



3D Marine Seismic Survey

ACCOBAMS MMO & PAM Report
Marine Seismic Survey
EPI Report No. E1118

Client	HELLENIQ UPSTREAM KYPARISSIAKOS S.A.
Area	Block 10
Survey	3D MSS
Regulatory Reference	<u>ΥΠΕΝ/Δ ΙΠΑ/103294/6963</u>
Dates	14 December 2022 - 07 January 2023
Contractor	PGS
Vessel	M/V <i>Ramform Hyperion</i>
MMO and PAM Team:	Manuel Garcia, Dimos Pipinis, Kasia Lisson, Marta Rimada, Panagiotis Kourouklis, Tena Sarcevic, Marta Plichta

Marine Mammal Observer and Passive Acoustic Monitoring Operator

FINAL REPORT

MISSION AT SEA FROM 14 DECEMBER 2022 TO 07 JANUARY 2023
TYPE OF MISSION: 3D MARINE SEISMIC SURVEY

EPI GROUP REPORT PREPARED ON 27 JANUARY 2023
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EXPLORATION BLOCK: BLOCK 10

MARINE MAMMAL OBSERVERS AND PASSIVE ACOUSTIC MONITORING OPERATORS FINAL REPORT

Survey dates	14 December 2022 – 06 January 2023
Survey type	3D Marine Seismic
Client	HELLENIQ UPSTREAM KYPARISSIAKOS S.A.
Contractor / Vessel	Petroleum Geo-Services (PGS)/ <i>Ramform Hyperion</i>

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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 14 December 2022 to 6 January 2023. The survey was performed in the lease area of Block 10, Kyparissiakos Gulf offshore of West Greece in the Ionian Sea.

The seismic data acquisition commenced on 14 December 2022 and was completed on 6 January 2023 (last shooting at 5:24 am).

There were 24 soft-starts during daylight, 22 at night and four (4) during dusk or dawn. Seismic operations were conducted over 24 days, during which 46 primary acquisition lines were completed, three (3) lines reshot/infilled, and 10 source tests were performed.

Weather conditions recorded during the survey consisted of northeast winds Beaufort 2 to 3 with sea states Beaufort 1 to 2 predominating, along with low swell heights.

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 mammals resulted in 551:45 hours of observers' effort during the survey period. Where 243:25 hours corresponded to day visual and 308:20 hours corresponded to night visual monitoring.

Acoustic monitoring for marine mammals resulted in 548:19 hours of monitoring effort during the course of the survey.

Overall, 65.9% of monitoring effort took place while the acoustic source was active, and 30.5% of monitoring effort took place while the acoustic source was not active.

There were five (5) visual sightings and five (5) acoustic detections of marine mammals.

In total, 55 pre-shooting searches were conducted and all of them combined visual and acoustic monitoring.

Three (3) shut-downs occurred on acquisition lines and one (1) delay occurred on commencement of a soft-start were implemented due to the presence of protected species.

There were no instances of non-compliance with the Environmental Action Plan (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 Marine Seismic Survey in Block 10 of the Kyparissiakos Gulf in Greek waters. The survey company Petroleum Geo-Services (PGS) carried out this seismic survey on behalf of HELLENiQ ENERGY on board the M/V *Ramform Hyperion* from 14 December 2022 to 6 January 2023.

The survey was completed following the conditions outlined in the approval from the regulator with reference ID: ΥΠΕΝ/ΔΙΠΑ/103294/6963, issued on 1 December 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 Kyparissiakos Gulf Block 10, 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 10 (Kyparissiakos Gulf) off the coast of Western Peloponnese, offshore Greece (Figure 1). The Lease Area has a total surface of 3,225 km² without its part that is within the protected areas of NATURA 2000 network. The minimum distance between the boundaries of the Lease Area and the coasts of Peloponnese and Zakynthos Island is approximately 6 km and 17 km, while the average distance is estimated at 12 km and 21 km respectively.

The survey area was located within Greek territorial waters in Western Greece, with water depths ranging from 200 m to approximately 3,400 m. (Figure 1).

There are 23 areas of interest for the conservation of marine/coastal habitats and species overlapping with Block 10, including thirteen (13) NATURA 2000 protected area and one National Park (Table 1 and Figure 1) and in addition of four (4) Areas of Outstanding Natural Beauty and one Preserved Natural Monument.

Table 1 Areas of Interest overlapping with the Block 10

AREAS OF INTEREST SUMMARY	
NATURA 2000	Dytikes kai Voreioanatolikes Aktas Zakynthos / GR2210001 / Special Protected Areas (SPA) / Sites of Community Importance (SCI).
	Kolpos Lagana Zakynthos (Akr. Geraki - Keri) kai Nisides Marathonisi kai Pelouzo / GR2210002
	Nisoi Strofades / GR2210003
	Nisides Stamfani kai Arpyia (Strofades) kai Thalassia Zoni / GR2210004
	Ekvoles (Delta) Pineiou / GR2330003
	Thines kai Paraliako Dasos Zacharo, Limni Kaiafa, Strofylia, Kakovatos / GR2330005
	Thalassia Periochi Kolpou Kyparissia: Akr. Katakolo – Kyparissia / GR2330008
	Thines Kyparissia (Neochori – Kyparissia) / GR2550005
	Nisoi Sapientza kai Schiza, Akrotirio Akritas / GR2550003
	Limnothalassa Pylos (Divari) kai Nisos Sfaktiria, Agios Dimitrios / GR2550004
	Thalassia Periochi Stenou Methonis / GR2550007
	Limnothalassa Giavolas kai Nisos Sfaktiria / GR2550008
	Thalassia Periochi Notias Messinia / GR2550010
National Parks	Zakynthos National Marine Park

Table 2 Coordinates of the survey area.

