HORIZON NUCLEAR POWER

WYLFA NEWYDD

ENERGY WORKING FOR BRITAIN

Wylfa Newydd Project

6.4.88 ES Volume D - WNDA Development App D13-6 - Marine Mammal Baseline Review

PINS Reference Number: EN010007

Application Reference Number: 6.4.88

June 2018

Revision 1.0

Regulation Number: 5(2)(a)

Planning Act 2008
Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009

Horizon Internal DCRM Number: WN0902-JAC-PAC-APP-00168

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Wylfa Newydd Project

Horizon Nuclear Power (Wylfa) Ltd

Marine Mammal Baseline Review

60PO8032/AQE/REP/001

WN034-JAC-PAC-REP-00001

Document history and status

Revision	Date	Description	By	Review	Approved
1	02/07/2015	Marine Mammal Baseline Review	Karen Watts	Rachel Wilson	Rob Bromley
2	01/04/2016	Address Comments from MB HNP	Karen Watts	Emma Collins	Rob Bromley
3	05/10/2016	Address further comments and addition of data	Karen Watts	Rachel Wilson	Rob Bromley
4	10/03/2017 30/04/2017	Re-present data and re-structuring of report Addition of additional data	Rachael Plunkett SMRU Consulting Karen Watts	Cormac Booth SMRU Consulting Rachel Wilson	Rob Bromley
5	10/07/2017	Addressing comments from GM and MB	Karen Watts	Rachel Wilson	Rob Bromley
6	25/10/2017	Addition of additional survey data and calculations update	Karen Watts Richard Gibbs	Rachel Wilson	Rob Bromley

7	11/01/2018	Update to incorporate all survey data	Karen Watts	Rachel Wilson	Rob Bromley

Distribution of copies

Revision	Issue approved	Date issued	Issued to	Comments
1	Rob Bromley	25/01/2016	Maia Gralewski	
2	Rob Bromley	28/062016	Maia Gralewski	Addressing Horizon comments
3	Rob Bromley	05/10/2016	Emma Beagley /Neil Burke	Addressing further comments and addition of data
4	Rob Bromley	30/04/2017	Neil Burke / Bryony Stocking	Restructure of report and update with additional data
5	Rob Bromley	14/07/2017	Production Management	Addressing further comments from HNP and IC
6	Rob Bromley	30/10/2017	Production Management	Addition of additional survey data and calculations update
7	Rob Bromley	12/01/2018	Production Management	Update to incorporate all survey data

Wylfa Newydd

Project no:	60PO8032
Document title:	Marine Mammal Baseline Review
Document No.:	60PO8032/AQE/REP/001
Revision:	4
Date:	14/07/2017
Client name:	Horizon Nuclear Power (Wylfa) Ltd
Client no:	WN034-JAC-PAC-REP-00001
Project manager:	Rob Bromley
Author:	Karen Watts
File name:	6.5-ENV-ESD-APP-076 [GM][MB]

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Executive Summary

Jacobs UK Ltd (Jacobs) was commissioned by Horizon Nuclear Power (Wylfa) Ltd to collate marine mammal data to characterise marine mammal presence in and around the Wylfa Newydd Development Area and north Anglesey coastline to enable assessments of the predicted effects of the Wylfa Newydd Power Station.

During all boat-based and land-based surveys undertaken by Jacobs since 2010/2011 on either a dedicated (e.g. land-based vantage point surveys (VP surveys) or casual/incidental basis (e.g. records made during other surveys such as fish, water quality, benthic surveys, GI works, and other walkover surveys) marine mammal sightings have been recorded. In addition, dedicated vessel transect surveys, Marine mammal autonomous underwater noise cetacean click detector (C-POD) surveys and dedicated land-based seal surveys have been undertaken since 2016. The dedicated vessel transect surveys continued until July 2017 with the C-PODs due were recovered in November 2017.

A review of existing literature was undertaken whereby additional data were collated from a variety of organisations such as Sea Watch Foundation and Natural Resources Wales as well as the published literature.

Three species of cetacean and one species of pinniped are common along the north coast of Anglesey; these are harbour porpoise (*Phocoena phocoena*), bottlenose dolphin (*Tursiops truncatus*), Risso's dolphin (*Grampus griseus*) and grey seal (*Halichoerus grypus*). Harbour porpoise was the most frequently reported cetacean during both the VP and vessel transect surveys and this species has been shown to be present off the coast of north Anglesey and around the Wylfa Newydd Development Area year round. Density values have been calculated from the vessel transect survey data (September 2016 to July 2017) using a g(0) = 0.5. The harbour porpoise density has been calculated to be 0.646 individuals km^{-2} with sea state correction and a corresponding abundance of 620 individuals (CI 461-833). Although these abundances are similar to that presented by Shucksmith *et al*. (2009) the density values calculated are lower with Shucksmith *et al*. (2009) reporting a density value of 1.261 individuals km^{-2} (using g(0) = 0.5). The Shucksmith *et al*. (2009) data (which covered a larger sea area) suggests a harbour porpoise abundance off north Anglesey of 618 individuals, which in turn represents 0.6% of the total Celtic and Irish Sea Management Unit.

Preliminary Passive Acoustic Monitoring (PAM) analysis reported detection rates for harbour porpoise ranged between 0.108 and 0.477 km^{-1} with an average detection rate of 0.304 km^{-1}. Whilst density and abundance estimates were not possible using the three C-PODs, acoustic monitoring using C-PODs indicate the area to the east of Wylfa Head shows a greater number of detections when compared to the areas of Cemlyn Bay and Porth-y-pistyll. The DPM day^{-1} correlated with other environmental factors such as sea surface temperature and Chlorophyll a particularly at Wylfa Head. Detections at Wylfa Head declined from July 2017, whilst detections appear to increase at Porth-y-pistyll. This was likely owing to movement of food sources or increased fishing activity within the area of Wylfa Head; harbour porpoise require a regular food source and actively move away from noisy activities (OSC, 2018 and Todd, V. Pers Comm., 2018). In addition, greatest the highest harbour porpoise activity was reported on the flooding tide. Of key importance for harbour porpoise is the fact that the Wylfa Newydd Development Area is located within the North Anglesey Marine candidate Special Area of Conservation (cSAC).

The bottlenose dolphin was the next most frequently reported cetacean during both the VP and vessel transect surveys. There are however, no reliable density estimates of bottlenose dolphins for Anglesey, however the bottlenose dolphin is present year round in Welsh waters with large pod sizes reported off Anglesey. A total of 212 individuals were recorded over 12 sightings during the VP surveys between 2010 and 2014 with one sighting consisting of a pod of 100 individuals. There is evidence from photo-ID studies that there is a seasonal migration of bottlenose dolphins from Cardigan Bay to north Anglesey in the winter months. There is a higher proportion of bottlenose dolphins belonging to the SAC reported off north Anglesey in the winter months, although they are present year round (Veneruso and Evans, 2012). These data confirm that there is connectivity between the Cardigan Bay SAC and the waters surrounding north Anglesey, which means that any bottlenose dolphin sighted off Anglesey should be considered to be part of the SAC population.

There is currently no population estimate for Risso's dolphins in the UK; however, Risso's dolphins regularly occur around the western and northern part of the Lleyn Peninsula, particularly around Bardsey Island (Evans *et al*., 2015a). Long-term studies of the Risso's dolphin around Bardsey Island undertaken by Whale and Dolphin

Conservation have indicated that there are between 121 and 141 animals (CV = 0.24) (de Boer *et al*., 2013). Risso's dolphin has also been sighted off the north coast of Anglesey near Bull Bay with the majority of sightings occurring to the east of Anglesey in similar locations described for the bottlenose dolphin. The three definite sightings of Risso's dolphin during the site-specific vessel transect surveys were located approximately 10 km offshore to the north of Middle Mouse island; to the east of the Wylfa Newydd Development Area approximately 2 km off Bull Bay; and finally, one sighting approximately 1 km from the shore to the east of Middle Mouse island.

Wales is thought to have between 3% and 4% (1,650 individuals) of the total UK grey seal pup production (Special Committee on Seals (SCOS), 2014). Population studies of the Celtic and Irish Sea have revealed that grey seals are present year round on both the Irish and Welsh coasts and are known to move between the two (Kiely *et al*., 2000). Studies of grey seals in north Wales identified the importance of the area for the Welsh population. Data from tagging studies in the Irish Sea show connectivity of seals in the Pembrokeshire Marine SAC, the Lleyn Peninsula and the Sarnau SAC, and the seals located in north Anglesey. The telemetry data show tag GPS locations recorded within the Wylfa Newydd Development Area from seals tagged on Anglesey. The seal density data presented in at-sea usage maps (Jones *et al*., 2013) around Anglesey show that grey seals tend to be concentrated around The Skerries and Lleyn Peninsula and to the east of north Anglesey towards the mainland and West Hoyle Bank. Around north Anglesey, the estimated density of grey seals reaches a maximum of 0.83 km^{-2} at The Skerries and the estimated density of grey seals in waters that overlap with the Wylfa Newydd Development Area is 0.16 km^{-2}. The VP surveys have confirmed that grey seals are present around north Anglesey and the Wylfa Newydd Development Area year round. Seal surveys conducted between October and January indicate that the Anglesey coastline is not important in terms of breeding sites for the grey seal, there were no grey seal pups sighted here despite seal pups still being present on Carmel Head. A total of six juvenile grey seals were sighted in the water (i.e. not hauled out) within the Survey Area (between Hen Borth and Porth Padrig).

1. Introduction

1.1 Overview

Horizon Nuclear Power Wylfa Limited (hereafter referred to as Horizon) is currently planning to develop a new Nuclear Power Station on Anglesey as identified in the National Policy Statement for Nuclear Power Generation (EN-6) (Department of Energy and Climate Change, 2011). The Wylfa Newydd Project (the Project) comprises the proposed new Nuclear Power Station, including the reactors, associated plant and ancillary structures and features, together with all of the development needed to support its delivery, such as highway improvements, worker accommodation and specialist training facilities. It also includes the licenced Disposal Site at Holyhead North (IS043). The Project will require a number of applications to be made under different legislation to different regulators. As a Nationally Significant Infrastructure Project under the Planning Act 2008, the construction and operation must be authorised by a Development Consent Order. A separate application for a Marine Licence for marine construction works and marine dredging and disposals is also required under the *Marine and Coastal Access Act 2009*.Jacobs UK Ltd (Jacobs) was commissioned by Horizon to characterise marine mammal presence in and around the Wylfa Newydd Development Area, north Anglesey coastline and the wider Celtic and Irish Sea.

This report details a review of cetaceans (whales, dolphins and porpoise) and pinnipeds (seals) that frequent the Irish Sea and Welsh coastline with a particular focus on the north coast of Anglesey. This review comprises a combination of desk-based review and baseline data collection and analyses using the following sources:

- Observations and records were made of marine mammals sighted during site-specific land-based vantage point marine surveys and during over-wintering bird surveys over a four-year survey programme.
- Observations were made of all incidental marine mammal sightings during all boat-based surveys undertaken by Jacobs to characterise the marine environment (i.e. to collect data for fish, water quality, benthic surveys, etc.), covering a five-year survey programme.
- Site-specific vessel transect surveys for marine mammals and birds began in May 2016 and dedicated marine mammal surveys continued until July 2017. In conjunction with the marine mammal and bird surveys, Passive Acoustic Monitoring (PAM) was undertaken between November 2016 and July 2017.
- Additional data were collated from a variety of organisations such as Sea Watch Foundation (SWF) and Natural Resources Wales (NRW).

The area covered by this baseline report incorporates the north Anglesey coast and the Wylfa Newydd Development Area. Literature covering a 200 km area incorporating data from the Celtic and Irish Sea (which incorporates the Disposal Site), has also been considered owing to the transient nature and mobility of marine mammals.

Figure 1.1 provides an overview of the locations referred to in this study.

1.2 The Project

The Project includes the Wylfa Newydd Power Station and Associated Development. The Wylfa Newydd Power Station includes two UK Advanced Boiling Water Reactors to be supplied by Hitachi-GE Nuclear Energy Limited, associated plant and Ancillary Structures and features. In addition to the reactors, development on the Power Station Site would include steam turbines, control and service buildings, operational plant, radioactive waste storage buildings, Ancillary Structures, offices and coastal developments. The coastal developments would include a Cooling Water System and breakwater, and a Marine Off-Loading Facility.

1.3 Site Description

The Wylfa Newydd Development Area (the indicative areas of land and sea, including the Power Station Site, the Wylfa NPS Site[1] and the surrounding areas that would be used for the construction and operation of the Power Station) covers an area of approximately 380 hectares (ha) of land and extending into the Irish Sea at Porth-y-pistyll. It is bounded in the north by the existing Magnox Power Station (the Existing Power Station). To the east, it is separated from Cemaes by a narrow corridor of agricultural land. The A5025 road and residential properties define part of the south-east boundary, with a small parcel of land spanning the road to the northeast of Tregele. To the south and west, the Wylfa Newydd Development Area abuts agricultural land, and to the west it adjoins the coastal hinterland.

The Wylfa Newydd Development Area includes the headland south of Mynydd y Wylfa candidate Wildlife Site. There are two designated sites for nature conservation within the Wylfa Newydd Development Area: the Tre'r Gof Site of Special Scientific Interest (SSSI) and the Anglesey Terns/Morwenoliaid Ynys Môn Special Protection Area. There is also a candidate Special Area of Conservation (cSAC) that has been submitted to the European Commission, but not formally adopted (North Anglesey Marine/Gogledd Môn Forol cSAC). The Wylfa Newydd Development Area is within 1 km of the Cae Gwyn SSSI, Cemlyn Bay SAC and the Anglesey Terns/Morwenoliaid Ynys Môn Special Protection Area and Cemlyn Bay SSSI[2].

The open coast location of north Anglesey is characterised by strong tidal flows (>1.5 m s^{-1}) and a seabed that slopes steeply to a depth of approximately 25 m to30 m. The substrata comprise a mix of bedrock, boulders and cobbles and sediments including gravel and sands in variable proportions.

The sublittoral coastline around north Anglesey comprises a diverse habitat assemblage characteristic of a moderately exposed, western UK rocky coastline and dominated by macrophytic algae.

1.3.1 The Holyhead North Disposal Site

The licensed Disposal Site at Holyhead North (IS043) is situated approximately 4 km off the west coast of South Stack, Anglesey, at its closest point, within the Irish Sea. The Holyhead North Disposal Site is rectangular, measuring around 6.5 km in length and 4.4 km in width, oriented along a roughly north-south axis. The area of the site is approximately 28.6 km^2. The southern and northern sections of the Disposal Site's eastern boundary are approximately 9 km and 10 km, respectively, from the exit of Holyhead Harbour, whilst the north-west corner is approximately 15 km distant.

Before 2017, the Holyhead North Disposal Site represented the northern half of the Holyhead Deep (IS040) Disposal Site; however, in 2017 it was designated a Disposal Site in its own right. The site IS040 was heavily active for several decades, receiving regular disposal events which in recent years have largely comprised maintenance dredging from Stena Line Ports. Capital dredging is required for construction of the Wylfa Newydd Project, and it is proposed that excavated material be disposed at the Holyhead North Disposal Site. The southern half of the historical Holyhead Deep Disposal Site was awarded an Agreement for Lease by the Crown Estate for the development of a marine tidal energy array called Deep Green Utility.

[1] The site identified on Anglesey by the *National Policy Statement for Nuclear Power Generation (EN-6)* as potentially suitable for the deployment of a new Nuclear Power Station.
[2] Note that the format of names for designated and conservation sites is consistent with JNCC guidance.

N
W
E
S

The Skerries
1BW
2BC
Middle Mouse
Craig yr Iwrch
3BE
Llanbadrig
Bull Bay
Cemaes Bay
Carmel Head
Cemlyn Bay
Point Lynas
Church Bay
Puffin Island

IRISH SEA

0 5 10 Kilometres

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Legend

Wylfa Newydd Development Area

An overview of the locations referred to within the marine mammal baseline report

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Project: Wylfa Newydd

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Scale @ A3 1:125,000 DO NOT SCALE

Figure 1.1 | Status **FINAL** | Project no. 60PO8099

1.4 Legislation, Policy and Guidance

Cetaceans and pinnipeds are protected by a number of pieces of legislation in the British Isles. The specific legislation covering each species is outlined in table 1.1 and broadly separates the marine mammal species into four groups: pinnipeds, small dolphin species, toothed whales and baleen whales.

Table 1.1: A summary of protection measures in place for marine mammals likely to occur around the British Isles. Information gathered from (CMS (2015); ACCOBAMS (2015); Council of Europe (2015); ASCOBANS (2015); Environment (Wales) Act (2016) (section 7) and JNCC assessments of favourable conservation status of habitats and species under article 17 of the Habitats Directive[3]

ACCOBAMS = Agreement on the Conservation of Cetaceans in the Black Sea, Mediterranean Sea and Contiguous Atlantic Area.

ASCOBANS = Agreement on the Conservation of Small Cetaceans in the Baltic, North East Atlantic, Irish and North Seas.

FV = Favourable, UI= Unfavourable-inadequate, XX=Unknown and -=not assessed.

Group	Common name	Scientific name	Wildlife and Countryside Act, 1981 and Wildlife (Ire) Order 1985	EC Habitats Directive (Annex)	Bonn Convention (Appendix)	Bern Convention (Appendix)	EU Council Regulation 338/97	ASCOBANS	ACCOBAMS	Environment (Wales) Act (2016): Section 7	Favourable Conservation status
Pinnipeds	Harbour seal	*Phoca vitulina*	✓	II, V	-	III	✓	-	-	-	UI
	Grey seal	*Halichoerus grypus*	✓	II, V	-	III	✓	-	-	-	FV
Small dolphin/porpoise	Atlantic white-sided dolphin	*Lagenorhynchus acutus*	✓	IV	II[4]	II	II	✓	✓	✓	XX
	Bottlenose dolphin	*Tursiops truncatus*	✓	II, IV	II[5]	II	II	✓	✓	✓	FV
	Harbour porpoise	*Phocoena phocoena*	✓	II, IV	II[6]	II	II	✓	✓	✓	FV
	Risso's dolphin	*Grampus griseus*	✓	IV	II[7]	II	II	✓	✓	✓	XX
	Short-beaked common dolphin	*Delphinus delphis*	✓	IV	II	II	II	✓	✓	✓	XX
	Striped dolphin	*Stenella coeruleoalba*	✓	IV	II	II	II	✓	✓	✓	-
	White-beaked dolphin	*Lagenorhynchus albirostris*	✓	IV	II[8]	II	II	✓	✓	✓	FV

[3] http://jncc.defra.gov.uk/page-4063
[4] Only North and Baltic Sea populations
[5] North and Baltic Sea populations
[6] North and Baltic Sea, western North Atlantic, Black Sea and North West African populations
[7] Only North and Baltic Sea and Mediterranean populations
[8] Only North and Baltic Sea populations

Group	Common name	Scientific name	Wildlife and Countryside Act, 1981 and Wildlife (Ire) Order 1985	EC Habitats Directive (Annex)	Bonn Convention (Appendix)	Bern Convention (Appendix)	EU Council Regulation 338/97	ASCOBANS	ACCOBAMS	Environment (Wales) Act (2016): Section 7	Favourable Conservation status
Toothed whales	Killer whale	*Orcinus orca*	✓	IV	II	II	II	✓	✓	✓	XX
	Long-finned pilot whale	*Globicephala melas*	✓	IV	II[9]	II	II	✓	✓	✓	XX
	Northern bottlenose	*Hyperoodon ampullatus*	✓	IV	II	III	II	✓	✓	✓	-
	Sperm whale	*Physeter macrocephalus*	✓	IV	I, II	III	II	-	✓	-	XX
	Sowerby's beaked whale	*Mesoplodon bidens*	✓	IV	-	II	II	✓	✓	-	-
Baleen whales	Fin whale	*Balaenoptera physalus*	✓	IV	-	II	I	-	✓	✓	FV
	Humpback whale	*Megaptera novaeangliae*	✓	IV	I	II	I	-	✓	✓	-
	Minke whale	*Balaenoptera acutorostrata*	✓	IV	-	II	I	-	✓	✓	FV
	Sei whale	*Balaenoptera borealis*	✓	IV	I, II	II	I	-	✓	-	-

1.4.1 Cetacean specific legislation

All cetaceans are listed under Annex IV of the EU Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora (the Habitats Directive) as European Protected Species (EPS) requiring a system of strict protection. Under the Conservation of Habitats and Species Regulations 2010 (as amended) (hereafter referred to as the Habitats Regulations) it is an offence to: deliberately capture, injure or kill an EPS (including all cetaceans), deliberately disturb an EPS or damage or destroy a breeding site or resting place of an EPS. Under the Habitats Regulations, disturbance is defined as an activity which impairs the ability of the EPS to survive, breed, rear/nurture their young, to migrate or an activity which significantly affects the local distribution or abundance of the species. In addition, the harbour porpoise (*Phocoena phocoena*) and the bottlenose dolphin (*Tursiops truncatus*) are afforded additional protection under Annex II as species of Community Interest whose conservation requires the designation of Special Areas of Conservation (SACs).

All cetacean species are protected within the 12 nautical mile (nm) limit of territorial waters under Schedule 5 of the Wildlife and Countryside Act 1981. This Act makes "deliberate disturbance" an offence. Parts 2 and 6 of the Nature Conservation Act 2004 provide amendments to the Wildlife and Countryside Act by strengthening the protection of threatened species (including cetaceans) to include "reckless" acts.

[9] North and Baltic Sea populations

The Agreement on the Conservation of Small Cetaceans in the Baltic and North Seas (ASCOBANS) was concluded in 1991 and came into force in 1994 forming part of the Bonn Convention (1979). This agreement offers protection to all odontocetes (toothed cetaceans), with the exception of the sperm whale and obliges signatories to implement management measures aimed at cetacean conservation. An extension to the agreement came into force in February 2008 to include the Northeast Atlantic and Irish Seas as well as the North and Baltic Seas (ASCOBANS, 2015).

The Agreement on the Conservation of Cetaceans in the Black Sea, Mediterranean Sea and Contiguous Atlantic Area (ACCOBAMS) is a cooperative tool for the conservation of marine biodiversity in the Mediterranean and Black Seas. Its purpose is to reduce threats to cetaceans in Mediterranean and Black Sea waters and improve our knowledge of these animals (ACCOBAMS, 2015).

1.4.2 Pinniped specific legislation

The grey seal (*Halichoerus grypus*) and the harbour seal (*Phoca vitulina*) are afforded protection under Appendix III of the Bern Convention and Annexes II and V of the Habitats Directive as species whose conservation may require the designation of SACs.

The Wildlife and Countryside Act 1981 section 11 protects any wild animal (including seals) out to 12 nm. Pinnipeds are protected under the Conservation of Seals Act 1970 section 1 which protects all seals out to 12 nm and which prohibits the killing/taking of seals by certain methods and during close seasons. The Conservation of Seals Act 1970 prohibits the following methods of killing or taking seals without a licence:

- use of any poisonous substance; and
- use of any firearm other than a rifle with specified ammunition.

There is a close season for grey seals from 1 September to 31 December, and for harbour seals from 1 June to 31 August. It is an offence to take or kill a seal during the close season. There are certain exceptions under this legislation, which are not considered offences and for which a licence is not required:

- taking/attempting to take a disabled seal for the purposes of tending and releasing it;
- unavoidable killing/injuring as an incidental result of a lawful operation; and
- killing/attempted killing of a seal to prevent it causing damage to a fishing net/tackle, or to fish held in the net, if the seal is in the vicinity of the net/tackle.

1.4.3 Other Legislation and Policy

The Habitats Directive defines when the conservation status of listed species is to be considered as favourable. The definitions it uses for this are specific to the Directive, and require that the range and population of the listed species should be at least maintained at their status when the Directive came into force in 1994 or, where the 1994 status was not viable in the long term, to be restored to a position where it would be viable. The assessment of conservation status does not only relate to that component of the species population to be found in SACs, but to the totality of the species throughout the UK. The 2007 Article 17 report (Commission of the European Communities, 2009) prepared under the Habitats Directive reported on the conservation status of the listed species. When assessing the conservation status of species, the parameters are range, population, habitat (extent and condition) and future prospects. Each of these parameters is assessed as being in one of the following conditions: Favourable, Unfavourable-inadequate, Unfavourable-bad, or Unknown. As shown in table 1.1, the marine mammals likely to occur around the British Isles have been assessed as Unknown for six species, Favourable for six species and Unfavourable-inadequate for one species.

In Wales the Habitats Directive is transposed through the Conservation of Habitats and Species Regulations 2010 (as amended) to 12 nm, (in relation to reserved matters) and then the Offshore Marine Conservation (Natural Habitats, &c. Regulations 2007 (as amended). The Habitats Regulations provide protection for designated sites, known as Natura 2000 sites (European sites). The designated sites include SACs, cSAC and

SPAs. In addition, Welsh Government Policy also provide protection of possible SPAs and SACs (pSPA, pSAC) and Ramsar sites.

If the risk of injury or significant disturbance cannot be reduced to negligible levels with mitigation, then an EPS licence is required. In Wales, EPS licensing is conducted through NRW. Licences are granted under the following circumstances:

1) the reason for the licence relates to one of the specified purposes listed in the Conservation of Habitats and Species Regulations 2010 (as amended), which includes renewable energy purposes;
2) there is no alternative way to reduce injury or disturbance risk; and
3) the action covered under the licence must not be detrimental to the 'favourable conservation status' of the species.

Following the establishment of devolved governments in Scotland, Wales and Northern Ireland in 1998, responsibility for the environment and biodiversity is primarily at the country level. The distinctive elements of biodiversity in each of the four countries of the UK are able to be considered both independently and in collaboration with neighbouring countries. This allows for conservation approaches to be tailored to the varying conditions within different areas of the UK. The Environment (Wales) Act received Royal Assent on 21 March 2016. Its purpose is to put in place the legislation required to plan and manage natural resources in a sustainable and co-ordinated manner throughout Wales. Section 7 of the Act (Biodiversity Lists and duty to take steps to maintain and enhance biodiversity) sets out the requirement for a list to be prepared of the habitats and species of principal importance in Wales.

2. Methodology

2.1 Marine Mammal Management Units and Designations

This document takes into consideration the Management Unit (MU) for each species of interest, as defined by the Inter-Agency Marine Mammal Working Group (IAMMWG, 2015b). A number of MUs have been agreed for the seven most common cetacean species in UK waters (harbour porpoise, bottlenose dolphin, common dolphin (*Delphinus delphis*), white-beaked dolphin (*Lagenorhynchus albirostris*), white-sided dolphin (*Lagenorhynchus acutus*), Risso's dolphin (*Grampus griseus*) and minke whale (*Balaenoptera acutorostrata*) and are defined as "*a geographical area in which the animals of a particular species are found to which management of human activities is applied*" (IAMMWG, 2015b). In terms of the grey and harbour seal, the South West England and Wales MU and the West England and Wales MU are of relevance to the Wylfa Newydd Project.

In order to account for known feeding ranges and mobility of marine mammal species the review has considered populations from SACs that have been designated for one or more Annex II species (bottlenose dolphin, common seal, grey seal and harbour porpoise) within the Celtic and Irish Sea. These are listed in table 2.1.

Table 2.1: Special Areas of Conservation (SAC) specifically relating to marine mammals.

Site	Site area	Distance from the Wylfa Newydd Project (km)	Qualifying features
Gogledd Môn Forol/North Anglesey Marine cSAC	324,895 ha (3,249 km^2)	0	The area has been designated as a cSAC for the Annex II species harbour porpoise as it was identified as being within the top 10% of persistent high density areas for harbour porpoise in UK waters during the summer season (Heinänen and Skov, 2015). The site includes some of the highest count rates in the UK (Evans *et al.* 2015a), supporting it as an important site for harbour porpoise. Estimates from SCANS II suggest that the site supports approximately 1,084 harbour porpoise (95% CI[10] 557-2,111) and represents approximately 4% of the UK part of the Celtic and Irish Sea (CIS) MU. This site has been graded 'B' for occurrence (>2-15% of the UK part of the MU population) (JNCC and NRW, 2015a).
Pen Llŷn a`r Sarnau/Lleyn Peninsula and the Sarnau SAC West Wales Marine/ Gorllewin Cymru Forol cSAC	146,023.5 ha (1,460 km^2) 737,700 ha (7,377 km^2)	50 to 60	This site has been designated a SAC for a number of Annex I habitats. The Annex II species bottlenose dolphin and grey seal are listed as qualifying features of this SAC. In addition, the southwest Lleyn Peninsula (incorporated within the wider SAC) has been designated a cSAC for the Annex II species, harbour. There are no population estimates for this site; however, estimates of the Irish Sea population by SCANS II (2008) suggests 15,200 individuals (CV[11] = 0.35). This site has been graded 'A' for occurrence (presence for between 10 and 12 months of the year) and recommended as a grade 'B' overall (Evans and Prior, 2012).

[10] Confidence Interval (CI) is used to describe the amount of uncertainty associated with a sample estimate of a population parameter.
[11] Coefficient of Variation (CV) is the statistical measure used to determine the dispersion of data points within a data series around the mean.

Site	Site area	Distance from the Wylfa Newydd Project (km)	Qualifying features
Gorllewin Cymru Forol/ West Wales Marine cSAC	737,717 ha (7,377 km^2)	50 to 60	This site has been designated as a cSAC for the Annex II species harbour porpoise as it was identified as being within the top 10% of persistent high density areas for harbour porpoise in UK waters during the summer season and as an important area during winter (Heinänen and Skov, 2015). Estimates from SCANS II suggest that the site supports approximately 2,506 harbour porpoise (95% CI 1,410-4,455) and represents approximately 9% of the UK part of the CIS MU. This site has been graded 'B' for occurrence (>2-15% of the UK part of the MU population) (JNCC and NRW, 2015b).
North Channel (Northern Ireland) cSAC	1,604 km^2	100 to 150	This site has been designated a cSAC for the Annex II species harbour porpoise. It was identified as being within the top 10% of persistent high density areas for harbour porpoise in UK waters. The modelled outputs of this analysis demonstrate that the North Channel cSAC persistently contains densities of harbour porpoise which are within the top 10% of those for the Management Unit during winter and represents approximately 1.2% of the CIS MU (JNCC, 2017). Population estimates suggest that the site supports 537 individuals (CV 0.35). Overall this site has been graded 'B' (IAMMWG, 2015a)
Bae Ceredigion/Cardigan Bay SAC	95,860.36 ha (958.6 km^2)	100 to 150	This site has been designated an SAC for the Annex II species bottlenose dolphin. The bottlenose dolphin population of Cardigan Bay off the west coast of Wales has been estimated to consist of around 125 individuals. The dolphins appear to use the inshore waters of Cardigan Bay for both feeding and reproduction and, in the summer months, calves and juveniles are often observed with adult individuals or groups. This site also lists grey seals as an Annex II species present as a qualifying feature but not the primary reason for site selection.
Lambay Island and Ireland's Eye (Ireland) SAC	250 ha (2.5 km^2)	100 to 150	Lambay Island SAC is designated for two Annex II species, the grey seal and harbour seal. In 2005, a total of 56 grey seal pups were born within the Lambay Island SAC with a corresponding minimum population estimate for the site numbered between 196 and 252 grey seals of all ages. During the 2007 annual moult, an estimated 110 grey seals were present (National Parks and Wildlife Service (NPWS, 2013a)). During an aerial survey in August 2003, harbour seal population was reported as a maximum of 31 individuals within the Lambay Island SAC. Counts made post 2003-

Site	Site area	Distance from the Wylfa Newydd Project (km)	Qualifying features
			found between 38 and 47 individuals were recorded during the moult season (NPWS, 2013a).
Strangford Lough (Northern Ireland) SAC	15,398.54 ha (154 km^2)	100 to 150	Strangford Lough SAC is primarily designated for a number of Annex I habitats; however, the Annex II species harbour seal is also listed as a qualifying feature of this SAC. Estimated population of harbour seal stands at 210 individuals. The site has been graded 'C' for occurrence and has a global grade of 'C' (Natura 2000).
Murlough (Northern Ireland) SAC	11,902.03 ha (119 km^2)	100 to 150	Murlough SAC is primarily designated for a number of Annex I habitats and other Annex II species; however, the Annex II species harbour seal is listed as a qualifying feature of this SAC.
Rockabill to Dalkey Island (Ireland) SAC	27325.56 ha (273.3 km^2)	100 to 150	Rockabill to Dalkey Island SAC is designated for the Annex II species harbour porpoise. Survey effort targeting the 2008 summer-autumn season delivered initial estimates of 0.54 to 6.93 animals km^{-2} within the northern half of the site (overall estimate across four surveys: 2.03 individuals per km^2, n = 211±47 individuals, 95% Confidence Intervals: 137-327, CV = 0.23) and 0.48 to 2.05 animals km^{-2} within the southern half of the site, including outer Dublin Bay (overall estimate across four surveys: 1.19 individuals km^{-2}, n = 138 ± 33 individuals, 95% Confidence Intervals: 86-221, CV = 0.24) (NPWS, 2013b).
Sir Benfro Forol/Pembrokeshire Marine SAC	138,038.5 ha (1,380.4 km^2)	150 to 200	Pembrokeshire Marine SAC is designated for the Annex II species grey seal. It is the largest breeding colony on the west coast south of the Solway Firth, representing over 2% of annual UK pup production.
Slaney River Valley (Ireland) SAC	6,020.48 ha 60.2 km^2	150 to 200	Slaney River Valley SAC is designated for the Annex II species, the harbour seal. A comprehensive survey of the Irish harbour seal population was carried out in 2003 and additional records of the species within the site were compiled in 2010. A total of 17 harbour seals were recorded ashore during August 2003. Additional records from within the site comprised 22 harbour seals of all ages ashore in early September 2007 and 27 in early September 2009.
The Maidens (Ireland) SAC	7466.25 ha (74.65 km^2)	150 to 200	The Maidens SAC is designated for the Annex II species grey seal. There is a permanent population of grey seal at this site with a population of between 51 and 100 individuals.
Saltee Islands (Ireland) SAC	15,809.17 ha (158 km^2)	200	Great Saltee has a breeding population of grey seal, one of the very few in eastern Ireland. The breeding population was estimated at 571-744 individuals in

Site	Site area	Distance from the Wylfa Newydd Project (km)	Qualifying features
			2005. A one-off moult count in 2007 gave a figure of 246 individuals.

In addition to the listed SACs above there is one other cSAC (Bristol Channel Approaches) for harbour porpoise that has been graded 'A' for occurrence with an overall grading of 'B'. However, details are not included in the table given that this cSAC is more than 200 km away from the Wylfa Newydd Development Area.

2.2 Desk Based Methods

2.2.1 Cetaceans

Data have been gathered through a desk-based review and collation of available data. Central to the review of cetaceans is a database held by the SWF, which maintains and manages cetacean records (Evans *et al*., 2015a). The database incorporates both casual sightings and dedicated survey efforts from a number of different organisations, extending from the Bristol Channel in the south to the Isle of Man in the north. These organisations include:

- JNCC (European Seabirds at Sea);
- Irish Whale and Dolphin Group;
- Cardigan Bay Marine Wildlife Centre;
- Pembrokeshire Porpoise Survey;
- Whale and Dolphin Conservation;
- Marine Awareness North Wales;
- Scarweather Sands Survey;
- Gower Marine Mammal Project;
- Small Cetacean Abundance in the North and Adjacent Seas (SCANS and SCANS II);
- Northern Wind Power (RWE npower);
- Ceredigion County Council;
- Wildfowl and Wetlands Trust;
- Manx Whale and Dolphin Watch; and
- Swansea University.

In addition to the SWF data (described in greater detail in Appendix A) and other publically available cetacean literature has been considered. This comprises studies undertaken by other organisations and where results are in the public domain.

1. A review of the distribution of harbour porpoise around north Anglesey was undertaken by Shucksmith *et al*. (2009) over a three-year period (2002-2004). This study provides data on the harbour porpoise within five sectors around north Anglesey which are shown in Figure 2.1.

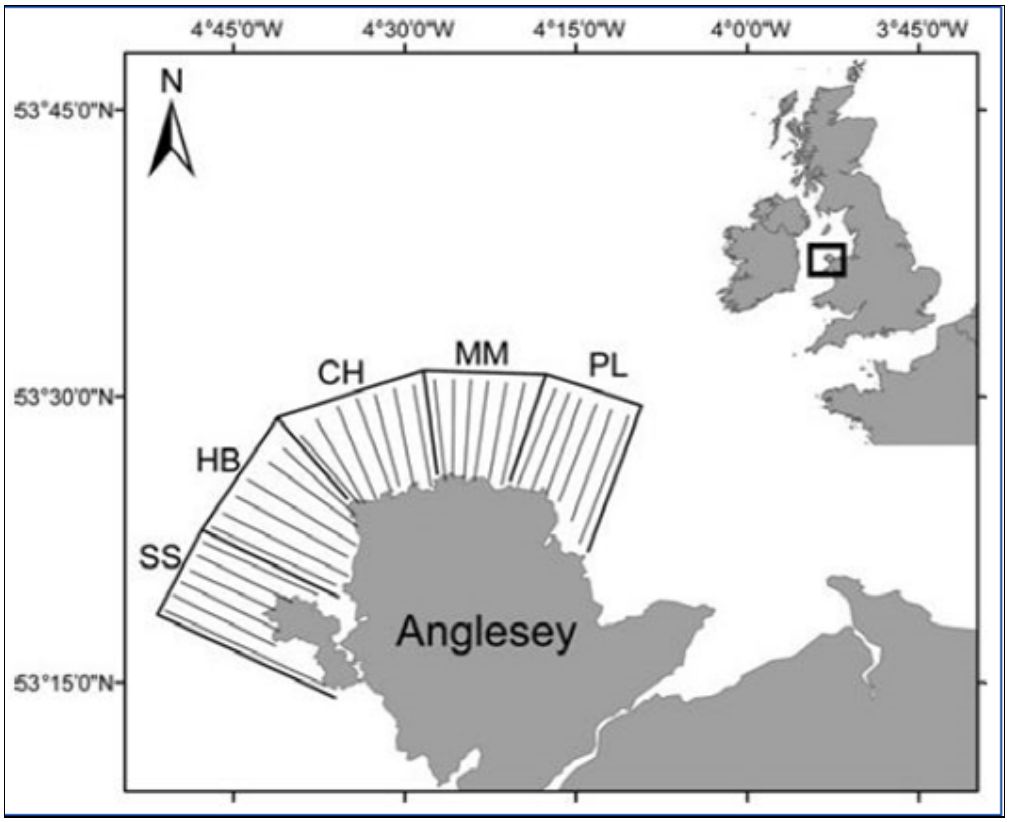


Figure 2.1: The harbour porpoise study area used by Shucksmith, *et al*. (2009) split in to five sectors: SS - South Stack; HB - Holyhead Harbour; CH - Carmel Head; MM - Middle Mouse; PL - Point Lynas. Map taken from Shucksmith, *et al*. (2009).

2. Data was collected using acoustic surveys on behalf of the Welsh Government for The Skerries Tidal Stream Array (Gordon *et al*., 2011). These surveys have been used to provide information relating to harbour porpoise density and area usage:
    - Self-contained acoustic monitoring devices (such as T-PODs[12]) deployed at six locations between The Skerries and Carmel Head of north Anglesey and left unattended for approximately three weeks.
    - Towed acoustic surveys using a zig-zag design with hydrophones deployed and operated between The Skerries and Carmel Head.
3. A review of the visual vessel based surveys undertaken by SEACAMS (2015) cited in Tethys (2018) on behalf of Minesto for the Holyhead Deep area of the Irish Sea. The surveys were undertaken around west Anglesey, which made use of visual observers and a towed high-frequency hydrophone array, recorded harbour porpoise, bottlenose dolphin and grey seal. These surveys have been used to provide additional information relating to presence of marine mammals within the Irish Sea.

2.2.2 Pinnipeds

As discussed above, two species of pinnipeds, grey and harbour seals, frequent the Irish Sea. Data on the population size and pup production for grey and harbour seals in the UK are provided in reports from SCOS. Estimated at-sea seal densities have been obtained from at-sea usage maps (Jones *et al*., 2013). These maps combine telemetry data with aerial survey counts at haul-out sites to give a population at mean level usage.

[12] T-POD is a battery operated omni-directional hydrophone with an analogue processor, a digital logging system and analysis software. T-PODs log frequency, duration and bandwidth of each odontocete click and can be used to target certain species such as the harbour porpoise.

SCOS (2015) estimated the number of harbour seals in West England and Wales to be 35 animals between 2007and 2014.

A review of the visual vessel based surveys undertaken by SEACAMS (2015) cited in Tethys (2018) on behalf of Minesto has been incorporated within this report. These data specifically targeted the Holyhead Deep area of the Irish Sea. These surveys have been used to provide additional information relating to presence of pinnipeds.

Datasets from a number of grey seal studies throughout the Celtic and Irish Sea have been used to provide baseline information of the breeding and population census for grey seals. These studies include:

- *Distribution and census of pup production in North Wales 2001* (Westcott, 2002);
- *Grey seal breeding census: Skomer Island 2013* (Büche and Stubbings, 2014);
- *Grey seal breeding census: Skomer Island 2014* (Büche and Stubbings, 2015);
- *Grey seal distribution and abundance in North Wales 2002 – 2003* (Westcott and Stringell, 2004);
- *Grey seal pup production for North Wales 2002* (Westcott and Stringell, 2003);
- *Grey seals: Status and monitoring in the Irish and Celtic Seas (Kiely et al., 2000);*
- *Monitoring of breeding grey seals in Ireland 2009 – 2012* (O'Cadhla *et al*., 2013);
- *Pembrokeshire marine SAC grey seal monitoring 2005* (Strong *et al*., 2006).
- *When aerial surveys will not do: grey seal pup production in cryptic habitats of Wales* (Stringell *et al*., 2014).

Data from detailed telemetry studies undertaken by the Sea Mammal Research Unit (SMRU) are included within this baseline report. These studies involved tagging grey seals from five SAC sites: Pembrokeshire Marine; Lleyn Peninsula and the Sarnau; Monach Islands, Isle of May; and Berwickshire and North Northumberland Coast. In total, 18 grey seal adults and 17 grey seal pups were tagged (SCOS, 2014).

2.3 Field Methods

To supplement the desk-based data review, surveys have been undertaken along the north Anglesey coast. These surveys included dedicated surveys as well as recording incidental/casual sightings.

Dedicated vessel transect surveys were scheduled to be undertaken on a monthly basis between May 2016 and August 2017. Marine mammal visual observations were recorded on all surveys and PAM was scheduled to be undertaken between November 2016 and August 2017; these are displayed in table 2.2. On a few occasions, surveys were unable to be undertaken or not all 12 transect could be surveyed owing to a deterioration in the weather; the various surveys that were undertaken and number of transects completed are displayed in table 2.2.

Table 2.2 : Breakdown of the different marine mammal surveys undertaken along the north Anglesey coast between May 2016 and July 2017. N.B. surveys did not occur on in March, June or August owing to down weather.

Survey date	Marine mammal visual survey	Passive Acoustic Monitoring (PAM) survey	Number of transects surveyed
26-27/05/2016	Yes – European Seabirds at Sea (ESAS)	-	22 (Block 1 and Block 2)
16-17/06/2016	Yes - ESAS	-	21 (Block 1 and Block 2)
28-29/06/2016	Yes - ESAS	-	23 (Block 1 and Block 2)
19-20/07/2016	Yes - ESAS	-	23 (Block 1 and Block 2)
17-18/08/2016	Yes - ESAS	-	23 (Block 1 and Block 2)

Survey date	Marine mammal visual survey	Passive Acoustic Monitoring (PAM) survey	Number of transects surveyed
21-22/09/2016	Yes - MMO	-	23 (Block 1 and Block 2)
20/10/2016	Yes - MMO	-	12 (Block 1)
29/11/2016	Yes - MMO	Yes	12 (Block 1)
20/12/2016	Yes - MMO	Yes	Four (Transect 4 to Transect 8) (Block 1)
18/01/2017	Yes - MMO	Yes	Five (Transect 1 to Transect 5) Block 1
19/01/2017	Yes - MMO	No	Seven (Transect 6 to Transect 12) Block 1
17/02/2017	Yes - MMO	Yes	Nine (Transect 4 to Transect 12) Block 1
March 2017	No	No	-
06/04/2017	Yes - MMO	Yes (data affected by other noise sources)	12 (Block 1)
12/05/2017	Yes – MMO	Yes (data affected by other noise sources)	Eight (Transect 1 to Transect 8) (Block 1)
June 2017	No	No	-
09/07/2017	Yes - MMO	Yes, however, there was an equipment failure	12 (Block 1)
August 2017	No	No	-

2.3.1 Dedicated Vessel Transect Surveys – Marine Mammal Visual Observations

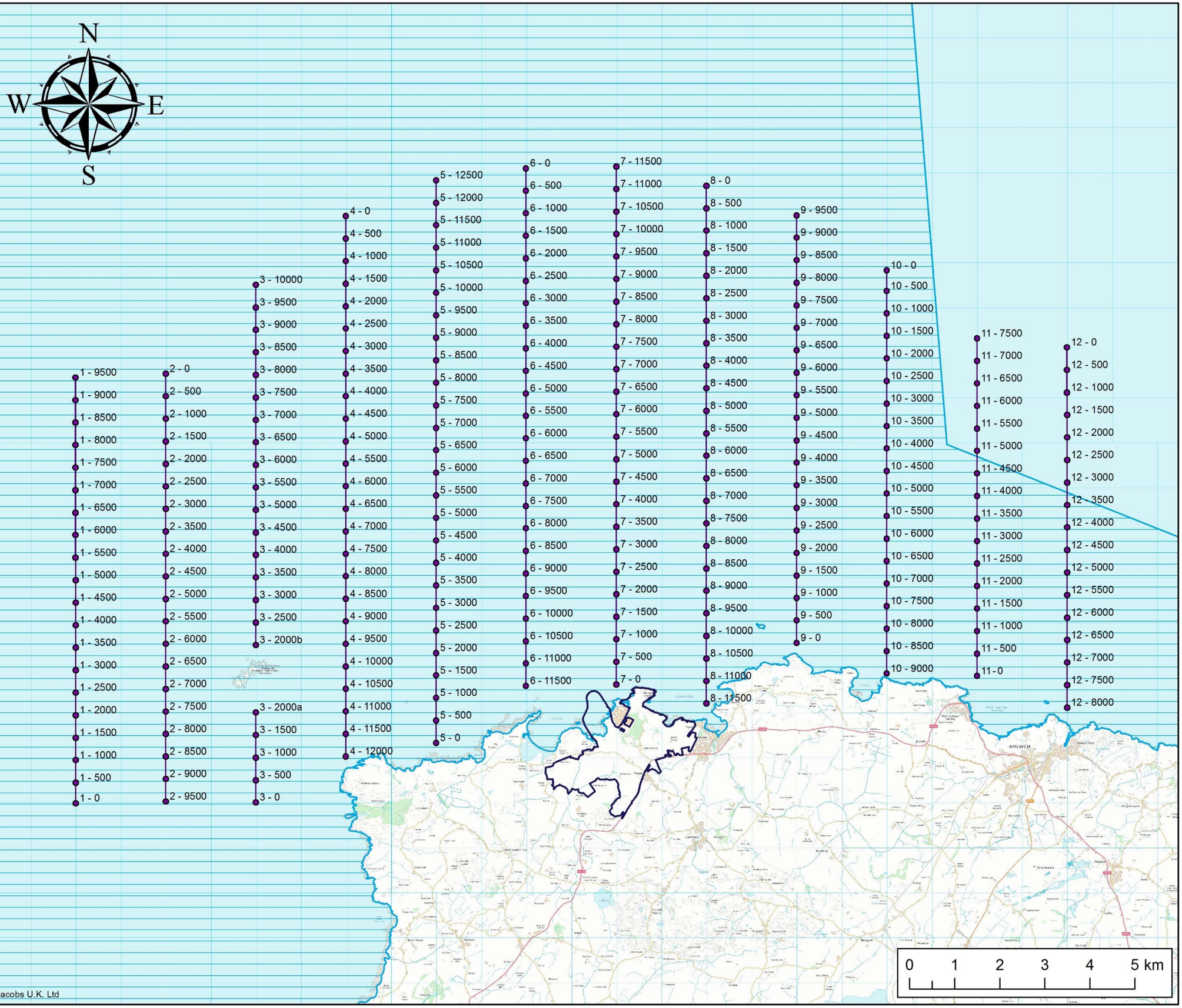
Between May and August 2016 marine mammal sightings were recorded by trained European Seabirds at Sea (ESAS) surveyors. This methodology changed in September 2016 with the inclusion of dedicated MMOs aboard the vessel. The data collection method was also changed in order to provide estimated distance (via range-finding stick) and bearing (via compass) of the sighting rather than the allocation of sightings into distance bands.

This document considers the results from all surveys that occurred between May 2016 and July 2017. The purpose of the surveys between May 2016 and May 2017 was to characterise the baseline environment and to incorporate the known foraging range of Sandwich terns (*Thalasseus sandvicensis*) belonging to the Cemlyn Bay colony. The surveys were also used to determine which species marine mammals are present in the area, whether there is any spatial or temporal pattern to marine mammal presence and to estimate, where possible, marine mammal densities in the survey area. In addition to this, MMO and PAM surveys were continued until August 2017.

A total of 21 survey days were undertaken. All surveys were conducted by trained MMOs that have undertaken a JNCC MMO course and in November 2016 the marine mammal survey methodology was supplemented by the addition of a towed hydrophone to collect data on marine mammal vocalisations, the methodology of which is considered in Section 2.3.2 and Appendix B.

For each survey undertaken between May 2016 and October 2016 inclusive, a total of 23 transects across two blocks (Block 1 and Block 2) were surveyed (Figure 2.2 and Figure 2.3); for surveys following the departure of the Sandwich terns (October 2016 onwards), only Block 1 (a total of 12 transects) was surveyed. Owing to down weather, surveys in March, June and August 2017 were not completed. The lengths of the transects on the

maps are displayed at 500 m intervals for snapshots of marine birds, however, sightings of marine mammals were recorded along the entire transect line not only during snapshots.



