MARINE MAMMAL OBSERVERS

FINAL REPORT

SHIMSHON & DANIEL 3D SURVEY

24 December 2013 – 16 January 2014

Vision Project Services

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NOTICE

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SUMMARY

The intention of this report is to provide a review of the marine mammal and protected species mitigation survey efforts, during the performance of a 3D seismic data acquisition. The survey was carried out with PGS, utilizing *M/V Ramform Sovereign for* **Isramco**. The operation took place in the Eastern Mediterranean with Ashdod 40 Nm to the southeast, Tel Aviv 50 Nm to the east and Haifa 72 Nm to the northeast.

The reporting period commenced on the 24th December 2013 and lasted until 16th January 2014. Two dedicated marine mammal observers (MMO) and one experienced passive acoustic monitoring operator (PAM) were on-board the vessel.

Visual monitoring and mitigation for marine mammals were carried out in accordance with JNCC guidelines, with modifications for the local area.

During daylight hours, observations included a 60-minute pre-firing watch (all waters were more than 200 meters depth) for marine mammals prior to all air-gun operations including air-gun tests. The primary aim of this visual monitoring is to assess the presence of marine mammals in the 500 meters mitigation zone and to delay operations until the animals are clear of this zone.

MMO/PAM Objectives

- Zero injury to marine mammals and sea turtles.
- Minimal acoustic disturbance to marine mammals and sea turtles.
- Minimal loss of seismic production due to MMO and PAM mitigation.
- Sighting and documenting of marine mammals and sea turtles.
- 60 minutes pre-watches (30 minutes for less than 200m water depth | 60 minutes for 200m water depth and greater) before production and various gun tests

Project Summary

- The project consisted of 24 consecutive days beginning on the 24th December and ending on the 16th January 2014.
- Two dedicated MMO and one experienced PAM operator were on-board *M/V Ramform Sovereign.*
- Visual observations were carried out for 250 hours and 40 minutes and acoustic watches proceeded for 225 hours 43 minutes.
- Total of number of soft starts was 66. 100% of all soft starts fully complied with the guidelines.
- Total number of airgun sequences (attempts at or full finish of a line from the first production day until the last) was 65, with 28 of these initiated during daylight hours. Thirty five were commenced during night time and 2 during dusk observations. All of these were preceded by a 1 hour pre-firing visual watch or an acoustic watch for marine mammals within the 500-meter exclusion zone. There were 6 tests of the guns/arrays followed by lines and 1 test line.
- There were no marine mammal sightings during the survey.
- PAM had one minor detection on the 27th December
- No mitigation action was required during the survey.

1.0 BACKGROUND

1.1 Introduction

The *M/V Ramform Sovereign* conducted a 3D seismic survey in the Eastern Mediterranean for Isramco. For precise positions please refer to table 1 underneath. Survey area was located close to the Suez Canal zone and relatively close to the separation zone for directions to Israel (Ashdod, Ashqelon & Gaza). The M/V *Ramform Sovereign* left the previous prospect area in Cyprus on 23rd December 2013 and started shooting on new survey area; Shimshon & Daniel Licenses 24th December 2013. Operations ceased on 16th January 2014.

The survey was about 1320 km^2 with a total number of 65 prime lines.

Water depths were between 980 and 1350m.

The *M/V Ramform Sovereign* was acquiring these 3D surveys using a 14 cables x 100m separation x 8100m streamer active length configuration with RDH Solid Active Section streamer depth profile and Bolt 1900 LLXT Air Gun.

Point	Latitude	Longitude
1	32º16’32’’ N	33º29’04’’ E
2	32º28’50’’ N	33º32’22’’ E
3	32º35’33’’ N	33º35,54’’ E
4	32º28’46’’ N	33º46’47’’ E
5	32º23’44’’ N	33º42’47’’ E
6	32º19’06’’ N	33º50’13’’ E
7	32º14’02’’ N	33º45’31’’ E
8	32º08’57’’ N	33º53’38’’ E
9	32º03’04’’ N	33º49’30’’ E
10	32º00’46’’ N	33º53’11’’ E
11	32º00’07’’ N	33º52’44’’ E
12	32º02’25’’ N	33º49’03’’ E
13	32º00’28’’ N	33º47’40’’ E
14	32º09’51’’ N	33º32’38’’ E

