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Awel y Môr Marine Mammal Baseline Characterisation

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1 Introduction

The purpose of this document is to provide a characterisation of the baseline environment to understand the range of species, and the abundance and density of marine mammals that could potentially be impacted by the Awel y Môr offshore wind farm (AyM). The baseline data have been compiled through a combination of literature reviews and data obtained from site-specific surveys. The abundance and density estimates identified in this baseline characterisation form the basis of the quantitative impact assessment presented in the PEIR (Volume 2, Chapter 7: Marine Mammals).

1.1 Study Area

The marine mammal study area varies depending on the species, considering individual species ecology and behaviour. For all species, the study area covers the AyM array area and offshore export cable corridor (ECC) and is extended over an appropriate area considering the scale of movement and population structure for each species. For each species, the area considered in the assessment is largely defined by the appropriate species Management Unit (MU). The study area for marine mammals has been defined at two spatial scales: the MU scale for species specific population units and the marine mammal survey area for an indication of the local densities of each species.

AyM is located within the following MUs:

- Harbour porpoise: Celtic and Irish Seas MU
- Bottlenose dolphin: Irish Sea MU
- Risso's dolphin: Celtic and Greater North Seas MU
- Common dolphin: Celtic and Greater North Seas MU
- Minke whale: Celtic and Greater North Seas MU
- Grey seal: two options available:
    - OSPAR Region III: Celtic Seas (interim MU, proposed by NRW 2020)
    - Within the Wales MU and adjacent to the Northwest England MU (SCOS 2021)

Previously, surveys of the Gwynt y Môr offshore wind farm (GyM) were conducted in order to provide detailed density and abundance data within the local area. However, these data are now between six and nine years old and since then, there may have been changes in the distribution and abundance of marine mammals across the area. Therefore, site-specific aerial surveys were conducted, which encompassed the AyM Agreement for Lease (AfL) plus buffer (Figure 5).

1.2 Protected areas

There are many protected areas for marine mammals within their respective Management Units (MUs) (Table 1, Figure 1, Figure 2 and Figure 3). There are 15 harbour porpoise Special Areas of Conservation (SACs) within the Celtic and Irish Seas MU, 21 grey seal SACs in the OSPAR Region III: Celtic Seas MU, two bottlenose dolphin SACs in the Irish Sea MU, two minke whale Marine Protected Areas (MPAs) in the Celtic and Greater North Seas MU and one Risso's dolphin MPA in UK waters. Additionally, there are several Marine Nature Reserves (MNRs) in Manx waters (Isle of Man). Given that the MUs vary in size, not all of these protected areas are located within Welsh waters.

Table 1 Marine mammal protected areas within the relevant MU for each species.

Protected Area	Location
Harbour porpoise	
North Anglesey Marine/ Gogledd Mon Forol SAC	Welsh waters
West Wales Marine/ Gorllewin Cymru Forol SAC	Welsh waters
Bristol Channel Approaches/ Dynesfeydd Môr Hafren SAC	Welsh & English waters
North Channel SAC	Northern Irish waters
Rockabill to Dalkey Island SAC	RoI waters
Blasket Islands SAC	RoI waters
Roaringwater Bay and Islands SAC	RoI waters
Mers celtiques – Talus du golfe de Gascogne SAC	French waters
Ouesant-Molene SAC	French waters
Nord Bretagne DH SAC	French waters
Chaussee de Sein SAC	French waters
Abers-Cote des Legendes SAC	French waters
Baie de Morlaix SAC	French waters
Tregor Gaelo SAC	French waters
Cote de Granitrose-Sept-Iles SAC	French waters
Calf & Wart Bank MNR	Manx waters
Baie ny Carrickey MNR	Manx waters
Langness MNR	Manx waters
Laxey MNR	Manx waters
Niarbyl MNR	Manx waters
Port Erin MNR	Manx waters
West Coast MNR	Manx waters
Grey seal	
Pen Llyn a`r Sarnau/ Lleyn Peninsula and the Sarnau SAC	Welsh waters
Cardigan Bay/ Bae Ceredigion SAC	Welsh waters
Pembrokeshire Marine/ Sir Benfro Forol SAC	Welsh waters
Lundy SAC	English waters
Isles of Scilly SAC	English waters
Lambay Island SAC	RoI waters
Saltee islands SAC	RoI waters
Roaringwater Bay and Islands SAC	RoI waters
Blasket Islands SAC	RoI waters
Slyne head Islands SAC	RoI waters
Inishbofin and Inishshark SAC	RoI waters
Duvillaun islands SAC	RoI waters
Inshkea islands SAC	RoI waters
Slieve Tooney/Tormore Island/Loughros Beg Bay SAC	Northern Irish waters
Horn Head and Rinclevan SAC	Northern Irish waters
The Maidens SAC	Northern Irish waters
Monarch Islands SAC	Scottish waters
Treshnish Isles SAC	Scottish waters
North Rona SAC	Scottish waters
Ouesant-Molene SAC	French waters
Chaussee de Sein SAC	French waters
Calf & Wart Bank MNR	Manx waters
Langness MNR	Manx waters
Ramsey MNR	Manx waters
West Coast MNR	Manx waters

Protected Area	Location
Bottlenose dolphin	
Pen Llyn a`r Sarnau/ Lleyn Peninsula and the Sarnau	Welsh waters
Cardigan Bay/ Bae Ceredigion	Welsh waters
Baie ny Carrickey MNR	Manx waters
Douglas MNR	Manx waters
Laxey MNR	Manx waters
Minke whale	
Sea of the Hebrides MPA	Scottish waters
Southern Trench MPA	Scottish waters
Laxey MNR	Manx waters
Risso's dolphin	
North-east Lewis MPA	Scottish waters
Calf & Wart Bank MNR	Manx waters
Baie ny Carrickey MNR	Manx waters
Langness MNR	Manx waters

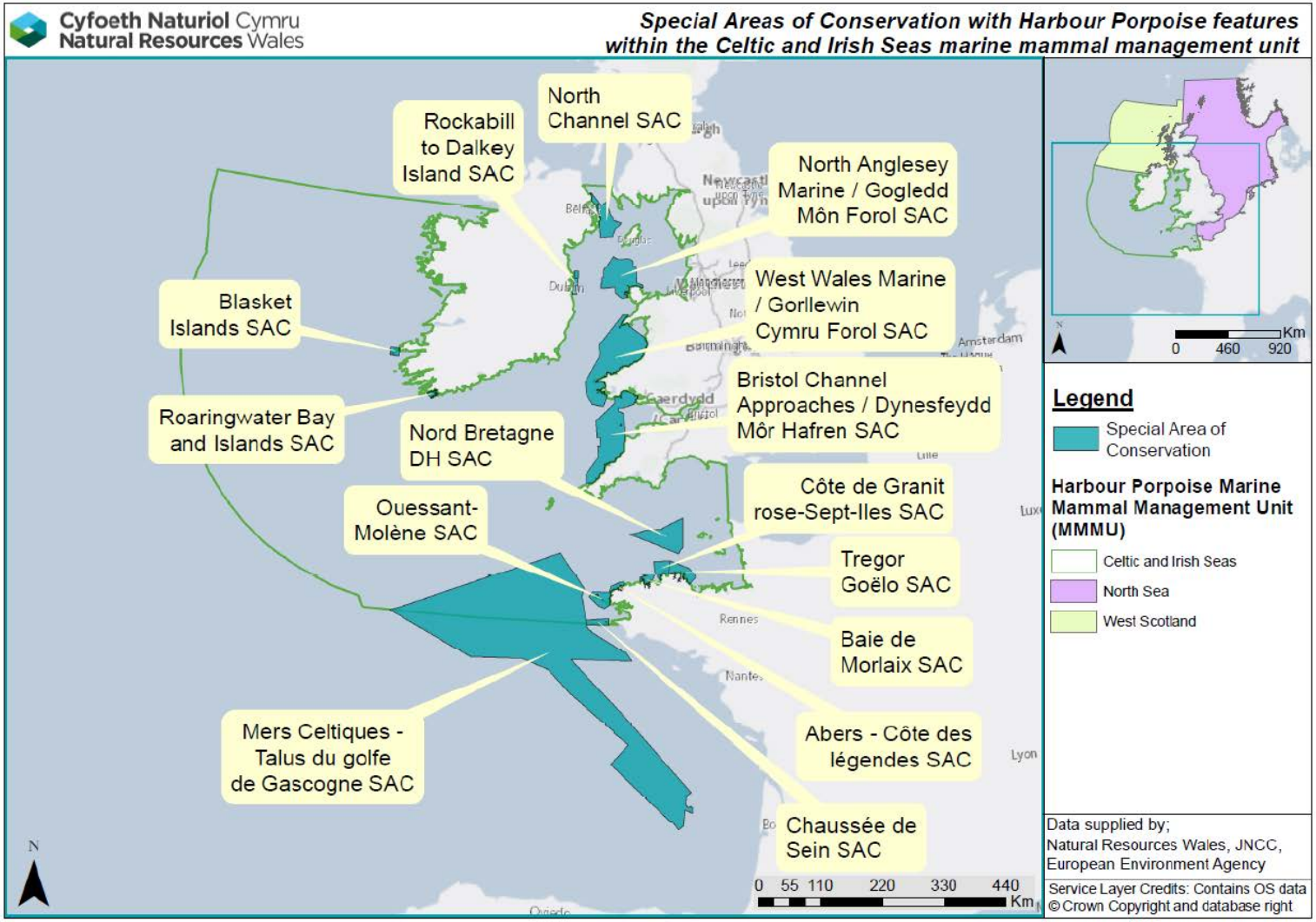

Figure 1 The Celtic and Irish Seas harbour porpoise MU and SACs within it (NRW 2020).

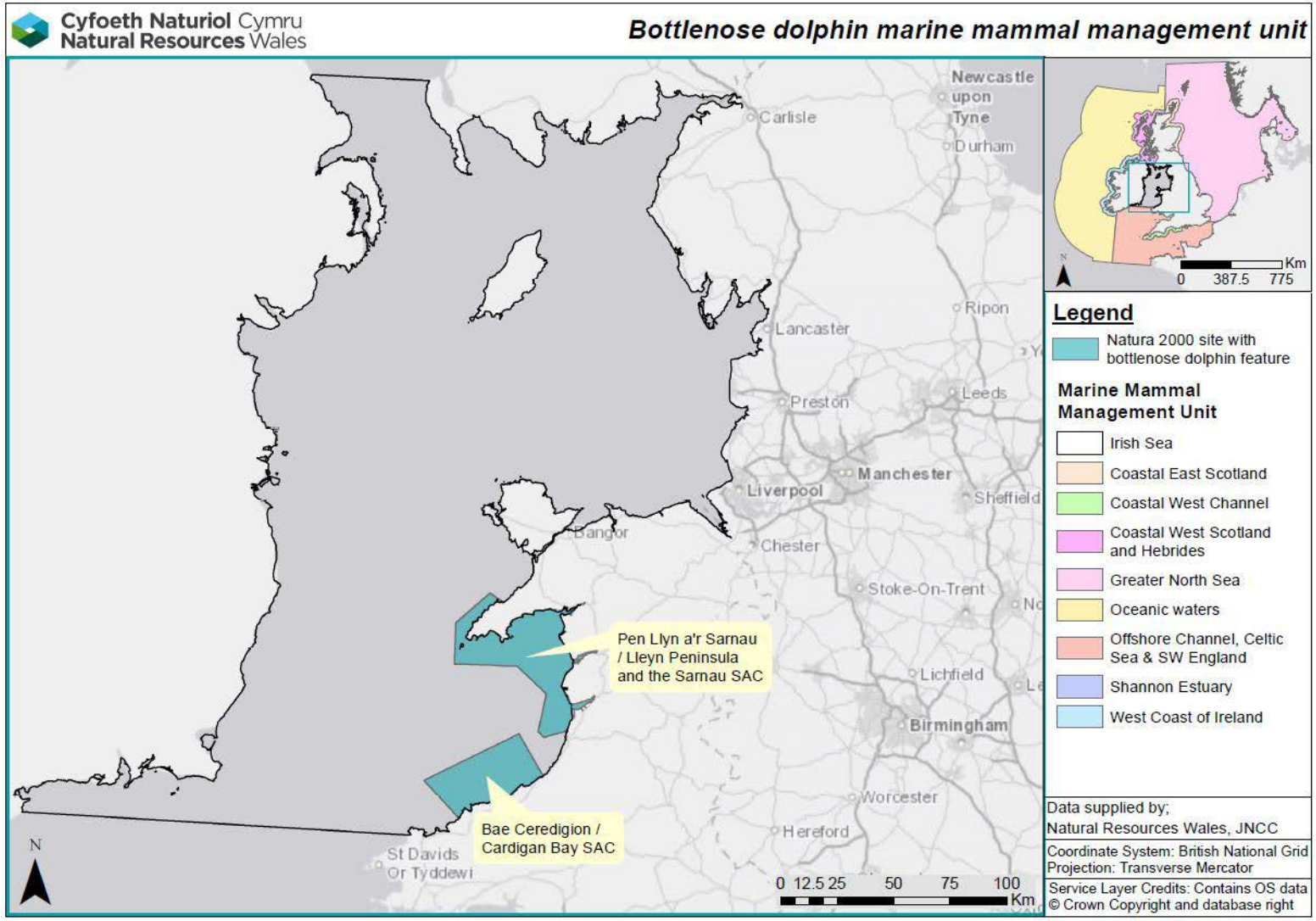

Figure 2 The Irish Sea bottlenose dolphin MU and SACs within it (NRW 2020).

Figure 3 The OSPAR Region III interim MMMU for grey seal and SACs within it (NRW 2020).

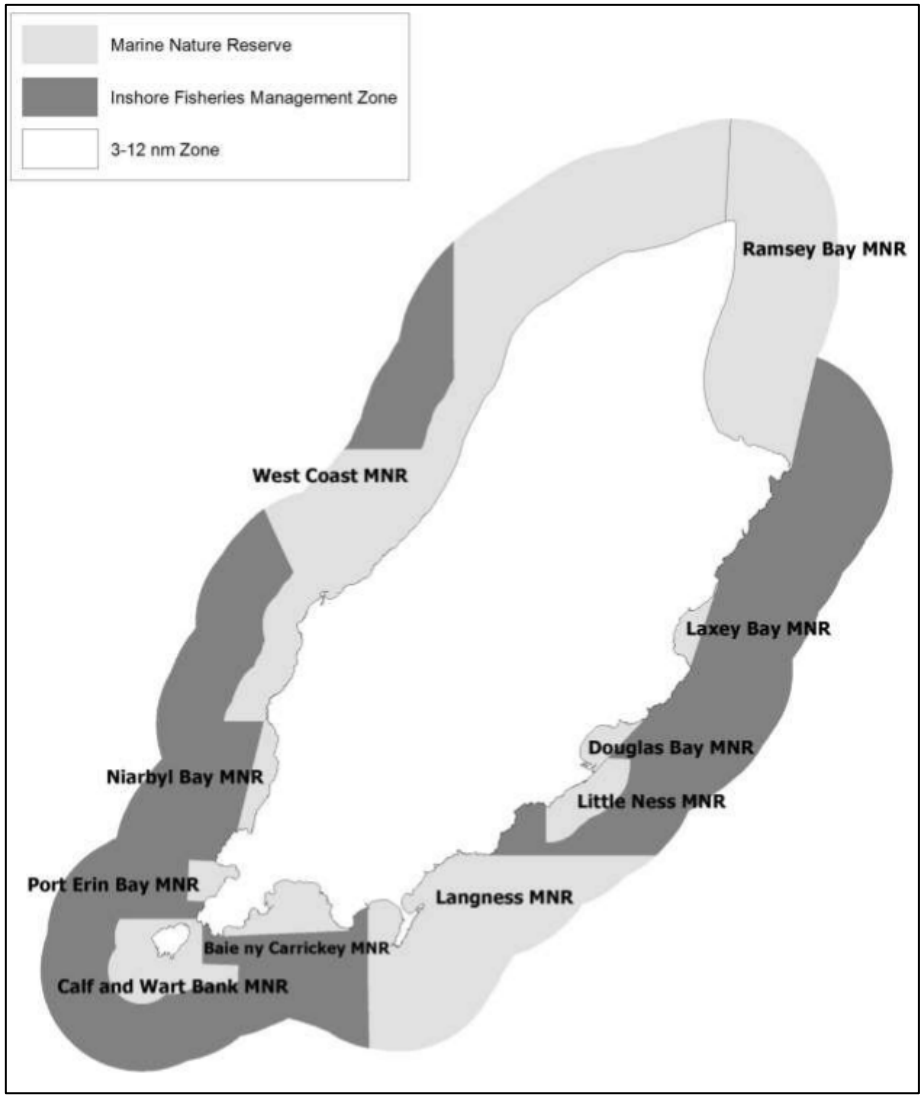

Figure 4 Manx Marine Nature Reserves.

2 Data sources

2.1 Site-specific surveys

The site-specific baseline characterisation surveys for AyM consist of monthly digital still aerial surveys conducted by APEM. The aim of these surveys for marine mammals is to collect data on the abundance and distribution of marine mammals to characterise the baseline to inform an Environmental Impact Assessment (EIA). Specifically, one objective was to obtain species specific density estimates for the site which can be used during the impact assessment to quantitatively predict the potential for impacts on each marine mammal species from construction, operation, and decommissioning. However, the data collected to date have highlighted that species identification rates are low and that they may not be suitable to provide species specific density estimates.

To obtain these baseline estimates of species abundance and distribution, a series of aerial surveys were conducted by APEM, completing one survey per month for two years, between March 2019 and February 2021. To ensure adequate conditions for species identification, surveys took place only under the following conditions: Cloud base > 1,700 ft, visibility >5 km, wind speed <30 knots, and sea state at a maximum of four. If poor weather conditions prevented data collection, surveys were conducted at the next available time, however a minimum of seven days was required between data collection months.

Surveys were designed to cover the windfarm array area plus a 4 km buffer to the North and an 8 km buffer to the south of the site, informed by post-construction species surveys from GyM (Figure 5). The gridded survey design consisted of data collected from East-West at 4 km spacing, leading to the standard 10% coverage using 2 cm ground sampling distance (GSD) imagery, captured from 1,700 ft. Sampling at high altitudes allows for clearance in excess of the 500 ft proposed turbines, allowing for consistent monitoring in the post-construction phase. Additionally, sampling at 2 cm GSD allows for the identification of a large of majority of marine megafauna, while also minimising disturbance.

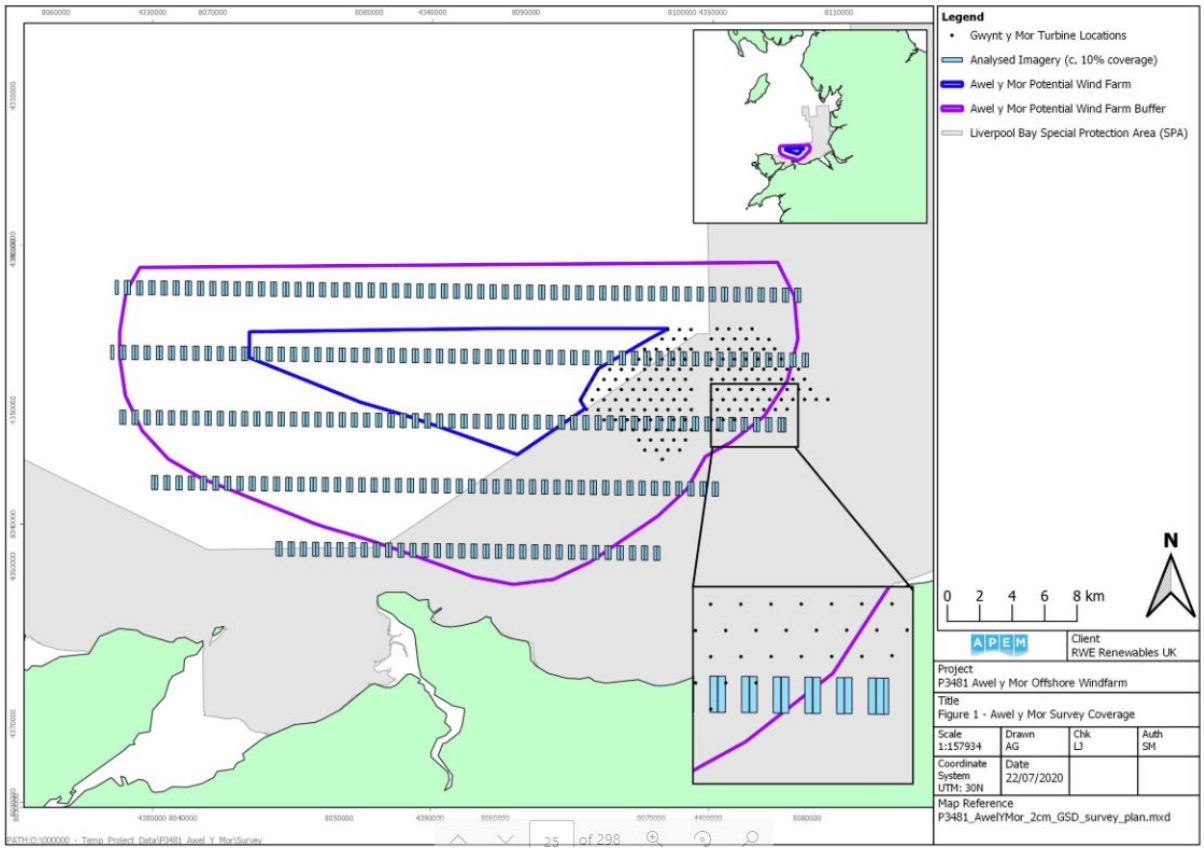

Figure 5 Marine mammal Survey Area[1].

Over the two years of surveys, there were 152 marine mammal sightings (Table 2). The majority (49%) were sightings of unknown "dolphin/porpoise", 27 were harbour porpoise (18%), six sightings (4%) were unidentified dolphins, 38 were seals (25%) (assumed to be grey seals given the location) and seven sightings were not able to be identified further than "unidentified marine mammal". Given the range of dolphin species present in the Irish Sea (including bottlenose dolphins, Risso's dolphins and short-beaked common dolphins, as well as less frequent sightings of striped dolphins, Atlantic white-sided dolphins, and white-beaked dolphins), the classification of "dolphin species", "dolphin/porpoise" is insufficient to provide species specific information to inform the impact assessment.

Table 2 Marine mammal sightings obtained from the APEM site-specific surveys of Awel y Môr plus buffer.

Survey	Date	Harbour Porpoise	Dolphin/ porpoise	UnID Dolphin Species	UnID Seal Species	UnID marine mammal
1	01/04/2019	1	8	0	2	0
2	29/04/2019	1	4	0	1	0
3	13/05/2019	1	13	0	3	0
4	14/06/2019	0	0	0	1	0

[1] Please note: the array boundary was refined in January 2021 in response to stakeholder feedback, however all surveys covered the original array area boundary.

Survey	Date	Harbour Porpoise	Dolphin/ porpoise	UnID Dolphin Species	UnID Seal Species	UnID marine mammal
5	14/07/2019	0	3	0	2	0
6	05/08/2019	2	3	0	1	0
7	02/09/2019	0	0	0	0	0
8	11/10/2019	0	0	0	0	0
9	30/11/2019	0	0	0	1	0
10	17/12/2019	0	1	0	0	0
11	03/01/2020	0	1	0	3	0
12	06/02/2020	10	16	3	9	0
13	02/03/2020	0	5	0	3	0
14	01/04/2020	2	2	0	0	0
15	02/05/2020	0	2	0	3	0
16	07/06/2020	7	3	0	1	0
17	13/07/2020	2	5	0	2	2
18	02/08/2020	1	6	0	0	3
19	03/09/2020	0	0	0	0	0
20	08/10/2020	0	0	0	2	0
21	03/11/2020	0	0	0	0	0
22	22/12/2020	0	0	0	1	0
23	01/01/2021	0	0	3	1	2
24	01/02/2021	0	2	0	2	0
Total		**27**	**74**	**6**	**38**	**7**
% of total		**18%**	**49%**	**4%**	**25%**	**5%**

2.2 GyM surveys

The initial GyM EIA completed a number of site-specific visual (boat and land based) surveys during 2003 and 2004, and also completed both towed and static acoustic monitoring between 2004 and 2005. The only cetacean species detected within the windfarm footprint was the harbour porpoise, with detections year-round throughout the footprint. In the wider study area harbour porpoise, bottlenose dolphins (n=2, group size=20) and short-beaked common dolphins (n=2, group size=12->200) were recorded (CMACS Ltd 2011). Grey seals were recorded within the GyM site, although no numbers were presented in the GyM Offshore Wind Farm Technical Report (CMACS Ltd 2005).

Baseline monitoring was carried out using both digital aerial surveys and visual marine mammal sightings data from vessels involved in windfarm related activity (CMACS Ltd 2011). There were four winter aerial surveys undertaken between October 2010 and March 2011, and a summer survey in July 2010. Only one animal was detected within the GyM site during these aerial surveys (in January 2011). Due to poor image quality the animal was not identified to species level, but it was suggested

from size to be either an adult grey seal or small cetacean. In the July survey, two animals were detected; one a small cetacean and one a basking shark or medium sized cetacean. During baseline benthic surveys, a group of >15 bottlenose dolphins and two harbour porpoise were observed within the GyM site in September 2010. None of these datasets were sufficient to generate density or abundance estimates.

GyM implemented marine mammal mitigation, with associated monitoring, during construction (piling of >80 monopiles) between 8th May 2012 and 5th April 2013 (CMACS Ltd 2013). Visual observations by trained marine mammal observers (MMOs) covered a 500 m radius mitigation zone around each monopile, to ensure no marine mammals were present in a 30-minute period prior to pile driving. Passive acoustic monitoring (PAM) was also deployed to assist with marine mammal detections. Marine mammal detections during construction are likely lower than baseline levels as two types of acoustic deterrents were used (Aquamark 210 pingers and Airmar DB Plus II): these were deployed 30-minutes prior, during and 30-minutes post piling during most of the installations. In total the MMOs completed 226 hours of visual watches during construction, with ten sightings in total. The sightings consisted of harbour seal (n=1), grey seal (n=3), unidentified seal species (n=4), harbour porpoise (n=1) and an unidentified dolphin species (n=1, group size=2). PAM Operators completed 360 hours of acoustic surveillance, resulting in one acoustic detection of harbour porpoise (confirmed by a visual sighting). The MMOs also conducted 182 hours of 'off-duty' casual watches, resulting in 22 marine mammal sightings with no less than 50 individuals observed, consisting of seals (harbour seal n=2, grey seal n=3, unidentified seal species n=5), harbour porpoise (n=2, group size=2-15 individuals) and bottlenose dolphin (n=6, group size=1-16 individuals). These sightings were either within the windfarm footprint or during vessel transfer outside the GyM site. While these sightings inform the species present at the site, they do not provide density or abundance estimates.

A total of 17 post construction digital aerial surveys were conducted between July 2016 and March 2019 of the GyM offshore windfarm, buffer and wider area (Goddard et al. 2017, Goddard et al. 2018, Goulding et al. 2019). A total of 110 marine mammals were counted in the images, of which there were "dolphin/porpoise" (n=20), "unknown phocids" (n=22), grey seals (n=63), harbour porpoise (n=4) and "unknown marine mammals" (n=1). As with the current surveys of the AyM site, these GyM post construction surveys had low species identification rates and low sightings rates for cetaceans.

The previous GyM surveys confirmed that the species present in the area included porpoise, dolphins, and seals, however, none of the surveys detailed above were able to provide a density estimate for any of the marine mammal species.

2.3 Small Cetaceans in the European Atlantic and North Sea (SCANS)

The main objective of the SCANS surveys was to estimate small cetacean abundance and density in the North Sea and European Atlantic continental shelf waters. The SCANS I surveys were completed in 1994, SCANS II in July 2005 and SCANS III in July 2016 (Hammond et al. 2017, Hammond et al. 2021) and all comprised a combination of vessel and aerial surveys. Both aerial and boat-based survey methodologies were designed to correct for availability and detection bias and allow the estimation of absolute abundance (Aguilar de Soto et al. 2016 project, Hammond et al. 2017, Hammond et al. 2021). The aerial surveys involved a single aircraft method using circle-backs (or race-track) methods whereas the boat-based surveys involved a double platform 'primary' and 'secondary' tracker methodology.

While the SCANS surveys provide sightings, density and abundance estimates at a wide spatial scale, the surveys are conducted during a single month, every 11 years and therefore do not provide any fine scale temporal or spatial information on species abundance and distribution.

The SCANS I surveys were not conducted around the AyM windfarm development but did cover the South Wales region (Block A). These surveys had a search effort of 2,974 km, covering a surface area of 201,490 km^2 in sea states of four or less. While the impacts of construction would not be predicted to travel such distances, movement of animals within these regions are known to occur, and therefore individuals sighted in the Southern Welsh waters may also be recorded around the AyM development area.

The AyM Project is located within SCANS III Block F; however, it is likely that underwater noise generated during the construction of the Project will extend into the adjacent Block E (Figure 6). The key limitation of the SCANS III data is the low level of both spatial and temporal coverage. Block F is 12,322 km^2 and only 619.8 km was surveyed under primary effort. Block E is 34,870 km^2 and only 2,252.7 km was surveyed under primary effort. Therefore, spatial coverage within each survey block is low. All aerial surveys were conducted between 27 June and 31 July 2016, and therefore these data are not necessarily representative of densities at other times of the year. In addition to this, there were no sightings of bottlenose dolphins, Risso's dolphins or common dolphins in Block F, and therefore there is no density estimate available for these species in this block, nor were there any sightings of common dolphins in Block E. For Risso's dolphins, the density estimate for Block E is based on only two sightings (Figure 26). These data highlight that both Risso's and common dolphins are not abundant in the eastern part of the Irish Sea (in July).

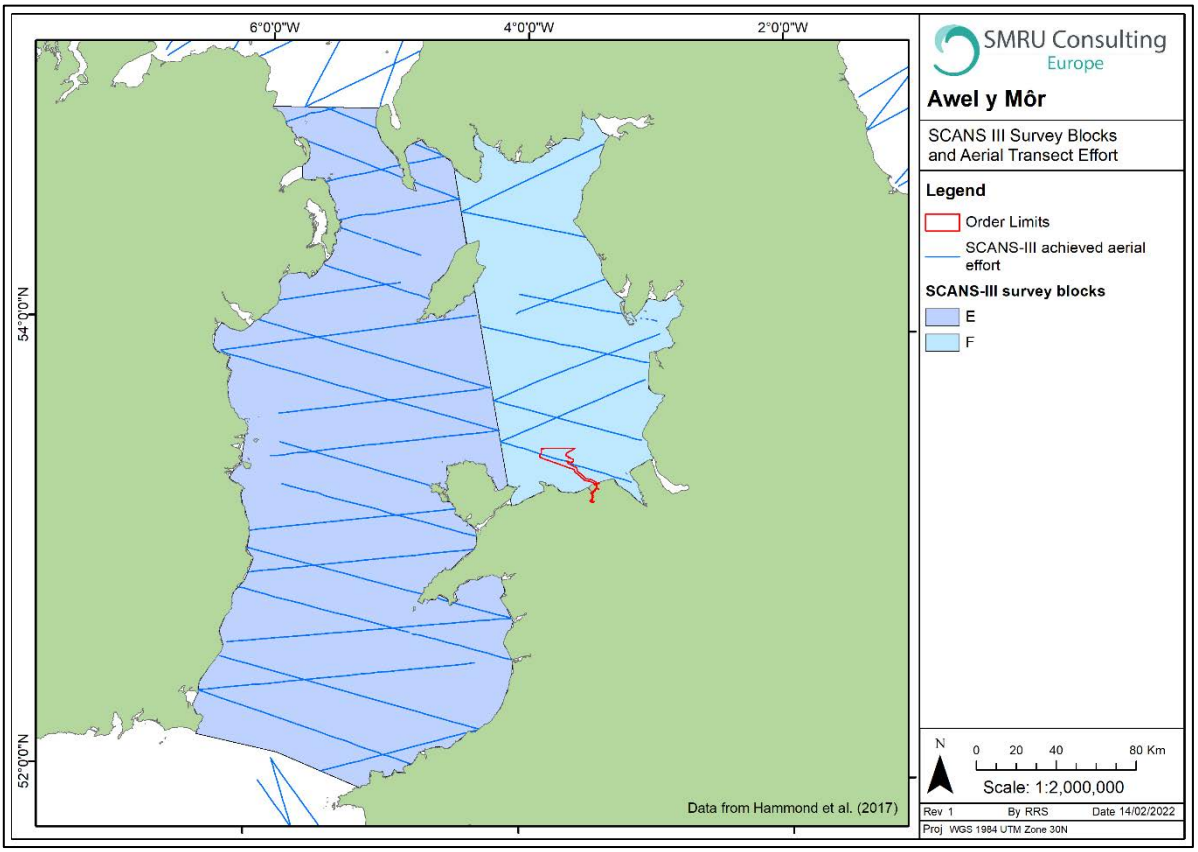

Figure 6 SCANS III survey blocks E and F and aerial survey transect effort (Hammond et al. 2017).

The AyM Project is located within SCANS II Block O which covers the Irish Sea (Figure 7). The same limitations as the SCANS III dataset applies to SCANS II. Spatial coverage within each survey block was low and for Block O only 2,264 km was surveyed under primary effort within a total block area of 45,417 km^2. All aerial surveys were conducted in July 2005, and therefore these data are not representative of densities at other times of the year. There are density estimates for survey Block O

for harbour porpoise (Burt et al. 2006b), bottlenose dolphins (Burt et al. 2006a) and common dolphins (Burt et al. 2006a), however, there is no density estimate for Risso's dolphins in SCANS II Block O as none were sighted.

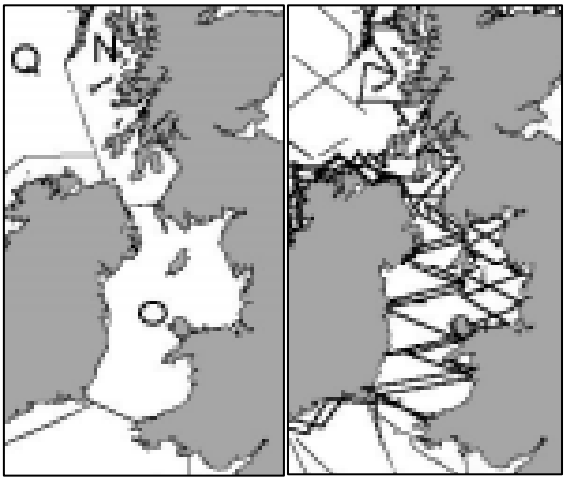

Figure 7 SCANS II survey blocks (left), effort (right) in relation to the Project (Hammond et al. 2006).

2.4 Welsh Marine Atlas (Baines and Evans 2012)

The Atlas of the Marine Mammals of Wales collated data from 16 projects/groups to assess the distribution of marine mammals in the Irish Sea (St George's Channel and greater part of the Bristol Channel). The database comprised of 216,031 km of effort from vessel and aerial surveys and 13,399 hours of land-based effort, covering a 20-year period from 1990 to 2009. The project database comprised 32,986 cetacean sightings totalling 99,085 individuals of 12 species.

To produce the distribution maps, interpolation was used to estimate counts where there were few or no data in order to produce a continuous surface. Two different interpolation models were used: inverse distance weighted (IDW) interpolation (deterministic method) and kriging interpolation (geostatistical method). The authors state that the kriging interpolation is a better method as it is more sophisticated and uses spatial correlation to explain variation in a surface, however it does assume that the data are normally distributed which is rarely an appropriate assumption for count data. The IDW method assumes that the correlation between data points decays as the inverse of distance, which the authors highlight is likely to be incorrect.

While these data do provide good broad scale information on the distribution of marine mammals in Irish waters, they do have several limitations. The data are between 11 and 30 years old and survey coverage was considered to be inadequate in many areas (Baines and Evans 2012). Survey effort was highest in coastal areas and vessel-based effort was primarily collated in the summer months between April and September. Variations in viewing conditions, platform height and speed and observer experience across surveys/projects will have influenced detection efficiency which were not fully accounted for in the modelling. In addition, only sightings rates per unit of distance is available, since very few of the surveys/groups provided range estimates to the sightings, and therefore it was not possible to fit detection functions and conduct Distance Analysis to obtain absolute density estimates.

2.5 ObSERVE (Rogan et al. 2018)

Extensive aerial surveys were conducted in the offshore waters of Ireland between 2015 and 2017 to investigate the occurrence, distribution, and abundance of key marine species. For cetaceans, the surveys consisted of line-transects, with observer effort concentrated within approximately 500 m

either side of the aircraft. The surveys were divided into eight areas (stratum), of which, only Stratum 5 is of relevance to the AyM project as it was the only strata located in the Irish Sea (Figure 8).

The key limitation of this dataset is that Stratum 5 covers only the Irish coastal waters of the Irish Sea and does not cover the AyM Project area (Stratum 5 is approximately 100 km from the AyM array area). The density estimates for Strata 5 therefore may not be representative of density estimates in the AyM area and are therefore not ideally suitable to use for impact assessment.

