



Arklow Bank Wind Park Survey
Marine Mammal Mitigation Report

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Abbreviations

BEP	Best Environmental Practice
EPS	European Protected Species
HRS	High Resolution Survey
IWDGC	Irish Whale and Dolphin Group Consulting
JIP	Joint Industry Programme
MBES	Multibeam Echosounder
MMO	Marine Mammal Observer
MZ	Mitigation Zone
NPWS	National Parks and Wildlife Service
SAC	Special Area of Conservation
SBP	Sub-Bottom Profiler
SPL	Sound Pressure Level
SSS	Side Scan Sonar
USBL	Ultra Short Baseline

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1. Introduction

1.1. Project Overview

Sure Partners Ltd. commissioned a geophysical survey within the development area of the proposed Arklow Bank offshore wind farm. Following the export cable route survey, phase 2 continued on-board the AMS *Retriever* which involved surveying the main development area in water depths below 8.0m LAT, operating on a 24 and 12 hour basis. Marine Mammal Observers (MMO) were required for day light hours. As part of the project consenting requirements, marine mammal mitigation was to be in place for all geophysical acoustic operations. AlphaMarine, as acting contractors for the works, contracted Irish Whale and Dolphin Group Consulting to fulfil this role on their behalf.

Experienced MMOs were provided by IWDG Consulting to conduct all marine mammal mitigation for the geophysical acoustic operations associated with the survey. Observations were conducted on-board the dedicated survey vessel, AMS *Retriever*. National Parks and Wildlife Service (NPWS) of the Department of Arts, Heritage and the Gaeltacht 'Guidance to manage the risk to marine mammals from man-made sound sources in Irish waters' (NPWS, 2014) guidelines were employed in accordance with the Arklow Bank Wind Park Geophysical and Geotechnical Survey Noise Risk Assessment created by RPS for a best industry practice approach in order to mitigate against any possible disturbance to marine mammals.

The systems employed for the geophysical and environmental survey were as follows; sub-bottom profiler (SBP), side scan sonar (SSS), multibeam echo-sounder (MBES), and ultra-short baseline positioning system (USBL). Potential impacts of these systems on cetaceans vary depending on the following; the sound's propagation characteristics in the environment into which it is introduced, its intensity, frequency, duration and distance from operations.

A second geophysical survey vessel, the AMS *Panther* was located within the lease area carrying out a multibeam only survey over the top of the top of the Arklow bank, above the 8.0 LAT depth contour. According to NPWS Guidelines an MMO was not required for these operations as the survey area was deemed further than 1,500m from the entrance of a bay, inlet or estuary.

1.2. Survey Area

Arklow Bank is a shallow water sandbank in the Irish Sea, 13 km to the east of Arklow, County Wicklow. Arklow Bank covers an area of approximately 27km long by 2.5km wide. Water depths on the Bank generally vary between 2m and 25m, although there are areas which have water depths of less than 1m. The existing turbines are located towards the centre of the Bank, with water depths varying between 2m and 5m (Lowest Astronomical Tide (LAT)).

There are no designated conservation sites for marine mammals in the immediate vicinity of the works. Therefore, there will be no direct impacts on any protected sites associated with the works however, there is potential for qualifying and interest features (grey seal *Halichoerus grypus*) associated with Lambay Island SAC (and sites further afield, see Figure 1) to be present in project area. A known haul out and pupping site for grey seal exists at Brides Head, Wicklow, see Figure 1.