Table 1: Coordinates of Shimshon & Daniel 3D Survey

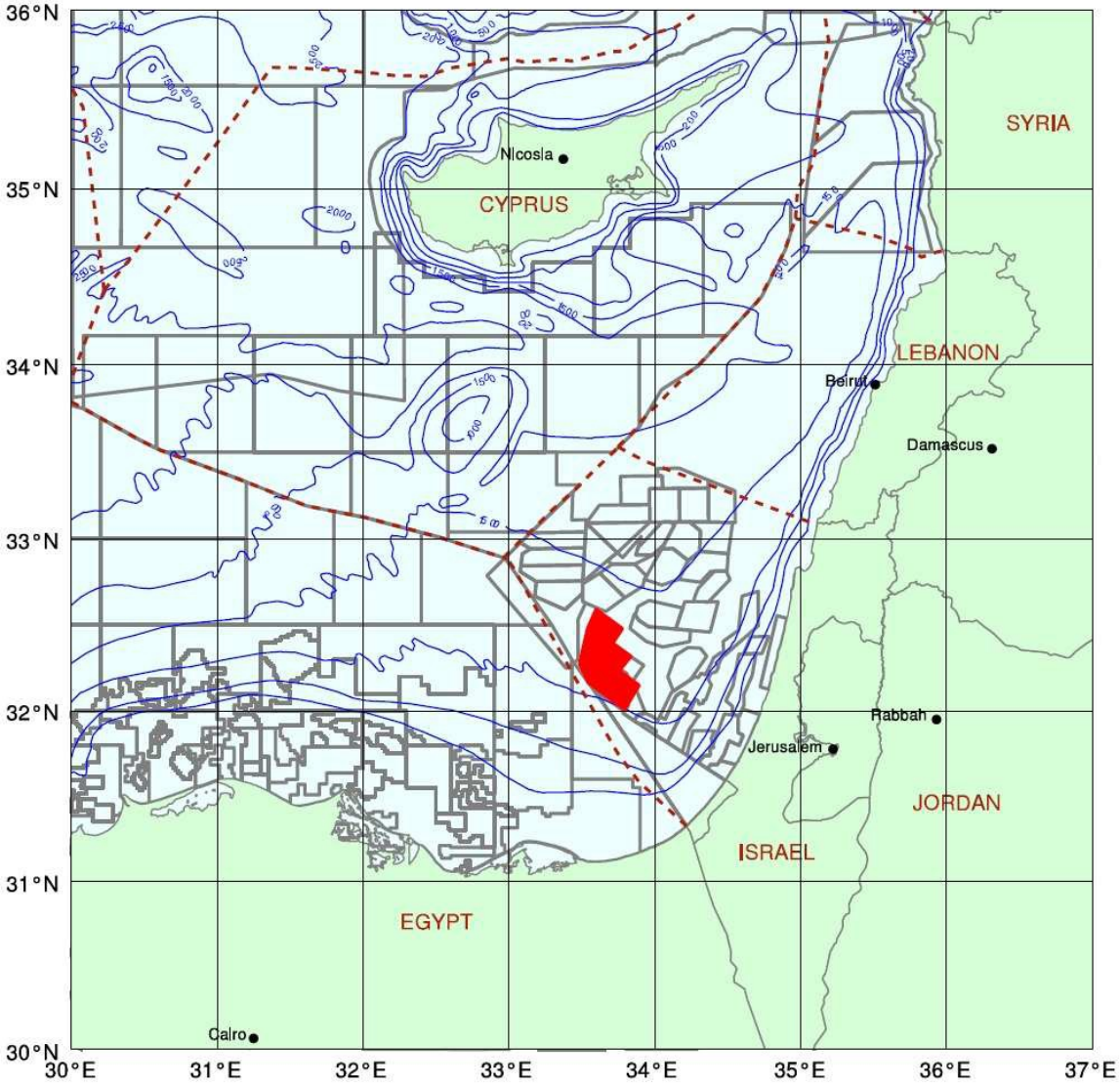

Figure 1: The survey area relative to the Israel coastline

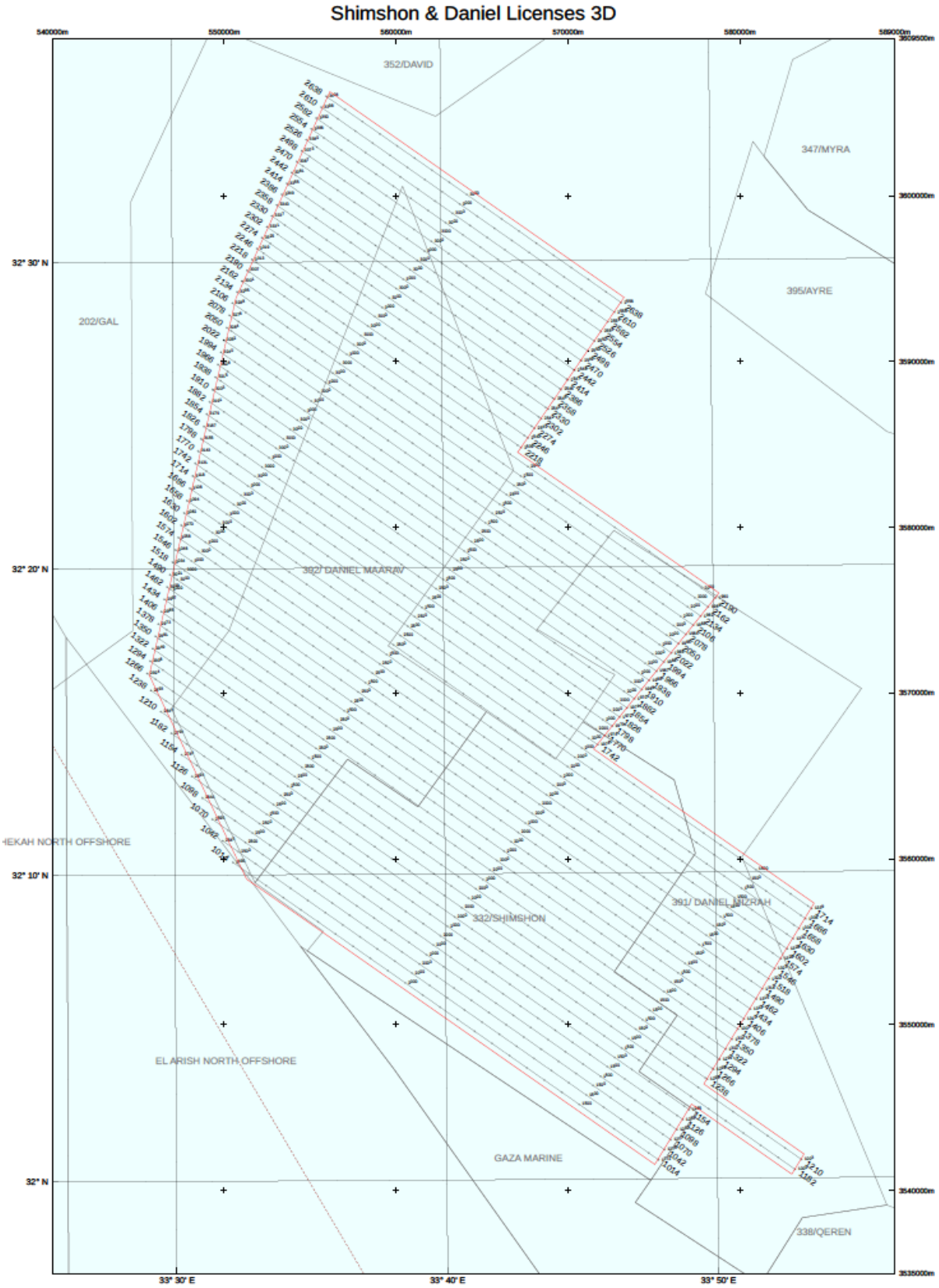

Figure 2: Location of Shimshon & Daniel 3D Seismic Survey area

1.2 Marine Mammals and Anthropogenic Noise

Cetaceans rely on their acoustic abilities for navigation, communication, social interaction, and forging strategies. Long term disruption to these biologically important functions could adversely affect the reproductive success of individuals and eventually the size of populations (Watkins et al. 1987, Croll et al 2001).

Marine seismic surveys produce some of the most intense manmade noises in the oceans and these surveys operate over extensive areas for extended periods of time. Seismic surveys have a substantial environmental footprint, which leaves the seismic array to produce peak pressures of sound higher than any other man-made source (NRDC, 2010). The sound emitted from the air guns can reach 5-300 Hz and overlap the 10 Hz – 200 kHz hearing level of cetaceans (NRC, 2003). Although seismic air gun arrays are designed to direct the majority of emitted energy downward through the seafloor, their sound emission horizontally is also significant (NRC, 2003).

Marine mammal reaction to sound depends upon a number of factors including individual species, state of maturity, experience, current activity, reproductive state, time of day, environmental conditions along with others (Richardson et al. 1995) disturbance to cetaceans behavior has been analyzed throughout observational studies and has provided evidence that cetaceans can be affected by seismic surveys creating physical (including physiological), perceptual, behavioral, and indirect impacts such as displacement from important feeding or breeding area. Physical or physiological effects comprise of permanent damage to body tissues, ears, and auditory malfunction. Whereas, perceptual effects contain mixed communication signals, distorted echolocation, and detecting prey within vicinity (Gordon et al, 2003/2004).