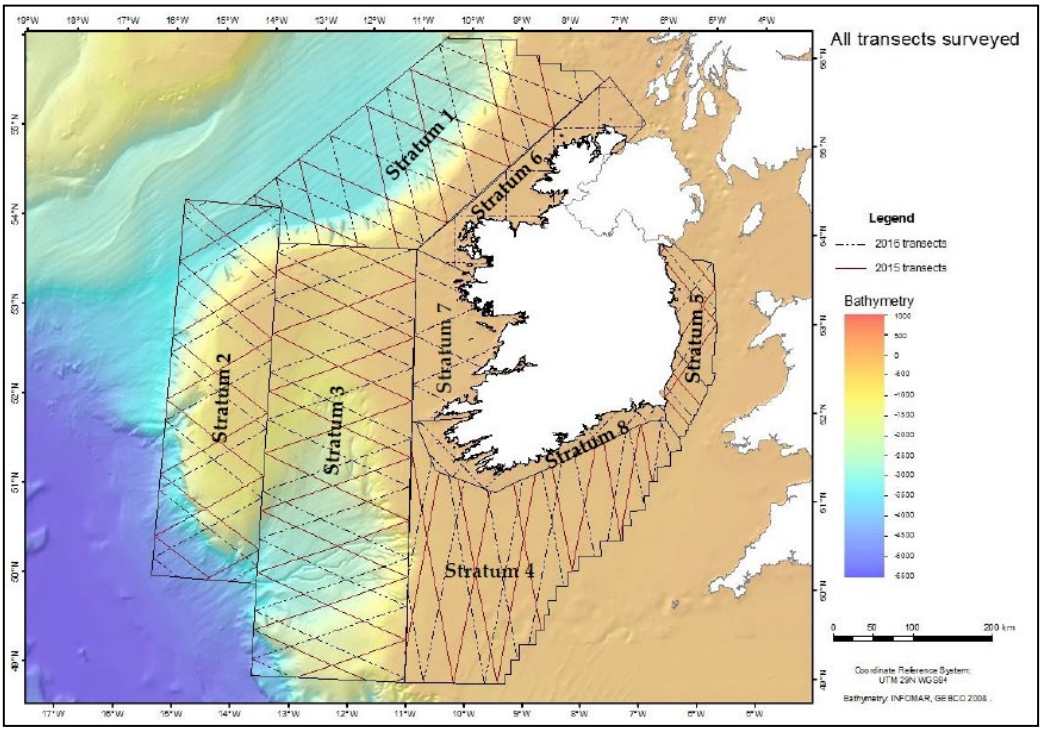

Figure 8 ObSERVE Aerial transect lines flown in summer and winter 2015 and 2016 in relation to bathymetry (Rogan et al. 2018).

2.6 JCP data

The JCP Phase III analysis included datasets from 38 sources, totalling over 1.05 million km of survey effort between 1994 and 2010 from a variety of platforms (Paxton et al. 2016). The JCP Phase III analysis was conducted to combine these data sources to estimate spatial and temporal patterns of abundance for seven species of cetaceans (harbour porpoise, minke whales, bottlenose dolphins, common dolphins, Risso's dolphins, white-beaked dolphins, and white-sided dolphins).

In 2017, JNCC released R code that can be used to extract the cetacean abundance estimates for summer 2007-2010 (average) for a user specified area (Figure 9). This code was originally created by Charles Paxton at CREEM and was modified by JNCC to include abundance estimates that are scaled to the SCANS III results.

There are several limitations of this dataset. The data are between 10 and 26 years old and as such, do not provide a recent density estimate against which to assess impacts. The authors state that the JCP database provides relatively poor spatial and temporal coverage, that the results should be considered indicative rather than an accurate representation of species distribution, and that due to the patchy distribution of data, the estimates are less reliable than those obtained from SCANS surveys. In addition, the authors categorically state that the JCP Phase III outputs cannot be used to provide baseline data for impact monitoring of short-term change or to infer abundance at a finer

scale than 1,000 km^2 because of issues relating to standardizing the data (such as corrections for undetected animals and potential biases) from so many different platforms/methodologies and the strong assumptions that had to be made when calculating detection probability. In addition, the density estimates obtained from the Data Analysis Tool is an averaged density estimate for the summer 2007-2010 and is therefore not representative of densities at other times of the year.

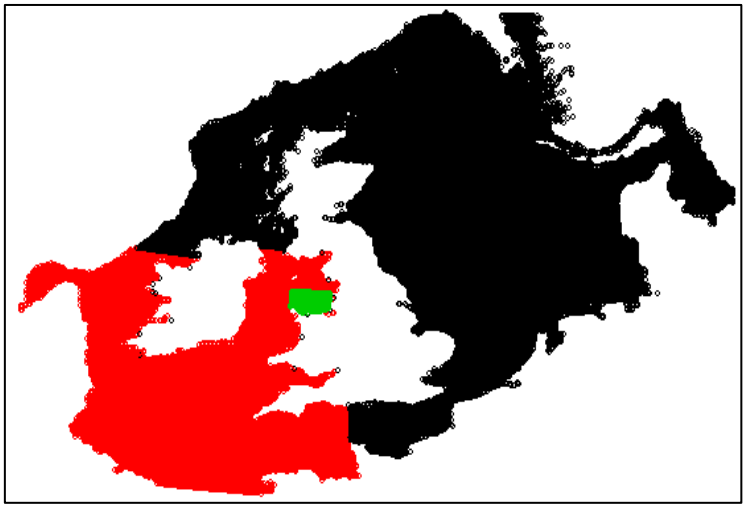

Figure 9 The user specified area used to extract cetacean abundance and density estimates from the JCP III R code. The map shows the whole area under consideration (black + red + green), the harbour porpoise Celtic and Irish Sea MU (red) and the specific area of interest (green).

Heinänen and Skov (2015) also used the JCP database to identify "discrete and persistent areas of high density" that might be considered important for harbour porpoise with the ultimate goal of identifying areas for SAC designation for the species. The analysis grouped data into three subsets: 1994-1999, 2000-2005 and 2006-2011 to account for patchy survey effort and analysed summer (April-September) and winter (October-March) data separately to explore whether distribution patterns were different between seasons and to examine the degree of persistence between the subsets.

2.7 Anglesey visual surveys (Shucksmith et al. 2009)

Shucksmith et al. (2009) conducted dedicated harbour porpoise surveys of 31 transect lines (Figure 10), monitored at least once between May and September between 2002 and 2004 to estimate abundance and density of harbour porpoises on the north coast of Anglesey.

The limitations of this data set are that the data are 16-18 years old, are summer only estimates and the survey area only covered the coastal waters around Anglesey and did not extend as far as the AyM Project site (survey site was a minimum of ~16 km from AyM array area). It is also important to note that this area is characterised by strong tidal currents associated with the headlands and may not be representative of conditions in less-tidal sites such as in the vicinity of AyM.

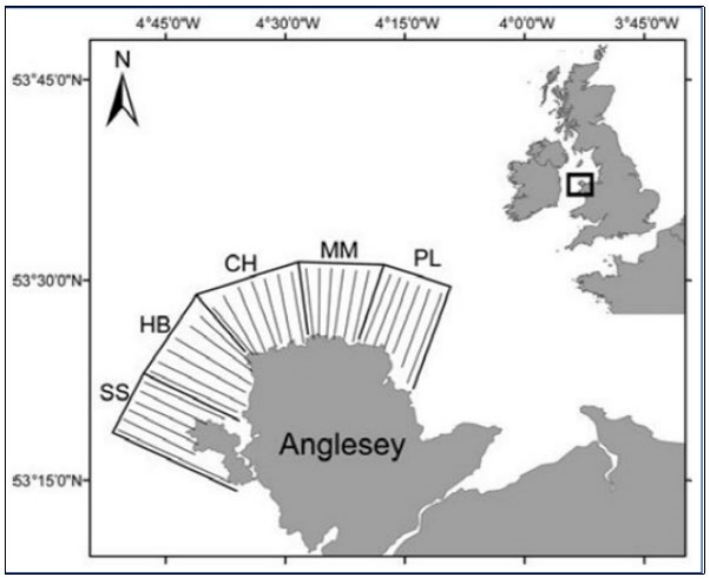

Figure 10 The harbour porpoise study area used by Shucksmith, et al. (2009) split in to five sectors: SS - South Stack; HB Holyhead Harbour; CH - Carmel Head; MM - Middle Mouse; PL - Point Lynas. Map taken from Shucksmith et al. (2009).

2.8 Anglesey towed acoustic surveys (Gordon et al. 2011)

In 2009, both visual and acoustic data were collected by Gordon et al. (2011) between The Skerries and Carmel Head using both visual observers and towed hydrophones (Figure 11).

The limitations of this dataset are that the data are 11 years old, and the survey area only covered the coastal waters around northwest Anglesey (approximately 40 km 'swimming' distance from AyM array area) and did not extend as far as the Project. It is also important to note that this site is also characterised by strong tidal currents and therefore is not particularly representative of conditions over the wind farm site and surrounding areas.

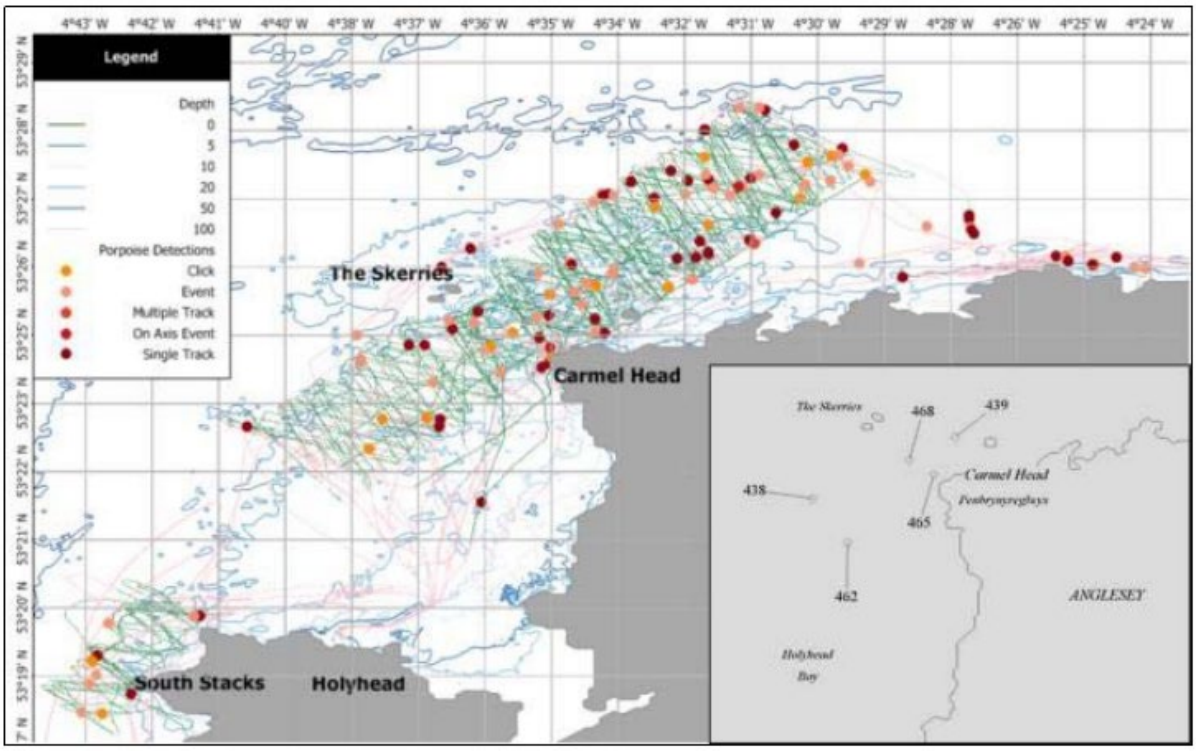

Figure 11 Locations of towed hydrophone acoustic detections and T-POD locations (inset) off The Skerries (Carmel Head and South Stacks) (Gordon et al. 2011).

2.9 Wylfa surveys (Jacobs 2018)

Visual line transect surveys around the north of Anglesey were undertaken in 2016 and 2017 (21 surveys across 14 months) to inform the baseline characterisation for the Horizon Nuclear Power Wylfa Newydd Project. Between May and August 2016, marine mammal sightings were recorded by trained European Seabirds at Sea (ESAS) surveyors. However, after this the methodology was altered to include dedicated MMOs providing continuous survey effort and recording bearings and distances to sightings.

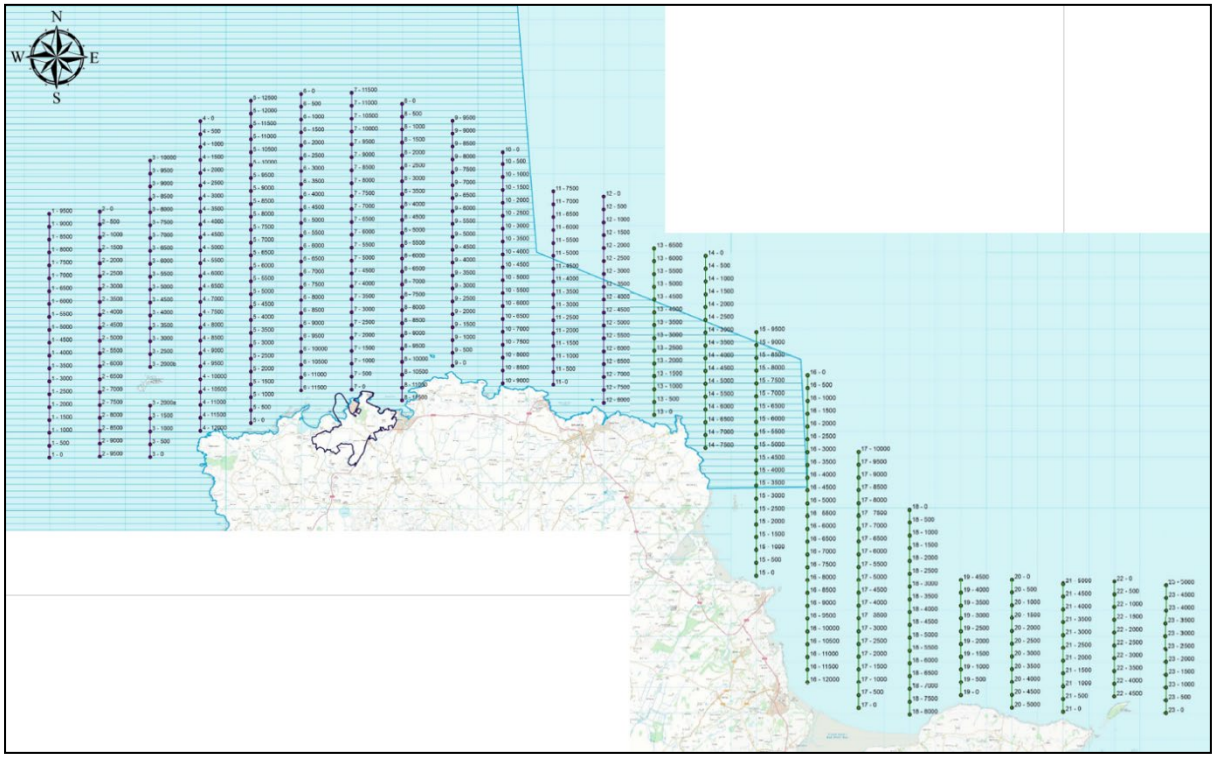

Figure 12 Vessel transect lines surveyed for Wylfa (Jacobs 2018).

2.10 Morlais surveys (Royal Haskoning DHV 2019)

Marine mammal data were collected to inform the baseline characterisation for the Morlais MDZ (Holy Island, West Anglesey). Two main surveys were conducted, the Natural Power vessel based visual surveys (24 surveys between Nov 2016 and Oct 2018) and the SEACAMS visual and acoustic surveys (18 surveys between Jan 2015 and Dec 2016) (Figure 13). The primary limitation of this dataset was that the true g(0) could not be estimated, and as such g(0)=1 was assumed, which will provide only a minimum density estimate for the site, with absolute density estimates likely to be at least twice these values based on the range of g(0) estimates observed in other surveys. In addition, the site is located approximately 56 km swimming distance from the AyM array area and so may not be representative of densities in the vicinity of the Project.

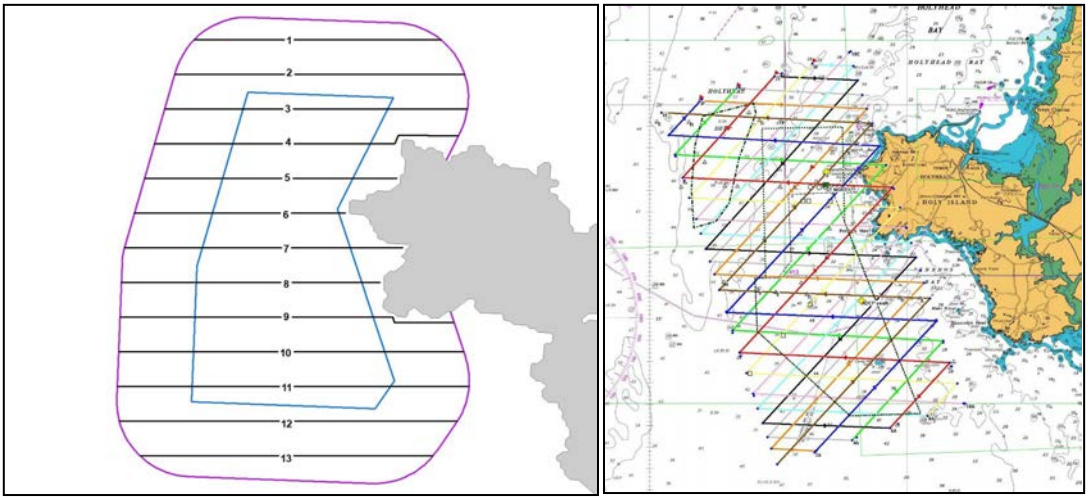

Figure 13 Survey transects for the Natural Power (left) and SEACAMS surveys (right) for the Morlais project (Royal Haskoning DHV 2019).

2.11 Bottlenose dolphin surveys

Surveys that predominantly focused on the Welsh coastline (mainly conducted by the Sea Watch Foundation) found bottlenose dolphins widely distributed within inshore regions, with certain areas exhibiting high densities. Furthermore, long term photo-identification projects have demonstrated movement of animals between the Cardigan Bay region and Northern Wales, as well as individuals from this population being sighted in the Irish Sea. Early studies of bottlenose dolphins in Cardigan Bay indicated towards a core sub-population of animals, with some individuals travelling further afield to North Wales. In 2011, 15 line-transect surveys were conducted in Cardigan Bay, covering 1,993 km, in addition to 1,706 km of effort during *ad libitum* surveys in Cardigan Bay SAC (Veneruso and Evans 2012). Between 2014 and 2016 line transect and photo-ID surveys for bottlenose dolphins were conducted within the Cardigan Bay SAC and the wider Cardigan Bay area from which sightings rates and abundance estimates were calculated (Lohrengel et al. 2018).

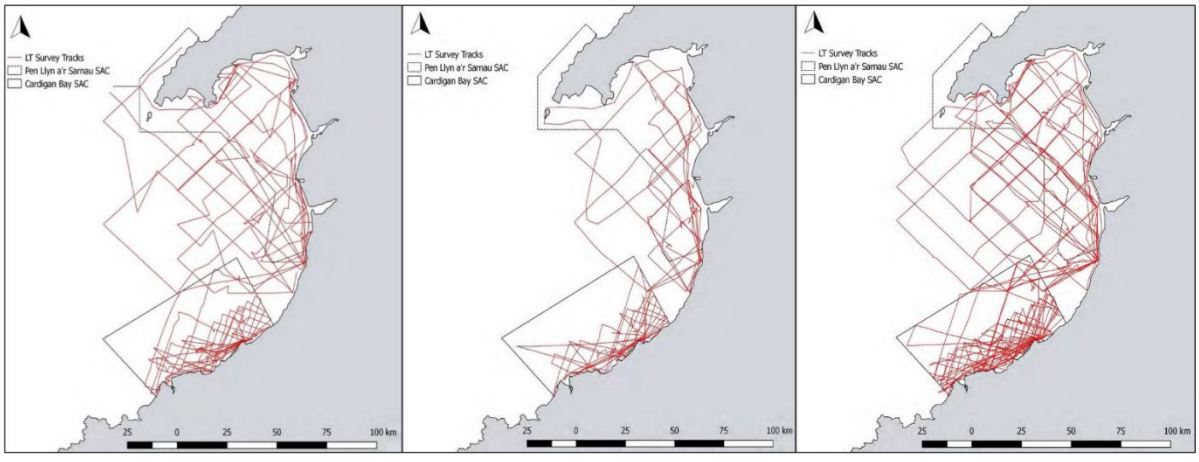

Figure 14 Tracks for line transect surveys undertaken in Cardigan Bay in 2014 (left), 2015 (middle) and 2016 (right) (Lohrengel et al. 2018).

2.12 Sea Watch Foundation - North Wales

The Sea Watch Foundation kindly provided sightings data in North Wales to include in this baseline characterisation. The data comes from a combination of sightings from the national UK sightings

database (held by the Sea Watch Foundation, 1960-2021) and several dedicated line-transect surveys undertaken by the Sea Watch Foundation in coastal waters of North Wales over the last twenty years (using both vessels and planes). Plots of sightings from Sea Watch surveys and casual sightings in addition to distribution maps for the area were provided by the Sea Watch Foundation (Evans et al. 2021) alongside density estimates for the coastal north Wales area which were modelled for the new Welsh Marine Atlas (Evans and Waggitt 2022 (in draft)) using the methods described in (Waggitt et al. 2020). The effort data for the north Wales area are shown in Figure 15.

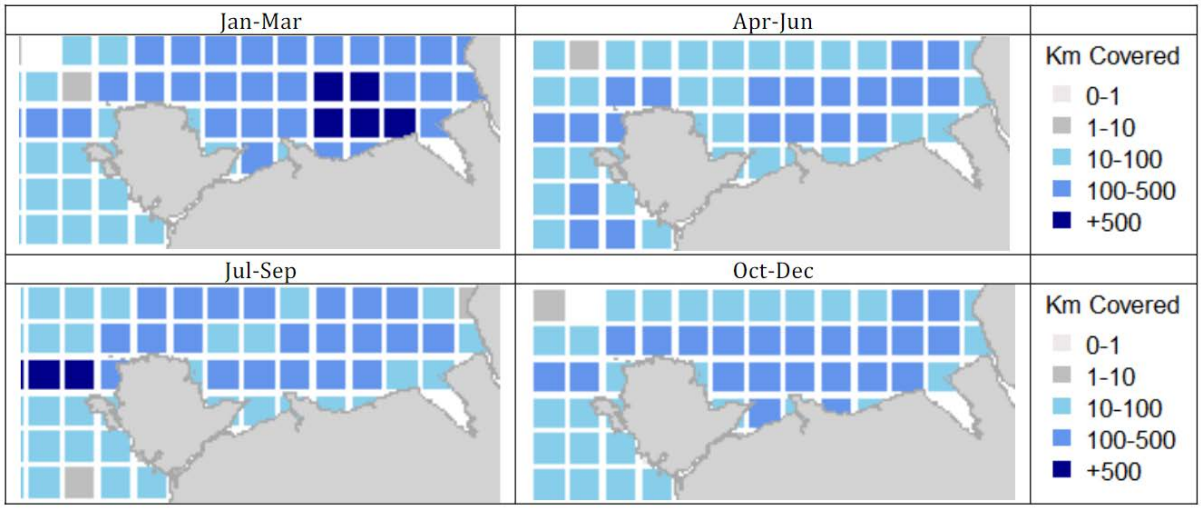

Figure 15 Distribution of Survey Effort in coastal North Wales (Evans et al. 2021).

Unfortunately, the Welsh Marine Atlas was still in draft at the time of writing, and could not be shared; therefore, the methods used, and the uncertainty of the resulting estimates are currently unknown. The report on cetaceans in north Wales (Evans et al. 2021) states that the updated Atlas uses data from the previous Atlas (data up to 2009) along with other surveys since 2009 to derive predicted densities based on the modelling presented in Waggitt et al. (2020). The Waggitt et al. (2020) species distribution maps of cetaceans were produced using data from total of 2.68 million km of survey data in the Northeast Atlantic between 1980 and 2018. Waggitt et al. (2020) predicted monthly and 10 km^2 densities for each species (animals/km^2) and estimated the probability of encountering animals using a binomial model (presence-absence model) and estimated the density of animals if encountered using a Poisson model (count model). The product of these two components were used to present final density estimations. The outputs of this modelling were monthly predicted density surfaces for 12 cetacean species at a 10 km resolution. There is no indication of whether the more recent sightings data are weighted more heavily than older data, which limits interpretation of how predictive the maps are to current distribution patterns. Therefore, while the density estimates obtained from these maps may be representative of relative density compared to other sites around the UK, they are not considered to be suitable density estimates for use in quantitative impact assessment, especially for species such as the harbour porpoise where it has been shown that the abundance within the Celtic and Irish Seas MU has decreased significantly in the last decade.

2.13 COFNOD – North Wales Environmental Information Service

COFNOD[2] is a Local Environmental Record Centre in Wales, and brings together the largest range and number of biodiversity and geodiversity data in North Wales. COFNOD kindly provided all marine mammal records that they hold for the north Wales area (area of search provided in Figure 16). There are a total of 2,909 marine mammal sightings available, which date back to 1961, though most sightings (87%) were recorded between 2020 and 2021 inclusive. The sightings include seven species of marine mammal: bottlenose dolphins (38), common dolphins (5), harbour porpoise (130), grey seals (2,694), harbour seals (8), long-finned pilot whales (1) Risso's dolphins (9) and unidentified species (24).

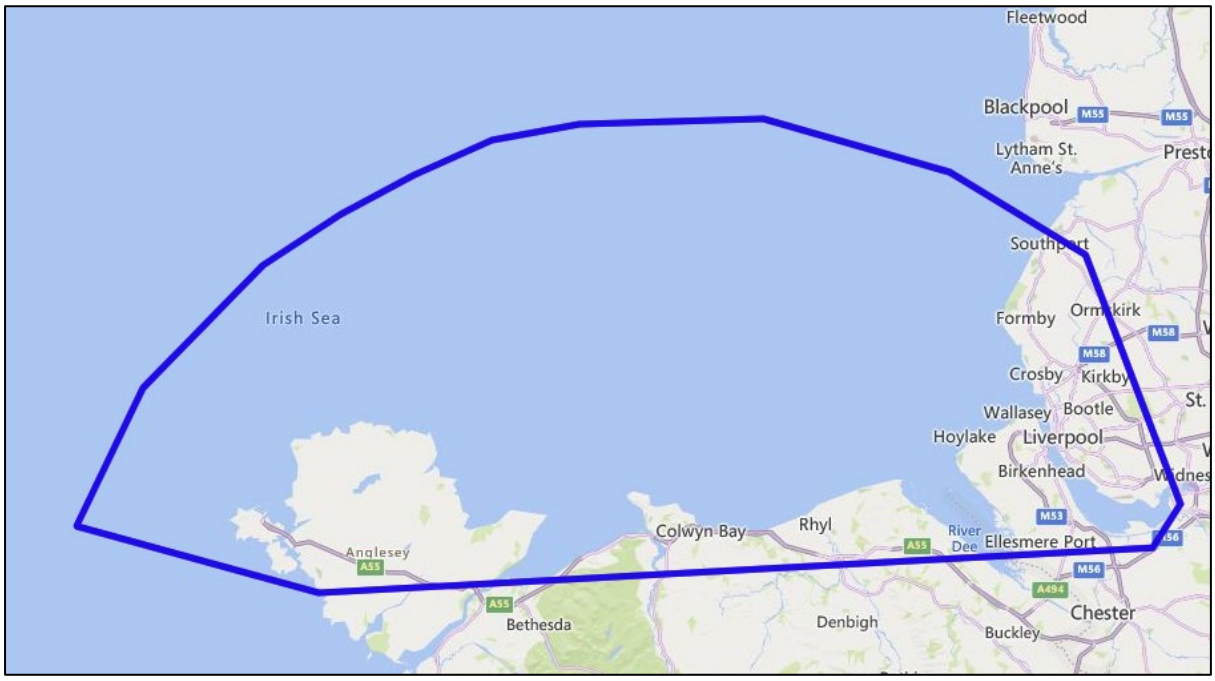

Figure 16 Area of search submitted to COFNOD.

2.14 Manx Whale and Dolphin Watch surveys

The Manx Whale and Dolphin Watch (MWDW) have conducted vessel-based surveys throughout the Manx territorial waters since 2007. Between 2007 and 2015 a total of 88 trips were conducted, totalling 9,504.4 km surveyed, most of which were conducted in the summer months between May and September. The surveys have reported five main species of marine mammals in Manx territorial waters: harbour porpoise, common dolphin, bottlenose dolphin, Risso's dolphin and minke whale. There were 819 cetacean sightings, of which 669 were of harbour porpoise (81.7%). The most recent records available in 2018 show there were an additional seven vessel-based surveys (including trips on vessels of opportunity) conducted between May and August, surveying 449km. Harbour porpoise were the most observed cetacean species as in previous years, with 28 sightings recorded. However, unlike previous years, there were no sightings of bottlenose dolphin or short-beaked common dolphin species during boat surveys in 2018.

In addition, land-based surveys (Figure 17) have been conducted since 2006 by local surveyors, where watch intervals (15 mins) are conducted, reporting environmental conditions and marine mammal sightings. Data are available through reports provided on the MWDW website for 2007-

[2] [redacted]

2016, with additional data obtained for 2018 (Felce 2014, 2015, Adams 2017, Clark et al. 2019). The surveys have also reported the same five main species of marine mammals in Manx territorial waters (Table 3). Similarly to the boat-based survey data, no bottlenose dolphin or short-beaked common dolphin positive intervals were recorded in 2018, although they were reported through public opportunistic sightings submissions. Reports of more recent survey data are not available on the MWDW website; however, they do provide a list of recently reported sightings[3]. Between April 2020 and March 2021 inclusive, 262 sightings events were reported, consisting of the same five species reported in previous years (Figure 18), therefore, while recent reports are not available, the recent sightings data show that the species composition in Manx waters has not changed.

[3] [redacted]

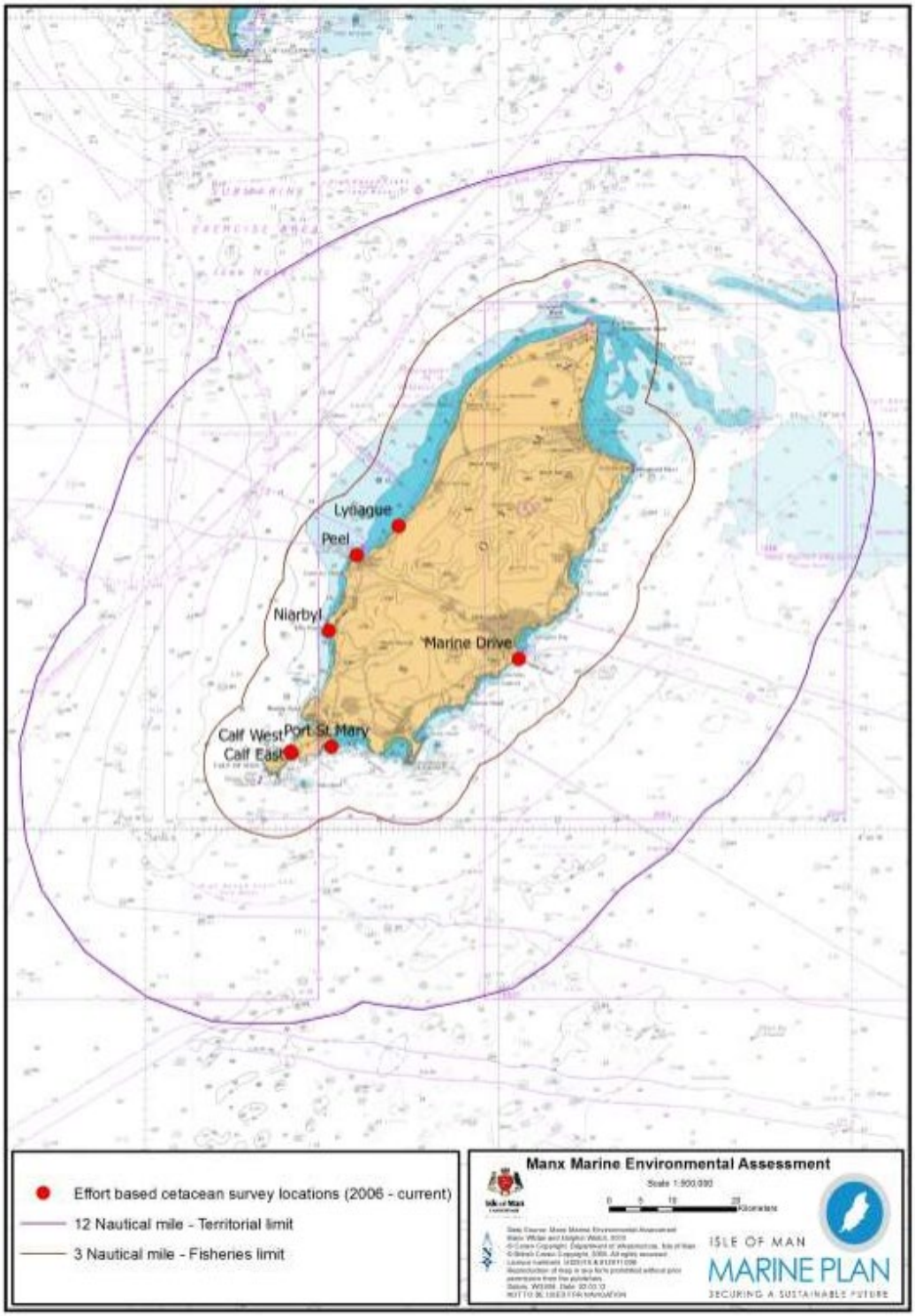

Figure 17 MWDW Effort based survey locations, (2006 – 2018) (Howe 2018).

Table 3 Marine mammal sightings from MWDW land-based surveys between 2006 - 2016 and 2018 (Felce 2014, 2015, Adams 2017, Clark et al. 2019).

	2018	2016	2015	2006-2014
Time surveyed (hours)	143.5	128.75	72.5	1344.25
# 15 min intervals surveyed	574	515	290	5377
Cetacean positive intervals	262 (30.1%)	45 (8.7%)	96 (33.2%)	1184 (22.0%)
Harbour porpoise (# positive intervals)	186	16	73	875
Minke whale (# positive intervals)	27	10	10	113
Risso's dolphin (# positive intervals)	49	14	14	154
Common dolphin (# positive intervals)	0	0	0	39
Bottlenose dolphin (# positive intervals)	0	3	1	26
Unidentified cetacean	0	2	0	12

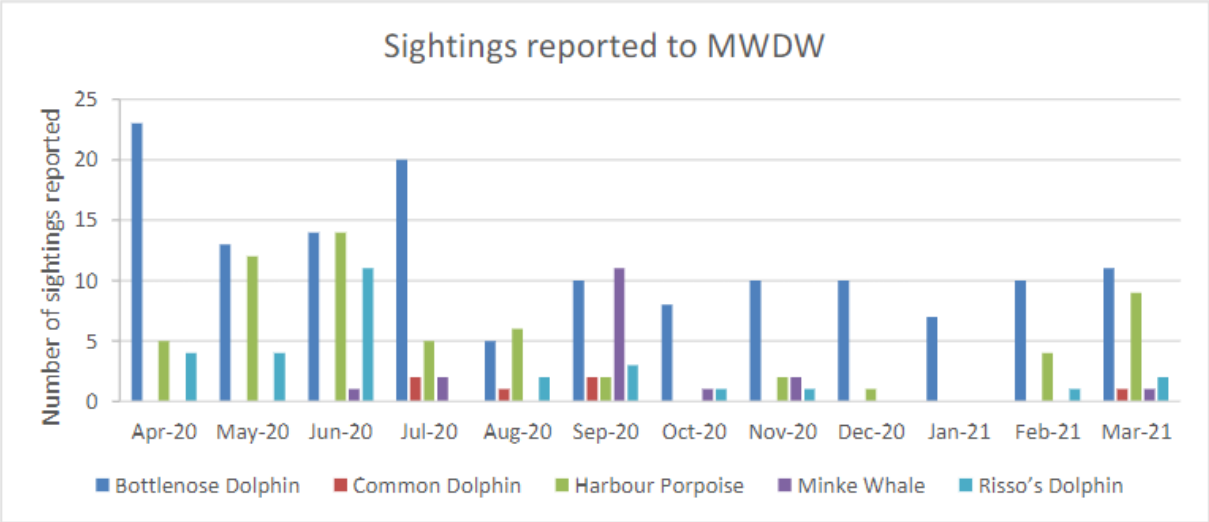

Figure 18 Sightings events reported to the MWDW between April 2020 and March 2021.

