Environmental Impact Assessment Report

NISA

North Irish Sea Array

Volume 9: Appendices (Offshore)

Appendix 14.2

Marine Mammal Baseline Characterisation

Statkraft

CIP Copenhagen Infrastructure Partners

GoBe APEM Group

ARUP

North Irish Sea Array Offshore Windfarm: Marine Mammal Baseline Characterisation

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2 Introduction

2.1 Purpose of report

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 North Irish Sea Array (NISA) offshore wind farm (hereafter the 'proposed development'). The baseline data have been compiled through a combination of literature reviews and data obtained from site-specific surveys.

In order to develop an offshore windfarm in a sustainable way and in accordance with current legislation and best practice, there is a requirement for *"formal comprehensive knowledge of the existing environment, including its natural variability"* in order to provide a *"necessary benchmark against which change may be predicated, detected, mitigated and measured when seeking to detect change as a result of impact from a project"* (DCCAE, 2018); this is known as the baseline.

The baseline characterisation provides information on the proposed development and the potential impact footprint, in terms of the species that are expected to be present, the abundance of animals expected to be present and the degree of spatial and temporal variation in that abundance. The purpose of the baseline characterisation survey and literature review is to identify the best abundance and density estimates for each marine mammal species that will be used in the quantitative impact assessment.

2.2 Approach

Baseline information was gathered by a combination of a desk-based review of existing data sources and consideration of site-specific survey data (see section 3). In total, more than 26 species of marine mammal have been recorded in Irish waters (Wall *et al.*, 2013), though most of these have been recorded off the west coast of Ireland and in deeper waters.

The initial literature review conducted to inform the marine mammal chapter of the scoping report identified the key species in the study area as: harbour porpoise, bottlenose dolphins, Risso's dolphins, minke whales, grey seals and harbour seals. Additionally, common dolphins have been considered in this baseline characterisation as they have since been sighted during the site-specific baseline surveys.

2.3 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 proposed development array area 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). Cetacean MUs were defined by IAMMWG (2023) as *"a geographical area in which the animals of a particular species are found to which management of human activities is applied. An MU may be smaller than what is believed to be a 'population' or an 'ecological unit' to reflect spatial differences in human activities and their management"*. Therefore, the MU scale is advised as the most appropriate scale against which to assess and manage human activities.

The study area for marine mammals has therefore been defined at two spatial scales: the MU scale for specific species (Figure 1) and the marine mammal survey area for all species (Figure 4) for an indication of the local densities of each species. The proposed development is located within the following MUs for each species (and thus these are the species-specific study areas):

- Harbour porpoise (*Phocoena phocoena*): Celtic and Irish Seas MU;
- Bottlenose dolphin (*Tursiops truncatus*): Irish Sea MU;
- Risso’s dolphin (*Grampus griseus*): Celtic and Irish Seas MU;
- Short-beaked common dolphin (hereafter ‘common dolphin’, (*Delphinus delphis*)): Celtic and Irish Seas MU;
- Minke whale (*Balaenoptera acutorostrata*): Celtic and Irish Seas MU;
- Grey seal (*Halichoerus grypus*): East regions of Republic of Ireland (RoI) and Northern Ireland MU; and
- Harbour seal (*Phoca vitulina*): East regions of RoI and Northern Ireland MU.

