MARINE MAMMAL OBSERVER (MMO)/PASSIVE ACOUSTIC MONITORING (PAM)/ACOUSTIC DETERRENT DEVICE (ADD) REPORT FOR EXPLOSIVE ORDNANCE DISPOSAL (EOD) AT ABERDEEN OFFSHORE WIND FARM, NORTH SEA

Prepared for Boskalis on behalf of

VATTENFALL

TECHNICAL REPORT 2

Survey period: 26 October – 05 November 2017

OSC™
OCEAN SCIENCE CONSULTING

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LIST OF ACRONYMS

ADD	Acoustic Deterrent Device
dB	DeciBels
DAU	Data Acquisition Unit
FRC	Fast Rescue Craft
Hz	Hertz
JNCC	Joint Nature Conservation Committee
kHz	KiloHertz
Km	Kilometre
kNm	KiloNewton Metre
m	Metre
Min	Minute
MMO	Marine Mammal Observer
MV	Motor Vessel
NI	National Instrument
OGP	Oil and Gas Producers
OSC	Ocean Science Consulting Ltd.
PAM	Passive Acoustic Monitoring
PAMGuard	Passive Acoustic Monitoring Guardianship
ROV	Remotely Operated Vehicle

SUMMARY

Marine mammal monitoring and mitigation measures were required for the removal of seven UneXploded Ordnance (UXO) targets at Aberdeen Offshore Wind Farm (AOWF) in the North Sea. Explosive Ordnance Detonation (EOD) was performed from Motor Vessel (MV) *Smit Kamara* by Boskalis (primary contractor) on behalf of Vattenfall, from 26 October–5 November 2017. Boskalis contracted Ocean Science Consulting Ltd (OSC) to supply specialist Marine Mammal Observer (MMO), Passive Acoustic Monitoring (PAM), and Acoustic Deterrent Device (ADD) mitigation services during EOD, to assist with implementation of Joint Nature Conservation Committee (JNCC) guidelines, collect field data, and maintain reporting procedures and standards, as stipulated in the JNCC guidelines for minimising the risk of injury and disturbance to marine mammals from explosions (August, 2010).

Visual and acoustic monitoring and deployment of a seal scarer and pingers were carried out by an experienced Marine Mammal Observer (MMO) and Passive Acoustic Monitoring Operator (PAMO) aboard MV *Ocean Predator*. During operations, *Ocean Predator* circled around each UXO target at approximately 750 metres distance, to ensure best possible coverage (before, during and after detonation) of the designated 1,500-metre mitigation zone. Prior to UXO detonation, a 1-hour joint visual and acoustic pre-watch was conducted for marine mammals, with visual watches focusing on the 1,500-metre mitigation zone around each target. Approximately 30 minutes into the pre-watch, the seal scarer and pingers were deployed from the vessel and operated for a full 30 minutes prior to clearance for detonation, while visual and acoustic monitoring continued. Once the all-clear was given, three deterrent charges (of 50, 100 and 150 g) were detonated approximately 5 minutes apart as a warning signal before the main detonation. Marine mammal monitoring continued until the final detonation.

During this reporting period, a cumulative total of 34 hours 36 minutes of joint visual / acoustic monitoring was undertaken. There were three marine mammal sightings at the project site. The first, a large group of bottlenose dolphins, was made at the beginning of the project period on 27 October, several days before the first detonation. The second, an adult grey seal in the mitigation zone, resulted in a 22-minute delay to operations to ensure the animal was clear of the target area before any detonation sequence commenced. The third, a juvenile grey seal, once again in the mitigation zone, occurred after the pre-watch was complete and the third deterrent charge had already been detonated. In this case, final detonation was postponed for a further 20 minutes to ensure the animal was clear of the target before detonation.

Post-detonations, thorough searches of the detonation areas were conducted to check for casualties. There were no deaths or injuries detected to any marine mammals, salmon or sea trout at any stage of the visual-monitoring efforts.

1. INTRODUCTION

Aberdeen Offshore Wind Farm (AOWF), also known as the European Offshore Wind Deployment Centre (EOWDC), is a test and demonstration project wholly owned by Aberdeen Offshore Wind Farm Limited, a subsidiary of Vattenfall Wind Power Limited (Vattenfall).

This report summarises the environmental mitigation procedures implemented during the pre-construction clearance of UneXploded Ordnance (UXO) from the site. A total of seven UXO targets were identified for demolition during the reporting period, with preparatory measures consisting of (i) visual and acoustic monitoring for marine mammals in the vicinity; (ii) preparation of the area around the UXO in readiness for charge placement, (iii) deployment of an Acoustic Deterrent Device (ADD) also known as a 'seal-scarer', and pingers, (iv) the use of deterrent charges of increasing size prior to final UXO detonation, and (v) post detonation searches for injured/dead marine mammals and fish.

2. MATERIALS & METHODS

2.1. Timing & Locations

The 11-day survey was undertaken from 26 October–5 November. The AOWF site is located around 3 km off the coast of Aberdeenshire, Scotland, to the north of Aberdeen harbour, in the northern North Sea, shown in **Figure 1.**

The area of the wind farm is approximately 7 square kilometres and will consist of 11 turbines (constructed in water depths of 20 to 30 metres) with an export capacity of 92.4 MW. The turbines will be installed on tripod suction bucket jacket foundations and will be connected by two export cables to an onshore substation at Blackdog village, from where the energy will be exported to the National Grid.

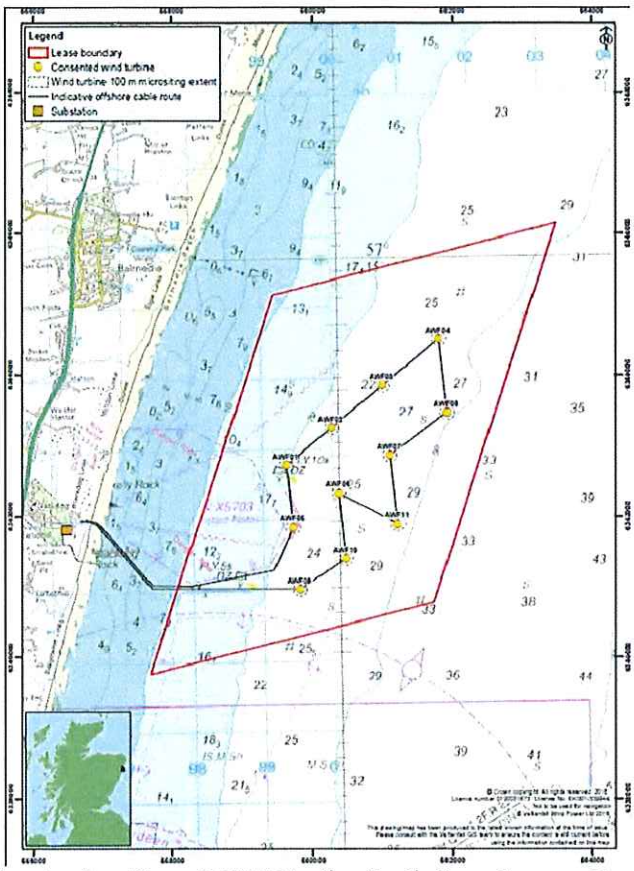

Figure 1. Chart showing location of AOWF in the North Sea. *Source:* Boskalis, 2017.

2.2. Vessels

MMO, PAM and ADD deployment were undertaken aboard MV *Ocean Predator*, shown in **Figure 2.**

Figure 2. MV *Ocean Predator*, from where the MMO and PAM Operator performed environmental monitoring and deployed an ADD. *Source:* OSC, 2017.

Pre, during and post detonation, *Ocean Predator's* VHF radio was used to communicate with other vessels in the vicinity. Throughout operations, *Ocean Predator* circled around each UXO target at a distance of 750 m, to ensure best possible visual and acoustic coverage of the designated 1.5 km mitigation zone. Explosives were deployed using a Remote Operated Vehicle (ROV) from MV *Smit Kamara*, and triggered from a Fast Rescue Craft (FRC), shown in **Figure 3.**

Figure 3. MV *Smit Kamara*, from where the ROV deployed explosives, and the FRC activated charges. *Source:* fleetmon.com, 2017.

2.3. MMO

Visual observations were undertaken by a dedicated Marine Mammal Observer (MMO) during daylight hours. Sightings of marine mammals were made with the naked eye and by systematically searching the area using 7 x 50 mm reticule binoculars. Information on the observation vessel's position, speed, heading, water depth and the source activity were recorded at least once every hour using standard JNCC recording forms.

A pre-watch of ≥60 minutes was carried out prior to any scheduled detonations, focusing on the 1.5 km mitigation area surrounding the target. If marine mammals were detected, range estimations were made using the naked eye, reticule binoculars and/or by relating the sighting to a nearby object of known distance (e.g. the UXO source or one of the support vessels). Species identifications were made whenever distance, length of sighting and/or visual conditions allowed, with photographs taken using a Nikon D3 SLR camera with a 300 mm f2.8 fixed lens and x1.7 converter. Identification features and the behaviour of any sighted mammals were further recorded, in addition to the activity of the source.