2.15 SCOS

Under the Conservation of Seals Act 1970 (in England) and the Marine (Scotland) Act 2010, the Natural Environment Research Council (NERC) (now part of UK Research and Innovation) provides scientific advice to government on matters related to the management of UK seal populations through the advice provided by the Special Committee on Seals (SCOS). The Sea Mammal Research Unit (SMRU) provides this advice to SCOS on an annual basis through meetings and an annual report. The report includes advice on matters related to the management of seal populations, including general information on British seals, information on their current status and addresses specific questions raised by regulators and stakeholders.

Surveys of harbour seals are carried out during the summer months. The main population surveys are carried out when harbour seals are moulting, during the first three weeks of August, as this is the time of year when the largest numbers of seals are ashore. Grey seals are also counted on all harbour seal surveys, although these data do not necessarily provide a reliable index of population size. Grey seals aggregate in the autumn to breed at traditional colonies, therefore their distribution during the breeding season can be very different to their distribution at other times of the year.

SMRU's main surveys of grey seals are designed to estimate the numbers of pups born at the main breeding colonies around Scotland. Breeding grey seals are surveyed biennially between mid-September and late November using large-format vertical photography from a fixed-wing aircraft. The SMRU grey seal pup counts round the UK are augmented by surveys conducted by Scottish Natural Heritage, The National Trust, Lincolnshire Wildlife Trust and Friends of Horsey Seals.

2.16 Seal Telemetry

Seal at-sea distribution SMRU has deployed telemetry tags on grey seals and harbour seals in the UK since 1988 and 2001, respectively. These tags transmit data on seal locations with the tag duration (number of days) varying between individual deployments. There are two types of telemetry tag which differ by their data transmission methods. Data transmission can be through the Argos satellite system (Argos tags) or mobile phone network (phone tags). Both types of transmission result in location fixes, but data from phone tags comprise better quality (GPS quality) and more frequent locations. The telemetry data were used to illustrate the distribution of seals at sea and to investigate the degree of connectivity between the AyM area and seal haul-out sites and SACs.

In the recent Department for Business, Energy and Industrial Strategy (BEIS) funded project (Carter et al. 2020), 100 grey seals were tagged with high resolution GPS around the UK between 2017 and 2019. Of these, seven were tagged at Ramsey and Skomer Island, 15 in the Dee Estuary and ten at Bardsey. These data added to previous tagging projects in 2012-2014 (in Blasket and Wexford) resulted in a total of 28 grey seals tagged in the Celtic and Irish Sea.

2.17 Seal at-sea densities

The seal at-sea usage maps were created in order to predict the at-sea density of seals in order to inform impact assessments and marine spatial planning. The original SMRU seal density maps were produced as a deliverable of Scottish Government Marine Mammal Scientific Support Research Programme (MMSS/001/01) and were published in Jones et al. (2015). These have since been revised to include new seal telemetry and haul-out count data and modifications have been made to the modelling process (Russell et al. 2017). A key limitation of the at-sea usage maps is that there was a lot of "null usage" in the data, where only a subset of all available haul-out sites were visited by a tagged animal. For haul-out sites where no animal had been tagged, or where no tagged animal had visited, it had to be assumed that usage declined monotonically with distance from the haul-out which meant that potential hotspots around these haul-outs will have been missed.

Given the limitations of the at-sea usage maps, and the fact that the grey seal at-sea usage maps were informed mainly by old, low resolution tracking data, BEIS funded a large-scale deployment of high resolution GPS telemetry tags on grey seals around the UK, and analyses to create up-to-date estimates of the at-sea distribution for both seal species (Carter et al. 2020). Telemetry data from 114 grey seals and 239 harbour seals were included in the analysis. To estimate the at-sea distribution, a habitat modelling approach was use, matching seal telemetry data to habitat variables (such as water depth, seabed topography, sea surface temperature) to understand the species-environment relationships that drive seal distribution. Haul-out count data were then used to generate predictions of seal distribution at sea from all known haul-out sites in the British Isles. This resulted in predicted distribution maps on a 5x5 km grid. The estimated density surface gives the percentage of the British Isles at-sea population (excluding hauled-out animals) estimated to be present in each grid cell at any one time during the main foraging season. It is estimated that grey seals spent 77% of their time at sea on average, therefore, using the 2019 best estimate of the grey seal population size in the British Isles (SCOS 2020), the total at-sea population size for the British Isles is estimated to be ~150,700 individuals (Carter et al. 2020).

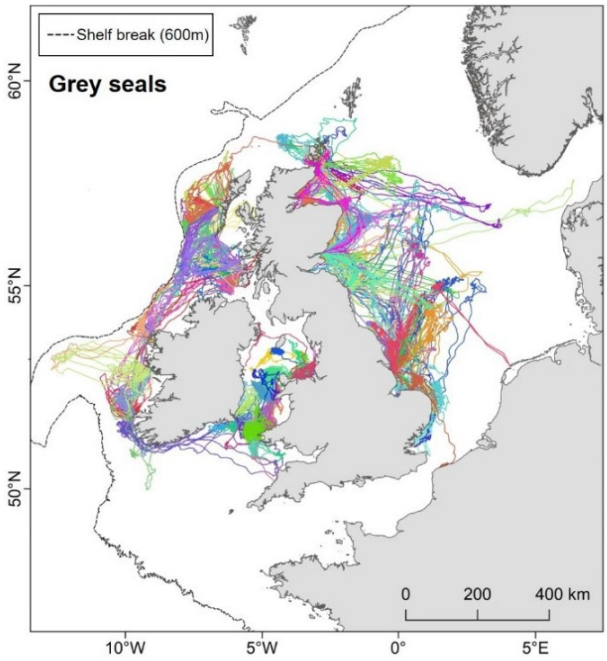

Figure 19 GPS tracking data for grey and seals available for habitat preference models (Carter et al. 2020).

3 Harbour porpoise

Harbour porpoise are distributed globally and can be found throughout UK in shallow waters (<200 m). Three MUs have been delineated for harbour porpoise in UK waters; the North Sea MU, the West Scotland MU (expected movement between North Sea and West Scotland MUs), and the Celtic and Irish Seas MU (IAMMWG 2015). AyM lies within the Celtic and Irish Seas MU, the current abundance estimate for this MU is 62,517 porpoise (95% CI: 48,324 – 80,877, CV: 0.13) (estimated using data from SCANS III and ObSERVE) (IAMMWG 2021). This is a significant decrease from the previous estimate using the SCANS II and CODA data which was 104,695 porpoise (95% CI: 56,774 – 193,065, CV: 0.32) (IAMMWG 2015). Harbour porpoise are listed as Least Concern on the IUCN red list, but as an Annex II species of the Habitats Directive, the designation of SACs is required as a component of their conservation. There are five SACs designated for harbour porpoise within the Irish Sea (Figure 1).

3.1 Site-specific surveys

Harbour porpoise were the only group that could be identified to species level in the site-specific APEM aerial surveys. They were sighted across the Survey Area, and within the GyM offshore wind farm, but in low numbers, with no evidence of a seasonal or spatial pattern to the sightings. The maximum density estimate for harbour porpoise within the Survey Area was 0.13 porpoise/km^2 (Table 4).

In addition to this, there were considerably more sightings of dolphins/porpoise which could not be identified further to species level. The maximum density estimate for dolphin/porpoise within the Survey Area was 0.21 animals/km^2 (Table 4).

Table 4 Harbour porpoise and dolphin/porpoise sightings, abundance and density estimates across the AyM Survey Area.

Survey	Count	Abundance	Lower CI	Upper CI	Precision	Density (#/km^2)
Harbour porpoise						
Mar-19	0	0	0	0	-	-
Apr-19	1	10	1	30	1	0.02
May-19	1	10	1	30	1	0.02
Jun-19	0	0	0	0	-	-
Jul-19	0	0	0	0	-	-
Aug-19	2	18	2	45	0.71	0.03
Sep-19	0	0	0	0	-	-
Oct-19	0	0	0	0	-	-
Nov-19	0	0	0	0	-	-
Dec-19	0	0	0	0	-	-
Jan-20	0	0	0	0	-	-
Feb-20	8	81	20	161	0.35	0.13
Mar-20	0	0	0	0	-	-
Apr-20	2	18	2	55	0.70711	0.03
May-20	0	0	0	0	-	-
Jun-20	6	51	6	137	0.40825	0.08
Jul-20	0	0	0	0	-	-
Aug-20	1	9	1	26	1	0.01
Sep-20	0	0	0	0	-	-
Oct-20	0	0	0	0	-	-
Nov-20	0	0	0	0	-	-
Dec-20	0	0	0	0	-	-
Jan-21	0	0	0	0	-	-
Feb-21	0	0	0	0	-	-
Dolphin/Porpoise						
Mar-19	5	42	5	101	0.45	0.07
Apr-19	4	40	10	81	0.5	0.06
May-19	13	131	61	222	0.28	0.21
Jun-19	0	0	0	0	-	-
Jul-19	3	26	3	61	0.58	0.04

Survey	Count	Abundance	Lower CI	Upper CI	Precision	Density (#/km^2)
Aug-19	3	27	3	73	0.58	0.04
Sep-19	0	0	0	0	-	-
Oct-19	0	0	0	0	-	-
Nov-19	0	0	0	0	-	-
Dec-19	1	9	1	26	1	0.01
Jan-20	1	10	1	30	1	0.02
Feb-20	13	131	40	252	0.28	0.21
Mar-20	5	43	9	85	0.44721	0.07
Apr-20	2	18	2	45	0.70711	0.03
May-20	2	17	2	42	0.70711	0.03
Jun-20	1	9	1	26	1	0.01
Jul-20	4	34	4	94	0.5	0.05
Aug-20	4	35	4	95	0.5	0.06
Sep-20	0	0	0	0	-	-
Oct-20	0	0	0	0	-	-
Nov-20	0	0	0	0	-	-
Dec-20	0	0	0	0	-	-
Jan-21	0	0	0	0	-	-
Feb-21	1	9	1	26	1	0.01

Correction factors were applied to the harbour porpoise data in order to correct for the proportion of animals below 2 m depth that were unavailable to be detected by the surveys. The correction factor is described in Voet et al. (2017) and is based the proportion of time spent at depth obtained from telemetry data from 35 harbour porpoise tagged around Denmark (Teilmann et al. 2013). This resulted in seasonal corrected density estimates for the array area and buffer, with a maximum density estimate of 1.03 porpoise/km^2 and density across the array area across the 2 years of 0.395 porpoise/km^2 (Table 5).

Table 5 Harbour porpoise season mean peak corrected abundance and density estimates.

		Array area		Buffer	
Season	Months	Mean peak abundance	Mean peak density	Mean peak abundance	Mean peak density
Winter	Dec – Feb	117	1.03	139	0.27
Spring	Mar – May	55	0.49	111	0.22
Summer	Jun – Aug	7	0.06	100	0.19

		Array area		Buffer	
Season	**Months**	**Mean peak abundance**	**Mean peak density**	**Mean peak abundance**	**Mean peak density**
Autumn	Sep - Nov	0	0	0	0
Average	**All**	**45**	**0.395**	**87.5**	**0.17**

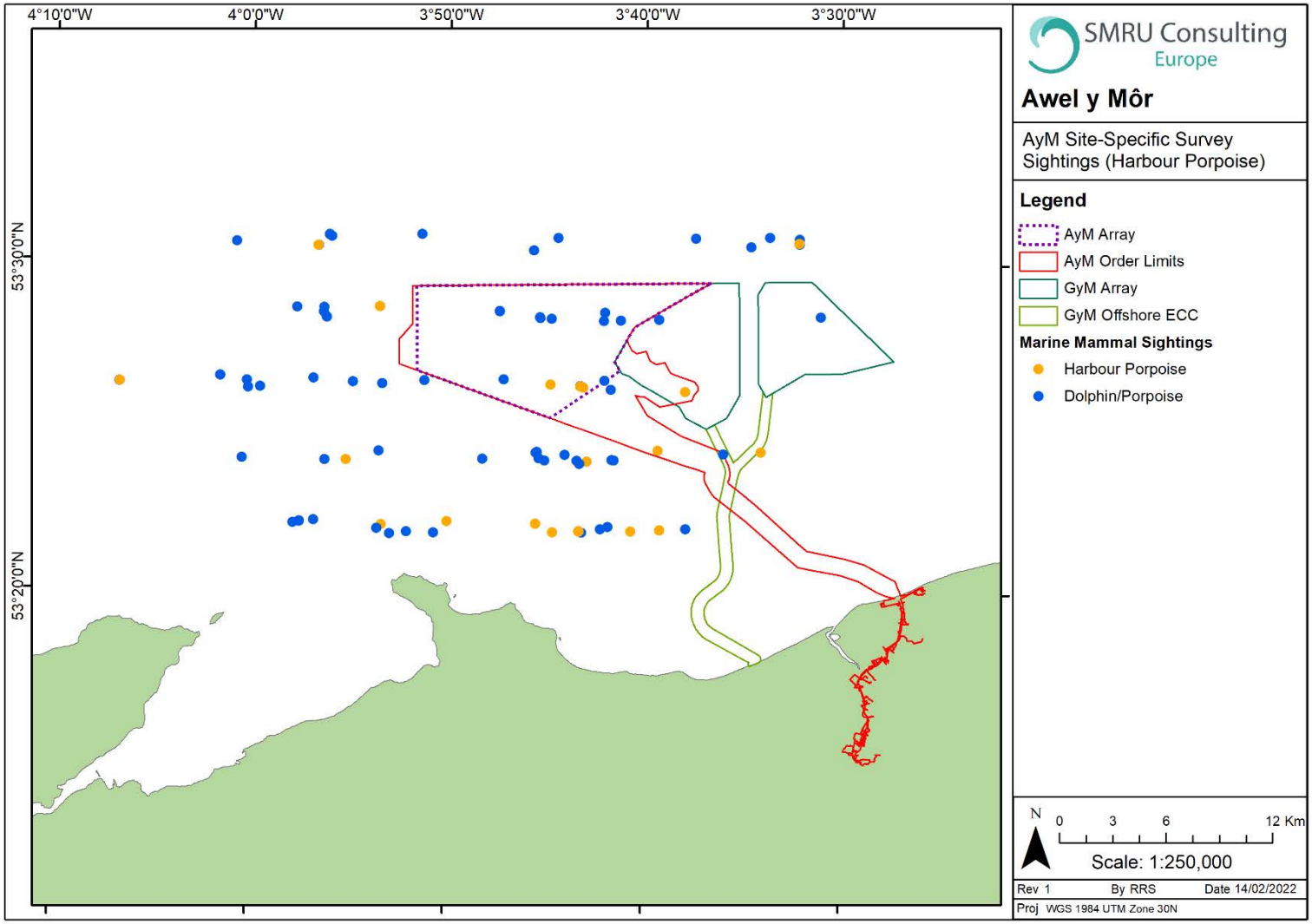

Figure 20 Harbour porpoise and "dolphin/porpoise" sightings during the 2 years of AyM site-specific surveys.

3.2 GyM surveys

The original GyM EIA conducted site-specific visual surveys between 2003-2004, and acoustic surveys between 2004-2005, with harbour porpoises detected throughout the year. During baseline monitoring, five aerial surveys took place between July 2010 – July 2011 but no porpoises were reported, although two unidentified animals were sighted, both of which could have been small cetaceans. During benthic baselines, two harbour porpoises were observed within the windfarm site in 2010. The low numbers of sightings resulted in a lack of density estimates for this species. Marine mammal mitigation was implemented during construction, with one harbour porpoise sighted and detected acoustically, and two more harbour porpoise groups observed during 'off-duty' hours. Between July 2016-March 2019, 17 post construction aerial surveys recorded four harbour porpoise sightings. In total, nine confirmed harbour porpoise groups were recorded between 2010-2019 in the GyM windfarm area.

3.3 Welsh Marine Atlas

The distribution maps show that harbour porpoise are widespread throughout the Irish Sea, with sightings rates being higher in more coastal waters (Figure 21 and Figure 22). The sightings rates in the vicinity of AyM are generally low, however sightings rates are much higher to the west of the site around North Anglesey. While these data provide an overview of the general distribution of harbour porpoise in the Irish Sea, they do not provide density estimates.

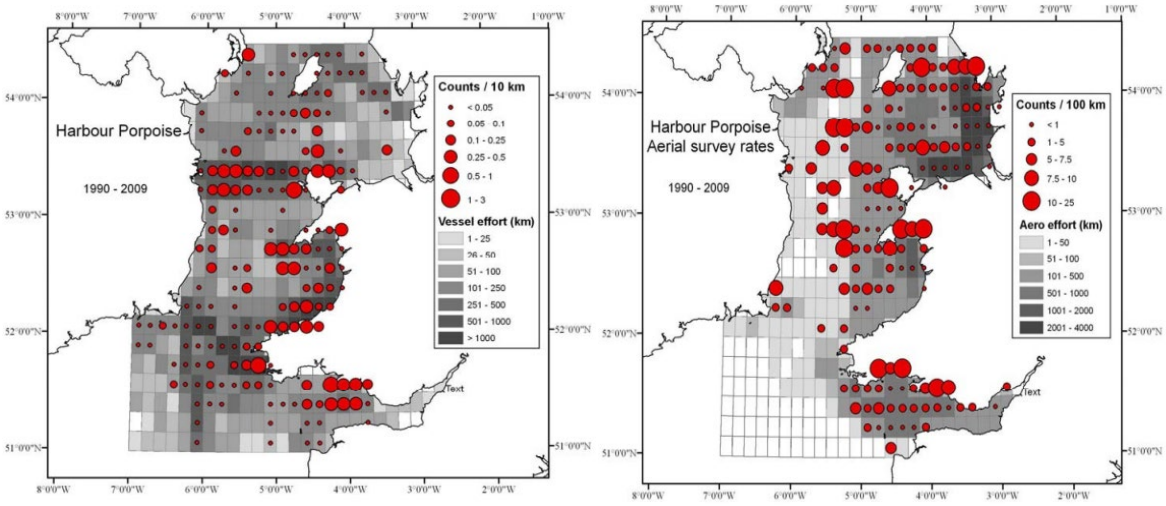

Figure 21 Long-term mean sightings rates for harbour porpoise in Wales. Left = vessel surveys, right = aerial surveys (Baines and Evans 2012).

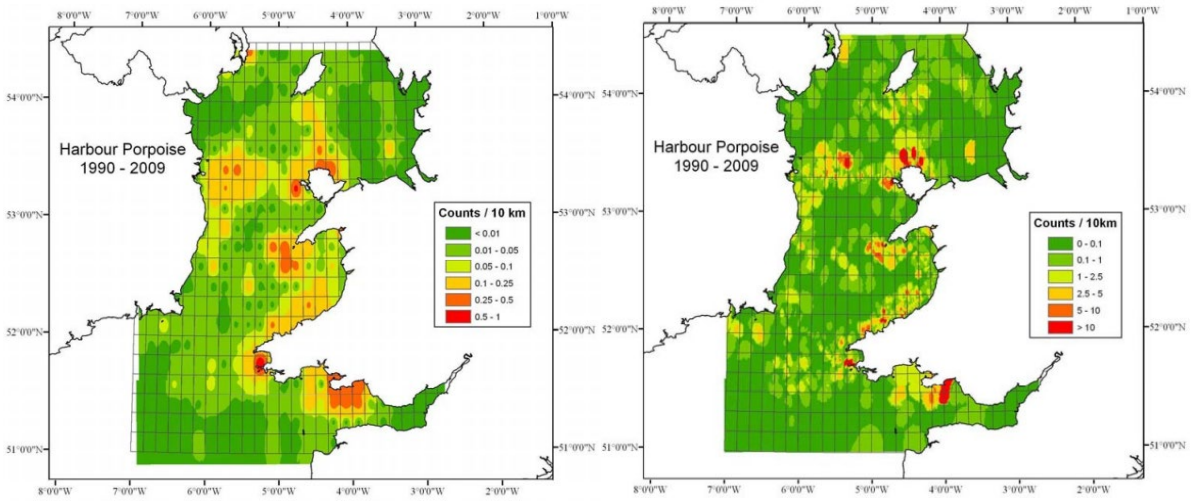

Figure 22 Harbour porpoise distribution in Wales. Left = IDW interpolation model and Right = Kriging interpolation model (Baines and Evans 2012).

3.4 Sea Watch Foundation - North Wales

Within the Sea Watch Foundation database, harbour porpoise were the most frequently recorded cetacean species in the coastal waters of North Wales, consisting of 70.4% of the records and 46.8% of the individuals (Evans et al. 2021). They have been recorded in the coastal waters of North Wales year-round, with a peak in sightings in July and August. Harbour porpoise were not evenly distributed in the coastal waters of North Wales, with hotspots identified around northwest and north Anglesey (Figure 23 and Figure 24). The overall densities of porpoises in the coastal waters of North Wales were estimated to vary between ~1.0-1.5 porpoise/km^2 near-shore and ~0.5-1.0 porpoises/km^2 further offshore (Evans et al. 2021).

However, as stated in section 2.12, there are significant limitations to the modelling used in the Waggitt et al. (2020) density maps, and as such, the resulting density estimates are not considered to be ideal for use in impact assessment. The density estimates presented here (0.5-1.5 porpoise/km^2) (Evans et al. 2021) are from the updated Welsh Marine Atlas, which is still in draft (Evans and Waggitt 2022 (in draft)) and as such the exact methodology used to obtain these estimates, and the resulting uncertainty in the density estimates is unknown. However, it is important to note that these density estimates are significantly higher than those obtained from the site-specific surveys (0.395), the SCANS III surveys (0.086) and the JCP Phase III data (0.13), and as such they will be presented in the impact assessment, alongside the JCP Phase III estimates for illustrative purposes. Since the impact ranges for AyM will extend into offshore waters, it is not considered to be appropriate to use the maximum density estimate of 1.5 porpoise/km^2, instead the impact assessment will show results using an more averaged density estimate across the coastal and offshore areas of 1 porpoise/km^2.

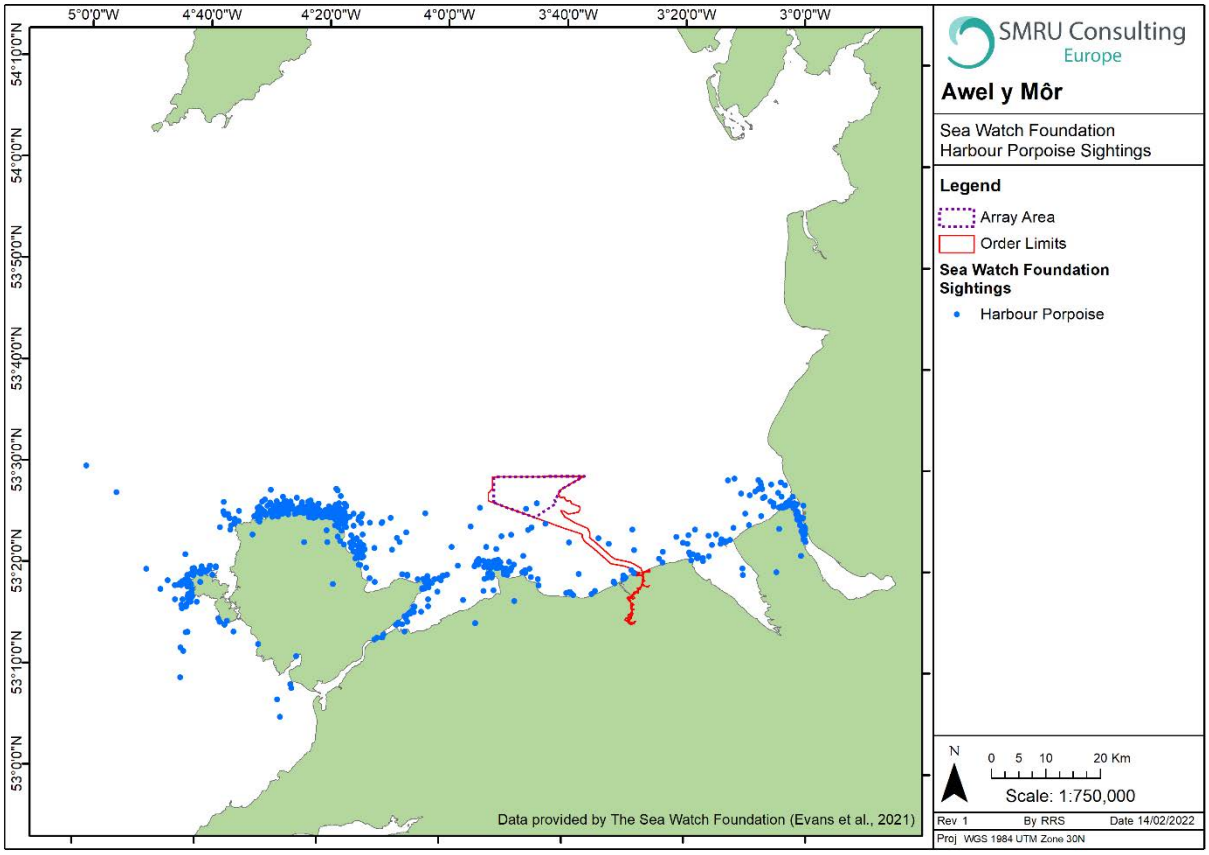

Figure 23 Harbour porpoise sightings in coastal waters of North Wales. Data provided by the Sea Watch Foundation (Evans et al. 2021).

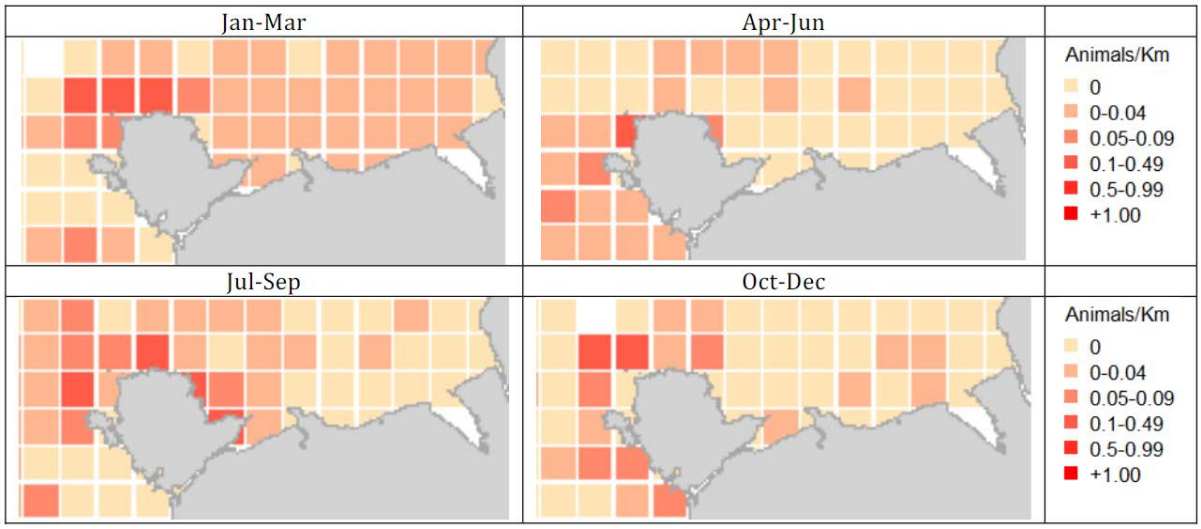

Figure 24 Distribution of harbour porpoises corrected for survey effort in coastal North Wales. Provided by the Sea Watch Foundation (Evans et al. 2021).

3.5 COFNOD

A total of 130 harbour porpoise sightings were obtained from the COFNOD database for the specified area of search. These sightings were located coastally across north Wales (Figure 25). No

effort data were provided and as such these data confirm species presence but cannot be used to estimate density.

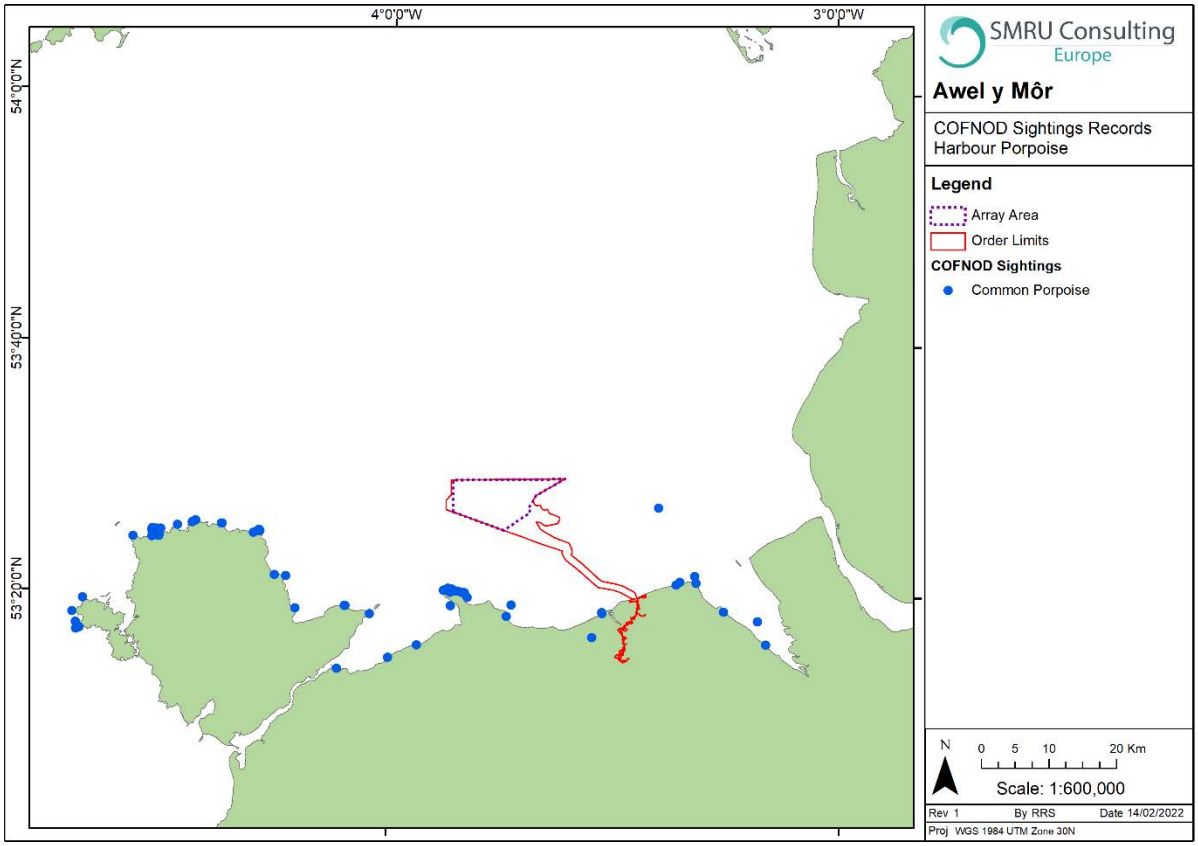

Figure 25 Sightings of harbour porpoise in the north Wales area – provided by COFNOD.

3.6 SCANS

The Irish Sea was not included in the SCANS I surveys in 1994. The SCANS II survey of Block O (which included the AyM area) recorded sightings of harbour porpoise throughout the block (Figure 27) and resulted in high estimates of harbour porpoise density of 0.335 porpoise/km^2 (Hammond et al. 2006). In contrast, the SCANS III surveys in Block F (eastern Irish Sea, which included the AyM area) found a low density estimate of harbour porpoise (0.086 porpoise/km^2), but in the nearby Block E (western Irish Sea) estimated a density of 0.239 porpoise/km^2 (Hammond et al. 2017, Hammond et al. 2021) (Table 6). There were sightings of harbour porpoise throughout the SCANS III Block F (Figure 26), including a sighting off the north Welsh coast, east of Anglesey which is very close to the AyM area.

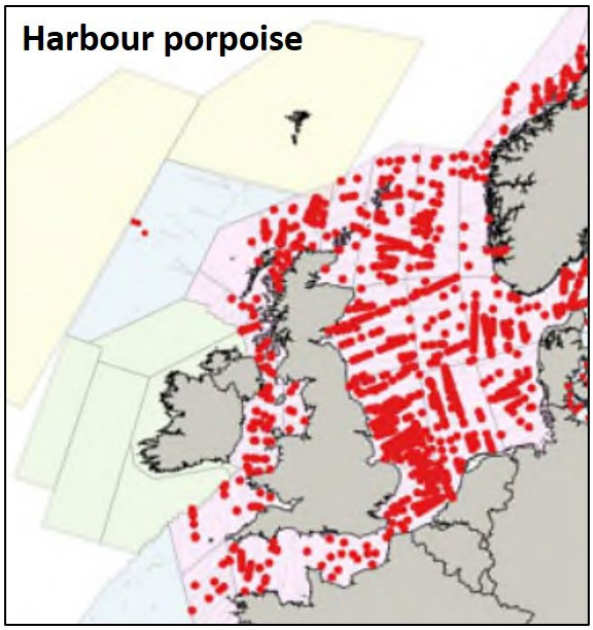

Figure 26 Sightings locations for harbour porpoise from the SCANS III survey (Hammond et al. 2017).

Table 6 Harbour porpoise density estimates from SCANS surveys.

Survey	Year	Block	Area (km^2)	Effort (km)	Density (#/km^2)
SCANS III	2016	F (eastern Irish Sea)	12,322	619.8	0.086
SCANS III	2016	E (western Irish Sea)	34,870	2,252.7	0.239
SCANS II	2005	O (entire Irish Sea)	45,417	2,264	0.335

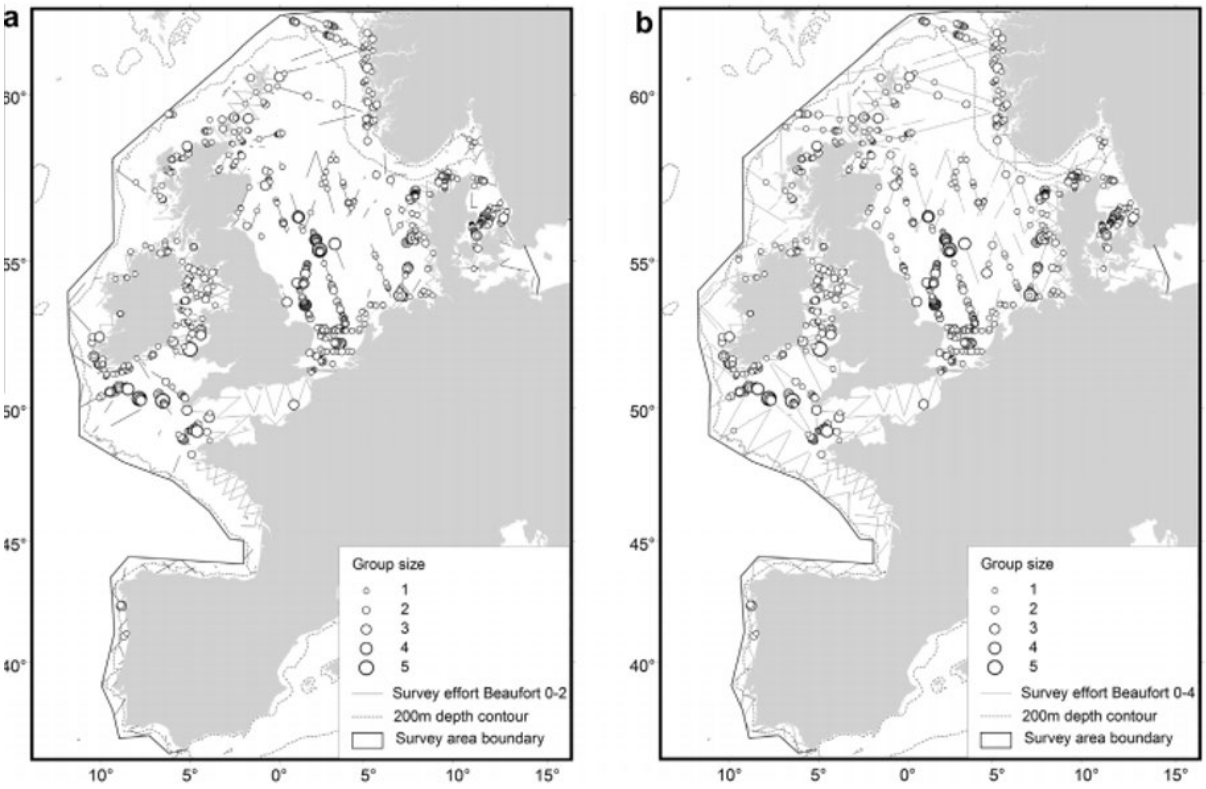

Figure 27 Distribution of harbour porpoise sightings with transects conducted in a) Sea states of Beaufort <2 and b) sea states of Beaufort <4 from SCANS II.