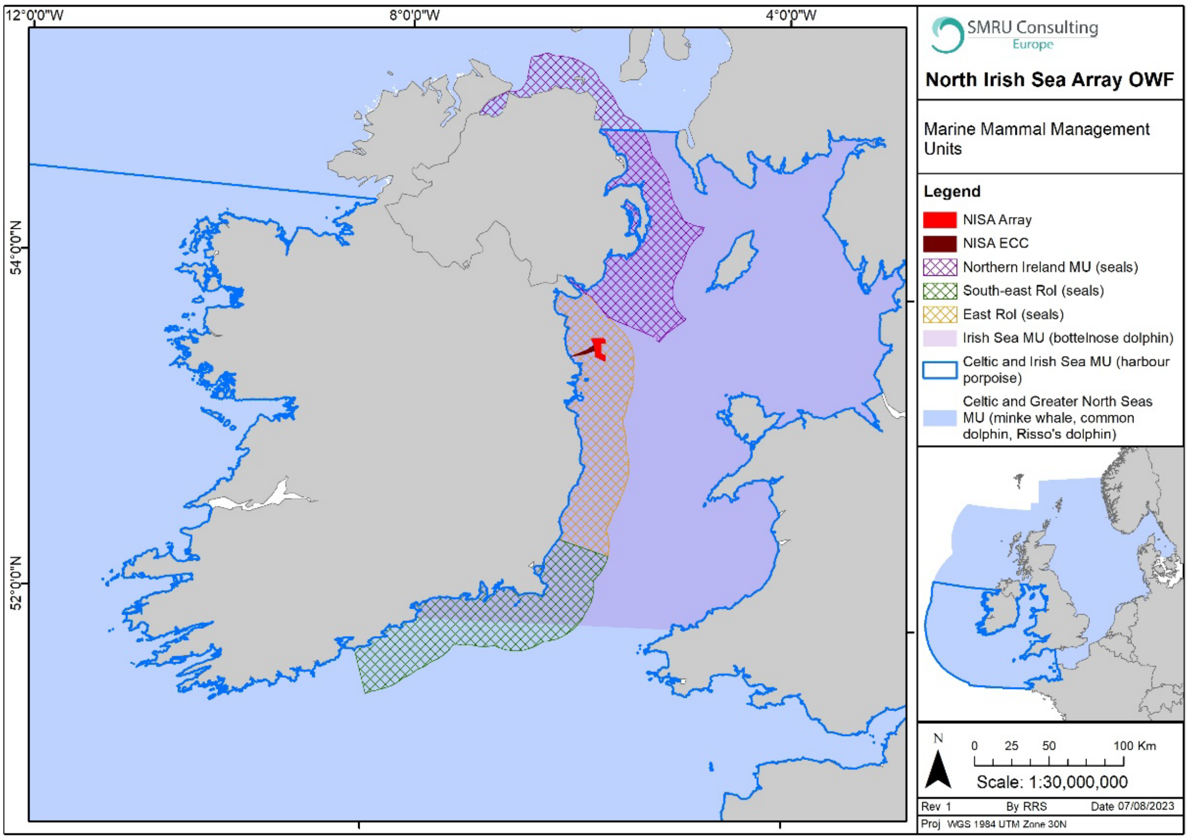

Figure 1 Marine mammal study area – Management Units.

2.4 Protected Sites

Within each marine mammal study area there are Special Areas of Conservation (SACs) that have been designated for specific marine mammal species. The SACs are shown in (Figure 2). Evidence of connectivity between the SACs and the proposed development is outlined in the species-specific paragraphs. The potential for impacts upon SACs is considered in the Natura Impact Statement (NIS).