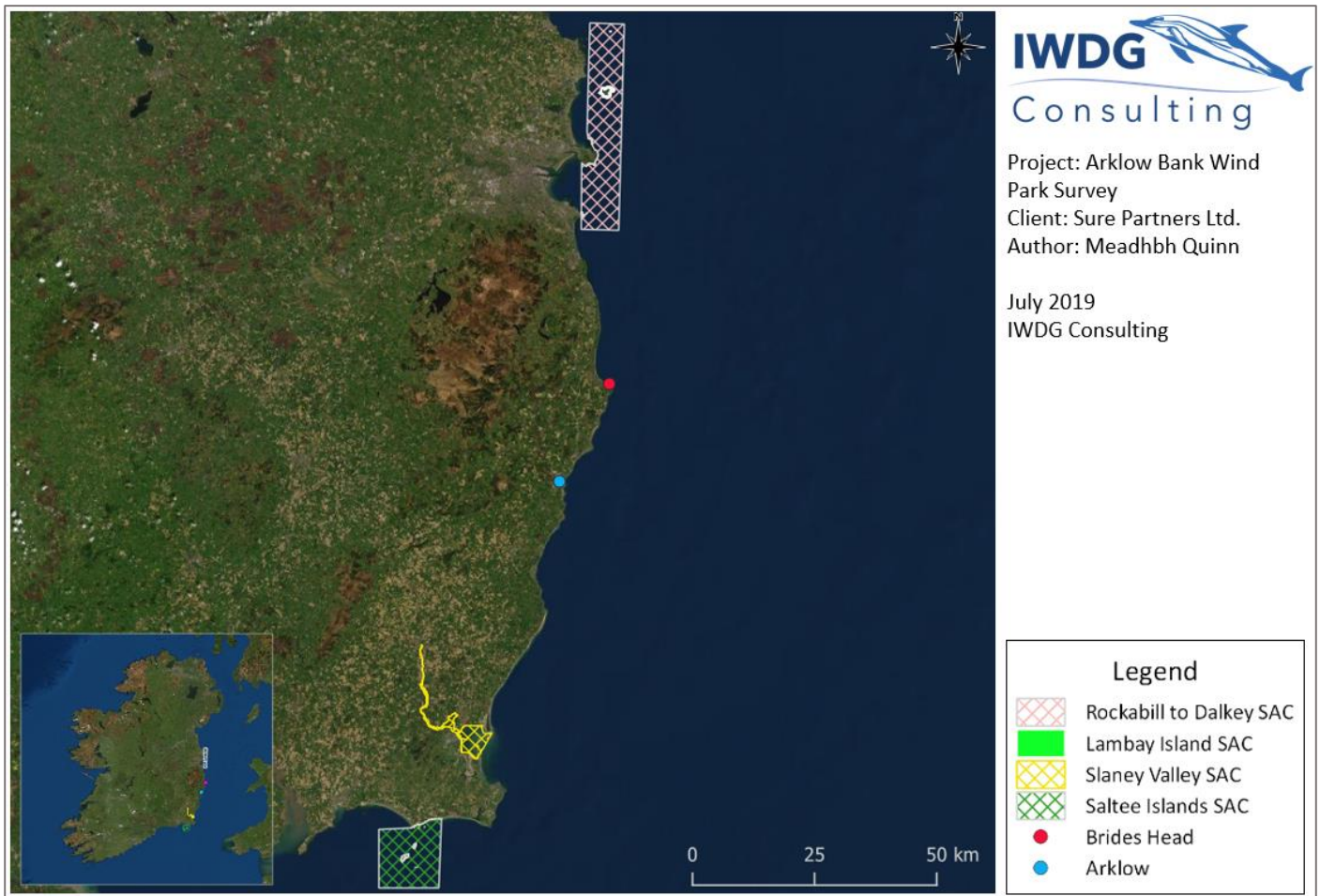


Figure 1: SACs with marine mammals as a feature of interest.

1.3. Marine Mammals and Underwater Noise

The addition of noise into the marine environment and its impact on marine mammals, which use sound for navigating, feeding and mating, is a key topic of concern. Cetaceans (whales, dolphins and porpoises) are particularly sensitive to underwater noise. The effects of noise can include death or serious injury and/or physical injuries that can have longer term consequences for the animal such as hearing sensitivity (TTS and PTS) and behavioural effects such as the displacement from an area.

Possible effects of underwater noise on marine mammals in general can be broadly summarised into three categories:

- Physical injury and/or death
- Auditory damage (temporary or permanent)
- Behavioural disturbance/avoidance

Southall *et al.* (2019) presents a comprehensive review of criteria for the onset of TTS (temporary hearing threshold shift) and PTS (permanent hearing threshold shift) for impulsive noise (*e.g.* boomer, sparker) and non-impulsive noise (*e.g.* sonar based survey equipment, drilling). The sound emitted by man-made sources may induce TTS or PTS in an animal in two ways; peak sound pressure levels (SPL peak) and cumulative sound exposure levels (SEL).

Marine mammal hearing group	TTS onset: SEL (weighted)	TTS onset: Peak SPL (unweighted)	PTS onset: SEL (weighted)	PTS onset: Peak SPL (unweighted)
LF	168 dB re 1 μ Pa _{2s} SEL	213 dB re 1 μ Pa SPL peak	183 dB re 1 μ Pa _{2s} SEL	219 dB re 1 μ Pa SPL peak
HF	170 dB re 1 μ Pa _{2s} SEL	224 dB re 1 μ Pa SPL peak	185 dB re 1 μ Pa _{2s} SEL	230 dB re 1 μ Pa SPL peak

VHF	140 dB re 1 $\mu\text{Pa}^2\text{s}$ SEL	196 dB re 1 μPa SPL peak	155 dB re 1 $\mu\text{Pa}^2\text{s}$ SEL	202 dB re 1 μPa SPL peak
PCW	170 dB re 1 $\mu\text{Pa}^2\text{s}$ SEL	212 dB re 1 μPa SPL peak	185 dB re 1 $\mu\text{Pa}^2\text{s}$ SEL	218 dB re 1 μPa SPL peak
PCA	123 dB re (20 μPa) ² s SEL	138 dB re 20 μPa SPL peak	138 dB re (20 μPa) ² s SEL	144 dB re 20 μPa SPL peak

Table 1: TTS- and PTS-onset thresholds for marine mammals exposed to impulsive noise.

LF (low frequency) cetaceans such as Balaena spp; HF (high frequency) cetaceans such as bottlenose dolphin; VHF (very high frequency) cetaceans such as harbour porpoise; PCW (phocid carnivores in water), pinnipeds such as grey and harbour seals; PCA (phocid carnivores in air), pinnipeds such as grey and harbour seal. SEL thresholds in dB re 1 $\mu\text{Pa}^2\text{s}$ under water and dB re (20 μPa)²s in air (PCA only); and peak SPL thresholds in dB re 1 μPa under water and dB re 20 μPa in air (PCA only).

* The LF high-frequency hearing parameters were determined using hearing data from other marine mammals.

Table 2: TTS- and PTS-onset thresholds for marine mammals exposed to non-impulsive noise.