3.7 ObSERVE

Across the entirety of the ObSERVE dataset, the abundance of harbour porpoise was found to be higher during the summer, with Stratum 4 (offshore southern Ireland) and 5 (coastal eastern Ireland) representing the highest local densities during those months. Over the survey period, a total of 104 harbour porpoise groups were sighted across all strata (Figure 28), with the mean group size estimated at 1.5 individuals (Rogan et al. 2018). In order to estimate the harbour porpoise density, the SCANS II g(0)=0.279 estimate was used to correct for bias, resulting in design-based estimates of density up to 1.046 porpoise/km^2 and model-based estimates up to 0.942 porpoise/km^2 for Stratum 5 (Table 7). While this study provides robust absolute density estimates of porpoise, given the distance of Stratum 5 from AyM and the evidence from SCANS III that densities are higher in the western Irish Sea, these density estimates may not be representative of the density or group sizes that are present in the AyM region and are therefore not considered to be the most suitable to take forward for the quantitative impact assessment.

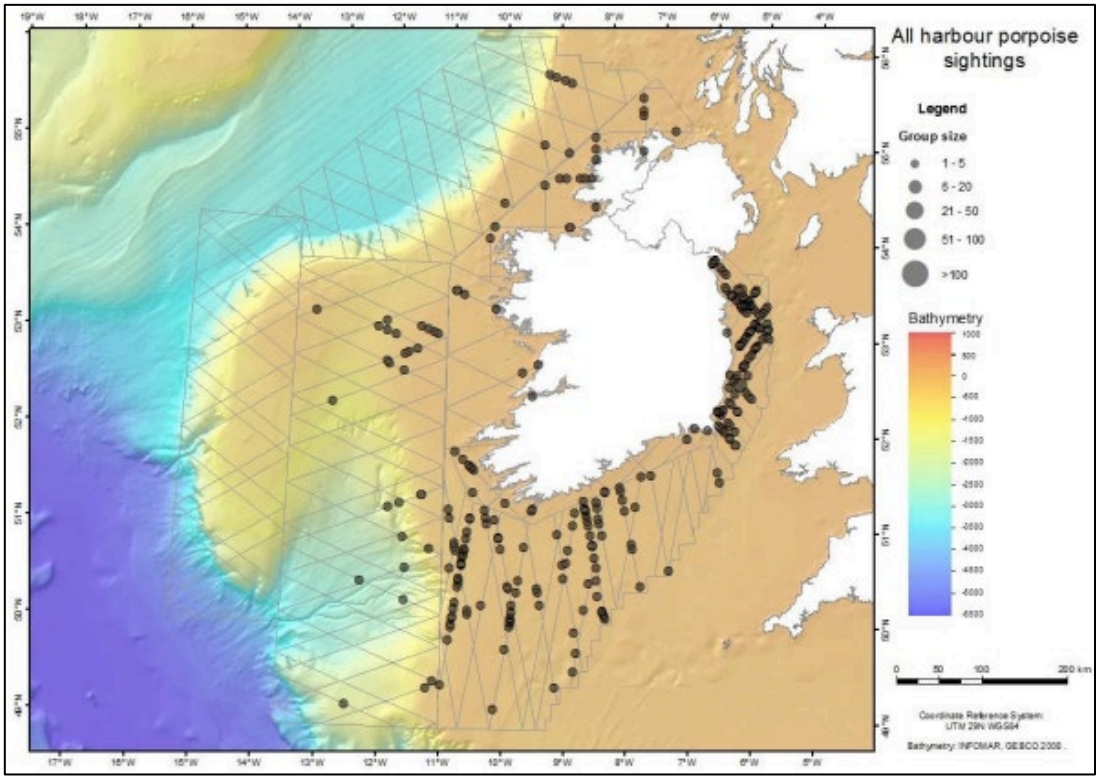

Figure 28 Sightings of harbour porpoise during the 2015-2016 ObSERVE surveys (Rogan et al. 2018).

Table 7 Corrected design and model-based estimates of density (#/km^2) for harbour porpoise obtained for the ObSERVE aerial surveys of Stratum 5 (Rogan et al. 2018).

		Harbour porpoise density (#/km^2)	
Survey	**Effort (km)**	**Design based**	**Model based**
Summer 2015	430	0.696	0.675
Winter 2015/16	463	0.867	-
Summer 2016	394	1.046	0.942
Winter 2016/17	395	0.924	-

3.8 JCP data

The collation of all data sources within the JCP analysis resulted in 20,032 harbour porpoise sightings throughout the entire survey area between 1994-2010, with over a third of these sighted using aerial surveys. The patterns of harbour porpoise distributions were found to be similar to those reported in Baines and Evans (2012) with high densities in the Hebrides region, however the high density of individuals usually observed between south Wales and Dublin appears to have decreased. Predictions for the OSPAR3 area, which includes Welsh waters, were made for waters up to 300 m in depth. Abundance estimates for harbour porpoise in the OSPAR3 area were highest in winter and summer with a point estimate of 127,900 and 127,600 individuals, respectively.

The user specified area (green in Figure 9) resulted in a density estimate of 0.13 porpoise/km^2 (CI: 0.06-0.16).

Heinänen and Skov (2015) also used the JCP database to identify “discrete and persistent areas of high density” that might be considered important for harbour porpoise with the ultimate goal of identifying areas for SAC designation for the species. The analysis grouped data into three subsets: 1994-1999, 2000-2005 and 2006-2011 to account for patchy survey effort and analysed summer

(April-September) and winter (October-March) data separately to explore whether distribution patterns were different between seasons and to examine the degree of persistence between the subsets. Estimated densities at North Anglesey reached >3 porpoise/km^2 in summer 2003, however the modelling indicates large variation in density estimates and distributions across years (Figure 29). The density estimates at the AyM site were generally low across all years and both seasons compared to other parts of the Irish Sea such as Pembrokeshire and Cardigan Bay (Figure 29). The authors note that "due to the uneven survey effort over the modelled period, the uncertainty in modelled distributions vary to a large extent". In addition, the authors stated that "model uncertainties are particularly high during winter", therefore caution should be used when considering the density estimates provided.

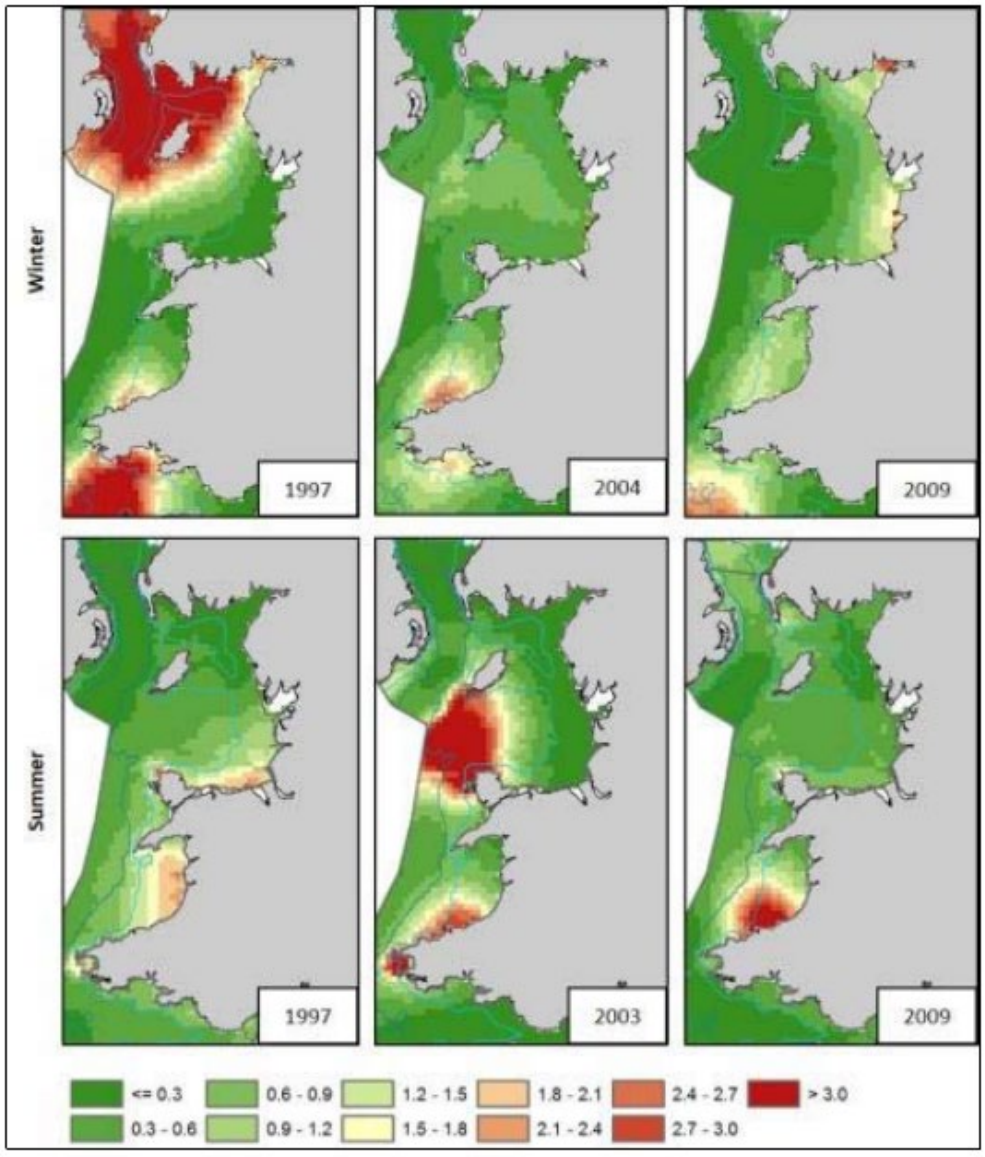

Figure 29 Predicted densities of harbour porpoise (#/km^2) in the Celtic and Irish Sea MU during winter and summer (Heinänen and Skov 2015).

3.9 Anglesey visual surveys

Shucksmith et al. (2009) conducted dedicated harbour porpoise surveys of 31 transect lines (Figure 10) monitored at least once between May and September between 2002 and 2004 to estimate

abundance and density of harbour porpoises on the north coast of Anglesey. Based on the assumption that g(0)= 1[4] the density of harbour porpoises for the 489 km^2 study site was estimated to be 0.630 individuals/km^2 (CV 0.2). To account for availability bias the authors also used a g(0) estimate of 0.5 (assuming 50% of the animals on the trackline were undetected) which resulted in a density estimate of 1.261 porpoise/km^2. Given that the surveys were limited to coastal waters, the resulting density estimates are unlikely to be representative of porpoise density estimates within the AyM site which is located further offshore.

3.10 Anglesey towed acoustic surveys

In 2009, both visual and acoustic data were collected by Gordon et al. (2011) between The Skerries and Carmel Head using both visual observers and towed hydrophones (Figure 11). The towed hydrophone surveys at The Skerries provided an acoustic detection rate of 9.4 detections/km. From this, a density of 0.38 porpoise/km^2 was estimated assuming g(0)=1, a group size of 1.5 and an effective strip width of 186 m. The authors used visual detections as a second independent platform to the acoustic detections with the intention of calculating a true g(0) value. However, the number of matched sightings and acoustic detections were low. A total of 33 porpoise were sighted visually within the acoustic effective strip half-width[5], with only 34% of these being detected acoustically. The acoustic detection function estimated that 50% of all potential detections would be made, and therefore it was estimated that the proportion of animals detected acoustically on the trackline was 0.68 (though the authors refer to this as a rather "ad hoc calculation"). Therefore, the density estimate for the Skerries using g(0)=1 would have been an underestimate.

3.11 Wylfa surveys

Visual line transect surveys around the north of Anglesey were undertaken in 2016 and 2017 (21 surveys across 14 months) to inform the baseline characterisation for the Horizon Nuclear Power Wylfa Newydd Project. The sightings rates varied across months, with highest rates in January (0.559 porpoise/km^2) and lowest in the summer months where sightings rates were <0.1 porpoise/km^2 (Figure 30). Using the estimate that g(0)=1, the density of harbour porpoise over the total area sampled (614 km^2) was estimated as 0.323 porpoise/km^2 (however as mentioned above, this assumption is invalid for marine mammal surveys and will result in an underestimated density). Therefore estimates assuming that g(0)=0.5 were also presented, which resulted in a density estimate of 0.646 porpoise/km^2. Given that the surveys were limited to coastal waters, the resulting density estimates are unlikely to be representative of porpoise density estimates within the AyM site which is located further offshore.

[4] The assumption of g(0)=1 means that when conducting the detection function in Distance Analysis, the model assumes that every animal on the transect line was detected. However, this is an unrealistic assumption for marine mammal surveys since animals may be underwater and not available for detection. This is referred to as availability bias and will result in the density estimates being underestimated.

[5] The effective strip half-width is the distance either side of the trackline at which as many animals are detected further away than are estimated to be missed closer to the trackline.

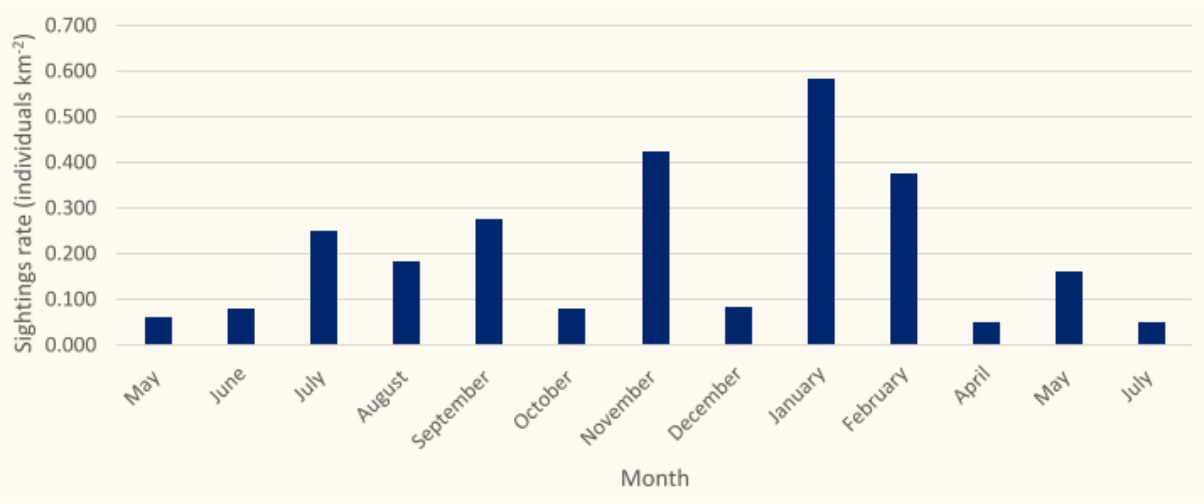

Figure 30 Harbour porpoise sightings rate across the 14 month vessel transect surveys (Jacobs 2018).

3.12 Morlais surveys

Marine mammal data were collected to inform the baseline characterisation for the Morlais MDZ (Holy Island, West Anglesey). The density estimate for the Natural Power surveys (using a g(0)=1) varied month to month with no clear seasonal trend, and were highest in January 2017 (1 porpoise/km^2, 95% CI: 0.02-1.11) (Royal Haskoning DHV 2019) with an average estimated density within the Morlais site of 0.213 porpoise/km^2 and 0.218 porpoise/km^2 in the 2 km buffer area (Figure 31).

The SEACAMS surveys recorded sightings from primary observers, an independent observer, and detections with a towed hydrophone. For the visual surveys, the g(0) was calculated as g(0)=0.61, resulting in a density estimate of 0.714 porpoise/km^2. Using the acoustic data, a g(0) of 0.51 was calculated, which resulted in a density estimate of 0.852 porpoise/km^2.

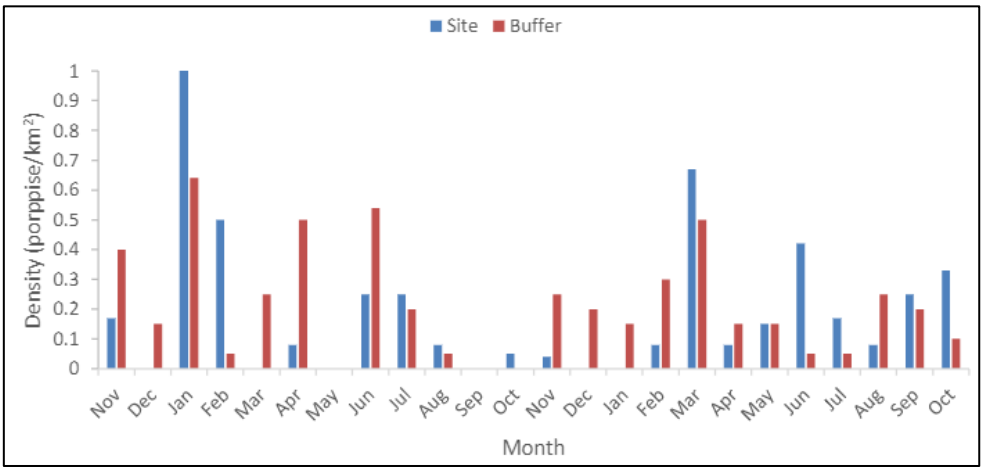

Figure 31 Harbour porpoise density estimates within the Morlais Site and within the site buffer (2 km) for the Natural Power surveys, assuming g(0)=1 (Royal Haskoning DHV 2019).

3.13 MWDW sightings

Harbour porpoise are the most frequently sighted cetacean throughout Manx territorial waters (Figure 32), comprising 81.3% of boat sightings, 75.1% of land-based survey sightings and 51% of opportunistic sightings between 2007 and 2014 (Felce 2014). Similar results were found during surveys in 2018 where harbour porpoise comprised and 73.7% of boat sightings, 71.0% of

land-based survey sightings and 46.9% of opportunistic sightings (Clark et al. 2019). Using the boat-based survey data (2007–2014), it is estimated that the density of harbour porpoise throughout Manx waters is 0.207/km² (0.137-0.312/km², CV=21.09%) (Howe 2018). Harbour porpoise are sighted year-round in Manx waters, with an increase in sightings between April and September.

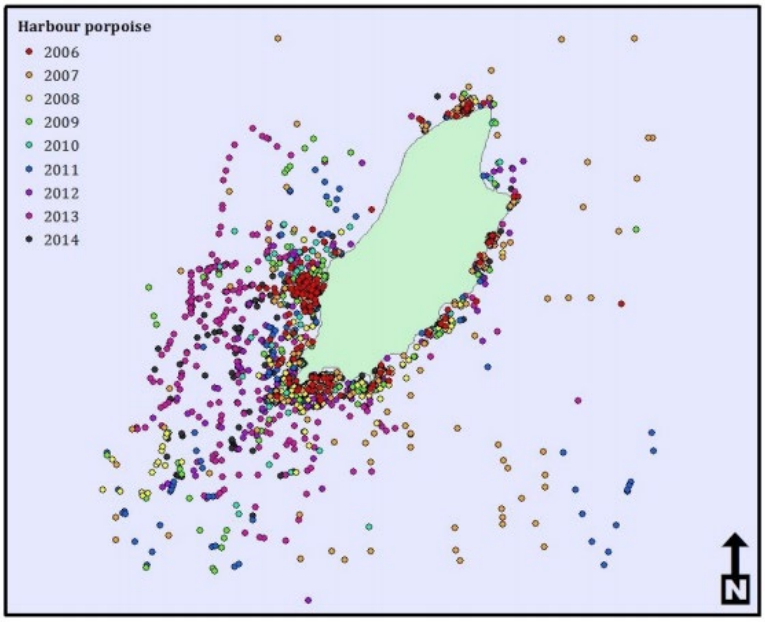

Figure 32 Sightings of harbour porpoise in Manx waters 2006 to 2014 (Howe 2018).

3.14 Summary

The density estimates obtained from the literature for harbour porpoise vary by over an order of magnitude, from 0.086 porpoise/km^2 to >1 porpoise/km^2 (Table 8). At a more local scale, density estimates around Anglesey range between 0.323 and 1.261 porpoise/km^2 (Table 8). Many of these local density estimates are all very coastal and in highly tidal habitats and do not necessarily represent densities at the AyM site or further offshore and therefore are unlikely to be appropriate for the impact assessment.

The APEM site specific surveys resulted in high numbers of unidentified sightings (60% of the total marine mammal sightings were categorised as either “dolphin/porpoise”, “dolphin species” or “unknown marine mammal”), which meant that the data was unsuitable to characterise the baseline in terms of species composition and the resulting density estimates were considered unreliable. In consultation, NRW agreed that the aerial survey data are not sufficient to inform the impact assessment due to the low rates of species identification. SMRU Consulting recommends that the JCP III density estimate is taken forward for harbour porpoise in the quantitative impact assessment. In addition to this, a value of 1.0 porpoise/km^2, obtained from the Sea Watch Foundation report (Evans et al. 2021) (averaged across the coastal and offshore estimates) will be presented in the impact assessment, though the precautions behind this (see section 2.12) mean that there is little confidence in this density estimate.

Table 8 Harbour porpoise density estimates.

Source	Area	Temporal	Density Estimate (#/km^2)	Approx. distance to AyM
AyM site specific	AyM	Year round	Adjusted:	Includes site

Source	Area	Temporal	Density Estimate (#/km^2)	Approx. distance to AyM
surveys		2019-2021	0.00–0.13 Corrected: 0.00–0.395	
GyM surveys	GyM	Various between 2003-2019	None provided	Adjacent to site
Sea Watch Foundation	**Coastal North Wales**	**Since 1990**	**~0.5 - 1.0 (offshore) 1.0 – 1.5 (coastal)**	**Includes site**
SCANS III (Block F)	Eastern Irish Sea	Summer 2016	0.086	Includes site
SCANS III (Block E)	Western Irish Sea	Summer 2016	0.239	11+ km
SCANS II (Block O)	Irish Sea	Summer 2005	0.3353	Includes site
JCP Phase III	**User specified area (AyM)**	**Summer only**	**0.13**	**Includes site**
ObSERVE (Stratum 5, design based est.)	Western Irish Sea	Summer 2015	0.696	100 km
ObSERVE (Stratum 5, design based est.)	Western Irish Sea	Winter 2015/16	0.867	100 km
ObSERVE (Stratum 5, design based est.)	Western Irish Sea	Summer 2016	1.046	100 km
ObSERVE (Stratum 5, design based est.)	Western Irish Sea	Winter 2016/17	0.924	100 km
ObSERVE (Stratum 5, model based est.)	Western Irish Sea	Summer 2015	0.675	100 km
ObSERVE (Stratum 5, model based est.)	Western Irish Sea	Summer 2016	0.942	100 km
Shucksmith et al. (2009) (g(0)=0.5)	North Anglesey	Summer only	1.261	16+ km
Shucksmith et al. (2009) (g(0)=1)	North Anglesey	Summer only	0.630	16+ km
Gordon et al. (2011)	NW Anglesey	Summer only	0.38	40 km
Jacobs (2018) (g(0)=1)	North Anglesey	Year round	0.323	25 km
Jacobs (2018) (g(0)=0.5)	North Anglesey	Year round	0.646	25 km
SEACAMS (g(0)=0.61)	West Anglesey	Year round	0.714	56 km
SEACAMS (g(0)=0.51)	West Anglesey	Year round	0.852	56 km
Natural Power - Morlais	West Anglesey	Year round	0.5–1.0	56 km
MWDW surveys	Manx territorial waters	Year round	0.207	75 km

4 Bottlenose dolphin

Bottlenose dolphins are found worldwide, and several distinct MUs exist for this species in European waters. The MU that incorporates AyM is the Irish Sea MU, which has an estimated abundance of 293 dolphins (95% CI: 108 – 793, CV: 0.54) (estimated using data from SCANS III and ObSERVE)

(IAMMWG 2021). This estimate is a decline from the previous estimate of 397 dolphins (95% CI: 362 – 414, CV: 0.23) (IAMMWG 2015), although the coefficient of variation in abundance estimate is significantly greater, resulting in a much larger range in the abundance estimate in 2021 (IAMMWG 2021). Bottlenose dolphins are classified as a Priority Species under the UK Post-2010 Biodiversity Framework and listed as Least Concern by the IUCN red list. As bottlenose dolphins are also listed under Annex II of the EU Habitats Directive, SACs must be assigned to aid in the protection of this species. There are two bottlenose dolphin SACs in the Irish Sea MU (Figure 2).

4.1 Connectivity

While the MUs implemented for bottlenose dolphins cover a wide geographic range, mixing of populations between the MUs has recently been observed. The Moray Firth is home to a small resident population of coastal bottlenose dolphins, but in 2019 an individual from this population was observed on the west coast of Wales[6]. Likewise, members of this population have also been sighted on the south coast of Ireland, and as far east as the waters surrounding the Netherlands. Subsequently, the development of the AyM windfarm could potentially impact multiple populations, however the extent of this is currently unknown.

Boat-based, land-based, and photo-identification surveys in general suggest connectivity of dolphins found in the Cardigan Bay area with northern Welsh waters and the Northern Irish Sea. Preference of coastal waters appears to be site-specific, with the proximity to shore differing between sites of high usage. It is also suggested that bottlenose dolphin presence is seasonal, and home range may be related to demographic factors. The studies below detail the information available on bottlenose dolphin distribution and connectivity between the Cardigan Bay SAC and other areas.

The results of a photo-ID analysis suggest that fewer bottlenose dolphins may be using the Cardigan Bay SAC than in recent years, and individuals that previously showed site fidelity now observed in North Wales, where there are increasing sightings of members of the population. Despite these observations, Cardigan Bay was highlighted as still important for bottlenose dolphins, particularly for mother calf pairs (Veneruso and Evans 2012). Somewhat supporting this hypothesis, Feingold and Evans (2014) found a small proportion of animals that exhibited site fidelity with limited home ranges in Cardigan Bay, but a large proportion of animals exhibited wide home ranges, with their distribution extending into North Wales and possibly the Northern Irish Sea. Equally, research conducted by Sea Watch in 2014, combined with photo-ID studies that commenced off the Isle of Anglesey in 2007 showed that 64% of individuals observed in the Cardigan Bay SAC were also found in North Wales. However, in the Cardigan Bay SAC, 7% of individuals were only sighted within that area, and similarly in North Wales, 8% of individuals exhibited localised home ranges (Norman et al. 2015).

More recently, a long-term study of bottlenose dolphin connectivity in Welsh waters found that 77% of the individuals observed in Cardigan Bay were also sighted in North Wales, and 20% were sighted in proximity to the Isle of Man, between 2001 and 2016 (Lohrengel et al. 2018). It therefore appears that while more recent surveys do demonstrate the presence of bottlenose dolphins in Cardigan Bay, a large proportion of the Welsh bottlenose dolphin population has a wide habitat range from the southern Cardigan Bay area, to the Isle of Man (Duckett 2018).

While bottlenose dolphins are found throughout the general Cardigan Bay area, sightings are often clustered in a few coastal locations (Norman et al. 2015). In 2014, 18 survey line-transect surveys and five *ad-libitum* surveys took place in Welsh waters, covering 2,766 km in total. High concentrations of animals were observed around New Quay headland, Ynys Locktyn, and between

[6] [redacted]

Pen Peles and Mwnt. The offshore southwest sector of Cardigan Bay SAC had no sightings, consistent with other years, although survey effort was low. Land-based surveys conducted along the welsh coastline found that the area surrounding Mwnt, close to the headland and to the reef at Pen Peles were highly used, with dolphins travelling between these areas only 300 m offshore. Sightings at Ynys Lochtyn, New Quay, and the headland were often found in close proximity to the shore, between 500-1,000 m from observers. In contrast, animals at Pen Peles were estimated to be 2.6 km from the coast, and few animals were sighed within 500 m land at Aberporth (Pierpoint et al. 2009), suggesting site specific differences in coastal habitat usage.

In summary, there is evidence for wider spread movement of bottlenose dolphins in Welsh waters, out of the SACs and therefore there is the potential for connectivity between the AyM site and bottlenose dolphin SACs. This needs to be considered within the HRA.

4.2 Site-specific surveys

No bottlenose dolphins were identified during the site-specific APEM aerial surveys. There were however sightings of unknown dolphin species which could not be identified to species level. The maximum density estimate for dolphin species within the Survey Area was 0.05 dolphins/km^2 (Table 9).

In addition to this, there were considerably more sightings of dolphins/porpoise in the data which could not be identified further to species level. The maximum density estimate for dolphin/porpoise within the Survey Area was 0.21 animals/km^2 (Table 9).

Table 9 Dolphin species and dolphin/porpoise sightings, abundance and density estimates across the AyM Survey Area.

Survey	Count	Abundance	Lower CI	Upper CI	Precision	Density (#/km^2)
Dolphin species						
Mar-19	1	8	1	34	1	0.01
Apr-19	0	0	0	0	-	-
May-19	0	0	0	0	-	-
Jun-19	0	0	0	0	-	-
Jul-19	0	0	0	0	-	-
Aug-19	0	0	0	0	-	-
Sep-19	0	0	0	0	-	-
Oct-19	0	0	0	0	-	-
Nov-19	0	0	0	0	-	-
Dec-19	0	0	0	0	-	-
Jan-20	0	0	0	0	-	-
Feb-20	3	30	3	81	0.58	0.05
Mar-20	0	0	0	0	-	-
Apr-20	0	0	0	0	-	-
May-20	0	0	0	0	-	-

Survey	Count	Abundance	Lower CI	Upper CI	Precision	Density (#/km^2)
Jun-20	0	0	0	0	-	-
Jul-20	0	0	0	0	-	-
Aug-20	0	0	0	0	-	-
Sep-20	0	0	0	0	-	-
Oct-20	0	0	0	0	-	-
Nov-20	0	0	0	0	-	-
Dec-20	0	0	0	0	-	-
Jan-21	3	26	3	69	0.57735	0.04
Feb-21	0	0	0	0	-	-
Dolphin/Porpoise						
Mar-19	5	42	5	101	0.45	0.07
Apr-19	4	40	10	81	0.5	0.06
May-19	13	131	61	222	0.28	0.21
Jun-19	0	0	0	0	-	-
Jul-19	3	26	3	61	0.58	0.04
Aug-19	3	27	3	73	0.58	0.04
Sep-19	0	0	0	0	-	-
Oct-19	0	0	0	0	-	-
Nov-19	0	0	0	0	-	-
Dec-19	1	9	1	26	1	0.01
Jan-20	1	10	1	30	1	0.02
Feb-20	13	131	40	252	0.28	0.21
Mar-20	5	43	9	85	0.44721	0.07
Apr-20	2	18	2	45	0.70711	0.03
May-20	2	17	2	42	0.70711	0.03
Jun-20	1	9	1	26	1	0.01
Jul-20	4	34	4	94	0.5	0.05
Aug-20	4	35	4	95	0.5	0.06
Sep-20	0	0	0	0	-	-
Oct-20	0	0	0	0	-	-
Nov-20	0	0	0	0	-	-
Dec-20	0	0	0	0	-	-

Survey	Count	Abundance	Lower CI	Upper CI	Precision	Density (#/km^2)
Jan-21	0	0	0	0	-	-
Feb-21	1	9	1	26	1	0.01

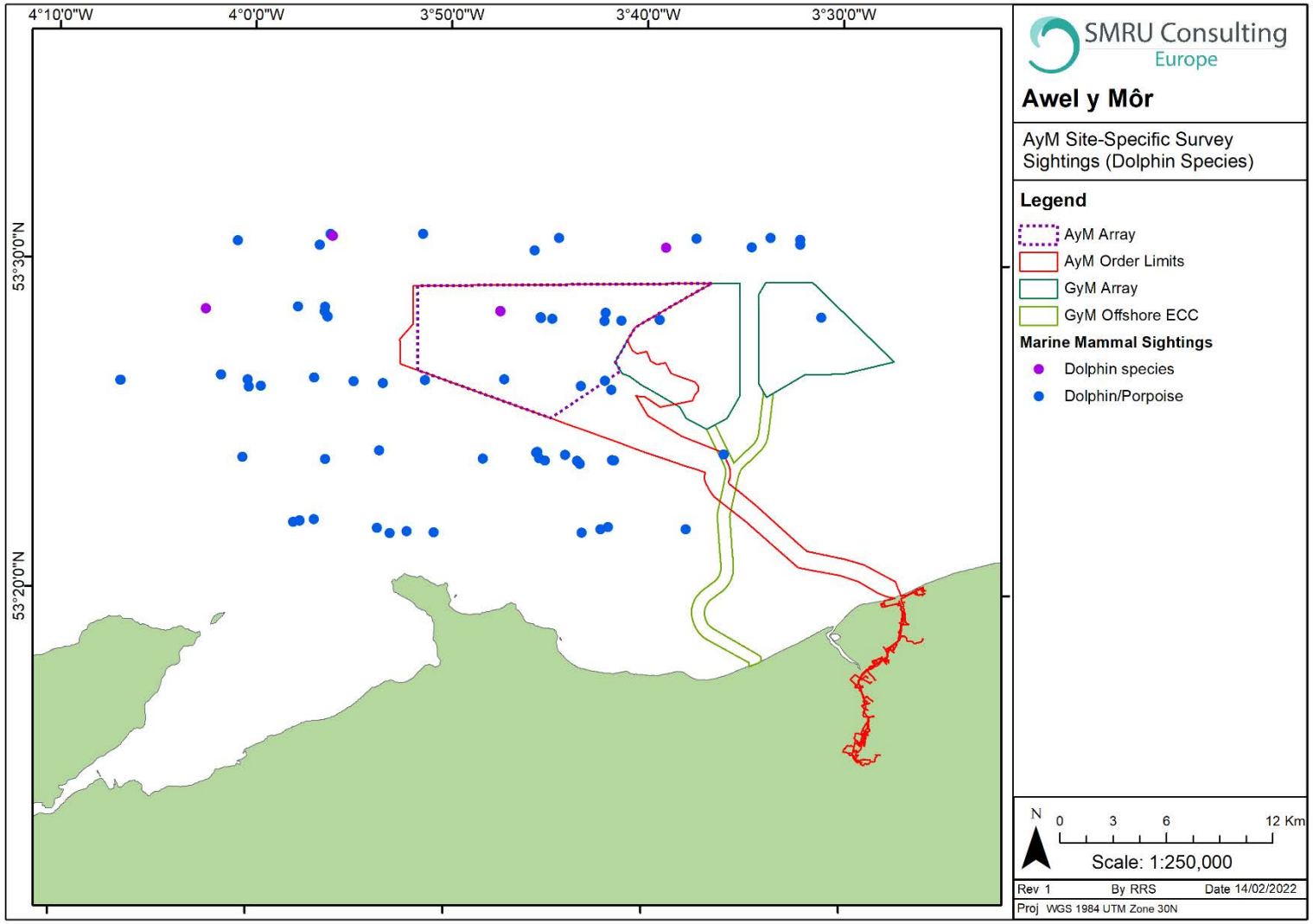

Figure 33 Dolphin species and "dolphin/porpoise" sightings during the 2 years of AyM site-specific surveys.

4.3 GyM surveys

During the GyM EIA between 2003-2005, no bottlenose dolphins were recorded in the windfarm area, however in the wider region two groups of ~ 20 bottlenose dolphins were sighted (CMACS Ltd 2011). During the baseline benthic surveys in September 2010, a group of ~15 bottlenose dolphins were sighted, and an aerial survey in January 2011 recorded the presence of a small cetacean that could not be identified. During the mitigation for windfarm construction, no confirmed sightings of bottlenose dolphins were recorded, but off-duty casual watches led to the detection of six bottlenose dolphin sightings. Between July 2016-March 2019, 17 post construction aerial surveys found 20 'dolphin/porpoise' images, but identification could not be confirmed. Between 2003-2019, nine confirmed groups of bottlenose dolphins were recorded in the windfarm region; however, due to issues with identification from these aerial surveys, this may not be representative.

4.4 Welsh Marine Atlas

The bottlenose dolphin distribution map clearly shows that the species is restricted to very coastal waters around Wales, with highest sightings rates in Cardigan Bay and north and east Anglesey (Figure 34 and Figure 35). The area of high sightings rates off east Anglesey is within the boundary of the AyM array area. While these data provide an overview of the general distribution of bottlenose dolphins in the Irish Sea, they do not provide density estimates.

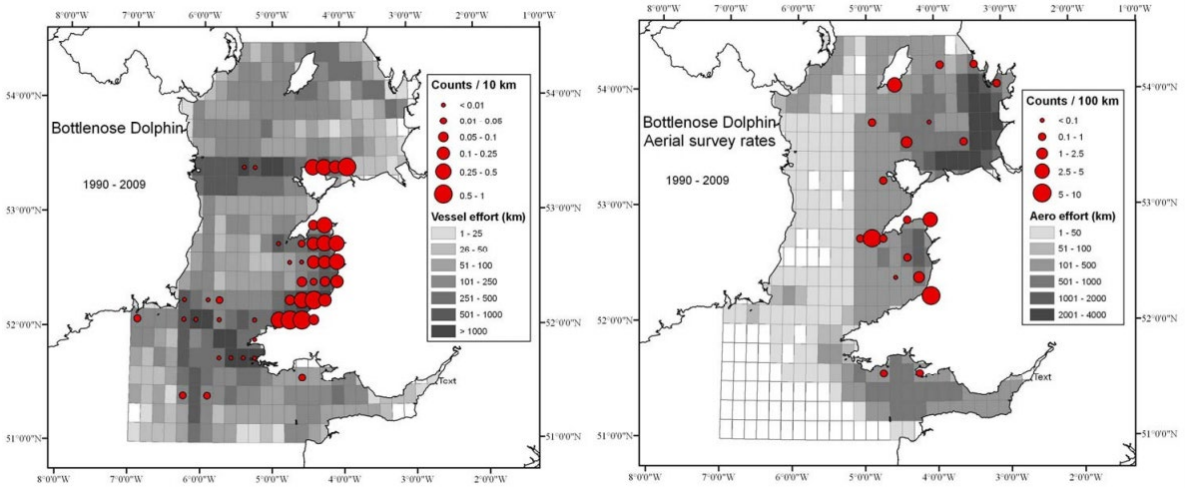

Figure 34 Long-term mean sightings rates for bottlenose dolphins in Wales. Left = vessel surveys, right = aerial surveys (Baines and Evans 2012).