Latitude (DDM)	Longitude (DDM)
37° 30.00' N	20° 55.00' E
37° 30.00' N	21° 30.00' E
37° 10.00' N	21° 30.00' E
37° 10.00' N	21° 25.00' E
37° 00.00' N	21° 25.00' E
37° 00.00' N	21° 30.00' E
36° 50.00' N	21° 30.00' E
36° 50.00' N	21° 00.00' E
37° 10.00' N	21° 00.00' E
37° 10.00' N	21° 55.00' E

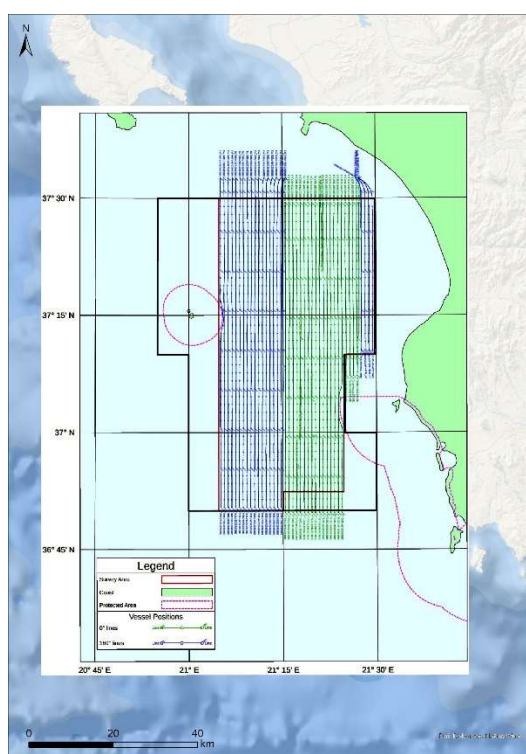


Figure 1: Location of the survey area

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, Mingozi 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	<i>Balaenoptera physalus</i>	Endangered
	Sperm whale	<i>Physeter macrocephalus</i>	Endangered
Toothed whales	Cuvier's beaked whale	<i>Ziphius cavirostris</i>	Data Deficient
	Long-finned pilot whale	<i>Globicephala melas</i>	Data Deficient
	Risso's dolphin	<i>Grampus griseus</i>	Endangered
	Bottlenose dolphin	<i>Turisops truncatus</i>	Vulnerable
	Short-beaked common dolphin	<i>Delphinus delphis</i>	Endangered
	Striped dolphin	<i>Stenella coeruleoalba</i>	Least Concern
Seals	Monk seal	<i>Monachus monachus</i>	Critical Endangered

Table 4 Turtles in the survey area

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

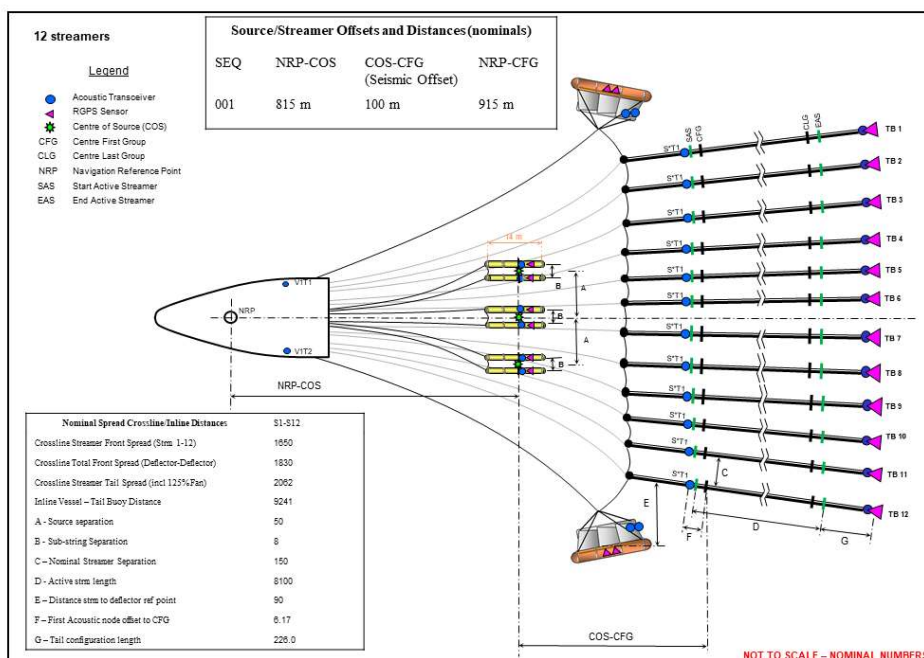


Figure 5: Survey equipment configuration (not in scale)

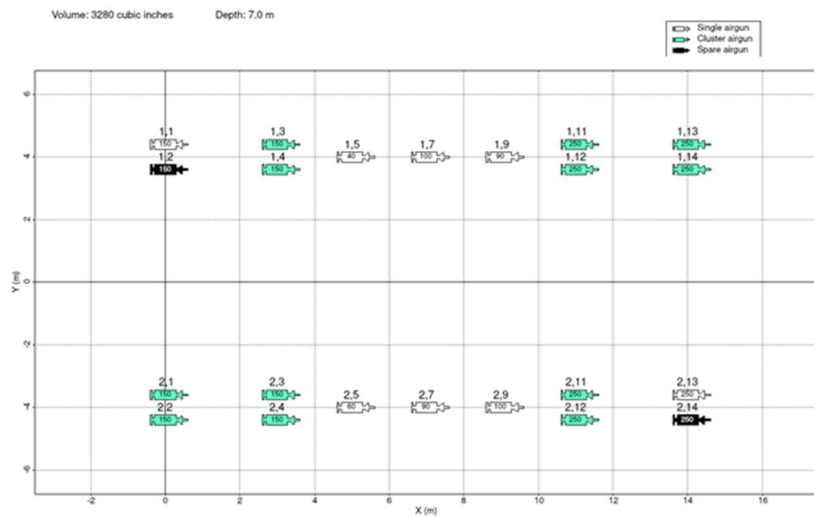


Figure 6: Air gun array.