Marine mammal hearing group	TTS onset: SEL (weighted)	PTS onset: SEL (weighted)
LF	179 dB re 1 $\mu\text{Pa}^2\text{s}$ SEL	199 dB re 1 $\mu\text{Pa}^2\text{s}$ SEL
HF	178 dB re 1 $\mu\text{Pa}^2\text{s}$ SEL	198 dB re 1 $\mu\text{Pa}^2\text{s}$ SEL
VHF	153 dB re 1 $\mu\text{Pa}^2\text{s}$ SEL	173 dB re 1 $\mu\text{Pa}^2\text{s}$ SEL
PCW	181 dB re 1 $\mu\text{Pa}^2\text{s}$ SEL	201 dB re 1 $\mu\text{Pa}^2\text{s}$ SEL
PCA	134 dB re (20 μPa) ² s SEL	154 dB re (20 μPa) ² s SEL

LF (low frequency) cetaceans such as Balaena spp; HF (high frequency) cetaceans such as bottlenose dolphin VHF (very high frequency) cetaceans such as harbour porpoise; PCW (phocid carnivores in water), pinnipeds such as grey and harbour seals; PCA (phocid carnivores in air), pinnipeds such as grey and harbour seal. SEL thresholds in dB re 1 $\mu\text{Pa}^2\text{s}$ under water and dB re (20 μPa)²s in air (PCA only).

1.4. Marine Species Legislation

All species of cetacean (whale, dolphin and porpoise) and otter occurring in Irish waters are listed in Annex IV of the EC Habitats Directive (92/43/EEC) as European Protected Species (EPS) which require a strict protection regime across their entire natural range within the EU, both within and outside Natura 2000 sites.

Grey seal, harbour seal, bottlenose dolphin and harbour porpoise are listed under Annex II of the EC Habitats Directive (92/43/EEC) as species of Community Interest, whose conservation requires the designation of Special Areas of Conservation (SACs), these sites must be managed in accordance with the ecological requirements of the species.

The European Communities (Birds and Natural Habitats) Regulations 2011-2015 transpose the EC Habitats Directive (92/43/EEC) into Irish law. Regulation 51(2) prohibits the following in relation to cetaceans (Annex IV sp.):

- all forms of deliberate capture or killing of specimens of those species in the wild,
- the deliberate disturbance of those species particularly during the period of breeding, rearing, hibernation and migration,
- the deterioration or destruction of breeding sites or resting places of those species.

Under Wildlife Acts 1976 to 2018, any species listed under the Fifth Schedule including cetaceans and seals is protected from injury, disturbance or damage to breeding and resting sites.

1.5. Project Licence Consents

There are no specific conditions within the foreshore lease for marine mammal mitigation, therefore BEP was employed following NPWS Guidelines which warranted the use of an approved and experienced MMO.

1.6. Mitigation Requirements

A job description stipulates the following mitigation requirements to be fulfilled during operations according to BEP:

- Pre-start monitoring: geophysical survey operations shall not commence if marine mammals are detected within a 350m radial distance of the vessel.
- Ramp-up procedure: prior to commencing survey operations a ramp-up procedure will be used.
- Line/ Station Changes: where line or station change will be greater than 40 minutes the geophysical equipment will be shut down followed by a full pre-start monitoring and ramp-up procedure.
- Breaks in sound output: If there is a break in sound output for a period of >10 minutes or if a marine mammal is observed in the 350m monitoring zone during a shorter break (5-10 minutes) the pre-start monitoring, and ramp-up procedure will be undertaken in full.

Detailed methods on how these mitigation requirements were fulfilled by the IWDG are provided in Methods Sections 2.4.

1.7. Marine Mammal Sensitivities

Information on marine mammal abundance and distribution comes from a range of resources, including estimates of cetacean abundance in European Atlantic waters in summer 2016 from the SCANS-III aerial and shipboard surveys (Hammond *et al.*, 2017), dedicated and opportunistic sightings surveys (e.g. Irish Whale and Dolphin Group) and various research papers.

Two species of pinnipeds, grey seal (*Halichoerus grypus*) and harbour seal (*Phoca vitulina*) and one species of cetacean, harbour porpoise (*Phocoena phocoena*) are most likely to be encountered during the geophysical survey. A summary of each species considered is provided below:

1.7.1. Pinnipeds (Seals)

Harbour seal (*Phoca vitulina*)

Harbour seal, often called 'common seal' is the smaller of two species of true seal (Phocidae) that commonly breed around the coasts of Britain and Ireland. Harbour seals come ashore in sheltered waters typically on sandbanks and in estuaries, but also in rocky areas. They give birth to their pups and mate during May-July approx. Moulting takes place between August-September approx. Foraging takes place 40-50km around their haul-out sites (SCOS, 2017.) They are vulnerable to disturbance at pupping/moulting stages in the life cycle. This species is not thought to pup/moult in the vicinity of the survey works. This species is present at Slaney River Valley SAC and Lambay Island SAC as a feature of interest.

Cronin *et al.*, (2004) reports a minimum population estimate for the Republic of Ireland of 2,955 harbour seals. Duck & Morris (2013) reports an increase of 3,489 harbour seals during 2011 and 2012 (combined) aerial surveys which covered the island of Ireland.