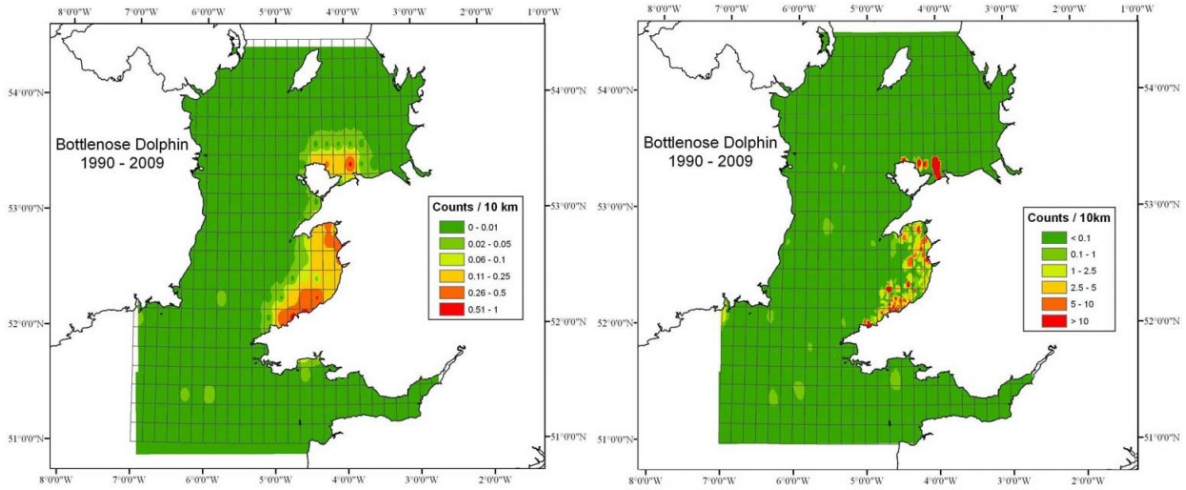

Figure 35 Bottlenose dolphin distribution in Wales. Left = IDW interpolation model and Right = Kriging interpolation model (Baines and Evans 2012)(Baines and Evans 2012).

4.5 SCANS

The Irish Sea was not included in the SCANS I surveys in 1994. The SCANS II survey of Block O (which included the AyM area) led to a density estimate of 0.0052 dolphins/km^2. During the SCANS III surveys, there were no estimates available for Block F as none were sighted (Figure 36), but in Block E the density of bottlenose dolphins was evaluated at 0.008 dolphins/km^2, comparable to the results from the SCANS II report (Table 10).

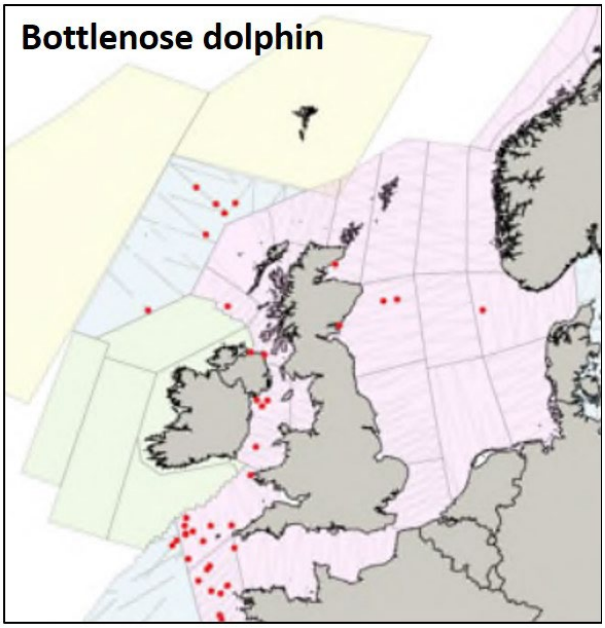

Figure 36 Sightings locations for bottlenose dolphins from the SCANS III survey (Hammond et al. 2017).

Table 10 Bottlenose dolphin density estimates from the SCANS surveys.

Survey	Year	Block	Area (km^2)	Effort (km)	Density (#/km^2)
SCANS III	2016	F (eastern Irish Sea)	12,322	619.8	0
SCANS III	2016	E (western Irish Sea)	34,870	2,252.7	0.008

Survey	Year	Block	Area (km^2)	Effort (km)	Density (#/km^2)
SCANS II	2005	O (entire Irish Sea)	45,417	2,264	0.0052

4.6 ObSERVE

Throughout the two-year survey period, bottlenose dolphins' sightings were lower in summer, as were group sizes. Despite our understanding that bottlenose dolphins from the waters surrounding Cardigan Bay have wide home ranges that extend into the Irish sea, only one group of five animals was observed in the Stratum 5 survey region (Figure 37). The SCANS III g(0)=0.414 estimate was used for bottlenose dolphins, resulting in density estimates up to 0.036 bottlenose dolphins/km^2 (Table 7). Given the distance of Stratum 5 from AyM these density estimates may not be representative of the density or group sizes that are present in the AyM region and are therefore not considered to be suitable to take forward for the quantitative impact assessment.

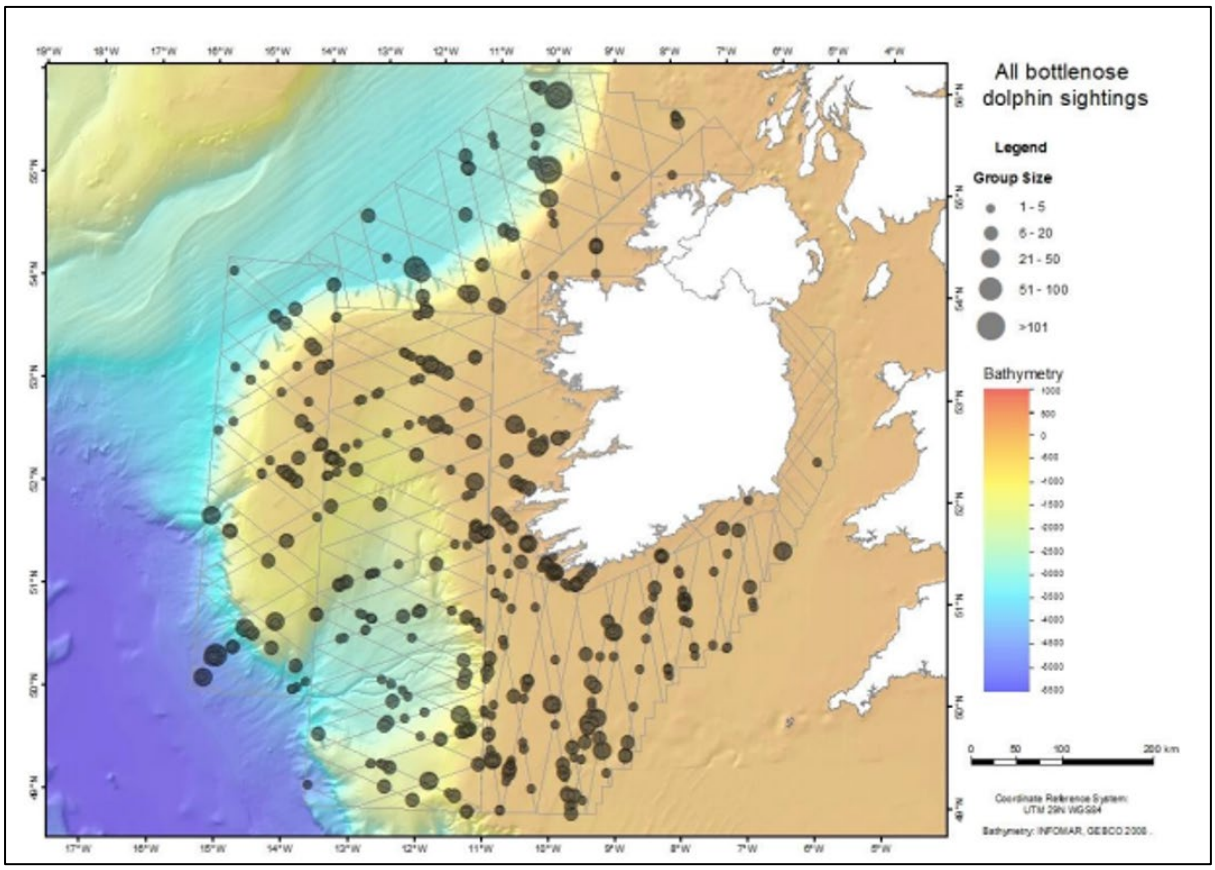

Figure 37 Sightings of bottlenose dolphins during the 2015-2016 ObSERVE surveys (Rogan et al. 2018).

Table 11 Corrected design and model-based estimates of density (#/km^2) for bottlenose dolphins obtained for the ObSERVE aerial surveys of Stratum 5 (Rogan et al. 2018).

		Bottlenose dolphin density (#/km^2)	
Survey	Effort (km)	Design based	Model based
Summer 2015	430	-	-
Winter 2015/16	463	-	-
Summer 2016	394	-	0.0106
Winter 2016/17	395	0.036	0.0201

4.7 Cardigan Bay

Sightings rates between 2014 and 2016 within the Cardigan Bay SAC ranged between 0.041 and 0.058 dolphins/km. Sightings rates between 2014 and 2016 within the northern Cardigan Bay area ranged between 0.017 – 0.025 dolphins/km, which is lower than the sightings rate within the SAC. The average sightings rates over the 2014-2016 study period across the wider Cardigan Bay area was 0.033 sightings/km (Lohrengel et al. 2018) (Figure 38).

Distance analysis of the line transect surveys within the Cardigan Bay SAC resulted in an abundance estimate of 84 dolphins in the SAC in 2016 (95% CI: 44-160) (Lohrengel et al. 2018). The Cardigan Bay SAC is 958.58 km^2 in size, therefore, assuming a uniform distribution within the SAC, the density estimate for the SAC is 0.088 dolphins/km^2 (95% CI: 0.046–0.167). Distance analysis of the line transect surveys within the wider Cardigan Bay area resulted in a population estimate of 174 dolphins in 2016 (95% CI: 150-246) (Lohrengel et al. 2018). The size of the wider Cardigan Bay area was reported to be 4,986.86 km^2 (Lohrengel et al. 2018), therefore, assuming a uniform density within the wider Cardigan Bay area, this results in a density estimate of 0.035 dolphins/km^2. The primary limitation of these data is that they did not extend into North Wales, and therefore did not cover the AyM area.

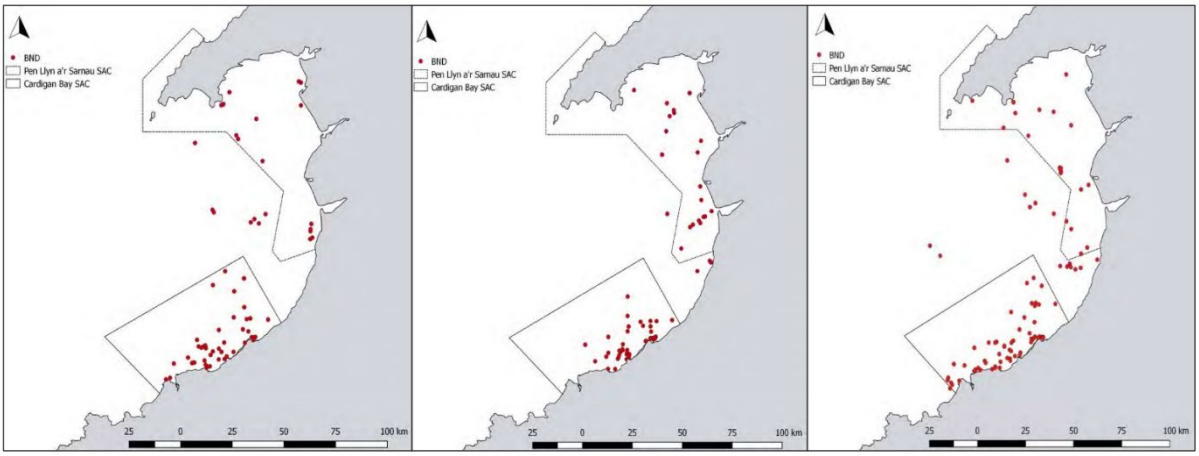

Figure 38 Bottlenose dolphin sightings in Cardigan Bay from line transect surveys conducted in 2014 (left), 2015 (middle), and 2016 (right). BND = bottlenose dolphin (Lohrengel et al. 2018).

4.8 North Wales

Previous surveys have recorded similar sighting rates of bottlenose dolphins within Cardigan Bay and in North Wales around the AyM site (Figure 34, Figure 35 and Figure 40) (Baines and Evans 2012, Evans et al. 2015). In addition, photo identification of bottlenose dolphins off Anglesey (Figure 40) has identified at least 75 individuals that have also previously been seen within the Cardigan Bay SAC (Feingold and Evans 2014), highlighting how the bottlenose dolphin's range and distribution extends to North Wales, Liverpool Bay and north at least to the Isle of Man (Pesante et al. 2008). A large proportion of the Cardigan Bay population spend the winter in waters off North Wales, whilst smaller numbers can be seen in this area throughout the year (Pesante et al. 2008). This northward migration was thought to occur mainly in the winter months, however more recent studies in June and July since 2008 confirm sightings and a shift in usage of dolphins in the region to regularly used areas around the Isle of Anglesey and Liverpool Bay during the summer months (Feingold and Evans 2014, Duckett 2018), though many of these individuals (61%) had only ever been recorded off North Anglesey and never in Cardigan Bay (Veneruso and Evans 2012). Photo-ID studies between 2001 and 2016 have shown that 77.3% of the marked dolphins sighted in the wider Cardigan Bay area have also been sighted in North Wales (for example, Figure 41 provides sightings histories for eight

individuals), indicating that most of the population has a large home range which extends beyond Cardigan Bay (Lohrengel et al. 2018).

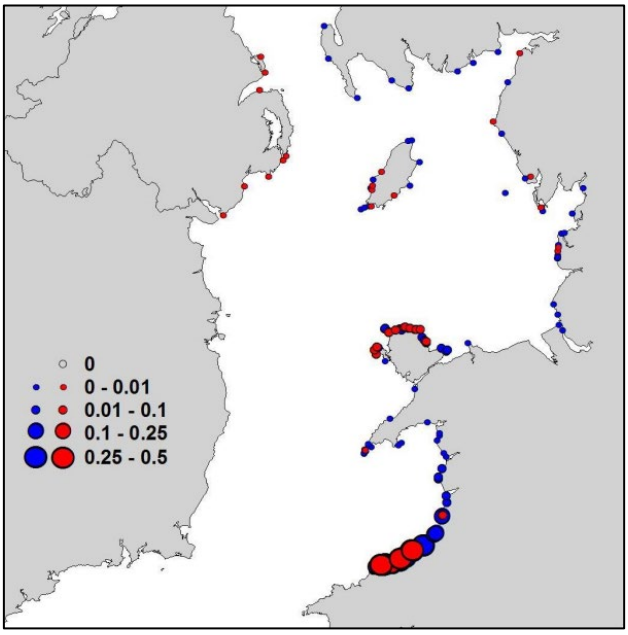

Figure 39 Map of GAM (by site number) predicted likelihood of occurrence for bottlenose dolphin Irish Sea management unit, 1994-2014 (red symbols = sites with >100 mins effort for 3+ years; blue symbols = remaining sites) (Evans et al. 2015).

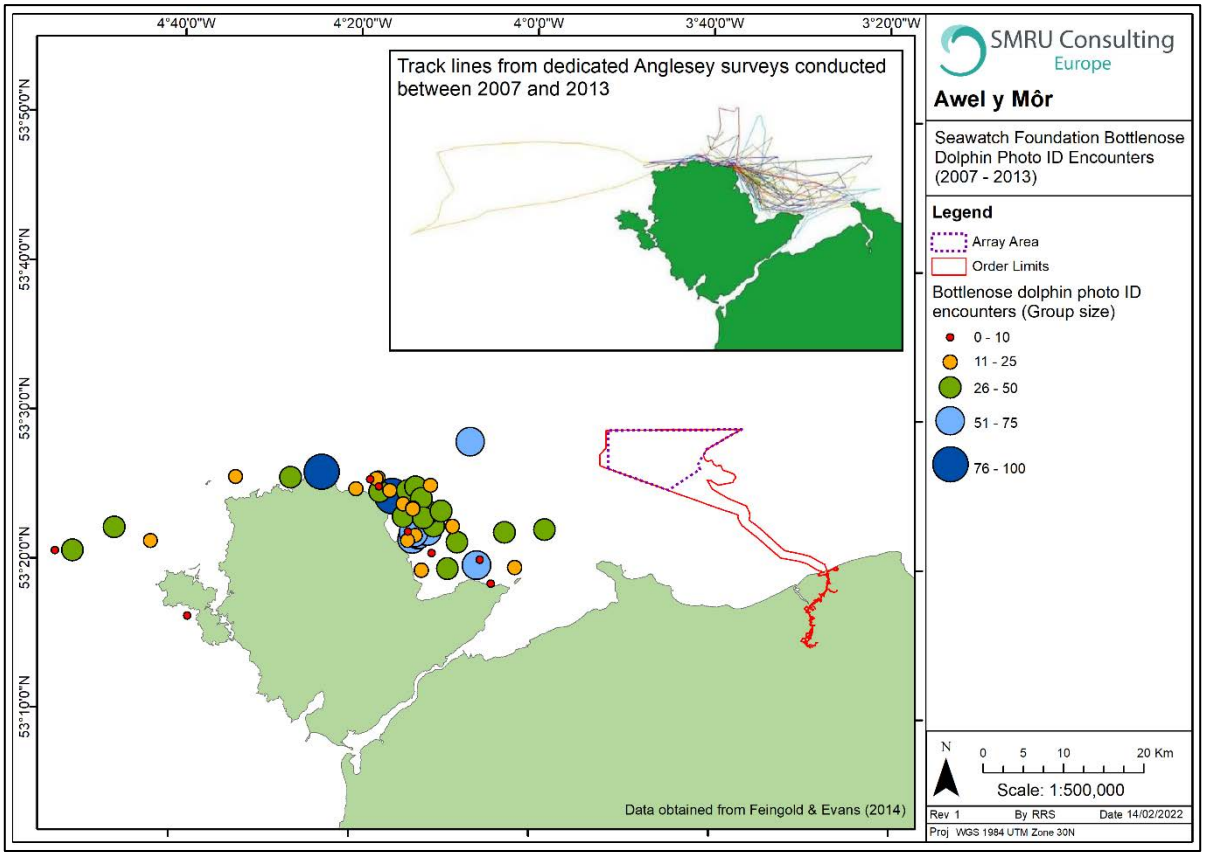

Figure 40 Bottlenose dolphin sightings recorded during photo-ID surveys around Anglesey. Data obtained from Feingold and Evans (2014).

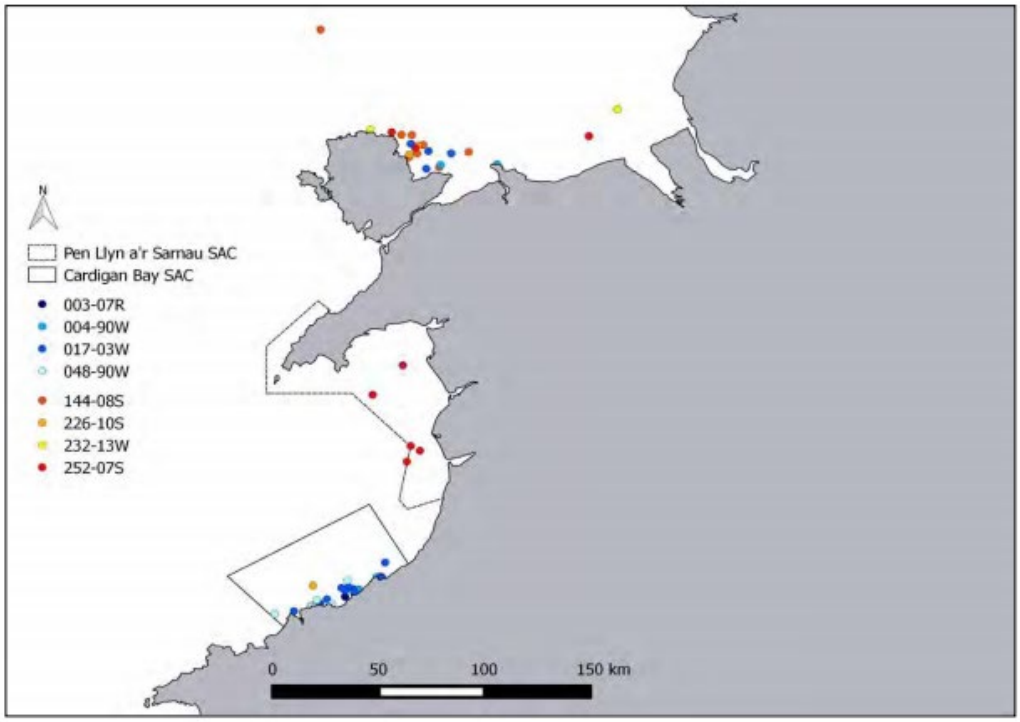

Figure 41 Individual sightings histories of eight bottlenose dolphins from 2001 to 2016 (Lohrengel et al. 2018).

4.9 Sea Watch Foundation - North Wales

Bottlenose dolphins have been recorded by the Sea Watch Foundation throughout the coastal waters of North Wales (Figure 42 and Figure 43), with sightings recorded year-round (peak in sightings between October and April) (Evans et al. 2021). In total, bottlenose dolphin sightings made up 18% of the records and 41% of the individuals in the Sea Watch Foundation database for the coastal North Wales area. The overall densities of bottlenose dolphins in the coastal waters of North Wales were estimated to vary between ~0.005-0.010 dolphins/km^2 with densities being slightly higher off north Anglesey (Evans et al. 2021). These densities are much lower than the predicted densities for the coastal areas of Cardigan Bay where densities were predicted to be ~0.025-0.050 dolphins/km^2.

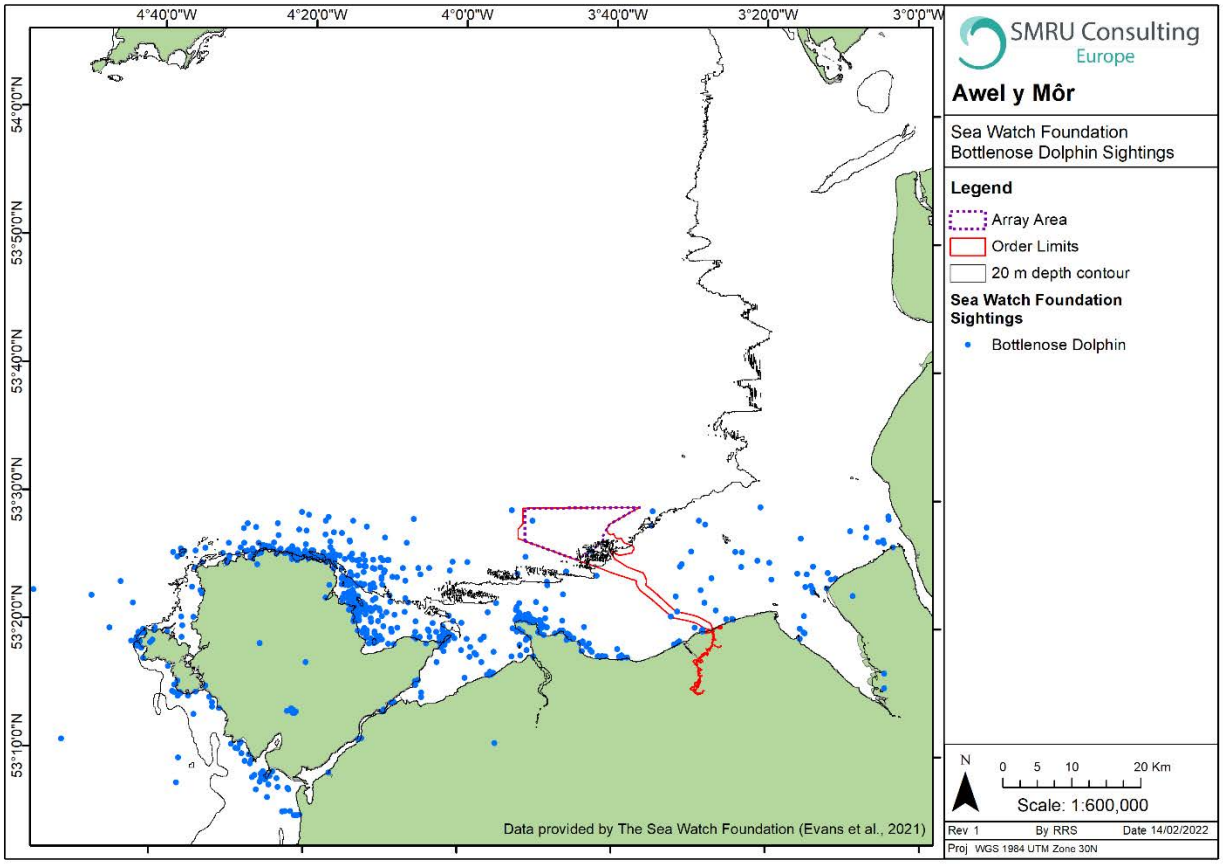

Figure 42 Bottlenose dolphin sightings in coastal waters of North Wales. Data provided by the Sea Watch Foundation (Evans et al. 2021).

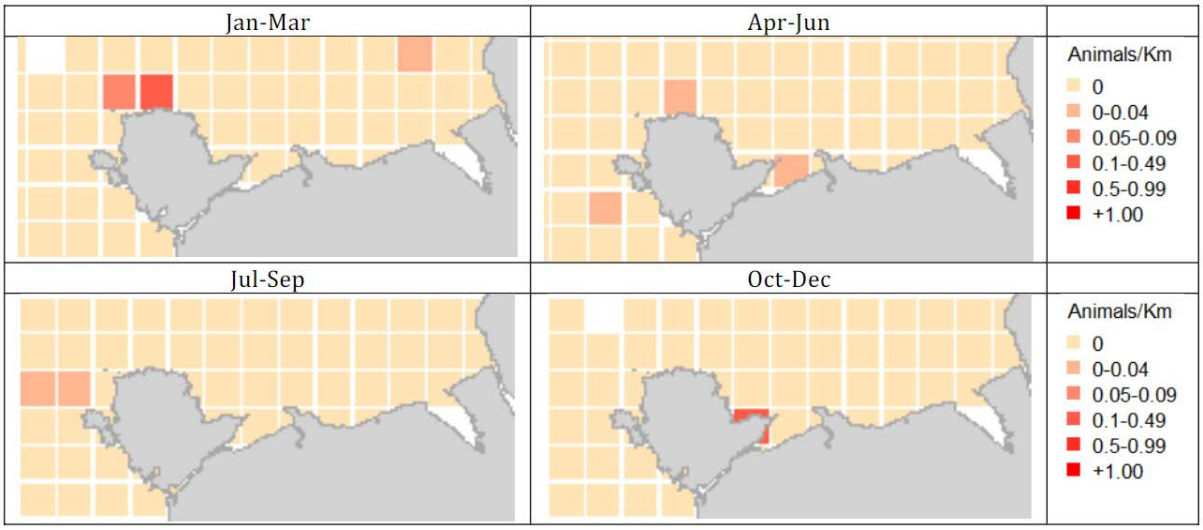

Figure 43 Distribution of bottlenose dolphins corrected for survey effort in coastal North Wales. Provided by the Sea Watch Foundation (Evans et al. 2021).

4.10 COFNOD

A total of 38 bottlenose dolphin sightings were obtained from the COFNOD database for the specified area of search. These sightings were located coastally across north Wales (Figure 44). No

effort data were provided and as such these data confirm species presence but cannot be used to estimate density.

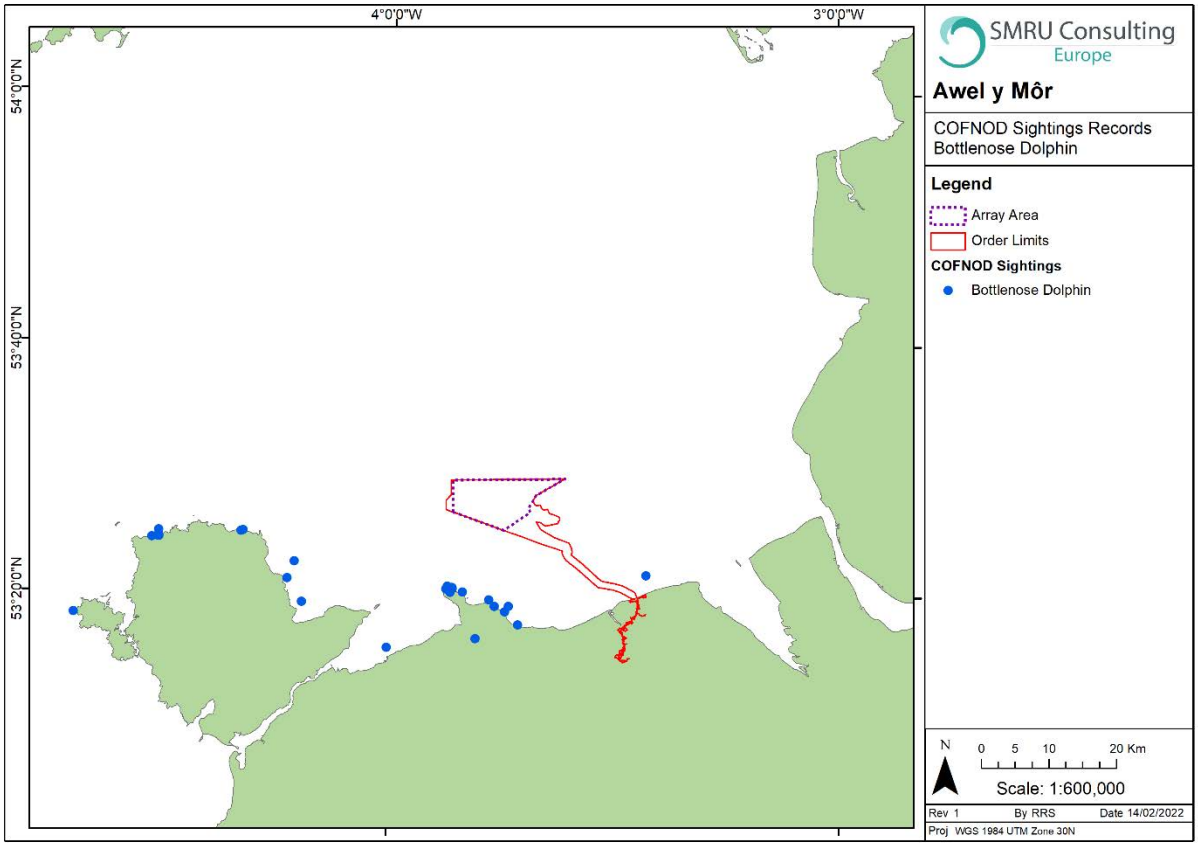

Figure 44 Sightings of bottlenose dolphins in the north Wales area – provided by COFNOD.

4.11 MWDW sightings

Bottlenose dolphins have been reported throughout Manx territorial waters (Figure 45), with sightings of bottlenose dolphins comprising of 0.2% of boat-based sightings, 2.2% of land-based sightings and 8.5% of opportunistic sightings between 2007 and 2014 (Felce 2014). No bottlenose dolphins were recorded in most recent 2018 boat-based and land-based surveys, but 29 opportunistic sightings of the species were reported to MWDW, comprising 5.8% of opportunistic sightings (Clark et al. 2019). They are sighted most frequently in the winter months between November and February (60%) and most of the individuals photographed for the ID catalogue have also been photographed in Cardigan Bay.

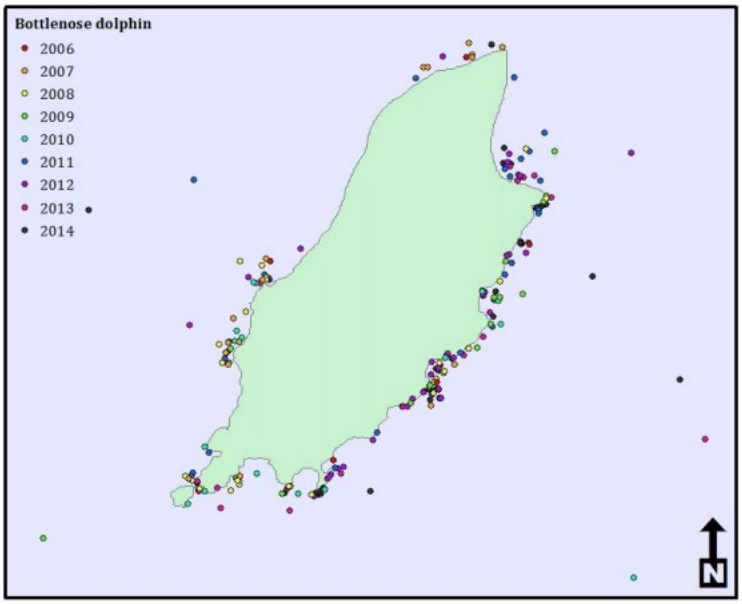

Figure 45 Sightings of bottlenose dolphins in Manx waters between 2006 and 2014 (Howe 2018).

4.12 Summary

Density estimates for bottlenose dolphins in the Irish Sea range between 0.008 and 0.088 dolphins/km^2 (Table 12). The problem with using large scale survey density estimates for bottlenose dolphins is that a uniform density surface across a survey block such as SCANS II or III does not take into consideration the habitat preference of coastal bottlenose dolphins in the UK, which are largely restricted to coastal waters (Quick et al. 2014). Therefore, a block wide uniform density estimate is unsuitable for this species and will not be reflective of the true expected distribution and resulting predicted impact numbers.

Given the evidence of large home ranges in the dolphin distribution, it is fair to assume that density estimates in North Wales may be similar to those in the wider Cardigan Bay area, as presented in Lohrengel et al. (2018). NRW advised in their s42 comments that the density surface for bottlenose dolphins is divided into two: inshore and offshore. For the inshore density, NRW recommend that use of the wider Cardigan Bay density estimate (0.035 dolphins/km^2) within the 20 m depth contour. For the more offshore waters beyond the 20 m depth contour, NRW recommends that the closest SCANS III density estimate is used (0.008 dolphins/km^2) (Figure 46). It is worth noting that the Sea Watch Foundation density estimates for the coastal waters of north Wales (0.005-0.010 dolphins/km^2) were lower than the selected Lohrengel et al. (2018) density estimate for the wider Cardigan Bay (0.035 dolphins/km^2).

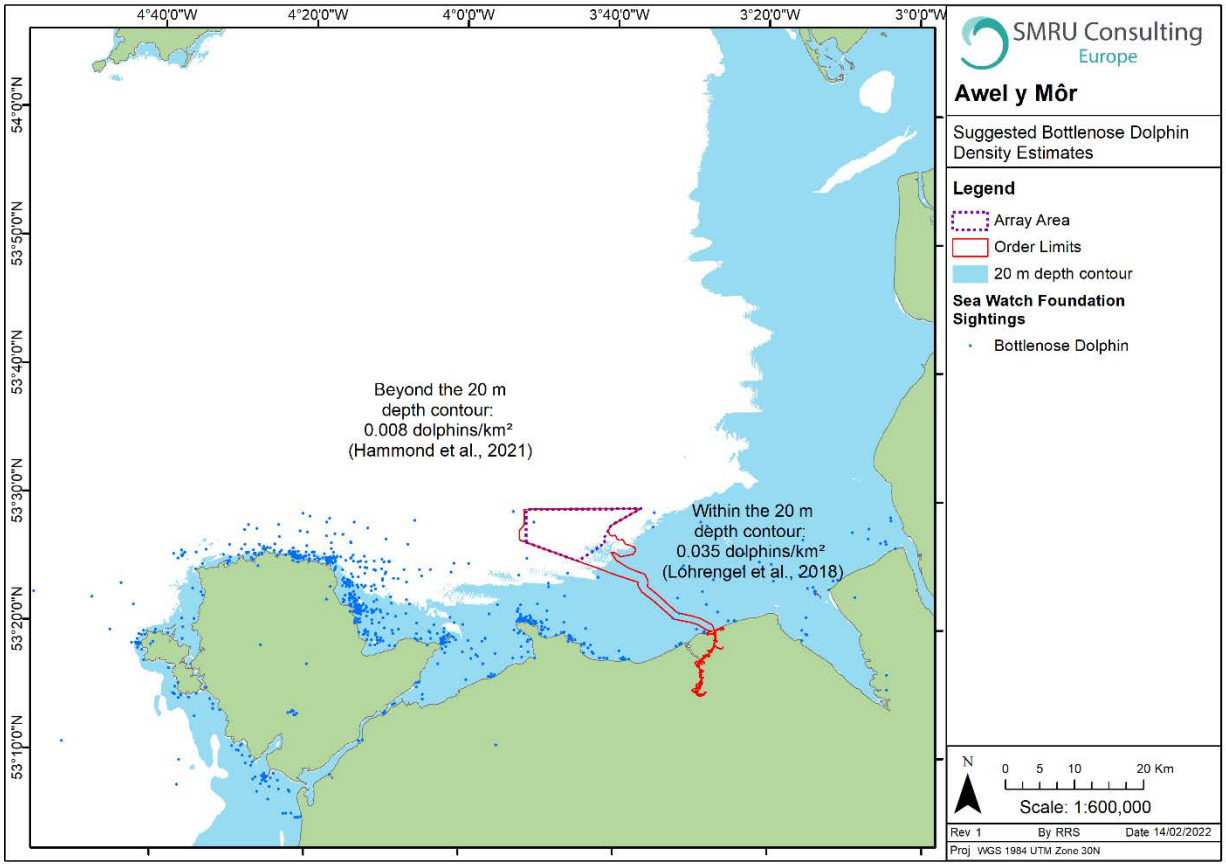

Figure 46 Suggested bottlenose dolphin density estimates to take forward to the quantitative impact assessment.