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/103294/6963, 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 Block 10 in the Kyparissiakos Gulf.

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 behavior 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 injured 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-hours 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 7 Observation Platforms.

Table 7: Observation Platforms.

PLATFORM	HIGH (m)	VISIBILITY
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 equiv.
	Olympus E-510 (Lens 40-150 mm 1:4-5.6)
	Panasonic LUMIX DMC80 (lens 100-300mm)
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 7x50 with compass and reticles
	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) to five (5) 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/ μ Pa (Hydrophone sensitivity is -195 dB re 1 V/ μ Pa 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.

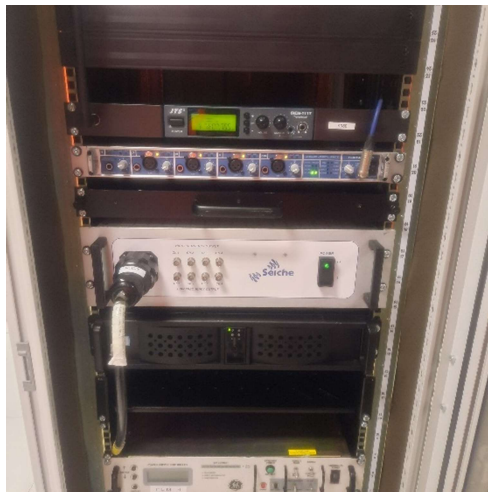


Figure 9 PAM electronics

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).

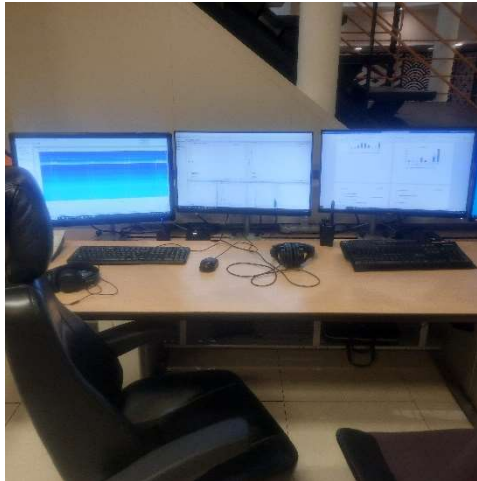


Figure 10: Local monitoring station

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



Figure 12. 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 14 December 2022 to 6 January 2023.

5.1 Operations summary

From the first day of production on 14th December 2022 to 6th January 2023, when the project was completed, a total number of 59 active source sequences occurred, consisting of 46 primary lines, 3 re-runs/infill lines and 10 source tests.

Of the total active source sequences (including tests and acquisition lines), 26 were initiated during daylight hours, 5 during dusk or dawn, 28 during hours of darkness. In total, 381 hours 48 minutes of active source were recorded throughout, comprising soft-starts, gun tests and production lines.

An automated system allowed the soft-start settings to be 21 minutes duration for all soft-starts, 28 of which took place during daytime and 22 during dark hours, with an average time of 33:37 (mm:ss) between

the beginning of soft-start and the start of the acquisition line and no approaches exceeding the 40 minutes 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 (14 December 2022 to 6 January 2023)		
	Total Source Active (hh:mm)	388:35
	Total Soft-Start to SOL (hh:mm)	28:01
SOURCE ACTIVITY TIME	Total Full Volume Source Time (hh:mm)	363:26
	Total Source Test time (hh:mm)	02:03
	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)	49
	Total N° of Soft-Starts	50
	Total N° of Source Test	10
	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	7
	Total N° of Soft-Starts during dawn/day	25
Total N° of Soft-Starts during night/dusk	25	
MITIGATION ACTION	N° of mitigation actions initiated	4
NON-COPLIANCE	N° 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 1 and 2 during visual monitoring (34.2% and 31.9% respectively) and the swell height was predominantly low (100%), less than 2 m.

Wind speeds were recorded with the most dominant wind speed being Beaufort force 2 and 3 (29.1% and 32.7% respectively). Wind direction was predominantly from the northeast NE (24.9%).

There was mainly no rain, and visibility was good (>5 km) for 90.6% of the monitoring time. Predominantly, sun glares were strong 36.3% of the time forward and 24.7% of the time from behind.

Weather conditions on watch were good for 99.5% (Figure 13) of 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.