Grey seal (*Halichoerus grypus*)

As one of the rarer seal species, its world population is estimated at just 350,000 to 400,000 individuals (SNH, 2017). Grey seals come ashore on remote islands, sandbanks and rocky coastlines to give birth to their pups. The breeding season occurs between August and December approx. Mating also takes place at breeding sites or in the water nearby. Moulting takes place between December and April approx. Foraging can take place 100km to several hundred kilometres offshore (SCOS, 2017). Individual mature grey seals of both sexes usually show high site fidelity and may return to within 10–100 m of individual breeding locations (Pomeroy *et al.*, 2000). They are vulnerable to disturbance at pupping/moulting stages in the life cycle. A known pupping site is located 19km from the survey area at Brides Head, Co. Wicklow (see Figure 1). This species is present within Lambay Island SAC and Saltee Islands SAC as a feature of interest.

Ó' Cadhla *et al.*, (2007) determined that a minimum population of 5,509-7,083 grey seals inhabits breeding colonies in the Republic of Ireland, over 80% of which were associated with seven key breeding locations along the east, southeast and Atlantic coasts. Findings from the 2009-2012 period (Ó' Cadhla *et al.*, 2013) determined population numbers for the same locations at approximately 7,284 - 9,365 seals of all ages. The 2009 census reported an all-age population of 270 – 347 grey seals on Lambay Island and Ireland's Eye, Dublin and 529 – 680 on the Saltee Islands, Wexford.

1.7.2. Cetaceans (Whales, Dolphins and Porpoises)

Harbour porpoise (*Phocoena phocoena*)

The harbour porpoise is the most widespread and abundant cetacean species in Irish waters (Berrow, 2001). It has been recorded off all coasts and over the continental shelf but is thought to be most abundant off the southwest and east coasts, highest relative abundance of harbour porpoises were recorded in the Irish Sea during the summer months (Wall *et al.* 2013). SCANS-III data (Hammond *et al.*, 2017) estimate harbour porpoise abundance to be estimated at 8,320 (CV= 0.28; 95% CI: 4,643-14,354) in the Irish Sea. This species is present within the Rockabill to Dalkey Island SAC as a feature of interest.

Bottlenose dolphin (*Tursiops truncatus*)

Bottlenose dolphins occur off all Irish coasts with inshore animals moving around the entire Irish coastline and between the UK and Ireland (Wall *et al.* 2013). They can also occur offshore, often in association with other cetaceans. Most offshore animals probably represent a separate population, although some inshore dolphins may move offshore during the winter months (Reid, *et al.*, 2003). SCANS-III data (Hammond *et al.*, 2017) estimate bottlenose dolphin abundance to be estimated at 288 (CV= 0.57; 95% CI: 0-664) in the Irish Sea.

Minke whale (*Balaenoptera acutorostrata*)

Minke whales are the smallest and most frequently sighted whales in Irish inshore waters (Berrow *et al.*, 2010). They occur off all coasts including the Irish Sea and over the continental shelf. Wall *et al.*, (2013) reported that minke whales were present in the Irish Sea from late April through to early August but were largely absent for the rest of the year, with highest relative abundance recorded off the south and south-west coasts in the Autumn. SCANS-III data (Hammond *et al.*, 2017) estimate minke whale abundance to be estimated at 603 (CV= 0.62; 95% CI: 134- 1,753) in the Irish Sea.

Short-beaked common dolphin (*Delphinus delphis*)

Common dolphins are Ireland's most widespread and abundant dolphin species and occur off all Irish coasts and over the continental shelf. Wall *et al.*, (2013) reported highest relative abundances off the south and southwest coasts and in low densities from late spring to mid-autumn in the Irish Sea and were found to be largely absent during the winter months. No sightings of common dolphin were observed by SCANS-III in the Irish Sea, however IWDG sightings and strandings scheme report a number of sightings and strandings along the east coast of Ireland.

Risso's dolphin (*Grampus griseus*)

Risso's dolphin are generally found in deep water habitats along shelf slopes, however in Ireland they can be found along inshore shelf slopes and in coastal waters. Risso's dolphins have been recorded in Irish Waters from April to November, with sightings peaking during the summer months (Wall *et al.*, 2013). SCANS-III data (Hammond *et al.*, 2017) estimate Risso's dolphin abundance to be estimated at 1090 (CV= 0.69; 95% CI: 0- 2,843) in the Irish Sea.

2. Methods

2.1. Survey Vessels

Survey work was completed on-board the survey vessel, AMS Retriever

Table 3 Summary of vessel specifications for the AMS Retriever

Vessel Name	AMS Retriever
Call Sign	MEH18
MMSI	232019241
Year Built	1997
Length overall	24.80 m
Breadth	9m
Max Draft	2m



Plate 1 Survey vessel AMS Retriever

2.2. High Resolution Survey Equipment

Several pieces of HRS equipment could be started sequentially or interchanged during the survey, requiring only one pre-watch prior to the start of initial acoustic output. Further addition of acoustic equipment required an additional pre-watch and ramp-up, whereby sound energy input to the marine environment is gradually or incrementally increased from levels unlikely to cause significant behavioural impact on marine mammals to the full output necessary for completion of the activity. The SBP device was ramped up in intensity while decreasing the trigger rate. MBES, SSS and USBL could not be ramped-up in frequency or intensity, nor was it possible to turn "on/off".