Table 12 Bottlenose dolphin density estimates.

Source	Area	Temporal	Density Estimate (#/km²)	Approx. distance to AyM
AyM site specific surveys	AyM	Year round 2019-2021	None	Includes site
GyM surveys	GyM	Various between 2003-2019	None provided	Adjacent to site
Sea Watch Foundation	Coastal North Wales	Since 1990	~0.005-0.010	Includes site
SCANS III (Block F)	Eastern Irish Sea	Summer 2016	0	Includes site
SCANS III (Block E)	**Western Irish Sea**	**Summer 2016**	**0.008**	**11+ km**
SCANS II (Block O)	Irish Sea	Summer 2005	0.0052	Includes site
ObSERVE (Stratum 5, design-based est.)	Western Irish Sea	Winter 2016/17	0.036	100 km
ObSERVE (Stratum 5,	Western Irish Sea	Winter 2016/17	0.0201	100 km

model based est)				
ObSERVE (Stratum 5, model-based est.)	Western Irish Sea	Summer 2016	0.0106	100 km
Lohrengel et al. (2018)	**Wider Cardigan Bay**	**2014-2016**	**0.035**	**100 km**
Lohrengel et al. (2018)	Cardigan Bay SAC	2014-2016	0.088	>150 km

5 Risso's dolphin

Risso's dolphins are found to be distributed sporadically in UK waters, with individuals commonly recorded around the Hebrides, and seasonally in the Celtic and Irish Seas. A single MU is implemented for Risso's dolphins in UK waters, labelled the 'Celtic and Greater North Seas' MU. The current abundance estimate for this MU is 12,262 (95% CI: 5,227 – 28,764, CV: 0.46) (estimated using data from SCANS III and ObSERVE) (IAMMWG 2021). Previously, there was no abundance estimates for this species due to the low numbers of Risso's sightings (IAMMWG 2015): this figure represents the first Risso's dolphin abundance estimate in the Celtic and Greater North Seas MU. There are currently no SACs designated for Risso's dolphins in UK waters, and in 2018 they were updated from Data Deficient to Least Concern on the IUCN red list.

5.1 Site-specific surveys

No Risso's dolphins were identified during the site-specific APEM aerial surveys. There were however sightings of unknown dolphin species which could not be identified to species level. The maximum density estimate for dolphin species within the Survey Area was 0.05 dolphins/km^2 (Table 9).

In addition to this, there were considerably more sightings of dolphins/porpoise which could not be identified further to species level. The maximum density estimate for dolphin/porpoise within the Survey Area was 0.21 animals/km^2 (Table 9).

5.2 GyM surveys

No confirmed sightings of Risso's dolphins were sighted during the GyM EIA surveys, baseline monitoring, construction monitoring or post-construction surveys. In July of 2010, a potential small cetacean was recorded but not identified. During the windfarm construction mitigation, an unidentified dolphin group was observed, but could not be further classified. The 20 images of 'dolphin/porpoise' collected during the aerial surveys between 2016-2019 could have included Risso's dolphins, but this cannot be verified.

5.3 Welsh Marine Atlas

The distribution of Risso's dolphins in the Irish Sea is patchy, with generally low sightings rates throughout. There are a few areas where sightings rates are higher, including north Anglesey, off Bardsey Island, north Pembrokeshire and southeast Ireland (Figure 47). Sightings rates are low in the vicinity of the AyM project. While these data provide an overview of the general distribution of Risso's dolphins in the Irish Sea, they do not provide density estimates.

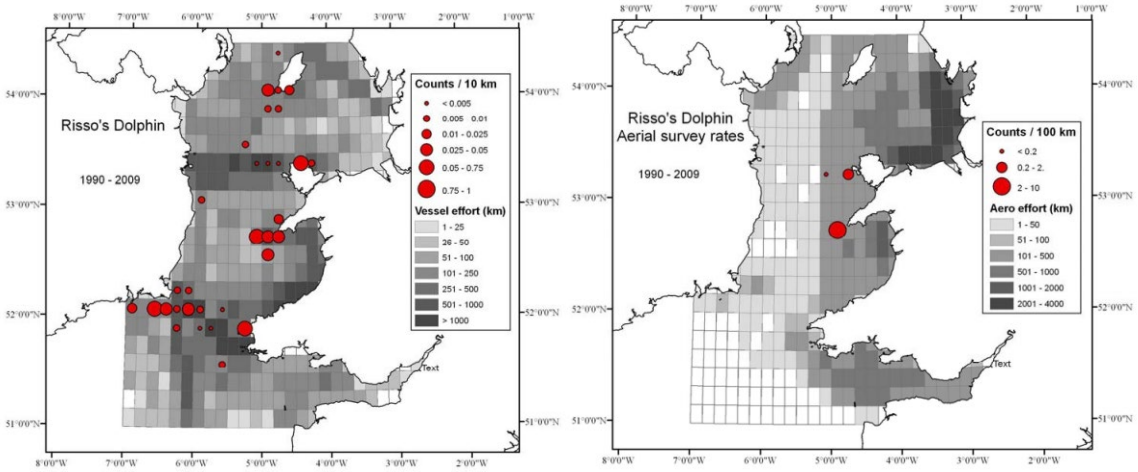

Figure 47 Long-term mean sightings rates for harbour porpoise in Wales. Left = vessel surveys, right = aerial surveys (Baines and Evans 2012).

5.4 Sea Watch Foundation - North Wales

Risso's dolphin distribution in Wales forms a wide band encompassing west Pembrokeshire, the western end of the Llŷn Peninsula and Anglesey in Wales, the south-east coast of Ireland in the west, and waters around the Isle of Man in the north (Evans et al. 2021). Within the coastal waters of North Wales, they have primarily been recorded north and west of Anglesey (Figure 48 and Figure 49). In total, Risso's dolphin sightings made up 8% of the records and 9% of the individuals in the Sea Watch Foundation database for the coastal North Wales area. They have been sighted between April and December, but acoustic monitoring in the Holyhead Deeps west of Anglesey indicates that the species is present offshore all year round (G. Veneruso, pers. comm. - referenced within Evans et al. 2021). The overall densities of Risso's dolphins in the coastal waters of North Wales were estimated to be ~0.02 dolphins/km^2 from January to June, with densities peaking at ~0.05 dolphins/km^2 west of Anglesey between July and September (Evans et al. 2021).

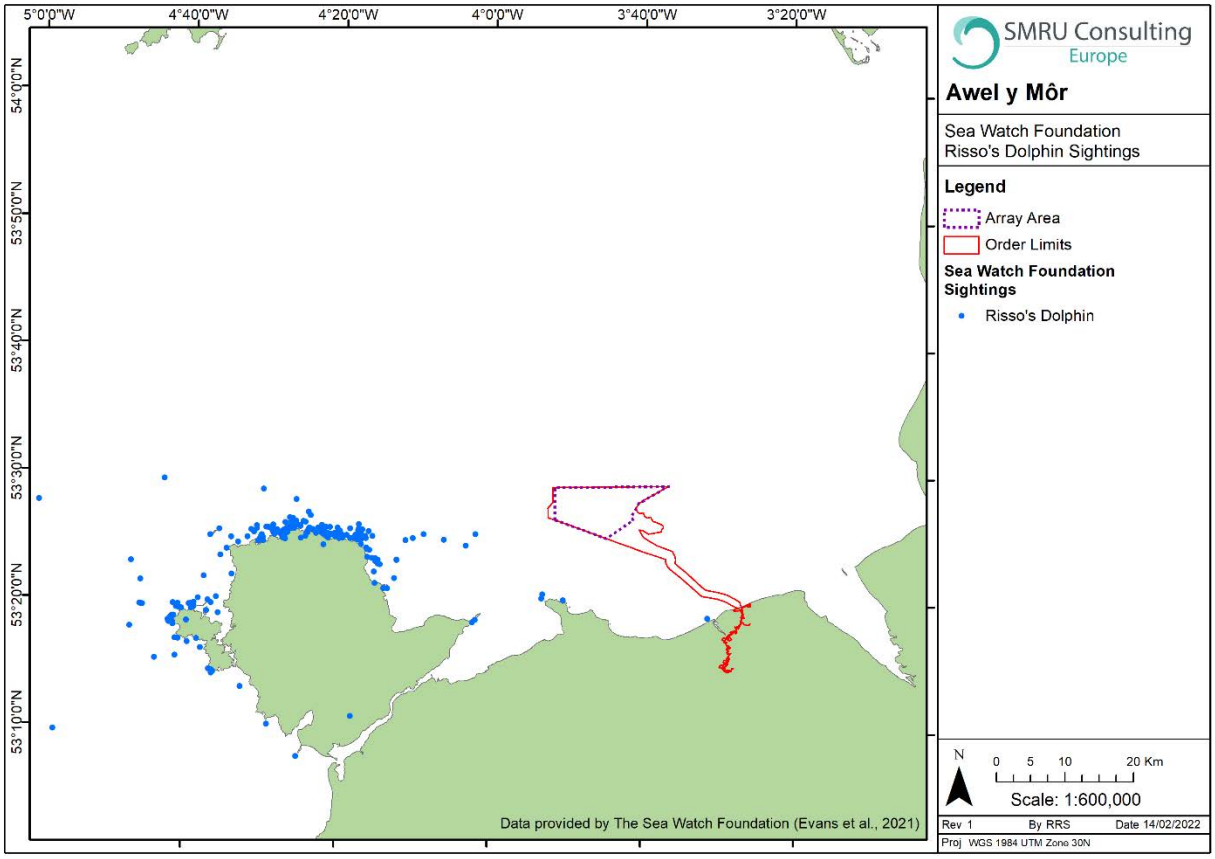

Figure 48 Risso's dolphin sightings in coastal waters of North Wales. Data provided by the Sea Watch Foundation (Evans et al. 2021).

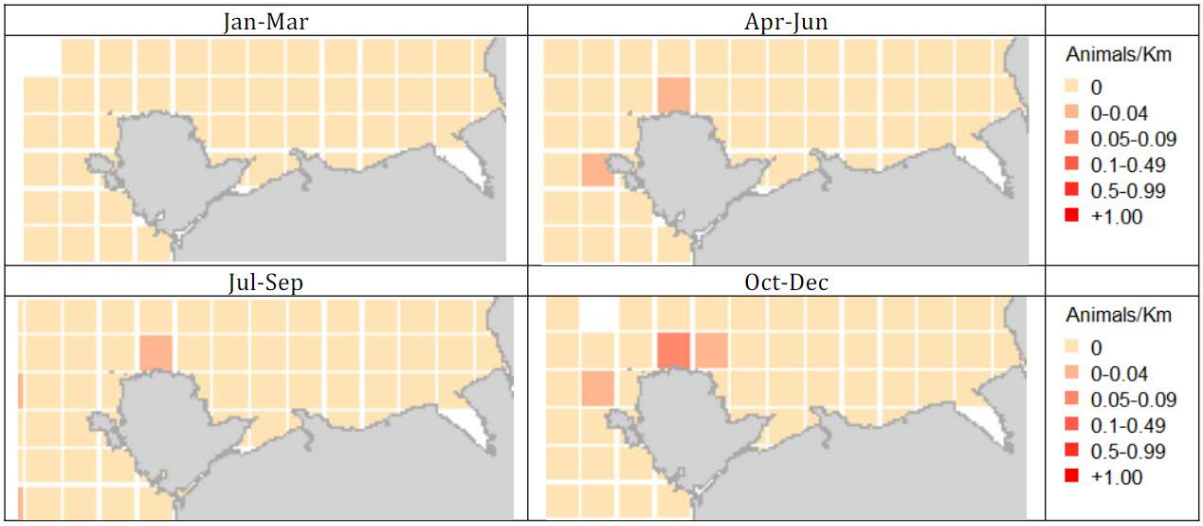

Figure 49 Distribution of Risso's dolphins corrected for survey effort in coastal North Wales. Provided by the Sea Watch Foundation (Evans et al. 2021).

5.5 COFNOD

A total of nine Risso's dolphin sightings were obtained from the COFNOD database for the specified area of search. These sightings were all located around Anglesey (Figure 50). No effort data were provided and as such these data confirm species presence but cannot be used to estimate density.

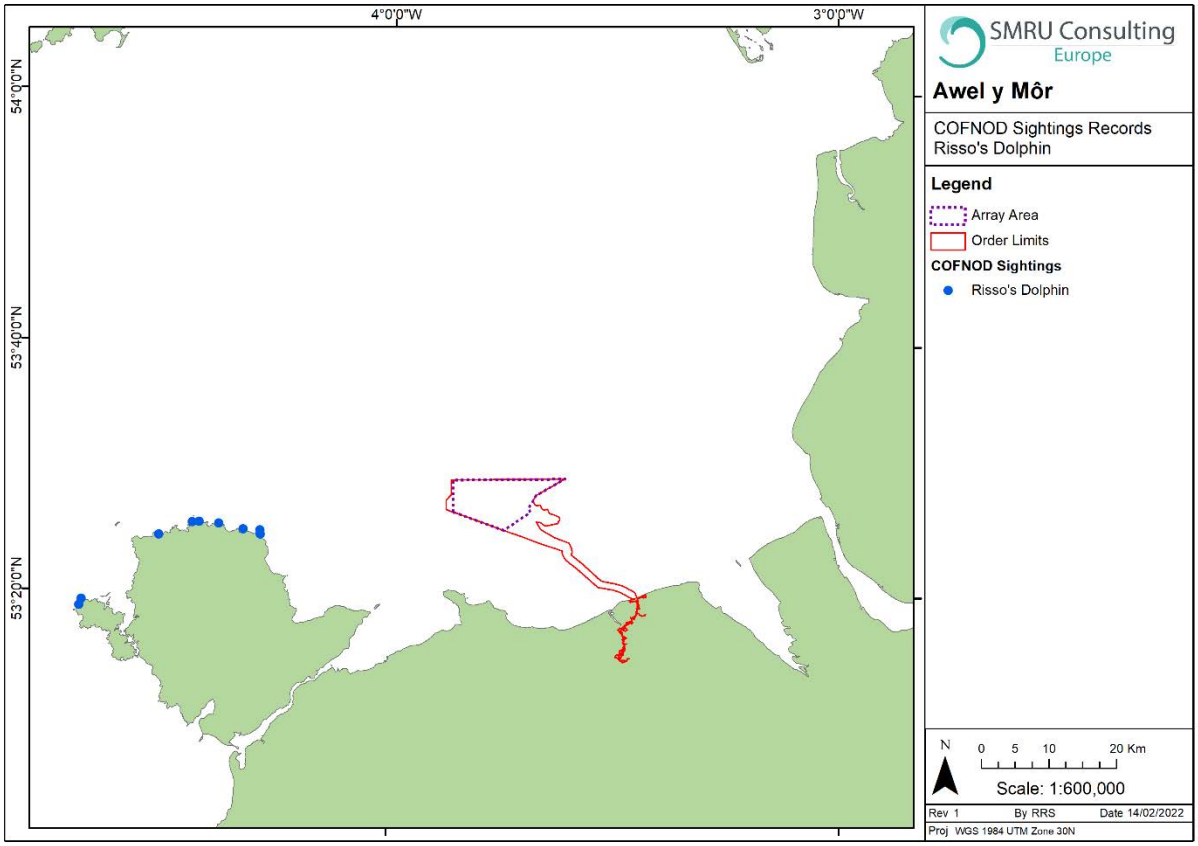

Figure 50 Sightings of Risso's dolphins in the north Wales area – provided by COFNOD.

5.6 SCANS

The Irish Sea was not included in the SCANS I surveys in 1994 (Hammond et al. 2002), and in SCANS II survey no Risso's dolphins were sighted in Block O (Hammond et al. 2006). The SCANS III surveys were unable to estimate density for the Block F that included AyM as no animals were sighted (Figure 51). However, the density of Risso's dolphins was computed for the adjacent Block E at 0.031 animals/km^2, where the actual Risso's dolphin sightings were located near the centre of the Irish Sea (Table 13) (Hammond et al. 2017, Hammond et al. 2021).

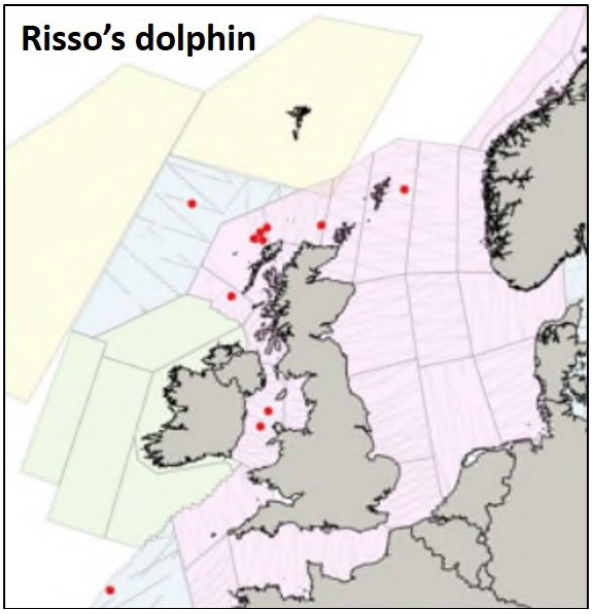

Figure 51 Sightings locations for Risso's dolphins from the SCANS III survey (Hammond et al. 2017).

Table 13 Risso's dolphin density estimates from SCANS surveys.

Survey	Year	Block	Area (km^2)	Effort (km)	Density (#/km^2)
SCANS III	2016	F (eastern Irish Sea)	12,322	619.8	0
SCANS III	2016	E (western Irish Sea)	34,870	2,252.7	0.031
SCANS II	2005	O (entire Irish Sea)	45,417	2,264	0

5.7 ObSERVE

Risso's dolphins were most frequently observed during the summer of 2016 and, in general, more animals were seen offshore in deeper waters. Only one individual was recorded in the Stratum 5 area, in the summer of 2015. The SCANS II g(0)=0.414 estimate was also used for Risso's dolphins, resulting in density estimates up to 0.0032 Risso's dolphins/km^2 (Table 14).

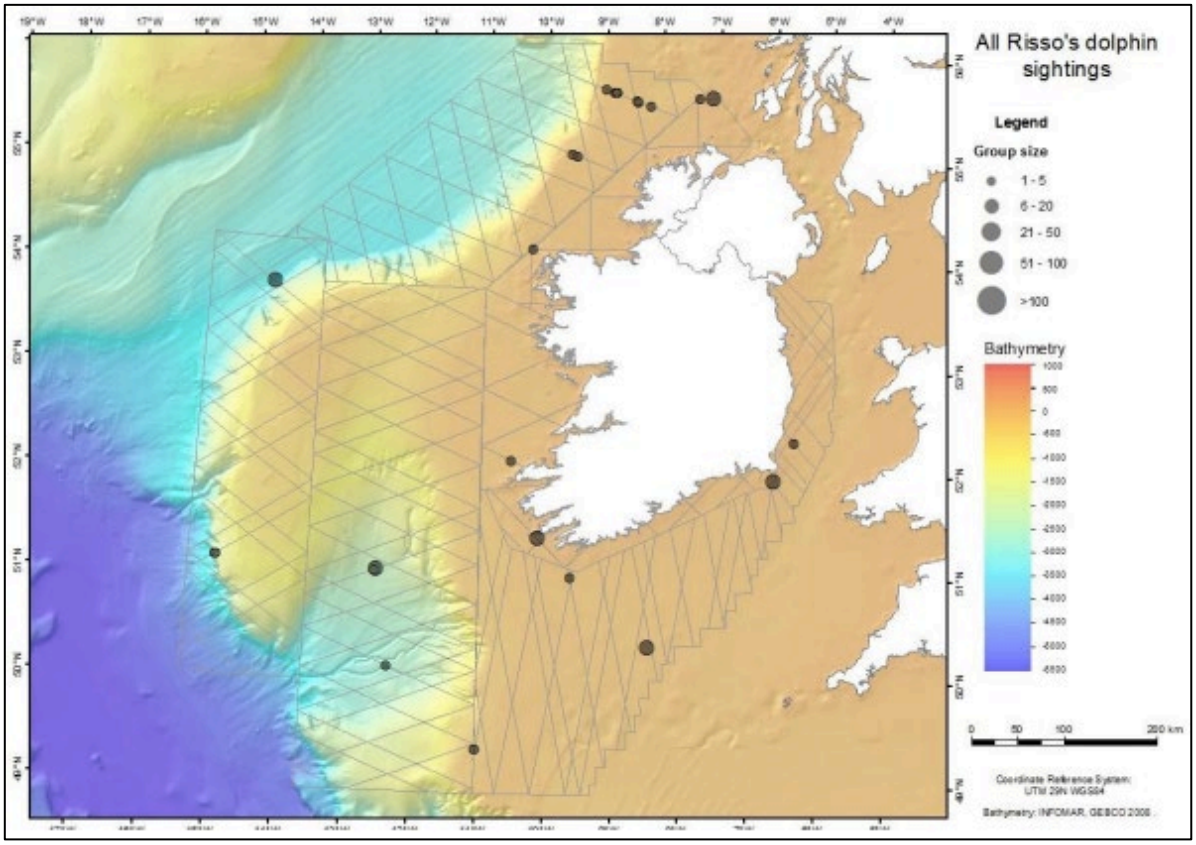

Figure 52 Sightings of Risso's dolphins from the ObSERVE surveys conducted between 2015-2016 (Rogan et al. 2018).

Table 14 Corrected design and model-based estimates of density (#/km^2) for Risso's dolphins obtained for the ObSERVE aerial surveys of Stratum 5 (Rogan et al. 2018).

		Risso's dolphin density (#/km^2)	
Survey	**Effort (km)**	**Design based**	**Model based**
Summer 2015	430	0.0032	-
Winter 2015/16	463	-	-
Summer 2016	394	-	-
Winter 2016/17	395	-	-

5.8 Morlais surveys

The Natural Power surveys for Morlais conducted between Nov 2016 and Oct 2018 recorded Risso's dolphin on three surveys (Sept 2017, May 2018 and Oct 2018), with group sizes between 8-20 dolphins. In addition, the SEACAMS surveys recorded four sightings of Risso's dolphins (Royal Haskoning DHV 2019). While these sightings confirm the presence of Risso's dolphins in the Anglesey area, they were not able to provide a density estimate.

5.9 MWDW sightings

Risso's dolphins are the most commonly seen dolphin species in Manx territorial waters, comprising 6.5% of sightings from boat surveys, 13.2% from land-based surveys and 18.5% of opportunistic sightings between 2007-2014 (Felce 2014) and 7.9% of sightings from boat surveys, 18.7% from land-based surveys and 30.4% of opportunistic sightings (Clark et al. 2019). Risso's dolphins are

highly seasonal, with almost all sightings reported between March and September, located primarily on the east and southern coasts of Manx waters (Figure 53) (Howe 2018).

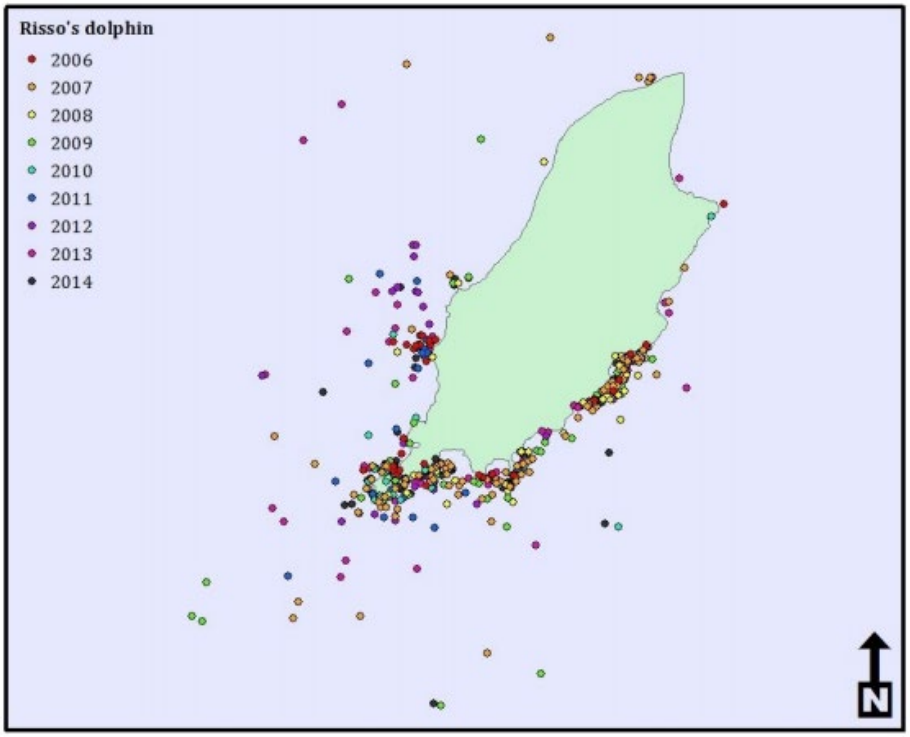

Figure 53 All sightings of Risso's dolphins in Manx waters 2006-2014 (Howe 2018).

5.10 Summary

There are no local density estimates for Risso's dolphins that could be found in the grey or published literature. The SCANS III and the ObSERVE estimates for the western Irish Sea are the only datasets available (Table 15), however neither estimate can be assumed to be representative of Risso's dolphin density in the Project Area. It should be noted, however, that given the apparent rarity of the species in the vicinity of the AyM site, it is not expected that encounters of Risso's dolphins would ever be high enough to calculate a reliable density estimate or provide a density surface for this species from any survey methodology. In the absence of any site-specific density estimate, and evidence that Risso's dolphins are present in North Wales from Sea Watch Foundation and Morlais survey sightings, it is considered to be precautionary to include this species quantitatively in the impact assessment. The best density estimate to take forward to assessment is that for SCANS III Block E (0.031 dolphins/km^2) since the Risso's dolphins sighted in this block were near the centre of the Irish Sea. NRW agreed with this approach in the s42 comments.

Table 15 Risso's dolphin density estimates.

Source	Area	Temporal	Density Estimate (#/km^2)
AyM site specific surveys	AyM	Year round 2019-2021	0
GyM surveys	GyM	Various between 2003-2019	0
Sea Watch Foundation	Coastal North Wales	Since 1990	~0.02-0.05

Source	Area	Temporal	Density Estimate (#/km^2)
SCANS III (Block F)	Eastern Irish Sea	Summer 2016	0
SCANS III (Block E)	**Western Irish Sea**	**Summer 2016**	**0.031**
SCANS II (Block O)	Irish Sea	Summer 2005	0
ObSERVE (Stratum 5, design based est)	Western Irish Sea	Summer 2015	0.0032

6 Common dolphin

Common dolphins most frequently occur in the Celtic Sea within UK waters, although the species are also recorded in the North Sea. A single MU has been implemented for common dolphins in the UK, titled the 'Celtic and Greater North Seas' MU, with an abundance estimate of 102,656 (CV=0.29; 95% CI=58,932 – 178,822) (estimated using data from SCANS III and ObSERVE) (IAMMWG 2021). This is a significant increase in abundance, being almost double the previous estimate of 56,556 (CV=0.28; 95% CI=33,014 – 96,920) (IAMMWG 2015). Common dolphins are listed as Least Concern on the IUCN red list and have no designated SACs in UK waters.

6.1 Site-specific surveys

No common dolphins were identified during the site-specific APEM aerial surveys. There were however sightings of unknown dolphin species which could not be identified to species level. The maximum density estimate for dolphin species within the Survey Area was 0.05 dolphins/km^2 (Table 9).

In addition to this, there were considerably more sightings of dolphins/porpoise which could not be identified further to species level. The maximum density estimate for dolphin/porpoise within the Survey Area was 0.21 animals/km^2 (Table 9).

6.2 GyM surveys

No confirmed observations of common dolphins were recorded during the EIA surveys, baseline monitoring, construction monitoring or post-construction surveys in the GyM windfarm site. However, during the initial EIA, two groups of short-beaked common dolphins were recorded in the wider study area, with group sizes between 12-200. In July of 2010, a potential small cetacean was recorded but not identified. The 20 images of 'dolphin/porpoise' collected during the aerial surveys between 2016-2019 could have included common dolphins.

6.3 Welsh Marine Atlas

Common dolphins are primarily distributed in the south west of the Irish Sea, in the Celtic Deep, offshore of Pembrokeshire, with very low sightings rates elsewhere (Figure 54 and Figure 55). In the vicinity of the AyM Project sightings rate are low.

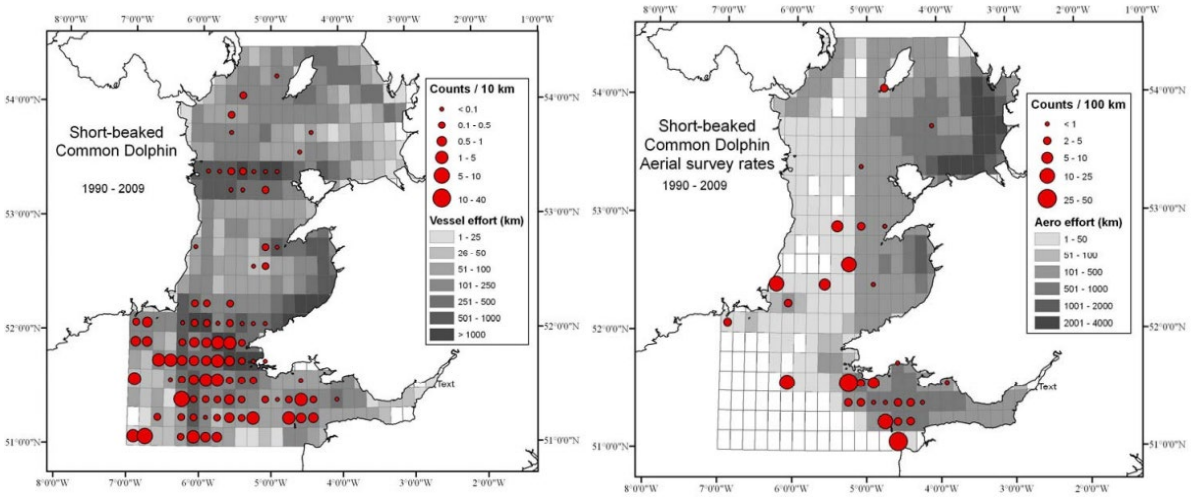

Figure 54 Long-term mean sightings rates for common dolphins in Wales. Left = vessel surveys, right = aerial surveys (Baines and Evans 2012).

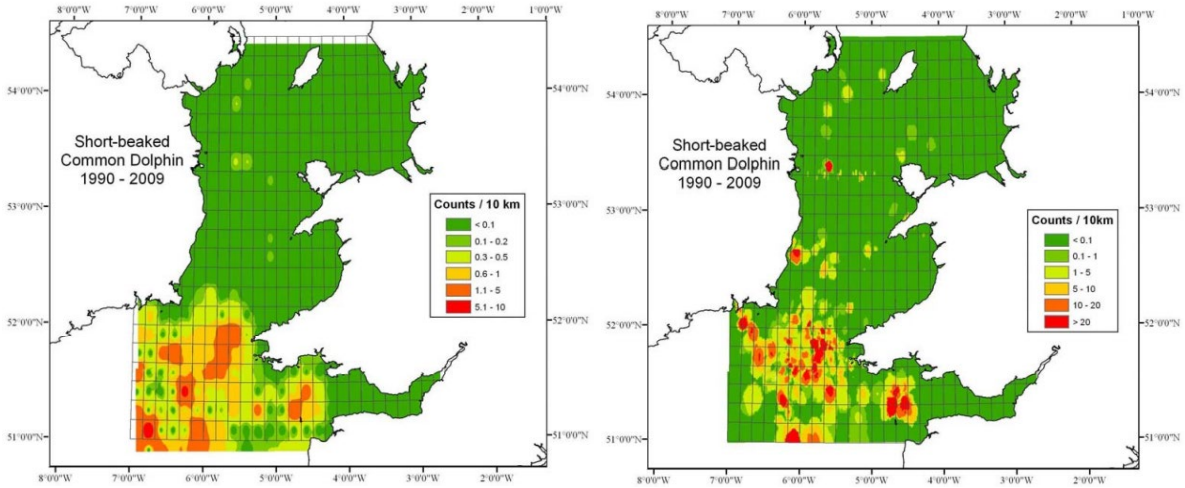

Figure 55 Common dolphin distribution in Wales. Left = IDW interpolation model and Right = Kriging interpolation model (Baines and Evans 2012).

6.4 Sea Watch Foundation - North Wales

Common dolphins have a predominantly offshore distribution, primarily at the southern end of the Celtic Deep. Common dolphin sightings recorded by Sea Watch in the coastal waters of North Wales shows a relatively small number of records throughout the area (Figure 56 and Figure 57) (Evans et al. 2021). In total, common dolphin sightings made up 1% of the records and 2% of the individuals in the Sea Watch Foundation database for the coastal North Wales area. The overall density of common dolphins in the coastal waters of North Wales were estimated to be ~0.005 dolphins/km^2 (Evans et al. 2021).

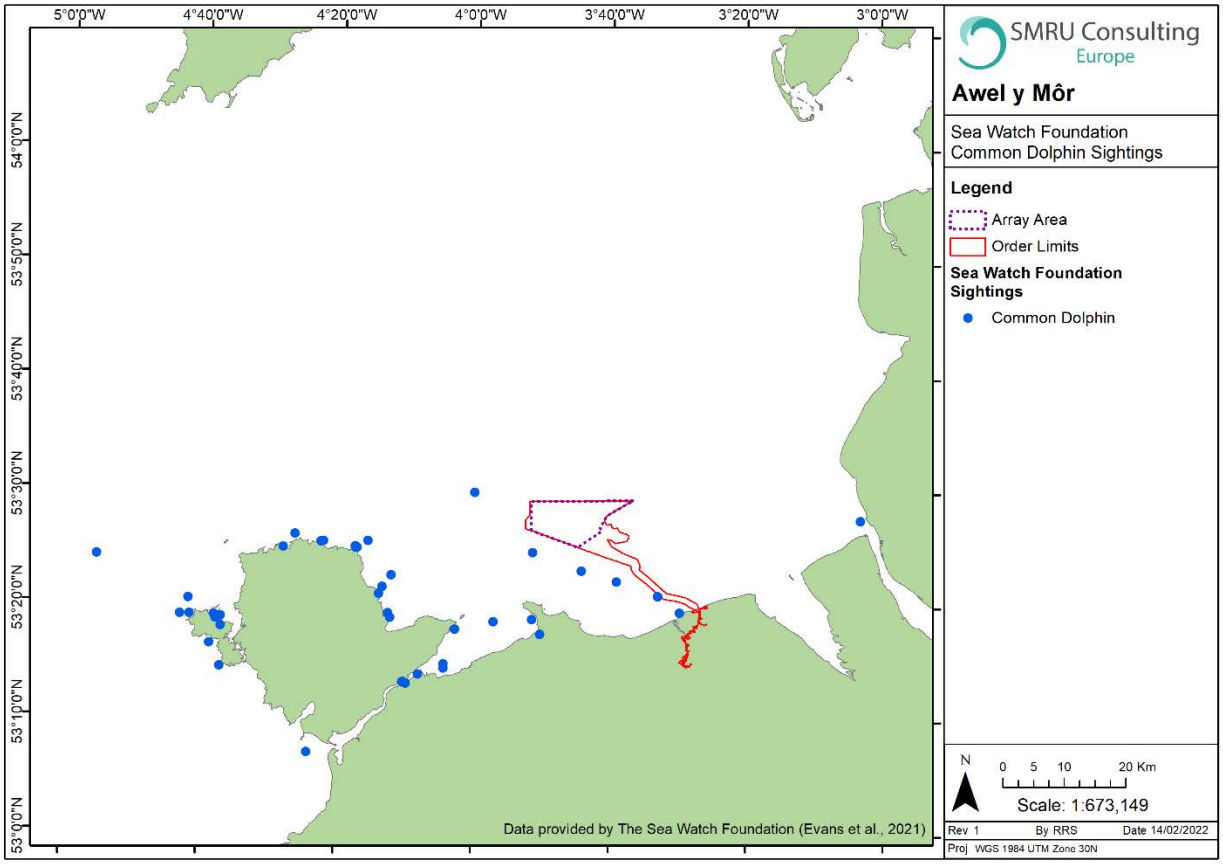

Figure 56 Common dolphin sightings in coastal waters of North Wales. Data provided by the Sea Watch Foundation (Evans et al. 2021).