2.4. PAM

Acoustic monitoring was conducted by one PAM operator during daylight hours alongside the visual watches, providing dual monitoring of the mitigation zone and facilitating correlations between acoustic and visual detections alike.

PAM equipment was owned and supplied by OSC and comprised top-end (dry-end) acoustic processing electronics, an intermediate deck cable for conveying

acoustic signals, and a bottom-end (wet-end) hydrophone array cable terminating with a depth sensor. Complete spares were provided for all PAM components in case of equipment failure, damage, or loss, but careful deployment/retrieval and routine maintenance throughout operations avoided unnecessary wear-and-tear.

Passive Acoustic Monitoring Guardianship (PAMGuard) software was utilised for monitoring all frequency ranges during conductor driving. PAMGuard is an open-source PAM software that consolidates existing PAM software functionality within a single application. The development and use of PAMGuard has been supported by the scientific community, the seismic industry, and most recently by the Oil and Gas Producers (OGP) 'Sound and Marine Life Joint Industry Programme'.

Low-frequency monitoring (sampling rate of 48,000 Hz allowing frequency detection to 24,000 Hz) was used to detect, for example, the whistles of dolphins (ca. frequency range of 8,000 Hz to about 16,000 Hz).

High frequency monitoring (sampling rate 500,000 Hz allowing frequency detection to 250,000 Hz) was used to detect high-frequency clicks for various species, including the harbour porpoise. Clicks range typically from approximately 30 kHz up to 160 kHz, and a click detector function via a National Instrument (NI) sound card in PAMGuard was configured to examine these frequencies.

Approximately 80 metres of hydrophone cable was towed behind *Ocean Predator*.

2.5. ADD

An Acoustic Deterrent Device (ADD) and pinger array were deployed from *Ocean Predator* approximately 30 minutes prior to the detonation of explosives, in a further attempt to keep animals away from the source. ADD equipment was owned and supplied by OSC, and is shown in **Figure 4**.

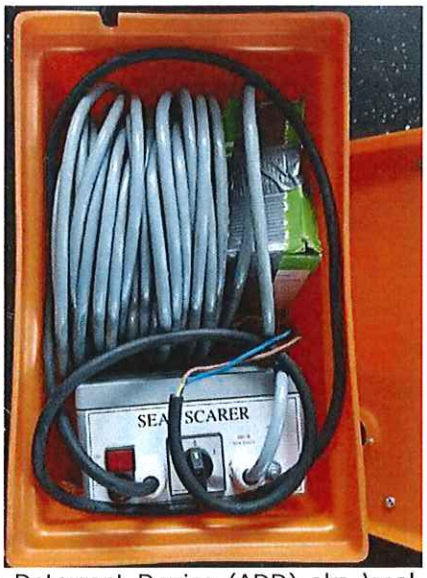

Figure 4. Acoustic Deterrent Device (ADD) aka 'seal-scarer' used to deter marine mammals from the immediate vicinity prior to demolition of the UXO target. *Source*: OSC, 2017.

The ADD comprised top-end (dry-end) control unit electronics housed in an orange-plastic container, and a bottom-end (wet-end) 20 m long transducer cable, which terminated with a hydrophone.

The ADD was activated ca. 30 min prior to commencement of a detonation and de-activated immediately prior to detonation, once the detonation sequence was cleared to proceed (i.e. no marine mammals detected by the MMO or PAMO).

2.6. Sound source

Explosives were the primary sound source. As a wildlife deterrent, three charges of 50, 100, and 150 g, were detonated immediately before the main detonation.

2.7. Marine mammal guidelines

In fulfilment of the regulatory requirements and mandatory reporting agreement by the Joint Nature Conservation Committee (JNCC) Guidelines for minimising the risk of injury and disturbance to marine mammals from explosions (JNCC, 2010), **Table 1** outlines mitigation measures implemented during the AOWF project.

Category	Details
Mitigation zone	1.5 km radius from UXO site
Pre-watch period by dedicated MMO and PAMO	≥60 minutes
Soft start / deterrent charges	Three deterrent charges of increasing size detonated before main demolition as a warning to marine wildlife
Detonation delays	At least 20 minutes from last sighting
Special requirements	Use of an Acoustic Deterrent Device (ADD) and acoustic pingers 30 minutes prior to detonation of target. Post-detonation searches of the detonation site.

Table 1. Summary of marine mammal mitigation measures during removal of UXO at AOWF. *Source*: OSC, 2017.

3. RESULTS

3.1. Overview

From 26 October to 4 November 2017, daylight ranged from 9.5 to 10 hours. During this reporting period, marine mammal monitoring was conducted on 7 out of the 11 days contiguous to EOD operations, with detonations being carried out over 4 separate days, for which the UXO forms are presented in the appendices.

3.2. MMO/PAM/ADD/EOD operations

All operations were fully compliant with JNCC guidelines. Cumulative total for MMO and PAM effort was 34 hours and 36 minutes: 27 hours and 42 minutes in the absence of the sound source; 4 hours and 12 minutes during ADD operation; and 2 hours and 42 minutes during detonation, illustrated in **Figure 5.**

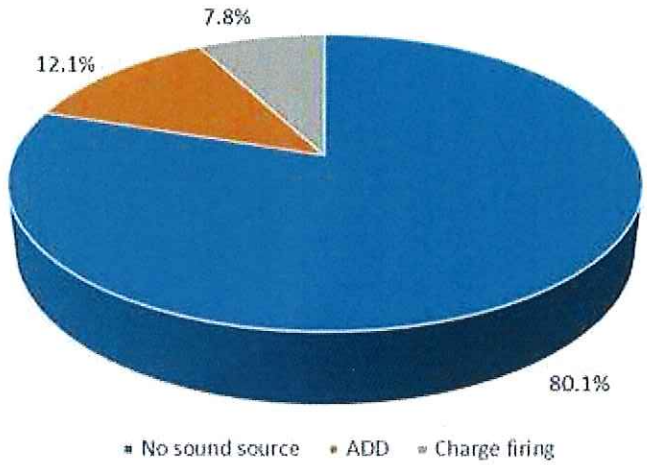

Figure 5. Combined MMO and PAM effort with respect to ADD and explosive noise sources for the reporting period 26 October to 4 November 2017. *Source*: OSC, 2017

MMO and PAM effort (and sighting) forms are provided in the appendices and ADD activation times are provided in **Table 2.**

UXO #	Lat (N)	Long (W)	Start time	End time	Duration (hh:mm)	Notes
634	57°13.717	001°58.675	14:10	14:40	00:30	
001	57°12.837	002°00.802	08:32	09:02	00:30	
224	57°12.410	002°00.800	13:00	13:30	00:30	
393	57°13.713	002°00.243	15:48	16:40	00:52	Re-deployed for 22 minutes after seal detection in mitigation zone prior to first deterrent charge
468	57°14.056	001°59.273	07:53	08:23	00:30	
777	57°13.341	001°59.262	13:51	14:21	00:30	
695	57°13.477	001°59.216	08:35	09:08	00:50	Re-deployed for 20 minutes after seal detection in mitigation zone after third deterrent charge

Table 2. ADD activation periods prior to detonations at AOWF. Coordinates in WGS 84' *Source*: OSC, 2017.

3.3. Marine mammal detections & mitigative actions

During the reporting period, three marine mammals were sighted. The first was an incidental sighting of an offshore group of bottlenose dolphins, reported by the guard vessel, *Seiont A*, on 27 October, when no detonation works were in progress. The second and third sightings of single grey seals (on 2 and 4 November) resulted in mitigative action and delayed detonations, as per **Table 3**.

Detonation #	Date	Common name	Scientific name	Time (UTC)	Group size	Source activity	Closest approach to source (m)	Mitigation action	Duration mitigation action (hh:mm)
001	27/10/17	Bottlenose dolphin	*Tursiops truncatus*	13:25	27+	None	2,000	None required	00:00
002	02/11/17	Grey seal	*Halichoerus grypus*	16:00	1	None	800	Delay to deterrent sequence	00:22
003	04/11/17	Grey seal	*Halichoerus grypus*	09:24	1	Firing	1,000	Delay to final detonation	00:20

Table 3. Summary of marine mammal species sighted 26 October to 4 November 2017. *Source*: OSC, 2017.

3.4. Post-detonation searches

Following UXO detonations, a visual search of the target area was undertaken, assisted by crews of the *Ocean Predator* and *Seiont A*, and no injured or dead marine mammals or salmon/sea trout were found.