- Norbit iWBMS Multibeam echo-sounder (MBES) was mounted on the side of the vessel 1m below the water line and operated between 360-440 kHz, with source levels of 230 dB re 1 μ Pa at 1m.
- Geo Marine Systems Sub Bottom Profiler (SBP) sparker type device was surfaced towed astern of the vessel and operated at a frequency of 1.35 kHz, with source levels at 100-600J. Source levels in SPL (*i.e.* dB re 1 μ Pa at 1m) were not available for this model, however based on a similar model, Geosource 200-400, SPL is recorded as 219 dB re 1 μ Pa at 1m. The device was used continuously throughout data acquisition and thus was the first device to ramped-up throughout the geophysical survey, followed by the deployment of other HRS equipment as required. Ramp-up was achieved by reducing the trigger rate from 5 seconds to 0.7 seconds (*i.e.* to normal fire rate).

- Edgetech 4200 Side Scan Sonar (SSS) was towed at variable distances astern of the vessel and operated on a dual frequency of 300/900 kHz, with source levels at 173 dB re 1 μ Pa at 1m.
- Ultra-Short Baseline (USBL) was mounted on the side of the vessel at 1.1m below the water line and operated between 19-36 kHz, with source levels <93 dB re 1 μ Pa at 1m.

2.3. Mitigation Team

The AMS *Retriever* operated on a 24-hour and 12-hour basis, with a dedicated MMO based onboard to provide mitigation for operations throughout daylight hours. Acting as consultant to the client at all times, the MMO liaised directly with the survey team with regards to the NPWS Guidelines. It was the MMO's responsibility for ensuring that the contractor was aware of their commitment to the latest NPWS Guideline procedures.

2.4. Mitigation Procedure

The latest NPWS Guidelines '*Guidance to manage the risk to marine mammals from man-made sound sources in Irish waters*' (NPWS, 2014) was underpinned during operations. These guidelines, specifically in relation to this project, are summarised below:

2.4.1. Pre-Start Monitoring

Sound producing activities should not be commenced during periods of darkness, poor visibility (such as fog), or during periods when the sea state is not conducive to visual mitigation (above Sea State WMO 4), as there is a greater risk of failing to detect the presence of marine mammals. The Mitigation Zone (MZ) should be monitored visually by MMOs for a minimum of 30 minutes prior to a soft start.

2.5. Mitigation Zone

The Mitigation Zone or Monitoring Zone (MZ) is the body of water surrounding the location of the noise source, which the observer monitored visually for the presence of marine mammals before and during operations. The extent of this zone represents the distance at which a marine mammal could still be exposed to sound levels capable of causing disturbance or injury. A MZ with a 350m radius for marine mammals from the sound source was adopted.

2.5.1. Delay if marine mammals detected within mitigation zone

Sound producing activities should not be commenced if marine mammals are detected within the mitigation zone or until 30 minutes after the last visual detection. The MMO should track any marine mammals detected and ensure they are satisfied the animals have left the mitigation zone.

2.5.2. Ramp-up Procedure

A ramp-up is the gradual increase of power or intensity incrementally over a set time period, until full operational power or intensity is achieved. The ramp-up duration should be a period of 40 minutes for SBP (sparker) and 20 minutes for other HRS equipment where the output peak sound pressure level exceeds 170 dB re: 1 μ Pa @1m.

Where the gradual ramp-up in frequency is not possible, the device shall be switched "on" and "off" in a consistent sequential manner over a period of 20 minutes prior to commencement of the full necessary output.

In all cases the delay between the end of ramp-up and the start of a survey line or station must be minimised to prevent unnecessary high-level sound introduction into the environment. Once the ramp-up procedure commences there is no requirement to halt or discontinue the procedure at night-time, nor if weather or visibility conditions deteriorate nor if marine mammals occur within the mitigation zone.

2.5.3. Break in sound output

If there is a break in sound output for a period of 5-10 minutes (e.g., due to equipment failure, shut-down, survey line or station change) then all Pre-Start Monitoring and a subsequent Ramp-up Procedure must be undertaken.

2.6. Visual Observation

Visual observations were undertaken on board the vessel to support all survey works. The MMO was to be confident that there were no marine mammals within the MZ prior to commencement of operations and to be aware of any marine mammals within the surrounding area outside the MZ. NPWS Guidelines recommend that as a minimum, 30 minutes of pre-start monitoring prior to

operations commencing should be conducted in favourable conditions. MMO effort continued after the dedicated pre-watch, even though operations were considered continuous, in order to assess marine mammal distribution and behaviour towards the operations; and in the case of a break down or stop to operations.

2.6.1. Observation Platform

Observations were carried out from the monkey island 4.6m above sea level which offered a 360 degree view. The MMO maintained visual observations during daylight hours.

Bearings and distances to sightings were recorded using reticular binoculars, and in combination with a distance stick. Data were collected using standard JIP22 deck forms. Environmental data were recorded every hour and when weather and/or activity changed.

2.6.2. Equipment

Each MMO in the field was equipped with:

- Opticron Marine2 7x50 binoculars (7x Magnification, 50mm Objective Lens Diameter)
- Range finding distance stick
- Handheld GPS
- Outdoor clothing and PPE

3. Results

3.1. Operations

Over the course of the 36 days, 334hrs 16mins of acoustic output was generated, time is inclusive of 40 minute and 20 minute ramp-up time for SBP and other HRS equipment, respectively. Full details of operations can be found in the Appendices.