Behavioral effects are associated with disruption of foraging, avoidance of individual areas, respiratory issues, and altered conception of mating rituals. Indirect effects contain reduced feeding rates due to lack of prey found within active areas. Marine turtles do not possess any conventional inner ear structure and are often considered to be deaf in the traditional physiological sense. However, they are considered susceptible to low frequency vibrations, which are likely to be attenuated through hard body parts such as the skull and carapace. This may affect foraging and migration behavior although definitive evidence is lacking in the current literature.

The risk assessment and management strategies outlined in *Biological Conservation*, emphasizes on the main strategy of slowly increasing the level of source when it is turned on (soft start) will provide the cetaceans an opportunity to travel out of a dangerous situation and the advantage of delaying source when cetaceans are detected within certain parameters (Harwood, 2000). In conclusion, as per JNCC guidelines utilized in this survey, both of these methods were instituted.

1.3 Marine Mammal and Mitigation Guidelines for Survey

Two marine mammal observers (MMOs) from Vision Project Services conducted visual monitoring throughout all daylight hours. In the hours of darkness a PAM operator from conducted night time passive acoustic monitoring (PAM), for the marine mammal and protected species mitigation survey required by JNCC with modifications for the local area.

The accepted guidelines for this survey were as follows:

- MMO/PAM conducted a Pre-Shooting Search by monitoring the 500m mitigation zone and adjacent waters for 60 minutes before initiation of the Soft Start procedure.

- If no marine mammals have been spotted in the 500-meter mitigation zone the soft start may proceed.
- Any break in air-gun activity during daylight hours/hours of darkness exceeding 10 minutes requires another 20-minute ramp-up. If the break is for less than 10 minutes and is during daylight hours/hours of darkness then shooting can recommence without a ramp-up as long as the MMO/PAM operator is on watch and there are no marine mammals or sea turtles within the 500 m exclusion zone around the source arrays.
- **Soft Start**
  A Soft Start was conducted by gradually increasing the volume and number of air guns over a period of 20 minutes until full power or the desired power level is reached.
  All full power air-gun activity must be preceded by a 20-minute soft start and this includes full power gun testing. Start of soft start to start of line must not exceed 40 minutes.
- **Gun Tests**
  If a single gun on low power was tested then a ramp-up was not required. If a single gun was being tested that is on high power or multiple guns are being tested - it is suggested that a gun of lower power is fired first and increased to the level of power of the gun test.
- If a protected species is observed within the 500m-exclusion zone in the 60 minutes before the ramp-up or gun test the instruction will be to DELAY the soft start/gun test until 20 minutes after the last sighting of the animal within the exclusion zone. The seismic crew will be informed of the movements of the animal and when the 20-minute delay has passed. If a whale is detected in the exclusion zone during the pre-watch, the DELAY will be extended to 60 minutes.
- If a whale is observed within the 500m exclusion zone during any gun activity (which includes the soft start) the instruction will be to SHUT DOWN IMMEDIATELY. After the exclusion zone has been clear of marine mammals and turtles for 60 minutes, a standard, full soft start can commence as above. The seismic crew will be informed of the movements of the animals and when the 60-minute delay has passed. Another soft start will be needed before shooting can commence.

Source mitigation zone(s)	500m
Pre-watch period	60min (in waters >200m depth)
Soft start length	20-40 minutes
Soft-start delays	0
Species covered	All marine mammals and sea turtles
Special requirements	N/A

Table 2: Mitigation measures summary

The survey was conducted offshore Israel, east Mediterranean, which supports a diverse marine mammal fauna, including several species listed by the Israel Marine Mammal Research & Assistance Center.

The mitigation measures for the protection of the cetacean and marine reptile populations in the survey area were modified taking into account the likely species to be encountered: Bottlenose dolphin *(Tursiops truncates)*, Short-beaked Common dolphin *(Delphinus delphis)*, Striped dolphins *(Stennela coeruleoalba)*, Risso's dolphin *(Grampus griseus)* and Cuvier's beaked whale *(Ziphius cavirostris)*, rough-toothed dolphins *(Steno bredanensis)*.

Marine reptiles:
Sea turtles; Green turtle (*Chelonia mydas*), leatherback turtle (*Dermochelys coriacea*) and loggerhead turtle (*Careta careta*).

2.0 EQUIPMENT & INSTALLATION

2.1. Seismic Equipment & Sound Emissions

This survey was conducted by the *M/V Ramform Sovereign* accompanied by the support vessels *M/V Torsvik* and M/V EDT Flying Enterprise.