As per **Figure 6**, owing to weather conditions on 5 November, a post-project visual survey at AOWF was not possible 24 hours (or indeed in the days to follow) after the final detonation (UXO #695), which was specified in the licensing guidelines. Consequently, the mitigation team undertook a systematic site survey in the afternoon of 4 November to check for any mammals/fish in the project area, when sea state conditions were ideal (Beaufort 1, with excellent visibility). The route taken to monitor the full AOWF site is shown in **Figure 7**. No injured/dead marine mammals or salmonid species were observed.

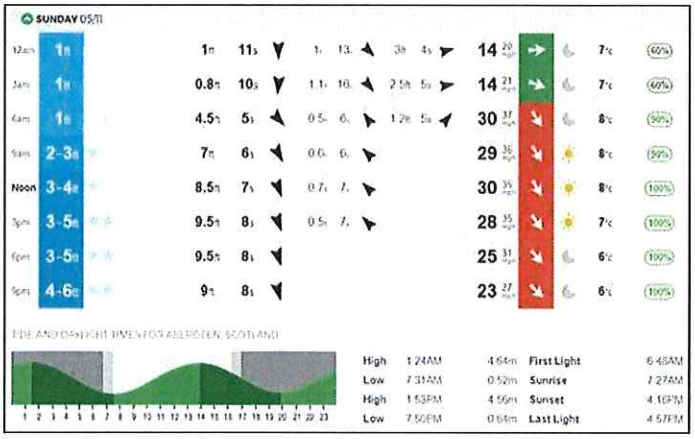

Figure 6. Weather forecast for Aberdeen Bay on 5 November 2017 showing conditions which would have rendered a post-survey search ineffective. *Source*: OSC, 2017.

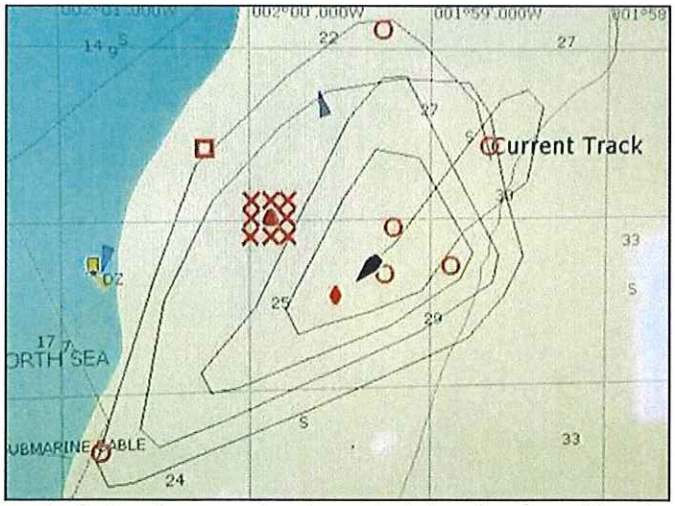

Figure 7. Post-project visual-survey tracks undertaken by the mitigation team to ensure effective coverage of AOWF in the afternoon following final site detonation of UXO #695. *Source*: OSC, 2017.

In view of the sea conditions on 5 November, a beach survey was organised along the shore adjacent to the project site, as an extra effort to search for any injured or dead marine mammals/fish, approximately 24 hours after the last UXO detonation. The search was undertaken approximately 1.5 miles north and south of the Blackdog village. No injured/dead marine mammals or salmonid species were observed on the beach or shoreline.

3.5. Environmental conditions

Generally, monitoring was only undertaken in favourable sea conditions and visibility. Sea states ranged from Beaufort 0 to 5 during the reporting period, but the vast majority of observations occurred in low swells of less than 2 metres with slight sea states of Beaufort 2 to 3 and south west winds, as per **Figure 8**. Strong sunshine resulted in glare on several days, but overall conditions were good for accomplished visual monitoring of the project area.

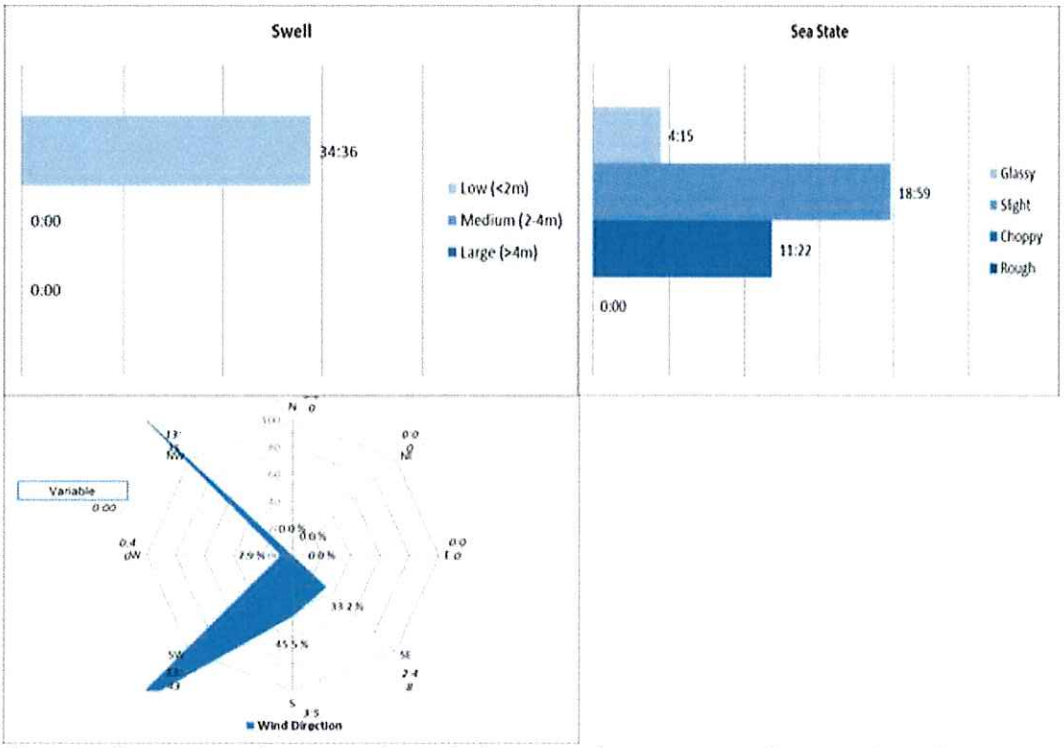

Figure 8. Sea conditions and wind direction during MMO effort conducted from 26 October to 4 November 2017. *Source*: OSC, 2017.

4. DISCUSSION

Contrary to concerns about the abundant marine wildlife in the project area, other than scattered sea birds (mainly auks and gulls) that were identified on a daily basis, marine mammals remained scarce within the project area throughout the reporting period. Minke whales and harbour porpoises frequently occur close to the shoreline during the spring and summer months in this region (e.g. Robinson et al., 2007; Robinson et al., 2009), but they were expected to be scarce at this time of year, hence the elected period for EOD removal. Other than

a single sighting of a solitary harbour porpoise reported by local shore-watchers from the headland at Torry Battery, by Aberdeen harbour, there was no evidence of the presence of either of these species in the immediate project area. The very small size and inconspicuous surface behaviour of harbour porpoises can make them difficult to spot visually; however, low sea states and swells were favourable for sighting these animals, and the lack of acoustic detections also supported their absence during the reporting period.

During the operational period, just two sightings occurred, both of grey seals. The first, on 2 November, 42 minutes into the pre-watch period when a single adult surfaced 800 m from the source. The ADD had already been deployed for 12 minutes and there were no further sightings of the animal for 20 minutes as the first deterrent charge was delayed by a further 2 minutes. However, just as the deterrent charge was about to commence, the animal surfaced again in almost exactly the same location. Detonation was postponed and the environmental team placed their vessel between the detonation target and seal, then redeployed the ADD. A further 20 minutes elapsed and the detonation sequence (increasing deterrent charges) proceeded as there was no further signs of the animal.

The second sighting of a juvenile grey seal was made after the completion of a thorough one-hour pre-watch and further to the deterrent charge already having been detonated. The animal surfaced close to the monitoring vessel approximately 1 km from the source. The final detonation was halted accordingly and once again the vessel was placed between the detonation target and the seal and the ADD was redeployed. After 20 minutes with no further sightings, detonation recommenced.

In both of the above cases, thorough post-detonation searches were made of the target areas to ensure that no marine mammals had been injured or killed as a result of the operations. In addition, there were no detected deaths or injuries to any salmon or sea trout at any stage of the project or during visual monitoring efforts by the mitigation team and/or support vessels.

In summary, JNCC (2010) guidelines were followed correctly at all times during this reporting period and communications between all operators and the mitigation team were exemplary. This resulted in zero issues of non-compliance and a significant mitigative effort by all parties during the operation.