3.2. Observation Effort

A dedicated MMO was based on the monkey island of the AMS *Retriever* to provide mitigation throughout operational hours. 210hrs and 10mins of visual monitoring effort was conducted over the course of 36 days. Pre-start monitoring was carried out prior to operations commencing. Fifty-six pre-watches were carried out in total. The MMO on duty worked an average of 6hrs a day to provide full marine mammal mitigation during operational hours. Full details of monitoring effort can be found in the Appendices.

3.3. Weather Conditions

For the majority of monitoring effort, weather conditions were considered favourable for marine mammal observation as sea state was recorded as sea state (WMO) 0 for 9%, 1 for 20%, 2 for 39%, 3 for 29% and 4 for 3%. Swell was recorded as low (<2m) for 99% of monitoring effort and medium (2-4m) for 1%. Visibility was good (>5km) for 87% of monitoring effort, moderate (1-5km) for 11% and poor (<1km) for 2%. Sun glare was recorded as 36% no glare, 43% strong, 4% variable and 17% weak.

South westerly winds followed by westerly winds were the most distributed wind directions recorded throughout the survey. South westerly winds of Beaufort 3 were the most frequently recorded direction and force throughout the survey. Beaufort wind force ranged from 1-5.

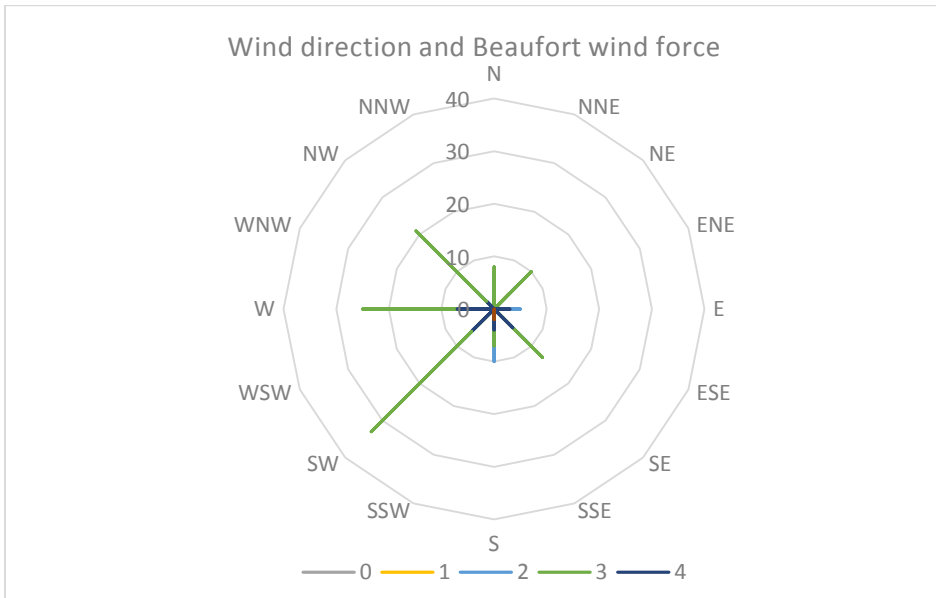


Figure 2 Wind direction and Beaufort wind force

3.4. Marine Mammal Sightings

A total of 45 sightings were recorded during MMO observations throughout the geophysical survey. Twenty-four (53%) harbour porpoise (*Phocoena phocoena*), seventeen (38%) sightings were grey seal (*Halichoerus grypus*), and 3 (7%) pinniped species. One dead common dolphin was observed (2%).

Of the 45 sightings, 9 (20%) sightings were observed when equipment was at full power, 5 (11%) during ramp-up procedure and 31 (69%) when equipment was not active. According to NPWS Guidelines (2014), if an animal enters the mitigation zone during operations a shut-down requirement is not necessary since operations are said to be continuous once started.

Behaviours from harbour porpoise recorded included travelling, slow swim and fast swim. No orientation responses or behaviour responses were observed from the animals towards the survey works whether operations were at full power or not operational. Grey seal behaviours included logging/resting at the surface, bottling, slow swim and observation of the vessel. On one occasion a grey seal was observed milling and opportunistically foraging among the fishing vessels in Arklow harbour. No designated haul-out areas for seals are recorded within the immediate vicinity.

Distribution of these sightings is visually represented in Figure 3. NPWS deck forms and marine mammal sighting forms are provided in the Appendices.