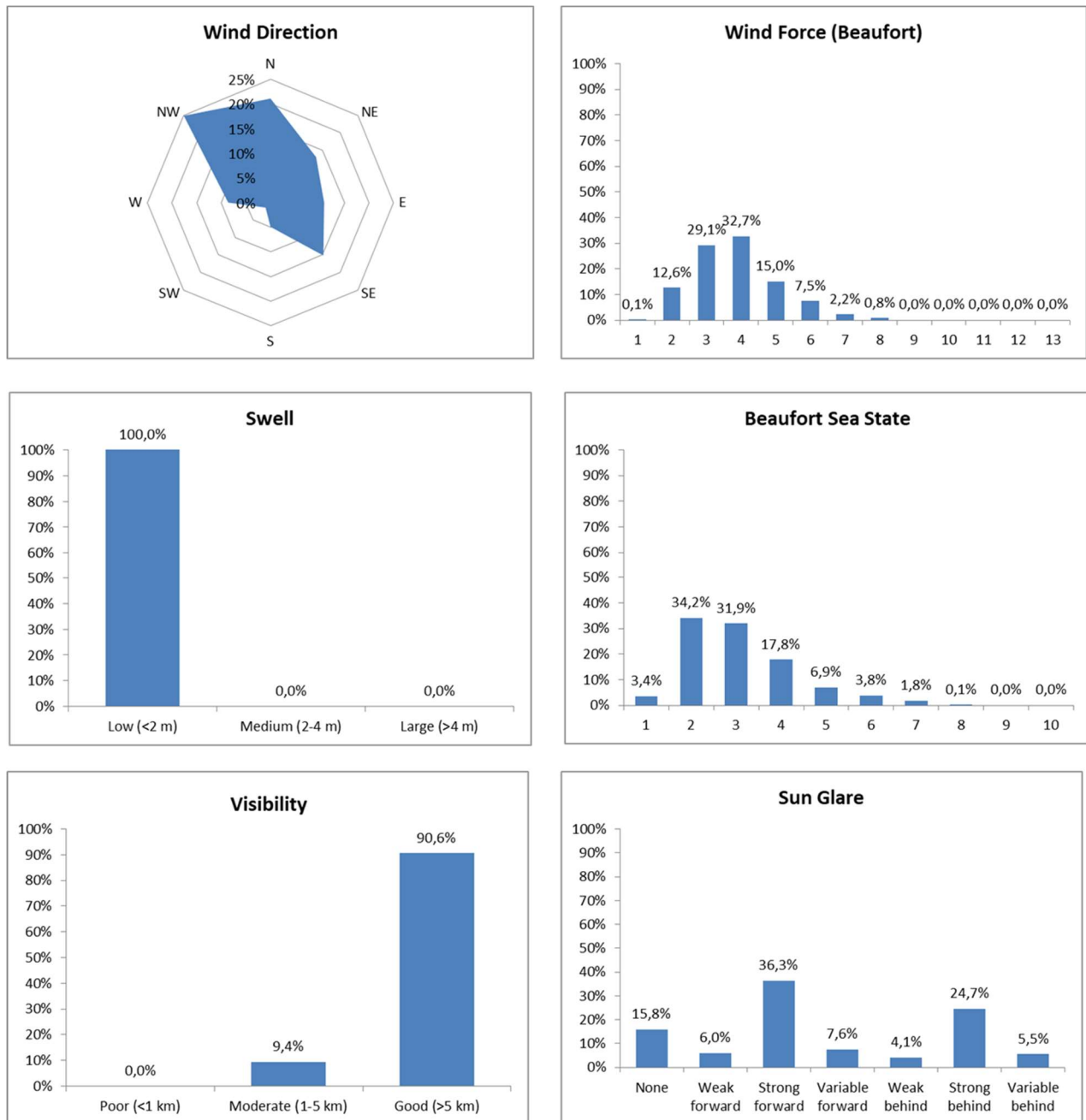


Figure 13: Weather condition during visual monitoring

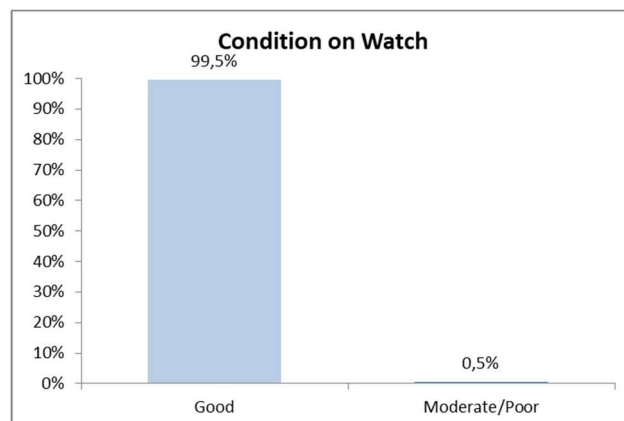


Figure 14: Weather conditions on watch

5.3 Visual and acoustic monitoring effort

From the first day of the 3D seismic survey on 14 December 2022 to 6 January 2023, when the project was completed, a total number of 50 pre-shooting searches, combined visual and acoustic, were conducted. All pre-shooting searches took place in deep waters (> 200 m) with 120 minutes duration each.

Table 11 Marine mammal mitigation summary

EFFORT MONITORING SUMMARY		
(14 December 2022 to 6 January 2023)		
MONITORING EFFORT	Total visual observation (hrs/min)	551:45
	Day visual Observation (hrs/min)	243:25
	Night visual observation (hrs/min)	308:20
	Total acoustic monitoring (hrs/min)	548:19
	Total monitoring (hrs/min)	1100:04
MONITORING EFFORT & SOURCE ACTIVITY	Total effort whilst source was inactive	335:55
	Total effort whilst source was active	764:09
PRE-SHOOTING SEARCH EFFORT	Total Nº of Pre-shooting searches	55
	Nº of Pre-shooting searches in shallow waters	0
	Nº of Pre-shooting searches in deep waters	55
SIGHTINGS & DETECTIONS	Nº of cetacean sightings	3
	Nº of seals sightings	0
	Nº of turtle sightings	2
	Nº of acoustic detections	5
MITIGATION	Nº of mitigation actions initiated	4
NON-COMPLIANCE	Nº of incidences of non-compliance	0

A total of 551:45 hours of dedicated marine mammal watches were carried out by the MMOs; 243:25 (hh:mm) took place during daytime and 308:20 (hh:mm) were during the night. 548:19 hours of dedicated marine mammal acoustic monitoring were carried out by the PAM operator from 14 December 2022 to 6 January 2023. Out of the total 1100:04 (hh:mm) of monitoring effort, 764:09 (hh:mm) (69.5%) were completed while the acoustic sources were active and 335:55 (hh:mm) (30.5%) were completed while the acoustic sources were silent (Figure 15).