Bottlenose dolphins are also known to be highly prevalent in this region (Weir et al., 2008), albeit, generally, in lower numbers at this time of the year. Opportunistic sightings of the species were made by the MMO and PAMO on a daily basis upon exiting and returning to Aberdeen harbour on the work boat, but the only sighting in the project area was made a couple of days before demolition work commenced by the guard vessel, *Seiont A*, as confirmed by the MMO from photographs taken by the skipper. Surprisingly, the sighting was made offshore, at a depth of 32 metres, to the east of the AOWF site, but the presence of numerous birds and the behaviour of the group suggested they were feeding there. Other than this, the dolphins appeared to keep well away from the operational area. Once operations had commenced, information from local watch groups, monitoring the mammals from the Torry Battery, reported the dolphins travelling to and from the harbour mouth from the south only, with no animals north of the harbour in the direction of the AOWF site.

5. ACKNOWLEDGMENTS

First and foremostly, thanks to Boskalis for contracting OSC for this work. OSC's team would also like to express its gratitude to the crew of MV *Ocean Predator*, who were most helpful, and Boskalis personnel aboard MV *Smit Kamara* who upheld excellent communication prior to and throughout all operations. Our field personnel (MMO, PAM, ADD, data collection, data management, and quality control) aboard Ocean Predator were Dr Kevin Robinson and João Gonçalves.

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7. APPENDIX

7.1. UXO forms

Detonation #01	Explosives reference - 634			
Time and Date	12:30		31/10/17	
Source coordinates	Latitude:	57°13.717N	Longitude:	001°58.675W
Target description	Fragmented UXO			
Size of charge(s)	Deterrent charges 50, 100 and 150g; main charge ± 6.7kg			
MMO	Started:	12:30	Finished:	15:15
PAM	Deployed:	12:30	Retrieved:	15:15
ADD	Deployed:	14:10	Retrieved:	14:40
Post-detonation search observations	Small explosion with no water, sediment or mud displacement. 300+ small sprat (4-5 cm) dead at surface plus two dead guillemots. No dead salmon, sea trout or injured marine mammals observed.			
Protected species encountered	None			
Comments	First deterrent charge was detonated early by the RIB whilst the ADD was still in the water and before the mitigation team had completed their mammal pre-watch and given the all clear. A stop action alert was actioned by the MMO before the RIB continued with the second deterrent charge. No dead salmon, sea trout or injured marine mammals observed.			

Detonation #02	Explosives reference – 001			
Time and Date	07:15		02/11/17	
Source coordinates	Latitude:	57°12.837N	Longitude:	002°00.802W
Target description	Fragmented UXO			
Size of charge(s)	Deterrent charges 50, 100 and 150g; main charge ± 6.7kg			
MMO	Started:	08:00	Finished:	09:02
PAM	Deployed:	08:00	Retrieved:	09:02
ADD	Deployed:	08:32	Retrieved:	09:02
Post-detonation search observations	Small explosion with no water, sediment or mud displacement. 100+ small pollack and saithe (12-15 cm) dead at surface. No dead salmon, sea trout or injured marine mammals.			
Protected species	None			

Detonation #03	Explosives reference – 224			
Time and Date	12:00		02/11/17	
Source coordinates	Latitude:	57°12.410N	Longitude:	002°00.800W
Target description	Fragmented UXO			
Size of charge(s)	Deterrent charges 50, 100 and 150g; main charge ± 6.7kg			
MMO effort	Started:	12:30	Finished:	13:50
Acoustic scan	Deployed:	12:30	Retrieved:	13:50
ADD	Deployed:	13:00	Retrieved:	13:30
Post-detonation search observations	Small explosion with no water, sediment or mud displacement. 500+ small sprat (4-5 cm) dead at surface. No dead salmon, sea trout or injured marine mammals observed.			
Protected species encountered	None			

Detonation #04	Explosives reference – 393			
Time and Date	14:13		02/11/17	
Source coordinates	Latitude:	57°13.713N	Longitude:	002°00.243W
Target description	Fragmented UXO			
Size of charge(s)	Deterrent charges 50, 100 and 150g; main charge ± 6.7kg			
MMO	Started:	15:18	Finished:	17:10
PAM	Deployed:	15:18	Retrieved:	17:10
ADD	Deployed:	15:48	Retrieved:	16:40
Post-detonation search observations	Small explosion with no water, sediment or mud displacement. 200+ small sprat (4-5 cm) dead at surface. No dead salmon, sea trout or injured marine mammals observed.			
Protected species encountered	1 x adult grey seal visually detected approx. 700 metres from the detonation location at 16:00. Last sighted in the mitigation area at 16:20.			
Mitigating actions	The first deterrent detonation was delayed 20 minutes from the last sighting, after which the area was declared clear for detonation of the first charge.			
Comments	The ADD was continued for a further 22 minutes during the delay.			

Detonation #05	Explosives reference – 468			
Time and Date	07:10		03/11/17	
Source coordinates	Latitude:	57°14.056N	Longitude:	001°59.273W
Target description	Fragmented UXO			
Size of charge(s)	Deterrent charges 50, 100 and 150g; main charge ± 6.7kg			
MMO	Started:	07:23	Finished:	09:00
PAM	Deployed:	07:23	Retrieved:	08:45
ADD	Deployed:	07:53	Retrieved:	08:23
Post-detonation search observations	Small explosion with no water, sediment or mud displacement. 200+ small sprat (4-5 cm) dead at surface. No dead salmon, sea trout or injured marine mammals observed.			
Protected species encountered	None			

Detonation #06	Explosives reference – 777			
Time and Date	07:15		03/11/17	
Source coordinates	Latitude:	57°13.341N	Longitude:	001°59.262W
Target description	Fragmented UXO			
Size of charge(s)	Deterrent charges 50, 100 and 150g; main charge ± 6.7kg			
MMO	Started:	13:20	Finished:	15:00
PAM	Deployed:	13:20	Retrieved:	14:45
ADD	Deployed:	13:51	Retrieved:	14:21
Post-detonation search observations	Small explosion with no water, sediment or mud displacement. 500+ small sprat (4-5 cm) dead at surface. No dead salmon, sea trout or injured marine mammals observed.			
Protected species encountered	None			

Detonation #07	Explosives reference – 695			
Time and Date	07:12		04/11/17	
Source coordinates	Latitude:	57°13.477N	Longitude:	001°59.216W
Target description	Fragmented UXO			
Size of charge(s)	Deterrent charges 50, 100 and 150g; main charge ± 6.7kg			
MMO	Started:	08:05	Finished:	10:00
PAM	Deployed:	08:05	Retrieved:	09:46
ADD	Deployed:	08:35	Retrieved:	09:08
Post-detonation search observations	Small explosion with no water, sediment or mud displacement. 100+ small sprat (4-5 cm) dead at surface. No dead salmon, sea trout or injured marine mammals observed.			
Protected species encountered	1 x juvenile grey seal visually detected approx. 1,000 metres from detonation location at 09:24 after 3rd deterrent charge had already been detonated.			
Mitigating actions	The operation was suspended, and the ADD was redeployed. The animal was not sighted again, and the main explosion was delayed a further 20 minutes to allow the mammal to move outside the mitigation area. The final detonation was made at 09:45.			
Comments	A more expansive search of the detonation area was conducted thereafter, but there was no further sign of this or any other marine mammals in the post-detonation or wider area.			

7.2. Cover page

Regulatory reference number	Country	Location	Ship/ platform name	Client	Contractor	Survey type (site, 2D, 3D, 4D, OBC, VSP, etc.)	Start date	End date	Number of source vessels	Type of source (e.g. airguns)	Number of airguns (only if airguns used)	Source volume (cu. in.)	Source depth (metres)	Frequency (Hz)	Intensity (dB re. 1µPa or bar metres)	Shot point interval (metres)	Method of soft start	Visual monitoring equipment used	Magnification of optical equipment	Height of eye above water surface (metres)	How was distance of animals estimated?	Number of dedicated MMOs	Training of MMOs	Was PAM used?	Number of PAM operators (PAM only)
	UK	Aberdeen, North S	Ocean Predator	Vattenfall	Boskalis EOD	explosives	26/10/2017	04/11/2017	1	explosives								binoculars	7 x 50	3.0	e	1	u	y	1