Vessel	*M/V Ramform Sovereign*
Call sign	9VBN9
Length overall	102 m
Width	40 m
Draft	17.4
Gross tonnage	13688 Tons
Streamers	14
Source	2

Table 3: *M/V Ramform Sovereign* vessel specifications

Vessel	*M/V Torsvik*	*M/V Flying Enterprise*
Call sign	OZ2029	P3NQ2
Length overall	39.2	55.26
Width	8.5	11.58
Draft	5.93.75	3.47
Speed	9	18
Flag	Faroe Islands	Cyprus

Table 4: *Torsvik* and *Flying Enterprise* vessel specifications

Acting as source and streamer vessel the *M/V Ramform Sovereign* towed 14 streamers: 8.1 km in length and submerged at 10 m (please refer to Figure 3). The following tables show the vessel specification of the *M/V Ramform Sovereign* (please refer to Table 3) and the support vessels M/V *Torsvik* and M/V *Flying Enterprise* (please refer to Table 4).

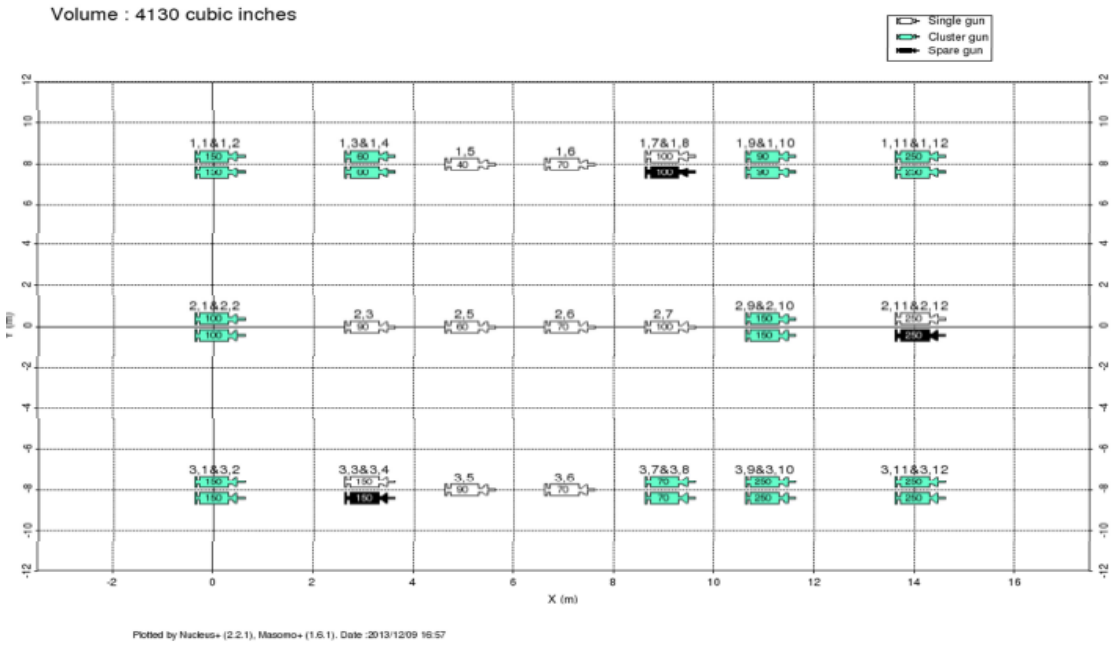

Figure 3: Gun array configuration: M/V *Ramform Sovereign*

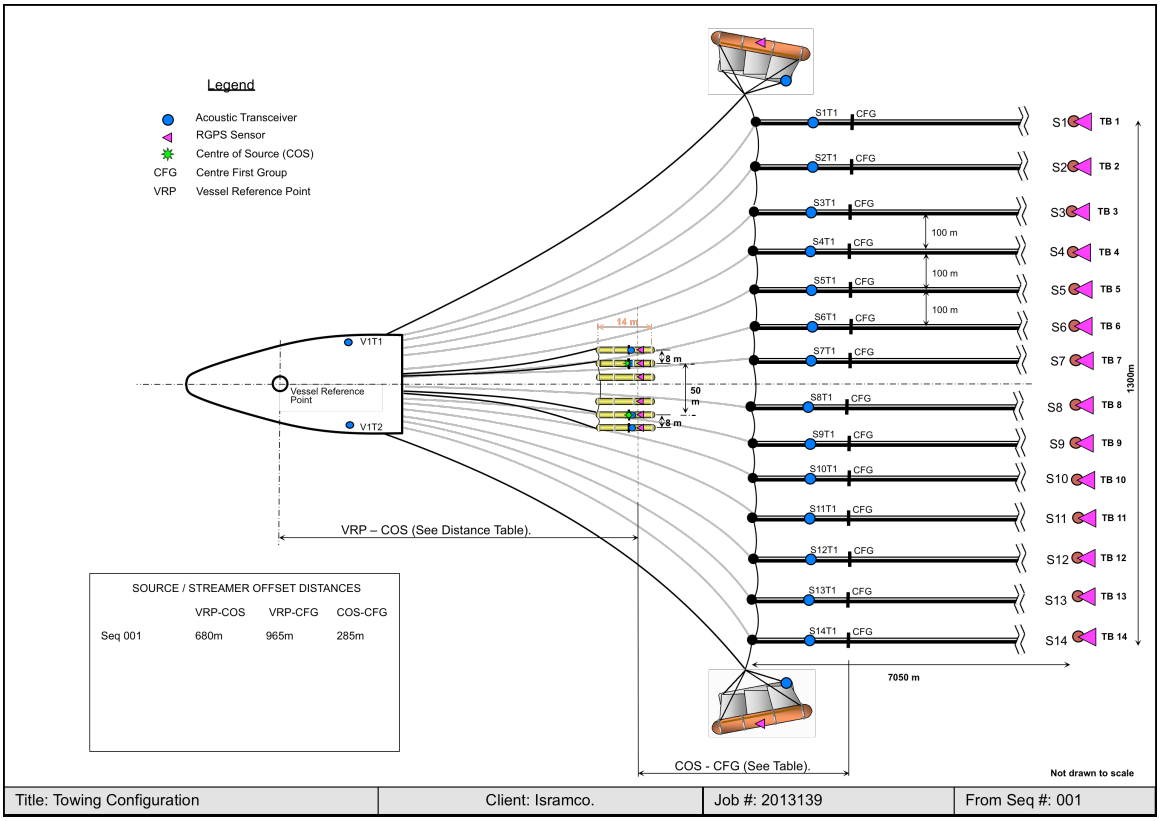

Figure 4: Streamer and airgun array distance parameters in relation to vessel

The vessel towed six gun sub arrays (Bolt 1900 LLXT) comprised of 12:10:12 guns (68 total), each towed at 8.0m depth, 650m aft of the vessel. All guns operated together at 2000psi with array volumes ranging from 100in^3 to 250in^3 for a maximum volume of 4130in^3 (please refer to Table 5). Soft starts were performed as per the agreed guidelines. The gradual increase in power was done automatically enabling the guns one by one.

Source	**M/V *Ramform Sovereign***
Source type	Bolt 1900 LLXT
Number of sources	2
Primary to bubble	25
Operating pressure	2000 psi
Maximum volume	4130 cu. In
Number of sub-arrays	3
Source length	14m
Source depth	8m
Streamers	**M/V *Ramform Sovereign***
Source type	RDH Solid Active Section
Number of sources	14
Streamer length	8100m
Streamer depth	10 m

Table 5: Gun array and streamer configuration

3.0 SURVEY METHODS

3.1 Marine Mammal Survey Methods

The main task of an MMO is to provide advice on the application of the adopted JNCC guidelines; to monitor adherence to these guidelines regarding air-gun operations and to guard a 500 m “safety zone” around the air-guns in a 30-60 minute period (30 minutes for less than 200m water depth| 60 minutes for 200m and greater water depth) before the commencement of a soft start.