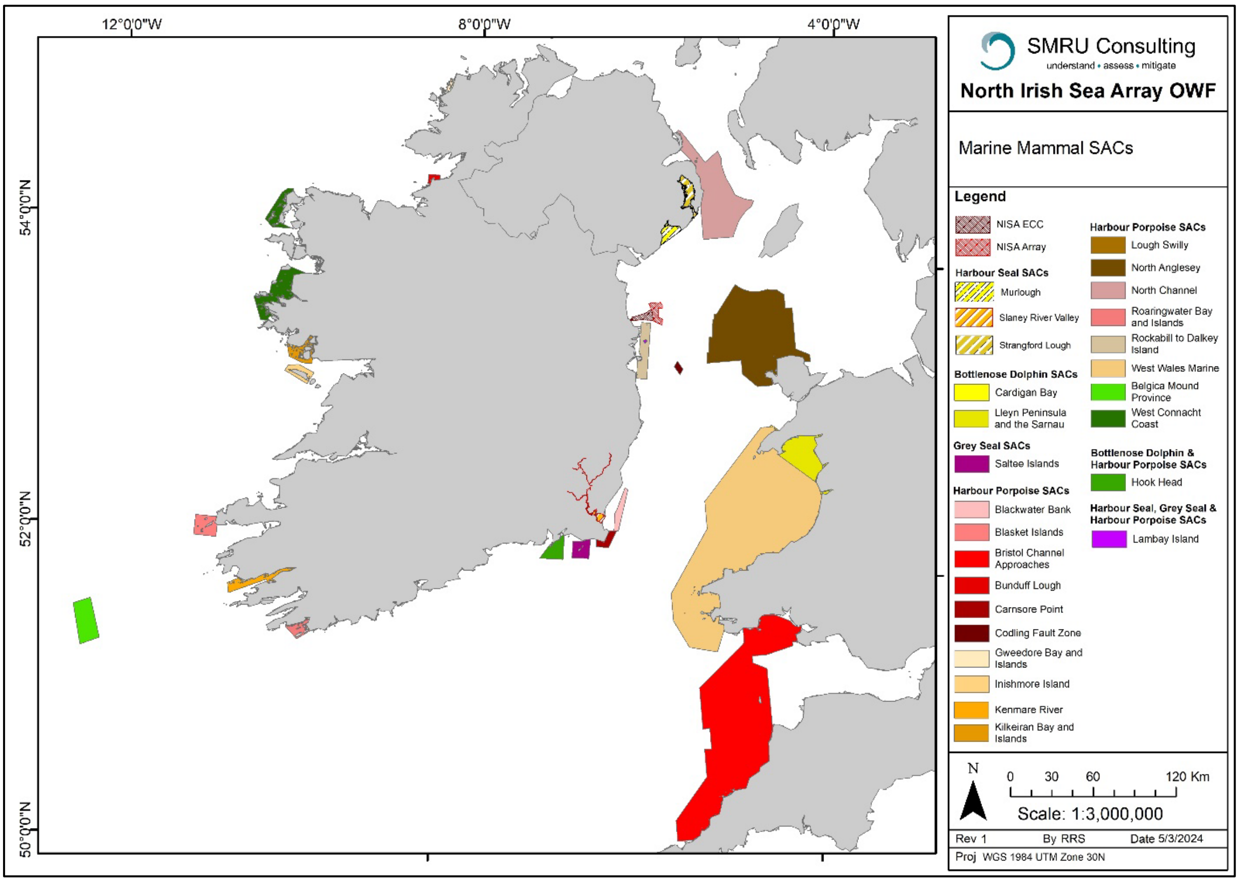

Figure 2 Marine mammal SACs within the marine mammal study area.

3 Data Sources

Table 1 and the following sections provide detail on the key data sources used to characterise the baseline study area for marine mammals in relation to the proposed development. This section details the survey and analysis methodology implemented in each study and the potential limitations associated with these.

Table 1 Data sources examined to inform the baseline characterisation for marine mammals.

Data source	Type of data	Temporal and spatial coverage
Site-specific surveys	Combination of visual boat-based surveys (Nov 2019, Jan 2020 - Mar 2020, June & July 2021) and digital aerial surveys (May 2020 - October 2022) (Natural Power, 2021, 2022)	The original site specific DAS survey extent mirrored the array area within the foreshore licence plus a 4km buffer. The DAS survey extent was updated in November 2020 to include the entire MAC boundary (which included the small area beyond 12nm that was not within the original DAS survey extent.)
SCANS IV (Gilles *et al.*, 2023)	Aerial and vessel visual surveys resulting in survey block specific density estimates	June, July, August 2022. All European Atlantic waters. The proposed development is located in block CS-D (western Irish Sea).
SCANS III (Hammond *et al.*, 2017,	Aerial and vessel visual surveys	June & July 2016. All European Atlantic waters. The