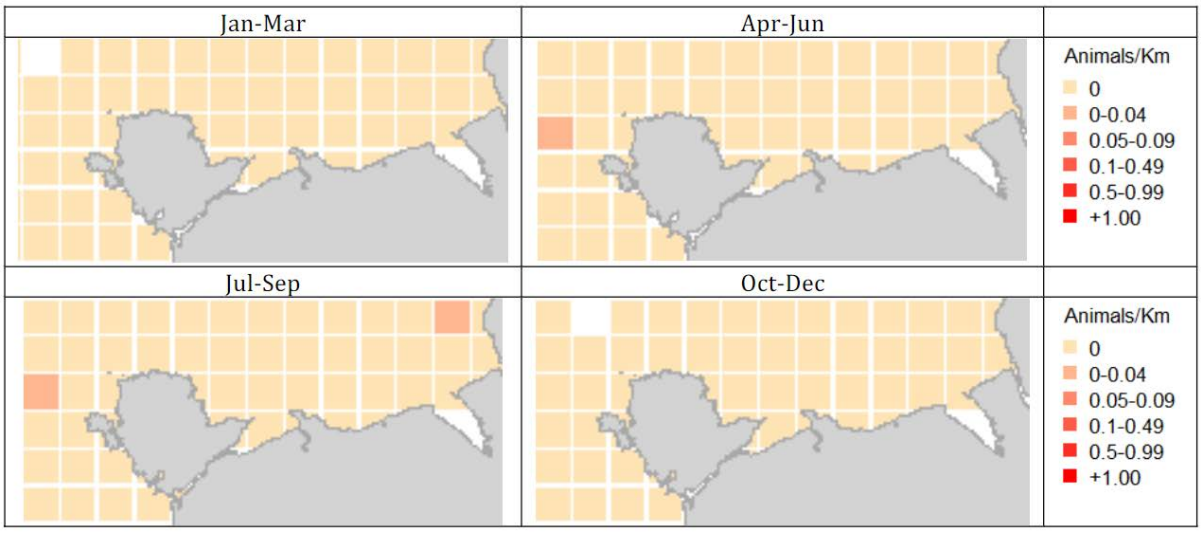

Figure 57 Distribution of common dolphins corrected for survey effort in coastal North Wales. Provided by the Sea Watch Foundation (Evans et al. 2021).

6.5 COFNOD

A total of five common dolphin sightings were obtained from the COFNOD database for the specified area of search. These sightings were all located along the coast of north Wales (Figure 58). No effort

data were provided and as such these data confirm species presence but cannot be used to estimate density.

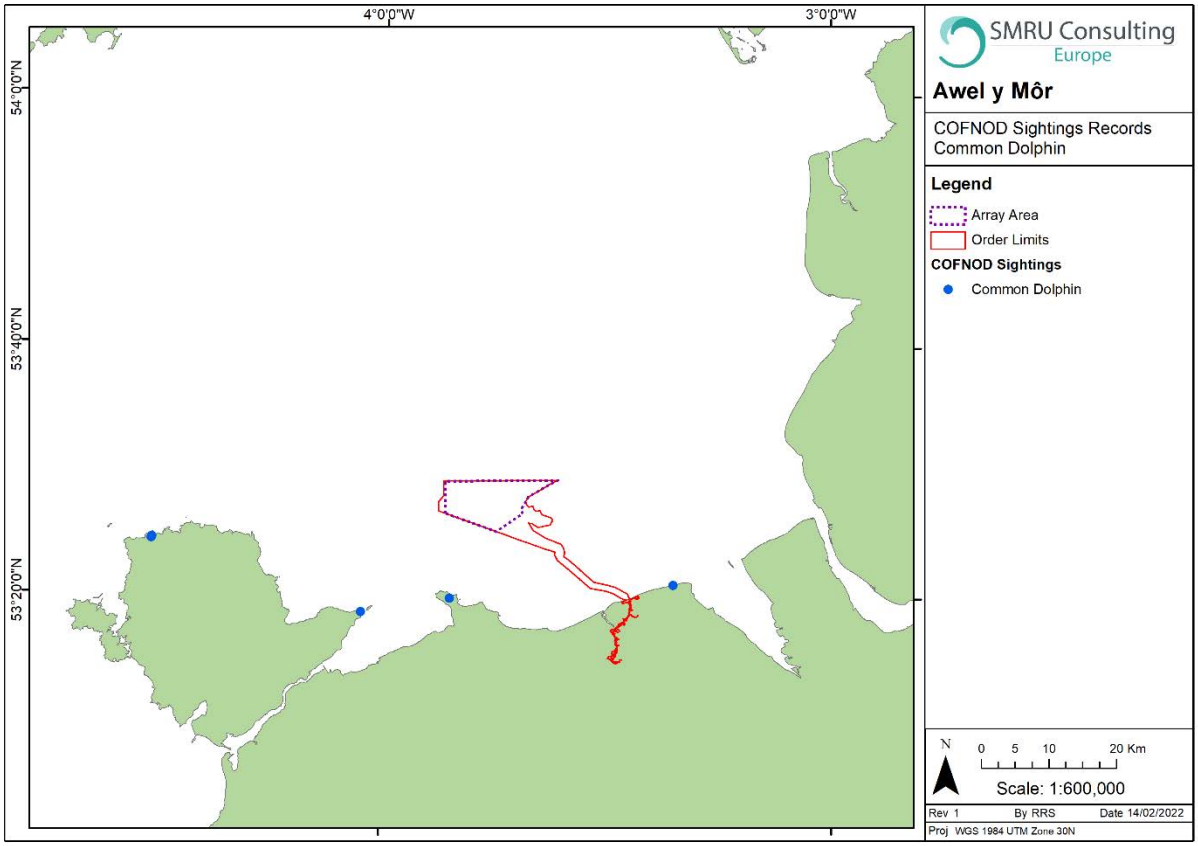

Figure 58 Sightings of common dolphins in the north Wales area – provided by COFNOD.

6.6 SCANS

The Irish Sea was not included in the SCANS I surveys in 1994. Block O for the SCANS II project did cover the windfarm location, and the density of common dolphins was estimated at 0.018 common dolphins/km^2, with an overall abundance estimate of 826 individuals. As no common dolphins were sighted in the SCANS III surveys in the Irish Sea, no density estimates were available.

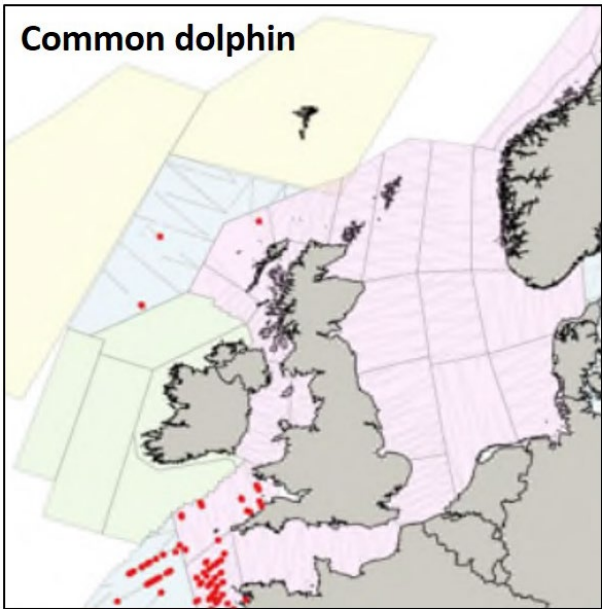

Figure 59 Sightings locations for common dolphins from the SCANS III survey (Hammond et al. 2017).

Table 16 Common dolphin density estimates from SCANS surveys.

Survey	Year	Block	Block	Area (km^2)	Effort (km)	Density (#/km^2)
SCANS III	2016	F (eastern Irish Sea)	F	12,322	619.8	0
SCANS III	2016	E (western Irish Sea)	E	34,870	2,252.7	0
SCANS II	2005	O (entire Irish Sea)	O	45,417	2,264	0.0081

6.7 ObSERVE

No common dolphins were sighted in Stratum 5 (east Ireland) during the ObSERVE surveys (Figure 60) (Rogan et al. 2018).

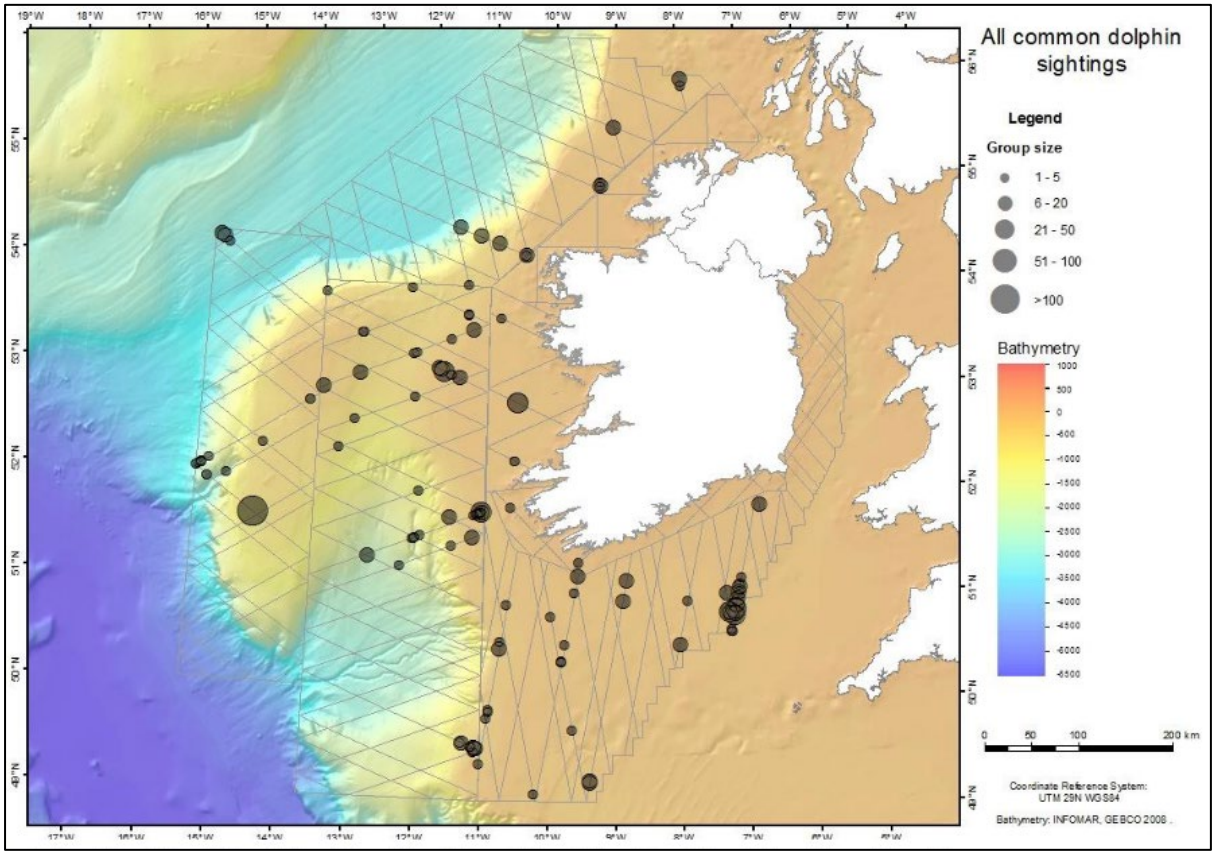

Figure 60 Sightings of common dolphins during the 2015-2016 ObSERVE surveys (Rogan et al. 2018).

6.8 MWDW sightings

Common dolphins are occasionally sighted in Manx territorial waters (Figure 61), comprising 1.4% of boat-based sightings, 3.3% of sightings from land-based surveys and 3.3% of opportunistic sightings between 2007 and 2014 (Felce 2014). No common dolphins were observed in the 2018 season during boat-based and land-based surveys, but 13 opportunistic sightings were reported, comprising 2.6% of opportunistic sightings (Clark et al. 2019). Common dolphins are highly seasonal to Manx waters, with most sightings being reported in June, July and August (84%) (Howe 2018).

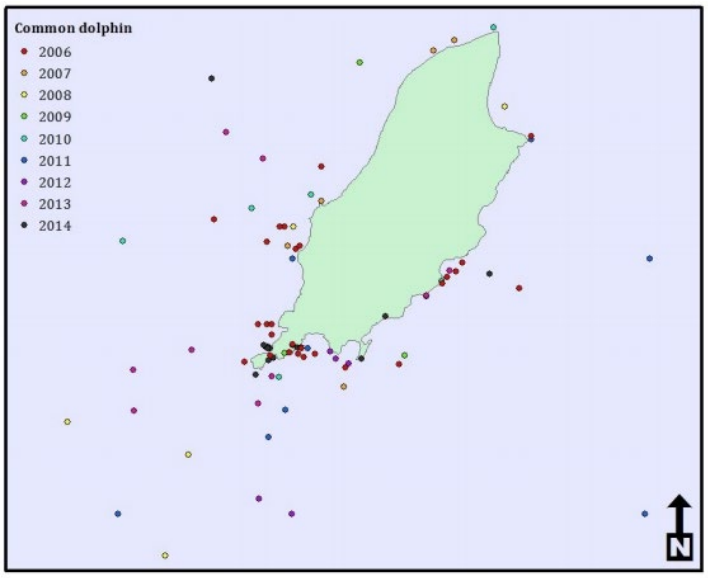

Figure 61 All sightings of Common dolphins in Manx waters 2006 to 2014 (Howe 2018).

6.9 Summary

While no common dolphins have been sighted during the site-specific surveys, they are known to be present in Welsh waters and as such, have been included in the impact assessment. Since common dolphins are not restricted to the coastal waters like bottlenose dolphins, a block wide uniform density estimate could be considered appropriate for this species. In their s42 comments, NRW advised that the most appropriate density estimate for common dolphins is the SCANS II Block O estimate of 0.0081 dolphins/km^2. This SCANS II estimate is slightly higher than the more local scale density estimate of ~0.005 dolphins/km^2 estimated by the Sea Watch Foundation (Evans et al. 2021), and is thus considered to be a conservative estimate for the area.

Table 17 Common dolphin density estimates.

Source	Area	Temporal	Density Estimate (#/km^2)
AyM surveys	AyM	Year round 2019-2021	0
GyM surveys	GyM	Various between 2003-2019	0
SCANS III (Block F)	Eastern Irish Sea	Summer 2016	0
SCANS III (Block E)	Western Irish Sea	Summer 2016	0
SCANS II (Block O)	**Irish Sea**	**Summer 2005**	**0.0081**
Sea Watch Foundation	Coastal North Wales	Since 1990	~0.005

7 Minke whale

Minke whales are known to be distributed globally and are listed as Least Concern on the IUCN red list but are protected as an EPS and as a Priority Species under the UK Post-2010 Biodiversity Framework. In European waters, a single MU for minke whales has been assigned, labelled the 'Celtic and Greater North Seas' MU. Within this MU, the abundance of minke whales is estimated to be 20,118 (95% CI: 14,061 – 28,786, CV: 0.18) (estimated using data from SCANS III and ObSERVE)

(IAMMWG 2021). The represents a similar value to the previous abundance estimate of 23,528 (95% CI:13,989 – 39,572, CV: 0.27;) (IAMMWG 2015). It is also noted that minke whale presence in UK waters is seasonal, with migrations leading to peaks in minke whale abundance during the summer (JNCC, 2015). Until 2020, there were no protected areas assigned to minke whales in UK waters, but two have been recently proposed and designated in Scottish waters (Sea of the Hebrides and Southern Trench.

7.1 Site-specific surveys

No minke whales were identified during the site-specific APEM aerial surveys.

7.2 GyM surveys

No confirmed observations of minke whales were recorded during the EIA surveys, baseline monitoring, construction monitoring or post-construction surveys in the GyM windfarm site. In July 2010, a medium sized cetacean or basking shark was spotted but further identification was not possible.

7.3 Welsh Marine Atlas

Minke whales were mainly sighted in the summer months between April and September (Baines and Evans 2012) and have a patchy distribution within the Irish Sea (Figure 62). Sightings rates are low in the vicinity of the AyM project compared to more offshore locations in the south west Irish Sea.

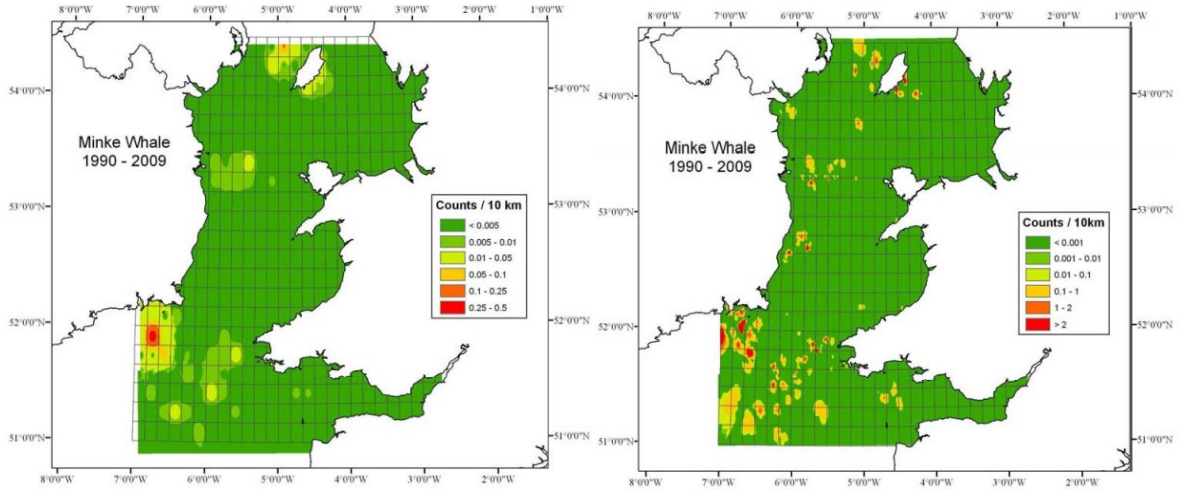

Figure 62 Minke whale distribution in Wales. Left = IDW interpolation model and Right = Kriging interpolation model (Baines and Evans 2012).

7.4 Sea Watch Foundation - North Wales

Minke whales have been described as “uncommon” in the coastal north Wales area, with a largely offshore distribution. Minke whales are mainly present in the summer months (May-Nov), with most sightings in the St George’s Channel (specifically the Celtic Deep), but with casual sightings also reported further north in the deeper parts of the Irish Sea, west of Anglesey (Figure 63) (Evans et al. 2021). No density estimate was provided for minke whales.

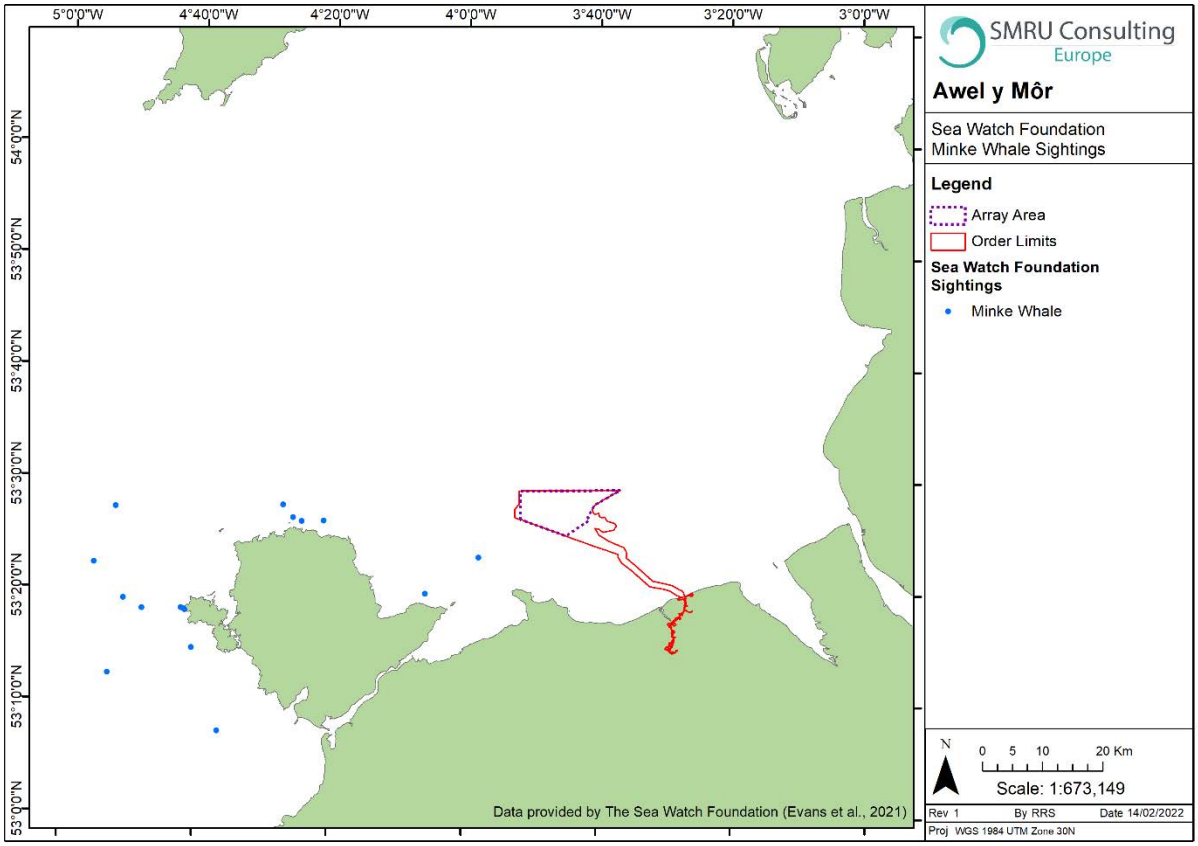

Figure 63 Minke whale sightings in coastal waters of North Wales. Data provided by the Sea Watch Foundation (Evans et al. 2021).

7.5 COFNOD

There were no minke whale sightings in the COFNOD database for the specified area.

7.6 SCANS

The Irish Sea was not included in the SCANS I surveys in 1994. The SCANS II survey of Block O (which included the AyM area) led to a density estimate of 0.0236 whales/km^2. During the SCANS III surveys, there were no estimates available for Block F as none were sighted (Figure 64), but in Block E the density of minke whales was evaluated at 0.017 whales/km^2, comparable to the results from the SCANS II report (Table 18). In this instance, a summer only estimate is considered to be appropriate since minke whales are seasonal in the area and are only expected to be present in the summer months (Baines and Evans 2012).

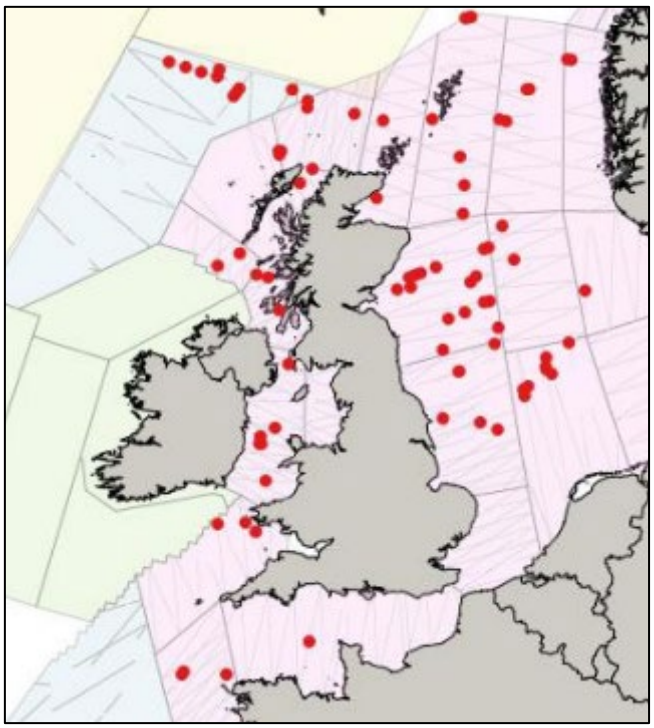

Figure 64 Sightings locations for minke whales from the SCANS III survey (Hammond et al. 2017).

Table 18 Minke whale density estimates from SCANS surveys.

Survey	Year	Block	Area (km^2)	Effort (km)	Density (#/km^2)
SCANS III	2016	F (eastern Irish Sea)	12,322	619.8	0
SCANS III	2016	E (western Irish Sea)	34,870	2,252.7	0.017
SCANS II	2005	O (entire Irish Sea)	45,417	2,264	0.0236

7.7 ObSERVE

Minke whales were the most frequently sighted mysticete species during the ObSERVE surveys, with four sightings made in Stratum 5 (Figure 65), all of which were recorded in the summer surveys (as expected). The highest design-based density estimate for minke whales in Stratum 5 was 0.045 whales/km^2 (Table 19). Given the distance between survey Stratum 5 and the AyM site, these density estimates are not necessarily representative of summer minke whale densities at AyM and so are not considered to be the most appropriate density estimates to take forward to impact assessment.

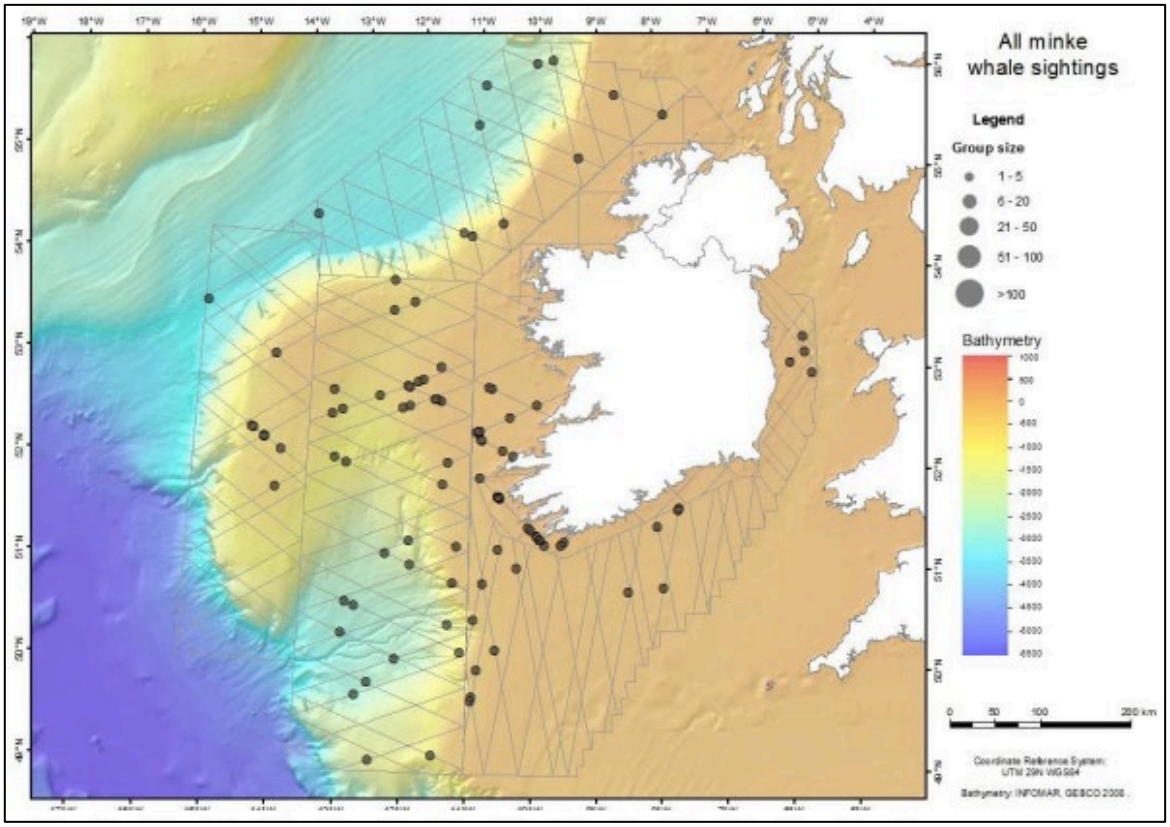

Figure 65 Sightings of minke whale along the ObSERVE survey transects from 2015-2016 (Rogan et al. 2018).

Table 19 Corrected design-based estimates of density (#/km^2) for minke whales obtained for the ObSERVE aerial surveys of Stratum 5 (Rogan et al. 2018).

Survey	Effort (km)	Design based density (#/km^2)
Summer 2015	430	0.045
Winter 2015/16	463	-
Summer 2016	394	0.016
Winter 2016/17	395	-

7.8 MWDW sightings

Minke whales are sighted regularly in Manx territorial waters in the summer, comprising 8.5% of boat-based sightings, 9.7% of sightings from land-based surveys and 14.2% of opportunistic sightings between 2007 and 2014 (Felce 2014) and 18.4% of boat-based sightings, 10.3% of sightings from land-based surveys and 12.5% of opportunistic sightings in 2018 (Clark et al. 2019). They are highly seasonal and are sighted mainly in the summer months, with 97.2% being reported between May and November. Both the seasonality and the distribution of minke whale sin Manx territorial waters in considered to reflect the seasonality and distribution of their main prey (Atlantic herring, *Clupea harengus*) (Figure 66) (Howe 2018).

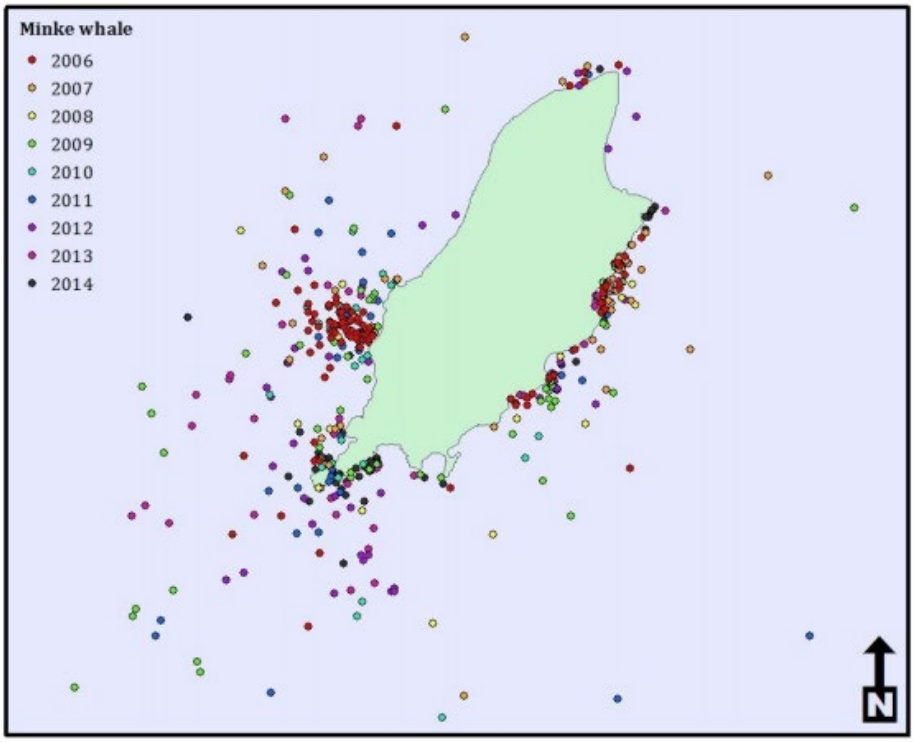

Figure 66 All sightings of Minke whales in Manx waters 2006 to 2014 (Howe 2018).

7.9 Summary

While none were recorded in the AyM site-specific surveys, or the various GyM surveys, minke whales are expected to be present in the Irish Sea in the summer months and therefore should be included in the AyM impact assessment. In the absence of data from the site-specific surveys, the most reliable and recent density estimate for minke whales in the Irish Sea is the SCANS surveys of 0.017 whales/km^2 (which is almost identical to the density estimate obtained from the 2016 summer ObSERVE surveys). NRW agreed with this approach in the s42 comments.

Table 20 Minke whale density estimates.

Source	Area	Temporal	Density Estimate (#/km^2)
AyM surveys	AyM	Year round 2019-2021	0
GyM surveys	GyM	Various between 2003-2019	0
SCANS III (Block F)	Eastern Irish Sea	Summer 2016	0
SCANS III (Block E)	**Western Irish Sea**	**Summer 2016**	**0.017**
SCANS II (Block O)	Irish Sea	Summer 2005	0.0236
ObSERVE (Stratum 5, design based est)	Western Irish Sea	Summer 2015	0.045
ObSERVE (Stratum 5, design based est)	Western Irish Sea	Summer 2016	0.016

8 Grey seal

Grey seals are found in coastal waters around the UK and Northern Ireland, and pup production estimates show that the population has been rapidly increasing over the last decade. The latest population estimate for the UK (based on 2016-2018 pup production estimates and total population estimates at the start of the 2019 breeding season) is 149,700 adult grey seals (95% CI: 120,000–174,900) (SCOS 2021). Based on grey seal photo-ID data held by NRW, there are an estimated 2,688 adult female grey seals using haul-out sites around the Welsh coastline between 1992 and 2016, and data have shown that adult grey seals found within SACs in Wales range over the wider Celtic and Irish Seas (Langley et al. 2020).

8.1 Management unit

The relevant MU for grey seals in under discussion, and therefore two MUs are presented here and in the quantitative impact assessment:

- OSPAR Region III: Celtic Seas (interim MU, proposed by NRW 2020)
- Within the Wales MU and adjacent to the Northwest England MU (SCOS 2021)

8.1.1 OSPAR Region III MU

NRW (2020) does not agree with the seal MUs provided in IAMMWG (2013) (used in SCOS reporting), as it "*does not reflect known seal population movement and distribution or management boundaries*". Therefore, NRW suggests that until the IAMMWG defines a more suitable MU for grey seals, the OSPAR Region III Celtic Sea area is an appropriate interim MU. As shown in Figure 3, this encompasses the Celtic Seas (including the Irish sea, Republic of Ireland waters, Northern Irish waters, Scottish waters, English waters and French waters). Using the grey seal mean habitat preference map, there are an estimated 50,900 grey seals at sea within the OSPAR Region III MU at any one time. It is estimated that grey seals spend 77% of their time at sea on average, therefore accounting for the 23% of grey seals on land, the population estimate of grey seals within the OSPAR Region III MU is approximately 66,100 grey seals.

8.1.2 SCOS MUs

AyM is located within the Wales MU for grey seals, but is adjacent to the Northwest England MU, and therefore it is considered appropriate to combine the two MUs for the purpose of assessment in relation to AyM. Estimates of grey seals counted in August 2016-2019 in the Wales and the Northwest England MUs are provided in SCOS (2021) (Wales=900, NW Eng=250, total=1,150), however the report states that there are no SMRU surveys in Wales or Northwest England, and that estimates are "*compiled from counts shared by other organisations*" (including NRW) "*or found in various reports & on websites*" (e.g. Westcott and Stringell 2004, Stringell et al. 2014). It is estimated that grey seals spend 23% of their time hauled-out on average, and therefore, accounting for the grey seals at sea, the population estimate for the combined Wales and Northwest England MUs is approximately 5,000 grey seals. However, given the lack of dedicated SMRU surveys in these areas, this estimate should be considered with caution due to the limited data used to inform the estimate.

8.2 Site-specific surveys

A total of 20 seals were sighted during Year 1 of the site-specific APEM aerial surveys. These were identified as "unknown seal species" however given the lack of harbour seals in Welsh waters, it is fair to assume that these sightings are all grey seals. The maximum monthly density estimate for seals within the Survey Area for Year 1 was 0.14 seals/km^2 (Table 21).

Table 21 Seal sightings, abundance and density estimates across the AyM Survey Area in Year 1 of the site-specific surveys.