The MMOs maintained watch during daytime conditions, whereas the PAM operator sustained watch within nighttime hours. Both parties placed their focus on pre-watches and during the different stages in gun activity (i.e. Soft start, Full power, Start of line, End of line, Gun tests, and abrupt stopping of the guns.).

3.1.1 Visual Observations (MMO)

The observers had a full 360 degree view around the vessel from outside the sky-lounge, a perfectly designed deck above the bridge for observations. Initial visual scanning was done with the naked eye to increase the visual field at one time. Occasional scans were made using binoculars and if a species was sighted an observer would use them to quantify group numbers, a strategy which allows more accurate species identification and note behaviors. Ranges could be determined using a calibrated range finding ruler/stick (using the Heinemann Equation) and/or by using known distances as calibrations. Digital Panasonic and Nikon cameras was used to document sightings and aid in positive identification of species.

Location and effort form (Appendix 1) recorded data at the start of each watch (using UTC time), changes in gun activity, and deviations in notable weather conditions. This data incorporated: observer on duty, latitude/longitude, vessel speed, source activity, wind direction, Beaufort wind speed, sea state, and swell.

Marine mammal pre-watch and gun operation start and stop times were recorded in the Operation form (Appendix 1). Any data on gun operations including soft start duration, time at full power, and end of line were provided by the seismic crew.

Sightings of cetaceans would be recorded in the Marine Mammal Sighting form. Any sighting including multiple individuals, species, or consecutive dive/surfacing behaviors would be considered a single sighting. Data recorded on this form would include: date, time, vessel position (latitude/longitude), speed, course over ground, number of individuals, identification of species, behavior(s), distance from the vessel and sound source, and the sound source activity before and after the sightings.