Hammond *et al.*, 2021, Lacey *et al.*, 2022)		proposed development is located in block E (western Irish Sea).
SCANS II (Hammond *et al.*, 2013)	Aerial and vessel visual surveys	June & July 2005. All European Atlantic waters. The proposed development is located in block O (entire Irish Sea).
ObSERVE (Rogan *et al.*, 2018)	Visual aerial surveys	4 surveys: summer 2015, winter 2015, summer 2016 and winter 2016. Offshore waters around Ireland, within and beyond Ireland's continental shelf. The offshore development area is entirely located within ObSERVE survey Stratum 5.
Irish marine mammal atlas (Wall *et al.*, 2013)	Collation of data from Irish Whale and Dolphin Group (IWDG), the ISCOPE I and II projects, ferry survey programme and the PReCAST surveys.	2005-2011 Irish EEZ.
IWDG Irish Sea surveys (Berrow *et al.*, 2011)	Visual and acoustic survey	2 surveys in August 2011. Inshore surveys in 2 blocks: Block A (northern Irish Sea – including the proposed development) and Block B (southern Irish Sea).
IWDG SAC surveys (Berrow and O'Brien, 2013, O'Brien and Berrow, 2016, Berrow *et al.*, 2021)	Visual and acoustic line transect surveys	1 survey in 2013 4 surveys in 2016 6 surveys in 2021 Rockabill to Dalkey Island SAC.
IWDG Irish coastal water surveys (Berrow *et al.*, 2008)	Vessel based visual line transect surveys and T-POD acoustic monitoring	6 survey days between July-September 2008. 5 sites (North County Dublin, Dublin Bay, Cork coast, Roaringwater Bay SAC and Galway Bay).
IWDG Greater Dublin Drainage Project surveys (Meade *et al.*, 2017)	Land based observations, vessel-based surveys and CPOD acoustic monitoring	24 surveys: March 2015-March 2017. Land: North-eastern cliffs of Howth Head Vessel: waters off Loughshinny and Portmarnock area CPODs: 3 sites: East of Loughshinny, North of Lambay Island and off Portmarnock.
Marine Ecosystems Research Programme (MERP) maps (Waggitt *et al.*, 2019)	Collation of data from Joint Cetacean Protocol (JCP) (aerial and vessel)	1980 and 2018. European Atlantic waters.
Distribution and abundance of cetaceans Wales and its adjacent waters (Evans and Waggitt,	Maps of sighting rates and indicative density surface maps from aerial and vessel survey data	1990 – 2020 Wales and adjacent seas, including the whole Irish Sea.

2023)		
Seal counts 2017-2018 (Morris and Duck, 2019)	Aerial survey	August 2017 and 2018. Entire coastline of Ireland.
Seal telemetry (Cronin *et al.*, 2016)	Telemetry tags	Strangford Lough: 33x harbour seals (2006, 2008 & 2010) Raven Point (Co Wexford) : 19x grey seals 2013 & 2014 Great Blasket Island: 8x grey seals 2009
Seal at-sea density (Russell *et al.*, 2017)	Density surface based on telemetry and count data	Telemetry data: 1991-2015. Count data: 2015. UK, Republic of Ireland and France.
Seal counts 2005 (Ó Cadhla *et al.*, 2007)	Aerial survey	Spring & summer 2005. Entire coastline of the Republic of Ireland.
Seal counts 2017-2018 (Morris and Duck, 2019)	Aerial survey	August 2017 and 2018. Entire coastline of Ireland.
Seal telemetry (Cronin *et al.*, 2016)	Telemetry tags	Strangford Lough: 33x harbour seals (2006, 2008 & 2010). Raven Point (Co Wexford) : 19x grey seals 2013 & 2014. Great Blasket Island: 8x grey seals 2009.
Codling surveys (Codling Wind Park Limited, 2020)	Visual vessel surveys	April 2013 – March 2014 and again in Oct 2018 – Oct 2019. Codling Wind Park array area.
Arklow surveys (RPS, 2020)	Visual vessel surveys Digital aerial surveys	Monthly vessel surveys: July 1996 and March 1997, and June 2000 and June 2009. Arklow Bank wind farm array area plus a 5 km buffer. Monthly aerial surveys between March 2018 and February 2020. Lease Area plus a 4 km buffer.
Oriel surveys {RPS, 2019 #9864}	Boat-based survey Acoustic monitoring survey (4x CPoDs)	Surveys started in 2018. Unknown timeline

3.1 Site-specific surveys

Site-specific surveys for the proposed development included a combination of vessel-based and digital aerial surveys. Vessel surveys began in November 2019 and were conducted through to March 2020. For the remainder of the surveys, due to the COVID-19 pandemic, the primary survey method switched to digital aerial surveys, which were conducted monthly from May 2020 to October 2022 resulting in 29 surveys. Vessel-based surveys were also conducted again in August 2020 and June/July 2021 to help apportion the unidentified sightings from the digital aerial surveys. The original site specific DAS survey extent mirrored the array area within the foreshore licence plus a 4km buffer. The DAS survey extent was updated in November 2020 to include the entire MAC boundary (which included the small area beyond 12nm that was not within the original DAS survey extent.