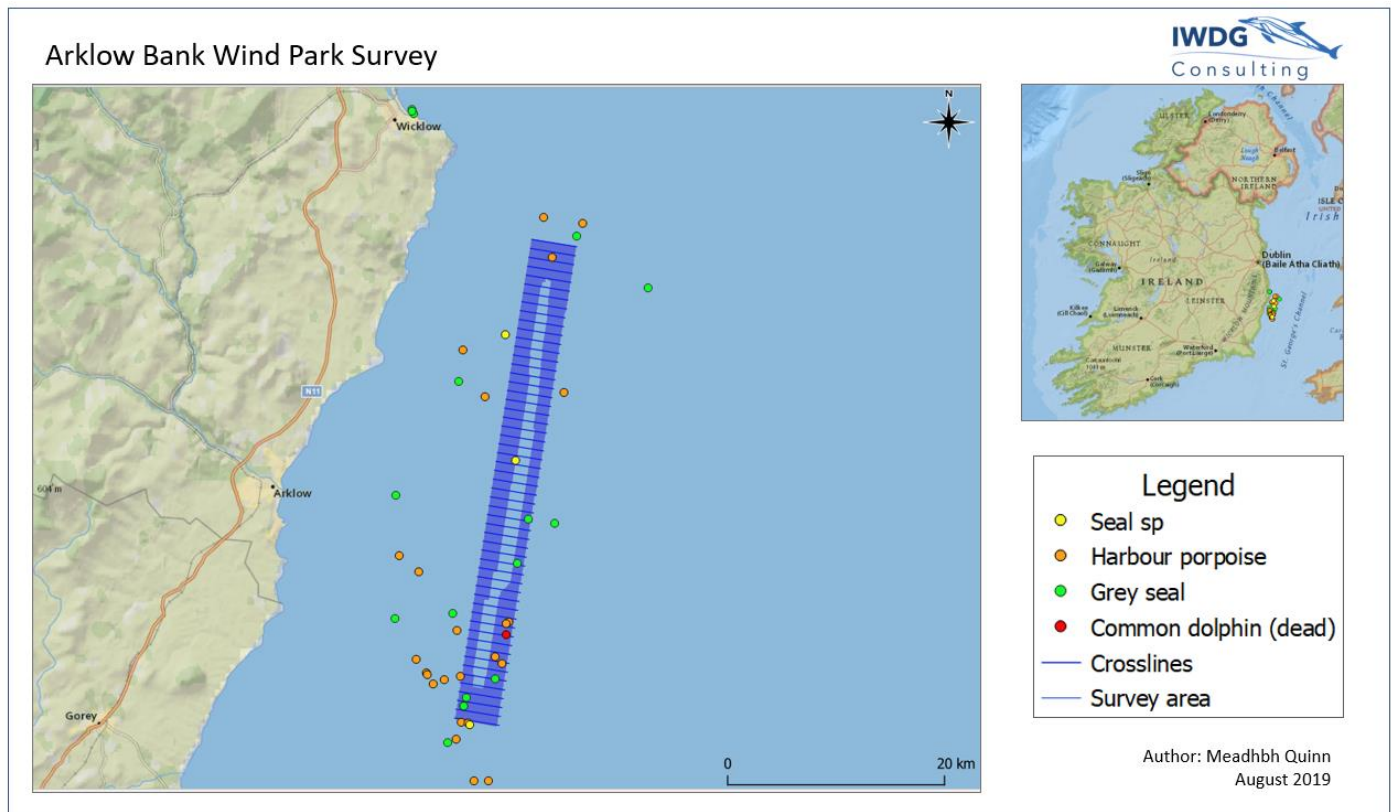


Figure 3: Marine mammal sightings Arklow Bank Wind Park survey

3.5. Marine Mammal Delays and Mitigation

Survey operations were delayed on three occasions as a result of a marine mammal being present within the 350m MZ. Total time delay due to marine mammal activity was 1hr and 30mins for the overall survey. Delays are not inclusive of mandatory 30-minute pre-watch, or time from the MMO's initial go ahead to actual start of ramp-up.

On the 26th of July a harbour porpoise (sighting no. 14) was observed at 100m within the MZ during the dedicated pre-watch. The MMO advised the surveyor team to delay start of operations by 30 minutes. The animal was not observed within the MZ since the last time of sighting. A further delay due to weather was instigated, monitoring for marine mammals was continued though-out this delay and a ramp-up procedures began at 20:38 UTC.

On the 27th of July a grey seal (sighting no. 17) was observed at 100m within the MZ during the dedicated pre-watch. The MMO advised the surveyor team to delay start of operations by 30 minutes. The animal was not observed within the MZ since the initial time of sighting and ramp-up procedures began at 08:00 UTC.

On the 29th of July a harbour porpoise (sighting no. 21) was observed at 75-100m within the MZ during the dedicated pre-watch. The MMO advised the surveyor team to delay start of operations by 30 minutes, while slowly moving the vessel west in the opposite direction of the travelling animal. The animal was not observed within the MZ since the last time of sighting and ramp-up procedures began at 08:00 UTC

A summary of delays can be found in Table 4. Three delays were instigated throughout the geophysical survey.

Table 4 Summary of delays to operations due to marine mammals within the MZ

Date	Time of Delay (hr:min)	Description of delay	Sighting Reference Number	Closest Distance of Approach to Noise Source (m)
26/07/2019	00:30	Delay due HP within the 350m MZ	14	100m
27/08/2019	00:30	Delay due GS within the 350m MZ	17	100m
29/08/2019	00:30	Delay due HP within the 350m MZ	21	75m

4. Discussion

4.1. Sightings

A total of 45 sightings were recorded during MMO observations throughout the survey. Grey seal (*Halichoerus grypus*) and harbour porpoise (*Phocoena phocoena*) were the most abundant species observed.

On the 28th of July a dead common dolphin was observed floating 400m from the vessel, the individual had no obvious marks/injuries on its visible side and was in fresh condition.

On the 31st of July, three sightings of harbour porpoise were observed within an 8 minute time period consisting of 8 adults and 4 juveniles. Animals were observed swimming at pace in various directions, possibly feeding in the area, in 7.5- 36m depth of water south of the Arklow Bank. The majority (75%) of sightings of harbour porpoise were observed south of the 52° 45'N latitude.

Sightings of grey seals were not specific to one particular area or depth but ranged throughout the survey areas.