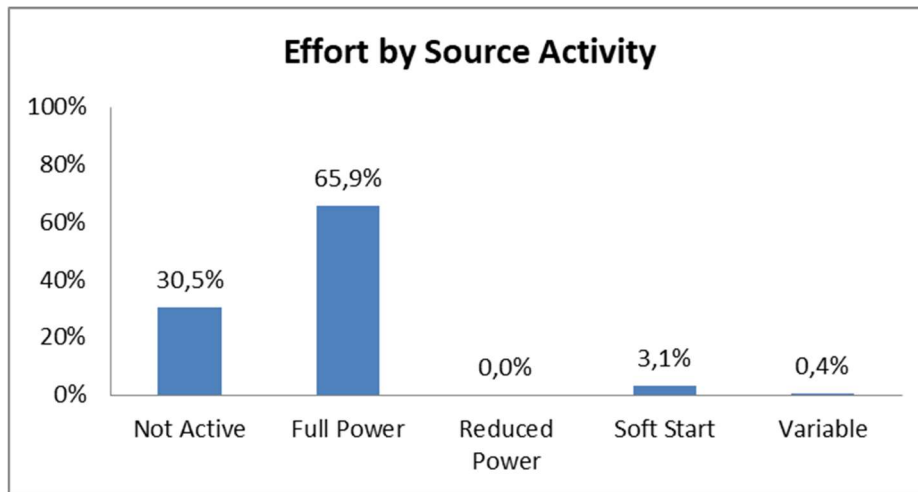


Figure 15 Time in hh:mm of visual and acoustic effort by source activity.

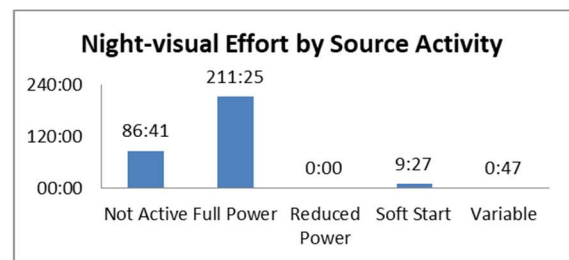
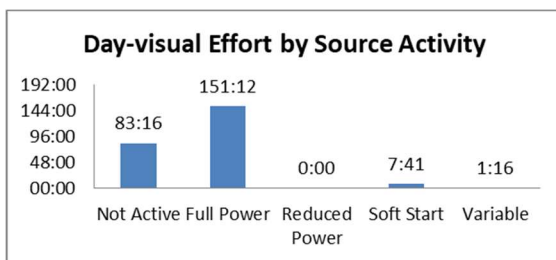


Figure 16 Day and night visual effort by source activity

5.4 Visual sighting

The survey was conducted in the Kyparissiakos Gulf, West coast of Greece, where depths varied between 200m and over 3400m, allowing for the possibility of encountering both deep-water and shallow-water species.

In total, there were five (5) sightings of protected species, one of them positively identified as sperm whales (*Physeter macrocephalus*), two unidentified dolphins' species (Delphinidae) sightings, one loggerhead sea turtle (*Caretta caretta*), and one unidentified sea turtle species (*Cheloniidae sp.*).

Table 12 provides a selection of the data collected during each sighting, including species, range to source, and source status at the time of the sightings.

Table 12 MMO sightings 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
001	Unidentified dolphin	Delphinidae	3	36° 57.57' N	21° 05.64' E	15:58	Full Volume	1536	None Required
002	Unidentified dolphin	Delphinidae	4	36° 57.18' N	21° 17.26' E	09:34	Full Volume	711	Shut down
003	Sperm whale	<i>Physeter macrocephalus</i>	6	37° 12.11' N	21° 17.91' E	07:24	Full Volume	1252	Shut down
004	Loggerhead sea turtle	<i>Caretta caretta</i>	1	37° 03.92' N	21° 19.66' E	13:20	Full Volume	20	Shut down
005	Unidentified sea turtle	<i>Cheloniidae sp.</i>	1	37° 32.70' N	21° 26.15' E	07:24	Not active	648	Soft-start delay

Sighting ID# 001: On 16 December 2022 at 15:58 UTC, a group of at least three (3) individuals, unidentified dolphin species (Delphinidae), were spotted for seven (7) minutes at a distance of approximately 1450 m from the port side of the vessel, outside of the exclusion zone while in acquisition at full volume and no mitigation measures were required.

Sighting ID# 002: On 18 December 2022 at 09:34 UTC, a group of at least four (4) individuals of unidentified dolphin species (adult and juveniles) were spotted at a distance of 550 m from the port side of the vessel, 1300 m from the guns, swimming and diving in the same direction as the vessel. At 09:52 UTC, the pod of dolphins entered the exclusion zone while acquisition was at full volume. A shut down commenced at 9:53 UTC.

