauna Observers Team was in full and harmonious cooperation with the representatives of HELLENiQ UPSTREAM S.A., including the two Client Representatives exclusively hired to monitor the seismic operations on the vessel, such as the Senior Environmental Coordinator of the HSE Department and the G&G representative under the coordination of the HSE Manager at the HELLENiQ UPSTREAM's HQ's. For the entire duration of the 3D Marine Seismic Survey, the seismic crew was diligently performing all mitigation requirements, and the procedures were in full compliance with the EAP approved by the regulator.

- The seismic survey was carried out during winter season to minimize impacts on marine mammal breeding season.
- The average speed of the vessel was 4.3 knots, which complied with the recommendation of the working group IWC-IUCN-ACCOBAMS to reduce speed to 10 knots maximum in order to minimize the strike risk with marine fauna.
- A total of 28 soft-starts were carried out before starting an acquisition line or gun-array test in accordance with procedures described.

- Exclusion Zones (EZ) with a radius of 750 m, and 1500 m for sperm whales and beaked whales, were established from the center of the noise source.
- Shutdown in seismic operations due to aggregations of vulnerable species (such as Cuvier's beaked whales and sperm whales) anywhere in the monitoring area was established.
- 120 min of visual and acoustic pre-watches were performed before any firing of guns, including soft-starts, acquisition lines, air-gun tests, and resuming operations after unexpected breaks.
- Soft-start duration was a minimum of 20 minutes.
- Soft-start duration and time from soft-start to SOL was less than 40 minutes as required.
- No source was active (including soft-starts) within the 1000m safety buffer zone from the Natura 2000 protected areas.
- Good communication was maintained between the MMO/PAM team and seismic crew throughout the survey to ensure that all guidelines were implemented effectively concerning the protection of marine mammals and sea turtles within the exclusion zones.
- Turtle guards (Figure 21), a structure welded to the underside of tail buoy designs, aims to exclude sea turtles from becoming fatally entrapped in gaps at the front of the tail buoy undercarriage. In the event of turtle entrapment in seismic equipment, the Contractor's appropriately trained staff must intervene immediately to remove the trapped animal, weather permitting.
- There was 24-hour acoustic monitoring as required.
- As a matter of good practice, the Client introduced shut-down in operations when a sea turtle entered within the Exclusion Zone (EZ) as a mitigation action.
- As per approved EAP Mitigation Measures and in compliance with the ACCOBAMS Guidelines, in order to avoid any inconsistency with measures addressed and prior to the commencement of the survey, the following point regarding mitigation procedures was confirmed. The mitigation team was informed that the number of dedicated visual observers (MMO) on continuous watch during the nighttime, concurrently, during seismic operations could be one (1) observer. Before starting operations, the Client confirmed this amendment taking into consideration results obtain from the previous campaign and overall MMO/PAM effort. In any case, while conducting the survey, there was no inconsistency with guidelines and mitigation measures applied. Throughout the project, during nighttime hours in every shift, one (1) Marine Mammals Observer (MMO) was conducting visual monitoring alongside the passive acoustic monitoring performed by the PAM operator.

Figure 19 Turtle guards

6 References – Guidelines

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