7.3. MMO effort

Regulatory reference number	Ship/ platform name	Date	Visual watch or PAM	Observer's / operator's name(s)	Time of start of section of watch (UTC)	Time of end of section of watch (UTC)	Source activity	Length of watch	Start position - degrees latitude	Start position - minutes latitude	Start position - north/ south	Start position - degrees longitude	Start position - minutes longitude	Start position - east/ west	Depth of water at start postion (metres)	End position - degrees latitude	End position - minutes latitude	End position - north/ south	End position - degrees longitude	End position - minutes longitude	End position - east/ west	Depth of water at end position (metres)	Speed of vessel (knots)	Wind direction	Wind force	Sea state	Swell	Visibility (visual watch only)	Sun glare (visual watch only)	Precipitation	Comments
	Ocean Predator	27/10/2017	v	Kevin Robinson	12:15	13:15	n	01:00	57	13.26	n	1	58.15	w	31.3	57	13.7	n	1	58.84	w	31.1	3.1	sw	3	s	o	g	v	n	
	Ocean Predator	27/10/2017	v	Kevin Robinson	13:15	14:15	n	01:00	57	13.67	n	1	58.84	w	31.1	57	13.3	n	1	58.99	w	30.5	3.7	sw	3	c	o	g	v	n	
	Ocean Predator	27/10/2017	v	Kevin Robinson	14:15	15:15	n	01:00	57	13.33	n	1	58.99	w	30.5	57	12.9	n	1	58.65	w	31.1	0.7	sw	3	c	o	g	v	n	
	Ocean Predator	27/10/2017	v	Kevin Robinson	15:15	16:00	n	00:45	57	12.85	n	1	58.65	w	31.1	57	13.4	n	1	59.11	w	31.3	0.6	sw	2	c	o	m	v	n	
	Ocean Predator	27/10/2017	v	Kevin Robinson	16:00	16:21	n	00:21	57	13.41	n	1	59.11	w	31.3	57	13.7	n	1	58.68	w	30.2	2.2	sw	2	s	o	m	v	n	
	Ocean Predator	28/10/2017	v	Kevin Robinson	06:55	07:35	n	00:40	57	13.22	n	1	59.57	w	30.9	57	13.3	n	1	58.85	w	31.0	4.4	w	3	c	o	m	n	n	
	Ocean Predator	29/10/2017	v	Kevin Robinson	08:10	09:05	n	00:55	57	14.38	n	1	59.17	w	30.0	57	14.1	n	1	59.69	w	25.4	3.6	nw	5	c	o	m	n	n	
	Ocean Predator	29/10/2017	v	Kevin Robinson	09:05	09:55	n	00:50	57	14.08	n	1	59.69	w	25.4	57	13.8	n	1	59.19	w	27.0	3.1	nw	5	c	o	m	v	n	
	Ocean Predator	29/10/2017	v	Kevin Robinson	09:55	10:55	n	01:00	57	13.78	n	1	59.19	w	27.0	57	14.3	n	1	59.08	w	30.0	2.7	nw	5	c	o	m	v	n	
	Ocean Predator	29/10/2017	v	Kevin Robinson	10:55	11:50	n	00:55	57	14.28	n	1	59.08	w	30.0	57	13.9	n	1	59.77	w	31.2	3.5	nw	5	c	o	m	v	n	
	Ocean Predator	30/10/2017	v	Kevin Robinson	08:10	09:00	n	00:50	57	12.64	n	2	1.09	w	22.5	57	12.8	n	2	1.27	w	22.8	1.2	sw	2	s	o	g	v	n	
	Ocean Predator	30/10/2017	v	Kevin Robinson	14:08	15:05	n	00:57	57	12.94	n	2	1.27	w	19.0	57	12.4	n	2	0.29	w	21.8	2.0	sw	1	g	o	g	n	l	
	Ocean Predator	30/10/2017	v	Kevin Robinson	15:05	16:10	n	01:05	57	12.40	n	2	0.29	w	21.8	57	13.8	n	1	59.07	w	31.1	3.0	s	3	s	o	g	n	l	
	Ocean Predator	31/10/2017	v	Kevin Robinson	12:30	13:30	n	01:00	57	13.77	n	1	59.07	w	31.1	57	13.5	n	1	58.51	w	30.0	3.6	s	3	c	o	g	n	l	
	Ocean Predator	31/10/2017	v	Kevin Robinson	13:30	14:24	n	00:54	57	13.45	n	1	58.51	w	30.0	57	14.1	n	1	58.00	w	30.0	3.4	s	3	c	o	g	n	l	
	Ocean Predator	31/10/2017	v	Kevin Robinson	14:24	14:42	s	00:18	57	14.11	n	1	58.00	w	30.0	57	13.8	n	1	57.20	w	30.0	3.4	s	3	c	o	g	n	l	1st small charge detonated, no comm
	Ocean Predator	31/10/2017	v	Kevin Robinson	14:42	14:47	s	00:05	57	13.82	n	1	57.20	w	30.0	57	13.7	n	1	57.22	w	31.0	2.1	s	3	c	o	g	n	l	2nd small charge detonated
	Ocean Predator	31/10/2017	v	Kevin Robinson	14:47	14:58	s	00:11	57	13.68	n	1	57.22	w	31.0	57	13.3	n	1	57.26	w	31.0	2.2	s	3	s	o	g	n	n	3rd charge detonated
	Ocean Predator	31/10/2017	v	Kevin Robinson	14:58	15:15	n	00:17	57	13.30	n	1	57.26	w	31.0	57	13.3	n	2	57.20	w	31.3	2.1	s	2	s	o	g	n	l	Detonation 634
	Ocean Predator	02/11/2017	v	Kevin Robinson	07:15	08:10	n	00:55	57	12.50	n	2	1.11	w	20.7	57	13.1	n	2	0.97	w	22.3	3.9	nw	2	s	o	m	n	n	15 mins search of post-detonation ar
	Ocean Predator	02/11/2017	v	Kevin Robinson	08:10	08:32	n	00:22	57	13.12	n	2	0.97	w	22.3	57	12.6	n	2	0.38	w	24.0	3.1	nw	2	s	o	g	n	n	
	Ocean Predator	02/11/2017	v	Kevin Robinson	08:32	09:04	n	00:32	57	12.56	n	2	0.38	w	24.0	57	12.3	n	2	0.64	w	23.1	4.2	nw	2	s	o	g	n	n	
	Ocean Predator	02/11/2017	v	Kevin Robinson	09:04	09:08	s	00:04	57	12.29	n	2	0.64	w	23.1	57	12.1	n	2	0.56	w	23.0	4.4	nw	2	s	o	g	n	l	1st small charge detonated
	Ocean Predator	02/11/2017	v	Kevin Robinson	09:08	09:13	s	00:05	57	12.12	n	2	0.56	w	23.0	57	12.1	n	2	0.17	w	29.1	3.1	nw	2	s	o	g	n	n	2nd small charge detonated
	Ocean Predator	02/11/2017	v	Kevin Robinson	09:13	09:23	s	00:10	57	12.14	n	2	0.17	w	29.1	57	12.4	n	1	59.62	w	32.0	2.6	nw	2	s	o	g	n	n	3rd charge detonated
	Ocean Predator	02/11/2017	v	Kevin Robinson	09:23	09:50	n	00:27	57	12.36	n	1	59.62	w	32.0	57	12.5	n	2	1.08	w	23.0	2.1	nw	2	s	o	g	n	n	Detonation 001
	Ocean Predator	02/11/2017	v	Kevin Robinson	09:50	10:30	n	00:40	57	12.54	n	2	1.08	w	23.0	57	12.6	n	2	1.25	w	22.3	3.1	nw	2	s	o	g	n	n	15 mins search of post-detonation ar
	Ocean Predator	02/11/2017	v	Kevin Robinson	10:30	11:30	n	01:00	57	12.56	n	2	1.25	w	22.3	57	12.6	n	2	1.11	w	23.3	3.5	nw	2	s	o	g	n	n	
	Ocean Predator	02/11/2017	v	Kevin Robinson	11:30	12:30	n	01:00	57	12.59	n	2	1.11	w	23.3	57	12.6	n	2	0.74	w	25.6	3.7	nw	1	s	o	g	n	n	
	Ocean Predator	02/11/2017	v	Kevin Robinson	12:30	13:30	n	01:00	57	12.61	n	2	0.74	w	25.6	57	12.0	n	2	1.20	w	24.9	4.1	nw	1	s	o	g	n	n	