Survey	Count	Abundance	Lower CI	Upper CI	Precision	Density (#/km^2)
Seal species						
Mar-19	1	8	1	25	1	0.01
May-19	3	30	3	71	0.58	0.05
Jul-19	2	18	2	44	0.71	0.03
Aug-19	1	9	1	27	1	0.01
Nov-19	1	9	1	26	1	0.01
Jan-20	3	30	3	81	0.58	0.05
Feb-20	9	91	30	161	0.33	0.14

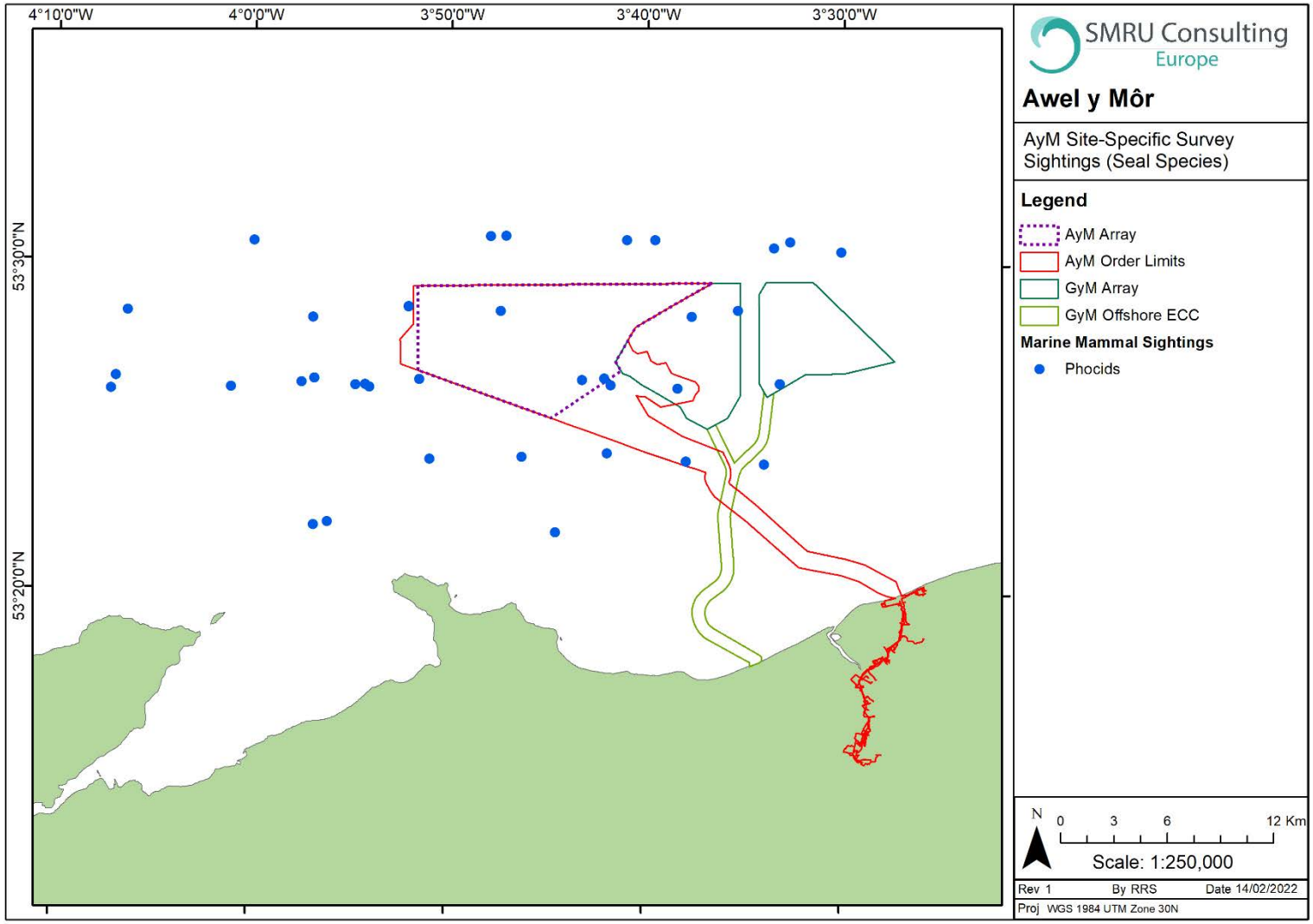

Figure 67 Seal sightings during the 2 years of AyM site-specific surveys.

8.3 GyM surveys

During the GyM EIA conducted between 2003-2005, grey seals were recorded within the wind farm site, but no numbers were included (CMACS Ltd 2005). In the aerial surveys for the baseline monitoring in January 2011, a small cetacean or grey seal was observed but could not be further classified. Three grey seals were sighted by MMOs during construction monitoring, and another four seals were recorded that could not be identified. Off-duty MMOs also sighted another three grey seals, and another five unclassified seal species. The aerial surveys conducted between 2016-2019 counted 63 grey seals and another 22 images of 'unknown phocids'. In total, 69 grey seal sightings were confirmed between 2003-2019 in the GyM windfarm area.

8.4 COFNOD

A total of 2,694 grey seal sightings were obtained from the COFNOD database for the specified area of search. These sightings were located coastally across north Wales, with the majority of sightings being recorded at Angel Bay (78.4%), Cemlyn (7.4%) and the Dee Estuary (5.5%) (Figure 68). No effort data were provided and as such these data confirm species presence but cannot be used to estimate density.

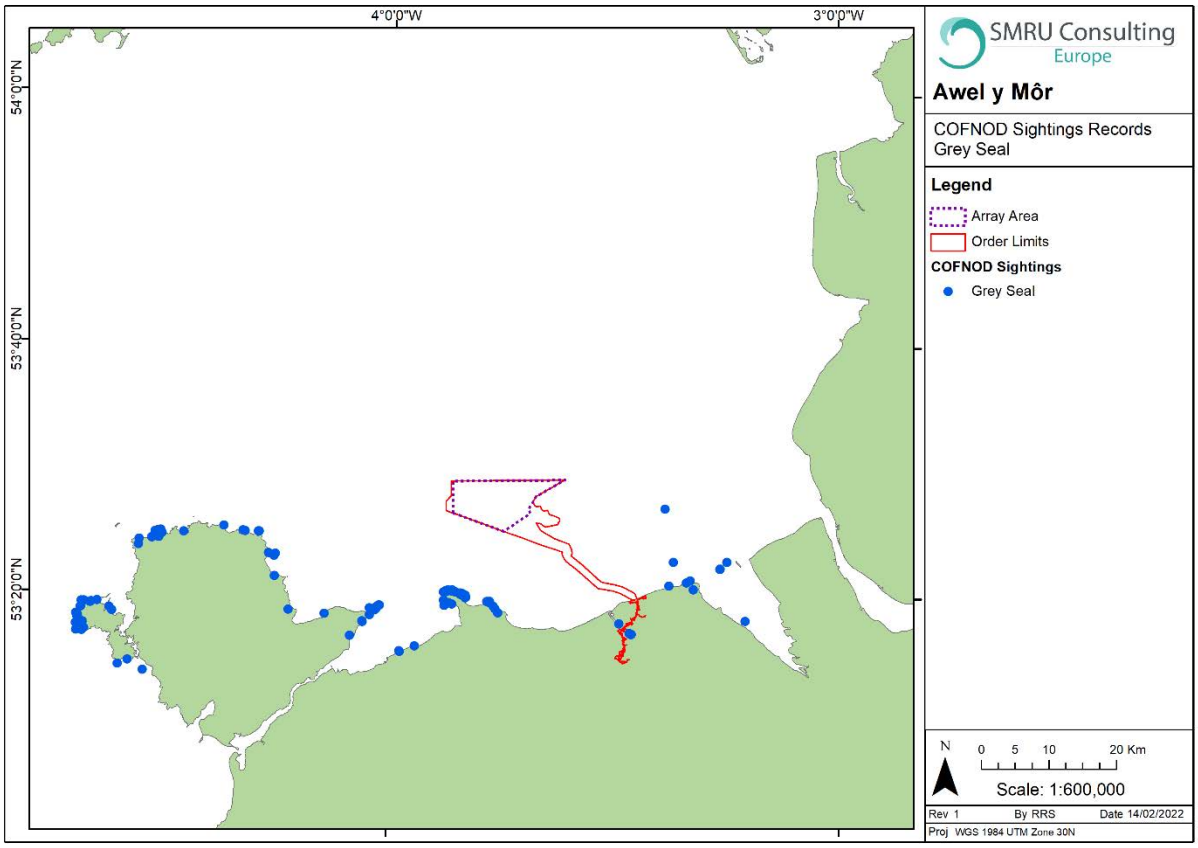

Figure 68 Sightings of grey seals in the north Wales area – provided by COFNOD.

8.5 Haul-outs

In Wales, grey seals are notoriously difficult to count at haul-out sites from aerial surveys as, during the pupping season they haul-out in caves and in "*cryptic habitats where topographic features completely or partially obscure the habitat from aerial view*"; therefore ground and vessel-based

surveys are more likely to result in accurate estimates, but are challenging due to cost, personnel and resource limitations (Stringell et al. 2014).

Grey seals haul-out around the Welsh coastline which NRW monitors partly through the maintenance of the EIRPHOT database of photo-ID data from 246 sites around the Welsh coast and islands (main locations shown in Figure 69). In North Wales, grey seals mainly haul-out around the coast of Anglesey (including the Skerries), around Llandudno (Angel Bay) and the Dee Estuary (Hilbre North and West Hoyle Sandbank). At the Dee Estuary, there were 236 unique individuals identified by left head extracts from the EIRPHOT database, and photo-ID data showed connectivity between the Dee estuary and the Skerries, with some connectivity with Cardigan Bay and Skomer (Langley et al. 2018).

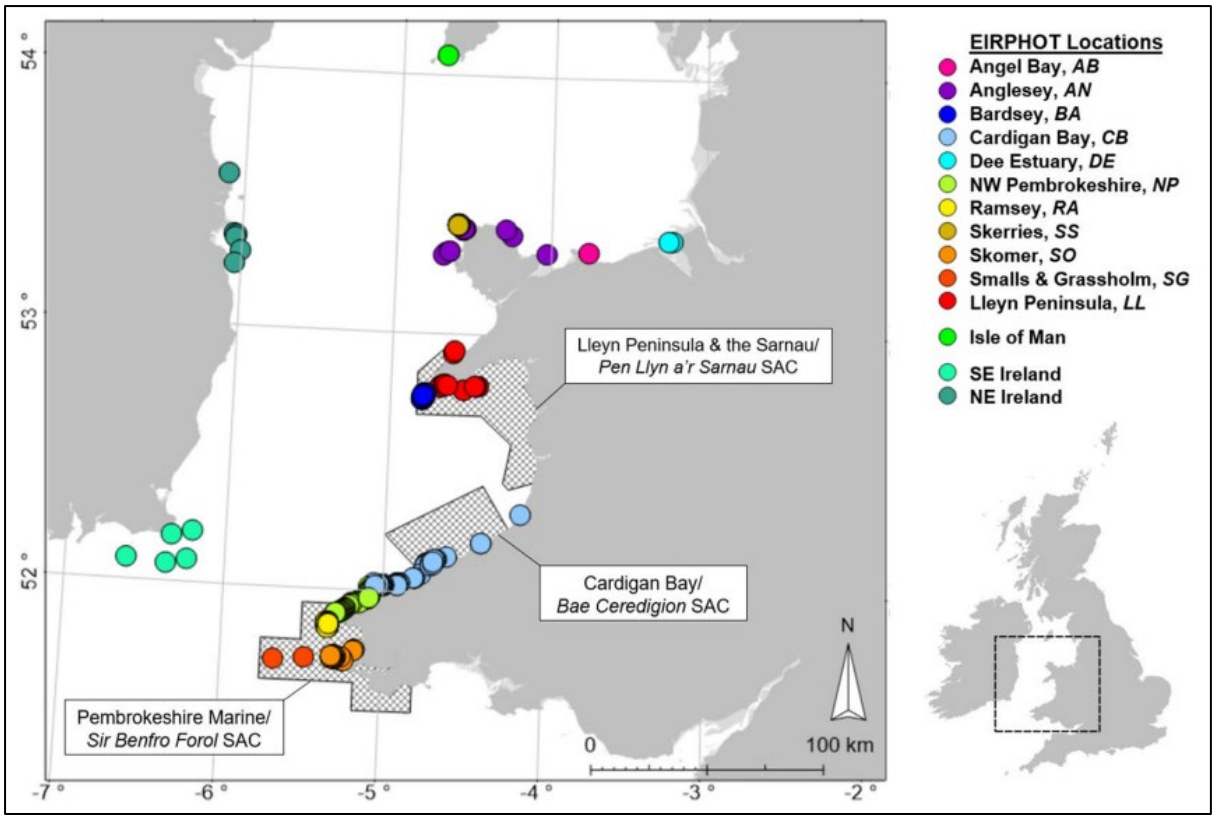

Figure 69 Celtic and Irish Sea grey seal haul-out sites covered by the EIRPHOT database (Langley et al. 2020).

Monitoring of grey seals by the Angel Bay Seal Volunteer Group, supported by the North Wales Wildlife Trust has been conducted at Angel Bay, Llandudno (Porth Dyniewaid) for the last 5 years and they are now assisting with monitoring efforts at Pigeon's Cave, on Great Orme (Angel Bay Seal Volunteer Group 2021). Angel Bay is located a minimum distance of ~11 km from the array area, ~11 km from the ECC and ~21 km from the landfall site. Pigeon's Cave is located a minimum distance of ~11 km from the array area, ~12 km from the ECC and ~26 km from the landfall site. These locations are visited all year round by seals, with the sites used for pupping, mating and moulting from mid-August to April. During the 2020-2021 season, the maximum seal haul-out count in one instance was 247 seals, occurring at Angel Bay in November 2020 (Figure 70). Though far fewer surveys have been conducted at Pigeon's Cave, the sightings do confirm grey seal presence over the 2020-2021 season (Figure 72). The haul-out count data highlights that both sites are known grey seal pupping areas, and for Angel Bay, the counts have shown an overall increasing trend since records began in 2016 (Figure 71).

Figure 70 Monthly maximum seal count at Angel Bay from 2020-2021 (Angel Bay Seal Volunteer Group 2021).

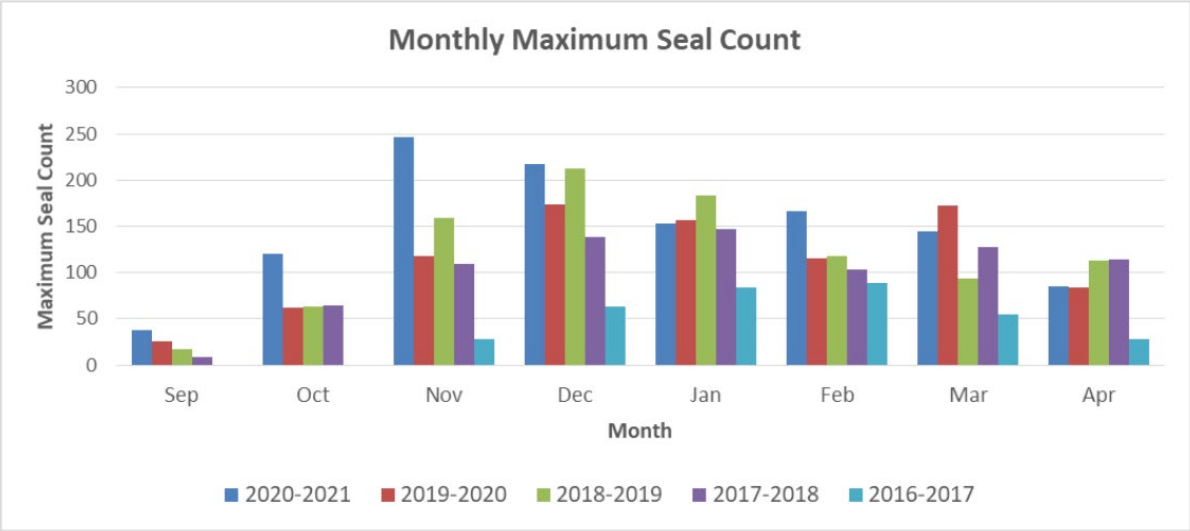

Figure 71 Monthly maximum seal count at Angel Bay from 2016-2021 (Angel Bay Seal Volunteer Group 2021).

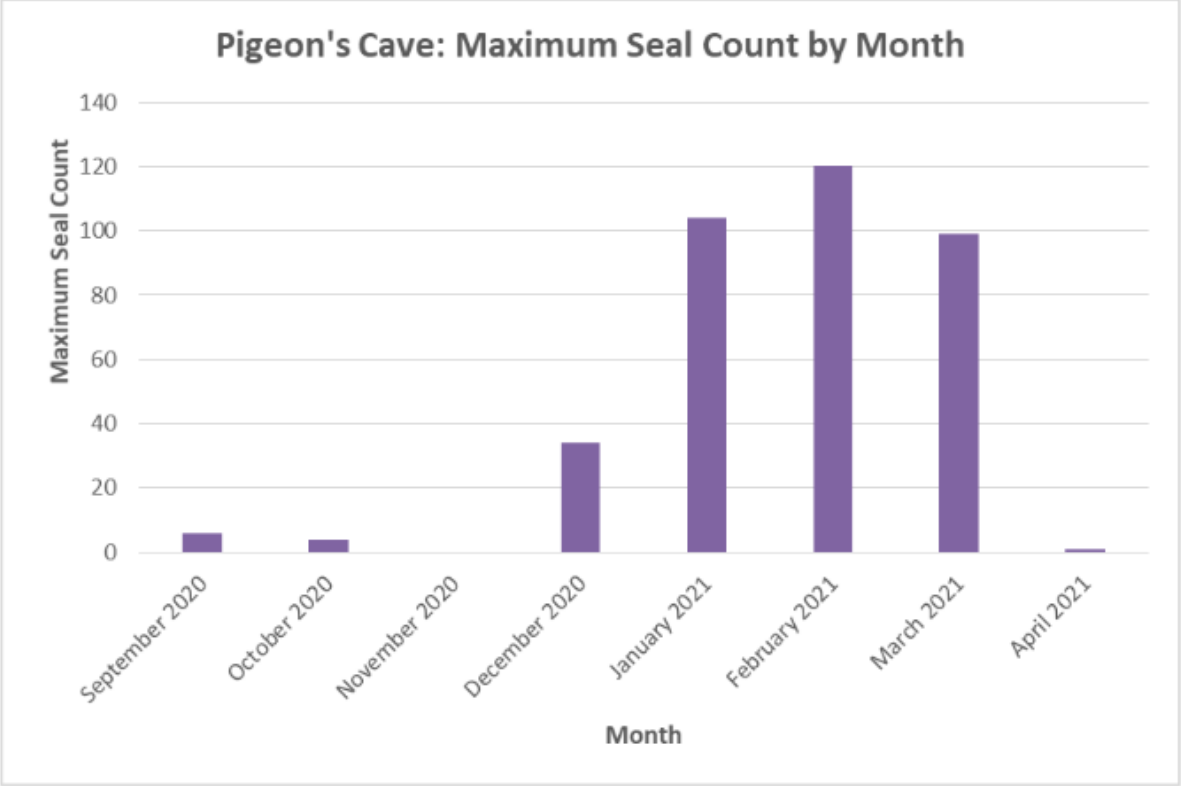

Figure 72 Monthly maximum seal count at Pigeon's Cave from 2020-2021 (Angel Bay Seal Volunteer Group 2021).

8.6 Pupping

Grey seals typically express a preference for remote breeding sites and cryptic habitats (Stringell et al. 2014, SCOS 2020, 2021) which can make pup abundance difficult to quantify. In 2016, total UK pup production was estimated at 65,400 (95% CI: 57,800–71,800) based on ground count data and estimates from less frequently aerial surveyed colonies. An estimated 2,000 of these pups were in Wales, resulting in a 2018 population estimate of 4,700 individuals for the Welsh region (SCOS 2020). This was recently updated in SCOS (2021) to provide a 2019 estimate of 5,000 individuals in Wales. The 2016 estimates resulted from the observation of 96 pups in North Wales (Stringell et al. 2014), 465 pups in North Pembrokeshire and 345 pups on Skomer and adjacent mainland sites. This represents a 10.1% increase from the SCOS estimate of pup production in 2014 (1,650) (SCOS 2018).

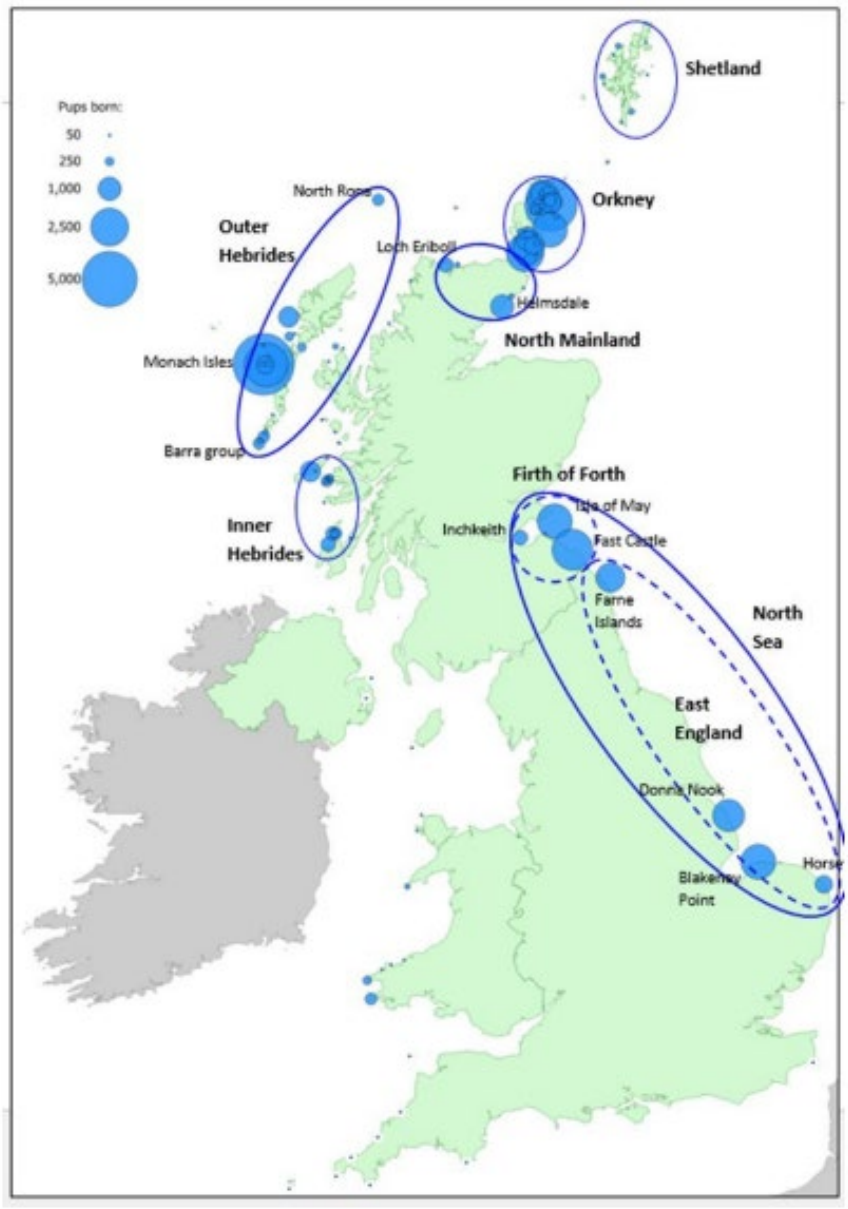

Figure 73 Distribution and size of the main grey seal breeding colonies in the UK. Blue ovals indicate groups of regularly monitored colonies within each region and blue circles represent number of pups born (SCOS 2020).

The largest breeding population in the Irish Sea and south-west UK is located in Pembrokeshire (Figure 73), accounting for 4% of the UK breeding population (Strong and Morris 2010, Stringell et al. 2014). The majority of this pup production is located around Yyns Dewi/ Ramsey Island and the north Pembrokeshire mainland coast between St Davids Head and the Teifi Estuary (Morgan et al. 2018). In North Wales, smaller breeding populations can be found on the west coast of Anglesey and the Lleyn Peninsula (Figure 74). Pupping sites around Anglesey are within 50 km of the AyM array area.

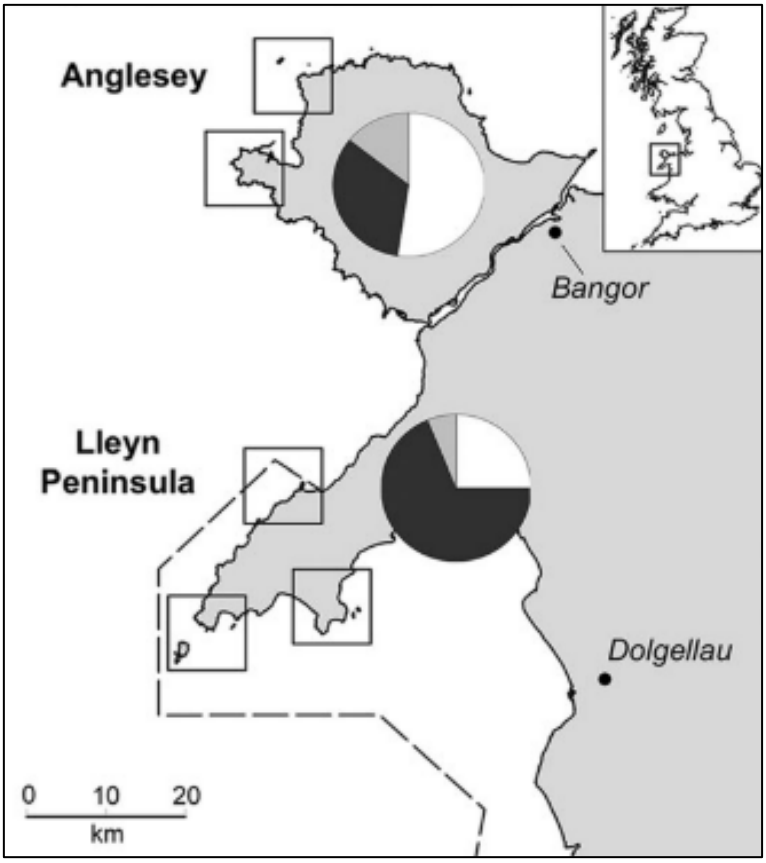

Figure 74 Grey seal pupping sites in North Wales (open boxes). Pie charts indicate the proportion of cave (black), other cryptic (grey) and non-cryptic/open onshore pupping habitats for Anglesey (n=21 sites) and the Lleyn Peninsula (n= 16 sites) (Stringell et al. 2014).

In the south-west of the UK (including Wales) the pupping season occurs between August and November, with peak births in September and October (Morgan et al. 2018, Langley et al. 2020, SCOS 2020). However, pups have also been recorded outside of this period and have been recorded throughout the year at Ramsey Island (Morgan et al. 2018).

8.7 Seal at-sea distribution

The at-sea distribution map shows high at-sea densities of grey seals in the Liverpool Bay area and reasonably high densities within the AyM array area and ECC, relative to average densities around the Welsh coastline (Figure 75) (Carter et al. 2020). Within a 50 km buffer of the AyM array area, the mean prediction is approximately 1,632 grey seals at sea at any one time. Within the AyM red line boundary, grey seal densities are expected to be highest in the coastal parts of the ECC, with densities decreasing with increasing distance from shore, to lower densities within the array area. These data represent the best estimates of the at-sea densities of grey seals in the vicinity of AyM, and therefore this density surface will be taken forward for use in the quantitative impact assessment.

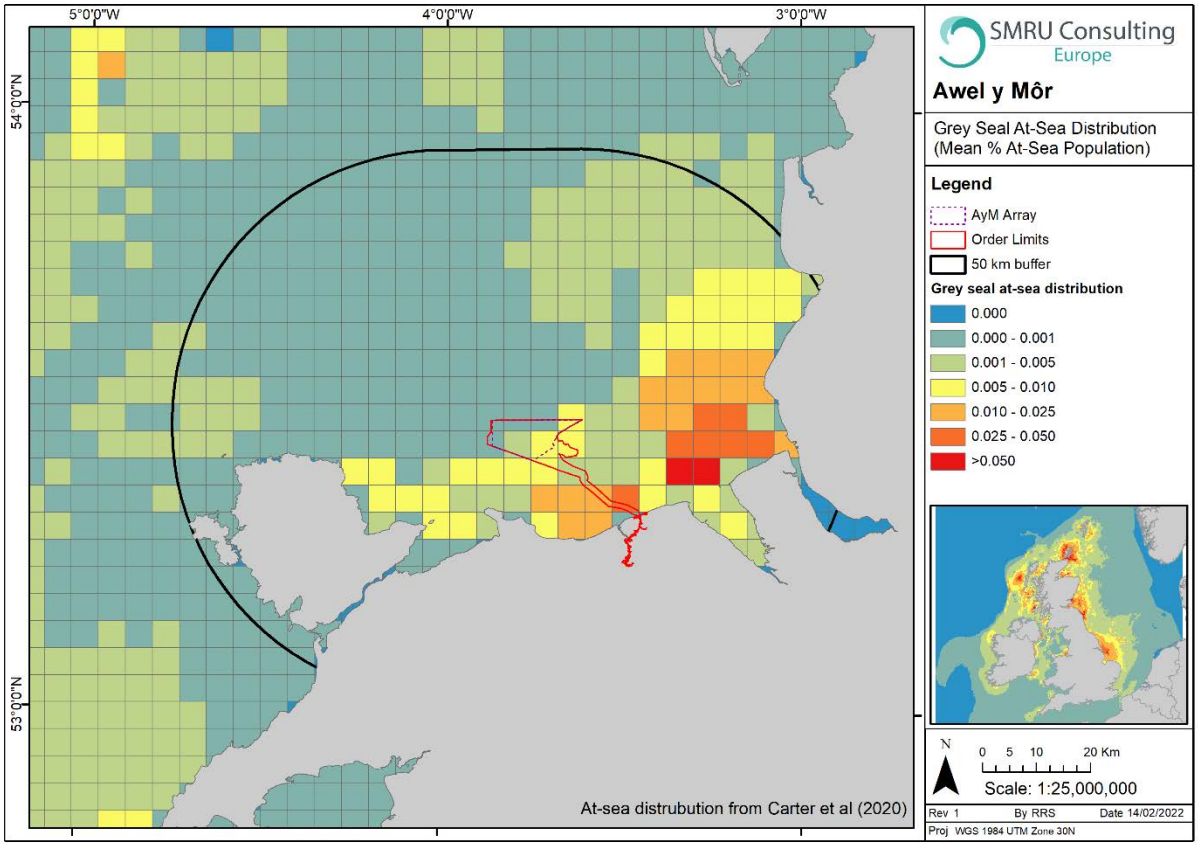

Figure 75 At-sea distribution of grey seals from haul-outs in the British Isles in 2018. Map shows mean percentage of at-sea population estimated to be present in each 5 x 5 km grid cell at any one time.

8.8 Telemetry

Within the 50 km buffer of the AyM array area, there are telemetry tracks from 34 grey seals, 33 of which were tagged in the West England and Wales MU, and one of which was tagged in the West Scotland MU (Figure 76). The 34 grey seals within the 50 km buffer of the AyM array area showed connectivity with the following grey seal SACs: Pen Llyn a`r Sarnau/ Lleyn Peninsula and the Sarnau (Wales), Cardigan Bay/ Bae Ceredigion (Wales), Pembrokeshire Marine/ Sir Benfro Forol (Wales) the Saltee Islands (Ireland) and the Isles of Scilly Complex SAC (England) (note: one seal had telemetry tracks near but not within the Lambay Island SAC in Ireland). The highest levels of connectivity were with the Pen Llyn a`r Sarnau/ Lleyn Peninsula and the Sarnau SAC, where 13 of the 34 grey seals recorded telemetry track data (38%). There was much lower levels of connectivity with the other SACs: only five of the 34 seals recorded telemetry data within the Pembrokeshire Marine/ Sir Benfro Forol SAC (15%), only three of the 34 seals recorded telemetry data within the Cardigan Bay/ Bae Ceredigion SAC (9%), three of the 34 seals recorded telemetry data within the Saltee Islands SAC (9%) and two seals (both pups) recorded telemetry data within the Isles of Scilly Complex SAC (6%). This connectivity between seals in the vicinity of AyM and with SACs will need to be considered in the HRA. Likewise, the connectivity with the Republic of Ireland and with the Isle of Man will need to be considered in the assessment of transboundary effects.

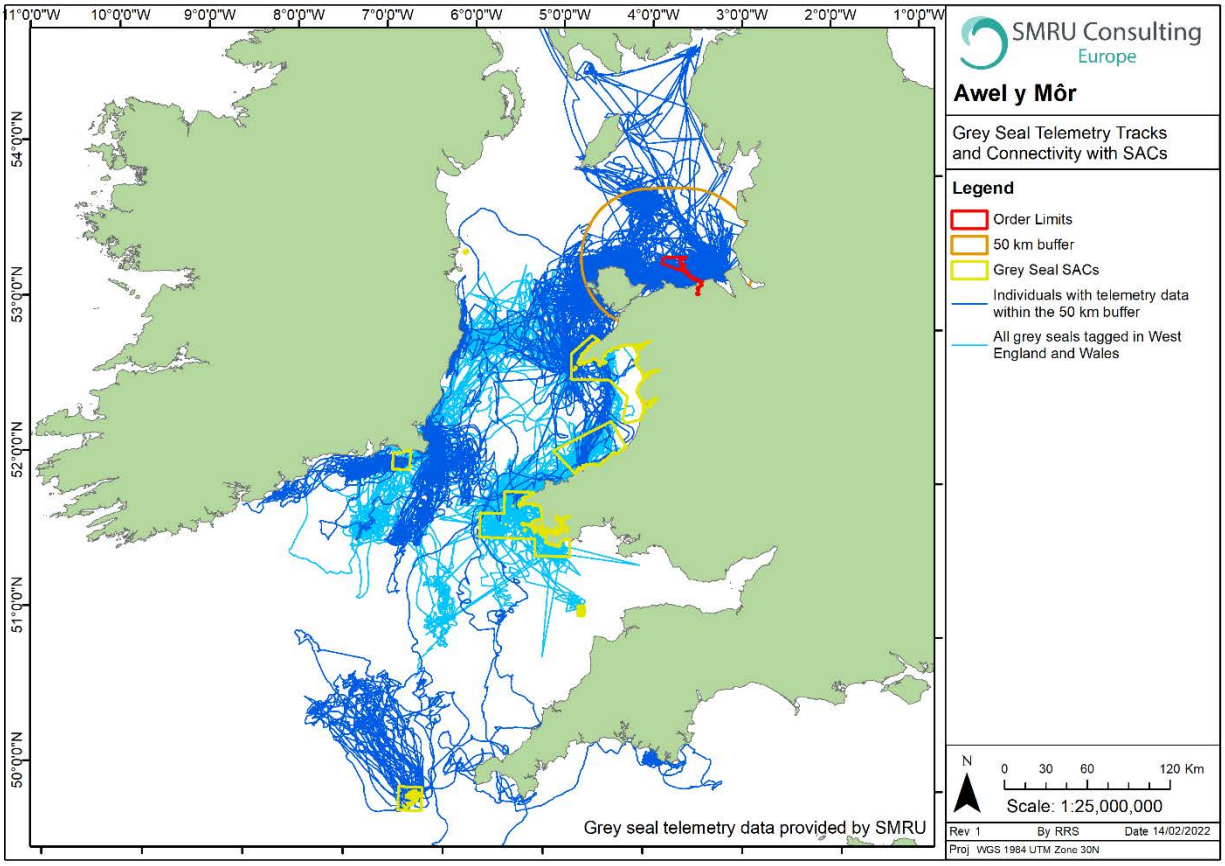

Figure 76 Grey seal telemetry tracks in the vicinity of AyM and connectivity with grey seal SACs.

8.9 Summary

The most appropriate density estimate for grey seals to be taken forward to the impact assessment is the usage data provided in the seal habitat preference maps, which can be scaled to predict the number of grey seals at-sea within each grid cell.

9 Conclusions

The data available for this baseline characterisation have confirmed that harbour porpoise, grey seals, bottlenose dolphins, Risso's dolphins, common dolphins and minke whales are likely to be present in the vicinity of AyM and should be considered within the quantitative impact assessment. While there are a range of density estimates available from various surveys for each species, the most robust and relevant density estimate outlined in Table 22 are the ones recommended to take forward to the quantitative impact assessment.

Table 22 Species, MU size and density estimate recommended for use in the AyM quantitative impact assessment.

Species	MU	MU Size	MU Ref	Density (#/km^2)	Density Ref
Harbour porpoise	Celtic and Irish Seas	62,517	IAMMWG (2021)	1.0 0.13	Evans et al. (2021) JCP Tool
Bottlenose dolphin	Irish Sea	293	IAMMWG (2021)	0.035 within the 20 m depth	Lohrengel et al. (2018)

Species	MU	MU Size	MU Ref	Density (#/km^2)	Density Ref
				contour, 0.008 beyond.	SCANS III
Risso's dolphin	Marine Atlantic	12,262	IAMMWG (2021)	0.031	SCANS III
Common dolphin	Celtic and Greater North Seas	102,656	IAMMWG (2021)	0.0081	SCANS II
Minke whale	Celtic and Greater North Seas	20,118	IAMMWG (2021)	0.017	SCANS III
Grey seal	Ospar region III	66,100	Derived from Carter et al. (2020)	Grid cell specific	Carter et al. (2020)
	Wales and NW England MUs combined	5,000	Derived from (SCOS 2021)		

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