All cetacean data would be calculated via the JNCC cetacean sightings spreadsheet corresponding regulatory reference number, date, time, detection type, position, depth, species, bearing to mammal, range to mammal, total number of individuals, presence of calves, behavior of mammal, final direction of travel, air-gun source activity, exclusion zone entrance, time of closest approach, and action taken if any required including power down and/or loss of production.

3.1.2 Acoustic Observations (PAM)

Passive acoustic monitoring (PAM) was carried out during all hours of darkness by a PAM Operator. The PAM equipment was supplied by Seiche Measurements Ltd and comprised a 250m hydrophone array cable. Pamguard software (v1.12.05 BETA) was used throughout the survey.

3.2 Reporting and Communication

Reports were submitted on a daily basis throughout the project and included information on marine mammal sightings, observation effort, a brief weather report, and seismic operations pertaining to the MMO watch times for the reporting period. The reports were submitted to the client representative.

There was full co-operation from the PGS personnel for the implementation of JNCC guidelines and all pre-firing watches and soft starts were executed to full satisfaction.

4.0 RESULTS

4.1 Observing Effort, Sighting and Survey Conditions

Overall a total of 250 hours and 40 minutes of visual monitoring was carried out and 225 hours 43 minutes accounted for passive acoustic monitoring. Visual monitoring with air-gun activity was 149 hours and 52 minutes, and without gun activity was 100 hours and 48 minutes (Table 6.)

Method:	Visual monitoring:
Total watch time	**250:40**
Total watch time with airgun activity	**149:52**
Total watch time without gun activity	**100:48**

Table 6: Total MMO watch times with/without gun activity

The total source activity for this report period was 328 hours and 27 minutes; soft starts (soft start to start of lines) accounted for 39 hours and 47 minutes (daylight: 17 hours and 4 minutes and nighttime: 21 hours 29 minutes), production (start of line to end of line) firing 286 hours and 30 minutes, and gun testing 2 hours and 4 minutes.

4.1.1 Observer Effort & Sightings

From December 24th 2013 until January 16th 2014 the total marine mammal observation time was 250 hours and 40 minutes. There were no marine mammals and reptiles visually sighted during this report period.

In addition, passive acoustic monitoring was conducted for 225 hours and 43 minutes. There was one acoustic detection.

The MMO's kept a vigilant watch prior to all daylight seismic source activity.

4.1.2 Survey conditions

Sea conditions were good for observations with force between 2-4 winds mainly north-easterly (28%), south-easterly (20%) and easterly (17%), predominantly slight seas and low swell. Weather and visibility were good without precipitation for most of the day. The sighting conditions throughout the survey are summarized below in Figure 4 expressed as the percentage of the total observation time.