Legend

- Wylfa Newydd Development Area Boundary
- The North Anglesey Marine / Gogledd Môn Forol cSAC
- Block 1 waypoints
- Block 1 transects

JACOBS
1st Floor, Kenneth Dibben House, Enterprise Road
Southampton Science Park, Southampton, SO16 7NS, UK
Tel: +44(0)2380111250 Fax: +44(0)2380111251
http://www.jacobs.com

Client: HORIZON NUCLEAR POWER

Project: WYLFA NEWYDD PROJECT

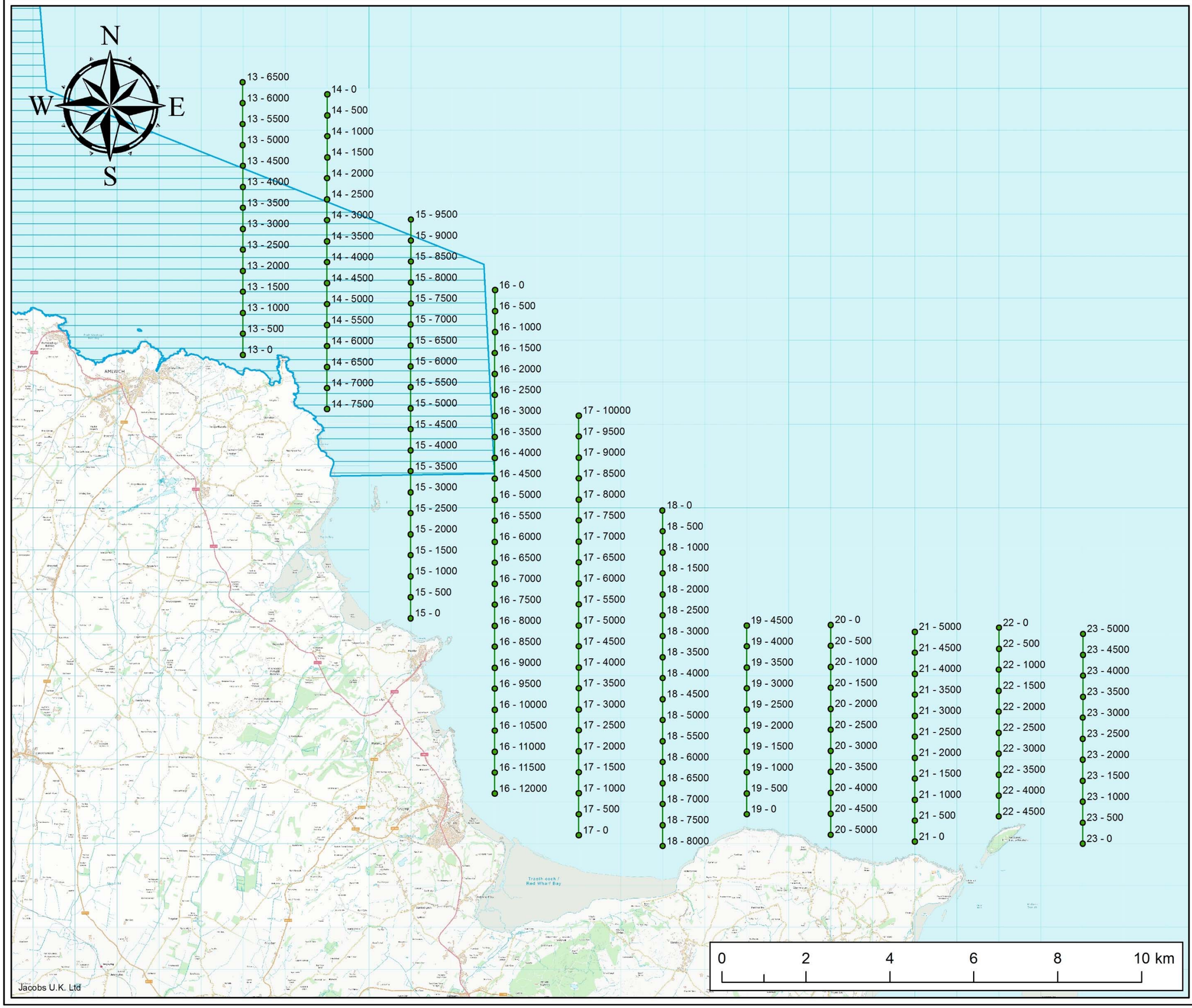
Drawing title: Vessel transects surverys - Block 1

Drawn by	Check'd by	Rev'd by	Appr'd by	Date	Rev.
VG	KW	RW	RB	OCT 17	02

Ref. no. APP_13.06_2.2

Scale @ A3 1:80,000 DO NOT SCALE

Figure 2.2 | Status FINAL | Project no. 60PO8077



Legend

- Wylfa Newydd Development Area Boundary
- Block 2 waypoints
- Block 2 transects
- The North Anglesey Marine / Gogledd Môn Forol cSAC

JACOBS

1st Floor, Kenneth Dibben House, Enterprise Road
Southampton Science Park, Southampton, SO16 7NS, UK
Tel: +44(0)2380111250 Fax: +44(0)2380111251
http://www.jacobs.com

Client: HORIZON NUCLEAR POWER

Project: WYLFA NEWYDD PROJECT

Drawing title: Vessel transects surverys - Block 2

Drawn by	Check'd by	Rev'd by	Appr'd by	Date	Rev.
VG	KW	RW	RB	OCT 17	02

Ref. no. APP_13.06_2.3

Scale @ A3 1:85,000 DO NOT SCALE

Figure 2.3 | Status **FINAL** | Project no. 60PO8077

The survey methodology involved two surveyors carrying out observations on either side of the boat (one on port and one on starboard). A distance of 500 m split into Bands A-E was observed from each side of the boat (known as the buffer), Bands A to E are described below:

- Band A: 0 – 50 m
- Band B: 50 m – 100 m
- Band C: 100 m – 200 m
- Band D: 200 m – 300 m
- Band E: >300 m (up to 500 m only).

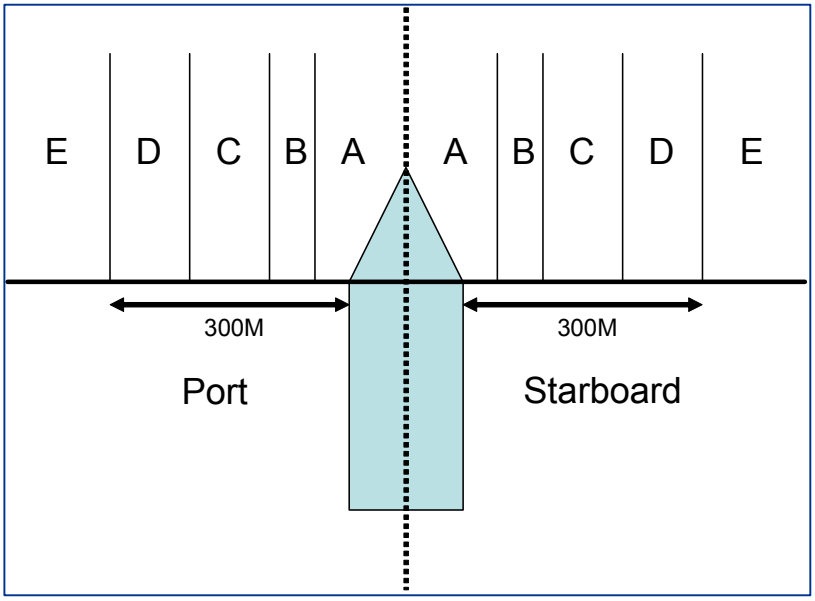


Figure 2.4: Illustration of observation methodology utilising European Seabirds at Sea methodology.

All marine mammals observed were assigned to a distance band, marine mammals located beyond 500 m were considered out of the transect (recorded as an incidental/casual record) and therefore not included in any subsequent analysis. The information was recorded by a scribe (seated in between port and starboard observers). Recorded on the data sheet was:

- date and time;
- port/starboard;
- species;
- number and age of individuals;
- distance Band;
- behaviour (e.g. travelling/bobbing/feeding);
- direction heading;
- weather (including sea state, glare, precipitation and cloud cover); and
- GPS location of vessel.

Survey effort (displayed in table 2.2), in terms of area surveyed, differed between months with highest effort in June 2016 (229.15 km^2) and lowest in December 2016 (36.59 km^2). Differences are owing to sampling intensity and changeable weather conditions.

Table 2.3: Date and area surveyed during boat based surveys (May 2016 to July 2017 inclusive). May 2016 to September 2016 inclusive Blocks 1 and 2 were surveyed. October 2016 onwards Block 1 was surveyed (Figure 2.2 and Figure 2.3).

Date	Area surveyed per day (km^2)	Area surveyed per month (km^2)
26/05/2016	64.27	97.05
27/05/2016	32.77	
16/06/2016	64.20	229.15
17/06/2016	46.11	
28/06/2016	86.75	
29/06/2016	32.27	
19/07/2016	87.63	120.26
20/07/2016	32.63	
17/08/2016	32.26	120.01
18/08/2016	87.75	
21/09/2016	87.42	129.73
22/09/2016	42.31	
20/10/2016	75.53	
29/11/2016	77.64	
20/12/2016	36.59	36.59*
18/01/2017	34.31	76.94
19/01/2017	42.63	
17/02/2017	58.25	
06/04/2017	76.86	
12/05/2017	55.59	
09/07/2017	78.38	

**reduced number of transect lines surveyed*

Where sufficient sighting numbers were reported (at least 60 to 80 observations) (Buckland *et al*., 2007), density and abundance estimations using the dedicated MMO data between September 2016 to July 2017 within Block 1 were calculated. In order to estimate these values, the programme DISTANCE 6.0 (RELEASE 2 [patched]) was used to fit the half-normal cosine model to the data, chosen for having the lowest Akaike's Information Criterion (AIC). The model applied corrected the data for both sea state and distance of the sightings from the surveyors. The data was pooled together for all months and transects in order to improve precision (Barlow *et al.,* 2001) and to satisfy the requirements of DISTANCE to stratify the data. The output gave global values of density and abundance.

The actual distance of the mammal perpendicular to the observer, within a search effort area of 0-500 m, was used for the calculations. As per the methodology of Shucksmith *et al.* (2009), the general recommendation that truncation of 5-10% of the largest perpendicular distance should occur in order to remove extreme observations or outliers (Buckland *et al*., 2001), the data have been truncated at 400 m, removing 10.81% of observations (the closest possible percentage to this method). These distances were then grouped by the following parameters:

- 0 m – 50 m;
- 50 m – 100 m;

- 100 m – 200 m;
- 200 m – 300 m; and
- 300 m – 400 m.

The data was then corrected for distance and sea state using the Multiple Covariates Distance Sampling (MCDS) engine which allows the addition of sea state as a covariate. Sea state was recorded using the Beaufort scale and ranged from 0-3.

For all calculations the cluster size was estimated using the mean of observed clusters after failing the test ($p = <0.05$) for the size-bias regression method. The calculations were made for both of the following assumptions:

- That all animals were detected on the trackline ($g(0)$[13] = 1), which was the estimate made in the study by Borchers *et al*. (1998).
- That 50% of the harbour porpoises were missed on the trackline ($g(0) = 0.5$), which was estimated in the study by Kraus *et al*. (1983).

The second assumption is likely to be more relevant as it accounts for the likelihood that the animals may be submerged, they may move away from the vessel prior to detection, and that they could have been missed by the observer (Shucksmith *et al*., 2009).

2.3.2 Dedicated Vessel Transect Surveys – Passive Acoustic Monitoring

Passive Acoustic Monitoring (PAM) surveys were undertaken between November 2016 and July 2017 with PAM effort conducted concurrently with the visual bird and marine mammal transect surveys on four survey days (see table 2.2).

PAM allows for the detection of animals when they are vocalising under water. Dolphins and porpoises echolocate, which means that they emit a series of high frequency click sounds for orientation and foraging. These echolocation clicks can be detected by PAM equipment for dolphin and porpoise detection. The PAM surveys were designed for the detection of harbour porpoise and dolphin echolocation clicks and dolphin whistles. The harbour porpoise is typically detectable out to a maximum of around 300 m whereas dolphin species are detectable at much greater distances (1-2 km (however, detection rates vary with the environmental and survey conditions). The range at which detection occurs is also likely to vary depending on the direction that the animal is travelling and to what extent clicks are produced when the animal is facing towards the hydrophones. This would be a particular issue with harbour porpoise clicks as these are highly directional so an animal facing away from the hydrophone array will not be detected.

Whilst other species might be present in the region (e.g. the minke whale and seal species) these do not vocalise reliably enough to be detected by PAM analysis and so were not assessed here.

Underwater sound was detected by a hydrophone array and digitised with a 500 kHz sampling frequency (see Appendix B for specifications of PAM equipment). The sound was recorded in wav-format using the open source software PAMGuard[14] (Gillespie *et al.* 2008) and stored on the computer hard drive. GPS positional information was collected directly in PAMGuard during the PAM surveys and auxiliary data such as array configuration and detector settings were also collected. These data were stored in binary files.

Prevailing noise levels varied both within and between survey dates, differing by up to 16.9 dB between the minimum and maximum of the median Sound Pressure Levels (SPL) determined within a survey (table 2.4). It is important to note that higher levels of prevailing noise have the potential to affect the detectability of harbour porpoise.

[13] g(0) is the probability of detecting something on the trackline, i.e. if g(0) = 1 this assumes nothing along the trackline is missed
[14] www.pamguard.org

Table 2.4 : Median SPL levels (rms SPL dB re 1µPa) per survey day. Given are the minimum, median and maximum values.

Date	Minimum	Median	Maximum
29/11/2016	94.5	105.9	111.4
20/12/2016	100.9	101.9	104.3
18/01/2017	104.4	107.5	109.2
17/02/2017	105.4	106.3	108.9
06/04/2017	104.9	107.7	112.8
12/05/2017	107.8	110.3	116.7

2.3.2.1 PAM analysis

Following the surveys, the sound files were processed using PAMGuard (version 1.15.11 CORE, 64 bit) in order to detect the sounds of harbour porpoises and dolphins. Specifically, in each sound file, the contents were analysed to detect the presence of harbour porpoise and dolphin click sounds, to detect dolphin whistles and to determine noise levels. This process is described in the following sections.

Detection of clicks

The click detector module of PAMGuard was used to filter out frequencies below 10 kHz and to detect and store sound snippets that include potential echolocation clicks. These sound snippets were then processed by specific classifiers for the detection of echolocation clicks.

Harbour porpoise echolocation clicks are short high frequency narrow band clicks. Their main energy is in a frequency range of 130 kHz with no energy below 100 kHz (Figure 2.5). The PAMGuard porpoise click classifier compared the energy in the frequency range of the porpoise click (test band) to energy in two frequency ranges in which a porpoise click does not contain any energy (control bands). For a click to be categorised as a harbour porpoise click, its frequency spectrum needed to be as such that the energy in the test band exceeded that in any of the control bands by a set amount.

Classified clicks were visually inspected for true harbour porpoise detections. Any clicks classified as harbour porpoise not showing a clear frequency spectrum and/or waveform of a harbour porpoise click or not being within a tracked click train were considered as false alarms.

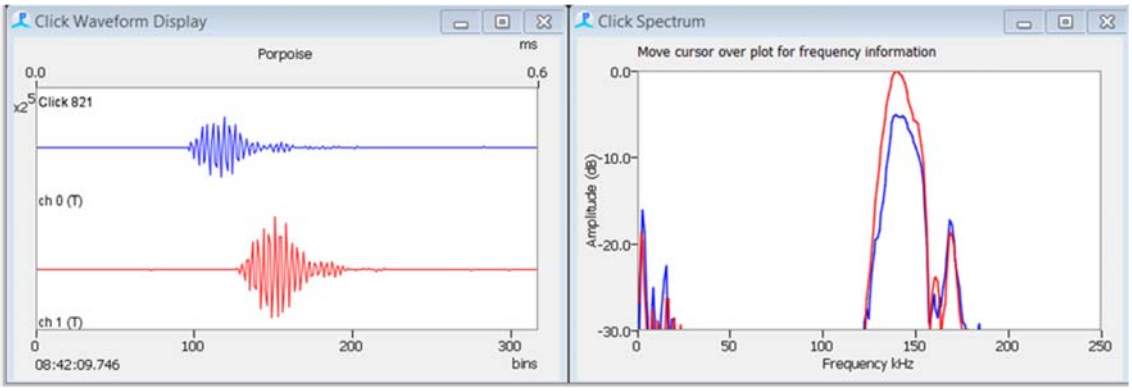


Figure 2.5 : Harbour porpoise echolocation click as presented by the PAMGuard software. Left: Waveform of an echolocation click on the two hydrophones of the PAM array. Right: Frequency spectrum of the clicks presented in the left display, colour-coded by hydrophone.

Dolphin echolocation clicks are very short high frequency clicks. The frequency band with main energy is very variable and can be distributed over a wide band or a narrow band from below 20 kHz to above 100 kHz. A

second PAMGuard click classifier was set to detect dolphin clicks with the default settings. However, in order to ensure that no dolphin clicks were missed by the classifier, all unclassified click detections were visually inspected for dolphin detections.

The waveform and frequency spectrum of dolphin clicks does not allow for the detection of dolphin encounters on the dolphin click's waveform and frequency spectrum alone. Therefore, the following criteria were used for the inspection of all click detections for dolphin encounters:

- A series of clicks must have been tracked by the hydrophone array.
- Amplitude of successive clicks show a gradual increase and decrease.

Given both of these criteria applied, the waveform, frequency spectrum and click interval were used to determine if a series of clicks was a true dolphin detection.

Allocation of events based on click detection

Dolphins and harbour porpoise emit series of clicks for echolocation (click train) with a spacing from one up to a few hundred milliseconds in-between successive clicks. Successive clicks of a click train generally show a gradual increase and decrease in click amplitude when recorded. Recording of a click train by more than one hydrophone in a towed array allows the clicking animal to be located.

Using the spacing between the two hydrophones, PAMGuard calculates the bearing of the vocalising animal relative to the hydrophone array (e.g. 0° = ahead of the array; 90° = perpendicular to the array, 180° = behind the array). Often, as the vessel passes by an echolocating animal, the track of clicks is clearly visible as a 'click train' (e.g. Figure 2.6). Based on the changing bearing of clicks over time, the number of animals detected can be estimated (a minimum, maximum and best estimate) and best estimate detection rates have been calculated (see Appendix B) for all detections).

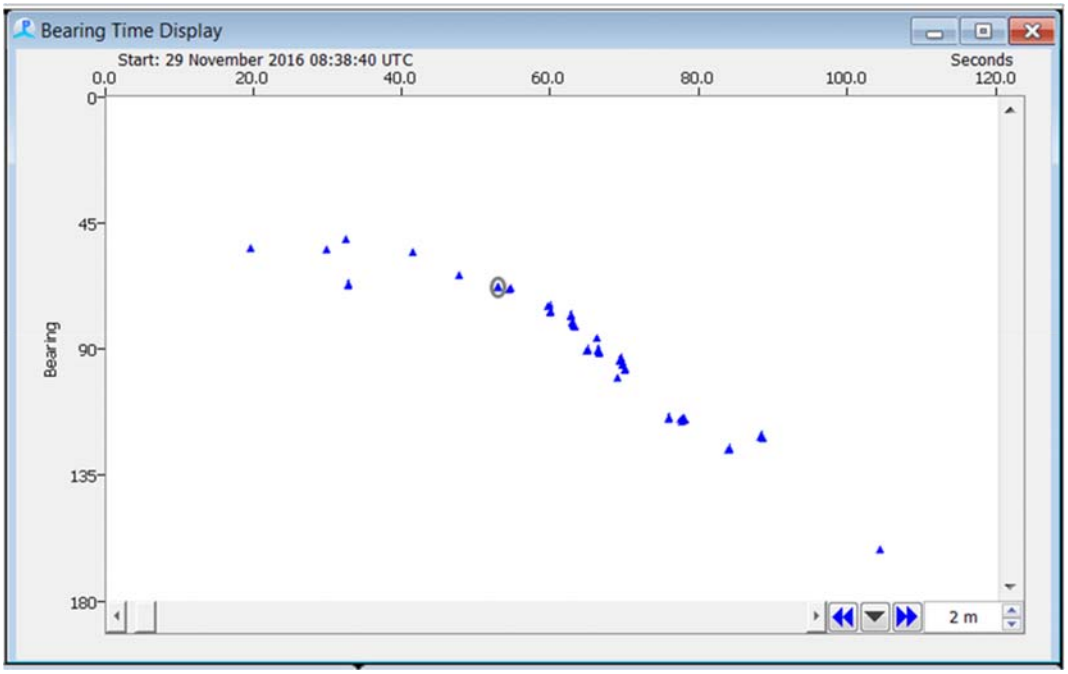


Figure 2.6 : Echolocation click train of a harbour porpoise captured at different bearings to the hydrophone array over a two-minute period.

Dolphin whistle detection

For the detection of whistles, the sound files were down-sampled from 500 kHz to 96 kHz sampling rate, as whistles are in the frequency range covered by this sampling rate. The sound was then fed into the PAMGuard module whistle and moan detector, which uses the spectrogram to search the audio data for tonal sound with the potential of being dolphin whistles. Detections were then visually inspected for dolphin whistles.

Noise levels

Noise levels were visually inspected and analysed to determine the quality of the PAM recordings, as these influence the detection range as well as the performance of the dolphin and porpoise classifiers. Only clicks with a sound energy above the prevailing noise levels were stored by the click detector and considered for further analysis (i.e. classified). Sound files were processed by the PAMGuard module "Filtered Noise", and only sound above 10 kHz was considered to match the sound processed by the click detector. As a measure of the noise level, the root-mean-square (RMS) sound pressure level (SPL) over a period of 10 milliseconds was calculated.

2.3.3 Survey effort

To determine detection rates, the survey effort ('whole survey effort' and 'per transect effort') was determined. When the vessel was on a transect, recordings were treated as 'on-effort'. When the vessel was turning, the hydrophone would be closer to the propeller and engine which would substantially increase the noise levels and likely affect PAM performance so these periods were removed from analysis and were considered to be "off effort".

Not all transect lines were completed on each survey day owing to deteriorating weather conditions. The surveys undertaken on the 19 January and 9 July 2017, no PAM data was available owing to a fault with the equipment. Details of the transect lines completed and the associated survey effort for PAM are presented in Section 3.2.3.4 and Appendix B (harbour porpoise detections) and Section 3.5 (dolphin detections).

2.3.4 Site-Specific C-POD surveys

A total of three C-PODs (autonomous underwater noise cetacean click detector) were deployed at three sites within the Wylfa Newydd Development Area and surrounding Study Area (labelled 1BE, 2BC and 3BW in Figure 1.1). The C-PODs were deployed using subsurface mounted moorings in water depths of approximately 20 m and located approximately 2 m above the seabed. Two C-PODs were deployed in the vicinity of Porth-y-pistyll and Cemlyn Bay with the third located to the west of Wylfa Head. Data was collected and analysed for harbour porpoise and dolphin detections as per Ocean Science Consulting (OSC) (2017) report (Appendix C). Following an acoustic release failure on the C-POD located at Site 3BE (Wylfa Head) in June and July 2017 a reduced number of survey days were logged for this site and therefore a reduced number of Detection Positive Minutes (DPM) recorded.

The purpose of these surveys was to augment existing marine mammal data and to provide additional understanding of area usage.

2.3.5 Dedicated Vantage Point Surveys

Site-specific land-based visual Vantage Point (VP) surveys were undertaken for marine birds and mammals with full methods described in appendix D13-7 (seabirds baseline report) (Application Reference Number 6.4.89). Dedicated surveys were conducted by trained MMOs that have undertaken a JNCC MMO course. These surveys were undertaken at four VP locations (Figure 2.5 and Appendix A), forming a total survey area of 3.57 km^2. The purpose of these surveys was to characterise the baseline environment and to determine which species of bird and marine mammal are present in the area.

It is common practice to record seabird and marine mammal sightings concurrently however, in coastal areas, seabird densities can be quite high which may result in an underestimation of marine mammal sightings (e.g. Sparling *et al*., 2011, Macleod *et al*., 2011). Owing to the nature of the sighting records, these sightings data have not been corrected for animals missed during the survey (typically achieved via distance sampling; e.g.

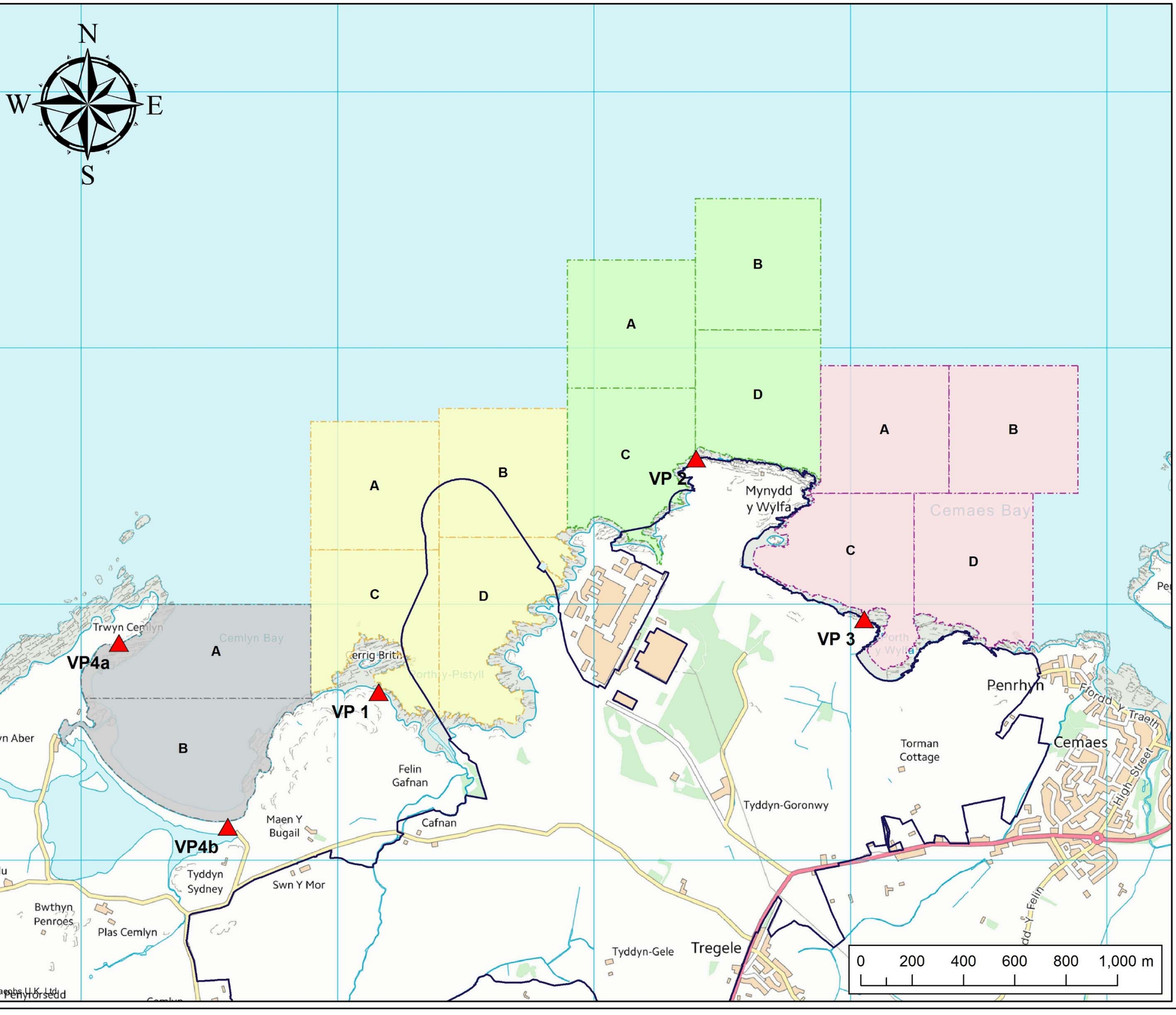
Buckland *et al*., 2005). This means that absolute density and abundance estimates cannot be calculated and so are not presented in this report.

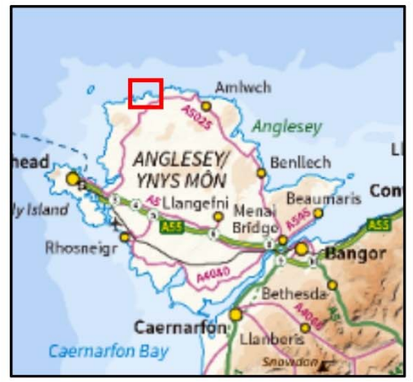
During the analysis phase, the areas for VP1, VP2 and VP3 were subsequently divided into four sectors (A-D), and VP4 was divided into two sectors (A and B) and surveyed from two different vantage points, in order to provide more detail on the location of certain species within each VP (Figure 2.4).

VP surveys were undertaken for a pre-determined length of time (between 30 minutes and three hours) and were sub-divided into 15-minute sections during the analysis phase. Surveys ran between January 2011 to September 2013 (inclusive) and April 2014 to September 2014 (inclusive). For reasons detailed in appendix D13-7 (Application Reference Number 6.4.89), the highest number of observational hours recorded was during the spring and summer months (between May and July). Each mammal sighted was recorded in the following way:

- position within a sector (A-D) of each VP location (1-4);
- common name of species;
- number of individuals sighted;
- estimated age, e.g. adult/calf; and
- sea state.

Land-based survey efforts were carried out within 1 km of the coast and yielded 1,746 hours of effort across the four-year monitoring programme. Where sighting records were more than 90 individuals, sightings rates per unit effort for the marine mammal encountered were calculated from the land-based survey data.





Legend

- Wylfa Newydd Development Area
- Vantage Points
- Survey Area 1
- Survey Area 2
- Survey Area 3
- Survey Area 4

Total area surveyed: 3.57 km^2

JACOBS
1st Floor, Kenneth Dibben House, Enterprise Road
Southampton Science Park, Southampon, SO16 7NS, UK
Tel: +44(0)2380111250 Fax: +44(0)2380111251
http://www.jacobs.com

Client: HORIZON NUCLEAR POWER

Project: WYLFA NEWYDD PROJECT

Drawing title: Location of Vantage Points (VP) and survey sectors

Drawn by	Check'd by	Rev'd by	Appr'd by	Date	Rev.
VG	KW	RW	RB	OCT 17	02

Ref. no. APP_13.06_2.7

Scale @ A3 1:14,000 DO NOT SCALE

Figure 2.7 | Status FINAL | Project no. 60PO8032

2.3.6 Site-Specific Land-Based Seal Surveys

Land-based seal surveys were undertaken along the north Anglesey coastline within the vicinity of Cemlyn Bay and Cemaes Bay between 30 October 2016 and 25 January 2017. Survey methods were adapted from Sayer (2012), Westcott (2008) both cited in Marine Ecological Solutions (MES) (2017) (Appendix C) and informed by Westcott and Stringell (2004). A total of twelve sites were visited on a regular basis over the three-month period. Further and more detailed methodology is described within MES (2017) report Appendix C.

The purpose of these surveys was to investigate potential pupping sites during the expected grey seal breeding season as well as potential haul-out sites along the north Anglesey coast. Casual records of all marine mammals were also noted throughout the survey period with each record recording the following information:

- date and time;
- location;
- species and age;
- behaviour; and
- number.

2.3.7 Incidental/Casual Sightings

This section summarises two other data-types – henceforth described as incidental sighting and casual sightings. A brief description for each is provided below.

Incidental sightings of all marine mammals around the north coast of Anglesey have primarily been recorded during other boat-based surveys (primarily conducted for fish, plankton and benthic surveys) since April 2010 with each incidental sighting recording the following information:

- date and time;
- approximate position using GPS (usually within 100 m);
- species (where possible);
- number of individuals;
- approximate age-class (i.e. adult/juvenile/calf or pup); and
- behaviour (i.e. hauled-out, travelling, feeding, spy hopping/bobbing).

Information regarding sea state or weather conditions were not recorded during these surveys. The number of boat-based survey days during which a marine mammal could have been sighted incidentally are illustrated in table 2.3

Casual sightings are those made typically without a measure of how much survey effort was expended in observations. These records collected over extended periods of time can be valuable for identifying species occurring in the region and can provide information on what marine mammal species are present in the area of interest. They can also provide an indication of a species' approximate distribution and relative seasonality, although the information is potentially biased and uncorrected for effort and observer experience. The SWF database provides a large collection of reported marine mammal sightings from combined opportunistic/casual sightings and effort-related sightings.

Table 2.3: Total number of marine boat-based surveys (in days) that occurred between 2010 and 2014, during which incidental sightings of marine mammals could have been recorded.

Month	2010	2011	2012	2013	2014
January	-	2	1	-	-
February	-	5	7	5	5

Month	2010	2011	2012	2013	2014
March	-	1	2	1	1
April	2	6	2	3	3
May	4	5	5	3	3
June	6	6	9	1	7
July	7	6	3	3	3
August	15	2	4	4	1
September	2	2	1	1	3
October	4	2	3	1	1
November	4	7	2	4	4
December	2	-	-	-	-
Total number of days	**46**	**44**	**39**	**26**	**31**

A number of walkover, boat and other land-based surveys also took place whereby presence of marine mammals were recorded. For these types of surveys, only approximate location (in terms of National Grid Reference and distance from shore), species and approximate number of individuals were noted. As with the boat-based surveys, no information on sea state or weather conditions was recorded.

3. Cetacean Baseline

3.1 Overview

The SWF database has reported a total of 18 species of cetacean in the Irish Sea since 1990, 14 of which have been sighted within the last 10 years (table 3.1) (Evans *et al*., 2015a).

Table 3.1: SWF sightings records for the Irish Sea between 2004 and 2014 (Evans *et al*., 2015a) listed in order of total number of individuals.

Common name	Scientific name	Number of records	Percentage of total records	Number of individuals	Percentage of total individuals
Bottlenose dolphin	*Tursiops truncatus*	6041	42.7	33,174	55.16
Harbour porpoise	*Phocoena phocoena*	5872	41.5	18,285	30.4
Risso's dolphin	*Grampus griseus*	845	6.0	3976	6.6
Short-beaked common dolphin	*Delphinus delphis*	289	2.0	2422	4.1
Minke whale	*Balaenoptera acutorostrata*	718	5.1	1157	1.9
Killer whale	*Orcinus orca*	43	0.3	88	0.15
Humpback whale	*Megaptera novaeangliae*	21	0.1	22	<0.1
Fin whale	*Balaenoptera physalus*	11	0.08	22	<0.1
Atlantic white-sided dolphin	*Lagenorhynchus acutus*	3	0.02	17	<0.1
Long-finned pilot whale	*Globicephala melas*	3	0.02	12	<0.1
Northern bottlenose whale	*Hyperoodon ampullatus*	1	<0.1	3	<0.1
White-beaked dolphin	*Lagenorhynchus albirostris*	1	<0.1	1	<0.1
Sei whale	*Balaenoptera borealis*	1	<0.1	1	<0.1
Pygmy sperm whale	*Kogia breviceps*	1	<0.1	1	<0.1
Unidentified dolphin species		148	1.0	657	1.1
Unidentified cetacean species		127	0.9	273	0.45
Unidentified large whale species		26	0.2	35	<0.1
Unidentified whale species		2	0.014	1	<0.1
Unidentified small whale species		1	<0.1	1	<0.1

A number of species recorded in the Irish Sea (incorporating the Irish Sea MU (IS MU)) are termed by SWF as occasional visitors, with five species (harbour porpoise, bottlenose dolphin, Risso's dolphin, minke whale and the short-beaked common dolphin) recorded as regularly occurring; the former three being the most frequently observed (Evans *et al*., 2015a). Minke whale and the short-beaked common dolphin are termed by SWF as summer visitors to the Irish Sea and generally occupy the offshore Celtic Deep area. The minke whale is most common in the St George's Channel and towards the Isle of Man, whilst the short-beaked common dolphin is

found centred at the southern end of the Irish Sea with the highest densities extending eastwards towards the coast and the islands of west Pembrokeshire (Baines and Evans, 2012; Evans *et al*., 2015a).

Marine mammal species recorded around the north coast of Anglesey during the vessel and VP surveys include the harbour porpoise, bottlenose dolphin and the Risso's dolphin; therefore these are the species under consideration within this review.

The minke whale and the common dolphin are found more commonly in the offshore and southern parts of the Celtic and Irish Sea. These species are not considered further in this report for the following reasons:

- Only two sightings of a baleen whale species (possibly minke whale) and no sightings of common dolphin were recorded during the dedicated vessel transect surveys or VP surveys; and
- both species comprise of less than 5% of the total number reported by Evans *et al*. (2015a.

For the three cetacean species of interest, IAMMWG (2015b) defined the following areas as MUs:

- harbour porpoise – Celtic and Irish Sea (CIS);
- bottlenose dolphin – Irish Sea (IS); and
- Risso's dolphin – Celtic and Greater North Seas (CGNS).

The intention of the following sections is to present information on the three most commonly observed cetacean species off north Anglesey: the harbour porpoise, the bottlenose dolphin and the Risso's dolphin. Each species section will provide general species information, information on their abundance and distribution within the Irish Sea and specifically off north Anglesey. The data within each section has been presented in such a way so that the most reliable data sources are detailed first.

3.2 Harbour Porpoise

In the UK, harbour porpoise is considered to have a Favourable conservation status (JNCC, 2007). In Wales the harbour porpoise is a species of "*principal importance for the purpose of conserving biodiversity*" on the interim list currently under Section 7 of the Environment (Wales) Act (2016). In order to conserve biodiversity, by maintaining or restoring Annex II species to a favourable conservation status, the Habitats Directive requires the designation of SACs for these species; this includes the harbour porpoise. As such, in 2016 five candidate SACs (cSACs) for harbour porpoise were proposed in England, Northern Ireland and Wales. This includes four cSACs in the CIS MU.

Of key importance for harbour porpoise, is the fact that the Wylfa Newydd Development Area (Wylfa Newydd Development Area) is located within the North Anglesey Marine cSAC. This site was selected, based on the Heinänen and Skov (2015) modelling and persistence analyses which identified the north Anglesey area as being one of the top 10% persistent high density areas for harbour porpoise in UK waters during the summer season. The Heinänen and Skov (2015) analysis estimated that 1,084 individuals (95% Confidence Interval: 557 – 2,111) are supported in the north Anglesey area for at least part of the year, which represents approximately 1.04% of the estimated abundance of porpoise in the entire CIS MU and 2.3% of the abundance of porpoise in the UK Exclusive Economic Zone (EEZ) portion of this MU.

The Conservation Objectives for the North Anglesey Marine cSAC are summarised by JNCC (2016) as follows:

"*To avoid deterioration of the habitats of the harbour porpoise or significant disturbance to the harbour porpoise, thus ensuring that the integrity of the site is maintained and the site makes an appropriate contribution to maintaining Favourable Conservation Status (FCS) for the UK harbour porpoise. To ensure for harbour porpoise that, subject to natural change, the following attributes are maintained or restored in the long term:*

1) the species is a viable component of the site;

2) there is no significant disturbance of the species; and

3) *the supporting habitats and processes relevant to harbour porpoises and their prey are maintained.*

Therefore, activities within the site should be managed to ensure access [for harbour porpoise] *to the site. Any disturbance should not lead to the exclusion of harbour porpoise from a significant portion of the site for a significant period of time".*

3.2.1 General Species Information

Harbour porpoise in the UK are present year round and areas of relatively high density have largely persisted across three decades (Baines and Evans, 2012). The harbour porpoise is a small cetacean that must feed regularly in order to fulfil their energetic requirements. They are known to be relatively short-lived (maximum of 24 years) and are highly mobile and wide-ranging individuals (Evans and Prior, 2012).

Studies have shown that the distribution of harbour porpoises is directly influenced by the distribution of prey (e.g. Read and Westgate, 1997; Herr *et al*., 2009; Sveegaard, 2011 all cited in Jones *et al*., 2013) as well as being indirectly affected by environmental variables that influence prey distribution or foraging efficiency. Harbour porpoise are known to feed on a variety of fish species including flounder (*Platichthys flesus*), herring (*Clupea harengus*), sandeel (Ammodytidae), sprat (*Sprattus sprattus*), sole (*Solea solea*) and whiting (*Merlangius merlangus*), as well as a variety of cephalopods and crustaceans (Evans and Baines, 2010). Higher acoustic activity of harbour porpoise at night could be directly linked to their food resource (Gordon *et al*., 2011).

3.2.2 Presence in the Irish Sea

The harbour porpoise is the most widely distributed cetacean found in the Irish Sea (Evans *et al*., 2015a). Harbour porpoise abundance within the CIS MU has been estimated as 104,695 individuals (CV: 0.32; 95% Confidence Intervals: 56,774-193,065; IAMMWG (2015b) using data sourced from Hammond *et al.* (2013) and Macleod *et al*. (2009). Population estimate of the Irish Sea (SCANS II, survey block O) for harbour porpoise was 15,230 individuals (CV = 0.35) with a density equivalent of 0.34 individuals km^{-2} (Hammond *et al*., 2013).

The harbour porpoise is not evenly distributed within the Irish Sea. Heinänen and Skov (2015) modelled 18 years of survey data from the Joint Cetacean Protocol data alongside environmental covariates to predict harbour porpoise density across the entire Irish Sea region. These models found persistent high-density areas of the north coast of Wales (Pembrokeshire and Cardigan Bay), northwest Wales (Anglesey, Lleyn Peninsula) and part of the Bristol Channel (Carmarthen Bay) (Figure 3.1).

Heinänen and Skov (2015) found that harbour porpoise density in the CIS MU during the summer was best explained by their available covariate data on:

- water depth;
- surface sediments;
- current speed eddy potential; and
- number of ships.

During the winter, harbour porpoise density was best explained by the covariates:

- water depth;
- current speed; and
- some influence from surface salinity

However, it should be noted that there were fewer survey data available with which to build winter models.

The densities off the north coast of Anglesey were predicted by Heinänen and Skov (2015) to be higher in the summer months with predicted 2003 densities reaching >3 porpoise km^{-2} (proportional model SE 0.2-0.3), while winter densities were lower, reaching 0.3-0.6 km^{-2} in 2004 (Figure 3.1).

It should be noted that the high densities in the summer months in 2003 off the north coast of Anglesey are not observed in the data for 2009 where the predicted density off north Anglesey reached only 1.8-2.1 km^{-2} (proportional model SE 0.2-0.3) off Carmel Head.

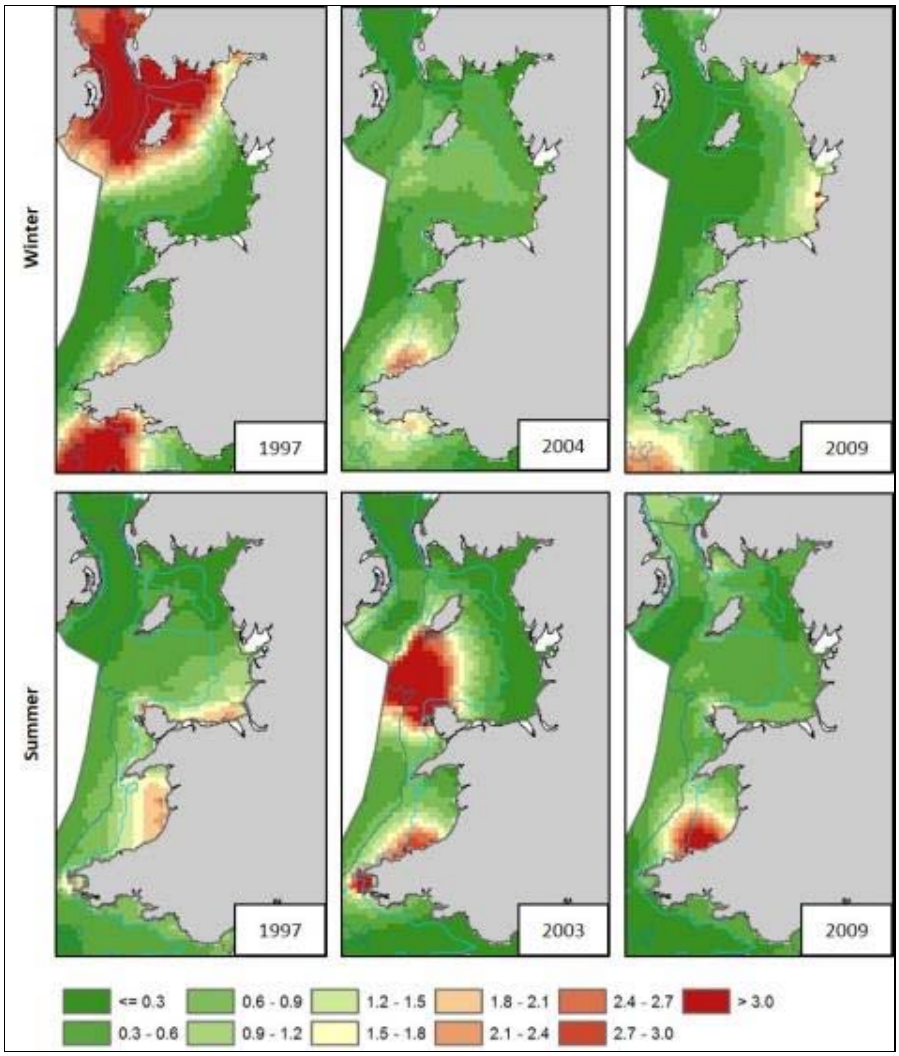


Figure 3.1 : Predicted densities of harbour porpoise (number km^{-2}) in the Celtic and Irish Sea MU during winter and summer (Heinänen and Skov, 2015).

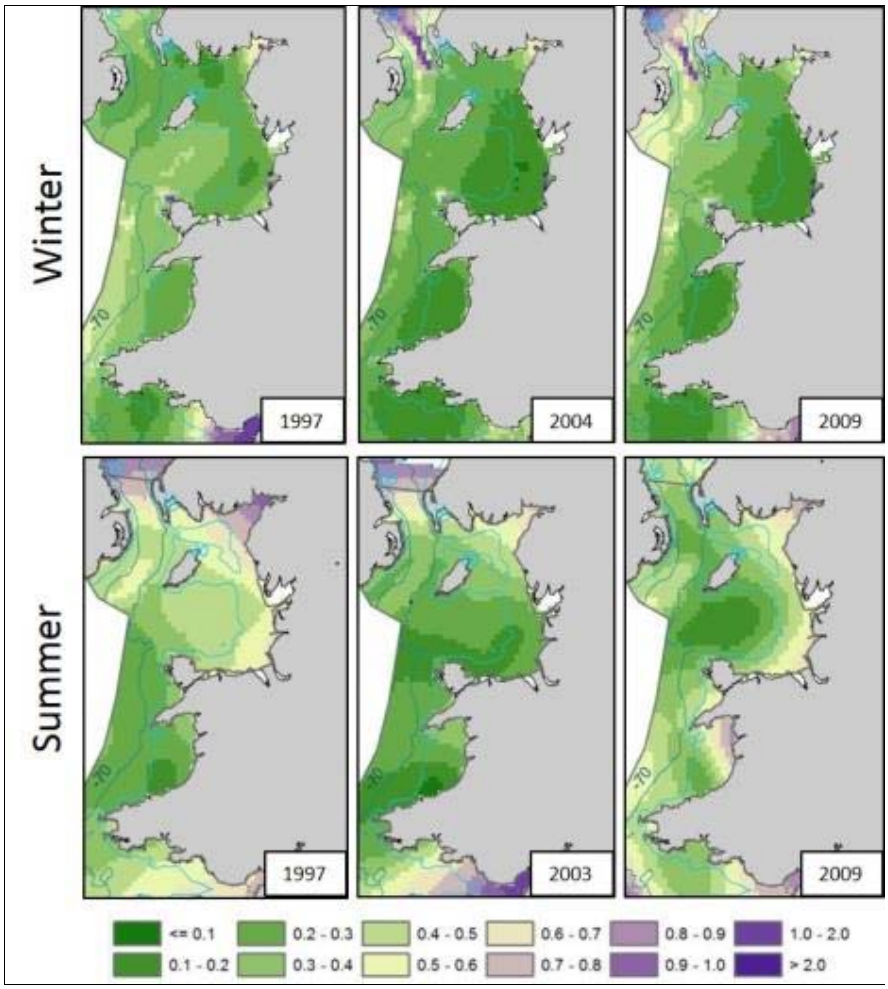


Figure 3.2 : Proportional model standard errors (SE/density) for harbour porpoise density estimates in the Celtic and Irish Sea MU during winter and summer (Heinänen and Skov, 2015).

Hot spots of harbour porpoise presence located around the northwest and north coast of Anglesey have been identified from both effort-based and incidental/casual sightings reported in Evans and Prior (2012) and Evans, *et al*. (2015a) (Appendix A: A.1; Figure A.1 (bottom)). Higher densities exist north to the Isle of Man and off the west coast of the Lleyn Peninsula southwards into Cardigan Bay (Appendix A: A.1; Figure A.1 (top)).

High densities are also apparent within St Brides Bay, Pembrokeshire; Swansea Bay; and the River Loughor, off Llanelli (Figure 3.3 and Figure 3.4). The data obtained from the interpolated map of harbour porpoise distribution in the Irish Sea (Baines and Evans, 2012; Figure 3.4) shows that harbour porpoise occurrence along the north Anglesey coast ranges between 0.1-1 counts km^{-1}. Data obtained from effort-based and incidental/casual sightings of harbour porpoise in the Irish Sea also shows a peak during the summer months (in particular June to August) (Evans *et al*., 2015a; Appendix A: A.1; Figure A.2), though it is likely this may be as a result of increased incidental/casual sightings in these months.

Since the 1980s dedicated cetacean effort-based watches have occurred from a number of land-based sites around the UK. These data have been reported to the SWF and collated to produce a database of effort-related sightings. Using these data, Evans, *et al*. (2015b) reported high count rates of harbour porpoise (three to five individuals hr^{-1}) from land-based surveys at North Stack (>50 hours of effort), Llanbadrig (>350 hours of effort) and Point Lynas (>2,000 hours of effort) on the Anglesey coast. Elsewhere along the Anglesey coast, between North Stack and Point Lynas, between one and three individuals hr^{-1} were recorded and along the east side of Anglesey and northeast mainland coast of Wales, less than one individual hr^{-1} was recorded (Evans *et al.*, 2015b).

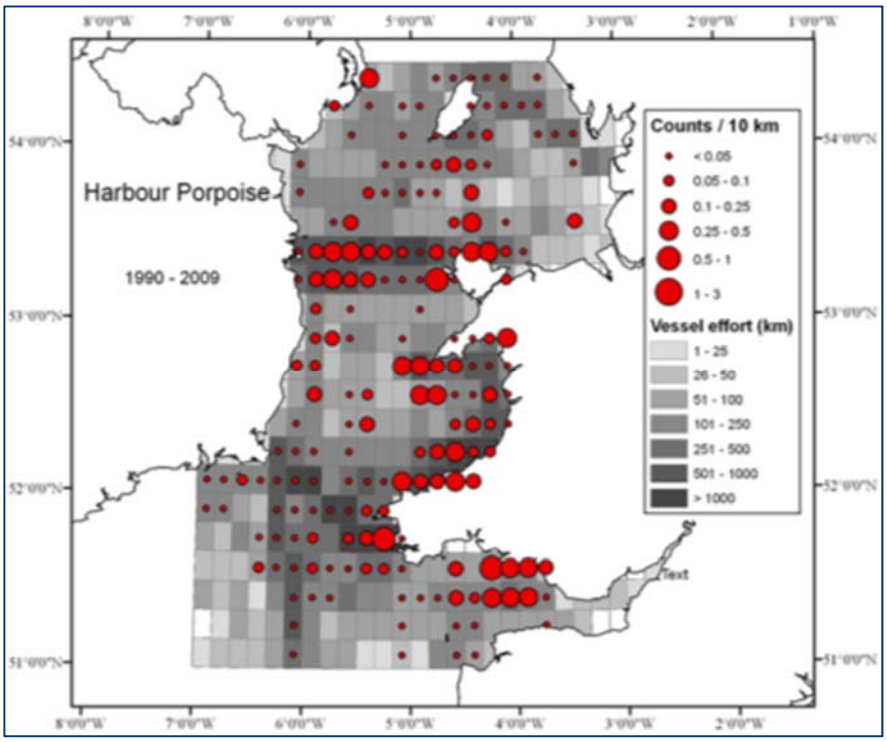


Figure 3.3: Distribution of harbour porpoise corrected for survey effort in the Irish Sea (taken from Baines and Evans, 2012).

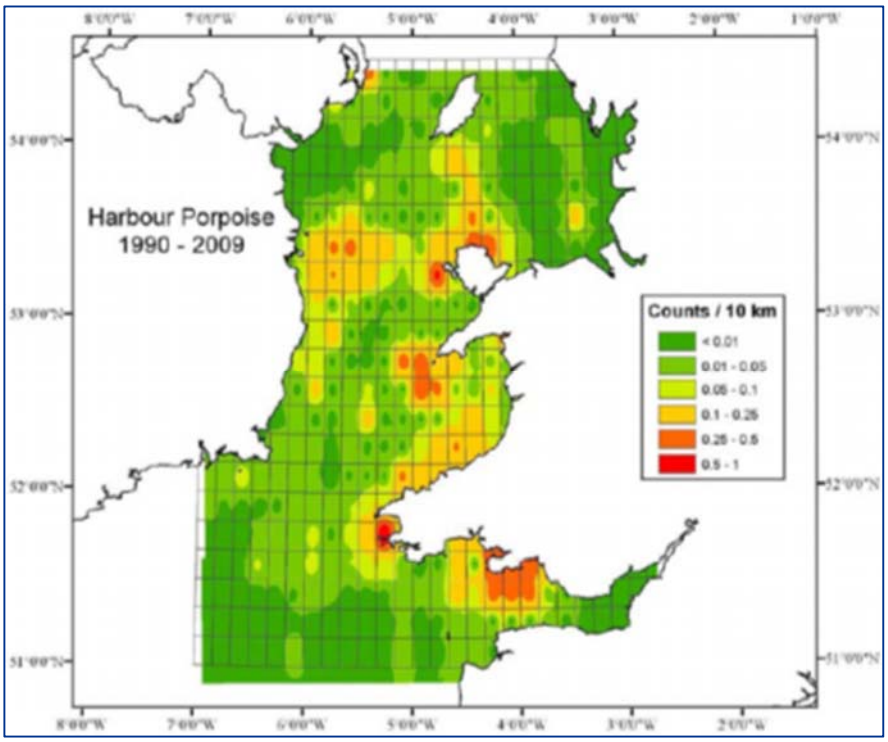


Figure 3.4 : Interpolated map of harbour porpoise distribution in the Irish Sea (taken from Baines and Evans, 2012).

3.2.3 Presence off North Anglesey

3.2.3.1 Shucksmith *et al*., 2009 Harbour Porpoise Surveys

Shucksmith *et al*. (2009) undertook dedicated harbour porpoise surveys covering 31 transect lines each monitored at least once between May and September between 2002 and 2004 (Figure 2.1). This study yielded 213 sightings consisting of 347 individuals across the three years. The authors noted high variance in the encounter rate (85.1%) and suggested that this was likely due to the heterogeneity of the survey site.