	Ocean Predator	02/11/2017	v	Kevin Robinson	13:30	13:32	n	00:02	57	12.04	n	2	1.20	w	24.9	57	12.1	n	2	1.25	w	23.1	4.3	nw	1	s	o	g	n	n	
	Ocean Predator	02/11/2017	v	Kevin Robinson	13:32	13:36	s	00:04	57	12.11	n	2	1.25	w	23.1	57	12.4	n	2	1.24	w	22.6	4.0	nw	1	s	o	g	n	n	1st small charge detonated
	Ocean Predator	02/11/2017	v	Kevin Robinson	13:36	13:41	s	00:05	57	12.38	n	2	1.24	w	22.6	57	12.7	n	2	1.00	w	24.2	3.9	nw	1	s	o	g	n	n	2nd small charge detonated
	Ocean Predator	02/11/2017	v	Kevin Robinson	13:41	13:49	s	00:08	57	12.67	n	2	1.00	w	24.2	57	13.1	n	2	0.18	w	27.3	3.8	nw	1	s	o	g	n	n	3rd charge detonated
	Ocean Predator	02/11/2017	v	Kevin Robinson	13:49	14:13	n	00:24	57	13.08	n	2	0.18	w	27.3	57	13.3	n	2	0.16	w	26.7	3.1	nw	1	s	o	g	n	n	Detonation 224
	Ocean Predator	02/11/2017	v	Kevin Robinson	14:13	15:00	n	00:47	57	13.28	n	2	0.16	w	26.7	57	13.5	n	2	0.93	w	23.1	4.6	nw	1	s	o	g	v	n	15 mins search of post-detonation ar
	Ocean Predator	02/11/2017	v	Kevin Robinson	15:00	16:00	n	01:00	57	13.50	n	2	0.93	w	23.1	57	13.5	n	2	0.89	w	19.6	4.5	nw	1	s	o	g	v	n	
	Ocean Predator	02/11/2017	v	Kevin Robinson	16:00	16:40	n	00:40	57	13.48	n	2	0.89	w	19.6	57	14.1	n	2	0.23	w	22.0	4.1	nw	1	s	o	g	n	n	
	Ocean Predator	02/11/2017	v	Kevin Robinson	16:40	16:46	s	00:06	57	14.08	n	2	0.23	w	22.0	57	14.4	n	1	58.55	w	24.5	4.7	nw	1	g	o	g	n	n	1st small charge detonated
	Ocean Predator	02/11/2017	v	Kevin Robinson	16:46	16:50	s	00:04	57	14.42	n	1	58.55	w	24.5	57	14.6	n	1	59.16	w	25.4	6.4	nw	1	g	o	m	n	n	2nd small charge detonated
	Ocean Predator	02/11/2017	v	Kevin Robinson	16:50	16:57	s	00:07	57	14.59	n	1	59.16	w	25.4	57	14.6	n	1	59.12	w	25.0	1.4	nw	1	g	o	m	n	n	3rd charge detonated
	Ocean Predator	02/11/2017	v	Kevin Robinson	16:57	17:10	n	00:13	57	14.59	n	1	59.12	w	25.0	57	13.9	n	2	0.12	w	24.0	0.8	nw	1	g	o	m	n	n	Detonation 393, followed by 15 mins
	Ocean Predator	03/11/2017	v	Kevin Robinson	07:10	08:00	n	00:50	57	13.77	n	1	59.33	w	30.6	57	14.0	n	1	58.56	w	30.9	2.2	sw	1	s	o	m	n	n	
	Ocean Predator	03/11/2017	v	Kevin Robinson	08:00	08:24	n	00:24	57	14.02	n	1	58.56	w	30.9	57	14.0	n	2	0.04	w	23.1	3.1	sw	2	s	o	g	v	n	
	Ocean Predator	03/11/2017	v	Kevin Robinson	08:24	08:29	s	00:05	57	14.04	n	2	0.04	w	23.1	57	14.2	n	2	0.33	w	20.3	3.5	sw	2	s	o	g	v	n	1st small charge detonated
	Ocean Predator	03/11/2017	v	Kevin Robinson	08:29	08:34	s	00:05	57	14.18	n	2	0.33	w	20.3	57	14.4	n	2	0.51	w	17.9	3.5	sw	2	s	o	g	v	n	2nd small charge detonated
	Ocean Predator	03/11/2017	v	Kevin Robinson	08:34	08:42	s	00:08	57	14.38	n	2	0.51	w	17.9	57	14.7	n	2	0.02	w	19.8	3.3	sw	2	s	o	g	v	n	3rd charge detonated
	Ocean Predator	03/11/2017	v	Kevin Robinson	08:42	09:00	n	00:18	57	14.69	n	2	0.02	w	19.8	57	13.7	n	1	59.22	w	30.3	3.3	sw	2	s	o	g	v	n	Detonation 468
	Ocean Predator	03/11/2017	v	Kevin Robinson	09:00	09:55	n	00:55	57	13.65	n	1	59.22	w	30.3	57	12.8	n	1	58.90	w	39.7	3.8	sw	2	s	o	g	v	n	15 mins search of post-detonation ar
	Ocean Predator	03/11/2017	v	Kevin Robinson	09:55	10:55	n	01:00	57	12.84	n	1	58.90	w	39.7	57	12.7	n	1	58.97	w	35.2	3.2	sw	3	s	o	g	v	n	
	Ocean Predator	03/11/2017	v	Kevin Robinson	10:55	12:00	n	01:05	57	12.73	n	1	58.97	w	35.2	57	13.4	n	1	58.83	w	34.1	3.3	sw	3	s	o	g	n	n	
	Ocean Predator	03/11/2017	v	Kevin Robinson	12:00	13:00	n	01:00	57	13.44	n	1	58.83	w	34.1	57	13.5	n	1	58.76	w	34.5	3.4	sw	3	s	o	g	n	n	
	Ocean Predator	03/11/2017	v	Kevin Robinson	13:00	14:00	n	01:00	57	13.49	n	1	58.76	w	34.5	57	13.2	n	1	59.92	w	29.2	2.8	sw	4	c	o	g	v	n	
	Ocean Predator	03/11/2017	v	Kevin Robinson	14:00	14:23	n	00:23	57	13.18	n	1	59.92	w	29.2	57	13.6	n	1	58.68	w	34.0	3.4	sw	4	c	o	g	v	n	
	Ocean Predator	03/11/2017	v	Kevin Robinson	14:23	14:25	s	00:02	57	13.56	n	1	58.68	w	34.0	57	13.4	n	1	58.70	w	34.6	2.8	sw	4	c	o	g	v	n	1st small charge detonated
	Ocean Predator	03/11/2017	v	Kevin Robinson	14:25	14:34	s	00:09	57	13.37	n	1	58.70	w	34.6	57	13.2	n	1	58.79	w	34.8	2.1	sw	4	c	o	g	v	n	2nd small charge detonated
	Ocean Predator	03/11/2017	v	Kevin Robinson	14:34	14:44	s	00:10	57	13.15	n	1	58.79	w	34.8	57	12.8	n	1	58.09	w	34.9	2.1	sw	4	c	o	g	v	n	3rd charge detonated
	Ocean Predator	03/11/2017	v	Kevin Robinson	14:44	15:00	n	00:16	57	12.76	n	1	58.09	w	34.9	57	13.0	n	1	58.20	w	34.0	2.8	sw	4	c	o	g	v	n	Detonation 777, followed by 15 mins
	Ocean Predator	04/11/2017	v	Kevin Robinson	07:12	08:00	n	00:48	57	13.43	n	1	59.63	w	26.6	57	13.7	n	1	58.82	w	30.2	4.9	se	1	g	o	m	v	n	
	Ocean Predator	04/11/2017	v	Kevin Robinson	08:00	09:09	n	01:09	57	13.74	n	1	58.82	w	30.2	57	13.3	n	1	58.59	w	31.1	3.3	se	1	g	o	g	v	n	
	Ocean Predator	04/11/2017	v	Kevin Robinson	09:09	09:16	s	00:07	57	13.28	n	1	58.59	w	31.1	57	13.3	n	1	59.26	w	33.2	3.5	se	1	g	o	g	v	n	1st small charge detonated
	Ocean Predator	04/11/2017	v	Kevin Robinson	09:16	09:23	s	00:07	57	13.28	n	1	59.26	w	33.2	57	13.2	n	1	59.93	w	32.7	3.8	se	1	g	o	g	v	n	2nd small charge detonated
	Ocean Predator	04/11/2017	v	Kevin Robinson	09:23	09:45	s	00:22	57	13.16	n	1	59.93	w	32.7	57	14.2	n	1	59.08	w	26.8	3.5	se	1	g	o	g	v	n	3rd charge detonated
	Ocean Predator	04/11/2017	v	Kevin Robinson	09:45	10:00	n	00:15	57	14.20	n	1	59.08	w	26.8	57	13.1	n	1	59.46	w	31.1	4.2	se	1	g	o	g	v	n	Detonation 695, followed by 15 mins