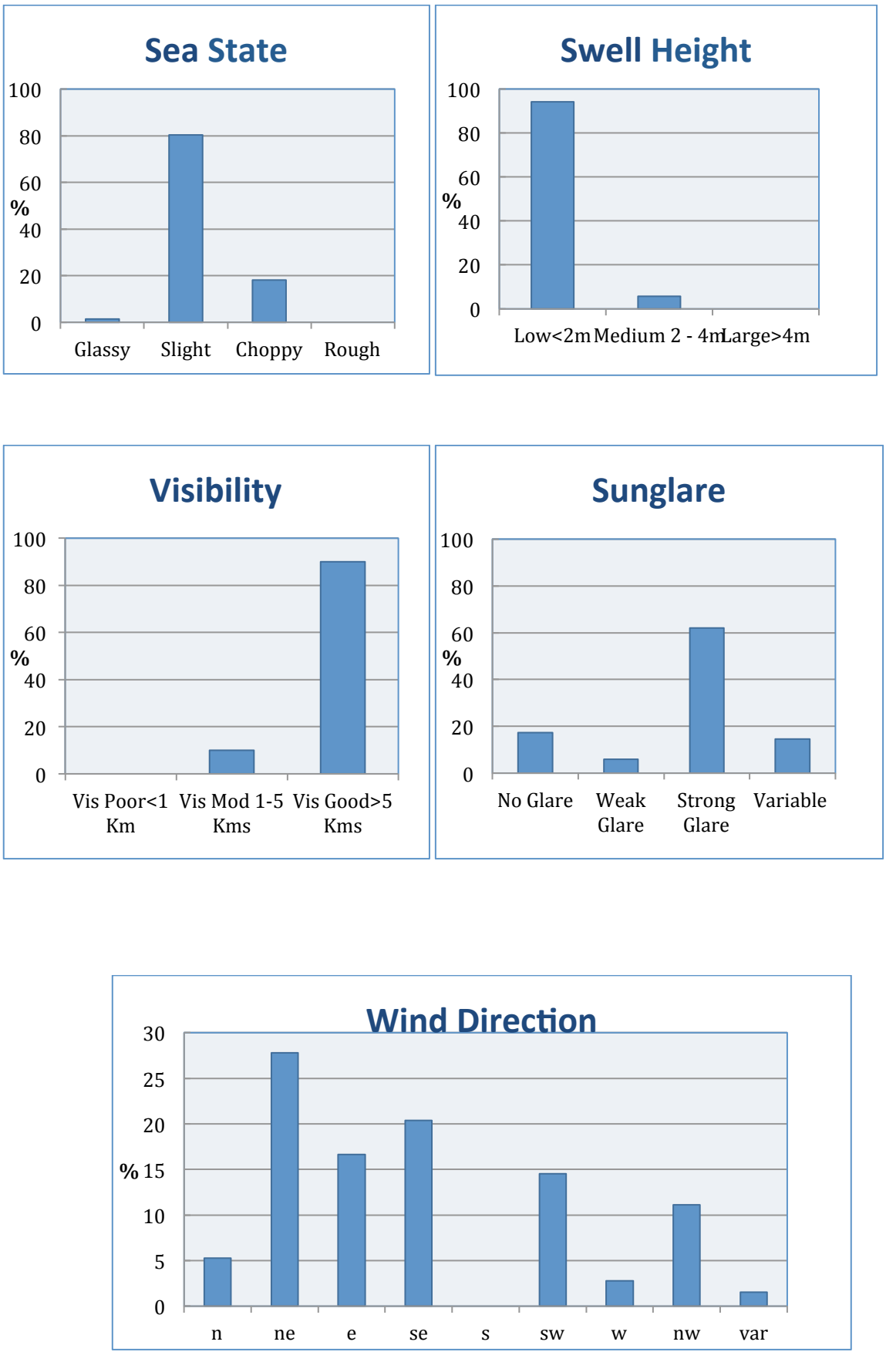

Figure 4: Sightings conditions: the percentage of observation time for JNCC classifications of Wind Direction, Sea State, Swell Height, Visibility and Glare.

4.2 Other Animal Sightings

4.2.1 Birds

Very few land and seabirds were seen during the course of the survey, but occasionally a few birds were observed included; Falcon Lesser Kestrel, *(Falco naumanni)* (please refer to photograph 4), Northern Gannet *(Morus bassanus),* Armenian Gull (*Larus armenicus*) and Yellow-legged Gull *(Larus michahellis).*

Photograph 4: Falcon (Lesser Kestrel)

5.0 COMPLIANCE WITH GUIDELINES

5.1 Monitoring airgun operations and soft-starts

The seismic crew observers gave the MMO or PAM operator (dependent on time of day) a 1.5 hour warning to start of line via two-way VHF radio to allow the necessary 60 minute pre-watch for marine mammals and soft start. The MMO or PAM operator would give the 'OK' or 'not clear' as necessary. If marine mammals were present within the 500m exclusion zone at any time the seismic observers were notified via two-way VHF radio.

In total there were 72 seismic source events. The soft starts for this particular survey were performed by firing the smallest source element in the array first and then adding in the next largest until full power was achieved, and later the start of line. Overall, 4 tests were conducted in daylight hours and 2 tests during nighttime.

There were 66 soft starts in total, 29 soft-starts were carried out during the hours of daylight and 35 occurring within the hours of darkness. In addition, 2 were carried out at dusk. Dependent on hour of day, the MMO or PAM operator carried out a pre-watch prior to any gun activity.

5.2 Mitigation action

All soft start conformed to the current JNCC (2010) guidelines. No mitigation was required at any point during the entire duration of this seismic survey.

6.0 CONCLUSIONS & RECOMMENDATIONS

- During the period covered in this report there were no marine mammals in the survey area.
- The proximity to the Suez Canal zone, merchant traffic activity and naval vessel operations might be possible factors for the avoidance of marine mammals and reptiles in the area.
- The absence of acoustically sensitive deep-diving cetaceans can be explained by benthic topography of the East Mediterranean specially Levant basin, characterized by the lack of deep-sea trenches and ridges.
- There were not much fishing and other biological activity – this is a possible factor of limitation of dolphin sightings in the area.
- JNCC mitigation guidelines were followed correctly at all times.
- MMO watch and pre-watch times were kept continuously according to schedule during all daylight hours, with good communication with seismic crew.
- Observation from the monkey deck / Sky-lounge allows for a 360º view, which makes perfect conditions for monitoring the Exclusion Zone as well as the surrounding areas.
- Continuation of control of the environmental risks impacts of seismic operation in the future might be recommended.
- Data recording can be helpful to assess the future conservation plans in the East Mediterranean

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***Appendices included with this final report in separate attachment**