Unfortunately, it was not possible to estimate g(0) in this study and so the authors used a g(0) value of 1 to estimate density. Shucksmith *et al*. (2009) estimated a density over the 489 km^2 area to be 0.63 individuals km^{-2} and an abundance of 309 individuals (CI 199-447), under the assumption that g(0) = 1. However, given that it is highly unrealistic to assume a g(0) of 1, the authors used other g(0) values to produce density and abundance estimates from these data. The Barlow (1988) g(0) estimate of 0.769 (approximately 23% of the animals on the trackline were missed) was applied to the data and resulted in a density estimate of 0.820 individuals km^{-2} and an abundance of 402 individuals (CI 260-576). The Kraus *et al*. (1983) estimate for g(0) was assumed to be the most applicable to the Shucksmith *et al*. (2009) dataset as it was obtained from a survey in which the observation platform height was approximately the same. This g(0) estimate of 0.5 (50% of the animals on the trackline were missed) was therefore applied to the dataset and resulted in a density estimate of 1.261 individuals km^{-2} and an abundance estimate of 618 individuals (CI 406-909).

Using the population size estimated by Hammond *et al*. (2013) cited in IAMMWG (2015b) of 104,695 animals, the population of harbour porpoise along the north coast of Anglesey, as calculated by Shucksmith *et al*. (2009) under the assumption of g(0) = 0.5, represents approximately 0.6% (0.4-0.9%) of the total CIS MU. It should be noted however, that this is a highly mobile species and so the individuals in the north Anglesey area are likely to be subject to high turnover, meaning that while the abundance in the area at any one time is estimated at 618, many more individuals could be at risk of impact over the duration of any construction work.

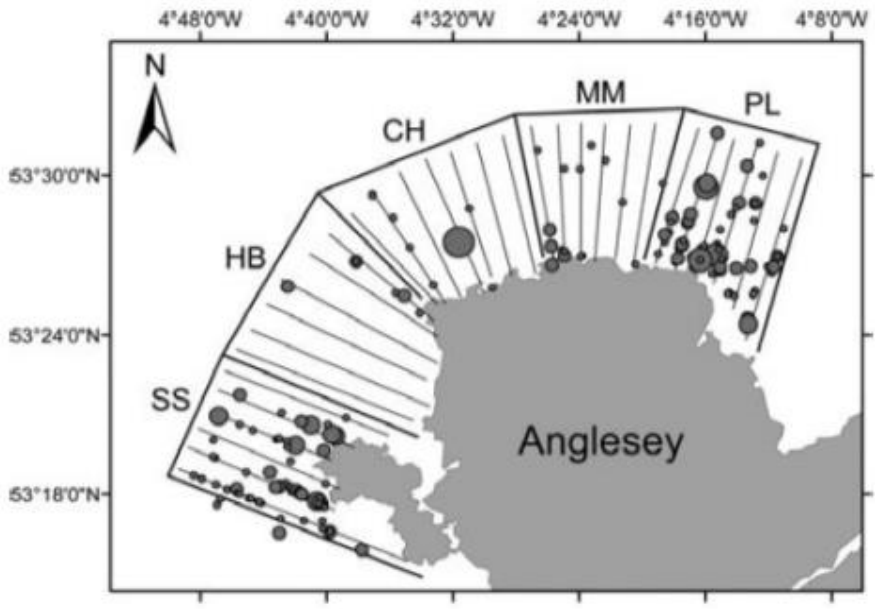


Figure 3.5 : Sightings of harbour porpoise and pods of harbour porpoise in each sector and distance from the coastline. Small circles represent individual sightings while the largest circle represents a pod size of 20 individuals with the majority of pod sizes being between one and five individuals. For abbreviations, see Figure 2.1: the harbour porpoise study area used by Shucksmith, *et al*. (2009) split into five sectors.

3.2.3.2 Gordon *et al*., 2011 Acoustic Surveys

In 2009, acoustic data were collected by Gordon *et al*. (2011) between The Skerries and Carmel Head using towed hydrophones and static T-PODs with the aim of collecting data at tidal rapid sites in Wales to assess the potential risks if tidal turbines were installed at these sites. Towed hydrophone surveys were conducted at The Skerries field site (Carmel Head and South Stacks) between 20 July 2009 and 13 August 2009 and five T-PODs were deployed between 21 July 2009 and 12 August 2009 (Figure 3.6). The towed hydrophone surveys at The Skerries provided an acoustic detection rate of 9.4 detections km^{-1}. From this, a density of 0.38 porpoise km^{-2} was estimated with an uncorrected g(0) and assuming a group size of 1.5 and an effective strip width of 186 m.

The static T-POD surveys showed that levels of porpoise activity varied between locations, with total DPM varying between 0.2% to 4.1% at the five Skerries T-POD locations (table 3.2). The highest rate of DPM was at T-POD 468 located between The Skerries and Carmel Head. It is important to note that both the towed hydrophone and static T-POD surveys were conducted between July and August in one year only and so may not be representative of porpoise presence at other times of the year.

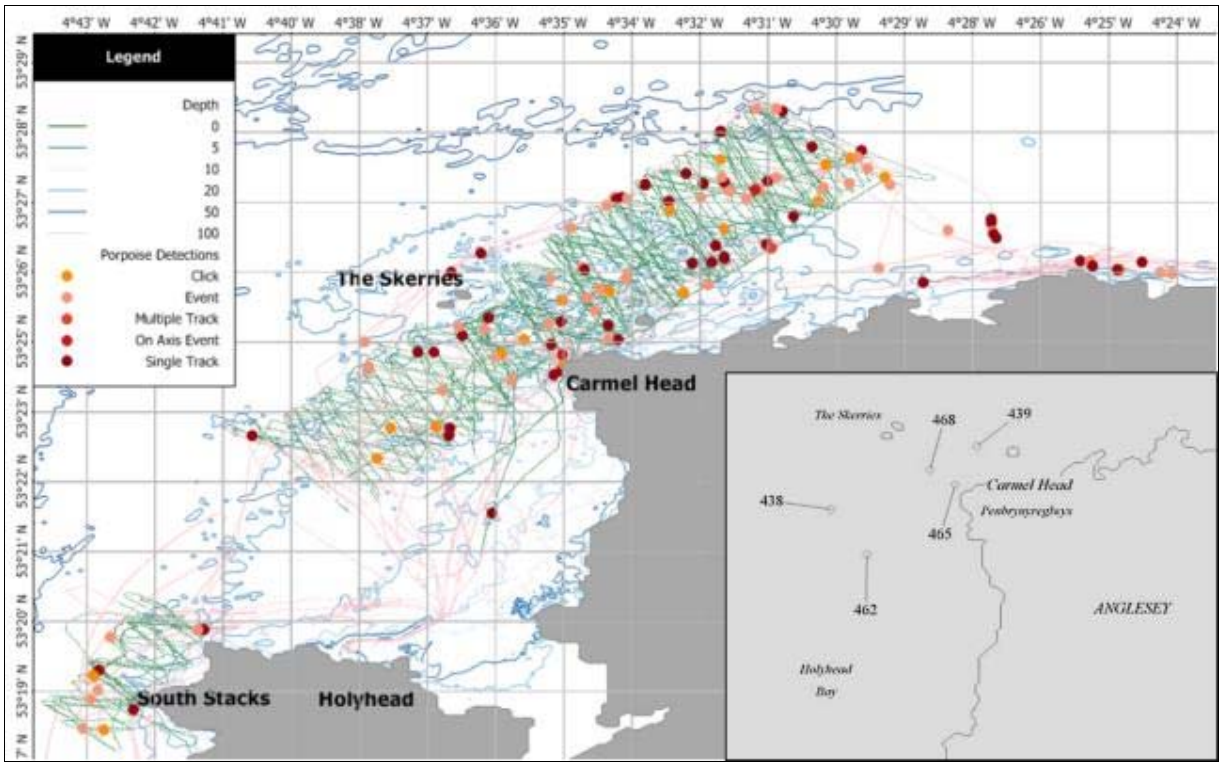


Figure 3.6: Locations of towed hydrophone acoustic detections and T-POD locations (inset) off The Skerries (Carmel Head and South Stacks) (Gordon et al., 2011).

Table 3.2: Summary of % DPM values, an index of harbour porpoise activity levels. Detection Positive Days (% DPD) is given as a measure of daily occurrence: the percentage of days on which porpoises were recorded at each location. Each T-POD has been ranked by median daily %DPM. Taken from Gordon *et al.* (2011).

The Skerries – T-POD	%DPD	Total %DPM	Median daily %DPM	Daily DPM% range	Rank
T438	100	1.4	1.25	0.35-4.43	2
T439	100	0.3	0.28	0.07-1.11	4
T462	71	0.2	0.07	0.00-0.56	5
T465	94	0.6	0.60	0.00-1.32	3
T468	100	4.1	4.24	1.11-7.92	1

3.2.3.3 SEACAMS (2015) Visual Vessel Based Surveys

A total of 39 individuals of harbour porpoise was reported by SEACAMS (2015) cited in Tethys (2018) in the west Anglesey area, corresponding to a rate of 1.88 sightings per hour. seems likely that the Holyhead Deep site is well-used by harbour porpoise, although relative densities suggest the site is not amongst the areas of highest importance in the Irish Sea.

3.2.3.4 Site-Specific Vessel Survey Data – MMO visual observations

Sightings records from the vessel transect survey days (table 2.2) yielded a total of 236 individual harbour porpoise from 166 sightings (Appendix D; table D.1) across Block 1 (May 2016-July 2017) and Block 2 (May 2016-October 2016). The highest number of individuals sighted on any one survey day was 35 individuals, recorded on 29 November 2016 in Block 1. There were three survey days, 27 May 2016 and 16-17 June 2016,

when no sightings were recorded. The location of all sightings are presented in Appendix D; Figure D.1. The sightings data show concentrations of sightings close to the coast and where both Block 1 and 2 were surveyed, more than half (65%) were sighted within Block 1. Most harbour porpoise occurred on Transect lines 1 and 2 within Block 1 (where 24 and 35 individuals respectively were recorded over the 14 month survey period) to the west and north of The Skerries (see Appendix D; Figure D.1). There were 23 sightings of harbour porpoise on the three transects closest to the Wylfa Newydd Development Area (Transects 6-8 inclusive) totalling 41 individuals. There were 35 sightings of 59 individuals near to the coast between Cemaes Bay and Bull Bay which is situated immediately east along the coast from the Wylfa Newydd Development Area, along Transect numbers 9 to 12 inclusive.

The data displayed in Figure 3.7 as individuals km^{-2} shows the highest sightings rate was recorded in January 2017 with 0.559 individuals km^{-2}. The months of May, June, October and December 2016 and April and July 2017 reported a sightings rate below 0.1 individuals km^{-2}. Despite the sightings rate showing a general positive trend over time, it is unclear if this was driven by favourable survey conditions, a high occurrence of individuals or both.

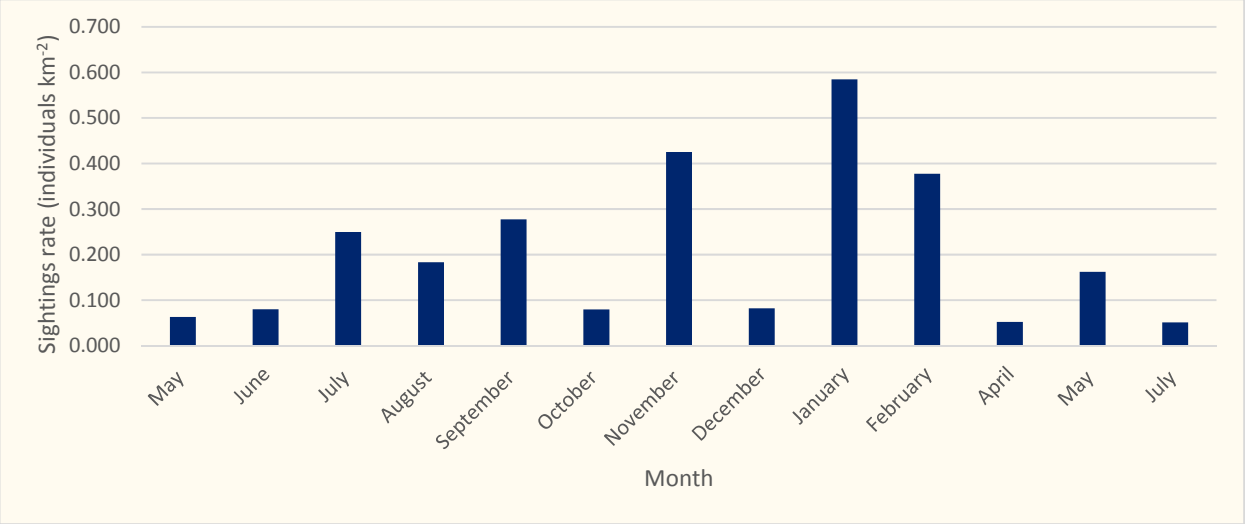


Figure 3.7 : Harbour porpoise sightings rate (individuals km^{-2}) across the 14 month vessel transect surveys.

As noted in Section 2.3.1, the marine mammal sightings during the first four months (May to August 2016 inclusive) of surveys were recorded prior to the presence of dedicated MMOs therefore may represent an underestimate of the marine mammals available for sighting.

Density (with sea state correction) has been calculated for all data collected by the dedicated MMO surveyors within Block 1. Using the estimate that g(0) = 1, the density of harbour porpoise over the total area sampled (614 km^2) is 0.323 individuals km^{-2}. The abundance was estimated to be 310 individuals (CI 230-416). However, as discussed in Section 3.2.3.1, a g(0) of 1 is unrealistic and therefore the assumption of g(0) = 0.5 has been applied, giving a density of 0.646 individuals km^{-2} and an abundance of 620 individuals (CI 461-833). Although these estimated abundance values are similar to those reported by Shucksmith *et al*. (2009), the density values are lower (see Section 3.2.3.1) which at a g(0) = 0.5 estimated a density of 1.261, for example. Reasons for this could be the difference in months sampled, May-September (Shucksmith *et al*., 2009) compared to September to July for the 2016-17 vessel transect surveys. Sampling was also undertaken for a longer period of time in the Shucksmith *et al*. (2009) study (observations were reported over a three-year period) meaning that there were a greater number of observations which could be analysed, but with a greater stratification of data which would reduce the precision of calculations (Barlow *et al*., 2001). The most likely explanation is that sampling in the current vessel transect surveys occurred within areas (HB, CH, and MM) of the Shucksmith *et al*. (2009) study (Figure 2.1). Using these areas only, lower density and abundance values (i.e. excluding PL, and SS) (Figure 2.1)) provide a density range of 0.148-0.563 individuals km^{-2} (g(0) = 0.5). These values are similar to the current vessel transect survey estimates here.

3.2.3.5 Site-Specific Vessel Survey Data – PAM

The total number of surveys where data were available for processing was six with total distance surveyed and number of detections displayed in table 3.3. The total number of harbour porpoise detections per transect for each month surveyed is displayed in Appendix B; table B.6 to table B.11 inclusive.

All transects detailing click detections for each month surveyed are displayed in Appendix B; Figure B.1 to Figure B.5. Using all available data the total number of harbour porpoise detected across all surveys was 131 individuals with an average detection rate of 0.252 harbour porpoise km^{-1} across all surveyed transect lines and months.

Table 3.3 : Summary of harbour porpoise detections across all surveys.

Date	Total distance surveyed for PAM analyses	Number of harbour porpoise detections	Porpoise detections km^{-1}
29/11/2016	122.57	33	0.269
20/12/2016	58.75	28	0.477
18/01/2017	55.78	6	0.108
19/01/2017	Faulty PAM equipment		
17/02/2017	91.67	33	0.360
06/04/2017	106.90	12*	0.112
12/05/2017	80.07	18*	0.225
09/07/2017	Faulty PAM equipment		

**The data from the April and July survey were affected by the presence of other sound sources.*

Figure 3.8 illustrates the average harbour porpoise detection rate listed in table 3.3 for each month surveyed and shows the highest rate of detection occurred in December 2016 with the lowest rate of detection in January 2017. Interference from other sound sources during the April and May surveys meant that these two survey dates were not directly comparable to all other data and so average detection excluding these data was calculated to be 0.304 km^{-1}).

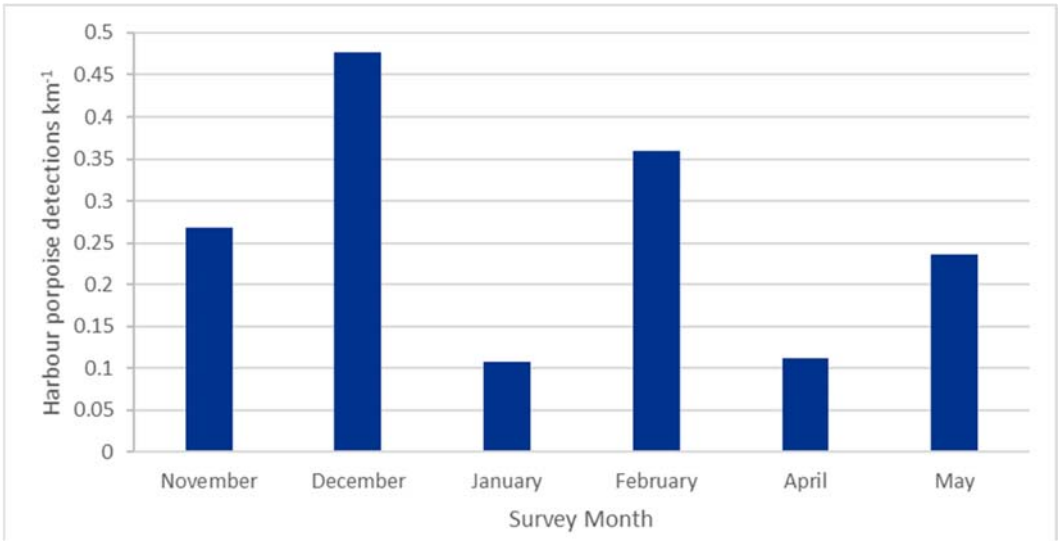


Figure 3.8 : Harbour porpoise detection rate (number of individuals km^{-1}) across all surveyed transects by survey date. N.B. the April and May data were affected by other noise sources and likely to affect the rate of detection.

There was no clear inshore/offshore spatial pattern in the detection data. Transect lines 4 to 9 in the centre had an average detection rate of 0.253 individuals km^{-1}), transects 1 to 3 inclusive had an average detection rate of 0.171 individuals km^{-1} and transects 10 to 12 inclusive had an average detection rate of 0.183 individuals km^{-1}.

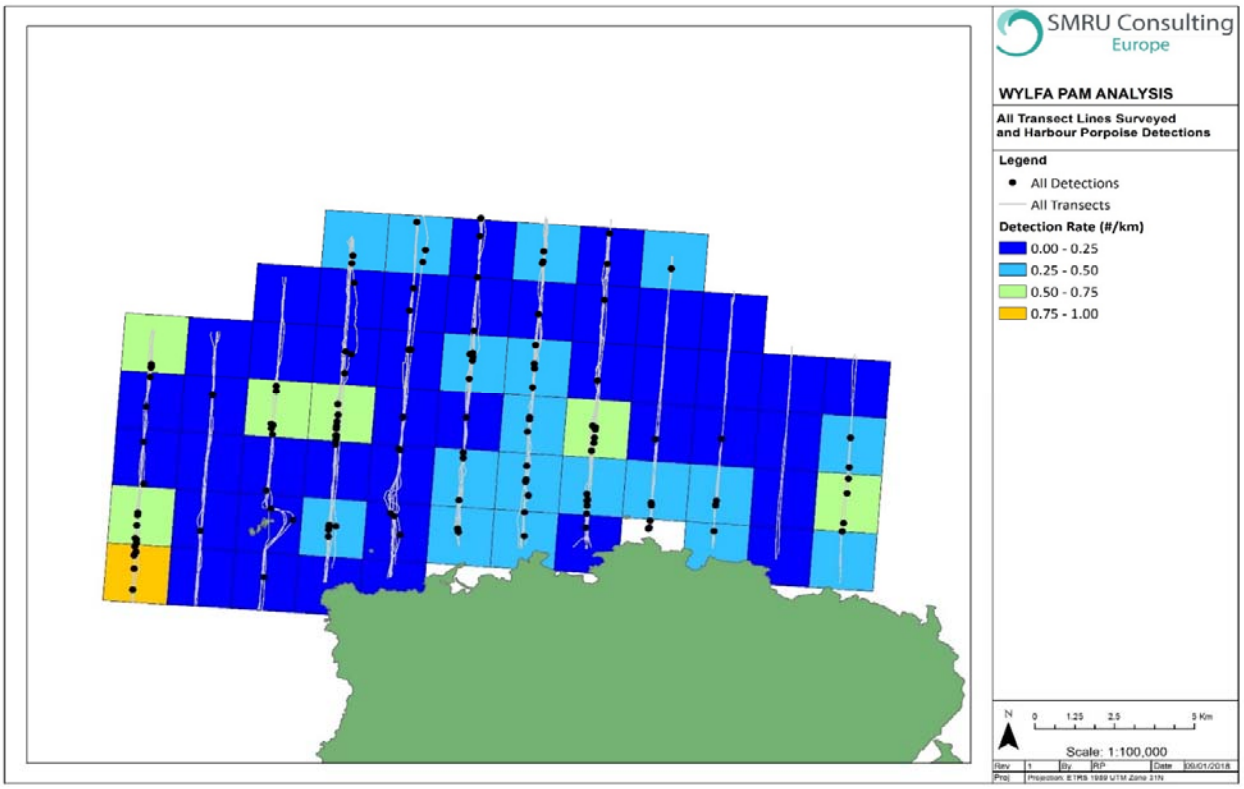


Figure 3.9 : Harbour porpoise detection rate grid showing number of harbour porpoise detections km^{-1} effort per 2 km by 2 km grid cell.

3.2.3.6 Site-Specific C-POD Monitoring

The location of the C-POD monitoring undertaken within the Wylfa Newydd Development Area can be found in Figure 1.1 with a final interpretive report provided in Appendix C. The results indicate the importance of this area, particularly for the harbour porpoise. The static C-POD surveys detected harbour porpoise presence every day (a survey period of 393 days) but also showed that levels of harbour porpoise activity varied between location which in turn depended on the time of year. Statistically significant results were apparent between DPM day^{-1} and Chlorophyll *a* concentration (at Site 3BE) and sea surface temperature (at Site 1BW and Site 3BE).

Site 1BW (outer region of Cemlyn bay) recorded the lowest number of detections (median 20, Inter-Quartile Range (IQR) of 31.35) followed by 2BC (outer region of Porth-y-pistyll) (median 91, IQR of 104.00) and 3BE (Wylfa Head) recording the highest number of detections (median 142, IQR of 235.50).Detections of harbour porpoise declined over the monitoring however, whilst detections at 1BW remained consistent throughout the monitoring, Site 2BC showed a general increase in detections over time with peaks occurring during winter 2016 and autumn 2017. Site 3BE in contrast, reported a sharp decline in detections from July 2017 onwards. it is likely that the decline in DPM at Site 3BE was owing to disturbance (for example increased fishing vessel activity in this area) or movement of food sources to other locations.

Harbour porpoise activity reported differences in peaks and troughs in relation to tide with an apparent preference for the flooding tide.

Overall, analyses showed that location 3BE had significantly more detections and longer peaks of harbour porpoise echolocation activity compared to 1BW or 2BC (Figure 1.1).

The physical geography of the bays (Porth-y-pistyll and Cemlyn) is such that a harbour porpoise individual travelling east could be detected at 3BE and again at 1BW and 2BC (and vice-versa) as it was en-route to other locations. Model analyses showed that change in location best supported the largest amount of variation in harbour porpoise detections; significantly higher Proportion DPM for harbour porpoise was reported at the location 3BE (a high energy site).

Density and abundance estimates were not possible with the number of C-PODs deployed for this monitoring but it is possible that there could be a higher proportion of harbour porpoise within cSACs when compared to other areas (as discussed by Heinanen and Skov, 2015). This could not be ascertained from the results presented here and in Appendix C but the higher acoustic presence is more likely a result of local (potentially resident) harbour porpoise populations exhibiting knowledge of temporo-spatially predictable feeding locations so would not necessarily remain in the local area. Another study by Read and Westgate (1997) cited in OSC 2018 reported harbour porpoise remain in localised areas for short periods and then travel great distances to find similar localised areas.

3.2.3.7 Site-Specific Vantage Point Survey Data

Individual sighting records for the harbour porpoise are displayed in Appendix E; Figure E.1 and show VP2 had the highest number of sightings for harbour porpoise across all surveys with VP3 ranked second in order of abundance. In terms of sightings rates, the harbour porpoise fluctuated through the year with no clear seasonal pattern (Figure 3.9) other than the fact that sightings rates were consistently below the VP location average between October and December (Figure 3.9). The sightings rate was consistently highest at VP2 across all months (Figure 3.9). The mean sightings rate for VP2 across all months and years was 0.672 harbour porpoise hr^{-1} effort (SD 0.718) with the months of January, February and July-September having sightings rates that were higher than the yearly average. The maximum sightings rates occurred during September with 2.5 harbour porpoise hr^{-1} effort (table 3.4).

The VP location with the second-highest average sightings rate was VP3 with a mean sightings rate across all months and years of 0.25 harbour porpoise hr^{-1} effort (SD 0.212). The months of January, April-June and August-September had sightings rates that were above the yearly average, with the maximum sightings rate of 0.83 harbour porpoise hr^{-1} effort during September (table 3.4).

The average sightings rate for VP1 across all months and years was 0.072 harbour porpoise hr^{-1} effort (SD 0.071) (table 3.4). The months of February, April, May and July-September had sightings rates that were higher than the yearly average with maximum sightings rates of 0.17 harbour porpoise hr^{-1} effort during February.

VP 4 consistently had the lowest harbour porpoise sightings rates across all months and years with sightings recorded only in the month of July where the sightings rate was 0.01 harbour porpoise hr^{-1} effort (table 3.4).

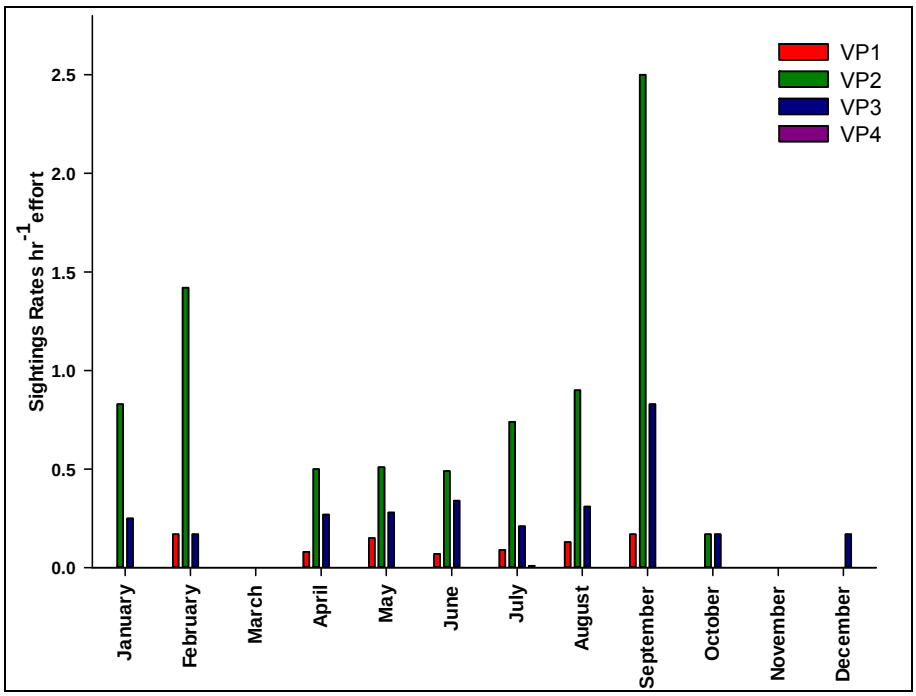


Figure 3.9: Monthly harbour porpoise sightings rates at the four VP locations across all survey years 2011-2014.

Table 3.4: Porpoise sightings rate (number per hour of effort) at each vantage point (VP) location between January 2011 and September 2014. Green shaded cells highlight those where the monthly sightings rate is above the annual average for that VP location.

	Harbour porpoise sightings rate (#/hr)			
Month	VP1	VP2	VP3	VP4
January	0	0.83	0.25	0
February	0.17	1.42	0.17	0
March	0	0	0	0
April	0.08	0.5	0.27	0
May	0.15	0.51	0.28	0
June	0.07	0.49	0.34	0
July	0.09	0.74	0.21	0.01
August	0.13	0.9	0.31	0
September	0.17	2.5	0.83	0
October	0	0.17	0.17	0
November	0	0	0	0
December	0	0	0.17	0
Average	**0.072**	**0.672**	**0.250**	**0.001**

3.2.3.8 Incidental/Casual Sightings

Sightings of harbour porpoise have been recorded through incidental/casual records during non-dedicated boat-based surveys between April 2010 and November 2014 (Appendix G; Figure G.1). No effort data are available

for these sightings other than number of survey days per month. Over the five years of data collection a total of 186 boat-based surveys were conducted recording a total of 250 harbour porpoise on an incidental/casual basis. The highest number of individuals sighted from any one incidental/casual record was 12 with an average of two individuals within a pod.

Given that there were no associated effort data, the incidental/casual sightings are presented as harbour porpoise positive survey days (table 3.5). The data show that the number of harbour porpoise positive days ranged from 0% (with zero harbour porpoise recorded on any survey day that month) to 100% (where individual harbour porpoise were incidentally recorded on every survey day that month). These data indicate that the harbour porpoise is present throughout much of the year in the north Anglesey area, but there was high intra-annual and inter-annual variation. This is also evident in Figure G.2 (Appendix G) which shows sightings year round with the highest number of harbour porpoise recorded during the spring and summer seasons in the area located to the west of the Wylfa Newydd Development (within the Middle Mouse sector described by Shucksmith *et al*. (2009)).

Table 3.5: Percentage of porpoise positive survey days obtained from incidental sightings during the fish, plankton and benthic surveys around north Anglesey between April 2010 and November 2014.

	Harbour porpoise positive survey days				
	2010	2011	2012	2013	2014
January		100%	0%		
February		40%	29%	20%	0%
March		0%	0%	0%	100%
April	50%	33%	0%	67%	100%
May	0%	0%	60%	33%	0%
June	33%	50%	22%	100%	0%
July	29%	33%	67%	67%	67%
August	0%	0%	25%	50%	100%
September	0%	0%	0%	100%	33%
October	50%	0%	33%	0%	0%
November	75%	29%	100%	50%	25%
December	0%				

Individual sighting records of harbour porpoise were made during the site-specific land-based seal surveys. All sightings were reported between November and December 2016 with one individual reported travelling outside of Porth-y-pistyll; two sightings of three individuals recorded feeding at the entrance of Port Wnal and between here and Wylfa Head; two individuals were recorded travelling past the bay at Porth Wnal and one further individual was recorded outside of Porth Wylfa.

In addition, a total of 14 individuals from five sightings was also recorded by surveyors during other land-based walkover surveys. All five sightings were recorded within 500 m of the coast in the vicinity of Wylfa Head with an average of two individuals within a pod. These records have been incorporated Figure F.1 (Appendix F).

3.2.4 Summary

All data sources examined indicate that harbour porpoise are present year round in waters around the north coast of Anglesey. Data sources from surveys local to the Wylfa Newydd Development Area, including the site-specific effort-based vantage point surveys, the site-specific effort-based vessel transect surveys, the Schucksmith *et al*. (2009) survey data and the incidental/casual sightings from local fish, plankton, water quality, land-based seal surveys and benthic surveys, have all recorded harbour porpoise in the vicinity of the Wylfa Newydd Development Area, specifically in and around both Cemlyn Bay (in the west) and Cemaes Bay (in the east). The site-specific effort-based vessel transect surveys have produced porpoise sightings rates of up to 0.559 individuals km^{-2}. In addition to this, surveys undertaken by SEACAMS (2015) on behalf of Minesto concluded that the Holyhead Deep region of the Irish Sea was of lower importance that other parts of the Irish Sea.

Density values have been calculated for September 2016 to January 2017 survey data providing a density value using a g(0) = 0.5 of 0.646 individuals km^{-2} with sea state correction and a corresponding abundance of 620 individuals (CI 461-833). Other estimates of harbour porpoise density for north Anglesey include the data presented by Shucksmith *et al*. (2009) who estimated that the density was 1.261 individuals km^{-2} using a g(0) estimate of 0.5. This produced a harbour porpoise abundance off north Anglesey of 618 individuals, which represents 0.6% of the total CIS MU. It is recognised that the current vessel transect surveys do not have the same coverage as the work undertaken by Shucksmith *et al*. (2009), namely the two areas around South Stack and Point Lynas. If these areas are removed, the current estimates of harbour porpoise density and abundance are in fact similar to those reported by Shucksmith *et al.* (2009) i.e. 0.148-0.563 individuals km^{-2} (g(0) = 0.5).

PAM analysis reported detection rates for harbour porpoise ranged between 0.108 and 0.477 km^{-1} with an average detection rate of 0.304 km^{-1}.

Whilst density and abundance estimates were not possible using the three C-PODs, acoustic monitoring using C-PODs indicate the area to the east of Wylfa Head shows a greater number of detections when compared to the areas of Cemlyn Bay and Porth-y-pistyll. The DPM day^{-1} correlated with other environmental factors such as sea surface temperature and Chlorophyll *a* particularly at Wylfa Head. Detections at Wylfa Head declined from July 2017, whilst detections appear to increase at Porth-y-pistyll. This was likely owing to movement of food sources or increased fishing activity within the area of Wylfa Head; harbour porpoise require a regular food source and actively move away from noisy activities (OSC, 2018 and Todd, V. Pers Comm., 2018). In addition, the highest harbour porpoise activity was reported on the flooding tide.

The harbour porpoise detection rates obtained from the PAM monitoring study are lower than the 9.4 detection km^{-1} obtained by Gordon *et al*. (2011). There are many potential reasons differences in detection rates, including differences in survey area (the present study covered a much larger survey area), different equipment, processing of the sound differently, different click detectors and classifiers and different software. It should also be noted that the definition of a “detection” differed between the two surveys. The Gordon *et al*. (2011) detection data contained single clicks, however, in this study only tracks and events involving multiple clicks were classified as detections. In addition to this, the prevailing noise levels may have differed between the two studies, as it has been noted that prevailing noise levels were high during the current study and that confounding factors of other noise sources would have caused an underestimate in the detection rate. Given the different survey methods and analysis approaches it is difficult to compare the detection rate between these two studies.

Previous studies have shown that there is often high spatial variation in harbour porpoise activity, even on a small scale. For example, in a previous studies moored C-PODs at sites in close proximity showed significantly different porpoise detection rates compared to a towed hydrophone array (e.g. Benjamins *et al*. 2016 and Benjamins *et al*. 2017). Therefore, large differences in porpoise detection rates between studies around north Anglesey is not unexpected. It has also been reported by Read and Westgate (1997) cited in OSC 2018 that harbour porpoise remain in localised areas for short periods and then travel great distances to find similar localised areas; it is likely that this would also occur around Anglesey.

3.3 Bottlenose Dolphin

In the UK, bottlenose dolphins are considered to have a Favourable conservation status (JNCC, 2007). In Wales, bottlenose dolphin is a species of "*principal importance for the purpose of conserving biodiversity*" on the interim list currently under Section 7 of the Environment (Wales) Act (2016). In order to conserve biodiversity by maintaining or restoring Annex II species to a favourable conservation status, the Habitats Directive requires the designation of SACs for this species. As such, there are two SACs in the Irish Sea, one which lists bottlenose dolphins as the primary reason for selection (Cardigan Bay/Bae Ceredigion SAC) and one which lists bottlenose dolphins as a qualifying feature (Pen Llyn a`r Sarnau/ Lleyn Peninsula and the Sarnau SAC). The conservation objectives for the Cardigan Bay SAC are to maintain the distribution and abundance of the SACs bottlenose dolphins. As with all other cetaceans, under the Wildlife and Countryside Act 1981 it is an offence to intentionally or recklessly disturb bottlenose dolphins. It is therefore likely that a full and quantitative impact assessment will be required for bottlenose dolphins in relation to the Wylfa Newydd Project, especially if there is any evidence for the Wylfa Newydd Project to affect to the Cardigan Bay SAC population.

3.3.1 General Species Information

Bottlenose dolphins are long-lived with females living more than 50 years and males between 40 and 45 years (Wells and Scott, 1999; 2002 cited in Pesante *et al*., 2008a). In general, the bottlenose dolphin is a coastal species in the UK, often sighted within 10 miles of land, frequently within two miles of the coast. Habitat analysis shows preference for areas between five and 10 metres depth, although areas of 25 to 30 metres depth have seen an increase in sightings since 2005 with the majority of the sightings in this region occuring over the slope range of Cardigan Bay (Pesante *et al*., 2008b). Although the bottlenose dolphin preys on a wide variety of schooling fish including bass (*Dicentrarchus labrax*), cod (*Gadus morhua*), herring, mackerel (Scombridae), salmon (*Salmo salar*), and sea trout (*Salmo trutta*), they are thought to favour bottom-living fish such as flounder and mullet (Mugilidae) (SWF, 2015).

3.3.2 Presence in the Irish Sea

The bottlenose dolphin is one of the most common cetacean species to occur in the coastal waters throughout the UK and the second most frequently recorded species (Evans *et al*., 2015a). Population estimates of the Irish Sea (SCANS II, survey block O) for bottlenose dolphin were reported to be in the region of 235 individuals (CV = 0.75) with a density equivalent of 0.0052 individuals km^{-2} (Hammond *et al*., 2013). More specifically, Cardigan Bay is the largest population in the UK with annual estimates for the wider area varying between 254 and 330 animals (CV = 0.25 – 0.28) for the years 2011 and 2013 inclusive (Feingold and Evans, 2014a). Open population model analysis suggest that for Cardigan Bay, bottlenose dolphin has a population estimate of 203 animals (Feingold and Evans, 2013). The bottlenose dolphin abundance within the IS MU has been estimated by Hammond, *et al*. (2013) and Macleod, *et al*. (2009) both cited in IAMMWG (2015b) as 397 individuals (CV = 0.23).

As with harbour porpoise, the bottlenose dolphin is not evenly distributed within the Irish Sea and particular areas have been described by Evans *et al*. (2015a and references therein) (and illustrated in Appendix A: A.2; Figure A.3) as important for this species. These areas include Cardigan Bay and Lleyn Peninsula (for which the species is a primary feature of both SACs). The coastal waters to the east of Anglesey around Bull Bay and towards the Llandudno coast, where large numbers of bottlenose dolphin have been reported (Evans *et al*., 2015a), are of particular importance (Figure 3.9 and Figure 3.10). The distribution and ranging patterns of bottlenose dolphins around Wales and in relation to SAC populations is discussed in further detail below in Section 3.3.3 (SAC Population).

The distribution of bottlenose dolphins is variable with main concentrations in the summer being around Tremadog Bay and southern Cardigan Bay whereas in the winter it is more widely dispersed, occurring off the north coast of Wales, particularly to the north and east of Anglesey (Evans *et al*., 2015a (Appendix A: A.2; Figure A.5). Nevertheless, the species can be seen at any time of the year throughout Welsh coastal waters. There is some indication that animals which once regularly inhabited Cardigan Bay are now spending more time off north Wales (Feingold and Evans, 2014a; 2014b; Norrman *et al*., 2015). The bottlenose dolphin is usually found in small coastal pods during the summer, centred in Cardigan Bay and extending northwards during the winter months where they have been known to form very large pods (Pesante *et al*., 2008b; Veneruso and

Evans, 2012). Average pod size in summer for Cardigan Bay has been calculated by Feingold and Evans (2014a) as 4.2 individuals (range 1-33, SD = 4.08, n = 1,862) compared to the much larger pod size found in the winter off Anglesey (26.4 individuals, range 2-100, SD = 24.5, n = 44).

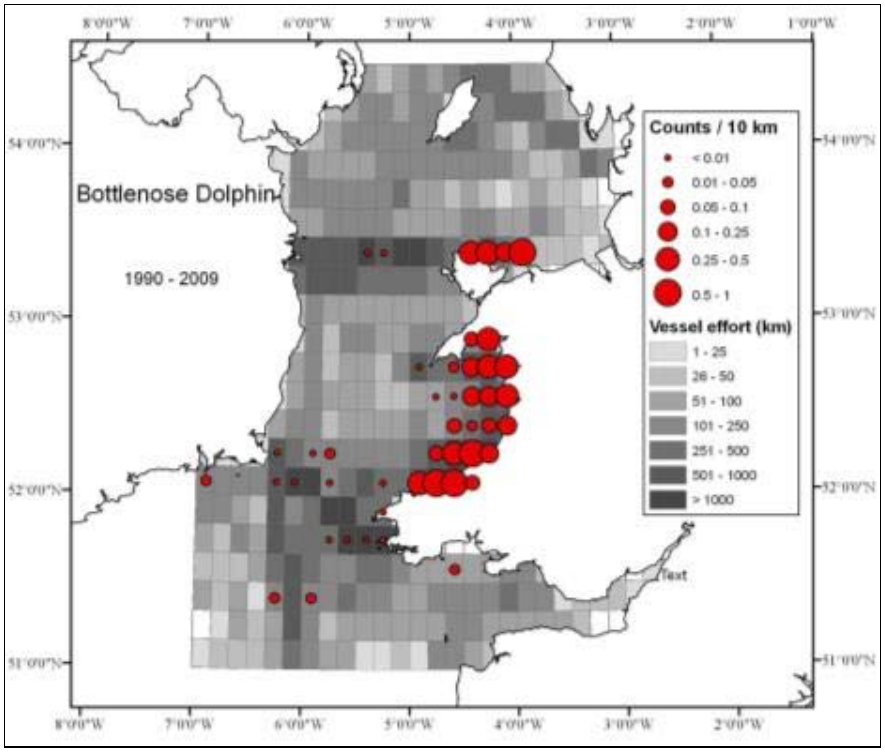


Figure 3.9: Distribution of bottlenose dolphin corrected for survey effort in the IS MU (taken from Baines and Evans, 2012). N.B. survey effort for Isle of Man and east coast of Ireland are not included here.

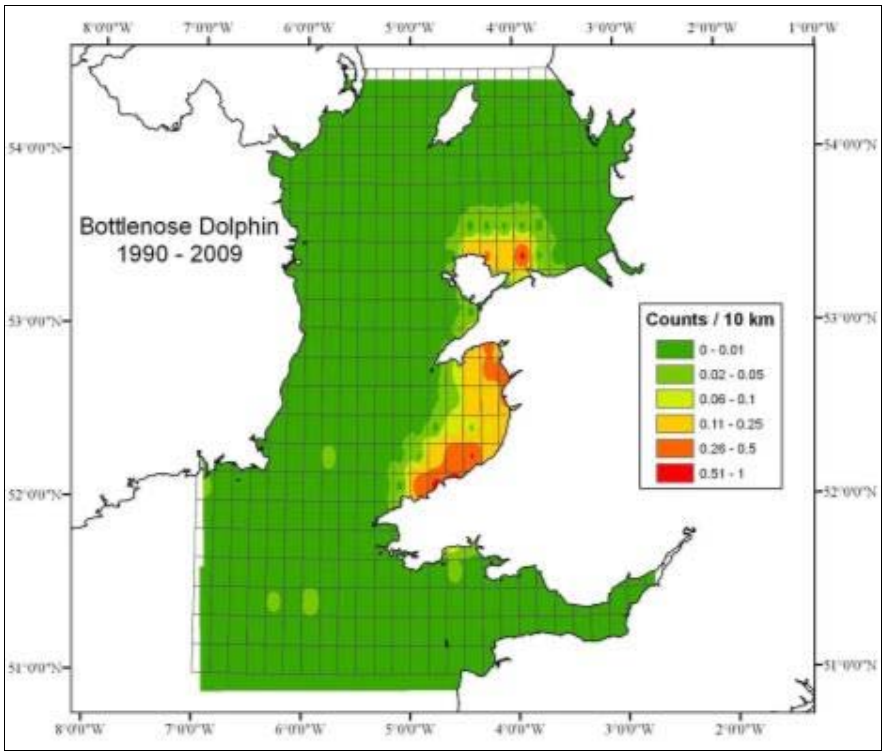


Figure 3.10: Interpolated map of bottlenose dolphin distribution in the IS MU (taken from Baines and Evans, 2012). N.B. survey effort for Isle of Man and east coast of Ireland are not included here.

3.3.3 SAC Population

The population within Cardigan Bay SAC has been studied extensively (Pesante, *et al*., 2008a; Baines and Evans, 2012; Veneruso and Evans, 2012; Feingold and Evans, 2014b and Norrman *et al*., 2015) and it is clear from these studies that the bottlenose dolphin distribution extends outside Cardigan Bay. Norrman, *et al*. (2015 and references therein) have described the Cardigan Bay SAC population as a combination of transients, occasional visitors and resident animals. Norrman *et al*. (2015) describe transients as bottlenose dolphins that have been seen less than four times and in only one or two years; between 17 and 19% of the population are considered transient. Occasional visitors (spotted between four and 11 times in three to six years) represent between 20% and 29% of the population and between 53% and 63% of bottlenose dolphins are considered resident inhabitants of Cardigan Bay, having been seen in more than six years and on more than 12 occasions.

The home range of the bottlenose dolphin in Welsh waters has been shown to extend from the Cardigan Bay SAC to the north coast of Anglesey (Figure 3.11). Photo-ID surveys from 221 identified individuals since 2007 have shown that 78% of these 172 individuals have been recorded in the Cardigan Bay SAC, the Lleyn Peninsula and the Sarnau SAC and in North Wales around the Isle of Anglesey (Norrman *et al*., 2015). Extended survey effort around Anglesey has established that individually identifiable bottlenose dolphins from the Cardigan Bay SAC have been regularly recorded on a seasonal basis around Anglesey (Pesante *et al*., 2008). These data therefore confirm connectivity between the Cardigan Bay SAC, the Lleyn Peninsula and the Sarnau SAC and the north coast of Anglesey.

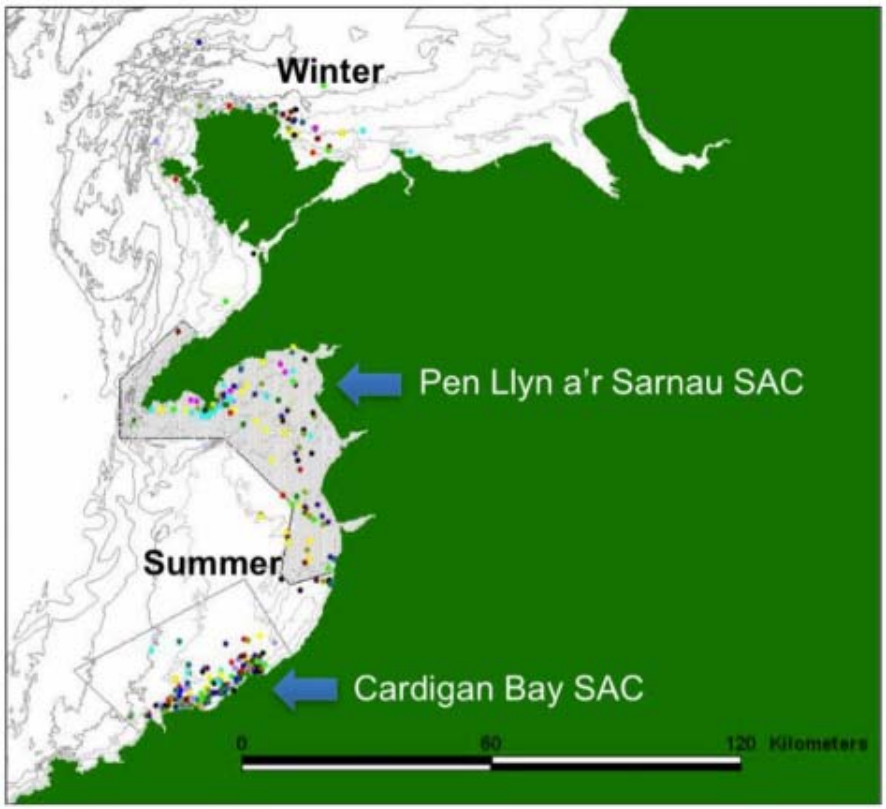


Figure 3.11: Home range patterns of the bottlenose dolphin in Welsh Waters (Norman et al., 2015).

Further evidence from photo-ID studies show that there is a seasonal migration of bottlenose dolphins from Cardigan Bay to north Anglesey in the winter months. Analyses of photo-ID surveys between December and February of individuals encountered off north Anglesey showed that 94% of the dolphins recorded had previously been recorded in Cardigan Bay (72% from the Cardigan Bay SAC) (Veneruso and Evans, 2012). During the summer months, 39% of individuals identified off north Anglesey had been previously recorded in Cardigan Bay (Veneruso and Evans, 2012). Therefore, while there is a higher proportion of SAC dolphins off north Anglesey in the winter months, SAC bottlenose dolphins are present off north Anglesey, year round. There is also evidence from photo-ID surveys in the summer months that there are dolphins present around north Anglesey that have never been previously recorded in Cardigan Bay.

3.3.4 Presence off North Anglesey

3.3.4.1 Site-Specific Vessel Survey Data

The vessel transect surveys have yielded two sightings totalling 14 individuals of bottlenose dolphin (a pod of four and 10 individuals respectively) (Appendix E; table E.1) across Block 1 and Block 2. The first sighting occurred on 26 May 2016 to the east of the Wylfa Newydd Development Area, approximately 3 km off Cemaes Bay whilst the second sighting (consisting of adults and one calf) was recorded on 19 January 2017 to the west of Cemlyn Bay, approximately 4 km offshore.

As noted in section 2.2.1, the marine mammal sightings before August 2016 surveys were recorded by the ESAS surveyors and, as such, may well represent an underestimate of the marine mammals available for sighting at this time.

3.3.4.2 Site-specific Vantage Point Survey Data

Vantage Point surveys between 2011 and 2014 yielded a total of six bottlenose dolphin individuals from three sightings (Appendix F; Figure F.1). Bottlenose dolphins were sighted in sectors VP4a (May 2013) (west of the

Wylfa Newydd Development Area in Cemlyn Bay, n = 2 and n = 3) and VP1a (June 2012) (immediately west of the Wylfa Newydd Development Area off Cerrig Brith, n = 3) (Appendix F; Figure F.1). The average pod size observed during the VP surveys was two animals.

As noted in section 2.2.1, the marine mammal sightings during these surveys were recorded by the bird surveyors and, as such, it is expected that the marine mammal sightings data obtained from these surveys are underestimates.

3.3.4.3 Incidental/Casual Sightings

Over the five years of data a total of 186 survey days were conducted, from which a total of 202 individuals of bottlenose dolphin was sighted incidentally (Appendix G; Figure G.1). On one occasion, during an intertidal fish survey, a group of 100 individuals was recorded as travelling. Given that there was no associated effort data, the incidental sightings are presented as bottlenose dolphin positive survey days (table 3.5). The data show that the number of bottlenose dolphin positive days ranged from 0% (where no individuals of bottlenose dolphin were incidentally recorded on any survey day that month) to 100% (where individuals of bottlenose dolphin were incidentally recorded on every survey day that month). The bottlenose dolphin was incidentally sighted on only 10 of the186 survey days.

In addition to these, two land-based walkover surveys (10 October 2012 and 12 December 2012) yielded two sightings of bottlenose dolphin totalling 53 individuals; one sighting comprised of a pod totalling 50 individuals recorded within 1 km of the Wylfa Newydd Development Area (these have been incorporated into Appendix F; Figure F.1). Whilst transiting between stations, during the January 2017 vessel transect surveys, one casual sighting of 15-20 individuals of bottlenose dolphin was recorded approximately 2 km off Wylfa Head.

These incidental/casual sightings confirm that the bottlenose dolphin is present in the waters close to the Wylfa Newydd Development Area. A total of five incidental/casual sightings were recorded within 5 km of Wylfa Newydd Development Area between the island of Craig yr Iwrch (northwest Anglesey), Cemlyn bay (immediately west of the Wylfa Newydd Development Area) and Cemaes Bay (immediately east of the Wylfa Newydd Development Area) (see Figure 1.1 for locations and Appendix G; Figure G.1). It should be noted that a lack of incidental/casual sightings does not mean an absence of dolphins.

Table 3.5: Percentage of bottlenose dolphin positive survey days obtained from incidental/casual sightings during the fish, plankton and benthic surveys around north Anglesey between April 2010 and November 2014.