Sightings were observed while operations were at full power and non-operational. Behaviour change effects are thought to be short-term, possibly resulting in brief orientation responses, temporary displacement, avoidance, or a change to diving behaviours. Due to the limited number of sightings and duration of the survey, it is unknown if operations caused any displacement from the area or injuries.

Given the high frequencies and high attenuation rate of MBES and SSS devices used during this survey; it is considered that these devices lie outside the audible ranges of marine mammals associated within the vicinity of the cable corridors. It can be concluded that use of these devices at high frequencies presents a negligible risk of injury to marine mammals. SBP and USBL frequencies do however lie within marine mammal's audible hearing range and operate at high and low SPL levels, respectively. High SPL levels of such impulsive noise emissions (depending on distance) may induce TTS (temporary hearing threshold shift), PTS (permanent hearing threshold shift) and behaviour change effects in both cetaceans and pinnipeds. Due to this sound exposure it is concluded that following NPWS Guidelines (2014) should continue to be enforced for BEP on both this and future geophysical surveys.

4.2. Mitigation Procedures

Procedures were underpinned by the recommended NPWS guidelines. These procedures were suitable for the operations being undertaken and provided a suitable level of protection whilst not being unnecessarily restrictive on operations. Weather conditions for operations were equally as limiting for those required for visual observations and therefore there was no delay to operations as a result of observations not being able to be undertaken. The ability to relocate the vessel to an area free of marine mammals before the start of acoustic operations allowed also for the added avoidance of marine mammals within the MZ.

4.3. Issues with Compliance

There were no breaches in compliance with NPWS Guidelines during the project with all necessary delays observed by the operations team, and who should be commended for their cooperation and flexibility.

4.4. Recommendations

The following recommendations are made following the findings of this report and the marine mammal observation undertaken on the project:

- Automated ramp-up option on HRS equipment

5. References

- Berrow, S.D. (2001) Biological diversity of cetaceans (whales, dolphin and porpoises) in Irish waters. In Marine Biodiversity in Ireland and Adjacent waters. Proceedings of a conference 26-27 April. 2001 Ed. Nunn, J.D. Ulster Museum, Belfast, 115-119.
- Berrow, S.D., Whooley, P., O'Connell, M. and Wall, D. (2010) Irish Cetacean Review (2000-2009). Irish Whale and Dolphin Group, 60pp.
- Ó'Cadhlá, O., Strong, D., O'Keeffe, C., Coleman, M., Cronin, M., Duck, C., Murray, T., Dower, P., Nairn, R., Murphy, P., Smiddy, P., Saich, C., Lyons, D. & Hiby, A.R. (2007). An assessment of the breeding population of grey seals in the Republic of Ireland, 2005. Irish Wildlife Manuals No. 34. National Parks & Wildlife Service, Department of the Environment, Heritage and Local Government, Dublin, Ireland.
- Ó'Cadhlá, O., Keena, T., Strong, D., Duck, C. and Hiby, L. (2013) Monitoring of the breeding population of grey seals in Ireland, 2009 - 2012. Irish Wildlife Manuals, No. 74. National Parks and Wildlife Service, Department of the Arts, Heritage and the Gaeltacht, Dublin, Ireland.
- Evans, P.G.H., Anderwald, P. and Baines, M.E. 2003. UK Cetacean Status Review. Report to English Nature and the Countryside Council for Wales.
- Hammond, P.S., Lacey, C., Gilles, A., Viquerat, S., Börjesson, P., Herr, H., Macleod, K., Ridoux, V., Santos, M.B., Scheidat, M., Teilmann, J., Vingada, J., and Øien, N. 2017. Estimates of cetacean abundance in European Atlantic waters in summer 2016 from the SCANS-III aerial and shipboard surveys. May 2017.
- NPWS (2008). The Status of EU Protected Habitats and Species in Ireland. National Parks and Wildlife Service, Department of the Environment, Heritage and Local Government.
- Pomeroy, P. P., Twiss, S.D., Redamn, P. 2000. Philopatry, Site Fidelity and Local Kin Associations within Grey Seal Breeding Colonies
- Reid, J., Evans, P. G. H., & Northridge, S. 2003. An atlas of cetacean distribution on the northwest European continental shelf. *Joint Nature Conservation Committee, Peterborough*.
- SCOS. 2017. Scientific Advice on Matters Related to the Management of Seal Populations: 2017. Sea Mammal Research Unit.
- SNH. 2017. Seals. Available at <https://www.nature.scot/plants-and-animals/mammals/marine-mammals/seals> Accessed 13/05/2019
- Southall, B.L., Finneran, J.J., Reichmuth, C., Nachtigall, P.E., Ketten, D.R., Bowles, A.E., Ellison, W.T., Nowacek, D.P. and Tyack, P.L., 2019. Marine Mammal Noise Exposure Criteria: Updated Scientific Recommendations for Residual Hearing Effects. *Aquatic Mammals*, 45(2), pp.125-232.
- Wall, D., Murray, C., O'Brien, J., Kavanagh, L., Wilson, C., Glanville, B., Williams, D., Enlander, I., Ryan, C., O'Connor, I., McGrath, D., Whooley, P. and Berrow, S. (2013) Atlas of the distribution and relative abundance of marine mammals in Irish offshore waters: 2005 – 2011. Irish Whale and Dolphin Group.