3.2 Vessel surveys

The original vessel surveys (Nov 2019, Jan 2020 and Mar 2020) were conducted following the European Seabirds at Sea (ESAS) protocols, with two trained and dedicated marine mammal observers. The vessel survey conducted in August 2020 was intended to collect supplementary ornithological data and marine mammal observers were not present, though off-effort sightings made by the bird surveyors were recorded. Supplementary vessel surveys were conducted in 2021 (June and July). The vessel survey area is shown in Figure 3.

The vessel surveys recorded the following marine mammal species:

- harbour porpoise
- common dolphin
- minke whale
- grey seal
- harbour seal

There were insufficient sightings during the vessel surveys to conduct Distance analysis (Buckland *et al.*, 2001). Instead, encounter rates have been reported (number of sightings of groups per km of survey effort). This is a valid indication of the level of marine mammal presence but does not provide an abundance or density estimate.

Table 2 Vessel site-specific surveys conducted at the NISA array area.

Month	Date	Transect Lines	Survey conditions	Marine Mammals
Nov 2019	28/11/2019	16-10	Wind: NW-NE, Force 2-4 Visibility: 4-5, Cloud: 8/8 Rain: 2-4 Sea state: 2-4 Swell: 0.5-1.5 m	Recorded concurrently by qualified marine mammal surveyors Grey seal: 3 sightings (3 individuals) Harbour porpoise: 6 sightings (9 individuals)
	29/11/2019	9-3	Wind: NE-E, Force 2-3 Visibility: 5, Cloud: 2/8-8/8 Rain: 0 Sea state: 2 Swell: 0.5 m	
Jan 2020	18/01/2020	1-6	Wind: W-WNW, Force 2-4 Visibility: 5, Cloud: 1-5/8 Rain: 0 Sea state: 2-4 Swell: 0.5 m	Recorded concurrently by qualified marine mammal surveyors Common dolphin: 2 sightings (20 individuals) Grey seal: 9 sightings (9 individuals) Harbour porpoise: 17 sightings (30 individuals) Harbour seal: 2 sightings (2 individuals)
	19/01/2020	7-12	Wind: W-SSW, Force 1-2 Visibility: 5, Cloud: 4-7/8 Rain: 0 Sea state: 1-2 Swell: 0.25-0.5 m	
	20/01/2020	13-16	Wind: SW-SSW, Force 3-4 Visibility: 5, Cloud: 1-4/8 Rain: 0 Sea state: 2-4 Swell: 0.5 m	
Mar 2020	05/03/2020	1-8	Wind: E-W, Force 1-3 Visibility: 5, Cloud: 6-7/8	Recorded concurrently by qualified marine mammal

			Rain: 0 Sea state: 1-3 Swell: 0.2-0.4 m	surveyors Harbour porpoise: 13 sightings (22 individuals) Grey seal: 11 sightings (17 individuals) Seal sp.: 1 sighting (1 individual)
	06/03/2020	9-16	Wind: SSE-NW, Force 1-4 Visibility: 5, Cloud: 2-8/8 Rain: 0-1 Sea state: 2-4 Swell: 0.3-0.5 m	
Aug 2020	06/08/2020	16-9	Wind: S-SE, Force 1-4 Visibility: 2-5, Cloud: 0-8/8 Rain: 0 Sea state: 2-4 Swell: 0.3-0.5 m	No marine mammal observers. No marine mammal sightings.
	07/08/2020	1-6	Wind: SE, Force 4-5 Visibility: 2-5, Cloud: 6-8/8 Rain: 0-3 Sea state: 3-5 Swell: 0.5-1.5 m	
Jun 2021	22/06/2021	Q17-Q5	Wind NE force 2-3 Cloud cover 2/8-6/8 No precipitation Good visibility Sea state 1-3 Swell height ≤0.5 m	2 marine mammal surveyors. Grey seal: 1 on-effort Minke whale: 7 on-effort, 3 off-effort Common dolphin: 15 on-effort Harbour porpoise: 9 on-effort, 1 off-effort
Jul 2021	21/07/2021	Q1-Q5	Wind NE force 2-3 Cloud cover 1/8 No precipitation Excellent visibility Sea state 1-3 Swell height 0.25 m	2 marine mammal surveyors. Grey seal: 0 on-effort, 1 off-effort Minke whale: 4 on-effort Common dolphin: 41 on-effort, 2 off-effort Harbour porpoise: 7 on-effort, 7 off-effort
	23/07/2021	Q5-Q12	Wind NE force 3 Cloud cover 3/8-6/8 No precipitation Good visibility Sea state 3-4 (occ. 5) Swell height 0.75-1.0 m	