	Bottlenose dolphin positive survey days				
	2010	2011	2012	2013	2014
January		0%	100%		
February		0%	14%	40%	20%
March		0%	0%	0%	0%
April	0%	0%	0%	0%	0%
May	0%	0%	0%	67%	0%
June	0%	0%	11%	0%	0%
July	0%	0%	0%	0%	0%
August	0%	0%	0%	0%	0%
September	0%	0%	0%	0%	0%
October	0%	0%	0%	0%	0%
November	0%	0%	50%	25%	0%
December	0%				

3.3.5 Summary

Bottlenose dolphins are present year round in Welsh waters. The bottlenose dolphin abundance within the IS MU has been estimated by Hammond *et al*. (2013) and Macleod *et al*. (2009) both cited in IAMMWG (2015b) as 397 individuals (CV = 0.23) with a density equivalent of 0.0052 individuals km^{-2} (Hammond *et al*., 2013). There are no other reliable density estimates of bottlenose dolphins off Anglesey. Cardigan Bay has the largest bottlenose dolphin population in the UK with annual estimates for this region (incorporating Lleyn Peninsula)

varying between 254 and 330 individuals (CV = 0.25 – 0.28) for the years 2011 and 2013 inclusive (Feingold and Evans, 2014a).

Larger pod sizes have been reported in Anglesey when compared to Cardigan Bay. Overall, the average pod size reported by Feingold and Evans (2014b) is five individuals in Cardigan Bay and 26 individuals in Anglesey. Both incidental/casual and VP surveys around Anglesey give average pod sizes of bottlenose dolphins which vary depending on the season and range between six individuals (spring) and 39 individuals (winter), with a maximum pod size of 100 recorded as an incidental sighting during an intertidal fish survey.

There is evidence from photo-ID studies that there is a seasonal migration of bottlenose dolphins from Cardigan Bay to north Anglesey in the winter months. There is a higher proportion of SAC dolphins off north Anglesey in the winter months, though SAC bottlenose dolphins are present off north Anglesey year round (Veneruso and Evans, 2012). These data confirm that there is connectivity between the Cardigan Bay SAC and the waters surrounding north Anglesey, which means that any bottlenose dolphins sighted off Anglesey and in relation to the Wylfa Newydd Development Area should be considered part of the SAC population.

3.4 Risso's Dolphin

In the UK, Risso's dolphins are considered to have an 'Unknown/Favourable conservation status with poor quality of data for both the population data and the habitat data (JNCC, 2007). They are listed as a European Protected Species and, in Wales, Risso's dolphin is a species of "*principal importance for the purpose of conserving biodiversity*" on the interim list currently under Section 7 of the Environment (Wales) Act (2016). As with all other cetaceans, under the Wildlife and Countryside Act 1981 it is an offence to intentionally or recklessly disturb Risso's dolphins.

3.4.1 General Species Information

The Risso's dolphin is a distinctive species with numerous scars and scratches which deepen with age, resulting in a lightening of the body. Although favouring deep offshore waters, they may be seen closer to the shore around oceanic islands, and in Britain and Ireland, most sightings occur within 10 km of the coast (SWF, 2016). Evans *et al.* (2015a) stated that the Risso's dolphin is thought to breed in the Celtic and Irish Sea and it is common to see calves wherever pods of Risso's dolphin have been sighted. They are active at the surface of the water and, although rarely bow-riding, they are often seen travelling alongside vessels and surfing the waves (SWF, 2016). Risso's dolphin are usually found in pods of fewer than 20 individuals but occasionally may exceed 50 individuals (Evans *et al*., 2015a). Their diet consists of cephalopods (such as octopus, cuttlefish and small squid), crustaceans and occasionally small fish. The SWF have observed them travelling in a line formation which is thought to improve effectiveness of hunting (SWF, 2016).

3.4.2 Presence in the Irish Sea

There are currently no population estimates for Risso's dolphins in UK waters (IAMMWG, 2015b) however, a photo-ID mark-recapture estimate of the population around Bardsey Island in 1997-2007 (using a closed population model) indicated there were between 121 and 145 animals (CV = 0.24) (de Boer *et al*., 2013).

In the UK, Risso's dolphins are most commonly sighted in the west, particularly around the Hebrides and are seasonally recorded in the Celtic and Irish Sea (IAMMWG, 2015b) where there is a relatively localised distribution described by Evans *et al*. (2015a) as a wide band running southwest to northwest Wales encompassing west Pembrokeshire, the western end of the Lleyn Peninsula and Anglesey (Appendix A: A.3; Figure A.6). Risso's dolphins are also found on the southeast coast of Ireland, and waters around the Isle of Man (Baines and Evans, 2012) (Appendix A: A.3; Figure A.6 (top)).

The Risso's dolphin is a regularly occurring species around the western and northern part of the Lleyn Peninsula, particularly around Bardsey Island where Whale and Dolphin Conservation undertake yearly Photo-ID monitoring (Evans *et al*., 2015a and references therein), but it is absent from Cardigan Bay (Appendix A: A.3; Figure A.6 (top); Figure 3.12 and Figure 3.13). Studies conducted by SWF, Whale and Dolphin Conservation and the Manx Whale and Dolphin Watch indicate movements of recognisable individuals of Risso's dolphin

between Cornwall, Pembrokeshire, the Lleyn Peninsula, Anglesey, the Isle of Man and West Scotland (Evans *et al*., 2015a).

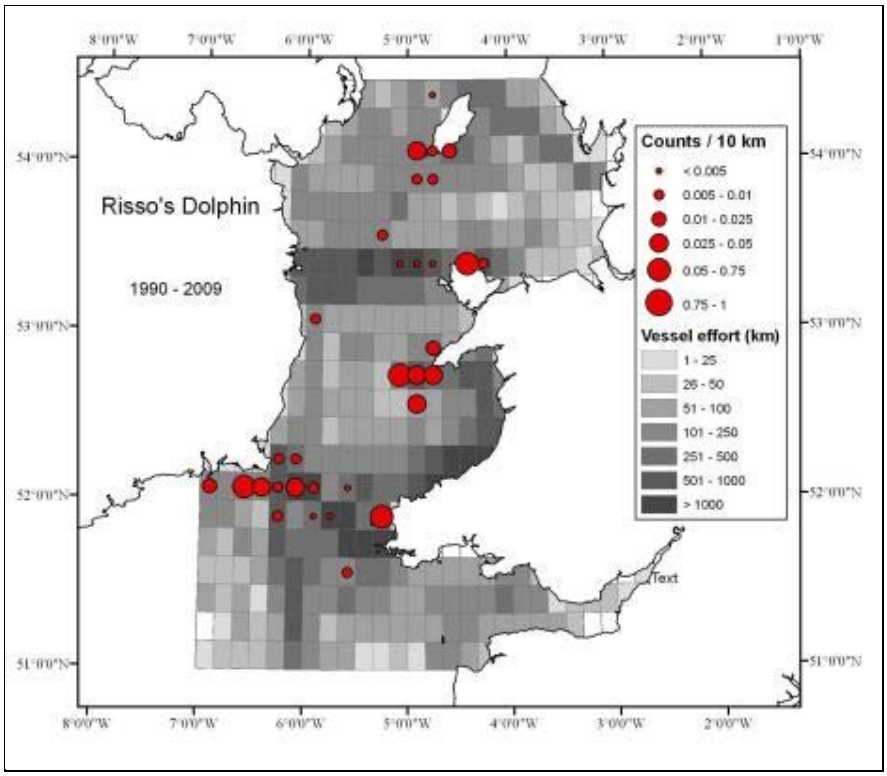


Figure 3.12: Distribution of Risso's dolphin corrected for survey effort in the Irish Sea (taken from Baines and Evans, 2012).

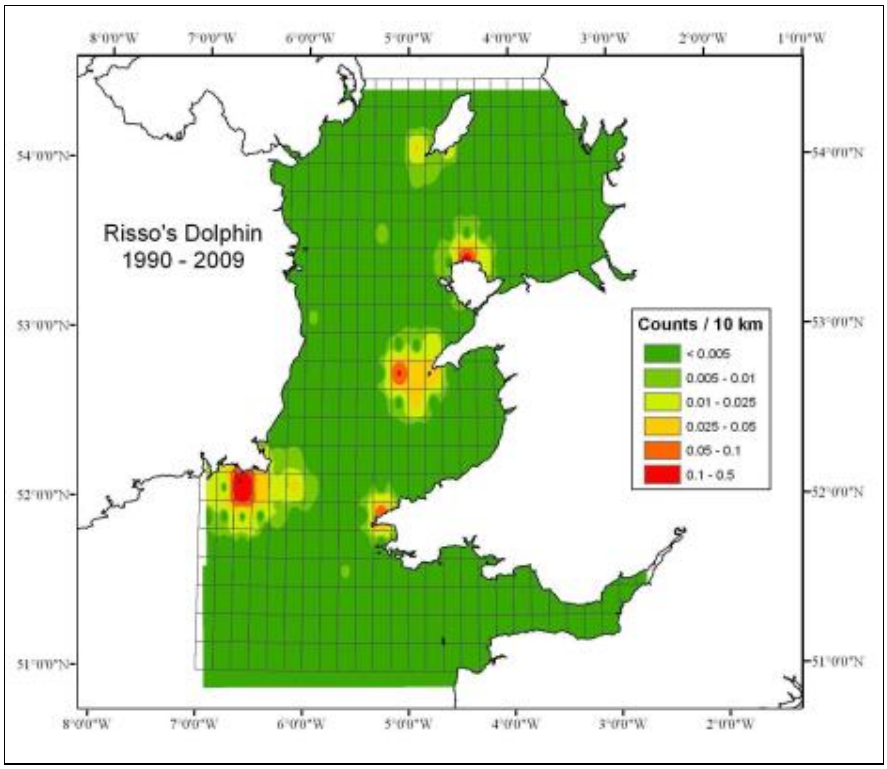


Figure 3.13: Interpolated map of Risso's dolphin distribution in the Irish Sea (taken from Baines and Evans, 2012).

3.4.3 Presence off North Anglesey

In general, Risso's dolphin distribution appears to have persisted over the long term, although numbers occurring off the coast of Wales can vary between years (Evans *et al*., 2015a). It is common to see up to a dozen individuals between September and November off the coast of Anglesey; much less common was the group of 50 individuals reported here in October 2015 (SWF, 2015). A plot of all sightings (casual and effort-related) of Risso's dolphin (Appendix A: A.3; Figure A.6 (bottom)) using the SWF database shows a similar pattern to the effort-corrected figures (Figure 3.12 and Figure 3.13) with most sightings occurring around north and west Lleyn Peninsula, north and east Anglesey and the Isle of Man. The vessel count data presented in Baines and Evans (2012) show counts of Risso's dolphins between 0.1 and 0.5 individuals 10 km^{-1} off north Anglesey and within the Wylfa Newydd Development Area (Figure 3.13).

3.4.3.1 Site-Specific Vessel Survey Data

Between May 2016 and January 2017, 17 vessel-transect survey days have been completed. These surveys have yielded three sightings of Risso's dolphin (Appendix E; table E.1) each with a pod size of two individuals. Two sightings occurred on the 26 May 2016; one sighting was located approximately 10 km offshore to the north of Middle Mouse island with the second sighting to the east of the Wylfa Newydd Development Area approximately 2 km off Bull Bay. The third sighting occurred on 21 September 2016 along Transect 9 (Block 1) (east of Middle Mouse) approximately 1 km from the shore.

As noted in section 2.2.1, the marine mammal sightings during the surveys between May 2016 and August 2016 were recorded by the bird surveyors and, as such, may well represent an underestimate of the marine mammals available for sighting.

3.4.3.2 Site-Specific Vantage Point Survey Data

No sightings of Risso's dolphins were reported during the VP surveys between 2011 and 2014. As noted in section 2.2.1, the marine mammal sightings during these surveys were recorded by the bird surveyors and, as such, it is expected that the marine mammal sightings data obtained from these surveys are underestimates.

3.4.4 Incidental/Casual Sightings

One sighting of one individual was recorded whilst transiting between sites on the dedicated vessel transect surveys, this was recorded approximately 3.5 km offshore from Porth Padrig. In addition, only one other potential sighting of Risso's dolphin was made during a marine boat-based survey located approximately 5 km offshore from Wylfa Head.

3.4.5 Summary

There is currently no population estimate for Risso's dolphins in the UK (IAMMWG, 2015b). However, Risso's dolphins regularly occur around the western and northern part of the Lleyn Peninsula, particularly around Bardsey Island (Evans *et al*., 2015a). Long-term studies (1997-2007) of Risso's dolphin around Bardsey Island undertaken by Whale and Dolphin Conservation have indicated that there are between 121 and 141 individuals (CV = 0.24) (de Boer *et al*., 2013). Risso's dolphins frequent the waters off the Lleyn Peninsula (particularly Bardsey Island) and have been sighted off the north coast of Anglesey near Bull Bay. It is thought that the majority of the sightings occur to the east of Anglesey in similar locations described for the bottlenose dolphin. The three definite sightings of Risso's dolphin during the site-specific vessel transect surveys were recorded in May (two sightings) and August (one sighting).

3.5 PAM and C-POD Analysis of Dolphin Detections

Dolphin detections from the C-PODs detected at least one dolphin on each day of the monitoring period. In total there was 41,265 dolphin DPM with no strong preference for any one mooring location although there was a statistically significant relationship to 2BC. Dolphin detections remained consistent throughout the monitoring period with no peaks occurring in any one particular season. Dolphin detections were correlated to chlorophyll *a* at 3BE whilst sea surface temperature correlated to dolphin DPM day^{-1} at 2BC. Dolphin activity reported differences in peaks and troughs in relation to tide, with an apparent preference for the flooding tide.

No dolphin clicks were identified by visual inspection in any of the survey days. There were also no dolphin whistles identified by the whistle and moan detector in PAMGuard for any of the surveys.

4. Pinniped Baseline

Two species of pinniped, the grey and harbour seal, frequent the Irish Sea and of these, only the grey seal has been recorded on a regular basis by Westcott (2002), Westcott and Stringell (2003 and 2004) and Jones *et al*. (2013) around north Anglesey. Seals will haul-out on land to breed, moult, rest and digest their food. In north Wales, they are known to use habitats such as intertidal rocky outcrops, beaches and sea caves that are tidally exposed (Countryside Council for Wales (CCW), 2009). Populations of pinnipeds are generally estimated from breeding census, and as such pup counts as well as adult and juvenile seals are taken during the breeding season when pups and seals are hauled out.

4.1 Harbour Seal

There are no dedicated systematic surveys for harbour seals in Wales. According to SCOS (2015), only sparse information is available for harbour seals in the West England and Wales MU with estimates compiled from data from other organisations and papers (e.g. Boyle, 2012; Sayer, 2010a, 2010b, 2012a, 2012b; Westcott, 2002). The estimate of August harbour seal counts in the West England and Wales MU for 1996-1997 was 15, for 2000-2006 was 20 and 2007-2014 was 35, though it is highlighted that this apparent increase in counts may be partly due to increased reporting and improved species identification (SCOS, 2015). This accounts for only 0.73% of the seals counted in England and Wales (2008 and 2014) and 0.12% of the seals counted in the entire UK (2007-2014).

Along the north coast of Anglesey, the estimated density of harbour seal at sea ranges between 0.00000976-0.0000304 km^{-2}; with a slightly higher estimated density at The Skerries with 0.00004544 km^{-2} (Jones *et al*., 2013; Figure 4.1). Since there is no documented evidence to suggest that harbour seals are present in Welsh waters or around Anglesey in any significant numbers, harbour seals have not been considered any further in this report (Appendix H; Figure H.1).

Figure 4.1 : Estimated harbour seal at sea usage around Anglesey (data obtained from Jones et al., 2013). Numbers show the estimated harbour seal density in each 5x5km grid cell. Note: to obtain density per km² the value in each grid cell must be divided by 25.

4.2 Grey Seal

4.2.1 General Species Information

Grey seals swim at an average of 1-2 m s^{-1} (Gallon *et al*., 2007) and dive to depths of up to 100 m (SCOS, 2015), though they have been recorded at much greater depths depending on the location. Grey seals are known to travel great distances having large foraging ranges (where they have frequently been recorded to travel over 100 km between haul-out sites) with foraging trips lasting anywhere between one and 30 days (SCOS, 2015). Grey seals spend a high percentage of time at or near haul-out sites (CCW, 2009). Grey seals have. Grey seals can sleep in the sea lying on the sea bed or floating upright but, like cetaceans, must return to the surface to breath. Grey seals feed mainly on benthic or demersal fish species such as sandeel, cod and other gadoid species, flatfish (such as flounder), herring and skates (CCW, 2009).

Grey seals spend several weeks ashore during the moulting season, which occurs in late spring (between three and five months after the breeding season), and during the breeding season (the key month in Wales is September although breeding can occur as late as December) (Westcott and Stringell, 2004).

4.2.2 Presence in the Irish Sea

The most recent UK-wide grey seal population estimate was an estimated 56,988 pups (95% CI 56,317-57,683 (based on 2012 pupping surveys)) and 111,600 adults (95% CI 91,400-139,200 in 2014), and the overall status was seen to be increasing. Wales is thought to have between 3% and 4% (1,650 individuals) of the total UK pup production (SCOS, 2014), though it should be noted that this estimate was produced for less frequently monitored colonies. Population studies of the Celtic and Irish Sea have revealed that grey seals are present

year round on both the Irish and Welsh coasts and are known to move between the two, with higher numbers of seals seen to move between the southeast coast of Ireland and the southwest coast of Wales (Kiely *et al*., 2000).

Jones *et al*. (2013) produced maps for grey seal distribution-at-sea estimates for the UK (these are displayed in Appendix H: Figure H.1). These maps combine telemetry data with aerial survey counts at haul-out sites to give a population at mean level usage. Grey seals are found in high numbers in certain areas of the Celtic and Irish Sea with maximum densities (over 150 seals 25 km^{-2} area) found to occur along certain coastal locations of Ireland and Wales. In particular, Lleyn Peninsula and West Hoyle Bank in Wales and the waters surrounding Lambay Island, as well as the southeast tip (Saltee Islands) of Ireland, appear to be hotspots for this species (Appendix H: Figure H.1).

SCOS (2014) described telemetry studies that have been undertaken by tagging grey seals at five SACs across the UK (Pembrokeshire Marine, Lleyn Peninsula and the Sarnau, Monach Islands, Isle of May, and Berwickshire and North Northumberland Coast). The results from all five SACs are illustrated in Figure 4.2 and indicate that both adults and pups travel between SACs; for example, seals have been shown to travel between Pembrokeshire Marine SAC, Lleyn Peninsula and the Sarnau SAC and the Saltee Islands SAC (Ireland).

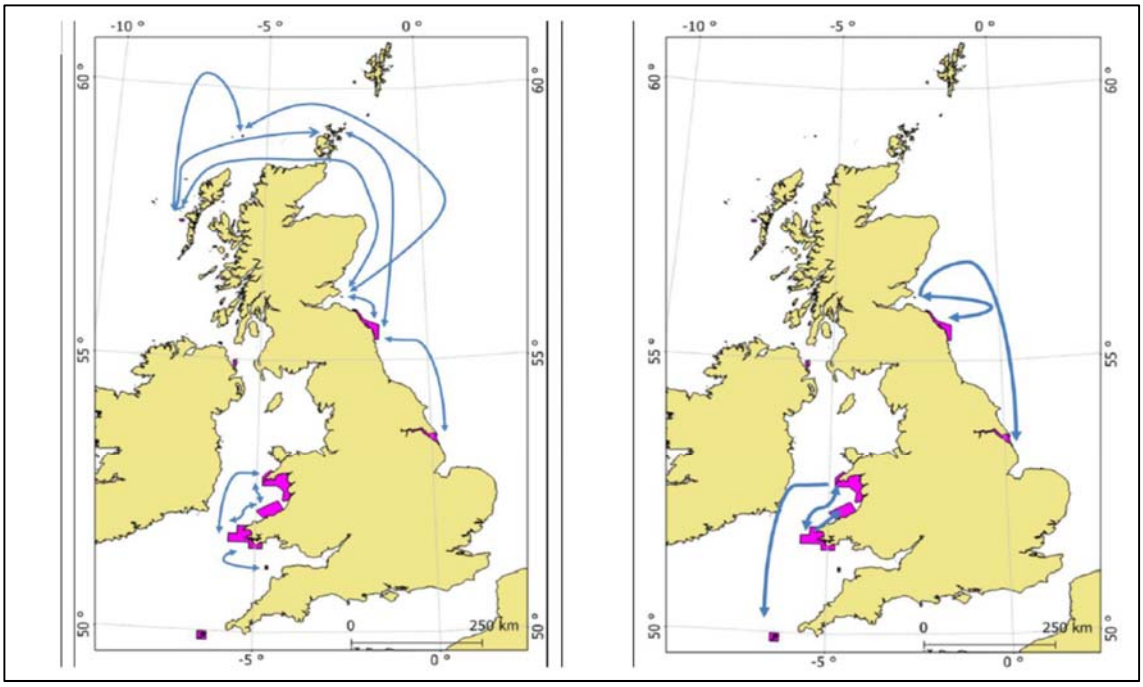


Figure 4.2 : The movements of grey seal adults (left) and pups (right) between SACs (for which grey seals are primary or qualifying features). Maps reproduced from SCOS (2014).

Strong, *et al.* (2006) carried out grey seal monitoring at the Pembrokeshire Marine SAC incorporating Ramsey Island whilst Büche and Stubbings (2014 and 2015) carried out yearly grey seal breeding censuses on Skomer Island (an area incorporated into the Pembrokeshire Marine SAC). Grey seal monitoring surveys of the Pembrokeshire mainland and Ramsey Island yielded 875 and 1,309 pups respectively, during the 2005 monitoring. In addition, 1,043 grey seals (adults and juveniles) were recorded on Ramsey Island compared to 788 grey seals (adults and juveniles) on Pembrokeshire mainland (Strong *et al*., 2006). Skomer Island has 16 main breeding sites and lies to the south of St. Brides Bay, Pembrokeshire Marine SAC. Büche and Stubbings (2014) reported a total of 179 pups born on the island during 2013 with the first pup born in August 2013 and the last one born in November 2013. In addition, a total of seven pups turned up on Skomer Island that were not born there. The busiest month for pupping was October with a total of 92 pups born during this month. In 2014, Büche and Stubbings (2015) repeated the work and recorded a total of 240 pups born on Skomer Island, the highest ever to be recorded at this site. The first pup was born on the 1 August 2014 and the

last one born during November 2014. In addition, 11 pups turned up on Skomer that were not born there and as with 2013, the busiest month for pups was October 2014, with 107 born.

A total of 91 site visits by Kiely, *et al*. (2000) were made on the eastern Irish coast between June 1997 and December 1998. Six islands were identified as grey seal haul-out or breeding sites and from these, Lambay Island and St. Patrick Island were both deemed important due to high usage of these sites by both juvenile (young) and adult grey seals. Other studies undertaken between 2009 and 2012 by O'Cadhla *et al*. (2013) showed a pup production of 77 pups with an all-age-range seal population of between 270 and 347 individuals for the Lambay Island and Ireland's Eye location. This compared to 151 pups with an all-age-range seal population of between 529 and 680 individuals at the Saltee Islands.

Grey seals also occur year round in Cardigan Bay with Pesante *et al*. (2008b) reporting a consistent number of this species during both line transect (6,784 km travelled) and *ad libitum* (unplanned) trips (7,875 km travelled) with a total of 279 individuals and 110 individuals recorded for each survey type, respectively, between 2005 and 2007 inclusive.

From these studies, it is clear that grey seals from SACs have the ability to frequent the waters within and around the Wylfa Newydd Development Area. Given that grey seal individuals are known to move between MUs and "*data differences in genetic population structure between regions is not synonymous with MUs",* care needs to be taken when using the context of MUs and in particular when looking at grey seals and the West England and Wales MU (SCOS, 2014).

4.2.3 Telemetry Data

Data from tagging studies in the Irish Sea were examined in order to describe the extent of 'foraging trips' of grey seals in the Irish Sea (SCOS, 2014). The telemetry data included in this study were from adult grey seals tagged at Ramsey (n=7), Bardsey (n=4), and Hilbre Islands (n=7) in 2004 and from pups tagged at Anglesey in 2009 and 2010 (n=3 and 5), Bardsey in 2009 (n=2) and Ramsey in 2010 (n=7).

Over the lifetime of the tags, pups made an average of 58 trips per seal (over the average tag duration of 151 days) with a median trip duration of 0.92 days (95% CI 0.12-7.89) between haul-out locations and covered an average distance of 19.47 km. The greatest distance travelled by one pup was 435.8 km. Grey seal adults made fewer trips with an average of 41 trips per seal (over the average tag duration of 131 days) and covered less distance (average maximum of 16.94 km) with trips between haul-out locations lasting on average 0.75 days (as a median, 95%CI 0.12-5.61). The greatest distance travelled by one adult was 172.6 km. The tag data showed that seals often move between haul-out locations, in particular Lleyn Peninsula, Cardigan Bay and haul-out locations around the Isle of Anglesey (Figure 4.3) (SCOS, 2014).

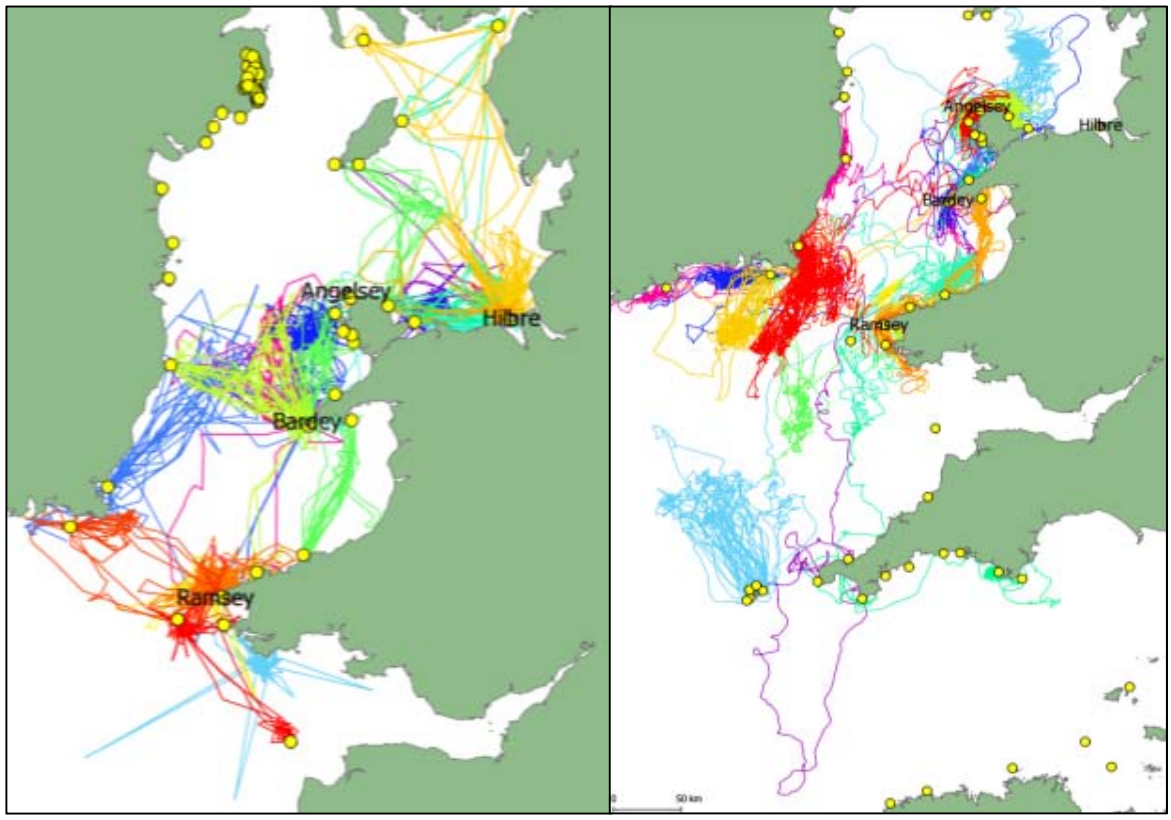


Figure 4.3 : Track of grey seal adults (left) and pups (right) tagged in Wales, colour-coded by individual. Known haul-out locations indicated with a yellow circle. Map reproduced from SCOS (2014).

The data show that most of the telemetry GPS locations around Anglesey were from seals tagged on Anglesey, although seals tagged at Bardsey, Hilbre and Ramsey also showed GPS locations around north Anglesey (Appendix H; Figure H.2). These data confirm that there is connectivity between seals of both the Pembrokeshire Marine SAC and the Lleyn Peninsula and the Sarnau SAC, and those of north Anglesey. The telemetry data show GPS locations recorded within the Wylfa Newydd Development Area from seals tagged on Anglesey (Appendix I; Figure I.2).

4.2.4 Presence off North Wales and Anglesey

Moulting for the Welsh grey seal populations occurs three to five months after breeding, normally in early spring. CCW (2009) stated that seals tend to use the islands to the east of Anglesey more during the winter months and Bardsey and West Hoyle Bank during the summer. The nearest grey seal breeding locations are located between Carmel Head and Cemlyn Bay (henceforth referred to as Carmel Head) and also The Skerries with the Lleyn Peninsula and Bardsey Island supporting the largest breeding colony in north Wales. Areas such as Carmel Head, North Stack, Trwyn Cilan and the Gwylan islands coast appear to be important locations during the breeding season with little usage outside of these times (CCW, 2009 and Figure 4.4).

Breeding in Welsh waters tends to occur between August and December; however, in north Wales, the grey seal pupping season spans from the beginning of September to the end of November and the number of births are thought to peak in mid-September (Westcott, 2002; Westcott and Stringell, 2003; 2004). The highest pup production estimates from the major breeding sites in Wales were 96 pups in North Wales (Stringell *et al*., 2014), 465 pups in Pembrokeshire in 2005 (Strong *et al*., 2006) and 379 pups born on Skomer and adjacent mainland sites in 2014 (SCOS, 2015).

4.2.4.1 Haul-Out Surveys

In terms of the north Wales population, estimates were given as between 242 and 307 grey seals (Westcott and Stringell, 2003; Westcott and Stringell, 2004 and Stringell *et al*., 2014). There are a number of major haul-out sites identified in three districts of north Wales (Lleyn Peninsula, Anglesey and West Hoyle Sandbank; Figure 4.4), all of which were surveyed between 2001 and 2003 for either pup production or site usage (Westcott, 2002; Westcott and Stringell, 2003; 2004). Since only three annual censuses have been undertaken in north Wales, trends in pup production over time cannot be confidently assessed, but pup abundance would appear to be stable or increasing within the limits of detection (limits include the presence of cryptic habitats and sea caves which are difficult to survey) and may indicate favourable conditions for SAC assessment (Stringell *et al*., 2014).

Studies of grey seals in north Wales identified the importance of the area for the 3% – 4% of the UK population that inhabits Welsh waters. Of the 15 haul-out sites visited in north Wales between January and December 2001 (Appendix H; Figure H.1), West Hoyle Sandbank had on average 35% of the total number of grey seals reported, with Ynys Môn and Bardsey Island having an average of 29% and 11% of the total number, respectively; other sites that showed significance as haul-out locations included Puffin Island and, to a lesser extent, The Skerries.

Following the survey undertaken between January and December 2001, Westcott and Stringell (2004) carried out a very similar survey at the 16 haul-out locations listed in table I.2 (Appendix I) between January 2002 and August 2003. Westcott and Stringell (2004) reported that whilst West Hoyle Sandbank maintained on average the greatest number of individuals (47% of the total number of grey seals reported), Bardsey and Ynys Dulas were ranked second and third most important with an average of 15% and 13% respectively. Other haul-out locations such as Puffin Island, Ynys Tudwal East and The Skerries had on average between 30 and 64 individuals hauled out on each site visit between 2002 and 2003. Westcott and Stringell (2004) considered a number of haul-out sites to be of significance around the Lleyn Peninsula and the Isle of Anglesey and these are illustrated in Figure 4.4

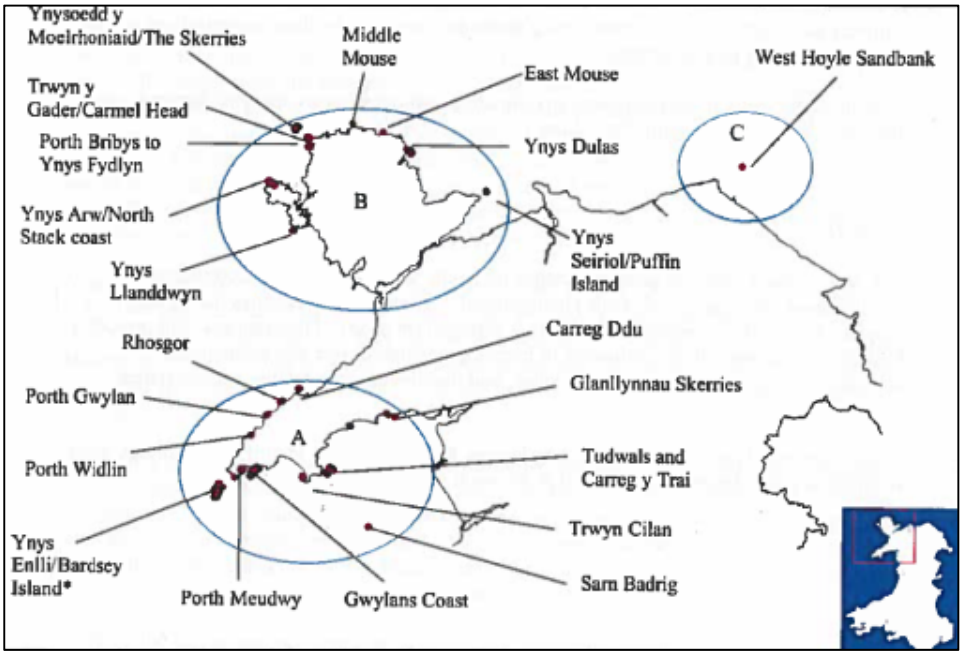


Figure 4.4 : Grey seal haul-out sites in 2002-2003. The three districts are: (A) Pen Llŷn (Lleyn Peninsula) including Ynys Enlli (Bardsey Island), (B) Ynys Môn (Anglesey) and (C) West Hoyle Sandbank. Map taken from Westcott and Stringell (2004).

4.2.4.2 At Sea Usage Maps

The seal density data presented in at-sea usage maps (Jones *et al*., 2013) around Anglesey (Appendix I; Figure I.3) show that grey seals tend to be concentrated around The Skerries and Lleyn Peninsula and to the east of north Anglesey towards the mainland and West Hoyle Bank. The density of grey seals at sea has previously been estimated in Jones *et al*. (2013) where grey seal telemetry and count data were combined to provide estimated usage. Around north Anglesey, the estimated density of grey seals reaches a maximum of 0.83 km^{-2} (95% CI 0-2.07) at The Skerries, which is approximately 7 km from the Wylfa Newydd Development Area. The estimated density of grey seals in waters that overlap with the Wylfa Newydd Development Area is 0.16 km^{-2} (95% CI 0.02-0.30).

4.2.4.3 Site-Specific Land-Based Surveys (pupping/haul-out site surveys)

A full report on the site-specific land-based surveys has been produced and included in Appendix C. The surveys yielded a total of five juvenile grey seals across all sites and survey dates. These seals were observed in the water near Porth Wnal (twice), Trwyn y Penrhyn, Cerrig Brith and Porth Padrig but none were seen to haul out.

Absence of seals hauling out or pupping within this survey area during a single winter period provides an indication of the general lack of suitability for breeding/hauled out grey seals at many of the sites within this area. However, surveys over one winter period only do not allow conclusions to be drawn as to the long-term usage of this area for seals, particularly when the start of the breeding season was missed. Despite this, whilst the surveys were underway, grey seals were known still to be pupping at Carmel Head (located to the west of Hen Borth (Figure 1.1 and Appendix C: Figure 2.1 (within report)). One grey seal pup was observed and photographed on 12 November 2016, with others confirmed anecdotally by walkers in the surrounding area around the same time. Therefore, any grey seal pups born within the survey area would have been observed as part of this survey.

4.2.4.4 Site-Specific Vessel Survey Data

The site-specific vessel-based transect surveys yielded a total of 35 individuals across the two survey blocks (Block 1 and Block 2) (Appendix E; table E.1). Of these, 20 individuals were reported within Block 1 and found to occur across all transects with the exception of Transects 1, 10 and 12. The closest grey seal sighting to the Wylfa Newydd Development Area was in Cemaes Bay immediately east of the Wylfa Newydd Development Area.

As noted in Section 2.2.1, the marine mammal sightings during the surveys up to September 2016 were recorded by the bird surveyors and, as such, may well represent an underestimate of the marine mammals available for sighting. Surveys occurring between September and July 2017 yielded 17 individuals with the majority (10 individuals) occurring between Transect 1 and Transect 6 inclusive.

4.2.4.5 Site-Specific Vantage Point Survey Data

Site-specific land-based VP surveys yielded a total of 193 grey seal sightings and 201 individuals. The average sightings rate (number of grey seals counted per hour of effort) was highest at VP3 across all months, with the highest monthly sightings rate in December of 0.67 grey seals hr^{-1} effort (table 4.1 and Figure 4.5). VP1 and VP2 had slightly lower average sightings rates than VP3. The highest sightings rate at VP1 was 0.26 grey seals hr^{-1} effort in May and at VP2 was 0.33 grey seals hr^{-1} effort in February and March. VP4 had the lowest average grey seal sightings rates though it had a maximum sightings rate similar to VP2 with 0.37 grey seals hr^{-1} effort during the month of September (table 4.1).

These data confirm that grey seals are present around north Anglesey and the Wylfa Newydd Development Area, year round. There appears to be a drop in the sightings rate between June and July across all VP locations followed by an increase in sightings rates between August and October. This may suggest some seasonal pattern in occurrence. However, as noted in Section 2.3.3 the marine mammal sightings during these surveys were recorded by the bird surveyors and, as such, it is expected that these data are underestimates.

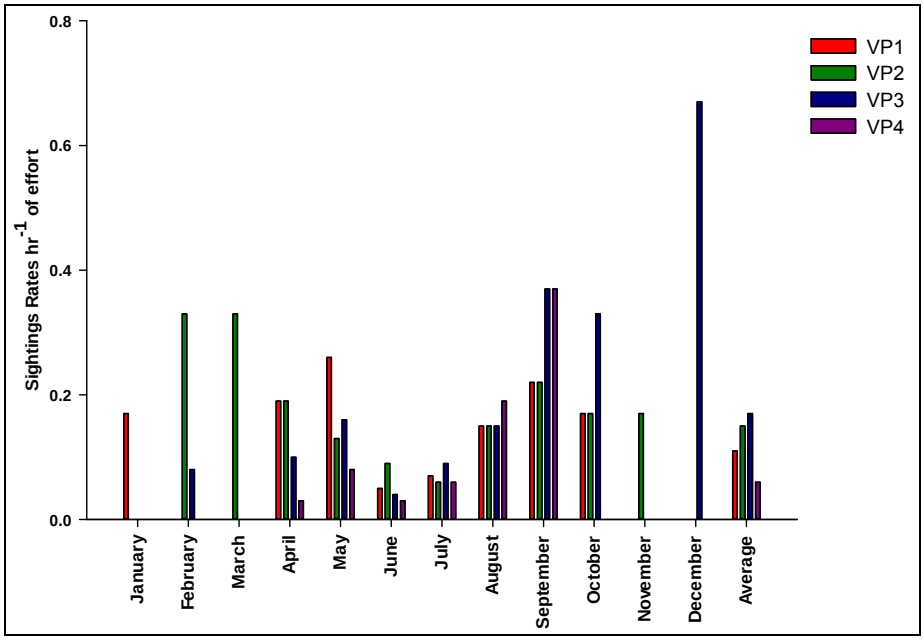


Figure 4.5: Grey seal sightings rates from VP surveys conducted between Jan 2011 and Sept 2014.

Table 4.1: Grey seal sightings rate from VP surveys conducted between Jan 2011 and Sept 2014. Months where the sightings rates exceeded the yearly average for each VP location are highlighted in green.

Month	Grey seal sightings rate (number hr^{-1} effort)			
	VP1	VP2	VP3	VP4
January	0.17	0.00	0.00	0.00
February	0.00	0.33	0.08	0.00
March	0.00	0.33	0.00	0.00
April	0.19	0.19	0.10	0.03
May	0.26	0.13	0.16	0.08
June	0.05	0.09	0.04	0.03
July	0.07	0.06	0.09	0.06
August	0.15	0.15	0.15	0.19
September	0.22	0.22	0.37	0.37
October	0.17	0.17	0.33	0.00
November	0.00	0.17	0.00	0.00
December	0.00	0.00	0.67	0.00
Average	**0.11**	**0.15**	**0.17**	**0.06**

4.2.4.6 Incidental/Casual Sightings

Sightings of grey seals were recorded incidentally during other boat-based surveys between April 2010 and November 2014. The primary objectives of these were fish, plankton or benthic surveys where marine mammals

were recorded opportunistically. Over the five years of incidental sightings data a total of 186 surveys days were conducted, from which between 25-28 grey seal individuals were recorded from eight sightings.

One particular sighting was of six individuals hauled out on rocks located to the southwest of Harry Furlough's Rocks (including the island Craig yr Iwrch) during a marine intertidal survey; these are the intertidal rock formations located to the west of VP4a (Figure 2.5). At this same location, a survey undertaken during the summer of 2015 yielded one sighting of grey seals (12 – 15 individuals).

Each of the other six sightings consisted of one grey seal individual, seen bobbing or travelling/feeding in the water column between Church Bay and Carmel Head (one individual), Cemlyn Bay (one individual), offshore from Wylfa Head (two separate individuals), Porth Wen (one individual) and to the southeast of Freshwater Bay (one individual) (Appendix F; Figure F.1).

Walkover surveys yielded five grey seal individuals on five separate occasions. Two individuals were recorded as bobbing one in Porth y Wylfa bay and the other off Cerrig Brith; one record seen hauled out at this latter location. The fourth sighting was recorded swimming off Wylfa Head with the final sighting in the water at Porth Wnal. These records have been incorporated into Figure E.1 (Appendix E).

In addition, marine mammal records yielded five sightings and individuals of grey seal during two-month Ground Investigation works taking place within Porth-y-pistyll. Each of these sightings was located within 1 km of the coast with all sightings occurring in July 2016.

All these sightings are within the vicinity of significant haul-out sites mentioned in Westcott and Stringell (2004).

4.2.5 Summary

Wales is thought to have between 3% and 4% (1,650 individuals) of the total UK pup production (SCOS, 2014), with north Wales being of importance for this Welsh population. In terms of the north Wales population, estimates were given as between 242 and 307 grey seals (Westcott and Stringell, 2003; 2004; Stringell *et al*., 2014). There are many suitable haul-out locations for grey seal across Anglesey, two of which (Carmel Head and The Skerries) are known for grey seal breeding (Westcott, 2002; Westcott and Stringell, 2004).

The pupping and haul-out survey of 2016-17 indicates that the north Anglesey coastline between Hen Borth and Porth Padrig does not provide suitable habitat for breeding with no grey seal pups recorded. It is known that grey seal pups were still present in the region (Carmel Head) during the surveys so, despite missing the beginning of the breeding season, any pups born within this area would have been seen. It is known that there are limited sites where grey seals are known to haul out, these being Harry Furlough's Rocks (including Craig yr Iwrch) and occasionally on Cerrig Brith. Despite this, no seals were found to haul out during the site-specific land-based seal surveys; five individuals were sighted in the water around Porth Wnal, Porth Padrig, Trwyn y Penrhyn and Cerrig Brith.

Telemetry data confirm that there is connectivity between seals in both the Pembrokeshire Marine SAC and the Lleyn Peninsula and the Sarnau SAC, with those in north Anglesey. The telemetry data also show GPS locations recorded within the Wylfa Newydd Development Area from seals tagged on Anglesey. The seal density data presented in at-sea usage maps (Jones *et al*., 2013) around Anglesey show that grey seals tend to be concentrated around The Skerries and Lleyn Peninsula and to the east of north Anglesey towards the mainland and West Hoyle Bank. Around north Anglesey, the estimated density of grey seals reaches a maximum of 0.83 km^{-2} (95% CI 0-2.07) at The Skerries and the estimated density of grey seals in waters that overlap with the Wylfa Newydd Development Area is 0.16 km^{-2} (95% CI 0.02-0.30). The VP surveys have confirmed that grey seals are present around north Anglesey and the Wylfa Newydd Development Area, year round. Where sightings were recorded during site-specific surveys, they were mostly reported as solitary animals and usually observed swimming or feeding in the coastal waters.

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Appendix A. Sea Watch Foundation Data (Evans *et al*., 2015a)

A.1 Harbour Porpoise

Figure A.2 displays the distribution of harbour porpoise sightings (combined opportunistic/casual sightings and effort-related sightings) in the Irish Sea (top) and more specifically the coast of Anglesey (bottom) as described by Evans, *et al*. (2015a). Figure A.2 shows plots of all sightings (opportunistic/casual sightings and effort-related) of harbour porpoise recorded by SWF between 2004 and 2014. These indicate similar distributions to those derived from data corrected for survey effort (Baines and Evans, 2012; Figure 3.3 and Figure 3.4). These sightings include those observations where calves were present. These SWF data confirm that harbour porpoise are present in Welsh waters year round, with the highest number of individuals sighted in June, July and August (Figure A.2). However, it should be noted that since these data contain casual/opportunistic records with no corresponding effort data, the lower number of individuals sighted in the winter months may reflect the reduction in number of surveys conducted throughout these months.

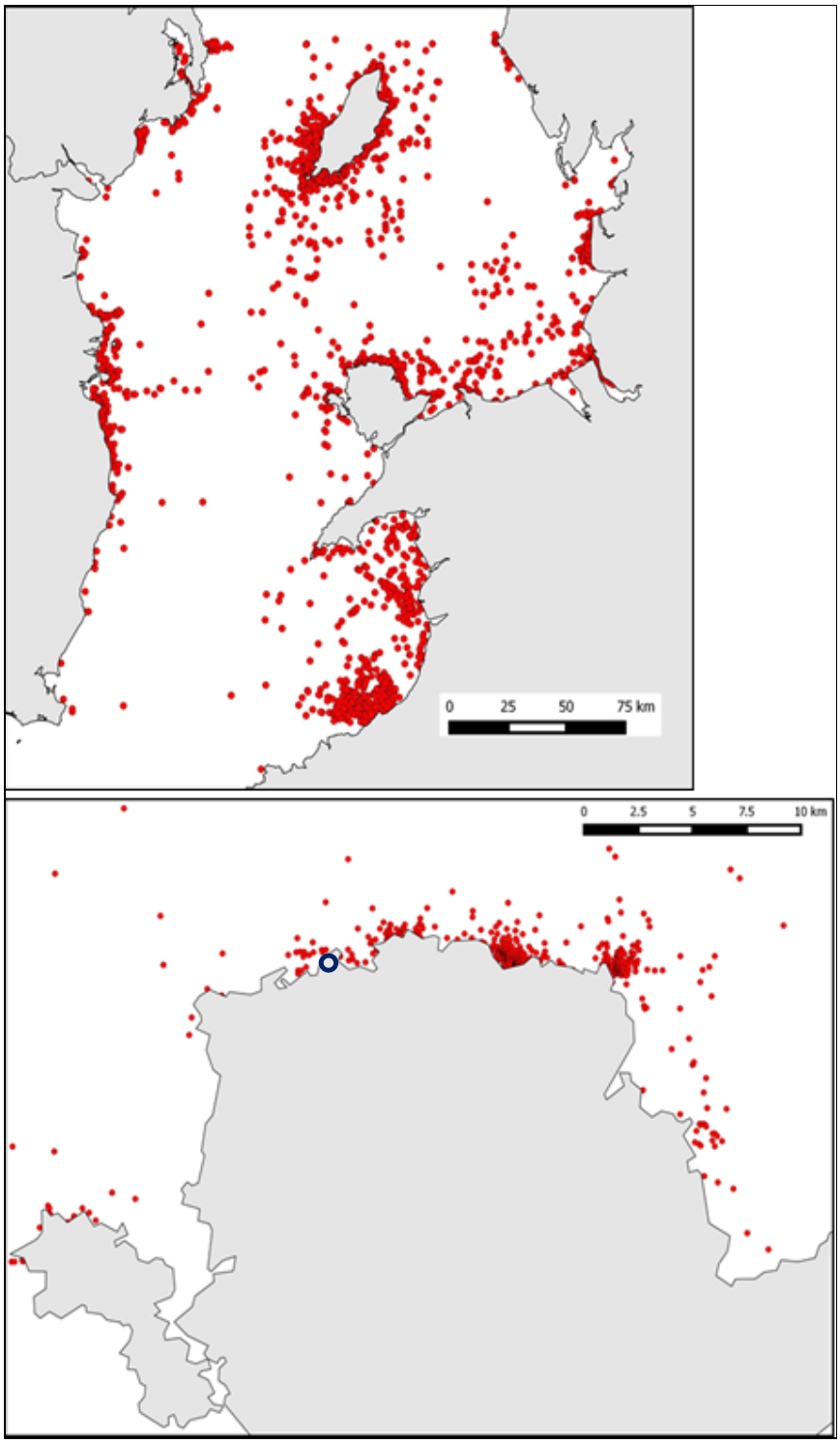

Figure A.1 : Distribution of harbour porpoise sightings (incidental /casual records and effort-based sightings) in the IS MU (top) and for the Isle of Anglesey (bottom). Data held by the Sea Watch Foundation and produced for Jacobs by Evans, *et al*. (2015a). Blue circle denotes the approximate area of the Wylfa Newydd development.

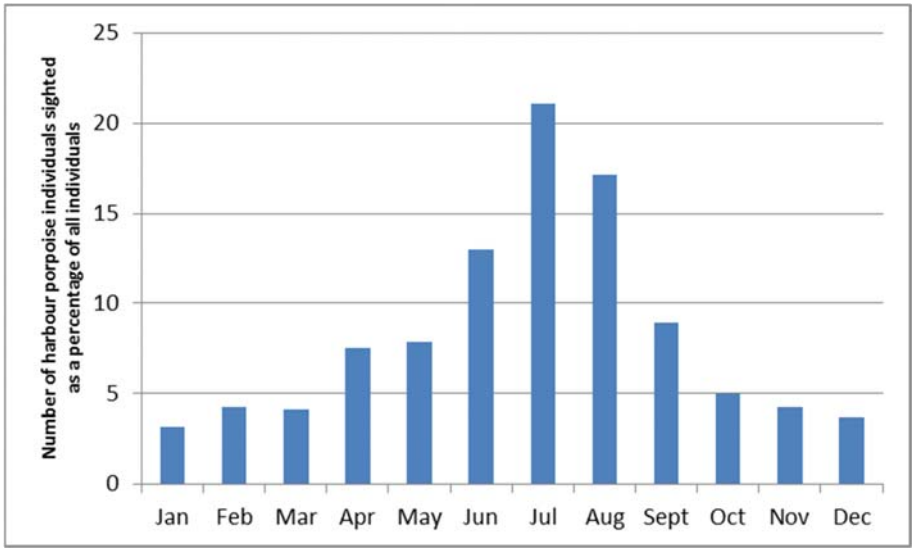

Figure A.2 : Average monthly distribution of harbour porpoise displayed as a percentage for 2004 to 2014 inclusive where n = 18,285 individuals. Data incorporates both incidental/casual records and effort-based sightings recorded by the Sea Watch Foundation. Reproduced from Evans, *et al*. (2015a).

A.2 Bottlenose dolphins

In the Irish Sea, a total of 33,174 bottlenose dolphins have been logged into the SWF database, accounting for more than 50% of the total number of individuals of cetacean recorded between 2004 and 2014 (table 3.1) (Evans *et al*., 2015a).

The SWF records of all sightings (opportunistic/casual sightings and effort-related) of bottlenose dolphins between 2004 and 2014 show that bottlenose dolphins are present year round in the IS MU with peak sightings recorded between June and September and fewest sightings occurring between January and March. It should be noted that since these data contain casual/opportunistic records with no corresponding effort data, the lower number of individuals sighted between January and March may be due to fewer surveys being conducted throughout these months. More specifically for north Anglesey, the bottlenose dolphin has been sighted year round with highest sightings during April and secondary peaks between November and January. These data suggest that dolphins migrate along the Welsh coast seasonally, and that the reduced number of sightings in the summer months off north Anglesey may be due to the movement of animals to elsewhere in the MU.

A plot of all sightings (casual and effort-related) of the species held on the SWF database shows the pattern of distribution for bottlenose dolphin in the IS MU and indicates high concentrations to the east and south of Anglesey (including West Hoyle Bank and south Lleyn Peninsula into Cardigan Bay) (Figure A.3 and Figure A.4).

There are also a large number of offshore sightings between the north Wales coast, west Wales coast and the Isle of Man (mainly in the eastern sector) as well as around the Isle of Man itself and the east coast of Ireland (Figure A.5 (top)). More specifically for the Wylfa Newydd Development Area, sightings from SWF database show sightings of bottlenose dolphin primarily to the northeast and east coast of Anglesey, with fewer sightings close to the Wylfa Newydd Development Area (though it should be noted that it is unknown if this is due to a lack of dolphin presence or a lack of survey effort in the area) (Figure A.5 (bottom)).