7.4. PAM effort

Regulatory reference number	Ship/ platform name	Date	Visual watch or PAM?	Observer's / operator's name(s)	Time of start of section of watch (UTC)	Time of end of section of watch (UTC)	Source activity	Length of watch	Start position - degrees latitude	Start position - minutes latitude	Start position - north/ south	Start position - degrees longitude	Start position - minutes longitude	Start position - east/ west	Depth of water at start postion (metres)	End position - degrees latitude	End position - minutes latitude	End position - north/ south	End position - degrees longitude	End position - minutes longitude	End position - east/ west	Depth of water at end position (metres)	Speed of vessel (knots)	Wind direction	Wind force (Beaufort)	Sea state	Swell
	Ocean Predator	27/10/2017	p	Joao Nuno Goncalves	12:15	13:15	n	01:00	57	13.26	n	1	59.15	w	31.3	57	13.7	n	1	58.8	w	31.1	3.1	sw	3	s	o
	Ocean Predator	27/10/2017	p	Joao Nuno Goncalves	13:15	14:15	n	01:00	57	13.67	n	1	58.84	w	31.1	57	13.3	n	1	59.0	w	30.5	3.7	sw	3	c	o
	Ocean Predator	27/10/2017	p	Joao Nuno Goncalves	14:15	15:15	n	01:00	57	13.33	n	1	58.99	w	30.5	57	12.9	n	1	58.7	w	31.1	0.7	sw	3	c	o
	Ocean Predator	27/10/2017	p	Joao Nuno Goncalves	15:15	16:00	n	00:45	57	12.85	n	1	58.65	w	31.1	57	13.4	n	1	59.1	w	31.3	0.6	sw	2	c	o
	Ocean Predator	27/10/2017	p	Joao Nuno Goncalves	16:00	16:21	n	00:21	57	13.41	n	1	59.11	w	31.3	57	13.7	n	1	58.7	w	30.2	2.2	sw	2	s	o
	Ocean Predator	28/10/2017	p	Joao Nuno Goncalves	06:55	07:35	n	00:40	57	13.22	n	1	59.57	w	30.9	57	13.3	n	1	58.9	w	31.0	4.4	w	3	c	o
	Ocean Predator	29/10/2017	p	Joao Nuno Goncalves	08:10	09:05	n	00:55	57	14.38	n	1	59.17	w	30.0	57	14.1	n	1	59.7	w	25.4	3.6	nw	5	c	o
	Ocean Predator	29/10/2017	p	Joao Nuno Goncalves	09:05	09:55	n	00:50	57	14.08	n	1	59.69	w	25.4	57	13.8	n	1	59.2	w	27.0	3.1	nw	5	c	o
	Ocean Predator	29/10/2017	p	Joao Nuno Goncalves	09:55	10:55	n	01:00	57	13.78	n	1	59.19	w	27.0	57	14.3	n	1	59.1	w	30.0	2.7	nw	5	c	o
	Ocean Predator	29/10/2017	p	Joao Nuno Goncalves	10:55	11:50	n	00:55	57	14.28	n	1	59.08	w	30.0	57	13.9	n	1	59.8	w	31.2	3.5	nw	5	c	o
	Ocean Predator	30/10/2017	p	Joao Nuno Goncalves	08:10	09:00	n	00:50	57	12.64	n	2	1.09	w	22.5	57	12.8	n	2	1.3	w	22.8	1.2	sw	2	s	o
	Ocean Predator	30/10/2017	p	Joao Nuno Goncalves	14:08	15:05	n	00:57	57	12.94	n	2	1.27	w	19.0	57	12.4	n	2	0.3	w	21.8	2.0	sw	1	g	o
	Ocean Predator	30/10/2017	p	Joao Nuno Goncalves	15:05	16:10	n	01:05	57	12.40	n	2	0.29	w	21.8	57	13.8	n	1	59.1	w	31.1	3.0	s	3	s	o
	Ocean Predator	31/10/2017	p	Joao Nuno Goncalves	12:30	13:30	n	01:00	57	13.77	n	1	59.07	w	31.1	57	13.5	n	1	58.5	w	30.0	3.6	s	3	c	o
	Ocean Predator	31/10/2017	p	Joao Nuno Goncalves	13:30	14:24	s	00:54	57	13.45	n	1	58.51	w	30.0	57	14.1	n	1	58.0	w	30.0	3.4	s	3	c	o
	Ocean Predator	31/10/2017	p	Joao Nuno Goncalves	14:24	14:42	s	00:18	57	14.11	n	1	58.00	w	30.0	57	13.8	n	1	57.2	w	30.0	3.4	s	3	c	o
	Ocean Predator	31/10/2017	p	Joao Nuno Goncalves	14:42	14:47	s	00:05	57	13.82	n	1	57.20	w	30.0	57	13.7	n	1	57.2	w	31.0	2.1	s	3	c	o
	Ocean Predator	31/10/2017	p	Joao Nuno Goncalves	14:47	14:58	f	00:11	57	13.68	n	1	57.22	w	31.0	57	13.3	n	1	57.3	w	31.0	2.2	s	3	s	o
	Ocean Predator	31/10/2017	p	Joao Nuno Goncalves	14:58	15:15	n	00:17	57	13.30	n	1	57.26	w	31.0	57	13.3	n	2	57.2	w	31.3	2.1	s	2	s	o
	Ocean Predator	02/11/2017	p	Joao Nuno Goncalves	07:15	08:10	n	00:55	57	12.50	n	2	1.11	w	20.7	57	13.1	n	2	1.0	w	22.3	3.9	nw	2	s	o
	Ocean Predator	02/11/2017	p	Joao Nuno Goncalves	08:10	08:32	n	00:22	57	13.12	n	2	0.97	w	22.3	57	12.6	n	2	0.4	w	24.0	3.1	nw	2	s	o
	Ocean Predator	02/11/2017	p	Joao Nuno Goncalves	08:32	09:04	n	00:32	57	12.58	n	2	0.38	w	24.0	57	12.3	n	2	0.6	w	23.1	4.2	nw	2	s	o
	Ocean Predator	02/11/2017	p	Joao Nuno Goncalves	09:04	09:08	s	00:04	57	12.29	n	2	0.64	w	23.1	57	12.1	n	2	0.6	w	23.0	4.4	nw	2	s	o
	Ocean Predator	02/11/2017	p	Joao Nuno Goncalves	09:08	09:13	s	00:05	57	12.12	n	2	0.56	w	23.0	57	12.1	n	2	0.2	w	29.1	3.1	nw	2	s	o
	Ocean Predator	02/11/2017	p	Joao Nuno Goncalves	09:13	09:23	s	00:10	57	12.14	n	2	0.17	w	29.1	57	12.4	n	1	59.6	w	32.0	2.6	nw	2	s	o
	Ocean Predator	02/11/2017	p	Joao Nuno Goncalves	09:23	09:50	n	00:27	57	12.36	n	1	59.62	w	32.0	57	12.5	n	2	1.1	w	23.0	2.1	nw	2	s	o
	Ocean Predator	02/11/2017	p	Joao Nuno Goncalves	09:50	10:30	n	00:40	57	12.54	n	2	1.08	w	23.0	57	12.6	n	2	1.3	w	22.3	3.1	nw	2	s	o
	Ocean Predator	02/11/2017	p	Joao Nuno Goncalves	10:30	11:30	n	01:00	57	12.56	n	2	1.25	w	22.3	57	12.6	n	2	1.1	w	23.3	3.5	nw	2	s	o
	Ocean Predator	02/11/2017	p	Joao Nuno Goncalves	11:30	12:30	n	01:00	57	12.59	n	2	1.11	w	23.3	57	12.6	n	2	0.7	w	25.6	3.7	nw	1	s	o
	Ocean Predator	02/11/2017	p	Joao Nuno Goncalves	12:30	13:30	n	01:00	57	12.61	n	2	0.74	w	25.6	57	12.0	n	2	1.2	w	24.9	4.1	nw	1	s	o
	Ocean Predator	02/11/2017	p	Joao Nuno Goncalves	13:30	13:32	n	00:02	57	12.04	n	2	1.20	w	24.9	57	12.1	n	2	1.3	w	23.1	4.3	nw	1	s	o
	Ocean Predator	02/11/2017	p	Joao Nuno Goncalves	13:32	13:36	s	00:04	57	12.11	n	2	1.25	w	23.1	57	12.4	n	2	1.2	w	22.6	4.0	nw	1	s	o
	Ocean Predator	02/11/2017	p	Joao Nuno Goncalves	13:36	13:41	s	00:05	57	12.38	n	2	1.24	w	22.6	57	12.7	n	2	1.0	w	24.2	3.9	nw	1	s	o
	Ocean Predator	02/11/2017	p	Joao Nuno Goncalves	13:41	13:49	s	00:08	57	12.67	n	2	1.00	w	24.2	57	13.1	n	2	0.2	w	27.3	3.8	nw	1	s	o
	Ocean Predator	02/11/2017	p	Joao Nuno Goncalves	13:49	14:13	n	00:24	57	13.08	n	2	0.18	w	27.3	57	13.3	n	2	0.2	w	26.7	3.1	nw	1	s	o
	Ocean Predator	02/11/2017	p	Joao Nuno Goncalves	14:13	15:00	n	00:47	57	13.28	n	2	0.16	w	26.7	57	13.5	n	2	0.9	w	23.1	4.6	nw	1	s	o
	Ocean Predator	02/11/2017	p	Joao Nuno Goncalves	15:00	16:00	n	01:00	57	13.50	n	2	0.93	w	23.1	57	13.5	n	2	0.9	w	19.6	4.5	nw	1	s	o
	Ocean Predator	02/11/2017	p	Joao Nuno Goncalves	16:00	16:40	n	00:40	57	13.48	n	2	0.89	w	19.6	57	14.1	n	2	0.2	w	22.0	4.1	nw	1	s	o
	Ocean Predator	02/11/2017	p	Joao Nuno Goncalves	16:40	16:46	s	00:06	57	14.08	n	2	0.23	w	22.0	57	14.4	n	1	58.6	w	24.5	4.7	nw	1	g	o
	Ocean Predator	02/11/2017	p	Joao Nuno Goncalves	16:46	16:50	s	00:04	57	14.42	n	1	58.55	w	24.5	57	14.6	n	1	59.2	w	25.4	6.4	nw	1	g	o
	Ocean Predator	02/11/2017	p	Joao Nuno Goncalves	16:50	16:57	s	00:07	57	14.59	n	1	59.16	w	25.4	57	14.6	n	1	59.1	w	25.0	1.4	nw	1	g	o
	Ocean Predator	02/11/2017	p	Joao Nuno Goncalves	16:57	17:10	n	00:13	57	14.59	n	1	59.12	w	25.0	57	13.9	n	2	0.1	w	24.0	0.8	nw	1	g	o
	Ocean Predator	03/11/2017	p	Joao Nuno Goncalves	07:10	08:00	n	00:50	57	13.77	n	1	59.33	w	30.6	57	14.0	n	1	58.6	w	30.9	2.2	sw	1	s	o
	Ocean Predator	03/11/2017	p	Joao Nuno Goncalves	08:00	08:24	n	00:24	57	14.02	n	1	58.56	w	30.9	57	14.0	n	2	0.0	w	23.1	3.1	sw	2	s	o
	Ocean Predator	03/11/2017	p	Joao Nuno Goncalves	08:24	08:29	s	00:05	57	14.04	n	2	0.04	w	23.1	57	14.2	n	2	0.3	w	20.3	3.5	sw	2	s	o
	Ocean Predator	03/11/2017	p	Joao Nuno Goncalves	08:29	08:34	s	00:05	57	14.18	n	2	0.33	w	20.3	57	14.4	n	2	0.5	w	17.9	3.5	sw	2	s	o
	Ocean Predator	03/11/2017	p	Joao Nuno Goncalves	08:34	08:42	s	00:08	57	14.38	n	2	0.51	w	17.9	57	14.7	n	2	0.0	w	19.8	3.3	sw	2	s	o
	Ocean Predator	03/11/2017	p	Joao Nuno Goncalves	08:42	09:00	n	00:18	57	14.69	n	2	0.02	w	19.8	57	13.7	n	1	59.2	w	30.3	3.3	sw	2	s	o
	Ocean Predator	03/11/2017	p	Joao Nuno Goncalves	09:00	09:55	n	00:55	57	13.65	n	1	59.22	w	30.3	57	12.8	n	1	58.9	w	39.7	3.8	sw	2	s	o
	Ocean Predator	03/11/2017	p	Joao Nuno Goncalves	09:55	10:55	n	01:00	57	12.84	n	1	58.90	w	39.7	57	12.7	n	1	59.0	w	35.2	3.2	sw	3	s	o
	Ocean Predator	03/11/2017	p	Joao Nuno Goncalves	10:55	12:00	n	01:05	57	12.73	n	1	58.97	w	35.2	57	13.4	n	1	58.8	w	34.1	3.3	sw	3	s	o
	Ocean Predator	03/11/2017	p	Joao Nuno Goncalves	12:00	13:00	n	01:00	57	13.44	n	1	58.83	w	34.1	57	13.5	n	1	58.8	w	34.5	3.4	sw	3	s	o
	Ocean Predator	03/11/2017	p	Joao Nuno Goncalves	13:00	14:00	n	01:00	57	13.49	n	1	58.76	w	34.5	57	13.2	n	1	59.9	w	29.2	2.8	sw	4	c	o
	Ocean Predator	03/11/2017	p	Joao Nuno Goncalves	14:00	14:23	n	00:23	57	13.18	n	1	59.92	w	29.2	57	13.6	n	1	58.7	w	34.0	3.4	sw	4	c	o
	Ocean Predator	03/11/2017	p	Joao Nuno Goncalves	14:23	14:25	s	00:02	57	13.56	n	1	58.68	w	34.0	57	13.4	n	1	58.7	w	34.6	2.8	sw	4	c	o
	Ocean Predator	03/11/2017	p	Joao Nuno Goncalves	14:25	14:34	s	00:09	57	13.37	n	1	58.70	w	34.6	57	13.2	n	1	58.8	w	34.8	2.1	sw	4	c	o
	Ocean Predator	03/11/2017	p	Joao Nuno Goncalves	14:34	14:44	s	00:10	57	13.15	n	1	58.79	w	34.8	57	12.8	n	1	58.1	w	34.9	2.1	sw	4	c	o
	Ocean Predator	03/11/2017	p	Joao Nuno Goncalves	14:44	15:00	n	00:16	57	12.76	n	1	58.09	w	34.9	57	13.0	n	1	58.2	w	34.0	2.8	sw	4	c	o
	Ocean Predator	04/11/2017	p	Joao Nuno Goncalves	07:12	08:00	n	00:48	57	13.43	n	1	59.63	w	26.6	57	13.7	n	1	58.8	w	30.2	4.9	se	1	g	o
	Ocean Predator	04/11/2017	p	Joao Nuno Goncalves	08:00	09:00	n	01:00	57	13.74	n	1	58.82	w	30.2	57	13.7	n	1	58.8	w	31.1	3.3	se	1	g	o
	Ocean Predator	04/11/2017	p	Joao Nuno Goncalves	09:00	09:16	s	00:16	57	13.74	n	1	58.76	w	31.1	57	13.3	n	1	58.6	w	33.2	3.5	se	1	g	o
	Ocean Predator	04/11/2017	p	Joao Nuno Goncalves	09:16	09:23	s	00:07	57	13.28	n	1	58.59	w	33.2	57	13.2	n	1	59.3	w	32.7	3.6	se	1	g	o
	Ocean Predator	04/11/2017	p	Joao Nuno Goncalves	09:23	09:45	s	00:22	57	13.16	n	1	59.26	w	32.7	57	14.2	n	1	59.1	w	26.8	3.5	se	1	g	o
	Ocean Predator	04/11/2017	p	Joao Nuno Goncalves	09:45	10:00	n	00:15	57	14.20	n	1	59.08	w	26.8	57	13.1	n	1	59.5	w	31.1	4.2	se	1	g	o