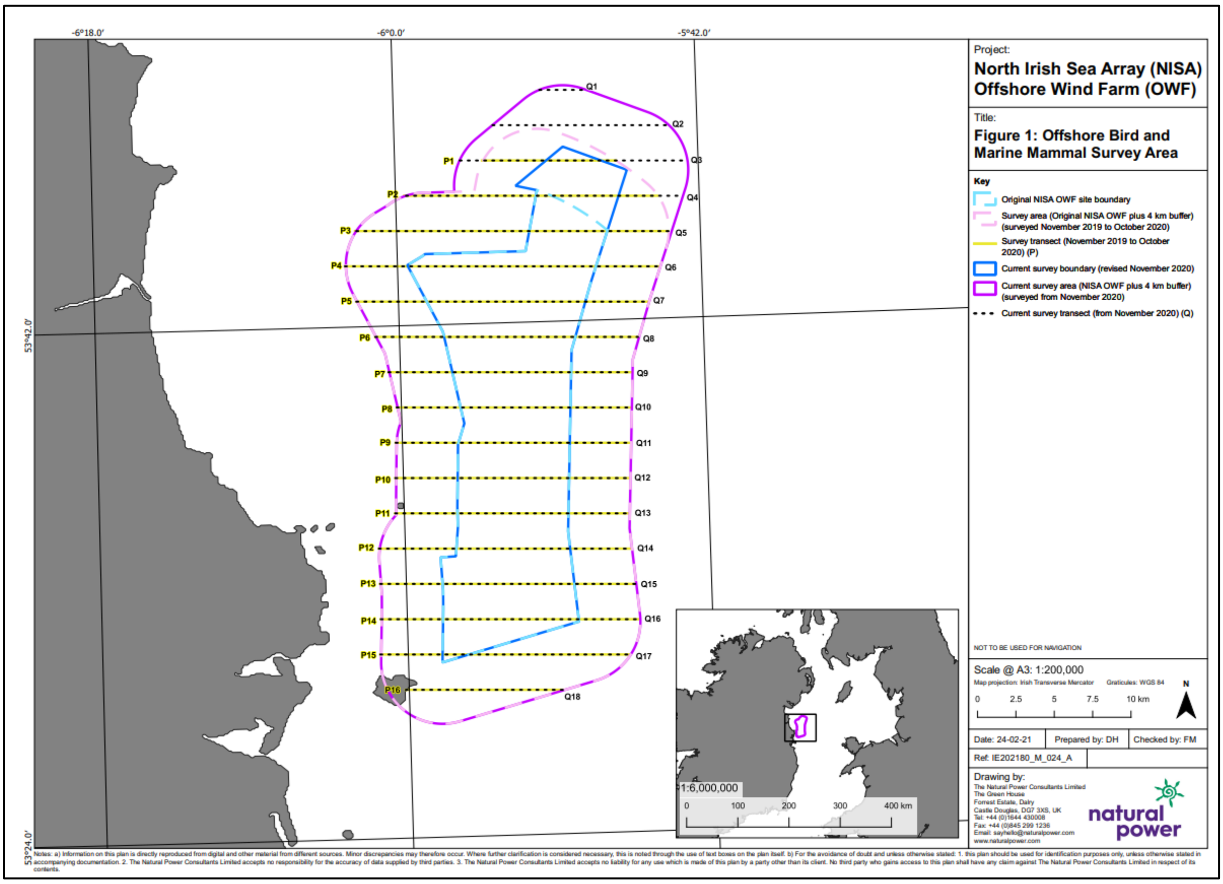

Figure 3 Marine mammal study area – vessel surveys.