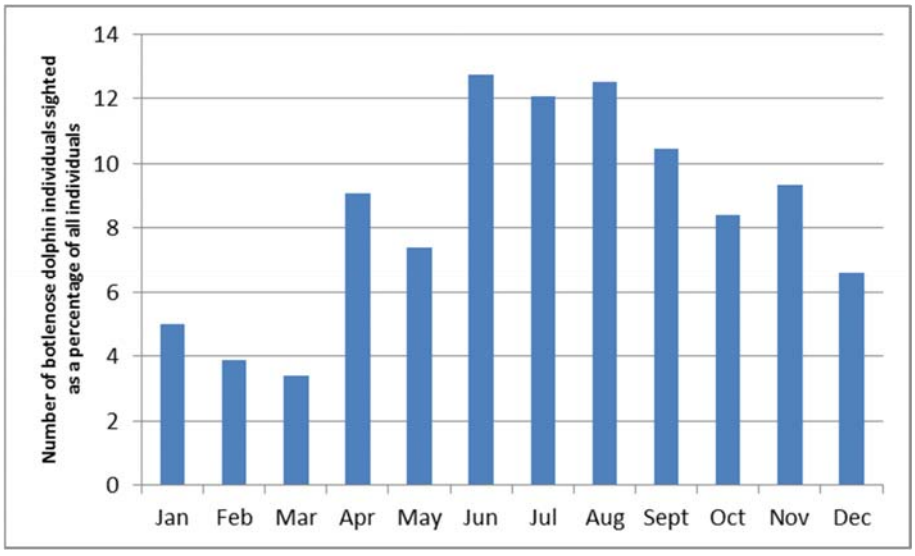

Figure A.3 : Average monthly distribution of bottlenose dolphin individuals displayed as a percentage between 2004 and 2014 inclusive in the IS MU and incorporates both incidental/casual records and effort-based sightings where n = 33,174 individuals. Reproduced from Evans, *et al.* (2015a).

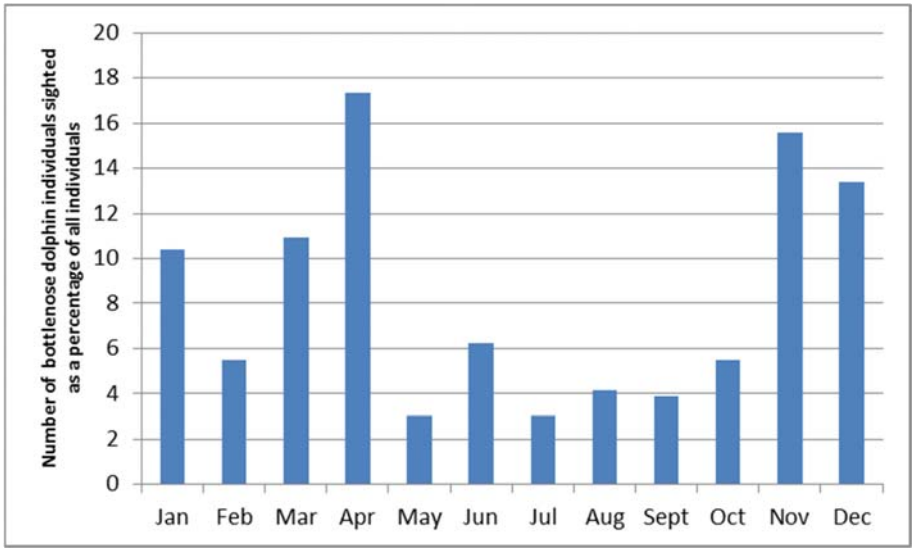

Figure A.4 : Average monthly distribution of bottlenose dolphin individuals displayed as a percentage between 2004 and 2014 inclusive in the waters surrounding Isle of Anglesey and incorporates both incidental/casual records and effort-based sightings where n = 6,480 individuals. Reproduced from Evans, *et al.* (2015a).

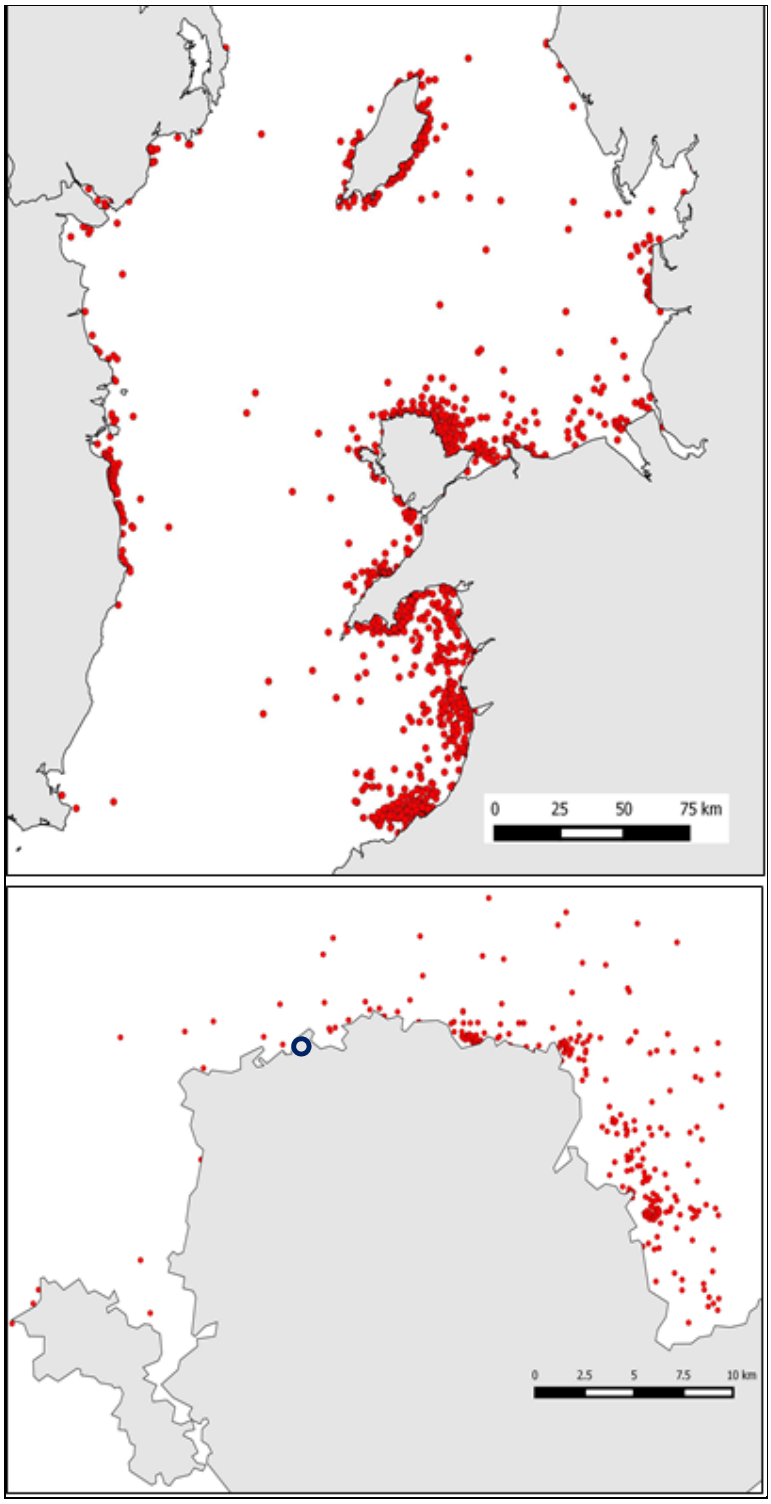

Figure A.5 : Distribution of bottlenose dolphin sightings (incidental /casual records and effort-based sightings) in the IS MU (top) and for the Isle of Anglesey (bottom). Data held by the Sea Watch Foundation and produced for Jacobs by Evans, *et al*. (2015a). Blue circle denotes the approximate area of the Wylfa Newydd development.

A.3 Risso's Dolphin

The SWF records of all sightings (opportunistic/casual sightings and effort-related) of Risso's dolphins between 2004 and 2014 show that Risso's dolphins are present year round in the IS MU with peak sightings recorded between late spring and early autumn (May to September). It should be noted that since these data contain casual/opportunistic records with no corresponding effort data, the lower number of individuals sighted in the winter months may be due to the lower number of surveys conducted throughout these months. Evans *et al*. (2015a) state that most sightings in north Wales (Lleyn Peninsula and Anglesey) actually occur between July and November, although around the Isle of Man, Risso's dolphin can be seen most months of the year.

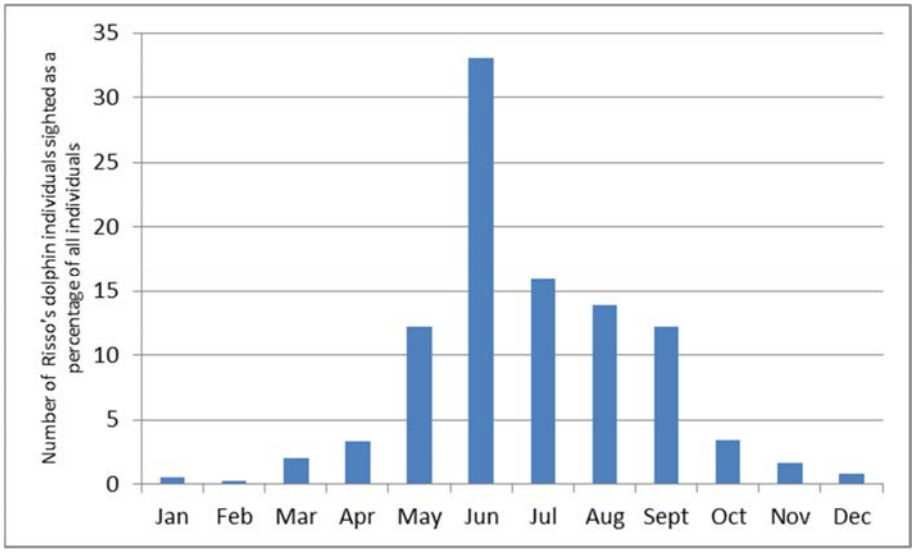

Figure A.6 : Average monthly distribution of Risso's dolphin individuals displayed as a percentage between 2004 and 2014 inclusive in the IS MU and incorporates both incidental/casual records and effort-based sightings (n = 3,976). Reproduced from Evans, *et al.* (2015a).

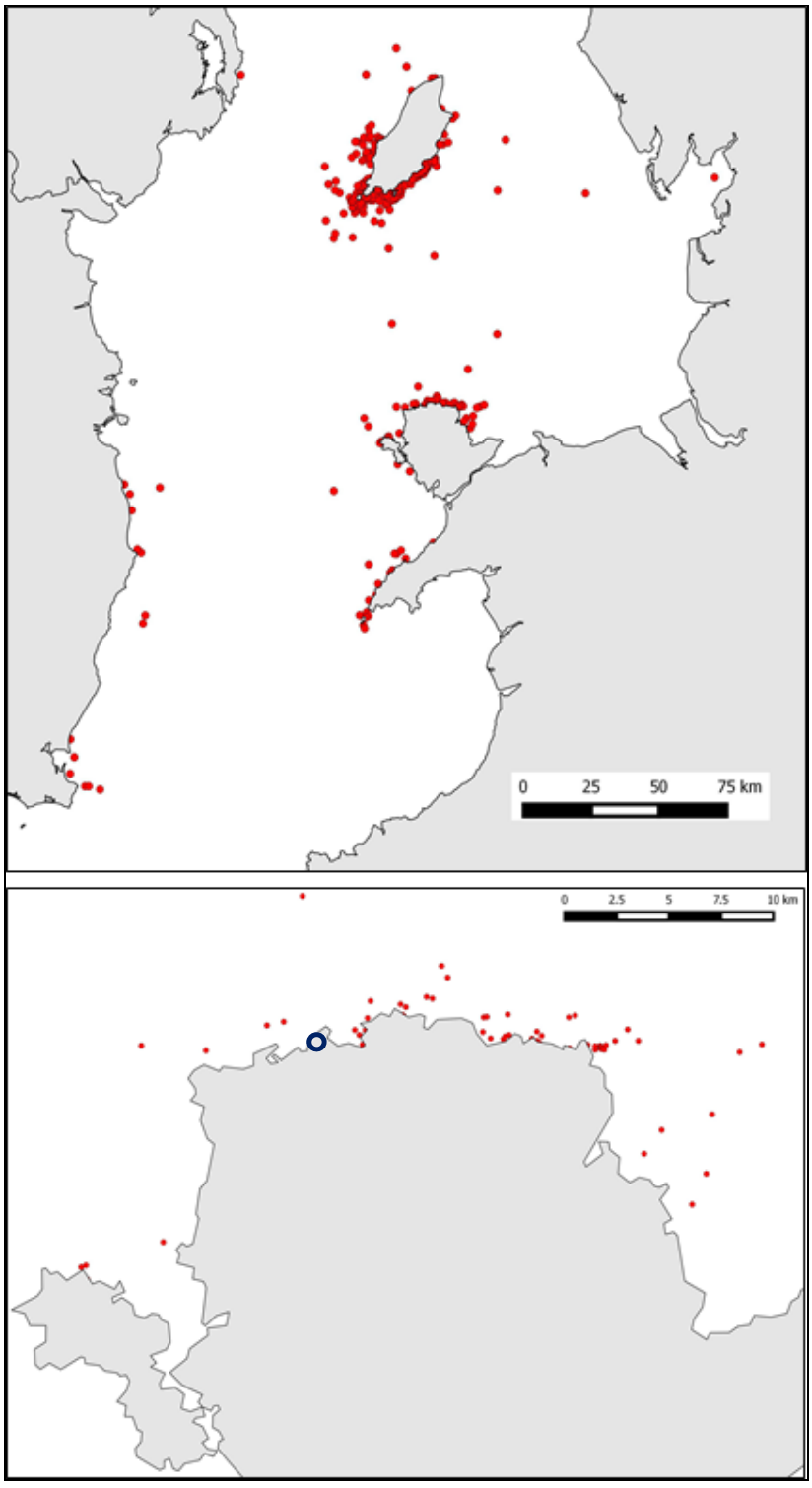

Figure A.7 : Distribution of Risso's dolphin sightings (incidental /casual records and effort-based sightings) in the IS MU (top) and for the Isle of Anglesey (bottom). Data held by the Sea Watch Foundation and produced for Jacobs by Evans, *et al*. (2015a). Blue circle denotes the approximate area of the Wylfa Newydd development.

Appendix B. PAM Analysis and Detection Maps

PAM Equipment

The PAM equipment consists of a pair of hydrophones, cables, amplifier, digitiser, laptop and PAMGuard software (see table 1 for equipment details). The hydrophones were spaced 30 cm apart and moulded in a fluid filled tube (streamer) set up to be towed behind a vessel and allowing for the detection and localisation (bearings) of dolphin and harbour porpoise echolocation clicks.

Table B.1 : Specifications of the towed PAM systems

TOWED HYDROPHONE	
Acoustic Sensors	2 x High Frequency Magrec. HP03 spherical ceramic with HP02 preamp (Low cut filter set at 2kHz). Nominal sensitivity 1.5kHz- 150kHz
Depth Sensor	Keller 4-20Ma 100m range. Automatically read and displayed within PAMGuard
Steamer Section	5m, 3 cm diameter polyurethane tube. Filled with Isopar M hydrophone fluid.
Cable	200m screened multi twisted pair, with strain relief and Kellum's grip towing eye.
TOPSIDE AMPLIFIER FILTER UNIT (Magrec HP/27ST)	
Supply Voltage	10-35 V DC
Supply current	200mA at 12 V
Input	Balanced input
Gain	0,10,20,30,40,50 dB
High Pass Filter	-6db/octave selectable 0, 40, 80, 400,1.6k, 3.2k
Output	2 X Balanced output via 3 pin XLR
Tans output	2 X Balanced output via 3 pin XLR (with 20kHz high pass filter for porpoise detection)
Headphone	Dual output via ¼" jack
Overall Bandwidth	10Hz-200kHz +/–3dB
GPS	Evermore USB/Serial GPS
COMPUTING	
Computer	Desktop or laptop PC with and wireless keyboard and mouse
Storage	External 2TB hard drive
Digitisers	National Instruments USB 6251 USB broad band Digital Acquisition
	Measurement Computing LS1028 (for logging depth)
	Sound card for MF recording if required
Software	PAMGuard with appropriate configurations

Harbour Porpoise Detections

For harbour porpoise, two event categories were defined:

Porpoise (PP)

One or more clicks following each other in an interval of less than a few hundred milliseconds and with similar bearing was considered as one animal as minimum, best and maximum number. Clicks must have a clear distinct frequency spectrum and / or wave-shape. Clicks or clusters of clicks with distinctively different bearings were considered as different animals.

Tracked porpoise (TP)

A train of clicks within a two minute period with increasing bearing over time was considered as tracked porpoise. This was considered as one animal as a minimum, best and maximum estimate provided that the time in-between clicks was less than a few hundred milliseconds. Longer intervals in-between clicks while still following a sensible track lead to a maximum estimate of two or three animals depending on the number and length of the period in-between successive clicks. Tracks occurring in an overlapping time period following their individual distinct change in bearing were considered as separate animals.

The following tables present the porpoise and tracked porpoise detections in each survey.

Table B.2 : All porpoise click detections identified on 29th November 2016. TP= Tracked porpoise, PP= harbour porpoise. For each porpoise detection event the estimated minimum, best and maximum number of porpoise individuals are given.

Transect	Start	End	Event Type	Clicks	Minimum	Best	Maximum	Latitude	Longitude
1	08:39:00	08:40:24	TP	34	1	1	1	53.40517	-4.66451
1	08:41:27	08:42:39	TP	26	1	1	1	53.4121	-4.66534
1	08:42:21	08:43:12	TP	9	1	1	1	53.41464	-4.66571
1	08:43:29	08:44:08	PP	3	1	1	2	53.41792	-4.66582
1	08:44:01	08:44:48	TP	25	1	1	2	53.41953	-4.66569
3	10:06:22	10:06:47	PP	27	1	1	1	53.42782	-4.60381
4	11:02:06	11:02:06	TP	4	1	1	1	53.4567	-4.57765
4	11:03:38	11:03:47	PP	11	1	1	1	53.45228	-4.57722
4	11:04:00	11:04:13	TP	8	1	1	1	53.45124	-4.57718
4	11:04:04	11:04:20	TP	35	1	1	1	53.45104	-4.57717
4	11:04:37	11:04:43	PP	2	1	1	1	53.44946	-4.57703
4	11:04:42	11:04:45	PP	2	0	0	1	53.44922	-4.577
4	11:05:31	11:05:53	PP	3	1	1	1	53.44684	-4.57674
4	11:12:56	11:13:15	PP	9	1	1	2	53.42455	-4.57568
4	11:13:26	11:14:00	TP	11	1	1	2	53.42306	-4.57558
4	11:14:10	11:14:45	TP	12	1	1	1	53.42089	-4.57539
5	11:34:06	11:34:23	TP	15	1	1	1	53.42923	-4.54577
5	12:06:04	12:07:42	TP	9	1	1	1	53.52111	-4.55133

Transect	Start	End	Event Type	Clicks	Minimum	Best	Maximum	Latitude	Longitude
7	13:17:47	13:18:34	TP	17	1	1	1	53.51265	-4.48997
7	13:18:36	13:18:43	PP	2	1	1	1	53.51576	-4.4902
8	13:51:57	13:52:41	TP	8	1	1	2	53.43123	-4.45542
9	14:00:38	14:00:49	TP	5	1	1	1	53.44134	-4.42613
10	14:39:55	14:40:02	TP	9	1	1	1	53.46139	-4.39649
10	14:40:00	14:40:18	TP	27	1	1	1	53.46109	-4.39647
10	14:47:16	14:47:32	TP	17	1	1	1	53.43395	-4.39519
8	13:51:57	13:52:41	TP	8	1	1	2	53.43123	-4.45542
9	14:00:38	14:00:49	TP	5	1	1	1	53.44134	-4.42613

Table B.3 : All porpoise click detections identified on 20th December 2016. TP= Tracked porpoise, PP= harbour porpoise. For each porpoise detection event the estimated minimum, best and maximum number of porpoise are given.

Transect	Start	End	Event Type	Clicks	Minimum	Best	Maximum	Latitude	Longitude
4	08:54:40	08:55:54	TP	18	1	1	1	53.45213	-4.57756
4	08:55:31	08:56:27	TP	10	1	1	1	53.45449	-4.57763
4	08:57:06	08:57:23	PP	4	1	1	1	53.4588	-4.57758
4	08:58:17	08:58:46	TP	11	1	1	1	53.46205	-4.57828
6	10:18:54	10:19:03	TP	9	1	1	1	53.4372	-4.51632
6	10:24:00	10:24:43	TP	19	1	1	1	53.4509	-4.5169
6	10:24:01	10:24:43	PP	5	1	1	1	53.45094	-4.51692
6	10:32:38	10:32:58	PP	4	1	1	1	53.47416	-4.51811
7	11:40:18	11:40:54	TP	4	1	1	3	53.42631	-4.483
8	12:10:08	12:10:52	TP	7	1	1	1	53.47736	-4.45802

Table B.4 : All porpoise click detections identified on 18th January 2017. TP= Tracked porpoise, PP= harbour porpoise. For each porpoise detection event the estimated minimum, best and maximum number of porpoise are given.

Transect	Start	End	Event Type	Clicks	Minimum	Best	Maximum	Latitude	Longitude
1	09:59:20	10:00:42	TP	54	1	1	2	53.4104	-4.6646
1	09:59:58	09:59:59	PP	7	1	1	1	53.4122	-4.6647
1	10:00:20	10:01:03	TP	19	1	1	2	53.4132	-4.6648
1	10:00:42	10:00:49	PP	4	1	1	1	53.4142	-4.6649
5	13:23:23	13:23:43	TP	9	1	1	1	53.4935	-4.5498

Table B.5 : All porpoise click detections identified on 17th February 2017. TP= Tracked porpoise, PP= harbour porpoise. For each porpoise detection event the estimated minimum, best and maximum number of porpoise are given.

Transect	Start	End	Event Type	Clicks	Minimum	Best	Maximum	Latitude	Longitude
4	10:53:39	10:54:30	TP	75	1	1	2	53.4243	-4.5725

Transect	Start	End	Event Type	Clicks	Minimum	Best	Maximum	Latitude	Longitude
4	11:10:46	11:11:05	TP	8	1	1	1	53.4722	-4.5769
4	11:13:24	11:13:42	TP	12	1	1	1	53.4789	-4.5776
4	11:23:16	11:24:35	PP	74	2	3	5	53.5064	-4.5795
5	11:36:49	11:37:18	TP	10	1	1	1	53.5127	-4.5458
5	11:38:20	11:38:32	TP	5	1	1	2	53.5089	-4.5464
5	11:49:01	11:49:02	PP	6	1	1	1	53.4815	-4.5469
5	12:00:44	12:01:27	TP	4	1	1	2	53.4498	-4.5465
6	12:23:24	12:23:42	TP	9	1	1	2	53.4262	-4.5148
6	12:43:44	12:44:46	TP	12	1	1	2	53.4810	-4.5175
6	12:58:09	12:59:28	TP	29	1	1	1	53.5186	-4.5210
6	12:59:30	13:00:12	PP	2	1	1	2	53.5227	-4.5215
7	13:21:25	13:21:28	PP	3	1	1	1	53.4865	-4.4888
7	13:23:34	13:25:28	TP	26	1	2	2	53.4808	-4.4885
7	13:40:08	13:40:22	TP	7	1	1	1	53.4342	-4.4849
8	14:08:48	14:09:41	TP	9	1	1	1	53.4577	-4.4561
8	14:08:48	14:09:24	TP	18	1	1	1	53.4577	-4.4561
8	14:09:15	14:09:58	TP	42	1	1	1	53.4593	-4.4562
8	14:10:14	14:10:33	PP	16	1	1	2	53.4620	-4.4563
8	14:10:31	14:12:09	TP	41	1	1	2	53.4626	-4.4563
8	14:32:39	14:32:47	TP	6	1	1	1	53.5233	-4.4603
9	14:40:04	14:40:18	TP	18	1	1	2	53.5142	-4.4294
9	14:59:42	15:00:35	TP	8	1	1	1	53.4606	-4.4275
9	15:07:34	15:08:47	TP	25	1	1	1	53.4401	-4.4259
9	15:09:53	15:11:09	TP	51	2	2	2	53.4332	-4.4257
12	16:33:11	16:33:54	TP	55	1	1	1	53.4376	-4.3351
12	16:34:02	16:34:05	TP	7	1	1	1	53.4402	-4.3349
12	16:37:42	16:37:55	TP	22	1	1	1	53.4495	-4.3349
12	16:39:27	16:39:35	TP	15	1	1	1	53.4541	-4.3350
12	16:40:35	16:40:59	TP	6	1	1	2	53.4565	-4.3352
12	16:43:39	16:44:43	TP	7	1	1	3	53.4667	-4.3362

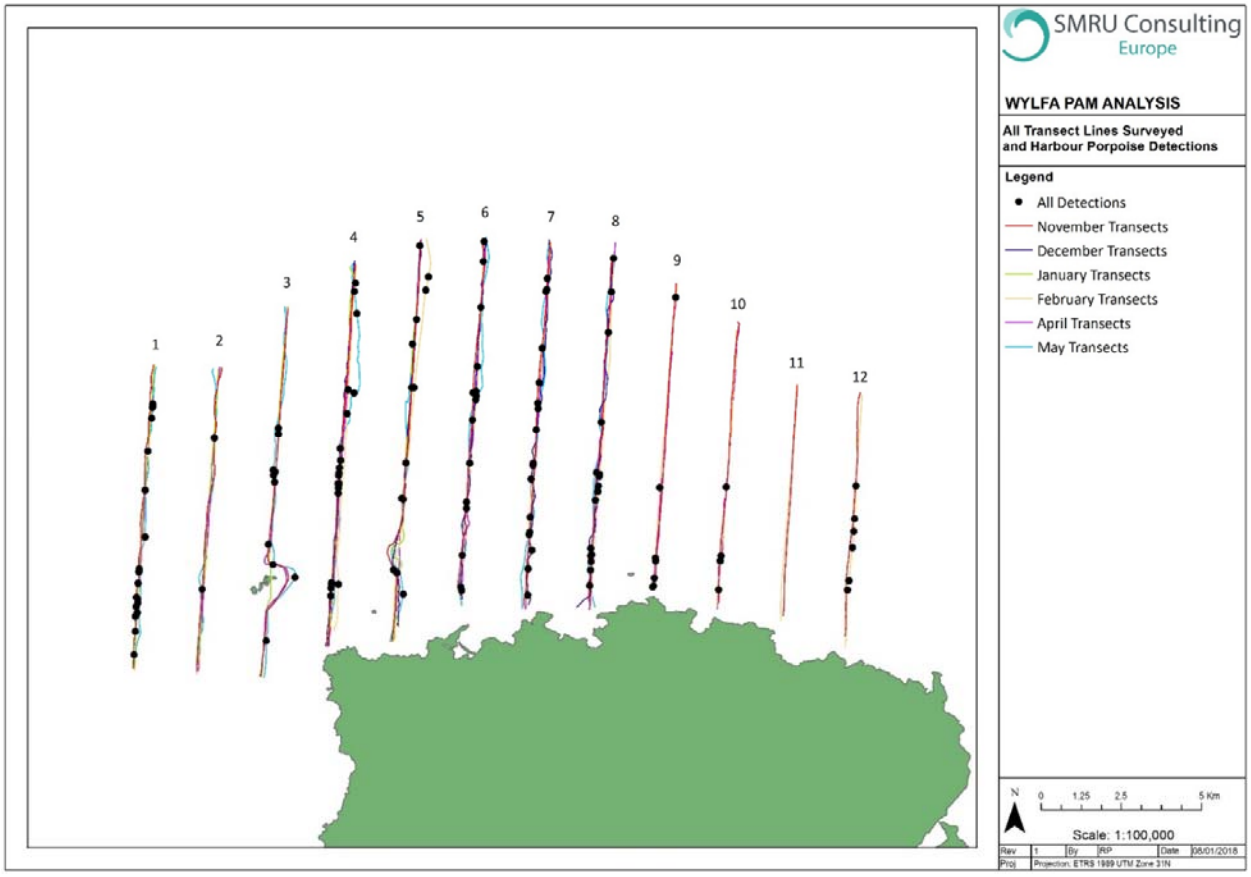

Figure B.1 : All harbour porpoise detections and the survey effort transect lines completed for each survey month (November 2016 to May 2017).

Table B.6 : Details of the survey effort conducted, the number of harbour porpoise detections and the detection rate by transect line 29 November 2016.

Transect	Distance (km)	Number of harbour porpoise detections	Harbour porpoise detections km^{-1}
1	9.53	8	0.839
2	9.58	1	0.104
3	12.18	4	0.328
4	11.98	9	0.751
5	12.77	3	0.235
6	11.16	1	0.090
7	11.39	2	0.176
8	10.75	1	0.093
9	9.53	2	0.210
10	8.82	2	0.227
11	7.23	0	0.000
12	7.65	0	0.000
Total	**122.57**	**33**	**0.269**

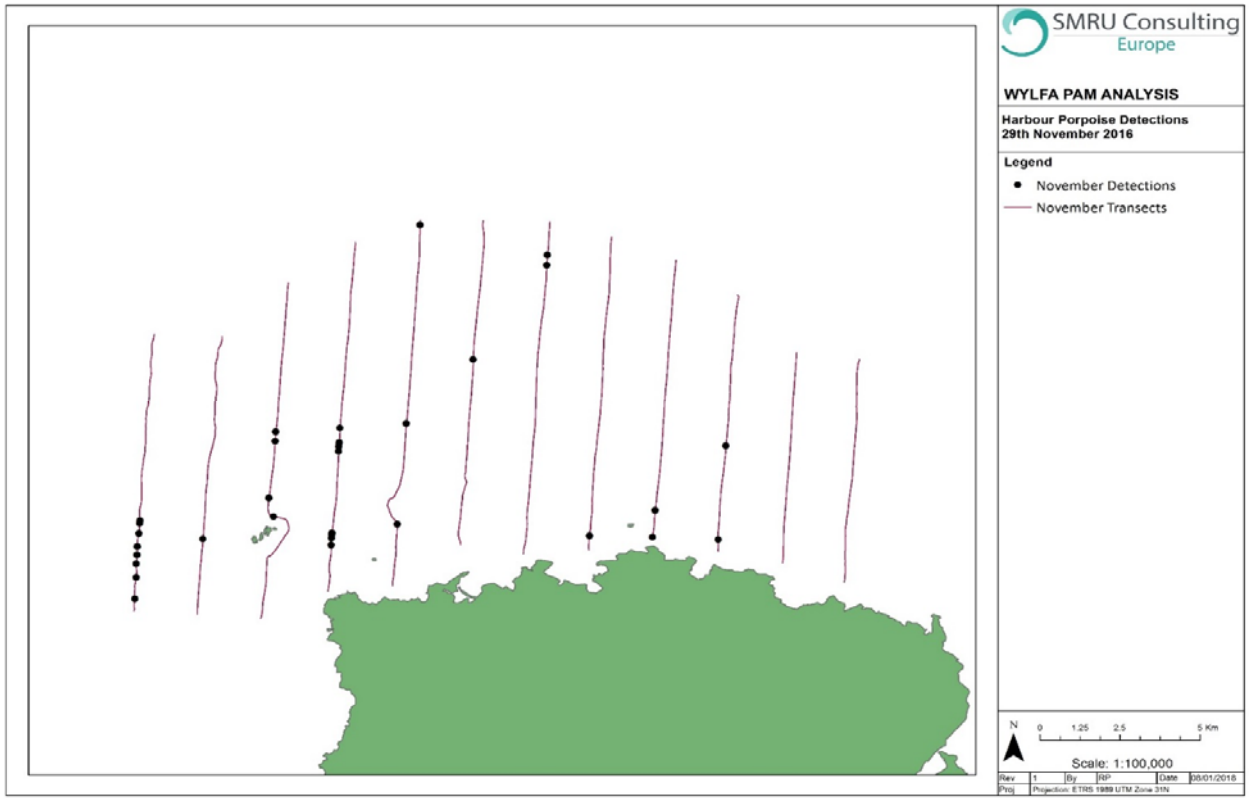

Figure B.2 : Harbour porpoise detections 29 November 2016.

Table B.7 : Details of the survey effort conducted, the number of harbour porpoise detections and the detection rate by transect line 20 December 2016.

Transect	Distance (km)	Number of harbour porpoise detections	Harbour porpoise detections km^{-1}
4	12.14	5	0.412
5	12.02	1	0.083
6	11.44	8	0.699
7	11.71	8	0.683
8	11.44	6	0.524
Total	**58.75**	**28**	**0.477**

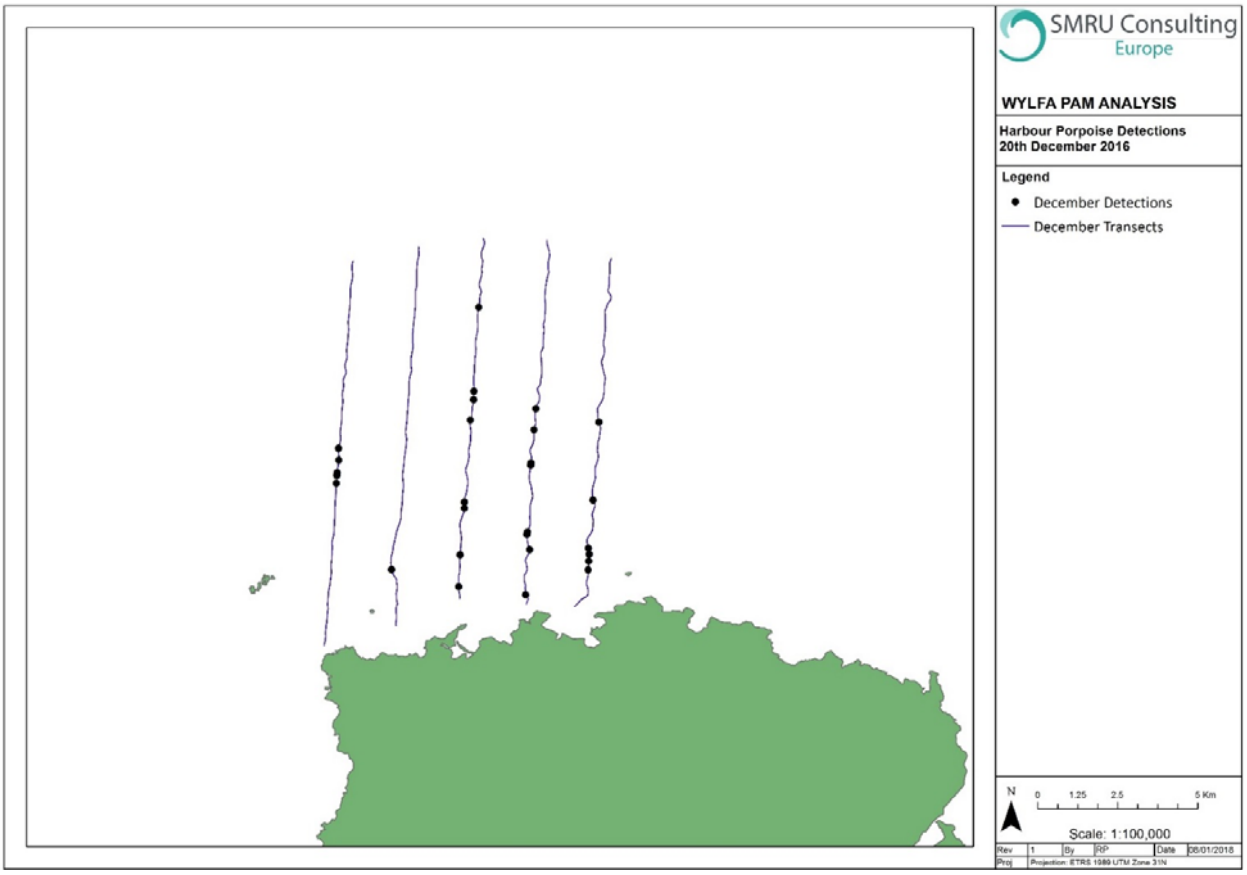

Figure B.3 : Harbour porpoise detections 20 December 2016.

Table B.8 : Details of the survey effort conducted, the number of harbour porpoise detections and the detection rate by transect line 18 January 2017.

Transect	Distance (km)	Number of harbour porpoise detections	Harbour porpoise detections km^{-1}
1	9.57	3	0.313
2	9.56	0	0.000
3	11.67	2	0.171
4	12.00	0	0.000
5	12.98	1	0.077
Total	**55.78**	**6**	**0.108**

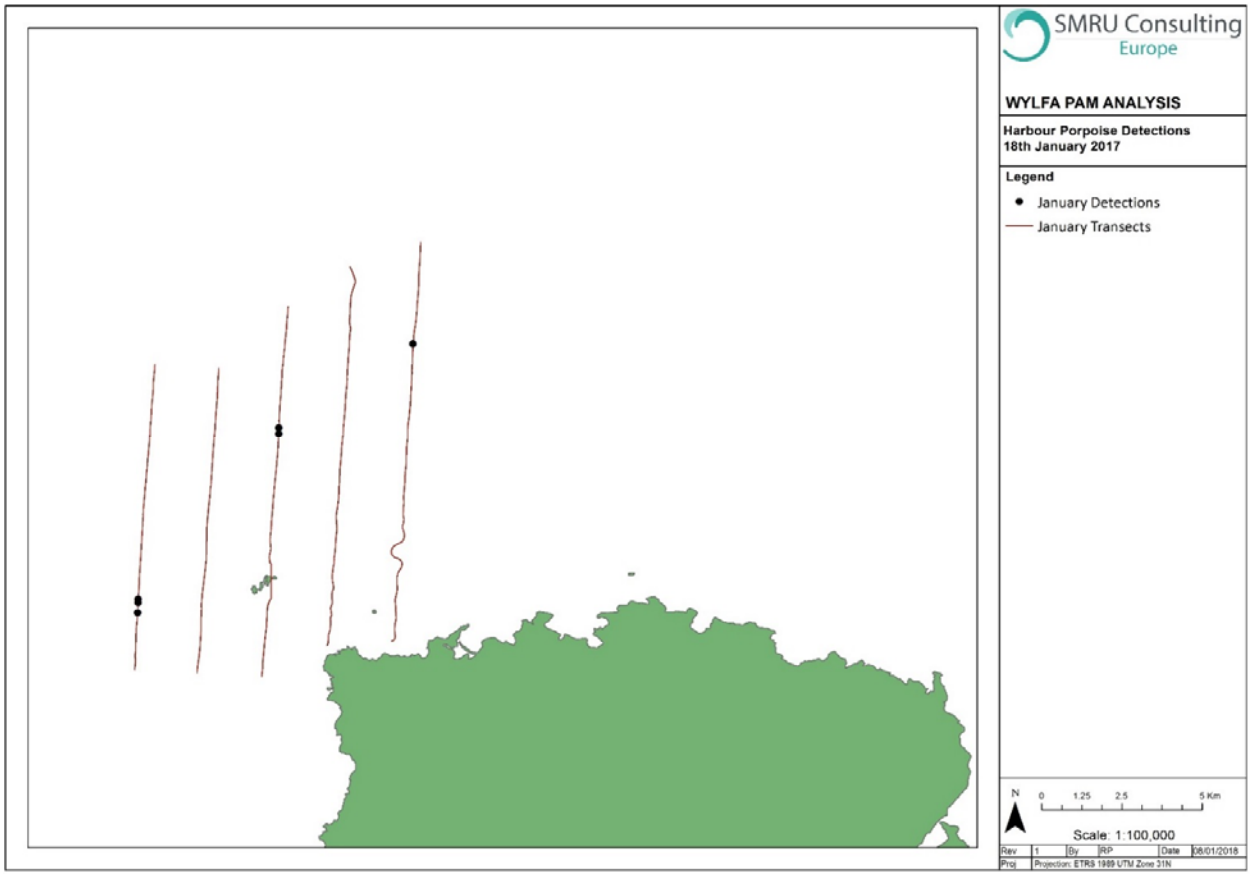

Figure B.4 : Harbour porpoise detections 18 January 2017.

Table B.9 : Details of the survey effort conducted, the number of harbour porpoise detections and the detection rate by transect line for 17th February 2017.

Transect	Distance (km)	Number of harbour porpoise detections	Harbour porpoise detections km^{-1}
4	11.47	5	0.436
5	12.57	4	0.318
6	11.47	5	0.436
7	11.51	3	0.261
8	11.09	5	0.451
9	9.56	5	0.523
10	8.69	0	0.000
11	7.40	0	0.000
12	7.91	6	0.759
Total	**91.67**	**33**	**0.360**

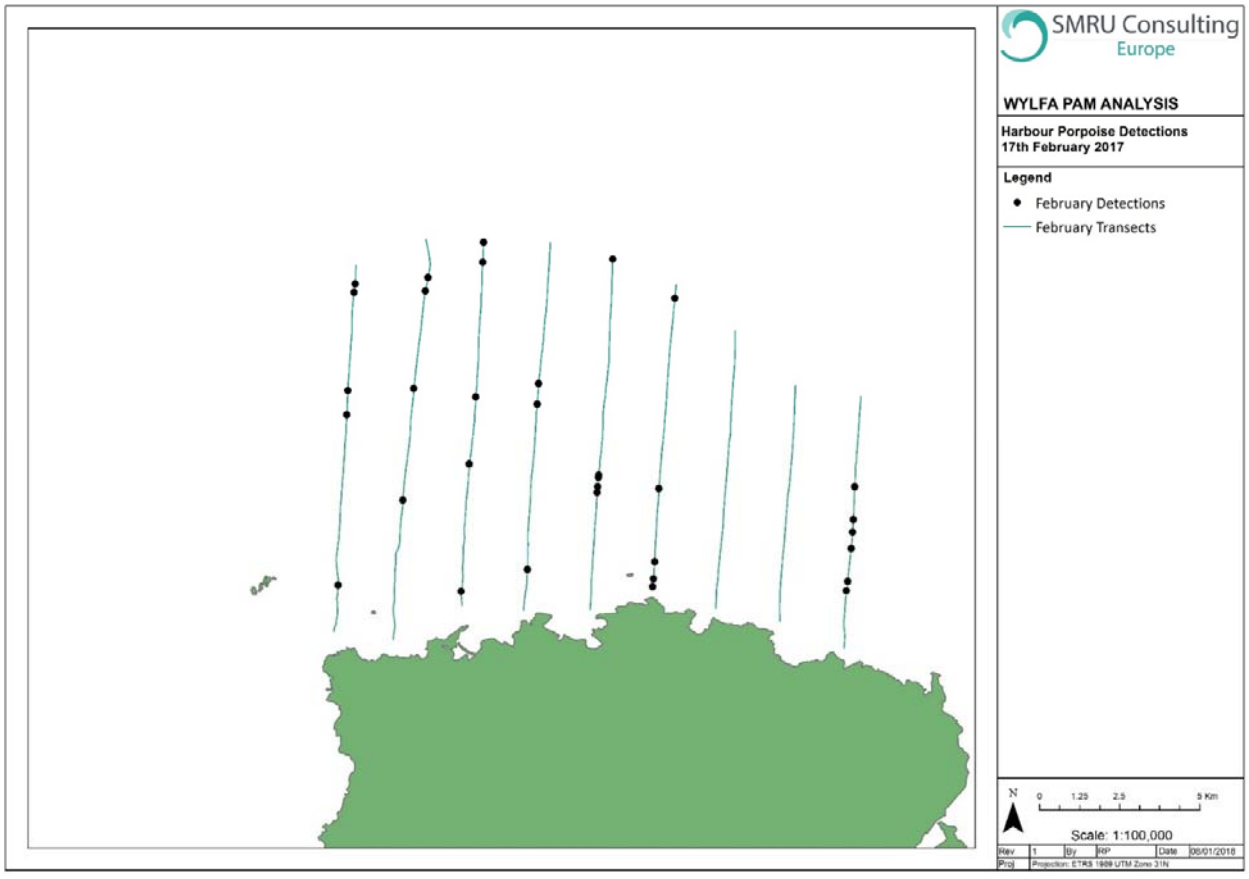

Figure B.5 : Harbour porpoise detections 17 February 2017.

Table B.10 : Details of the survey effort conducted, the number of harbour porpoise detections and the detection rate by transect line 6 April 2017.

Transect	Distance (km)	Number of harbour porpoise detections	Harbour porpoise detections km^{-1}
1	7.78	1	0.129
2	9.54	0	0.000
3	12.29	0	0.000
4	12.00	0	0.000
5	12.59	1	0.079
6	11.15	1	0.090
7	11.48	3	0.261
8	11.54	4	0.347
9	9.54	0	0.000
10	9.00	2	0.222
Total	**106.90**	**12**	**0.112**

Figure B.6 : Harbour porpoise detections 6 April 2017.

Table B.11 : Details of the survey effort conducted, the number of harbour porpoise detections and the detection rate by transect line 12 May 2017.

Transect	Distance (km)	Number of harbour porpoise detections	Harbour porpoise detections km^{-1}
1	9.52	6	0.630
2	9.71	2	0.206
3	12.51	4	0.320
4	12.26	2	0.163
5	12.78	3	0.235
6	11.66	0	0.000
7	11.63	1	0.086
Total	**80.07**	**18**	**0.237**

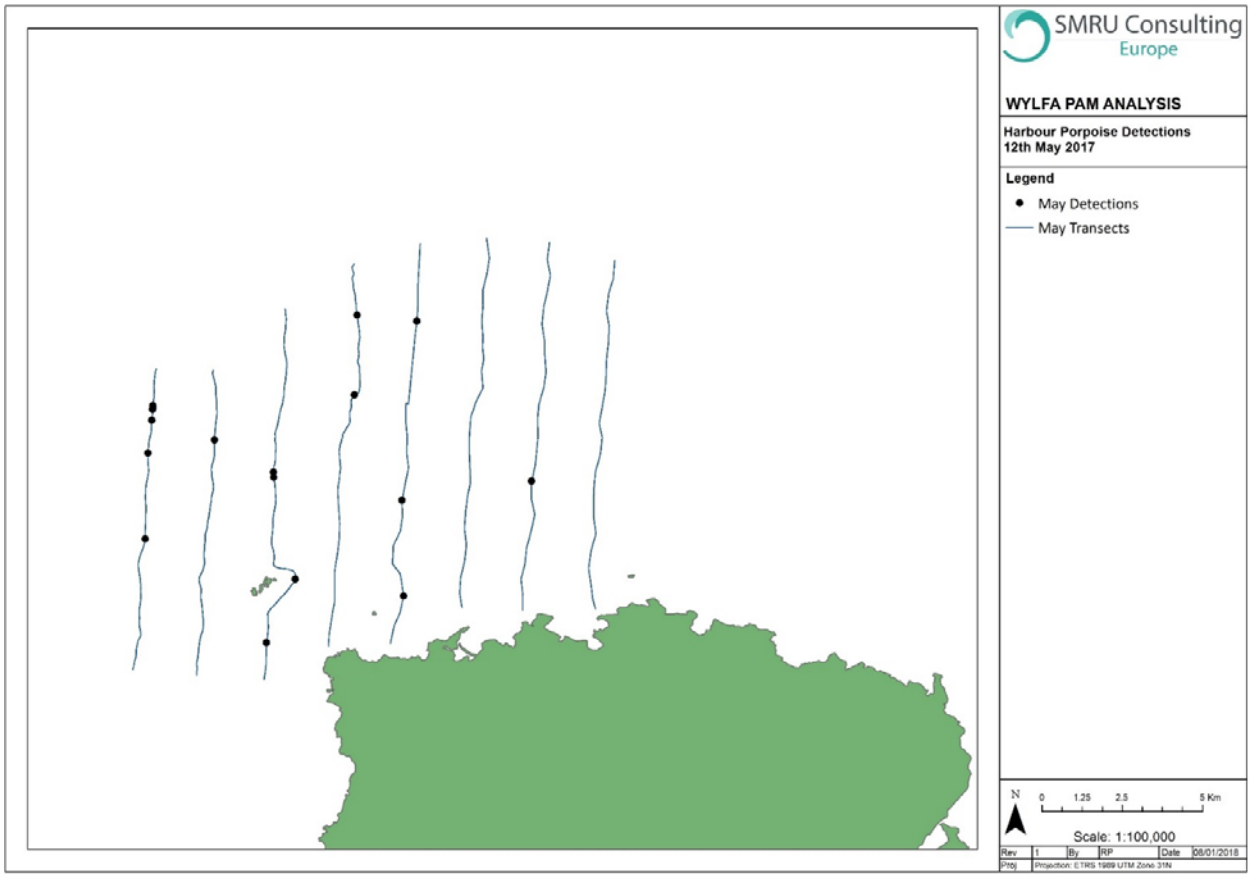

Figure B.7 : Harbour porpoise detections 12 May 2017.

Appendix C. Site-Specific C-POD Surveys Report

See separate report

C-POD MONITORING OF CETACEANS FROM 07/10/2016 – 03/11/2017: WYLFA NEWYDD DEVELOPMENT AREA, NORTH ANGLESEY COAST, WALES, UK

Prepared on behalf of

JACOBS®

FINAL REPORT: REV 1.0

January 2018

OSC™
OCEAN SCIENCE CONSULTING

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Suggested citation:
OSC (2018): C-POD monitoring of cetaceans from 07/10/2016 – 03/11/2017: Wylfa Newydd Development Area, north Anglesey coast, Wales, UK. Final Report: Rev 1.0 *for Jacobs.* Ocean Science Consulting Limited, Dunbar, Scotland, **32** pp.

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LIST OF ACRONYMS

ADCP	Acoustic Doppler Current Profiler
ANOVA	ANalysis Of VAriance (ANOVA)
BC	Baseline C-POD location in Centre
BE	Baseline C-POD location in East
BW	Baseline C-POD location in West
C-POD	Autonomous underwater echolocation-click detectors
cSAC	Candidate Special Area of Conservation
CTD	Conductivity Temperature Depth profiler
DNM	Detection Negative Minutes
DPM	Detection Positive Minutes
EC	European Community
EDR	Effective Detection Radius
EIA	Environmental Impact Assessment
EU	European Union
G1SST	Global 1km Sea Surface Temperature
GLM	Generalised Linear Model
ICI	Inter-Click Interval
IQR	Inter-Quartile Range
h	Hour
LAT	Lowest Astronomical Tide
MMO	Marine Mammal Observer
NaN	Not a Number
NASA	National Aeronautics and Space Administration
NBHF	Narrow-Band High Frequency
NetCDF	Network Common Data Form
OSC	Ocean Science Consulting Limited
OSCAR	Ocean Surface Current Analysis Real-time
P.DPM	Number of Minutes with a Positive Detection calculated as a Proportion of total recording minutes for each day
PAM	Passive Acoustic Monitoring
PSU	Practical Salinity Units
ROC	Receiver Operating Characteristic
SD	Secure Digital [card]
SDev	Standard Deviation
SNPP	Suomi-National Polar-orbiting Partnership
SONAR	Sound Navigation And Ranging
SST	Sea Surface Temperature
SWH	Significant Wave Height
UK	United Kingdom
VIRRS	Visible Infrared Imaging Radiometer Suite
XLSX	Microsoft Excel open spreadsheet files

1. SUMMARY

During a 13-month baseline survey period from 07/10/2016–03/11/2017, Passive Acoustic Monitoring (PAM) was undertaken with autonomous echolocation-click detectors called C-PODs, at three locations, adjacent to the Existing Power Station in Cemlyn and Cemaes Bays, north Anglesey coast, Wales, UK, hereinafter referred to as Wylfa Newydd Development Area (WNDA). C-PODs logged successfully throughout a period of 393 days, with only temporary loss of one C-POD (3BE), which broke free on three occasions, so data from those periods were excluded from analyses. Cetacean clicks in the form Detection Positive Minutes (DPM) were compared between three C-POD locations to the west (1BW), centre (2BC), and east (3BE) of the decommissioned power station, for both harbour porpoise (*Phocoena phocoena*) and dolphin species. DPM in relation to environmental parameters such as chlorophyll-*a*, Sea Surface Temperature (SST), empirical on-site Conductivity, Temperature and Depth (CTD) measurements, and tidal state were also investigated.