Sighting ID# 003: On 19 December 2022 at 07:24 UTC, a group of at least six (6) sperm whale (*Physeter macrocephalus*) individuals (adults and juveniles) were spotted at a distance of 1400 m from the starboard side of the vessel, swimming steady in the slow pace in the opposite direction to the vessel and diving. At 07:24 UTC, the MMO called for a shut down while in full volume and the mitigation action took place at 07:25 UTC.



Figure 17: Sighting #003. Sperm whales (*Physeter macrocephalus*). Photo P. Kourouklis

Sighting ID# 004: On 22 December 2022 at 13:20 UTC a medium sized loggerhead sea turtle (*Caretta caretta*) was spotted floating, swimming and breathing at 20 m from starboard bow. The turtle entered the exclusion zone at 13:25 UTC.



Figure 18: Sighting #004. (*Caretta caretta*) Photo: P. Kourouklis

Sighting ID# 005: On 3 January 2022 at 11:01 UTC, an unidentified sea turtle species (Cheloniidae) was spotted approximately 700 m from the port side of the vessel at 11:01 UTC. The animal was swimming in a parallel direction to the vessel. The carapace was covered with barnacles. Just before diving at 11:03 UTC, the turtle briefly exposed its flippers. A 30-minute delay of a soft-start was implemented.



Figure 19: Sighting #005-Unidentified turtle Photo: P.Kourouklis

5.5 Acoustic detections

Table 13 PAM operator Acoustic detection records

ID #	Common Name	Species	Individuals#	Latitude (DDM)	Longitude (DDM)	Time (UTC)	Source Activity at Initial Detection	Closest Approach to Source (m)	Mitigation Action
500	Unidentified dolphin	-	1	37° 35,70'N	21° 15,14' E	00:51	Not Active	<750	Delay SS
501	Unidentified dolphin	-	1	36° 57,18'N	21° 17,26' E	09:50	Full Volume	Not located	Shut-down by MMOs
502	Unidentified dolphin	-	1	36° 47,72 N	21° 20,32' E	20:24	Not Active	<750	Not required
503	Toothed whale	-	1	36° 59,90'N	21° 23,87' E	21:17	Full Volume	>750	Not required

Acoustic Detection AD#500: On 18 December 2022, an unidentified dolphin was detected at 00:51 UTC until 00:57 UTC during pre-watch while sources were inactive. The signal started with HF (25-80kHz) burst pulses and HF click trains up to 150kHz displaying a peak amplitude of 148 dB re 1 μ Pa. Based on the strength of the signal, the animal was inside of the mitigation zone. The sighting ended during the pre-watch and the 30-minute mitigation action was completed as well within the regular pre-watch time so there was no mitigation action needed.

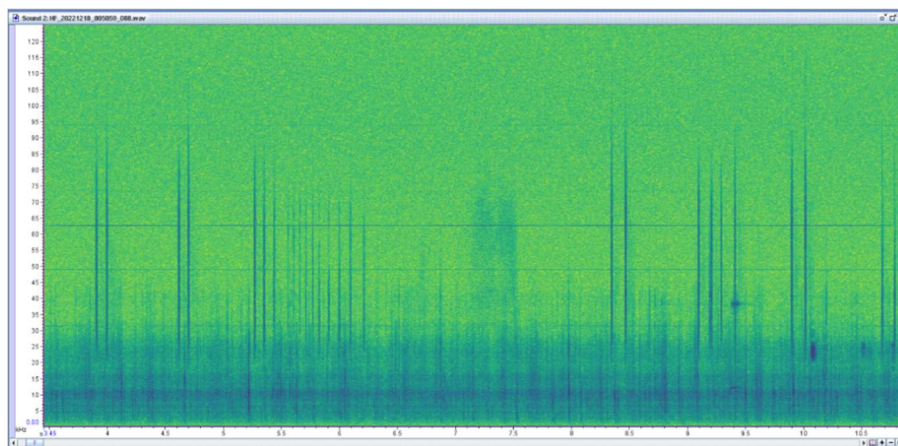


Figure 20: AD#500 Burst and HF echolocation clicks (Raven)

Acoustic Detection AD#501: On the 18 December 2022 at 9:50 UTC, whistles of an unidentified dolphin species (Delphinidae) were detected on the broadband spectrogram from 10 to 21 kHz frequency, showing up and down sweep with harmonics and a click train associated. No location on PAMGuard map was possible, but a clear signal suggested the dolphins were within the exclusion zone, which was confirmed visually by the MMOs.

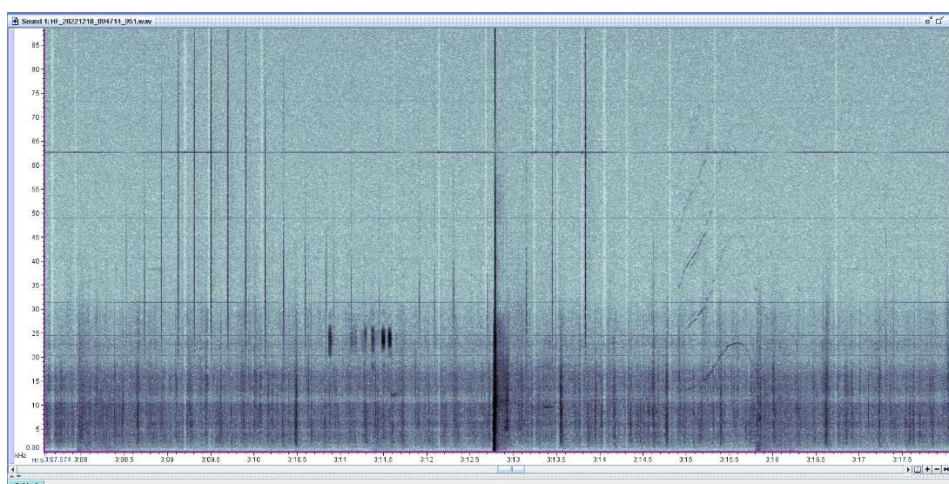


Figure 21: AD#501 Click train and whistles with harmonics of unidentified dolphin species (Audacity).