7.5. Sightings

Regulatory reference number	Ship/ platform name	Sighting number	Acoustic detection number	Date	Time at start of encounter (UTC)	Time at end of encounter (UTC)	Were animals detected visually and/ or acoustically?	How were the animals first detected?	Observer's/ operator's name	Position - degrees latitude	Position - minutes latitude	Position - north/ south	Position - degrees longitude	Position - minutes longitude	Position - east/ west	Water depth (metres)	Species or species group	Group	Description	Bearing to animal	Range of animal (metres)
	Ocean Predator	1		27/10/2017	13:25	13:30	v	l	Sarrett A Guard Vessel	57	13.84	n	1	58.45	w	31.5	Bottlenose dolphins	Dark grey in colour, with lar	105	1100	27
	Ocean Predator	2		02/11/2017	16:00	16:20	v	v	Kevin Robinson	57	13.54	n	1	58.81	w	24.3	Grey seal	Dark animal with large probo	90	210	1
	Ocean Predator	3		04/11/2017	09:24	09:24	v	v	Kevin Robinson	57	13.40	n	2	0.28	w	24.1	Grey seal	Dark animal with large probo	30	340	1

Sighting number	Total number	Number of adults (visual sightings only)	Number of juveniles (visual sightings only)	Number of calves (visual sightings only)	Photograph taken	Behaviour (visual sightings only)	Direction of travel (relative to ship)	Direction of travel (compass points)	Airgun/ source activity when animals first detected	Airgun/ source activity when animals last detected	Time animals entered the mitigation/ exclusion zone (if relevant) (UTC)	Time animals left the mitigation/ exclusion zone (if relevant) (UTC)	Closest distance of animals from airguns/ source (metres)	Time of closest approach (UTC)	First observed distance during soft start (if relevant) (metres)	Closest observed distance during soft start (if relevant) (metres)	Last observed distance during soft start (if relevant) (metres)	What action was taken?	Length of power down and/ or shut-down (if relevant)	Estimated loss of production (if relevant) due to mitigating actions (km)	Comments	Flag record
1					n	Actively feeding (bird association) an	v	s	n	n			1600						n	0		Identificat
2	1				n	Sighted twice and surfaced just the o	s	n	n	n	16:00	16:20	800	16:00					d	20		After the s
3		1			n	Milling at the surface, head out	s	s	s	s			1000	09:24					d	20		The detec