A total of 117,964 porpoise and 34,297 dolphin DPM were recorded throughout the study. C-PODs detected at least one porpoise and dolphin on each day of the survey period, but dolphins were not detected as frequently as porpoises. Peaks in porpoise detections were evident throughout autumn and winter compared with dolphins, which showed less periodicity. The most easterly mooring (3BE) around the headland (Wylfa Head) showed consistently significantly higher and longer peaks of porpoise echolocation activity compared to the other moorings. The pattern was less clear for dolphins, which exhibited no strong preference for any one location, though there was a statistically significant preference for the central mooring (2BC). Porpoise and dolphin DPM at all three locations were correlated significantly. Overall, harbour porpoise detections declined over the study whereas dolphin detections remained consistent throughout.

There was a general increase in chlorophyll-*a* concentration in spring and summer, whilst May 2017 had the highest peak at all locations. Both harbour porpoise and dolphin DPM d^{-1} at 3BE were correlated to chlorophyll-*a*. SST followed a similar pattern and was corelated at all three sites, with lowest temperatures in January and February. Porpoise DPM d^{-1} at 1BW and 3BE, and dolphin DPM d^{-1} at 2BC were correlated positively to SST. Empirical CTD data revealed few differences between sites, and a generally well-mixed water column, as expected in areas with high currents. Both porpoise and dolphin activity showed differences in peaks and troughs in relation to tide, with a preference for flood tide.

Results are in accordance with what is expected and observed in the literature for porpoises and dolphins in shallow, tidally-variable coastal waters. Patterns of acoustic detections at all C-PODs in relation to environmental conditions are typical for species that exhibit strong localised movements in relation to prey abundance. Local topography/oceanography of the region are probable causes for increased primary production, especially around Wylfa Head, where elevated upwelling and eddy formation is likely.

In conclusion, the coastal region around WNDA is an important location for both porpoises and dolphins, and represents an excellent baseline study prior to

development of a new power station, with which any future construction and operational-phase cetacean activity can be compared.

2. INTRODUCTION

2.1. Project scope

In 2016, Ocean Science Consulting Limited (OSC) was contracted by Jacobs to perform a baseline cetacean study using autonomous underwater echolocation-click detectors (C-PODs) close to the Existing Power Station on north Anglesey, Wales. This final report updates a former interim report (OSC, 2017a).

2.2. Survey area

WNDA includes a decommissioned power station situated on the north coast of Anglesey, Wales. This area is a designated candidate Special Area of Conservation (cSAC), since various marine mammal species frequent the region, including: harbour porpoise (*Phocoena phocoena*), bottlenose dolphin (*Tursiops truncatus*), and Risso's dolphin (*Grampus griseus*). These species are protected under European Community (EC) Directive on Conservation of Natural Habitats and of Wild Fauna and Flora, aka 'Habitats Directive' (92/43/EEC, 1992). The harbour porpoise and bottlenose dolphin are categorised as Annex II species, and Risso's dolphins as Annex IV species, under article 6 of the Habitats Directive. If candidacy for SAC is ratified, significant disturbance of these species would be prohibited.

2.3. Oceanographic features

Studies on marine communities show that fine-scale oceanographic features play a vital role in predator-prey dynamics within a region (Wolanski and Hamner, 1988). Physical processes such as tidal fronts and eddies are associated with headlands and other coastal topographies, resulting in increased nutrient availability and production (Johnston and Read, 2007; Neil *et al*., 2007). Tidal currents can influence movements of species both positively, by increasing foraging capabilities, and negatively by restricting movement patterns (Luschi *et al*., 2003). Oceanographic features and processes provide a mechanism for increased production, which translates into foraging habitats for porpoises and dolphins (Johnston *et al*., 2005; Bailey and Thompson, 2010).

2.4. Marine mammals around WNDA

The harbour porpoise is the most commonly observed marine mammal in north-western European continental shelf waters. Identified easily by its small, triangular fin and 'rolling' surfacing motion, this small, unobtrusive species is usually only observed visually in calm and clear weather conditions such as Beaufort sea state <2 (Hammond *et al*., 2002). Peaks in abundance are thought to be observed generally between July and September (Evans *et al*., 2003). Porpoise feed predominantly on whiting (*Merlangius merlangus*) and sandeels, *Ammodytidae* spp.(Santos and Pierce, 2003).

Shucksmith *et al*. (2009) undertook a study on abundance and distribution of the harbour porpoise on the north coast of Anglesey (Wales) and found porpoise presence to be mostly within 5 km of the shoreline, associated with oceanographic features and coastal bathymetry such as headlands. Heinänen and Skov (2015) related presence of harbour porpoise to local current speeds,

suggesting an optimum current speed of 0.4 ms^{-1}. This has been disputed by Benjamins *et al*. (2015), who suggested a higher critical speed of 3 ms^{-1}; thereafter, harbour porpoise presence declined with increasing current speed.

Harbour porpoise have also been shown to be associated with depth and salinity. For example, in the Baltic Sea, Mikkelsen *et al*. (2016) demonstrated that, during summer and autumn, optimum porpoise depth of occurrence was between 20-30 m. A Welsh study reported that porpoises exhibited strong association with the ebb tide, likely associated with prey availability (Pierpoint, 2008).

Bottlenose dolphins in the UK have two semi-resident populations: one located in Cardigan Bay and another in Moray Firth, Scotland (Pesante *et al*., 2008). The well-studied semi-resident population within Cardigan Bay demonstrates favourability to inshore waters (Bristow and Rees, 2001). This population is known to move northwards in winter towards Anglesey. Photo identification has shown individuals to belong to the Cardigan Bay residents (Pesante *et al*., 2008; Nuuttila *et al*., 2017). Through acoustic monitoring, Nuuttila *et al*. (2017) also revealed fine-scale temporal variation between bottlenose dolphins and harbour porpoise within the Cardigan Bay SAC, and bottlenose dolphins have also demonstrated favourability for bathymetry (Bearzi *et al*., 2008). Animals have also been found to exhibit presence in relation to tidal periodicity, showing a preference towards ebb tides in Irish waters (Berrow *et al*., 1996).

Abundance of Risso's dolphins within European waters is largely unknown; however, opportunistic sightings indicate presence in Welsh waters primarily between July and October (De Boer and Simmonds, 2003), and they have been observed and photographed around WNDA by the authors of this report. It is assumed that Risso's dolphins exhibit a preference for deep waters, but also occur in coastal areas defined by oceanographic features (Bearzi *et al*., 2011). In Welsh waters, De Boer *et al*. (2014) observed that Risso's dolphins show preference toward well-mixed waters with tidal fronts.

2.5. Acoustic monitoring

Acoustic monitoring techniques are used to monitor odontocete (toothed whale) echolocation behaviour. Acoustic detections have been achieved successfully using autonomous, self-contained, battery-powered, static, Passive Acoustic Monitoring (PAM), echolocation-click timing detectors called C-PODs and their analogue predecessor T-PODs (e.g. Koschinski *et al*., 2008; Carlström *et al*., 2009; Todd *et al*., 2009). According to the manufacturer (www.chelonia.co.uk), main advantages of the C-POD over the T-POD are: (1) false cetacean positive rate is lower, (2) logs broadband clicks from dolphin species that occasionally flood T-POD memory, (3) software more capable of differentiating trains from individual cetaceans and may distinguish several different groups of species, (4) frequency range of 20-160 kHz enables logging of all odontocetes continuously, except sperm whales (*Physeter macrocephalus*), (5) longer battery life, due to lower power requirements, (6) uses a removable Secure Digital (SD) memory card which allows considerably more data to be collected, (7) rapid servicing at sea, as SD cards can be exchanged easily, so that a field-computer is not required onsite for downloading data from the POD, (8) fewer user-controlled settings required, so that comparable data can be captured in different studies, and, (9) tighter standardisation, so that small trends over time can be identified.

3. MATERIALS & METHODS

3.1. Site location & C-POD deployment

Located on the north-west coast of Anglesey (Wales, UK), the Existing Power Station is situated between Cemlyn and Cemaes Bays (53.4128° N, 4.4517° W), as shown in **Figure 1.** C-POD mooring coordinates are specified in **Table 1**. Refer to OSC (2017a) for definitions of C-POD mooring locations, naming convention, and deployment/retrieval methods.

Location	Latitude (N)	Longitude (W)
1BW	53.418767	4.502033
2BC	53.420767	4.494217
3BE	53.422967	4.470117

Table 1. C-POD coordinates (WGS 1984). *Source*: OSC (2018).

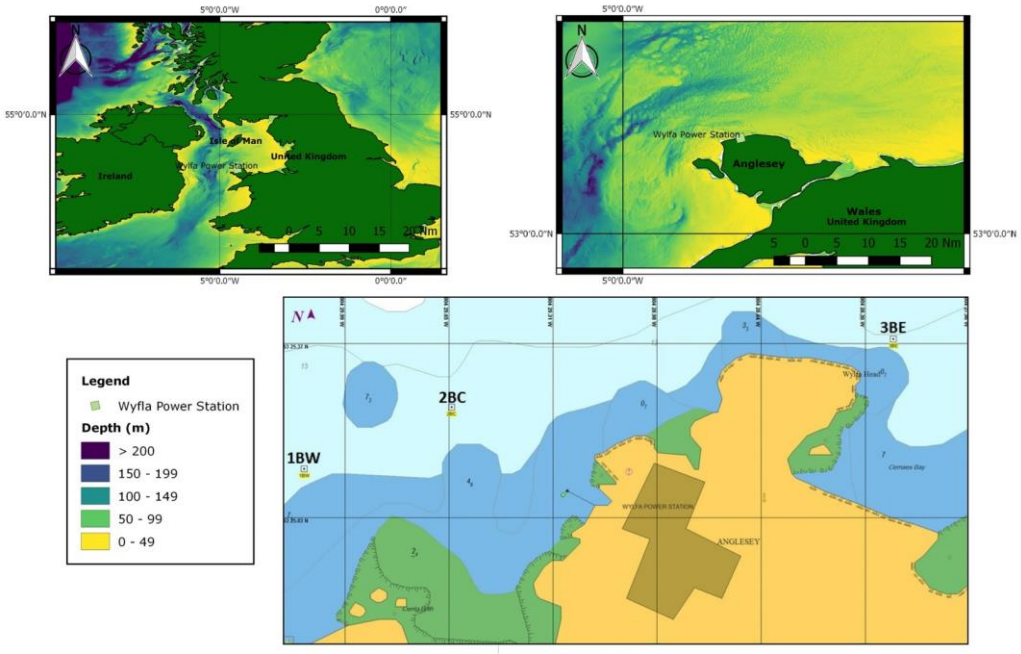

Figure 1. Chart showing C-POD mooring locations (yellow markers in light blue water), localised bathymetry (depth in m), and the Existing Power Station location (brown inset box-shaped footprint on yellow land). Charts generated in QGIS v 2.18 and C-MAP™ (Nobeltec® VNS Max Pro). *Source*: OSC (2018).

3.2. C-POD data processing

Raw click data were processed with C-POD.exe v2.044. To compare porpoise activity between all sites, each C-POD dataset was processed for number of minutes per day in which a porpoise click train was detected, hereinafter referred to as Detection Positive Minutes per day (DPM d^{-1}). Data were processed separately for Narrow-Band High Frequency (NBHF) click trains, considered as harbour porpoise, and other frequency click trains (termed 'Other cet' in C-

POD.exe), considered as dolphins. Click trains were filtered and only detections categorised into 'High' and 'Moderate' quality were analysed to minimise numbers of false positive detections. Outputs were saved into text files and/or Microsoft Excel open spreadsheet files (XLSX). The process above was repeated for Detection Positive Minutes per hour (DPM h^{-1}) to be used for tidal analysis.

Subsequently, an advanced numerical computing program (MATLAB v.2017b) was employed to process all DPM datasets further. A custom-written programming script imported data directly from text and XLSX files and saved DPM datasets to a MATLAB workspace where data were stored and accessed during analysis.

Porpoise and dolphin presence/absence for each day was determined for all three locations. Presence was defined as at least one DPM in a 24-hour period commencing from 00:00, expressed as a percentage of total days.

3.3. Environmental data sources

Daily Sea Surface Temperature (SST) and chlorophyll-*a* raw data were sourced from the Visible Infrared Imaging Radiometer Suite (VIRRS), one of the key instruments onboard the Suomi-National Polar-orbiting Partnership (SNPP) aircraft, accessed through the National Aeronautics and Space Administration (NASA) Ocean Colour Web portal (https://go.nasa.gov/2A3mQB1). Data were downloaded for each day of the study period at a resolution of 4 km and saved in Network Common Data Form (NetCDF) format. Global files were downloaded because of constraints with sourcing regional data from the portal. VIRRS data were not available for daily archived passes for the region and were incomplete, likely due to cloud cover. An attempt was made to source higher resolution Global 1 km SST (G1SST) data via NASA (https://go.nasa.gov/2BdZJ4Q), but large file sizes were time-consuming to process and thus unsuitable for this project.

Temperature and salinity were obtained from on-site Conductivity Temperature Depth (CTD) profile measurements of the water column (casts) at a point equidistant between 1BW and 2BC, and at 3BE. A minimum of six casts were undertaken at each of the two locations. CTD casts were undertaken during each of seven field visits to service C-PODs. Data were imported into Microsoft Excel spreadsheets.

Tidal data were taken from a tidal gauge located at Cemaes Bay (53.416705°N, 4.450012°W), ca. 2 km from the study location and ground-truthed to values in the charting program Nobeltec TimeZero Odyssey. Times and heights of low and high tide were available for each day in the survey period.

Two ocean current data sources were reviewed and found unsuitable for this project due to low resolution. Firstly, Nobeltec TimeZero Odyssey showed that the nearest available current data was 5 nm (9.26 km) away from any C-PODS. Secondly, data from NASA's Ocean Surface Current Analysis Real-time (OSCAR) satellite had a resolution of 1/3rd of a degree in each direction, which in longitude is ca. 20 nm (37.04 km).

3.4. Environmental data processing

Custom-written MATLAB script was used to process SNPP VIRRS raw data files and output SST and chlorophyll-*a* for each C-POD coordinate. The script extracted

SST and chlorophyll-*a* at the nearest POD position within the VIRRS' 4 km grid resolution.

CTD data were plotted. Daily means were calculated to yield a single set of values for each depth. Seasonal means and variations were also calculated.

Tidal datasets were processed and managed using MATLAB. This involved checking imported tidal data for errors and inconsistent formatting, sorting and saving tidal datasets to a functional workspace, and calculating time-based values such as 'time from low water' to be used during analysis of DPM h^{-1} and tides. As an alternative to DPM h^{-1}, mean DPM h^{-1} was calculated for this analysis to show a clearer graphical representation of DPM trends relative to tides.

3.5. Data analysis

Statistical analysis was performed in SigmaPlot v.12. Plots were generated in both SigmaPlot v.12 and MATLAB. Shapiro-Wilk tests were used to determine if data were normally distributed. Where transformation of non-normally distributed data failed to achieve normality, non-parametric tests were conducted. Inter-C-POD detection rate comparisons were made to determine median and inter-quartile ranges of each C-POD. Wilcoxon unmatched pair tests were undertaken to determine any significant difference between DPM d^{-1} per C-POD locations for porpoises and dolphins.

C-PODs can detect echolocation clicks from on-axis porpoises within approximately 300 m (Tougaard *et al*., 2006; Kyhn *et al*., 2012) and dolphins within 900 m (Roberts and Read, 2015). Distance between C-PODs 1BW and 2BC were 500 m apart (as requested by the client's experimental design), so both C-PODs could potentially log clicks from the same animal simultaneously, an unavoidable artefact known as 'autocorrelation'. This meant that these two C-PODs were not considered to be independent statistically. Moreover, C-PODs (and PAM technologies generally) cannot distinguish between bottlenose dolphin and Risso's clicks (Oswald *et al*., 2003); consequently, Spearman's rank correlation tests were used to assess autocorrelation between datasets. Spearman's rank order correlations were also used to examine correlation of DPM day^{-1} for both harbour porpoises and dolphins with SST and chlorophyll-*a*.

Scatterplots of porpoise and dolphin DPM day^{-1} over the study period were plotted with linear regression lines to illustrate temporal distribution of all C-PODs combined, and individually.

To compare empirical CTD data from 1BW/2BC with 3BE, a Mann-Whitney test was conducted on both temperature and salinity data for each date to determine if there was a significant difference between the two locations.

4.RESULTS

4.1. Overview

C-PODs logged successfully throughout a period of 393 days, with only temporary loss of one C-POD (3BE), which broke free on three occasions, so data from those periods were excluded from analyses. C-PODs commenced and finished logging on 07/10/2016 and 03/11/2017, respectively. C-PODs were retrieved and re-

deployed several times during this period, resulting in deployment logging times of 391.57, 391.56, and 344.75 days for 1BW, 2BC, and 3BE, respectively.

1BW and 2BC C-PODs remained in position through the study, so the only elapsed (non-logging) time during the study period was due to field visits when C-PODs were retrieved and re-deployed (to download data, replace batteries, and service instruments). At location 3BE, C-POD 2771 broke loose from its mooring on two separate occasions (15/05/2017 and 21/06/2017), because of an acoustic-release hardware failure (which was rectified – the faulty device was replaced). Consequently, off-site readings were recorded for a total of 44 days between 16/05/2017-13/06/2017 and 22/06/2017-06/07/2017. These readings account for the lower deployment logging time of 344.75 days at 3BE in **Table 2.** Total C-POD logging time and percentage of days with readings throughout the study period.

Location	C-POD	Total logging time (d)	% days with readings in study period
1BW	2767	391.57	100
2BC	2768	391.56	100
3BE	2771	344.75	87.72

Table 2. Total C-POD logging time and percentage of days with readings throughout the study period. *Source*: OSC (2018).

Porpoises and dolphins were logged at all three locations as follows:

- 1BW = 12,109 porpoise and 9,795 dolphin DPM;
- 2BC = 45,636 porpoise and 14,180 dolphin DPM; and,
- 3BE = 59,319 porpoise and 10,322 dolphin DPM.

3BE logged fivefold the amount of porpoise DPM compared to 1BW. Porpoise DPM decreased over the study, whereas dolphin DPM remained consistent.

DPM d^{-1} for porpoises and dolphins at all three moorings for the entire 13-month period are presented in **Figure 2**, and for quick numerical comparison, mean DPM d^{-1} are presented in **Table 3**. There was year-round activity for both porpoises and dolphins at all locations, with considerable variation between months and between mooring locations.

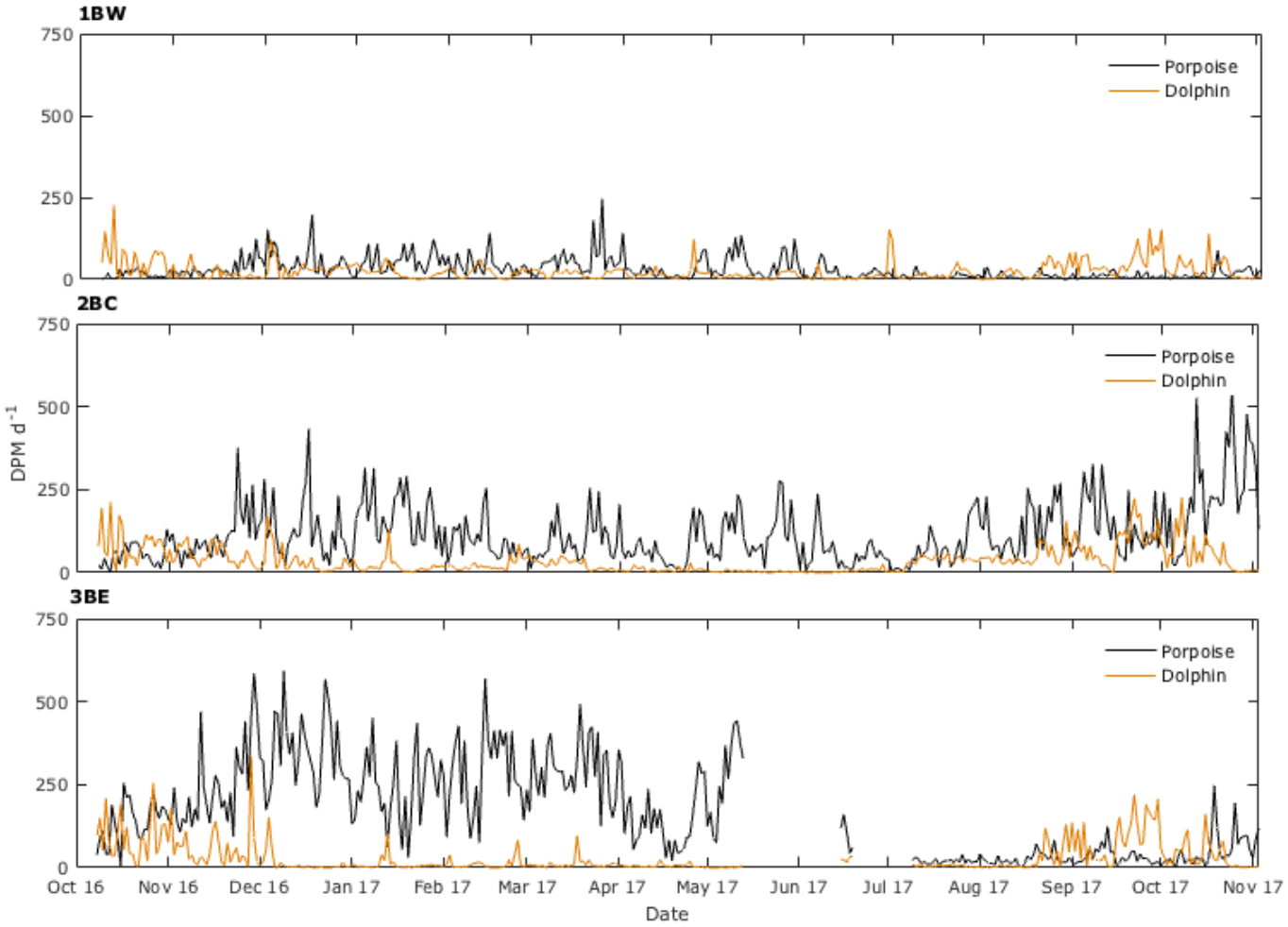

Figure 2. Porpoise and dolphin Detection Positive Minutes day^{-1} at each C-POD location throughout the entire study period. *Source*: OSC (2018).

DATE		Oct 16	Nov 16	Dec 16	Jan 17	Feb 17	Mar 17	Apr 17	May 17	Jun 17	Jul 17	Aug 17	Sep 17	Oct 17	Nov 17
Porpoise 1BW	Min	0	5	5	13	8	9	1	1	1	0	0	1	1	7
	Max	38	124	198	123	142	246	142	134	79	42	38	30	88	25
	Mean	15.12	34.23	52.39	55.55	42.32	57.48	28.47	46.68	20.07	10.48	10.06	9.87	16.23	18.67
Porpoise 2BC	Min	3	14	21	49	29	11	5	11	5	4	33	33	23	132
	Max	131	376	434	316	255	256	207	276	238	227	270	327	559	387
	Mean	52.64	115.27	127.77	169.68	95.39	94.58	71.70	119.32	59.53	68.90	129.74	141.93	225.10	278.33
Porpoise 3BE	Min	4	92	174	29	74	124	21	74	42	4	3	8	1	30
	Max	256	585	593	452	570	493	356	441	160	40	83	125	248	119
	Mean	135.32	243.13	348.68	237.48	290.00	291.16	147.63	262.73	96.13	18.72	26.97	34.57	51.90	78.67
Dolphin 1BW	Min	0	0	2	0	0	1	1	0	0	1	0	4	1	7
	Max	226	78	123	66	61	32	123	28	152	53	82	155	139	10
	Mean	58.16	15.67	33.39	19.87	20.89	17.42	18.13	10.13	14.50	13.23	24.29	56.20	30.83	8.67
Dolphin 2BC	Min	5	9	3	1	7	3	1	0	0	1	22	0	0	7
	Max	213	109	172	129	87	50	26	10	27	60	157	223	226	8
	Mean	82.84	51.60	33.23	19.06	22.07	25.61	8.73	3.23	4.73	33.03	49.32	90.30	57.83	7.33
Dolphin 3BE	Min	8	2	0	0	0	0	2	0	3	1	0	3	1	2
	Max	255	335	151	102	83	96	25	13	34	15	131	219	162	3
	Mean	97.96	54.30	11.71	9.52	10.75	10.61	5.50	2.67	21.63	5.44	21.87	88.87	36.27	2.33

Table 3. Porpoise and dolphin DPM per month minima, maxima and mean, at all locations. *Source*: OSC (2018).

Porpoise mean DPM d^{-1} at 1BW was attenuated compared to the other two moorings. Porpoise activity was broadly consistent throughout the year, with no notable peaks other than slight elevations from autumn/winter (November 2016 to March 2017), and in May 2017. At 2BC, there was generally higher activity overall than at 1BW, with peaks in autumn/winter (November 2016 to March 2017, and in October and November 2017), in May 2017, and in late summer (August to September 2017); however, at 3BE, very clear differences can be seen, with higher peaks in activity early in the winter months of the study than at the other two locations, and for a longer period of six months between October 2016 to May/June May 2017; there was a consistent upwards trend from the lowest DPM d^{-1} in July 2017 until the study terminated in November 2017, at which point, peaks in porpoise activity became higher at 2BC compared with 3BE.

Broadly, dolphin mean DPM d^{-1} showed peak dolphin activity at all locations in September/October 2016/2017. At 1BC, peaks were in October and December 2016, and in September and October 2017. At 2BC, peaks were in October and November 2016 and in August and September 2017. At 3BE, peaks were in October to December 2016, and September to October 2017.

4.2. Descriptive statistics

Statistics took account of reduced logging at 3BE. For non-parametrical statistical conventions, medians and Inter-Quartile Ranges (IQR) are presented in **Figure 3**. Porpoise detections varied between locations: an increase in porpoise detections from west to east was a clear trend. 1BW had the lowest number of detections (median =20.0, IQR =31.35), followed by 2BC (median=91.0, IQR=104.00) and 3BE (median=142.0, IQR=235.50). The pattern for dolphins was again, less clear, with a moderate increase at the central mooring location: 1BW (median=17.0, IQR=26.25), 2BC (median=23.0, IQR=39.25) and 3BE (median=7.0, IQR=63.25). These differences were statistically significant. A Wilcoxon unmatched pairs test found the median DPM d^{-1} was significantly higher for porpoise detections at 3BE compared with 1BW (P <0.001, W = 59,839) and 2BC (p <0.001, W = 21,117). There were significantly higher dolphin detections at 2BC than at 1BW (P <0.001, W = 28,003) and 3BE (P <0.01, W = 29,838), respectively.

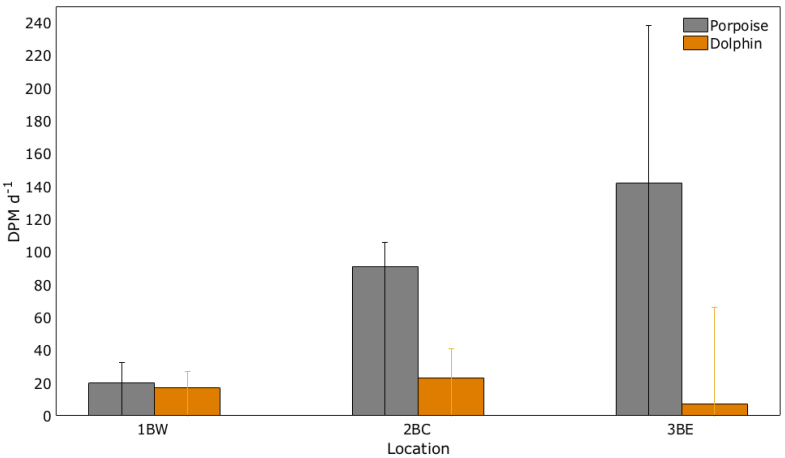

Figure 3. Median and Inter Quartile Range (IQR) cetacean DPM at each location throughout study duration. *Source*: OSC (2018).

4.3. Site comparison

A Spearman's rank order correlation test found that both porpoise and dolphin DPM between all three locations were correlated significantly, as per **Table 4**.

Species	Location 1	Location 2	Correlation coefficient	*P*	Correlated
Porpoise	1BW	2BC	0.41	<0.01	Y
	1BW	3BE	0.73	<0.01	Y
	2BC	3BE	0.12	<0.02	Y
Dolphin	1BW	2BC	0.57	<0.01	Y
	1BW	3BE	0.50	<0.01	Y
	2BC	3BE	0.61	<0.01	Y

Table 4. Spearman's rank order correlation between DPM at three locations. *Source*: OSC (2018).

When porpoise detections occurred at 1BW, there were also detections at 2BC and 3BE, as per **Figure 4**, and thus all C-POD locations were correlated. Likewise, a similar pattern was exhibited with dolphin detections, as per **Figure 5**, but this may have been influenced strongly by the high number of minutes in a day with zero detections.

Overall, harbour porpoise detections declined over the study period, as per **Figure 4**. At 1BE, porpoise DPM d^{-1} remained consistent thoughout the study. 2BC had peak detections in both winter 2016 and autumn 2017, showing an increase in detections thoughout the study. 3BE had a sharp decline in detections during the latter half of the study.

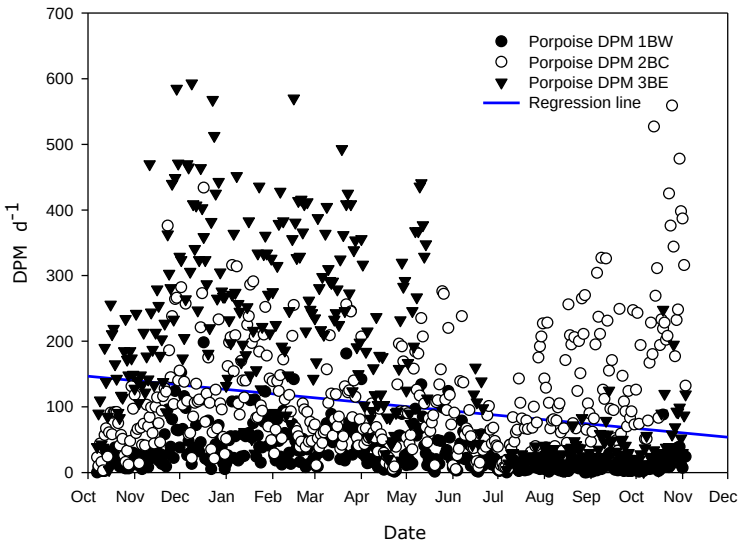

Figure 4. Scatterplot showing correlation between porpoise DPM at 1BW, 2BC and 3BE. *Source:* OSC (2018).

Dolphin DPM at all locations over the survey period remained consistent. Peaks in DPM were evident in October/November 2016 and 2017, as per **Figure 5**.

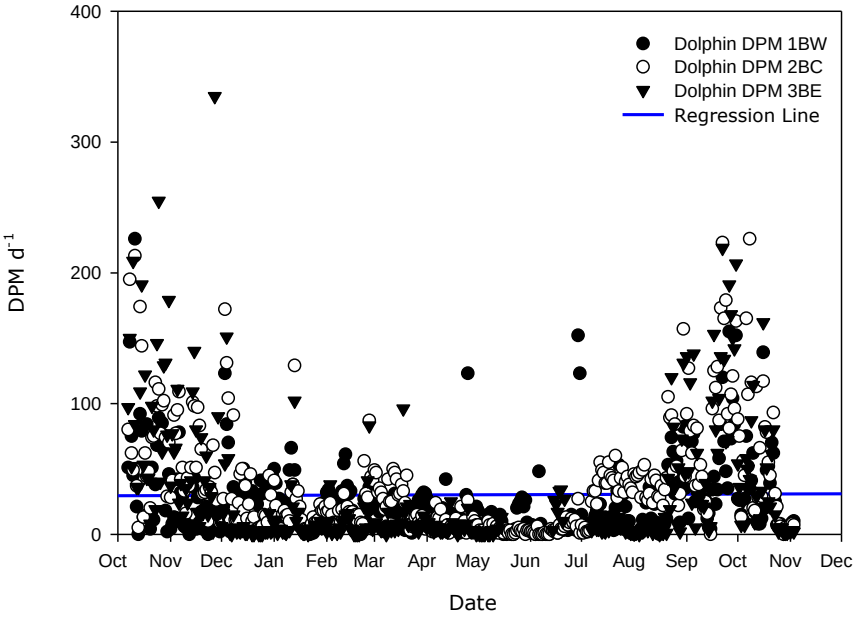

Figure 5. Scatterplot showing correlation between dolphin DPM at 1BW, 2BC and 3BE. *Source:* OSC (2018).

4.4. Presence/absence of species

On each day of the 393-day study period, porpoises and dolphins were detected by at least one C-POD. As per
Table 5, porpoises were detected at 1BW on 98.98% of days, 2BC on 100% of days, 3BE on 88.8% of days, and dolphins were detected at 1BW on 96.4% of days, 2BC on 97.0% of days, and 3BE on 85.2% of days; consequently, dolphins were detected less frequently than porpoises.

Species	Location	# days with detections (d)	% of days with detections
Porpoise	1BW	389	98.98
	2BC	393	100
	3BE	349	88.8
Dolphin	1BW	379	96.4
	2BC	381	97.0
	3BE	335	85.2

Table 5. Cetacean detection days at all locations. C-POD cetacean presence defined as at least one DPM per 24 hours from 00:00. Percentage of days with detections as a proportion of logging days. *Source*: OSC (2018).

4.5. Temporal detections

Linear regressions indicated that at 1BW and 3BE, porpoise detections decreased over the study period, but 2BC saw a slight increase, as per **Figure 6**. Dolphin detections remained consistent with time, as per **Figure 7**. There were more zero detections days for dolphins than porpoises. Dolphin detection peaked in October/November 2016/2017.

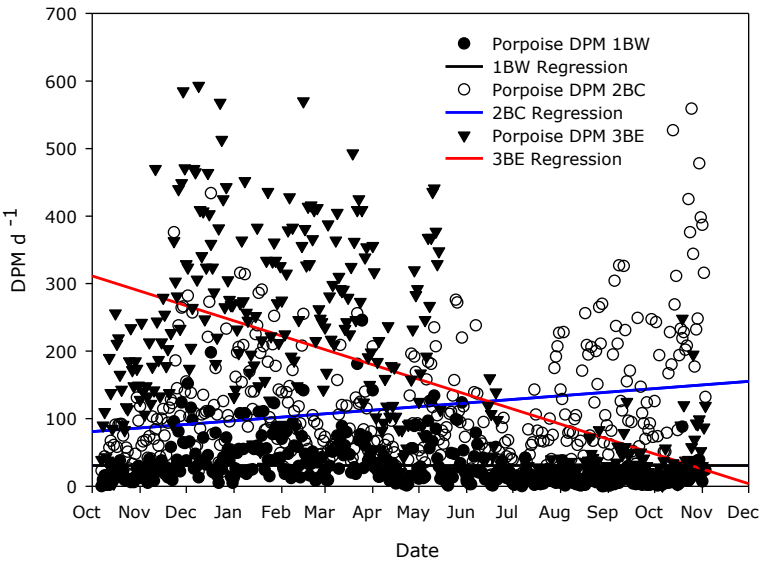

Figure 6. Linear regression lines for porpoise DPM d^{-1} over study duration at 1BW, 2BC and 3BE. *Source:* OSC (2018).

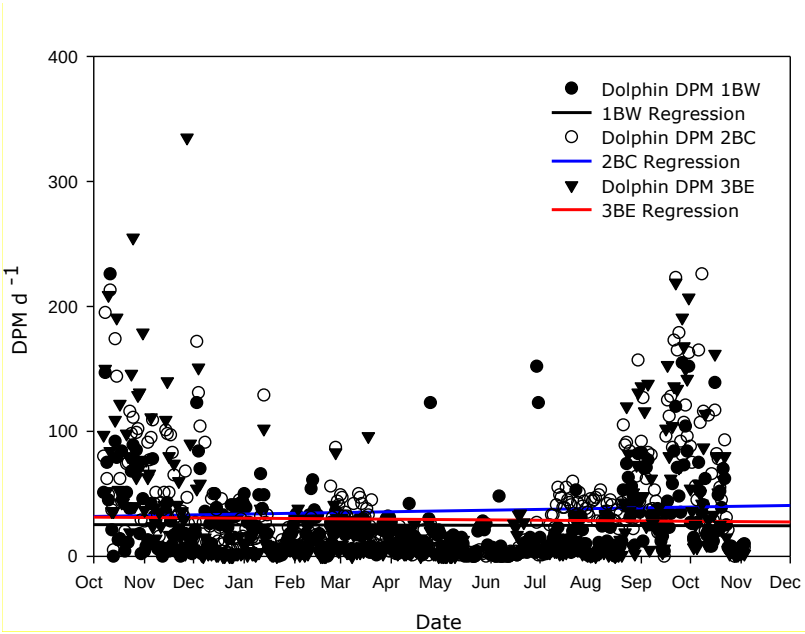

Figure 7. Linear regression lines for dolphin DPM d^{-1} over study duration at 1BW, 2BC and 3BE. *Source:* OSC (2018).

4.6. Cetacean presence/absence with chlorophyll-a

Figure 8 shows there was a general increase in chlorophyll-*a* concentration in spring and summer, with May 2017 showing the highest peak at all locations. **Table 6** shows that only harbour porpoise DPM d^{-1} at 3BE was correlated with chlorophyll-*a*.

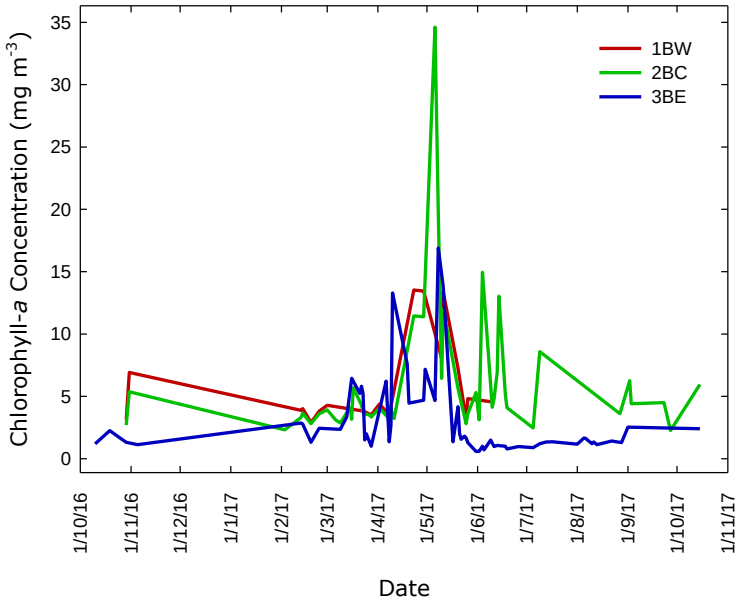

Figure 8. Chlorophyll-*a* concentration (mg m^{-3}) at the three C-POD locations, throughout study period. *Source:* OSC (2018).

Species	Location	Correlation coefficient	*P*	Correlated
Porpoise	1BW	0.04	0.84	N
	2BC	-0.03	0.84	N
	3BE	0.41	<0.01	Y
Dolphin	1BW	-0.10	0.64	N
	2BC	-0.22	0.13	N
	3BE	-0.28	0.06	N

Table 6. Spearman's rank order correlation of DPM d^{-1} in relation to Chlorophyll-*a*.

4.7. Presence/absence with SST

Figure 9 shows a similar pattern for SST at all three sites, as confirmed by a Spearman's rank correlation, presented in **Table 7**, with lowest temperatures occurring in January and February. Refer to **Table 8** for SST descriptive statistics throughout the study period.

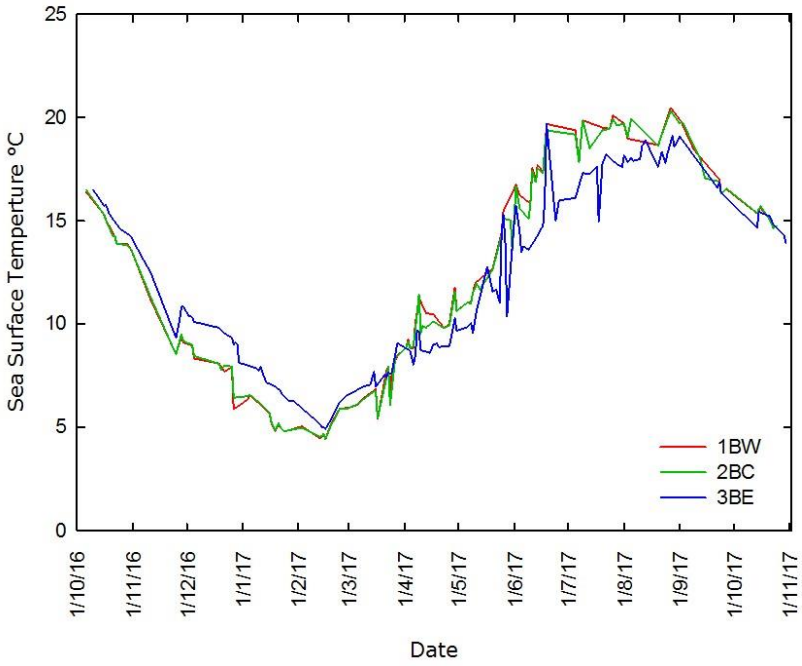

Figure 9. SST at the three C-POD locations throughout study period. *Source:* OSC (2018).

Location 1	Location 2	Correlation coefficient	*P*	Correlated
1BW	2BC	0.99	<0.01	Y
1BW	3BE	0.95	<0.01	Y
2BC	3BE	0.96	<0.01	Y

Table 7. Spearman's rank order correlation of SST between all three locations. *Source:* OSC (2018).

	Month	Oct 16.	Nov 16.	Dec 16.	Jan 17.	Feb 17.	Mar 17.	Apr 17.	May 17.	Jun 17.	Jul 17.	Aug 17.	Sep 17.	Oct 17.	Nov 17.
SST °C															
Min.	1BW&2BC	13.62	8.52	5.87	4.78	4.40	5.41	8.82	10.99	15.09	17.84	18.61	16.30	14.63	NaN
	3BE	14.24	9.33	8.12	6.27	4.90	6.96	8.02	9.55	13.48	14.96	17.60	16.35	13.95	NaN
Max.	1BW&2BC	16.50	11.28	8.99	6.57	5.90	8.47	11.76	15.45	19.68	20.09	20.46	19.79	15.70	NaN
	3BE	16.48	13.41	10.40	7.92	6.53	9.07	10.27	15.29	19.68	18.22	19.10	19.07	15.43	NaN
Mean	1BW&2BC	14.60	9.58	7.88	5.55	4.88	6.88	9.98	12.67	17.19	19.28	19.39	18.02	15.21	NaN
	3BE	15.21	11.18	9.56	7.01	5.45	7.56	9.05	11.92	15.12	17.17	18.24	17.22	14.83	NaN
SDev	1BW&2BC	0.95	1.07	0.88	0.65	0.50	0.99	0.86	1.56	1.22	0.72	0.66	1.42	0.40	NaN
	3BE	0.84	1.50	0.72	0.64	0.65	0.61	0.61	1.93	1.68	1.01	0.45	1.25	0.57	NaN

Table 8. SST minima, maxima, mean, and Standard Deviation (SDev) derived from SNPP VIIRS satellite data. SST values for 01/11/17-03/11/17 were Not a Number (NaN). *Source:* OSC (2018).

Spearman's rank order correlation tests showed that porpoise DPM d^{-1} at all locations and dolphin DPM d^{-1} at 3BE were correlated positively to SST, as per **Table** 9.

Species	Location	Correlation coefficient	*P*	Correlated
Porpoise	1BW	-0.59	<0.01	Y
	2BC	-0.23	<0.01	Y
	3BE	-0.69	<0.01	Y
Dolphin	1BW	-0.005	0.98	N
	2BC	0.17	0.06	N
	3BE	0.245	0.01	Y

Table 9. Spearman's rank order correlation of DPM d^{-1} and SST at each C-POD location. *Source:* OSC (2018).

4.8. CTD

Figure 10 and **Figure 11** presents results from on-site empirical CTD measurements taken at two locations. Temperature was invariant with depth for all casts, as per **Figure 10**, with distinct absence of thermoclines. With regards to salinity, **Figure 11** shows there were no distinct haloclines in any month; however, many casts exhibited small fluctuations in the upper 3 m of the water column.

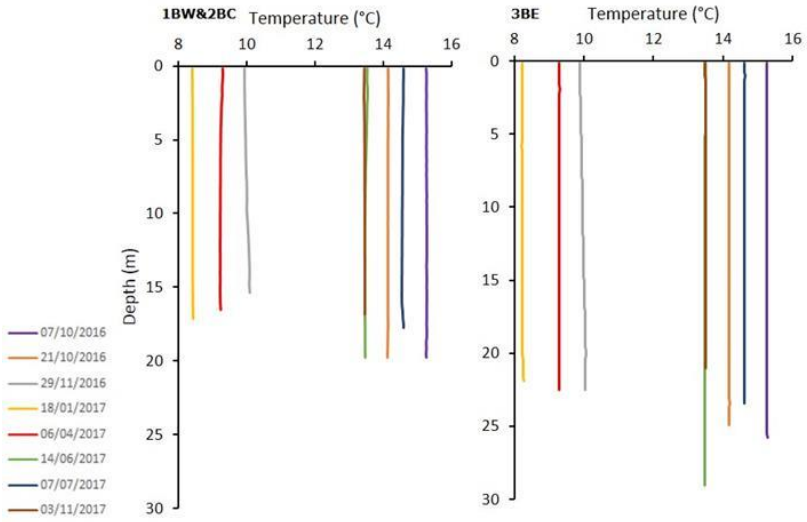

Figure 10. CTD mean temperature profiles. *Source:* OSC (2018).

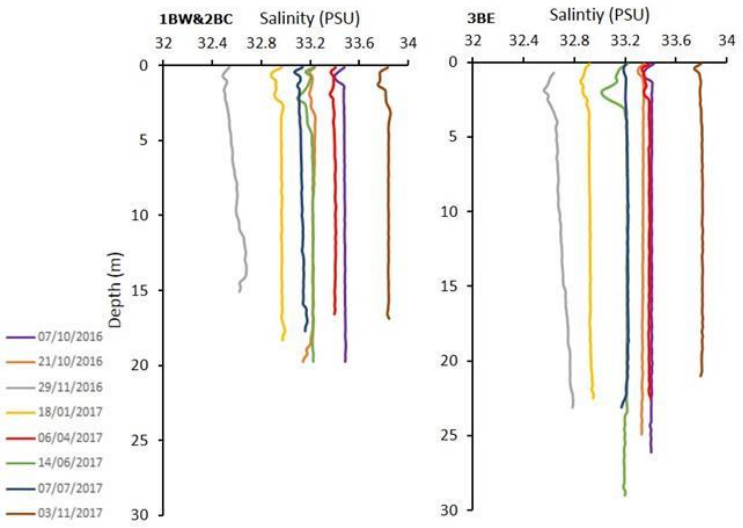

Figure 11. CTD mean salinity profiles. *Source:* OSC (2018).

Temperature measured by the CTD showed the warmest months to be October 2016, June, July and November 2017. The coldest months were January and April 2017. Difference between the two sampling locations was minimal, with the greatest disparity being 0.2°C in January.

Salinity was highest in April and October 2016 and November 2017, and lowest in November 2016. Differences exhibited between November 2016 and 2017 are prominent; in 2016 measurements were taken at the end of the month compared to the beginning of the month in 2017.

While not measured in this study, a qualitative cursory comparison with met office data revealed lower rainfall in November 2016 compared to November 2017. Moreover, met office average land temperature was colder in November 2016 compared to November 2017.

Where data were available, a cursory comparison of mean satellite-derived SST data, as per **Table 8**, for November 2016 to that of 2017, as per **Table 10**, indicates a minor 1°C difference at 3BE. Though qualitative, it appears that 2017 was a generally warmer year than 2016.

Mann-Whitney tests for each month revealed that SST, as per **Table 11**, and salinity, as per **Table 12**, between the two locations were always significantly different; however, differences were only slight.

Finally, a brief attempt to ground-truth empirical CTD temperature to satellite-derived SST is presented in **Table 13** and **Table 14**. Overall, differences were slight, reflecting the overall accuracy of the CTD. Nonetheless, June and July results varied by over 3°C at 1BW and 2BC, and by over 2°C in July 2017 at 3BE, with satellite-derived SST yielding higher temperatures than CTD measurements.

Month		Oct 16.	Nov 16.	Jan 17	Apr 17.	Jun 17	Jul 17	Nov 17
Water temperature °C								
Min.	1BW&2BC	14.14	9.92	8.42	9.21	13.47	14.53	13.44
	3BE	14.16	9.80	8.21	9.26	13.47	14.60	13.46
Max.	1BW&2BC	15.27	10.12	8.44	9.34	13.59	14.62	13.47
	3BE	15.27	10.08	8.28	9.31	13.51	14.64	13.51
Mean	1BW&2BC	14.70	10.00	8.43	9.26	13.50	14.58	13.46
	3BE	14.72	9.97	8.23	9.29	13.48	14.62	13.50
Salinity (PSU)								
Min.	1BW&2BC	33.08	32.38	32.72	33.30	32.88	32.97	33.53
	3BE	33.24	32.44	32.61	33.18	32.38	33.01	33.73
Max	1BW&2BC	33.50	32.74	33.01	33.42	33.26	33.20	33.93
	3BE	33.43	32.80	32.96	33.41	33.28	33.25	33.83
Mean	1BW&2BC	33.36	32.59	32.96	33.40	33.21	33.13	33.84
	3BE	33.37	32.70	32.92	33.39	33.20	33.20	33.81

Table 10. CTD water temperature mean, minima and maxima. Salinity is given in Practical Salinity Units (PSU); one PSU is equivalent to 1 g of salt per 1 kg of seawater. Deployments in chronological order. *Source:* OSC (2018).

Date	Water temperature °C 1BW/2BC	Water temperature °C 3BE	*P*
07/10/16	15.263	15.256	P <0.001
21/10/16	14.145	14.179	P <0.001
29/11/16	10.007	9.971	P <0.001
18/01/17	8.433	8.231	P <0.001
06/04/17	9.248	9.288	P <0.001
14/06/17	13.486	13.480	P <0.001
07/07/17	14.575	14.612	P <0.001
03/11/17	13.463	13.498	P <0.001

Table 11. CTD 3BE and 1BW/2BC Mann-Whitney test comparing median temperatures. *Source:* OSC (2018).

Date	Salinity (PSU) 1BW/2BC	Salinity (PSU) 3BE	*P*
07/10/16	33.484	33.408	P <0.001
21/10/16	33.219	33.337	P <0.001
29/11/16	32.594	32.696	P <0.001
18/01/17	32.969	32.924	P <0.001
06/04/17	33.390	33.391	P <0.001
14/06/17	33.198	33.214	P <0.001
07/07/17	33.135	33.218	P <0.001
03/11/17	33.842	33.810	P <0.001

Table 12. CTD 3BE and 1BW/2BC Mann-Whitney test comparing median salinity. *Source:* OSC (2018).

Month	SST water temperature (°C)	CTD water temperature (°C)
October 2016	14.60	14.70
November 2016	9.58	10.00
January 2017	5.55	8.43
April 2017	9.98	9.26
June 2017	17.19	13.50
July 2017	19.28	14.58
November 2017	NaN	13.46

Table 13. Satellite SST and CTD comparisons of mean temperature at 1BW and 2BC. NaN = Not a number. *Source:* OSC (2018).

Month	SST water temperature (°C)	CTD water temperature (°C)
October 2016	15.21	14.72
November 2016	11.18	9.97
January 2017	7.01	8.23
April 2017	9.05	9.29
June 2017	15.12	13.48
July 2017	17.17	14.62
November 2017	NaN	13.50

Table 14. Satellite SST and CTD comparisons of mean temperature at 3BE. NaN = Not a number. *Source:* OSC (2018).

4.9. Cetacean presence/absence with tide

Figure 12 shows mean DPM h^{-1} for both harbour porpoises and dolphins at all locations and times from low water. For porpoises, at both 1BW and 2BC there are noticeable peaks in mean DPM h^{-1} approximately five hours before and after low water (approximately one hour after and before high tide), but not at 3BE, which peaked at six hours from low water (approximately high tide).

For dolphins, the pattern was more variable. At 1BW and 3BE, there were noticeable peaks in mean DPM h^{-1} at six hours before low water (approximately high tide) and five hours after low water (approximately one hour before high tide), and at 3BE, the highest peak occurred at low water. At all three locations, peaks are observed at five hours after low water (approximately one hour before high tide).

There are troughs in mean DPM h^{-1} for porpoise at 1BW and both species at 2BC during low water. This decrease in activity during ebb tides, -6 to 0 hours, and increase in activity during flood tides, 0 to 6 hours, is particularly evident for dolphins at 2BC.