Acoustic Detection AD#502: On the 25 December 2022 at 20:24 UTC, an unidentified dolphin was detected on the spectrogram, whistles contours of 15 to 27 kHz frequency, upsweep with inflections and harmonics reaching more than 60 kHz. Echolocation clicks were shown in the HF spectrogram and HF click detector with a peak frequency of 140 kHz. Based on the strength of the signal, the animal was located inside of the exclusion zone, however no mitigation action was required as the detection took place while the sources were inactive and before the pre-watch started. The last signal was shown on PAMguard at 20:31 UTC.

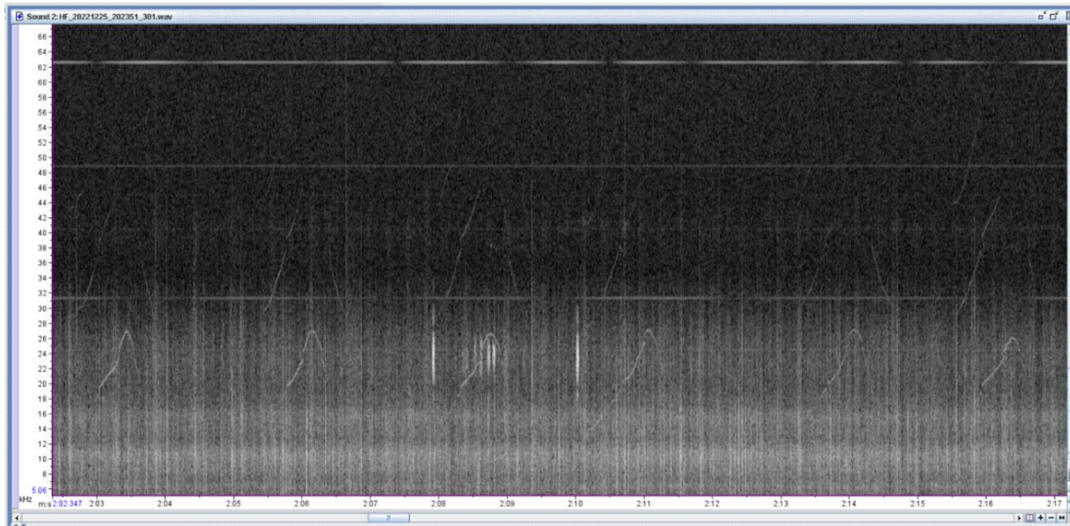


Figure 22: AD#502 unidentified dolphin's whistles with harmonics (Raven)

Acoustic Detection AD#503: On the 29 December 2022 at 21:17 UTC and 21:23 UTC, for a few seconds each time, there were echolocation click trains identified on the HF click detector, with a range of frequency of 25 to 63 kHz and an amplitude of 130dB and a fairly constant ICI. The characteristics of the click trains were typical of odontocetes. The sources were on full power but since the signal wasn't located in the map, there was no mitigation action required as per protocol.

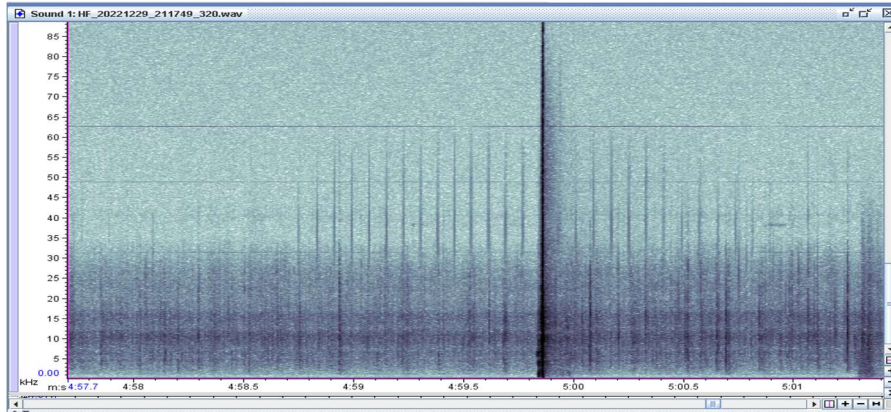


Figure 23: AD#503 toothed whale's echolocation click trains (Raven)

Acoustic Detection #504: At 20:24 UTC and until 20:42 UTC, there were intermittent echolocation click trains identified on the HF click detector with a range of frequency of 22 to 75 kHz and a mean amplitude of 130 dB and a fairly constant ICI. The characteristics of the click trains were typical of odontocetes. The sources were inactive during pre-watch when the detection started and active in soft-start when the detection ended, but based on the signal strength, the detection was located outside of the exclusion zone, so there was no mitigation action required as per protocol.