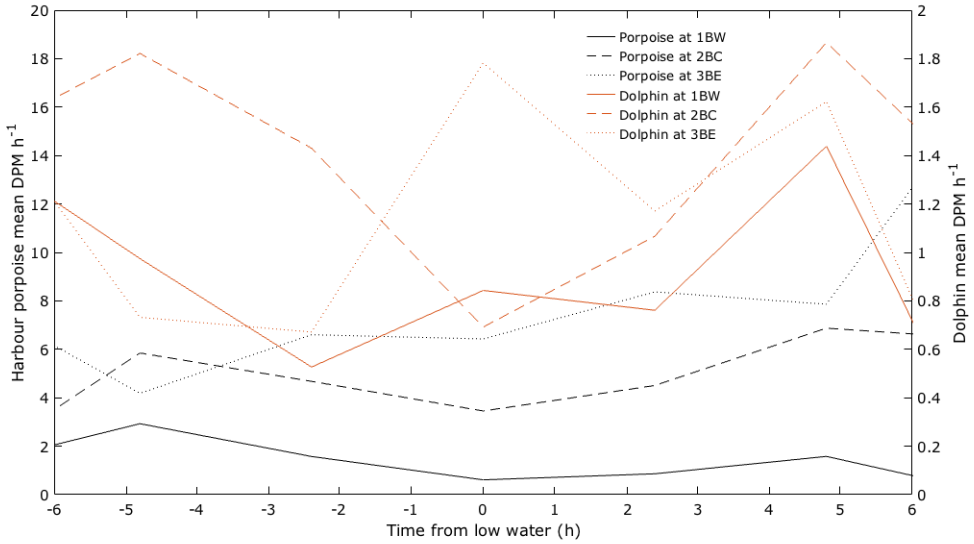

Figure 12. Mean DPM h^{-1} for harbour porpoise and dolphins at all locations and times from low water. Mean DPM h^{-1} for harbour porpoises is plotted on the primary y-axis (left) and mean DPM h^{-1} for dolphins is plotted on the secondary y-axis (right). Note the different scales for these axes. Ebb tide = -6 to 0 h before low water. Flood tide = 0 to 6 h after low water. *Source:* OSC (2018).

5. DISCUSSION

During 2016 and 2017, C-PODs were employed for 393 days of baseline PAM around WNDA. Harbour porpoises and dolphins were detected acoustically every day on at least one of the three C-PODs. There were higher acoustic detections of porpoises than dolphins, and both showed varying relationships to synoptic and empirical oceanographic measurements.

C-POD detection data were correlated positively at all three locations. There are two likely explanations as to why this was the case. Firstly, westerly C-PODs 1BW and 2BC were distanced 500 m apart, as stipulated by the client's experimental requirements; consequently, detections were (unavoidably) autocorrelated statistically. 3BE was located at a distance of 1.62 km from 2BC and 2.16 km from 1BW, and 3BE was also not in direct 'line-of-sight' underwater, due to headland (Wylfa Head), which prevented any possibility of detecting any animal at the easterly and westerly C-PODs simultaneously. Moreover, porpoise and dolphin detections at 3BE were beyond acoustic range of both 2BC and 1BW,

since C-PODs only detect echolocation clicks from on-axis porpoises within ca. 300 m (Tougaard *et al*., 2006; Kyhn *et al*., 2012), and within 900 m for dolphins (Roberts and Read, 2015). All C-PODs showed a similar seasonal pattern of detections for both porpoises and dolphins, which indicates a larger scale movement pattern of cetaceans in the area. Animals that approached the study area from the east likely travelled past 3BE and were then detected at 2BC and 1BW, and vice versa for animals approaching from the west. The authors of this report often observed cetaceans transiting in groups through the region.

Over the 13-month study period, it was clear that harbour porpoise detections were higher at each survey location than dolphin detections, with 3BE exhibiting higher levels than the other survey locations for harbour porpoises, and to a lesser extent, dolphins. Shucksmith *et al*. (2009) estimated that the population of harbour porpoise around Anglesey to be ca. 309 individuals. Density and abundance estimates were not possible with only three C-PODs, but it is possible that there could be a higher proportion of porpoises within the cSACs than in non-protected areas, as discussed in Heinänen and Skov (2015); however, this cannot be ascertained from results of this study. Higher acoustic presence is more likely a result of local (potentially resident) porpoise populations exhibiting knowledge of temporo-spatially predictable feeding locations. For example, harbour porpoises within the Canadian Bay of Fundy – an area characterised similarly by strong tidal activity – have been shown to demonstrate preference for remaining in localised areas for short periods, then travelling great distances to find similar localised areas (Read and Westgate, 1997). In general, lower detections of dolphins may be related to slightly different foraging preferences and less localised known foraging ranges, potentially linked to the more transient nature of non-resident dolphin populations in the region; certainly, typical bottlenose dolphin species group sizes have shown to vary between 16-64 individuals, higher than those seen in resident populations (Pesante *et al*., 2008). The Cardigan Bay bottlenose dolphin population comprises ca. 50 individuals (Bristow and Rees, 2001), and Anglesey is within their home-range (Pesante *et al*., 2008), but determination of individual numbers was not possible from this study. Nonetheless, compared to harbour porpoise detections, it is still evident that proportionately fewer dolphin detections occurred in this region.

Both porpoises and dolphins are sympatric around WNDA, concurrent with the findings of Simon *et al*. (2010) for other locations in Wales. This is likely due to similar prey preferences of mostly whiting and sandeels (Santos and Pierce, 2003). Data analysis to examine relationship between temporally-correlated porpoise and dolphin DPM d^{-1} was not performed, because C-PODs are not able to distinguish between bottlenose and Risso's dolphin clicks (Oswald *et al*., 2003), and the latter species is not known to exhibit agonistic interactions with porpoises. To support such analysis, concurrent visual observations would need to have been undertaken to ascertain if non-porpoise detections were due to bottlenose or Risso's dolphins. A proposal for such a study, which could also indicate abundance, has already been submitted to the client (OSC, 2017b).

Peaks in porpoise abundance are thought to be observed generally between July and September (Evans *et al*., 2003), but in Wales, harbour porpoises are known to be present in elevated numbers in autumn/winter (Simon *et al*., 2010), which is concurrent with the findings in this study. Dolphin sightings are expected generally to increase in summer/autumn (Evans *et al*., 2003), no specific conclusion can be drawn as to general trends in seasonal dolphin abundance, as

patterns were less clear, reflecting a potentially more transient movement of animals in the region. It can be concluded that the region around WNDA is used both seasonally and as a suitable year-round habitat for dolphins, similar to the Cardigan Bay SAC (Nuuttila *et al*., 2017).

Linear regression models showed overall porpoise detection declined throughout the study, whereas dolphin detections at all sites remained consistent. Models performed for each C-POD location showed that, for harbour porpoises, detections at 2BC rose compared to 3BE, which declined over time. Since the study covered only 13 months, it is not possible to determine if this was a trend that would be observed over successive years.

Acoustic detections made by C-PODs support both synoptic and empirical oceanographic data collected, as cetacean presence is likely driven by local environmental features such as temperature, and tide, which is a proxy for current. Harbour porpoise detections were shown to decline with increasing temperature at all survey locations when compared to SST, indicating a preference for cooler waters, which is potentially why there were fewer porpoise detections in summer months. Dolphin detections at 3BE rose with increasing SST, which superficially suggests a preference for warmer waters, but verification of all these observations would require inter-annual investigation. Whilst not statistically compared to mean SST values, empirical CTD data did not fluctuate greatly from satellite-derived data. Fully quantitative comparisons could not be made, since empirical CTD point measurements were sporadic, compared to plethoric daily SST values. CTD data revealed that comparable months in 2017 were warmer than the previous year, but this was likely an artefact of cast sampling date and time, as opposed to specific weather anomalies. Small fluctuations between the two CTD survey locations occurred for both salinity and temperature, but this small-scale difference was not prominent towards one or the other survey location, and variations are likely a response of freshwater inputs.

The general oceanography around WNDA is typical of shallow, tidally-mixed, coastal northern hemisphere waters. CTD casts showed that throughout the 13-month study period, waters around WNDA remain vertically well-mixed, with minimal thermo-haline stratification. Small fluctuations in salinity in the upper 3 m were typical and likely a result of groundwater inputs (Valiela *et al*., 1990). Nonetheless, it is clear from chlorophyll-*a* data that stratification may have occurred between April-June, during which period CTD casts were not taken. Generally, in winter, a coastal water column is well-mixed vertically, allowing plankton to remain suspended in the water body. Low light levels during this period maintain minimal primary production. In spring, when light levels increase, in conjunction with sufficient nutrient loads resuspended from the seabed during winter storms, phytoplankton become trapped in the upper layer, as determined by chlorophyll-*a* concentrations, which is a proxy for primary production (Friedland *et al*., 2012). This is due to increased sunlight in spring creating a thermally-stratified water body which causes waters in this area to become highly productive (Carstensen *et al*., 2015). Increased primary production leads to increased prey resources; a phenomenon which has been shown for similarly mixed waters in the Bay of Fundy (Watts and Gaskin, 1985), which in turn provides rich feeding locations for cetaceans.

SST and empirical CTD data readings were very similar. Minor variations observed are likely because CTD data are temporo-spatially constrained to the precise point of interest and thus more accurate than SST derived from SNPP VIRRS satellite at larger resolution.

The main topographic feature near WNDA is a pronounced headland (Wylfa Head). Headlands are known to increase primary production through upwelling effects, bringing nutrients to the water surface, increasing primary, secondary, and tertiary (prey) production, which is capitalised by cetaceans (Johnston *et al*., 2005). Headlands often also cause localised eddy formation, that aggregate prey, rendering fish shoals more accessible to cetaceans (Shucksmith *et al*., 2009). Higher acoustic detections observed at 3BE are likely a combination of oceanographic features and west to east movement patterns. The notable decline in detection over time at 3BE could be attributed to seasonal reduction in response to temperature, or prey resource shifts (Sveegaard *et al*., 2012), but again without inter-annual comparisons, conclusions should be conservative.

Tidal activity in this case has been used as a proxy for currents. The rise and fall of tide is a vertical movement that changes over the tidal cycle. The Anglesey area is well known for its strong tidal activity and presence of strong currents. Relationship between tide, harbour porpoise, and dolphins have been studied on numerous occasions (Mendes *et al*., 2002; Pierpoint, 2008; De Boer *et al*., 2014). It is evident that species at all locations have maintained presence under varying current regimes (Isojunno *et al*., 2012). Both porpoise and dolphin detections showed preference for flood tides, as also shown by De Boer *et al*. (2014), which is associated to prey movement and enhanced feeding (Mendes *et al*., 2002). It is evident that dolphins were present in the region throughout all tidal phases; however, at all three locations highest mean DPM h^{-1} occurred one hour before high tide. This is the point when tidal forces are strongest, and when eddies often form, causing increases in prey resource; a finding substantiated by Johnston and Read (2007) in the Bay of Fundy. To gain a greater understanding of localised current behaviours, use of an Acoustic Doppler Current Profiler (ADCP) at each location would give a higher resolution image of the relationship between species presence and tide/current.

In conclusion, the use of C-PODs has provided a useful study of both porpoise and dolphin presence around WNDA. There were higher acoustic detections of porpoises than dolphins, and porpoises may favour colder months, as reflected by correlation to SST. Dolphin peak detections occurred in September-November at locations, but both species were present year-round at all three locations. High detection rates of both species in this area suggest they are utilising the area to feed on prey resources. Coastal topography/oceanography in this area likely allows for upwelling and eddy formation, which in turn leads to increased primary, secondary, and tertiary production. The water column remained vertically well-mixed throughout the study period with no thermoclines or haloclines present; however, there may have been some stratification in April-June, which likely caused a spring phytoplankton bloom; however, year-round, strong currents constantly mixed and led to increased primary production in the area, which made it suitable for both harbour porpoise and dolphins to feed and maintain energy levels.

This study represents an excellent baseline prior to development of a new power station, with which any future construction and operational-phase cetacean activity can be compared.

6. REFERENCES

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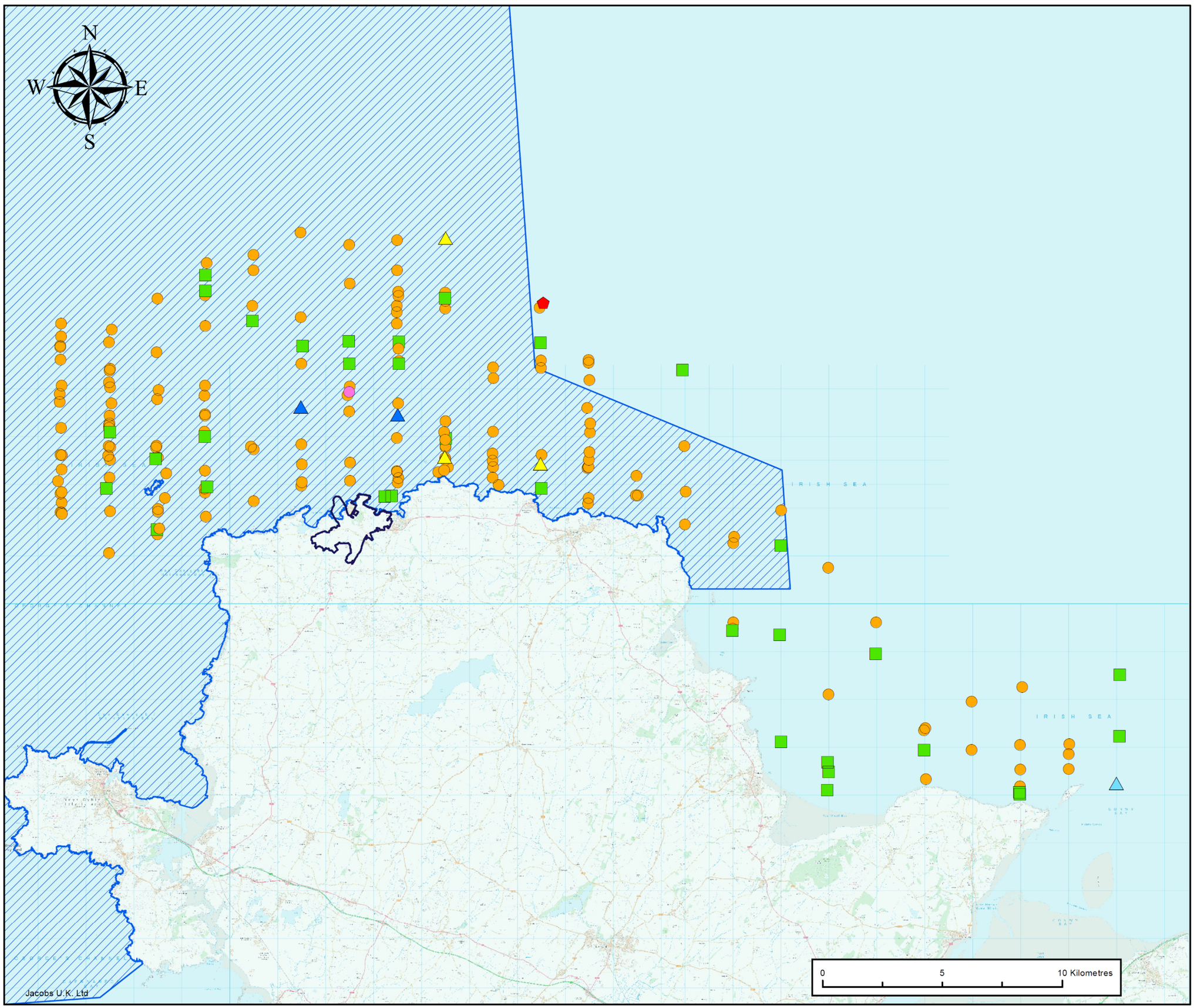
Appendix D. Site-Specific Visual Vessel Transect Survey Data



Legend

- Wylfa Newydd Development Area
- North Anglesey Marine / Gogledd Môn Forol cSAC

Marine mammal records (May 2016 - July 2017)

- Bottlenose dolphin
- Rissos dolphin
- Delphinidae (family of oceanic dolphins)
- Harbour porpoise
- Grey seal
- Balaenopteridae (family of baleen whales)
- Cetacean

Marine mammal records from vessel transect surveys May 2016 - July 2017

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Client: HORIZON NUCLEAR POWER

Project: Wylfa Newydd

Drawing title	Marine mammal records from vessel transect surveys May 2016 - July 2017				
Drawn by	Check'd by	Rev'd by	Appr'd by	Date OCT-17	Rev. 03
FL	KW	RW	RB	Ref. no. xxx	
Scale @ A3	1:150,000	DO NOT SCALE			
Figure D-1	Status **FINAL**			Project no. 60PO8099	

Table D.1: Number of individuals recorded during boat-based transect surveys between May 2016 and July 2017.

Date	Area surveyed (Ha)	Area surveyed (km^2)	Bottlenose dolphin		Harbour porpoise		Risso's dolphin		Cetacean indet.		Balaenopteridae		Grey seal	
			No. indiv.s sighted	Sightings rate km^{-2}	No. indiv.s sighted	Sightings rate km^{-2}	No. indiv.s sighted	Sightings rate km^{-2}	No. indiv. s sighted	Sightings rate km^{-2}	No. indiv's sighted	Sightings rate km^{-2}	No. indiv.s sighted	Sightings rate km^{-2}
26/05/2016	6,427.46	64.27	4	0.062232	6	0.093349	4	0.062232	-	0	-	0	3	0.046674
27/05/2016	3,277.45	32.77	-	0	-	0	-	0	-	0	-	0	2	0.061023
16/06/2016	6,401.83	64.02	-	0	-	0	-	0	-	0	-	0	-	0
17/06/2016	4,611.33	46.11	-	0	-	0	-	0	-	0	-	0	1	0.021685
28/06/2016	8,674.74	86.75	-	0	16	0.184443	-	0	3	0.065	-	0	1	0.011527
29/06/2016	3,227.06	32.27	-	0	1	0.030987	-	0	-	0	-	0	2	0.061975
19/07/2016	8,763.43	87.63	-	0	24	0.273865	-	0	-	0	-	0	1	0.011411
20/07/2016	3,262.79	32.63	-	0	6	0.183891	-	0	-	0	-	0	5	0.153243
17/08/2016	3,225.79	32.26	-	0	2	0.062000	-	0	-	0	-	0	-	0
18/08/2016	8,775.00	87.75	-	0	20	0.227920	-	0	-	0	-	0	3	0.034188
21/09/2016	8,742.00	87.42	-	0	26	0.297414	2	0.022878	-	0	-	0	1	0.011439
22/09/2016	4,231.00	42.31	-	0	7	0.165445	-	0	1	0.0650	-	0	2	0.047270
20/10/2016	7,553.00	75.53	-	0	4	0.052959	-	0	-	0	-	0	1	0.013239
29/11/2016	7,764.00	77.64	-	0	35	0.450798	-	0	-	0	-	0	3	0.038639
20/12/2016	3,659.00	36.59	-	0	3	0.081989	-	0	-	0	-	0	-	0
18/01/2017	3,431.00	34.31	-	0	25	0.728650	-	0	-	0	-	0	1	0.029146
19/01/2017	4,263.00	42.63	10	0.234576	20	0.469153	-	0	-	0	1	0.02345	5	0.117288
17/02/2017	5,825.00	58.25	-	0	23	0.394849	-	0	-	0	-	0	1	0.017167
06/04/2017	7,686.00	76.86	-	0	4	0.052042	-	0	-	0	-	0	1	0.013010
12/05/2017	5,559.00	55.59	-	0	9	0.161899	-	0	-	0	-	0	2	0.035977
09/07/2017	7,838.00	78.38	-	0	4	0.051033	-	0	-	0	-	0	-	0
Total	**123197.8**	**1231.98**	**14**	**0.296809**	**235**	**3.962695**	**6**	**0.085111**	**4**	**0.13**	**1**	**0.02345**	**35**	**0.724908**

Appendix E. Site-Specific Land-Based Seal Surveys Between Hen Borth and Porth Padrig, North Anglesey

See separate report.

Land-based seal surveys between Hen Borth and Porth Padrig, north Anglesey, over winter 2016/17.

Photos of mother and Stage 2 pup taken outside of survey area at Carmel Head on November 12th, 2016.

Liz Morris-Webb

Report No. 60PO8058/AQE/APP/001
Final: Rev. 1.0

Project Name: Wylfa Newydd Project
Project No. 60PO8058

Draft	Completed and Signed off by:	Date
Rev1	Originator: Liz Morris-Webb, Marine EcoSol Checker/Reviewer: Harry Goudge, Marine EcoSol Reviewer: Karen Watts/Rachel Wilson, Jacobs Approver: Rob Bromley, Jacobs	8th March 2017 10th March 2017 5th April 2017

Prepared for Jacobs UK Ltd (Jacobs) and the Horizon Wylfa Newydd Project.

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Disclaimer: This report comprises observations, comments and conclusions made by Marine EcoSol staff during and following land based seal surveys over winter 2016/17. Observations were limited to survey periods and therefore any results and conclusions should be considered a 'snapshot in time' of local seal populations.

Contents

List of Tables

1. Introduction

Marine Ecological Solutions (Marine EcoSol) was contracted by Jacobs UK Ltd (Jacobs) to undertake land-based seal surveys along the north Anglesey coastline, within the vicinity of Cemlyn Bay and Cemaes Bay, from October 30th, 2016 to January 25th, 2017. The timings of the survey coincided with the expected grey seal (*Halichoerus grypus*) breeding season (September-January) so that potential haul-out and pupping locations could be identified. Whilst the species of interest for pupping was the grey seal, all seal species (such as grey and harbour seal (*Phoca vitulina*)) sighted were also recorded.

1.1 Technical specification

Jacobs provided Marine EcoSol with 12 survey locations (stations) between Hen Borth in the west and Trwyn y Parc in the east, incorporating the area around Harry Furlough's Rocks. All stations were situated along, and accessible from, the coastal footpath and were surveyed for a minimum of 30 minutes every 17-20 days, not exceeding two hours either side of low water. The aim of the surveys was to note the presence and sex of adult and juvenile seals ashore at land-based stations, and to count and age any pups observed on land at stations; however, any seals seen in the vicinity of a haul-out location (.i.e. in the water) were also recorded.

Following the first four days of survey, during which each of the suggested stations were visited (October 30th, 2016 to November 9th, 2017), changes were made to the task-specific method statement and survey stations, in terms of viability for seal pupping and haul out. The changes (summarised in Section 2.1) were applied to the subsequent winter surveys, ending on January 25th, 2017.

2. Methods

Methods for the initial visit (pilot survey) followed the site/task-specific method statement provided by Jacobs (RAMS), and data were recorded in the field using the survey form shown in Appendix 1. Twelve stations were reconsidered following the pilot surveys in October 2016. Suggested changes were discussed with Jacobs and appropriate amendments made (summarised in Section 2.1 and detailed in Appendix 2).

Survey methods were adapted from Sayer (2012), Westcott (2008) and informed by Westcott and Stringell (2004). In summary, the proposed methods were as follows:

- Visit all survey stations at least once every three weeks, to ensure that every pup was counted within the three-week nursery period on the shore.
- Where possible, a 17-day interval was planned between visits to limit the chance of counting the same pup twice.
- Approach sites as discreetly as possible to avoid alerting seals to the approach of the surveyors and drawing the attention of members of the public to the seals. If approached by a seal, surveyors were to walk in the opposite direction to avoid disturbance of a potential mothering seal.
- Minimum of 30 minutes was spent at each site observing and recording seal activity.
- The maximum number of seals on the shore was counted within two hours of low water at each site. To ensure accurate records of seal numbers on the shore, seals on the shore were counted every 10 to 15 minutes until a stable number was reached. If the number of seals on the shore did not stabilise after 30 minutes, the surveyors stayed at the site until a stable number was attained.

- All adult seals on the shore were counted and their sex identified where possible, assisted by identification aids in Sayer (2012).
- For each pup observed on the shore, the 'Pup Stage' and 'Week number' was assigned (following descriptions in Sayer *et al.* (2012)) as follows:
    - 1 Umbilicalis,
    - 2 Fat, not barrel,
    - 3 Barrel white,
    - 4 Barrel moulting,
    - 5 Barrel moulted, and
    - Week 1, 2 or 3.
- Juvenile seals on the shore were counted and noted.
- Note the date and times at the site in addition to weather conditions (sea state, wind force and wind direction).

The survey form used for all 2016-17 surveys is provided in Appendix 1. The survey team comprised: Liz Morris-Webb, Harry Goudge and Paul Turkentine.

2.1 Amendments to station names following pilot survey (applied from November 23rd, 2016)

Appendix 2, Table A2.1 presents a detailed rationale for changing some of the station names and positions proposed by the initial RAMS, following preliminary surveys. These included excluding two stations from further surveys, moving a survey station to the east of Cemaes Beach (away from immediate frequent disturbance) and amending names given to two stations. Changes were agreed with Jacobs following the presentation of preliminary survey findings (October 30th - November 9th, 2016). The following amendments were applied from November 23rd, 2016:

- The station originally named Harry Furlough's Rocks (Station 2: 53 24.7206 N; 004 31.3404 W) was renamed (using the OS map) to Craig yr Iwrch.
- The original suggested station named Harry Furlough's Rocks/Cemlyn (Station 3: 53 24.8964 N; 004 30.7434 W) was not deemed suitable for pupping or haul outs due to regular use of the beach by dog walkers and its proximity to the coast path access. Surveys after November 9th, 2016visited the station as part of the roaming survey, rather than being targeted as a 30min full survey station.
- A new station named Harry Furlough's Rocks (Station 3: 53 24.995 N; 004 30.640 W) was selected on 23/11/16 as a better viewpoint of the rocks off the tip of Trwyn Cemlyn, to view winter seal haul outs on the rocks, rather than a potential pupping station.
- The proposed Cemlyn Bay station (Station 4: 53 24.675 N; 004 30.747 W) was not surveyed due to regular disturbance here by dogs, walkers and bird watchers.
- Trwyn r Parc (53 24.975 N; 004 26.898 W) was used regularly and frequently to exercise dogs (with up to seven seen at any one time); therefore, the station was moved to the quieter and more inaccessible bay of Porth Padrig (Station 12: 53 25.149 N; 004 27.0636 W).
- During the preliminary survey, wherever possible, sections of coast between stations were walked to identify any hidden or less accessible potential pupping or haul-out location, and to ensure that the most likely seal stations were selected for the ongoing survey. This was done by walking along the coast path, visually assessing potential stations using binoculars and recording notes and observations about such potential stations, referred to hereafter as the 'roaming surveys'.

- During these roaming surveys, several suitable and therefore potential pupping stations were identified, and these were revisited on subsequent surveys to ensure any pupping or haul outs were captured within the area of interest. Whilst walking these sections of coast, additional notes were recorded on the presence and behaviour of seals or other species of interest.

Further detail of the rationale for station amendments is provided in Appendix 2. Images of stations are provided in Appendix 3.

The final list of stations visited is presented in Table 2.1 and displayed in Figure 2.1 below.

Table 2.1: Seal survey stations surveyed between October 30th, 2016 and January 21st, 2017

Station Name	Viewpoint Position
Hen Borth	East shore: 53 24.4146 N 004 31.8606 W; West shore: 53 24.5526 N 004 31.6998 W
Craig yr Iwrch	53 24.7206 N 004 31.3404 W
Harry Furlough's Rocks	53 24.9950 N 004 30.6400 W
Cemlyn	53 24.6774 N 004 30.1764 W
Cerrig Brith	53 24.8262 N 004 29.8500 W
Porth-y-pistyll	53 24.7176 N 004 29.5362 W
Porth Wnal	53 25.1778 N 004 28.8354 W
Port yr Ogof	Viewpoint 1: 53 25.1916 N 004 28.4622 W; Viewpoint 2 (overlooking cave): 53 25.1190 N 004 28.5498 W
Porth Wylfa	Western viewpoint: 53 24.9740 N 004 28.0650 W; Eastern viewpoint: 53 24.9306 N 004 27.8808 W
Trwyn y Penrhyn	53 24.9384 N 004 27.2580 W
Porth Padrig	53 25.1490 N 004 27.0636 W

2.1 Amendments to methods following pilot survey (applied from November 23rd, 2016)

Following the initial survey and preliminary findings, the following amendments to survey methods were agreed with Jacobs and applied after November 23rd, 2016:

- Surveys were to take place between 14 and 17 days apart (rather than the ideal 17-20), due to daylight hours and tides.
- Following the initial detailed preliminary survey, it was possible to complete all stations over three days, providing that two days had the full four-hour tidal windows during daylight hours and the third day had a minimum of 2.5 hours of available light, within two hours either side of low water.
- Positive sightings of in-water seals were also to be recorded.
- To minimise potential disturbance to seals, upon arrival at each station, the following two points were notable:

- Surveyors attempted to hide below the skyline when surveying so they were not obvious to in-water seals
- Wherever time allowed, surveyors started observations five minutes after arriving at a station, allowing a 'settling in period', during which time high-visibility jackets and white helmets were removed. Seals are colour-blind and have scotopic vision, meaning they have greater sensitivity to contrast and brightness, compared with the human eye (Scholtyssek *et al.,* 2015).

10x50 binoculars were generally used, but in low light levels, good-quality 8x42 binoculars were found to be more functional. A spotting scope (x60) and tripod was also trialled to view stations 1km away, but deemed unsuitable in most of the winter weather conditions as the wind caused considerable scope shake and deemed the tripod almost redundant.

3. Results

Table 3.1 summarises each main survey station visited during initial surveys in 2016. Daylight and tide limitations meant surveys were split over 3-4 days to ensure appropriate coverage of all stations.

Appendices 4 and 5 provide more-detailed summaries of stations surveyed and also of the sections of coast (i.e. areas observed when walking between stations).

3.1 Positive seal sightings

No seals were observed ashore at any survey stations, or at any viable pupping stations on the coastal walk between stations.

Grey seals were observed in the water on five occasions: once at Cerrig Brith, twice at Porth Wnal, once at Trwyn Penrhyn and once at Porth Padrig. See Table 3.1 for a summary of sightings, or Appendices 3 and 4 for detailed summaries of stations and sections of coast respectively. All in-water seals observed were small individuals assumed to be juveniles or small adults. Although it was difficult to age or sex in-water seals, it was thought both males and females were observed on different occasions. At Porth Wnal, a seal was recorded as either playing or feeding, whilst all other seal records were relatively short observations.

3.2 The effect of weather

A range of weather conditions was experienced during this survey season, from clear and still conditions on sheltered stations to heavy rain, gale force winds and very rough seas on more-exposed open beaches. The suite of stations always provided a range of shelter options against wind conditions. Station-specific weather conditions were recorded and are provided in Appendix 4 with the tabulated survey data.

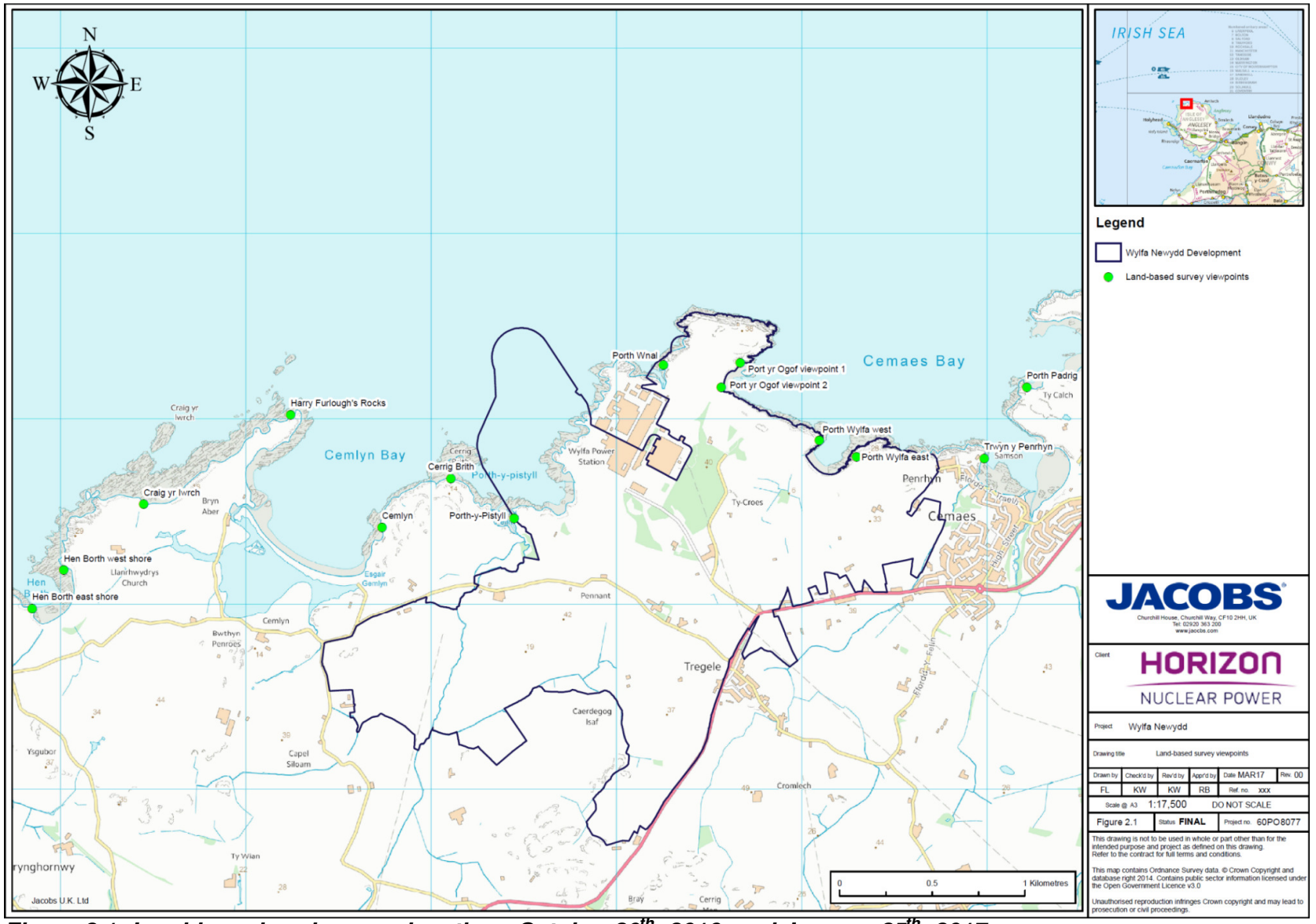

Figure 2.1: Land-based seal survey locations October 30th, 2016, and January 25th, 2017

Table 3.1: Summary results from land-based seal surveys, surveyed between October 30th, 2016, and January 25th, 2017. Stations were surveyed for a minimum of 30 minutes on each visit

Station No.	Station Name	Updated Main Viewpoint Position	Total No. of Station Visits	Dates of Surveys	Total Survey Time (hrs : mins)	Total No. of Seals Hauled Out (m / f)	Total No. of Seal Pups	Total No. of Seals in Water	Notes
1	**Hen Borth**	53 24.4146 N 004 31.8606 W supplemented by some observations on the approach to the survey station (see Appendix 2 for positions)	6	30/10/16 23/11/16 07/12/16 21/12/16 06/01/17 23/01/17	03:01	0	0	0	The first survey at this site required more time exploring the area to identify the best viewpoint.
2	**Craig yr Iwrch** (originally named Harry Furlough's Rocks)	53 24.7206 N 004 31.3404 W	6	30/10/16 23/11/16 07/12/16 21/12/16 06/01/17 23/01/17	03:31	0	0	0	
3	**Harry Furlough's Rocks**	53 24.995 N 004 30.640 W	5	23/11/16 07/12/16 21/12/16 06/01/17 23/01/17	02:35	0	0	0	The section of coast between Craig yr Iwrch and Harry Furlough's Rocks is possibly too exposed and easily accessible (disturbed) to be suitable for pupping. This station was specifically selected to confirm if Harry Furlough's Rocks are an important winter haul out.
4	**Cemlyn Bay**	n/a	n/a	n/a	n/a	n/a	n/a	n/a	Central area of the bay not surveyed as a main station due to regular walkers and dog walkers on-site. The area was viewable from Station 5 when the visibility allowed, during which time no seals were observed on the beach or in water.
5	**Cemlyn**	53 24.6774 N 004 30.1764 W	6	31/10/16 24/11/16 07/12/16 21/12/16 06/01/17 23/01/17	03:00	0	0	0	

Station No.	Station Name	Updated Main Viewpoint Position	Total No. of Station Visits	Dates of Surveys	Total Survey Time (hrs : mins)	Total No. of Seals Hauled Out (m / f)	Total No. of Seal Pups	Total No. of Seals in Water	Notes
6	**Cerrig Brith**	53 24.8262 N 004 29.850 W	6	31/10/16 24/11/16 08/12/16 22/12/16 07/01/17 24/01/17	04:19	0	0	1 grey seal (sex indet.)	Longer than 30mins spent at this site on several occasions due to potential seal sightings, disturbance from jet ski and early arrival at site.
7	**Porth-y-pistyll**	53 24.7176 N 004 29.5362 W	6	08/11/16 24/11/16 08/12/16 22/12/16 07/01/17 24/01/17	03:16	0	0	0	
8	**Porth Wnal**	53 25.1778 N 004 28.8354 W	6	08/11/16 24/11/16 08/12/16 22/12/16 07/01/17 24/01/17	03:01	0	0	2 grey seals (juvenile and/or small female)	
9	**Port yr Ogof**	53 25.1916 N 004 28.4622 W supplemented by some observations on the approach to the survey station (see Appendix 2 for positions)	6	08/11/16 24/11/16 08/12/16 22/12/16 07/01/17 24/01/17	03:14	0	0	0	

Station No.	Station Name	Updated Main Viewpoint Position	Total No. of Station Visits	Dates of Surveys	Total Survey Time (hrs : mins)	Total No. of Seals Hauled Out (m / f)	Total No. of Seal Pups	Total No. of Seals in Water	Notes
10	**Porth Wylfa**	West viewpoint: 53 24.9306 N 004 27.8808 W East viewpoint: 53 24.947 N 004 28.112 W	6 + 2 short visits <15mins	09/11/16 24/11/16 09/12/16 22/12/16 08/01/17 25/01/17 (short visits on: 08/11/16; 25/11/16)	03:36 + (00:17)	0	0	0	Typically surveyed on western viewpoint, but several instances of high winds meant that shelter was sought at the second (eastern) viewpoint.
11	**Trwyn y Penrhyn**	53 24.9384 N 004 27.258 W	6	09/11/16 25/11/16 09/12/16 23/12/16 08/01/17 25/01/17	03:00	0	0	1 grey seal (juvenile, poss. male)	Regular disturbance from dog walkers and beach goers and on one occasion winkle collectors were observed.
11a	**Trwyn y Parc**	53 24.9132 N 004 26.826 W	3	09/11/16 25/11/16 09/12/16	01:20	0	0	0	Site observations moved to Porth Padrig due to regular disturbance at Trwyn y Parc from dog walkers. Trwyn y Parc is used largely by people with dogs to play. Up to seven dogs (plus six people) on the site during one visit.
12	**Porth Padrig**	53 25.149 N 004 27.0636 W	5 + 1 short scoping visit more than 2hrs after low water.	25/11/16 09/12/16 23/12/16 08/01/17 25/01/17 (short scoping visit on 09/11/16)	02:30 + (00:13)	0	0	1 grey seal (juvenile male on scoping visit)	

4. Discussion

The aim of this survey was to identify sites used by grey seals for pupping or hauling out along the coast surrounding the site of the proposed Wylfa Newydd Power Station. This included the stretch of coast between Hen Borth and Porth Padrig. Within this area, surveys noted the presence of all other seal species, such as the harbour porpoise (*Phocoena phocoena*) (which have been reported in the Jacobs Marine Mammal Baseline report). Whilst surveyors were present within the survey areas, no adult or juvenile seals or grey seal pups were observed ashore, there was no evidence of unsuccessful pupping (i.e. dead pups) and grey seals were only noted in the water on five occasions.

4.1 The coast between Hen Borth and Porth Padrig as a seal pupping (nursery) area, put into local context

Although grey seal pupping has been noted on the north Anglesey coastline, there have not been any confirmed positive records of grey seal pups within the search area between Hen Borth and Porth Padrig. Carmel Head is noted as a popular area of sheltered pupping beaches and one large sea cave (Westcott and Stringell, 2004). Carmel Head is 1.8km west of Hen Borth, is much less accessible from the coast path and less frequented by dog walkers, when compared to the current survey area (Morris-Webb, *pers. comm.*). Westcott and Stringell (2003; 2004) surveyed from Carmel Head to Cemlyn Bay, but did not find any pups to the east of Carmel Head. Westcott and Stringell (2004) noted there are five beaches used for pupping on the Ynysoedd y Moelrhoniaid and Ynys Awr on The Skerries, 4km northwest of Carmel Head and 5.5km west-northwest of Hen Borth.

In terms of the grey seal pupping season, surveys undertaken in 2002 targeting pupping sites around the nearby Holy Island counted a total of 35 total pups from a wave ski (kayak) from 05/09/02 to 07/11/02 (Westcott and Stringell, 2003). In another report commenting on seal communities, Westcott and Stringell (2004) recognised the importance of the area around North Stack for grey seal pupping.

Surveys undertaken in the same year targeting pupping sites around Carmel Head found a total of two pups from 25/09/02 to 14/10/02 (Westcott and Stringell, 2003). Westcott noted that in 2001 pup production was higher at Carmel Head than in 2002, and that fly tipping on nursery sites may have contributed to lower numbers of pups recorded during 2002. Westcott also noted that accessibility to the beaches by walkers and inshore recreational boating activity may disturb seals and distract them from seeing potential pupping sites.

Westcott and Stringell (2003) counted a total of 15 pups around Ynysoedd y Moelrhoniaid, the main beach on The Skerries, between 16/10/02 and 08/11/02 as part of a different survey in the same year. Ynys Dulas and Puffin Island, other known assembly sites, were not deemed important as pupping sites during the 2002 surveys by Westcott and Stringell.

One anecdotal observation of a Stage 2 grey seal pup at Carmel Head on 12/11/16 (not part of these surveys and outside of survey area, see cover photograph) confirmed that seals were pupping in the area during the 2016/17 surveys, in keeping with the dates of the pupping season described by Westcott and Stringell following surveys in 2002 (2003; 2004).

In the 2016/17 surveys, seals were generally seen in windy conditions, but on other windy days no seals were seen at all, and as a result no conclusions can be drawn regarding the effect of weather on local seal sightings

4.2 The coast between Hen Borth and Porth Padrig as a seal winter haul-out area, put into local context

In terms of haul outs, the surveyors have previously seen grey seals in the water and around Harry Furlough's Rocks in summer. However, relative to the local population, these haul-out sites have been in very low numbers compared to those accepted as the largest local grey seal assembly sites, where over 115 adults were observed to congregate on beaches on some days in winter 2002 at Ynys Dulas (approximately 20km east of Hen Borth) and Puffin Island (35km southeast) in particular (Westcott and Stringell, 2004). The same survey identified up to 49 grey seals on beaches at smaller but regionally significant assemblies of grey seals at Ynysoedd y Moelrhoniaid, The Skerries (5.5km west-northwest of Hen Both), and smaller assemblages (including pups) around a section of coast around North Stack (13.5km southwest).

As all seals observed during the 2016-17 surveys were in water, it is suspected that seals were largely passing through or feeding, and possibly many of the sites surveyed were too frequently disturbed by walkers and dogs to be suitable as seal haul-out sites. Some of the small seals identified as juvenile grey seals may have been pups born this year, but this cannot be confirmed. Most of the grey seals observed were not in the area for long and did not haul out, with the exception of the Porth Wnal station in the outfall bay of the Existing Power Station, where seals appeared to make stay for longer periods of time. This was probably the site disturbed least by members of the public. There is a general background hum from the Existing Power Station, but no footpaths or dog walkers, and it is also the most sheltered of the survey stations, so together these factors may explain the use of the site more regularly by passing seals.

In addition, whilst the Existing Power Station was operational, the warmer outfall water at Porth Wnal meant there was a resident bass population in the bay (noted on diving surveys undertaken by Jacobs in 2007, 2010 and 2011). Once the Existing Power Station stopped generating power, the warmer outfall water stopped flowing into the bay, and following this cessation, it was noted during 2016 dive surveys that the associated bass population was absent (Morris-Webb, *pers. comm.*). If the historic presence of a resident shoal of fish was memorable to seals, they might continue using the bay as a feeding ground even though the fish population is no longer there.

4.3 Limitations and recommendations

Surveys were started late into the grey seal pupping season compared to previous surveys that observed seal pupping from the beginning of September around the north Anglesey coast (Westcott and Stringell, 2004). Ideally, any future surveys in the area should start earlier, in late August at the latest, to ensure that the beginning and end of the grey seal pupping season are surveyed. However, during a recreational coastal walk at Carmel Head on November 12th, 2016 (additional to these land-based surveys), the Author confirmed sightings of a Stage 2 grey seal pup shown in the cover image on the front page of this report. Therefore, the surveyors are confident that if pups were present at survey stations observed during these surveys, the method was robust enough to identify pups born after mid-October.

It is possible land-based surveys could have missed pups born out of view of the surveyors, such as within hidden caves or under overhanging cliffs, if such features exist within the survey area. Inaccessible areas including small and narrow 'gully' type beaches at the base

of undercut, vertical or steeply sloping cliffs were present in the survey area, and some of these had no direct line of sight from accessible areas. It is therefore possible grey seal pupping sites exist within the survey area that were not visible or accessible from land. Westcott and Stringell (2003) reported 67.3% of grey seal pups in north Wales were born on beaches with sea caves present. Conversely, Westcott and Stringell (2003) indicated that only 32.7% of grey seal pups were born on 'open' beaches (where sea caves were not present), which would best describe the survey stations within the present study. Boat-based surveys during the pupping season would be required to confirm if these few inaccessible sites were in fact used by grey seals as pupping sites. However, logistical issues of surveying on low spring tides during dawn and dusk and in poor winter weather conditions mean it is likely boat-based surveys would not be cost effective. If inaccessible sea caves are present in the area of interest, it should be noted that land-based seal surveys could identify as little as 32% of grey seal pups born in the area according to Westcott and Stringell (2003).

The 2016 surveys were mainly limited by tide and daylight. Failing light can limit viewing distances for some binoculars (10x50, suggested by the method statement). Binoculars with a lower aperture perform better in low light levels, and therefore in 2016, surveyors also carried a pair of 8x42 binoculars and x60 spotting scope and carbon fibre tripod to view distant shores (for example, enabling observation of seals at Harry Furlough's Rocks from Cemlyn). However, although the spotting scope gave an extended survey range, high winds often meant that the spotting scope was not a reliable survey tool.

In terms of survey logistics, it was very difficult to plan pupping surveys in the four-hour tidal window around low water spring tides in winter, which, in North Wales, are in the dark. Westcott and Stringell (2004), surveying by wave ski (an elaborate sit-on-top kayak) from the sea, suggested that Carmel Head grey seal pupping sites were best visited at mid-tide, which would allow an extra hour of daylight to visit sites and may enable more surveys in a day. This would be acceptable for observing pups which are usually above the high water mark. However, this advice from Westcott and Stringell is contrary to the general accepted procedural guidelines for seal pupping surveys elsewhere in the UK (Westcott, 2008; Sayer, 2012).

Finally, Westcott and Stringell (2004) recommended that sites subject to human pressure should be surveyed more regularly if hoping to count seals ashore. It may then be possible to detect the impact or regular disturbance on seal behaviour. The winter surveys would benefit from exploring the use of the survey stations at night on week days, when disturbance is minimal. However, there is a fine line between sufficient surveying effort, too frequent disturbance of seal pups and mothers, and minimising the probability of double counting seals during their nursery period. Ideally, surveys should be less frequent than 17 days to allow time for a young pup to move away from a site, or develop into a Stage 3 or 4 pup (Westcott, 2008; Sayer, 2012). Surveyors must minimise their distraction to seals, by removing bright clothing, but also remaining below the skyline when surveying, so they are not obvious to seals present in the water. However, during the 2016-17 surveys, despite surveyors' best efforts, seals did appear to watch surveyors even when below the skyline, so the presence of surveyors may have influenced the haul out behaviour of seals.

4.4 Conclusions

The lack of seals observed pupping or hauling out between Hen Borth and Porth Padrig during 19 survey days, from October 30th, 2016, to January 25th, 2017, indicated that the area was

not an important area for grey seal pupping or seals hauling out during the winter period of the 2016/17 year. These results are in keeping with the findings of surveys undertaken in 2002 for the Countryside Council for Wales focusing on seal assembly sites, pup production and population size in north Wales (Westcott and Stringell, 2003; 2004).

An absence of seals hauling out or pupping during a single winter period does not allow firm conclusions regarding the general suitability or long-term use of this area by grey seals for pupping or hauling out. However, within this period, grey seals were known to be pupping at Carmel Head, just outside the survey area (one being observed by the Author on November 12th, and others confirmed by walkers in the surrounding area). Therefore, the surveyors are confident that any grey seals born during these surveys within the survey area, would have been observed as part of this survey.