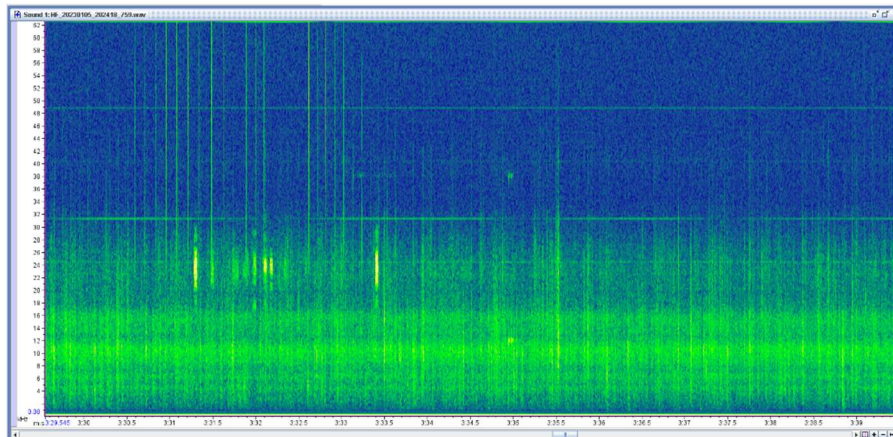


Figure 24: Acoustic Detection #504. Echolocation click train (Raven)

Figure 25 shows the location of all visual sightings and acoustic detections. More details are included in the ACCOBAMS recording form.

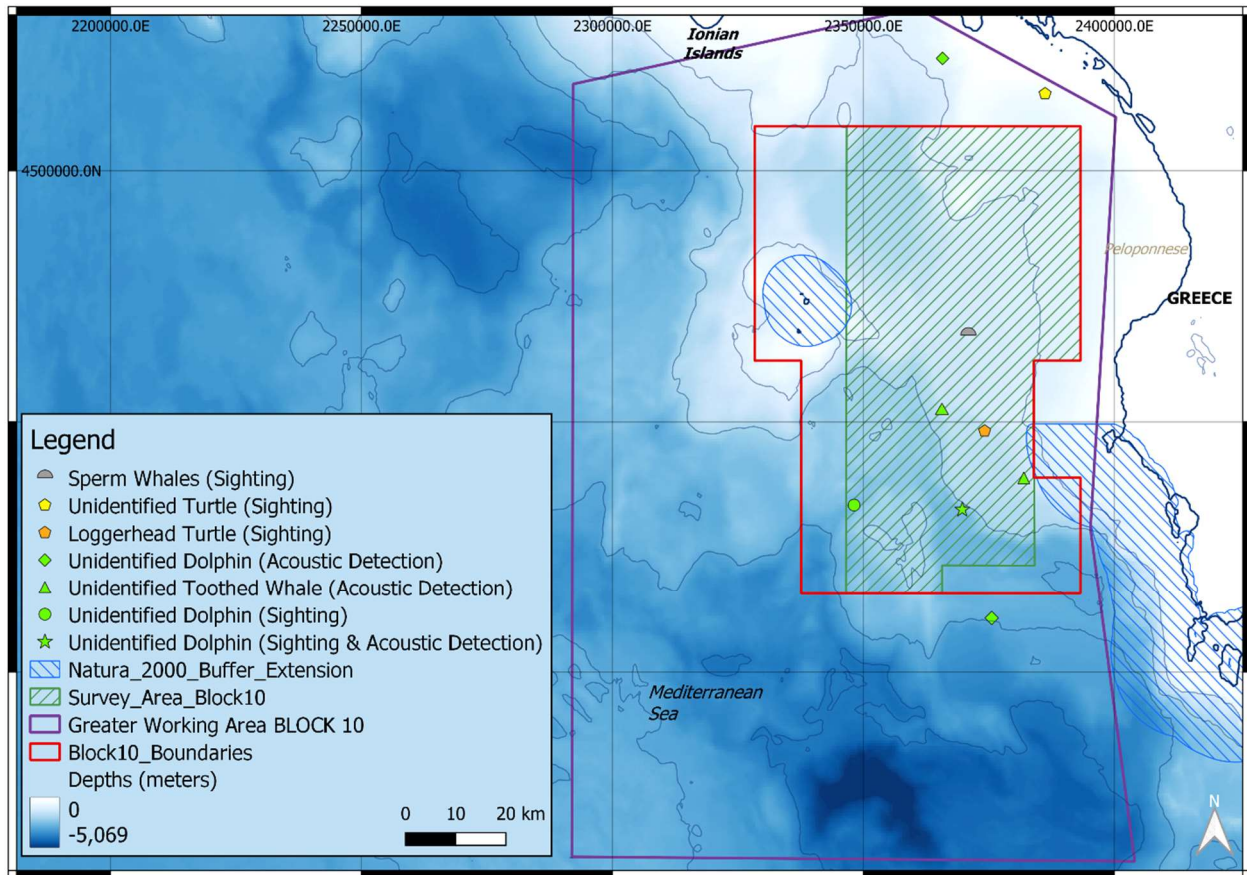


Figure 25: Map of MMO sightings and PAM detections.

5.6 Mitigation Incidences

Three (3) shut-downs while in full volume and one (1) delay on soft-start commencement were recorded due to the presence of animals within the Exclusion Zone; no unexpected breaks on seismic activity occurred.

5.7 Environmental Action Plan Compliance

The MFO 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, the HELLENiQ UPSTREAM's employees on board, such as the Senior Environmental Coordinator of the HSE Division 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 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 as per the approved Environmental Action Plan (EAP).
- 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 50 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 additional a 1500 m EZ 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 on continuous watch during the nighttime, concurrently, during seismic operations could be one (1). Before starting operations, the Client confirmed this amendment taking into consideration results obtain from the previous campaign in Kyparissiakos Gulf 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) at the time was conducting visual monitoring during nighttime hours throughout the project alongside the passive acoustic monitoring performed by the PAM operator and one Passive Acoustic Monitoring (PAM) operator.



Figure 26: Turtle guard.

6 References – Guidelines

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