5. References

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Appendices

Appendix 1: Land-based seal pupping survey form

Isle of Anglesey Assessment Monitoring for Seals		
STATION: **Date:** **Surveyors:** **Note:**	**Start Time:** **End Time:** **Time of LW:** **Picture Nos.**	**Positional Notes:**

Sea State	Stormy	V rough	Rough	Choppy	Calm	**Wind Force:**	Gale	V Windy	Windy	Breeze	Still	Wind Dir.:

Pup Number	**Wypt / No. on map**	**Stage**	**Week**	**Best Fit**	**Comment**

No. Males	**No. Females**	**No. Juveniles**

Leave Menai:
Sign In HNP:
Arrive car park nr station:
Arrive station:
Arrive car park / next station:
Sign out HNP:
Return Menai:

Time	**Waypoint**	**Note**

Time	**Waypoint**	**Note**

Appendix 2: Changes made to station names and locations following pilot surveys

Table A2.1: Amendments made to initial land-based seal survey stations, surveyed between October 30th, 2016 and January 21st, 2017

Original Station Name	Original Suggested Position	Comments on Original Station Following the First Visit to Each Station	Amendment from Original Specification (applied from Nov. 23rd)	Corrected Station Name	Updated Viewpoint Position
Hen Borth	53 24.414 N 004 31.850 W	Easily accessed main beach, with several smaller inaccessible coves.	Positions amended to more appropriate viewpoints. Split survey time between two viewpoints to ensure both sides of the bay observed to identify and age any pups. .		East shore 53 24.4146 N 004 31.8606 W West shore 53 24.5526 N 004 31.6998 W
Harry Furlough's Rocks	53 24.717 N 004 31.298 W	Site has a better view of the leeward side of Craig yr Iwrch than Harry Furlough's Rocks. Both sets of islands are good haul-out locations, but do not have much area above the intertidal zone suitable for pupping. The foreshore at this station is very easily accessible from the coast path, with dog walkers and kayakers seen near the site. There was also a couple walking along this section of beach looking for seal pups.	Corrected the station name. Position amended to more appropriate viewpoint.	**Craig yr Iwrch**	53 24.7206 N 004 31.3404 W
Harry Furlough's Rocks / Cemlyn	53 24.863 N 004 30.830 W	This site is likely to be even more disturbed and frequented by beach goers and dog walkers than Harry Furlough's Rocks, due to easy access and proximity to car park. The visibility to the other side of the bay was not as good as the reverse visibility from Cemlyn station.	Position amended to more appropriate viewpoint. Move station to a better viewpoint of Harry Furlough's Rocks with aim of assessing winter use as a haul-out site.	**Harry Furlough's Rocks**	53 24.995 N 004 30.640 W
Cemlyn Bay	53 24.675 N 004 30.747 W	This site is very close to regularly used viewpoint for the tern colony, and coast path, and a small bridge with easy beach access. Disturbance levels meant that this station was not surveyed.	Decided that this was not a suitable station. Not surveyed.		None

Original Station Name	Original Suggested Position	Comments on Original Station Following the First Visit to Each Station	Amendment from Original Specification (applied from Nov. 23rd)	Corrected Station Name	Updated Viewpoint Position
Cemlyn	53 24.677 N 004 30.117 W	It was not clear if this viewpoint was supposed to view the whole of Cemlyn Bay, or the small cove to the south of the viewpoint. This viewpoint has a clear view of the small cove to the south, and of the main Cemlyn beach. It would be possible to see moving large seals on the western shores of Cemlyn (and Harry Furlough's Rocks/Cemlyn), but not pups. From this station you could also potentially see (in good light and visibility) seals hauled out on Harry Furlough's Rocks, but again not pups. The small shingle cove to the south of the viewpoint, however, does have very easy access from the coast path, frequented by anglers, and looks as though cattle may frequent the beach too.	Position amended to more appropriate viewpoint. This station allows views of the small shingle cove, the central bay and the main beach for seals.		53 24.6774 N 004 30.1764 W
Cerrig Brith	53 24.835 N 004 29.808 W	Sheltered site with lots of overhangs and rockpools which is less accessible from the coast path than the other stations from Hen Borth. However, one jet ski was observed during the survey close to the shore, and there were noisy diggers working near Porth-y-pistyll and loud noises were audible from normal operations at the Existing Power Station site.	Position amended to more appropriate viewpoint.		53 24.8262 N 004 29.850 W
Porth-y-pistyll	53 24.738 N 004 29.574 W	Unclear whether this viewpoint was supposed to view the whole of Porth-y-pistyll or just the small embayment in the south (next to viewpoint). After looking around, it was difficult to find a viewpoint covering the entire bay, so the station viewpoint was set to survey the small embayment and close surrounds within view. Note: noisy diggers working near Porth-y-pistyll and loud noises were audible from normal operations at the Existing Power Station site.	Position amended to more appropriate viewpoint. From this viewpoint view the small beach next to the viewpoint and most of the central bay.		53 24.7176 N 004 29.5362 W
Porth Wnal	53 25.130 N 004 28.892 W	From this viewpoint, surveyors could clearly see across the outfall to Porth Wnal, without complicated access issues with Magnox. The outfall bay was all clearly visible too. Note that there is still water flowing from the outfall (although not in the same volume as previously).	Position amended to more appropriate viewpoint.		53 25.1778 N 004 28.8354 W

Original Station Name	Original Suggested Position	Comments on Original Station Following the First Visit to Each Station	Amendment from Original Specification (applied from Nov. 23rd)	Corrected Station Name	Updated Viewpoint Position
Port yr Ogof	53 25.141 N 004 28.439 W	Potentially a good quiet site for seals, although there is easy beach access here. The cave on the south side of the island looked viable as a haul-out with potential for pupping, but it was not possible to safely assess the cave for a closer view. In order to assess the cave's viability, surveyors would have to revisit on a better spring low water.	Positions amended to more appropriate viewpoints. Split survey time between two viewpoints to ensure both sides of the bay have resolution to identify and age any pups.		viewpoint 1 53 25.1916 N 004 28.4622 W viewpoint 2 (overlooking cave): 53 25.119 N 004 28.5498 W
Porth Wylfa	53 24.971 N 004 27.990 W	A good potential haul-out site, particularly at quiet times, although close to the path at beach level. Some areas of interest for potential pupping on the less accessible boulder areas, rather than the open shingle beach which has direct path access.	Positions amended to more appropriate viewpoints. Either of these viewpoints could be used for the full survey (depending on logistics of the direction of approach and time limitations).		Western viewpoint 53 24.974 N 004 28.065 W Eastern viewpoint 53 24.9306 N 004 27.8808 W
Trwyn y Penrhyn	53 24.900 N 004 27.199 W	A sheltered site, but very disturbed. At the time of visiting there were three winkle pickers, dog walkers and two surfers in the water.	Positions amended to more appropriate viewpoints. (However, unlikely to be a pupping site due to regular disturbance.)		53 24.9384 N 004 27.258 W
Trwyn y Parc	53 24.975 N 004 26.898 W	Survey abandoned due to high levels of disturbance and easy accessibility directly from car park. Four loud barking dogs playing on the site on the first visit, with six animated owners. Up to seven dogs were observed there on another occasion.	Changed main station location to more viable beach (Porth Padrig). Did not complete full surveys at this Trwyn y Parc due to high levels of disturbance. It could be a suitable haul-out/resting place at quiet times, so is worth checking if passing on a quiet day.	**Porth Padrig**	53 25.149 N 004 27.0636 W

Appendix 3: Photographs of stations

Station Name	Images
Hen Borth – west shore viewpoint (preferred final survey position)	
Hen Borth – east shore viewpoint	
Hen Borth – sheep on beach (taken from central bay, next to which the coast path runs at sea level with direct access onto beach)	

Craig yr Iwrch	
Harry Furlough's Rocks	 

	
Harry Furlough's Rocks/Cemlyn	
Cemlyn Bay	Not visited

Cemlyn	**Easy access**  **From viewpoint:** 

Cerrig Brith	
Porth-y-pistyll	 

Porth Wnal	
Port yr Ogof	 **Viewpoint south side of bay (including cave entrance):** 

Porth Wylfa (western viewpoint)	
Porth Wylfa (eastern viewpoint)	None taken
Porth Wylfa (beach viewpoint)	
Trwyn y Penrhyn	

	
Trwyn y Parc	
Porth Padrig	

Appendix 4: Survey summaries by station for land-based seal surveys, October 30th, 2016 – January 25th, 2017

Table A.4.1: Summary of weather and seal observations at Hen Borth between October 30th, 2016, and January 25th, 2017

Main viewpoint: 53 24.4146 N 004 31.8606 W
Alternative / Additional viewpoints which may have been explored in early surveys, or used as alternatives in very windy conditions:
53 24.5526 N 004 31.6998 W.

Date	Sea State	Wind Force	Wind Direction	Time of LW Cemaes	Start	End	Duration	Seals	Site-Specific Notes
30/10/2016	calm	breeze	E	16:35	15:00	15:53	00:46	0	Site surveyed from several locations on first two visits, with a break in between whilst walking between them. Signs of a number of sheep on the eastern end of the beach
23/11/2016	calm (in bay)	breeze	E	12:17	10:20	11:15	00:40	0	
07/12/2016	choppy	windy	S	09:51	08:15	09:00	00:35	0	
21/12/2016	calm (in bay)	very windy	W	10:12	08:35	09:05	00:30	0	50-60 sheep on beach
06/01/2017	calm (in bay)	windy	SW	10:26	08:32	09:02	00:30	0	50-60 sheep on beach
23/01/2017	calm	breeze	S	13:42	11:50	12:20	00:30	0	

Table A.4.2: Summary of weather and seal observations at Craig yr Iwrch between October 30th, 2016, and January 25th, 2017
Main viewpoint: 53 24.7206 N 004 31.3404 W

Date	Sea State	Wind Force	Wind Direction	Time of LW Cemaes	Start	End	Duration	Seals	Site-Specific Notes
30/10/2016	calm	breeze	E	16:35	16:20	16:50	00:30	0	Walkers on beach
23/11/2016	calm (in bay) (choppy outside bay)	breeze	E	12:17	11:35	12:05	00:30	0	Collector (of winkles?) on beach
07/12/2016	choppy	windy	S	09:51	09:20	09:50	00:30	0	Rough seas out of bay
21/12/2016	calm	very windy	WNW	10:12	09:34	10:05	00:31	0	
06/01/2017	calm (in bay)	windy	SW	10:26	09:30	10:00	00:30	0	
23/01/2017	calm	breeze	S	13:42	12:40	13:10	00:30	0	

Table A.4.3: Summary of weather and seal observations at Harry Furlough's Rocks between November 23rd, 2016, and January 25th, 2017
Main viewpoint: 53 24.995 N 004 30.640 W

Date	Sea State	Wind Force	Wind Direction	Time of LW Cemaes	Start	End	Duration	Seals	Site-Specific Notes
23/11/2016	rough	very windy	E	12:17	12:20	13:00	00:30	0	
07/12/2016	choppy	very windy	S	09:51	10:10	10:40	00:30	0	
21/12/2016	choppy	windy	W	10:12	10:30	11:05	00:35	0	
06/01/2017	calm (in bay)	very windy	SW	10:26	10:20	10:50	00:30	0	
23/01/2017	calm	breeze	S	13:42	13:30	14:00	00:30	0	

Table A.4.4: Summary of weather and seal observations at Cemlyn between October 30th, 2016, and January 25th, 2017
Main viewpoint: 53 24.6774 N 004 30.1764 W

Date	Sea State	Wind Force	Wind Direction	Time of LW Cemaes	Start	End	Duration	Seals	Site-Specific Notes
31/10/2016	calm	breeze	N	17:07	16:20	16:50	00:30	0	
23/11/2016	calm (in bay) (choppy outside bay)	breeze	E	12:17	12:25	12:30	00:05	0	Survey abandoned due to presence of drone operators (Jacobs) on the suspected pupping beach
24/11/2016	calm (in bay) (choppy outside bay)	windy	NE	13:21	11:21	11:51	00:30	0	Lobster pots and debris present on beach and in shallow water after big storms in preceding days.
07/12/2016	choppy	very windy	S	09:51	11:10	11:40	00:30	0	
21/12/2016	choppy	very windy	W	10:12	11:50	12:20	00:30	0	
06/01/2017	choppy	very windy	SW	10:26	11:25	11:55	00:30	0	
23/01/2017	calm	breeze	S	13:42	14:25	14:55	00:30	0	

Table A.4.5: Summary of weather and seal observations at Cerrig Brith between October 30th, 2016, and January 25th, 2017

Main viewpoint: 53 24.8262 N 004 29.850 W

Date	Sea State	Wind Force	Wind Direction	Time of LW Cemaes	Start	End	Duration	Seals	Site-Specific Notes
31/10/2016	calm	breeze	N	17:07	15:07	16:07	01:00	1 grey seal (in water, sex indet.)	Prolonged survey to see if seal hauled out, and also due to interruption from jet ski close by.
24/11/2016	calm (in bay) (choppy outside bay)	windy	NE	13:21	11:58	12:28	00:30	0	Walkers and dog walkers encountered along the coast path prior to and after the survey. Lobster pot buoys on the foreshore.
08/12/2016	choppy	very windy	S	11:02	09:02	09:32	00:30	0	Raining throughout survey
22/12/2016	choppy	very windy	W	11:19	08:45	09:49	00:30	0	Very windy on tops, calm in bays. Arrived on-site early so started survey >2hr before LW
07/01/2017	choppy	very windy	SW	11:40	09:30	10:10	00:30	0	
24/01/2017	calm	breeze	S	14:38	12:45	13:20	00:30	0	Retrieved some rope and litter from beach.

Table A.4.6: Summary of weather and seal observations at Porth-y-pistyll between October 30th, 2016, and January 25th, 2017

Main viewpoint: 53 24.7176 N 004 29.5362 W

Date	Sea State	Wind Force	Wind Direction	Time of LW Cemaes	Start	End	Duration	Seals	Site-Specific Notes
08/11/2016	calm	breeze	S	10:23	08:10	08:56	00:46	0	
24/11/2016	calm (in bay) (choppy outside bay)	windy	NE	13:21	12:40	13:10	00:30	0	
08/12/2016	calm	breeze	N	11:02	09:55	10:25	00:30	0	Raining throughout
22/12/2016	calm	windy	W	11:19	10:00	10:30	00:30	0	
07/01/2017	calm	still	n/a	11:40	10:30	11:00	00:30	0	
24/01/2017	calm	windy	S	14:38	13:40	14:10	00:30	0	

Table A.4.7: Summary of weather and seal observations at Porth Wnal between October 30th, 2016, and January 25th, 2017
Main viewpoint: 53 25.1778 N 004 28.8354 W

Date	Sea State	Wind Force	Wind Direction	Time of LW Cemaes	Start	End	Duration	Seals	Site-Specific Notes
08/11/2016	calm	breeze	SE	10:23	10:00	10:31	00:31	0	
24/11/2016	calm (in bay) (choppy outside bay)	windy	NE	13:21	13:30	14:00	00:30	1 grey seal (in water, juv. female)	One juvenile female seal seen swimming in the bay, near the headland on other side of bay from the viewpoint. Appeared to be feeding, or playing.
08/12/2016	choppy	windy	W	11:02	12:07	12:37	00:30	0	
22/12/2016	choppy	very windy	W	11:19	11:05	11:35	00:30	1 grey seal (in water, juv. female)	
07/01/2017	calm	breeze	W	11:40	11:55	12:25	00:30	0	
24/01/2017	calm	windy	S	14:38	14:45	15:15	00:30	0	

Table A.4.8: Summary of weather and seal observations at Port yr Ogof between October 30th, 2016, and January 25th, 2017

Main viewpoint: 53 25.1916 N 004 28.4622 W
Alternative / Additional viewpoints which may have been explored in early surveys, or used as alternatives in very windy conditions:
53 25.119 N 004 28.5498 W

Date	Sea State	Wind Force	Wind Direction	Time of LW Cemaes	Start	End	Duration	Seals	Site-Specific Notes
08/11/2016	calm	breeze	SE	10:23	11:10	11:50	00:35	0	Tried to view area near cave entrance in Port yr Ogof. Unfortunately, to view this area one would need foot access on a spring LW to walk to the cave mouth.
24/11/2016	choppy	windy	NE	13:21	14:14	14:45	00:30	0	Full survey split between two viewpoints.
08/12/2016	choppy	breeze	NE	11:02	10:41	11:40	00:35	0	Included use of spotting scope to assess viability of cave and small inlets around island. Unlikely to be a pupping cave, although a potential haul-out.
22/12/2016	choppy	windy	W	11:19	11:45	12:15	00:30	0	
07/01/2017	calm	still	n/a	11:40	12:45	13:15	00:30	0	Disturbance: 2 x people and 3 x dogs on beach
24/01/2017	calm	windy	S	14:38	15:35	16:05	00:30	0	

Table A.4.9: Summary of weather and seal observations at Porth Wylfa between October 30th, 2016, and January 25th, 2017

Main viewpoint: 53 24.974 N 004 28.065 W
Alternative / Additional viewpoints which may have been explored in early surveys, or used as alternatives in very windy conditions:
53 24.9306 N 004 27.8808 W; 53 24.8676 N 004 28.039 W

Date	Sea State	Wind Force	Wind Direction	Time of LW Cemaes	Start	End	Duration	Seals	Site-Specific Notes
08/11/2016	calm	breeze	SE	10:23	12:03	12:10	00:07	0	Not a full survey as it would have taken us >2hrs beyond LW (beyond method statement timings).
09/11/2016	calm (inside bay)	very windy	NW	11:42	12:25	13:10	00:40	0	
24/11/2016	choppy	windy	NE	14:13	15:00	15:30	00:30	0	Full survey undertaken on the cliff tops at west side of the bay.

Date	Sea State	Wind Force	Wind Direction	Time of LW Cemaes	Start	End	Duration	Seals	Site-Specific Notes
25/11/2016	choppy	windy	NE	13:21	15:00	15:10	00:10	0	Full survey undertaken on the cliff tops at west side of the bay the previous day, but a 10min survey undertaken today to check for seal activity from the eastern side of the bay
09/12/2016	calm	windy	SW	12:16	09:30	10:46	00:45	0	Quick check (10 minutes): Arrived on-site too early to start main survey so walked to west end of bay and stayed for 10 mins.
22/12/2016	calm	windy	W	11:19	12:35	13:10	00:35	0	Main survey
08/01/2017	calm	still	n/a	12:56	10:50	11:26	00:36	0	Gale force winds, so time near cliff edges to peer into these small potential pupping stations was not deemed necessary.
25/01/2017	choppy	windy	S	15:24	13:25	13:55	00:30	0	

Table A.4.10: Summary of weather and seal observations at Trwyn Penrhyn between October 30th, 2016, and January 25th, 2017
Main viewpoint: 53 24.9384 N 004 27.258 W

Date	Sea State	Wind Force	Wind Direction	Time of LW Cemaes	Start	End	Duration	Seals	Site-Specific Notes
09/11/2016	calm (inside bay)	very windy	NW	11:42	11:30	12:00	00:30	0	
25/11/2016	choppy	windy	NE	13:21	14:10	14:40	00:30	1 grey seal (in water, juv. / small male)	Same seal seen on two occasions, (14:15 and 14:20) in the bay to the left of the viewing station.
09/12/2016	calm	windy	SW	12:16	11:05	11:35	00:30	0	Three people (winkle collectors) seen walking on beach at this site.
22/12/2016	calm	gale	SW	11:19	11:55	12:25	00:30	0	Gale force winds, so time near cliff edges to peer into these small potential pupping stations was not deemed necessary.
08/01/2017	calm	still	n/a	12:56	11:45	12:15	00:30	0	Disturbance: one dog and walker along coast path next to station
25/01/2017	choppy	windy	S	15:24	14:10	14:40	00:30	0	

Table A.4.11: Summary of weather and seal observations at Trwyn y Parc between October 30th, 2016, and January 25th, 2017

Main viewpoint: 53 24.9132 N 004 26.826 W

Site not deemed suitable for seals due to high levels of dog activity. When time allowed, the site was surveyed during lunch and warm up breaks from car park.

Date	Sea State	Wind Force	Wind Direction	Time of LW Cemaes	Start	End	Duration	Seals	Site-Specific Notes
09/11/2016	rough	very windy	NW	11:42	10:05	10:25	00:20	0	Station very disturbed due to four large dogs playing on it. As a result, the survey was abandoned early in favour of scoping out better, more viable and quiet stations further east.
25/11/2016	calm	windy	NE	13:21	12:15	12:45	00:30	0	Another full survey to check viability of site for seals (whilst eating lunch in van). In the 30mins viewing, a total of six dogs were seen playing on the site, with five dog walkers.
09/12/2016	calm	windy	SW	12:16	12:55	13:25	00:30	0	Raining: one person and one dog seen on beach. Two cars in car park with people walking around.
22/12/2016	calm	gale	SW	11:19	short visit whilst parking			0	Gale force winds, so not surveyed
08/01/2017	calm	still	n/a	12:56	short visit whilst parking			0	Disturbance: six dogs, seven people
25/01/2017	choppy	windy	S	15:24	short visit whilst parking			0	

Table A.4.12: Summary of weather and seal observations at Porth Padrig between October 30th, 2016, and January 25th, 2017

Main viewpoint: 53 25.149 N 004 27.0636 W

Date	Sea State	Wind Force	Wind Direction	Time of LW Cemaes	Start	End	Duration	Seals	Site-Specific Notes
09/11/2016	choppy	very windy	NW	11:42	10:47	11:00	00:13	1 grey seal (in water, juv. / small male)	Scoping visit, no time for full survey
25/11/2016	calm	windy	NE	13:21	14:10	14:40	00:30	0	Walkers seen with dogs on coast path, close to the beach on cliffs.
09/12/2016	calm	windy	SW	12:16	11:05	11:35	00:30	0	Went straight to Porth Padrig, surveyed pup sites on way back

Date	Sea State	Wind Force	Wind Direction	Time of LW Cemaes	Start	End	Duration	Seals	Site-Specific Notes
22/12/2016	very rough	gale	SW	11:19	11:55	12:25	00:30	0	Gale force winds, so time near cliff edges to peer into these small potential pupping stations was not deemed necessary.
08/01/2017	calm	still	n/a	12:56	11:45	12:15	00:30	0	Disturbance: four people and one dog on the beach; several large families on coast path at top of cliffs above beach.
25/01/2017	calm	very windy	S	15:24	14:10	14:40	00:30	0	All potential pupping and haul-out sites were checked between this site and the next – each site for approx. 3-5 minutes.

Appendix 5: Observations from coastal walks between stations

Table A.5: Summary of land-based grey seal surveys within sections of coast between stations, surveyed between October 30th, 2016, and January 25th, 2017. Methods aimed to identify pupping and haul out activities along sections of coast between the main survey stations.

Station Name	Updated Viewpoint Position	Dates Visited	Total No. of Walk Over Surveys	Total No. of Observed Seals Hauled Out	Total No. of Observed Grey Seal Pups	Total No. of Observed Seals in Water	Notes
East of Hen Borth	53 24.4206 N 004 31.9572 W	30/10/16 23/11/16 07/12/16 21/12/16 06/01/17 23/01/17	6	0	0	0	
Survey Section 1: Hen Borth - Harry Furlough's Rocks							
Survey section 1: Viable pup station 0	53 24.4070 N 004 31.9290 W	30/10/16 23/11/16 07/12/16 21/12/16 06/01/17 23/01/17	6	0	0	0	
Survey section 1: Viable pup station 1	53 24.5940 N 004 31.6770 W	30/10/16 23/11/16 07/12/16 21/12/16 06/01/17 23/01/17	6	0	0	0	
Survey section 1: Viable pup station 2	53 24.6624 N 004 31.5804 W	30/10/16 23/11/16 07/12/16 21/12/16 06/01/17 23/01/17	6	0	0	0	
Survey section 1: Viable pup station 3	53 24.6774 N 004 31.5636 W	30/10/16 23/11/16 07/12/16 21/12/16 06/01/17 23/01/17	6	0	0	0	
Survey Section 2: Harry Furlough's Rocks - Harry Furlough's Rocks / Cemlyn							

Station Name	Updated Viewpoint Position	Dates Visited	Total No. of Walk Over Surveys	Total No. of Observed Seals Hauled Out	Total No. of Observed Grey Seal Pups	Total No. of Observed Seals in Water	Notes
Survey section 2: long beach inshore of Craig yr Iwrch	n/a (long beach)	30/10/16 23/11/16 07/12/16 21/12/16 06/01/17 23/01/17	6	0	0	0	Unlikely to be a beach used for pupping due to exposure and regular beach users. Walkers and intertidal collectors observed on-site.
Survey Section 3: Harry Furlough's Rocks / Cemlyn - Cemlyn Bay							
Survey section 3: Harry Furlough's Rocks / Cemlyn - Cemlyn Bay	53 24.8964 N 004 30.7434 W	30/10/16 23/11/16 07/12/16 21/12/16 06/01/17 23/01/17	6	0	0	0	Site was unlikely viable as too disturbed. Resting seals may haul out here on quiet days, but none observed.
Survey Section 4: Cemlyn Bay - Cemlyn							
Survey section 4: Cemlyn main beach	Main beach at Cemlyn (viewable from viewpoint 5)	30/10/16 23/11/16 07/12/16 21/12/16 06/01/17 23/01/17	6	0	0	0	Site was unlikely viable as too disturbed. Resting seals may haul out here on quiet days, but none observed.
Survey Section 5: Cemlyn - Cerrig Brith							
Survey section 5	From stations 5-6	31/10/16 21/12/16 23/01/17	3	0	0	0	No obvious viable pupping spots between Cemlyn and Cerrig Brith. Not surveyed on every survey date due to logistics (prioritising main stations during the tide and light window).
Survey Section 6: Cerrig Brith - Porth-y-pistyll							
Survey section 6	From stations 6-7	23/11/16 07/12/16 21/12/16 06/01/17 23/01/17	5	0	0	0	
Survey Section 7: Porth-y-pistyll - Porth Wnal							
Survey section 7	Not surveyed	n/a	n/a	n/a	n/a	n/a	Not surveyed due to difficulties with time limitations, and lots of building disturbance around this side of Wylfa Head during the first few surveys.

Station Name	Updated Viewpoint Position	Dates Visited	Total No. of Walk Over Surveys	Total No. of Observed Seals Hauled Out	Total No. of Observed Grey Seal Pups	Total No. of Observed Seals in Water	Notes
Viewpoint of small bay and inlet near Porth-y-pistyll	53 24.6924 N 004 29.5686 W	31/10/16 24/11/16 08/12/16 22/12/16 07/01/17 24/01/17	6	0	0	0	
Survey Section 8: Porth Wnal - Port yr Ogof							
Survey section 8	53 25.188 N 004 28.8264 W	08/11/16 24/11/16 07/01/17 24/01/17	4	0	0	0	Sites inaccessible during very high winds, so not visited on every survey event.
Survey section 8: Viable pup station 1	53 25.2342 N 004 28.7112 W	08/11/16 24/11/16 08/12/16 07/01/17 24/01/17	5	0	0	0	Sites inaccessible during very high winds, so not visited on every survey event.
Survey section 8: Viable pup station 2	53 25.2588 N 004 28.7052 W	08/11/16 24/11/16 08/12/16 07/01/17 24/01/17	5	0	0	0	Sites inaccessible during very high winds, so not visited on every survey event.
Survey section 8: Viable pup station 3	53 25.2672 N 004 28.7010 W	08/11/16 24/11/16 08/12/16 07/01/17 24/01/17	5	0	0	0	Sites inaccessible during very high winds, so not visited on every survey event.
Survey section 8: Viable pup station 4	53 25.2180 N 004 28.4268 W	08/11/16 24/11/16 08/12/16 07/01/17 24/01/17	5	0	0	0	Sites inaccessible during very high winds, so not visited on every survey event.
Survey Section 9: Port yr Ogof - Porth Wylfa							
Survey section 9: Viable pup station 1	53 25.011 N 004 28.2156 W	08/11/16 24/11/16 08/12/16 22/12/16 07/01/17 24/01/17	6	0	0	0	After several visits in different exposures, decided this is an unlikely pupping site, but may be used as a sheltered resting location for passing seals.
Survey Section 10: Porth Wylfa - Trwyn y Penrhyn							

Station Name	Updated Viewpoint Position	Dates Visited	Total No. of Walk Over Surveys	Total No. of Observed Seals Hauled Out	Total No. of Observed Grey Seal Pups	Total No. of Observed Seals in Water	Notes
Survey section 10: Viable pup station 1	53 24.9450 N 004 27.7788 W	09/11/16 25/11/16 09/12/16 08/01/17 25/01/17	5	0	0	0	Sites inaccessible during very high winds, so not visited on every survey event.
Survey section 10: Viable pup station 2	53 24.9504 N 004 27.7032 W; 53 24.9354 N 004 27.6318 W	09/11/16 25/11/16 09/12/16 08/01/17 25/01/17	5	0	0	0	Sites inaccessible during very high winds, so not visited on every survey event.
Survey section 10: Viable pup station 3	53 24.9354 N 004 27.6318 W	09/11/16 25/11/16 09/12/16 08/01/17 25/01/17	5	0	0	0	Sites inaccessible during very high winds, so not visited on every survey event.
Survey Section 11: Trwyn y Penrhyn - Trwyn y Parc							
Survey section 11	not surveyed						Popular recreational beach with many disturbances, so no survey in this section between stations
Survey Section 12: Trwyn y Parc - Porth Padrig							
Survey section 12: Viable pup station 1	53 24.9822 N 004 26.9592 W	09/11/16 25/11/16 09/12/16 08/01/17 25/01/17	5	0	0	0	Sites inaccessible during very high winds, so not visited on every survey event.
Survey section 12: Viable pup station 2	53 25.0812 N 004 27.1068 W	09/11/16 25/11/16 09/12/16 08/01/17 25/01/17	5	0	0	0	Sites inaccessible during very high winds, so not visited on every survey event.
Survey section 12: Viable pup station 3	53 25.1082 N 004 27.069 W	09/11/16 25/11/16 09/12/16 08/01/17 25/01/17	5	0	0	0	Sites inaccessible during very high winds, so not visited on every survey event.

Appendix F. Site-Specific Land-Based Visual Vantage Point Survey Data

N
W
E
S

A
B
C
D
293
60
50
56
137
66
46
6
24
2
1
VP 1
VP 2
VP 3
VP4a
VP4b
Mynydd y Wylfa
Trwyn Cemaes
Bryn Aber
Felin Gafnan
Maen Y Bugail
Tyddyn Sydney
Swn Y Mor
Cafnan
Fronddu
Bwthyn Penroes
Plas Cemlyn
Penyrorsedd
Cemlyn Lodge
Caerdegog Isaf
Tyddyn-Gele
Tregele
Tyddyn-Goronwy
Torman Cottage
Penrhyn
Cemaes
Fford-Y-Felin
High Street
0
500
1,000 Metres

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Legend

Vantage Points

Vantage Point Survey Areas

- Survey Area 1
- Survey Area 2
- Survey Area 3
- Survey Area 4

Marine Mammals Records by Areas (2011 - 2014)

Marine Mammals Records by Sectors (2011 - 2014)

Species

- Grey Seal
- Harbour Porpoise
- Bottlenose Dolphin

NOTE: Where sightings have not been assigned a specific sector they are shown only within the overall count for the vantage point.

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Project: Wylfa Newydd Project

Drawing title: Marine Mammals Records from Land-Based Surveys

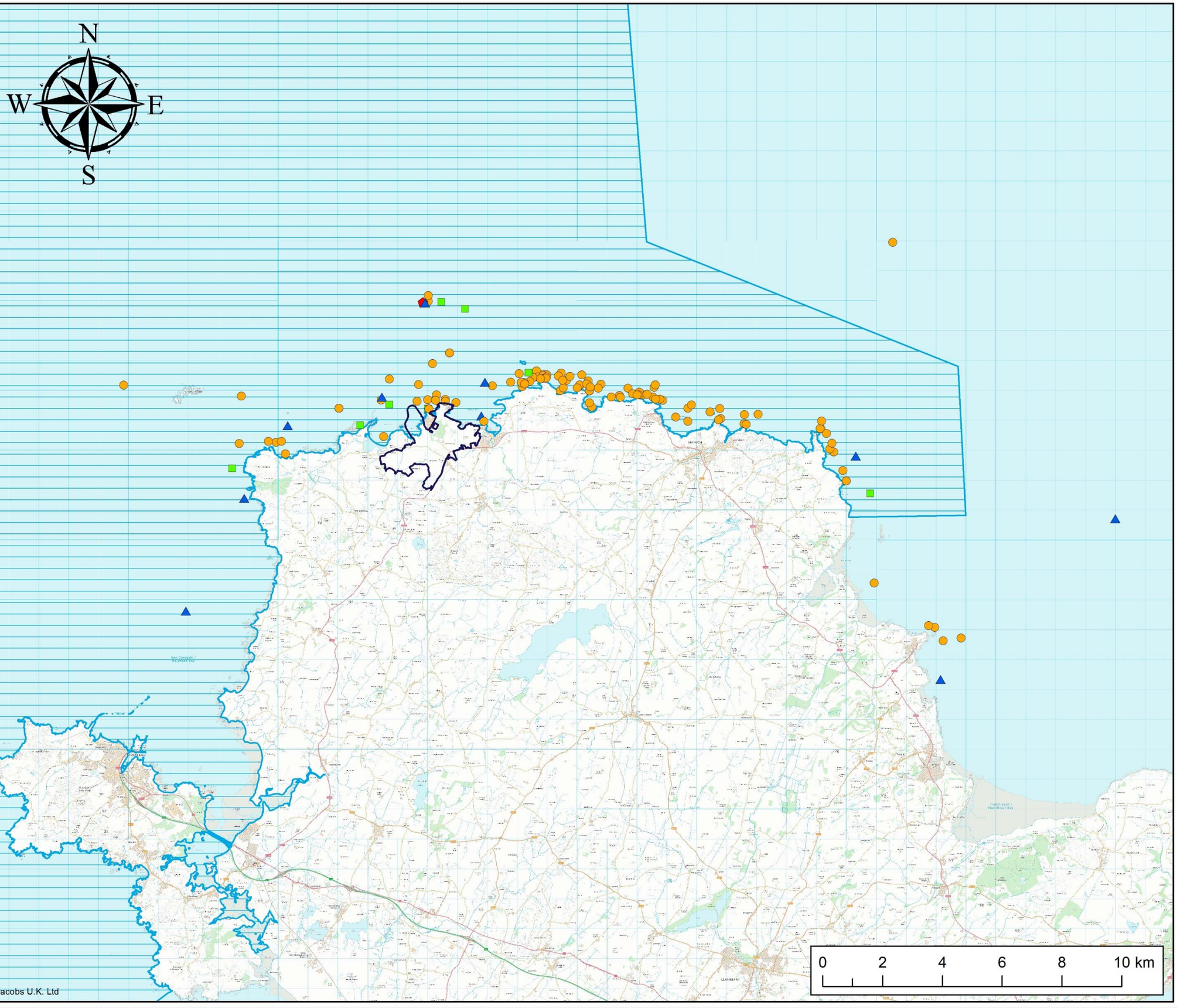
Drawn by	Check'd by	Rev'd by	Appr'd by	Date	Rev.
VG	KW	RW	RB	NOV 17	02

Ref. no. APP_13.06_F.1

Scale @ A3 1:14,000 DO NOT SCALE

Figure F.1 | Status FINAL | Project no. 60PO8032

Appendix G. Incidental/Casual Records Data



Legend

- Wylfa Newydd Development Area
- The North Anglesey Marine / Gogledd Môn Forol cSAC

Marine Mammals Records (May 2010 - November 2014)

- Bottlenose dolphin
- Grey Seal
- Harbour Porpoise
- Unidentified Cetacean

Notes:

Marine mammal records shown on this drawing were collected whilst undertaking other boat based surveys.

Symbols indicate one sighting and not number of individuals.

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Drawing title: Incidental/casual marine mammal records from boat-based surveys

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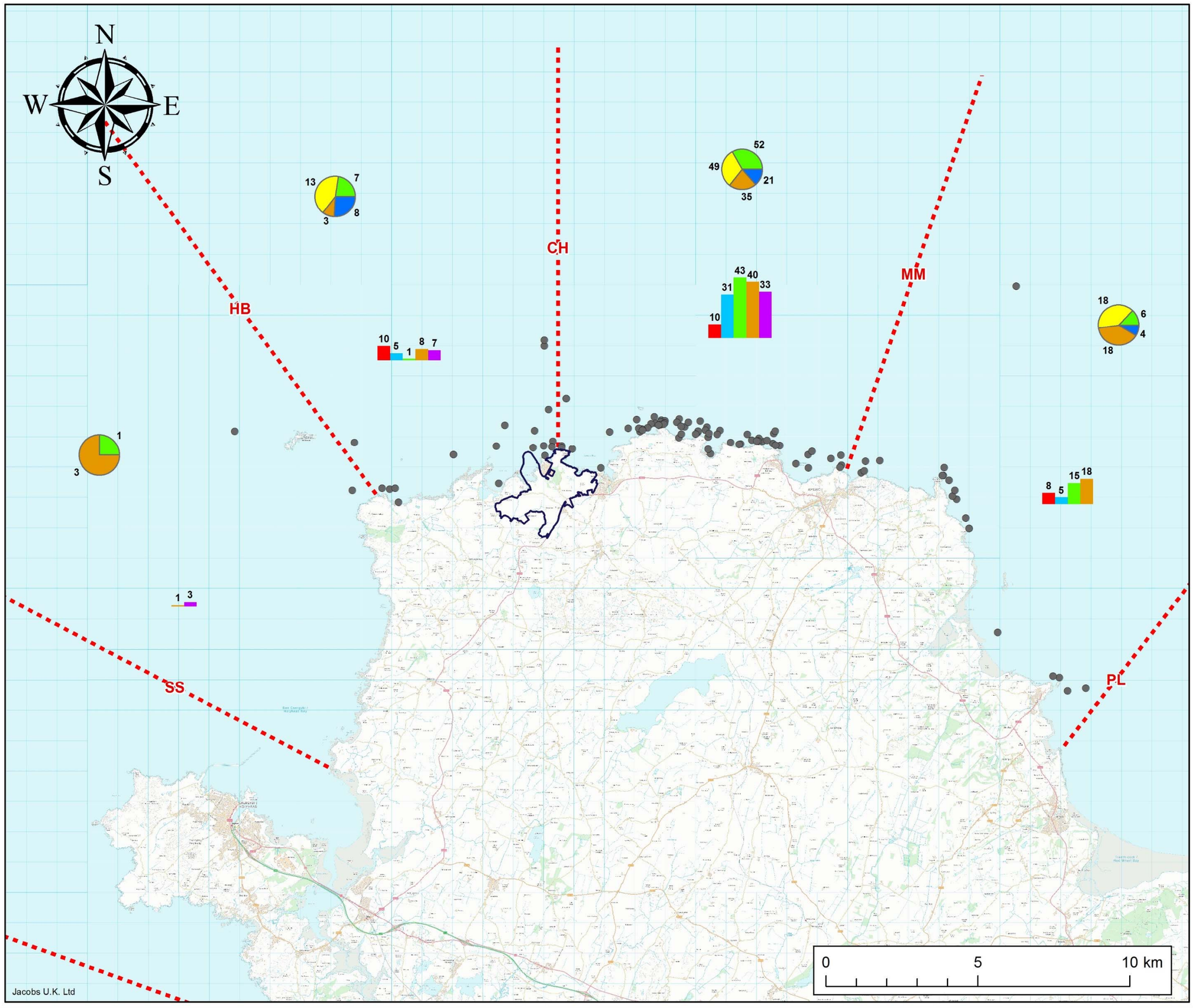
VG	KW	RW	RB	OCT 17	02

Ref. no. APP_13.06_G.1

Scale @ A3 1:120,000 DO NOT SCALE

Figure G.1 | Status **FINAL** | Project no. 60PO8077



Legend

Wylfa Newydd Development Area

Boat Sightings Sectors

SS – South Stack
PL – Point Lynas
MM– Middle Mouse
HB – Holyhead Harbour
CH – Carmel Head

Habour Porpoise *(Phocoena phocoena)*
Recorded in north Anglesey between
May 2010 and November 2014

Locations Recorded

Records by seasons

Spring
Summer
Autumn
Winter

Records by Years

2014
2013
2012
2011
2010

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Project WYLFA NEWYDD PROJECT

Drawing title Marine Mammals Records from Boat-Based Surveys

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VG	KW	KW	RB	OCT 17	03

Ref. no. APP_13.06_G.2

Scale @ A3 1:118,000 DO NOT SCALE

Figure G.2 | Status FINAL | Project no. 60PO8032

Appendix H. Distribution of the Harbour Seal Around the British Isles

N
W E
S

0 100 200 300 400 km

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Legend

Harbour seal *(Phoca vitulina)* at-sea estimated usage

- 0 - 1
- >1 - 5
- >5 - 10
- >10 - 50
- >50 - 100
- >100 - 150
- >150

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Client HORIZON NUCLEAR POWER

Project: Wylfa Newydd Project

Drawing title: Harbour seal *(Phoca vitulina)* at sea estimated usage around the UK

Drawn by	Check'd by	Rev'd by	Appr'd by	Date	Rev.
VG	KW	RW	RB	NOV 17	01

Ref. no. APP_13.06_H.1

Scale @ A3 1:5,000,000 DO NOT SCALE

Figure H.1 | Status **FINAL** | Project no. 60PO8032

Appendix I. Distribution of the Grey Seal Around the British Isles and specifically, north Anglesey

INSERT FIGURE I.1 HERE

N
W E
S

0 100 200 300 400 km

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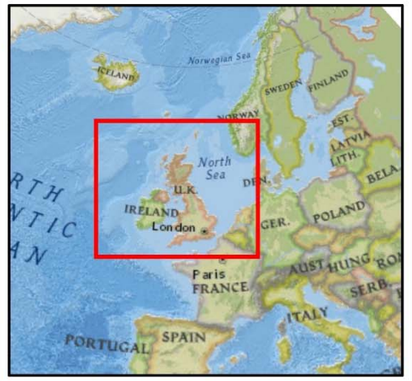

Legend

Grey seal *(Halichoerus grypus)* at-sea estimated usage

- 0 - 1
- >1 - 5
- >5 - 10
- >10 - 50
- >50 - 100
- >100 - 150
- >150

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Project: Wylfa Newydd Project

Drawing title: Grey seal *(Halichoerus grypus)* at sea estimated usage around the UK

Drawn by	Check'd by	Rev'd by	Appr'd by	Date	Rev.
VG	KW	RW	RB	02/06/15	01

Ref. no. APP_13.06_I.1

Scale @ A3 1:5,000,000 DO NOT SCALE

Figure I.1 | Status **FINAL** | Project no. 60PO8032

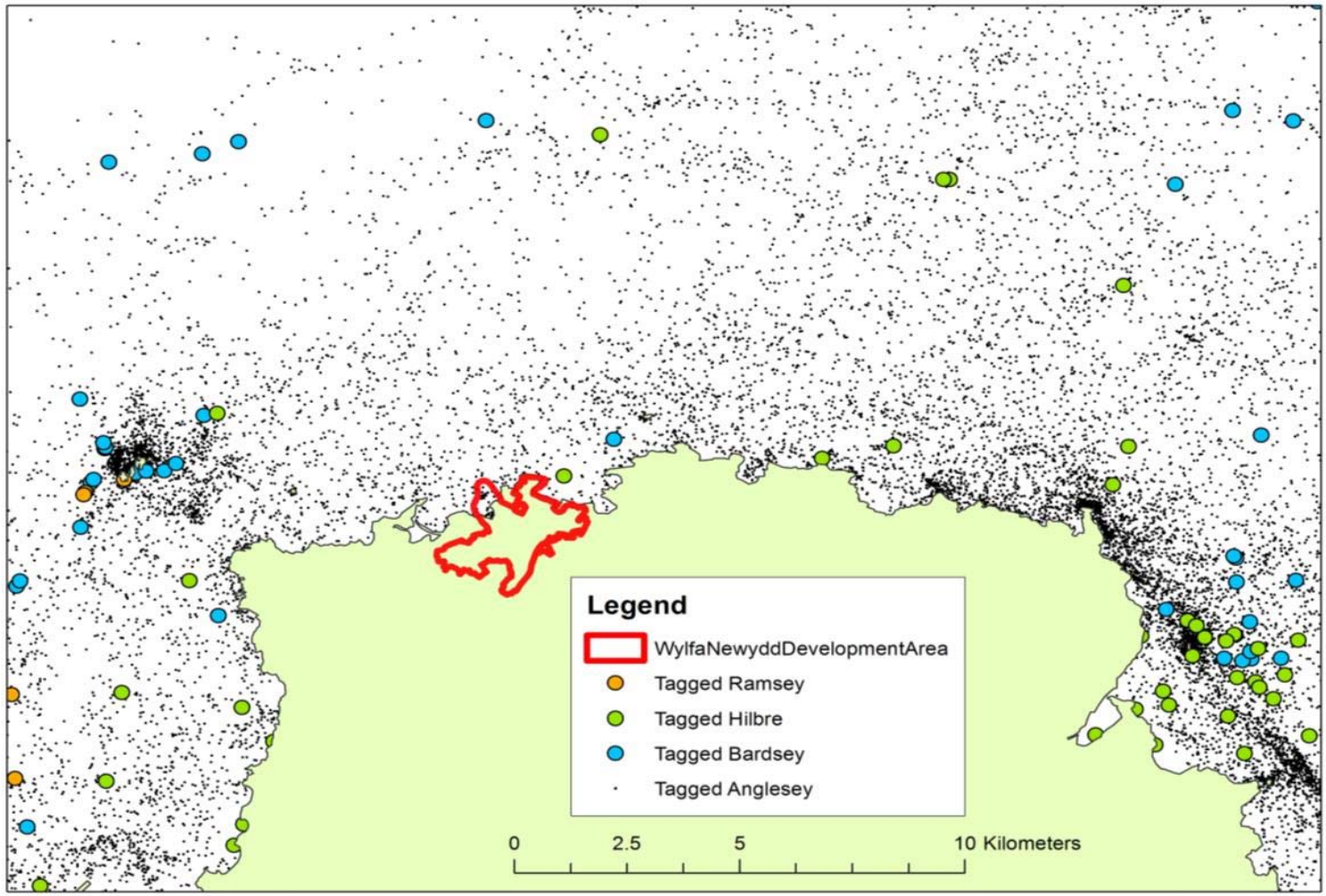

Figure I.2 : Grey seal telemetry GPS locations around north Anglesey and in relation to the Wylfa Newydd Development Area (data provided by SMRU Consulting).

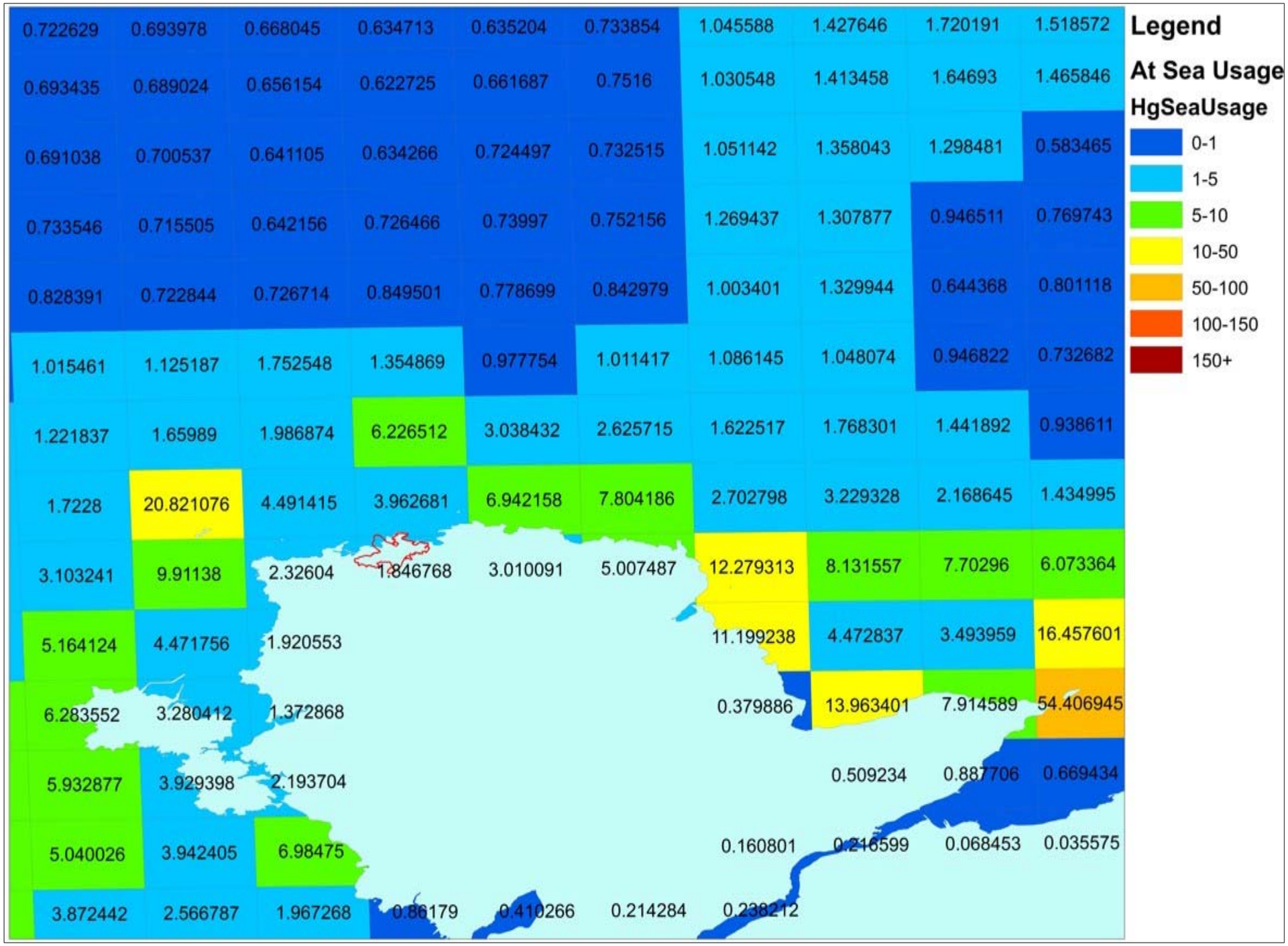

Figure I.3 : Grey seal at sea usage for the waters around Anglesey. Each grid cell contains the estimated grey seal density (per 25km² cell). Data obtained from Jones *et al*. (2013).

Table I.1: Average number of all-age-range grey seals located at each haul-out site per month between January 2001 and December 2001. Data adapted from Westcott (2002) results. "-" = not surveyed.

Haul-out site	Average number of grey seals per site (January 2001 – February 2002)													
	J	F	M	A	M	J	J	A	S	O	N	D	J	F
Afon Dwyfor	-	0.0	0.0	0.0	0.0	1.0	2.3	6.0	4.7	0.0	0.0	0.0	0.0	0.0
Ynys Tudwal East	5.0	9.0	5.5	4.5	0.5	0.0	2.0	0.0	3.3	27.3	7.0	12.0	-	2.0
Ynys Tudwal West	0.0	9.0	9.0	33.5	15.5	21.7	34.0	33.0	12.0	4.3	9.3	10.7	-	20.0
Carreg y Trai	0.0	0.0	0.0	5.5	23.5	59.3	31.5	32.7	21.0	0.3	11.5	0.5	-	0.0
Ogof Lwyd (East)	0.0	0.0	0.0	0.5	1.0	1.3	1.5	0.3	2.0	0.0	0.0	1.5	-	0.0
Ogof Lwyd (West)	20.0	2.0	2.0	0.0	0.5	0.0	0.3	2.3	4.3	8.5	2.0	15.0	-	1.0
Ynys Gwylan-fawr	1.0	0.0	0.0	1.6	1.0	1.0	0.8	0.5	2.5	2.0	3.0	3.5	-	0.0
Ynys Gwylan-bach	0.0	1.0	3.3	4.0	4.5	3.0	3.3	4.8	3.5	0.0	1.0	4.0	-	10.0
Bardsey Island	-	-	43.1	66.9	111.7	105.0	121.9	88.2	61.4	33.6	44.0	74.0	-	-
Rhosgor	-	-	-	-	-	-	-	-	-	-	5.3	7.7	4.0	10.5
Carreg Ddu	5.5	3.8	3.2	1.6	0.3	2.3	3.0	4.0	2.0	0.0	0.5	4.5	2.0	2.0
The Skerries	-	-	19.0	18.0	37.3	32.1	59.1	13.7	48.0	21.0	43.0	66.0	-	-
Puffin Island	100.0	131.0	92.5	30.5	11.0	15.0	15.0	17.0	15.3	32.0	41.0	44.5	-	114.0
Ynys Môn	243.0	334.0	259.0	176.0	114.7	89.0	93.3	82.3	93.7	130.7	182.0	221.0	-	-
West Hoyle Sandbank	111.2	132.3	145.4	261.0	270.5	218.0	359.6	334.8	178.3	104.3	167.3	117.7	-	-
Overall average north Wales	**485.7**	**622.1**	**582.1**	**603.7**	**591.9**	**548.7**	**727.5**	**619.4**	**451.9**	**364.0**	**517.0**	**582.5**	**6.0**	**159.5**

Table I.2: Average number of all-age-range grey seals located at each haul-out site per month between January 2002 and August 2003. Data adapted from Westcott (2002) and Westcott and Stringell (2004) results. "-" = not surveyed.

Haul-out site	Average number of grey seals per month between (January 2002 and August 2003)																			
	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A
Ynys Tudwal East	-	-	-	-	-	-	-	39.0	36.0	53.5	29.0	29.5	21.0	16.3	21.7	36.5	-	-	-	-
Ynys Tudwal West	-	-	-	-	-	-	-	8.0	11.3	5.0	0.0	0.5	2.0	0.0	1.0	20.0	-	-	-	-
Carreg y Trai	-	-	-	-	-	-	-	10.3	18.0	15.5	0.0	1.0	2.0	0.0	0.3	1.0	-	-	-	-
Ynys Gwylan-fawr	-	-	-	-	-	-	-	0.0	12.5	30.0	10.0	20.0	-	11.0	8.7	6.0	-	-	-	-
Ynys Gwylan-bach	-	-	-	-	-	-	2.0	8.3	21.3	19.0	8.0	25.0	-	-	-	-	-	-	-	-
Bardsey Island	91.6	108.0	-	-	-	-	-	148.1	106.4	51.5	59.8	70.5	86.0	0.0	-	-	-	-	-	149.2
Rhosgor	-	-	-	-	-	-	2.0	6.0	7.3	19.3	9.7	9.5	-	1.0	2.3	12.0	-	-	-	-
Carreg Ddu	-	-	-	-	-	-	22.0	1.0	0.7	2.0	2.5	5.0	-	0.7	0.0	2.5	-	-	-	-
The Skerries	-	-	-	-	-	-	-	36.0	35.5	0.0	38.5	-	-	36.0	49.0	42.0	-	-	-	-
Ynys Dulas	-	-	-	-	-	-	-	28.5	28.0	37.5	111.0	128.0	123.0	122.0	109.0	61.0	-	-	-	-
Puffin Island	-	-	-	-	-	-	-	28.3	24.3	19.0	106.0	82.5	124.0	124.5	42.0	28.0	-	-	-	-
Ynys Mon	-	-	-	-	-	-	-	0.0	0.0	0.0	0.0	0.0	-	0.0	-	-	-	-	-	-
West Hoyle Sandbank	67.4	81.3	166.5	188.4	299.5	307.4	238.3	221.5	186.0	94.3	150.0	88.0	70.0	82.7	164.0	-	-	-	330.0	-
Porth Cadlan to Trwyn Talfarach	-	-	-	-	-	-	-	0.0	0.0	0.0	0.0	0.0	-	-	0.0	0.0	-	-	-	-
Porth Widlin to Traeth Penllech	-	-	-	-	-	-	-	1.0	0.5	2.3	1.0	1.0	-	0.0	-	0.0	-	-	-	-
Trwyn Cilan	-	-	-	-	-	-	-	0.0	8.4	8.7	2.0	4.5	-	3.0	0.3	2.0	-	-	-	-
Overall average north Wales	**159.0**	**189.3**	**166.5**	**188.4**	**299.5**	**307.4**	**264.3**	**536.0**	**497.4**	**358.7**	**527.4**	**465.0**	**428.0**	**397.2**	**398.3**	**211.0**			**330.0**	**149.2**