3.3 Aerial surveys

In May 2020, monthly digital aerial surveys (DAS) conducted by APEM Limited commenced, following the same 16 transect lines as the previous vessel surveys. The surveys were flown at an altitude of ~1,300 feet, at a speed of ~120 knots, resulting in coverage of 15% of the sea surface within the survey area. As images were analysed post-survey, observers onboard the aircraft were not required.

From November 2020 the proposed development array area was revised slightly (light blue boundary in Figure 3) and as such the survey area was also revised to ensure a 4 km buffer around the MAC was included. This amended the survey design to a total of 18 transects (Figure 4). In total, 29 aerial surveys were conducted between May 2020 and October 2022 (Table 3).

Table 3 Aerial site-specific surveys conducted at the NISA array area.

	Month	Date	Survey conditions
1	May 2020	13/05/2020	Few to scattered clouds, good visibility, wind from N-W, sea state 3.
2	Jun 2020	02/06/2020	Overcast, good visibility, wind from N-W, sea state 1-2.
3	Jul 2020	18/07/2020	Broken cloud to overcast, good visibility, wind from NW, sea state 2.
4	Aug 2020	15/08/2020	No cloud, good visibility, wind from W, sea state 1-2.
5	Sep 2020	10/09/2020	Overcast, good visibility, wind from W, sea state 2-3.
6	Oct 2020	17/10/2020	Overcast, good visibility, wind from E, sea state 1-2.
7	Nov 2020	13/11/2020	Scattered cloud, good visibility, wind from SSE, sea state 2-3.
8	Dec 2020	12/12/2020	No cloud, good visibility, wind from W, sea state 2-3
9	Feb 2021	21/02/2021	Scattered cloud, good visibility, wind from S, sea state 1.

10	Mar 2021	19/03/2021	No cloud, good visibility, wind from ENE, sea state 1.
11	Apr 2021	07/04/2021	Broken cloud, good visibility, wind from NW, sea state 1-2.
12	May 2021	14/05/2021	No cloud, good visibility, wind from W, sea state 0.
13	Jun 2021	03/06/2021	Scattered cloud, good visibility, wind from N then SW, sea state 2-3.
14	Jul 2021	05/07/2021	Broken cloud, good visibility, wind from S, sea state 3.
15	Aug 2021	22/08/2021	Broken cloud, good visibility, wind from NW, sea state 1.
16	Sep 2021	05/09/2021	Broken cloud, good visibility, wind from S, sea state 1.
17	Oct 2021	08/10/2021	Broken cloud, good visibility, wind from SW, sea state 2.
18	Nov 2021	05/11/2021	Overcast, good visibility, wind from W, sea state 2-3.
19	Dec 2021	05/12/2021	Clear to scattered cloud, good visibility, wind from N, sea state 3-4.
20	Jan 2022	11/01/2022	Few clouds, good visibility, wind from W, sea state 2.
21	Feb 2022	11/02/2022	Overcast, good visibility, wind from W, sea state 1.
22	Mar 2022	05/03/2022	Scattered cloud, good visibility, wind from N-NE, sea state 2-3.
23	Apr 2022	01/04/2022	Scattered cloud, good visibility, wind from N-NW, sea state 3.
24	May 2022	12/05/2022	No cloud, good visibility, wind from W-SW, sea state 1.
25	Jun 2022	04/06/2022	Scattered cloud, good visibility, wind from NE, sea state 3.
26	Jul 2022	04/07/2022	Broken cloud, good visibility, wind from W, sea state 0-1.
27	Aug 2022	06/08/2022	Scattered cloud, good visibility, wind from W, sea state 1.
28	Sep 2022	01/09/2022	Few clouds, good visibility, wind from NE, sea state 1.
29	Oct 2022	01/10/2022	Overcast, good visibility, wind from SW-W, sea state 3.

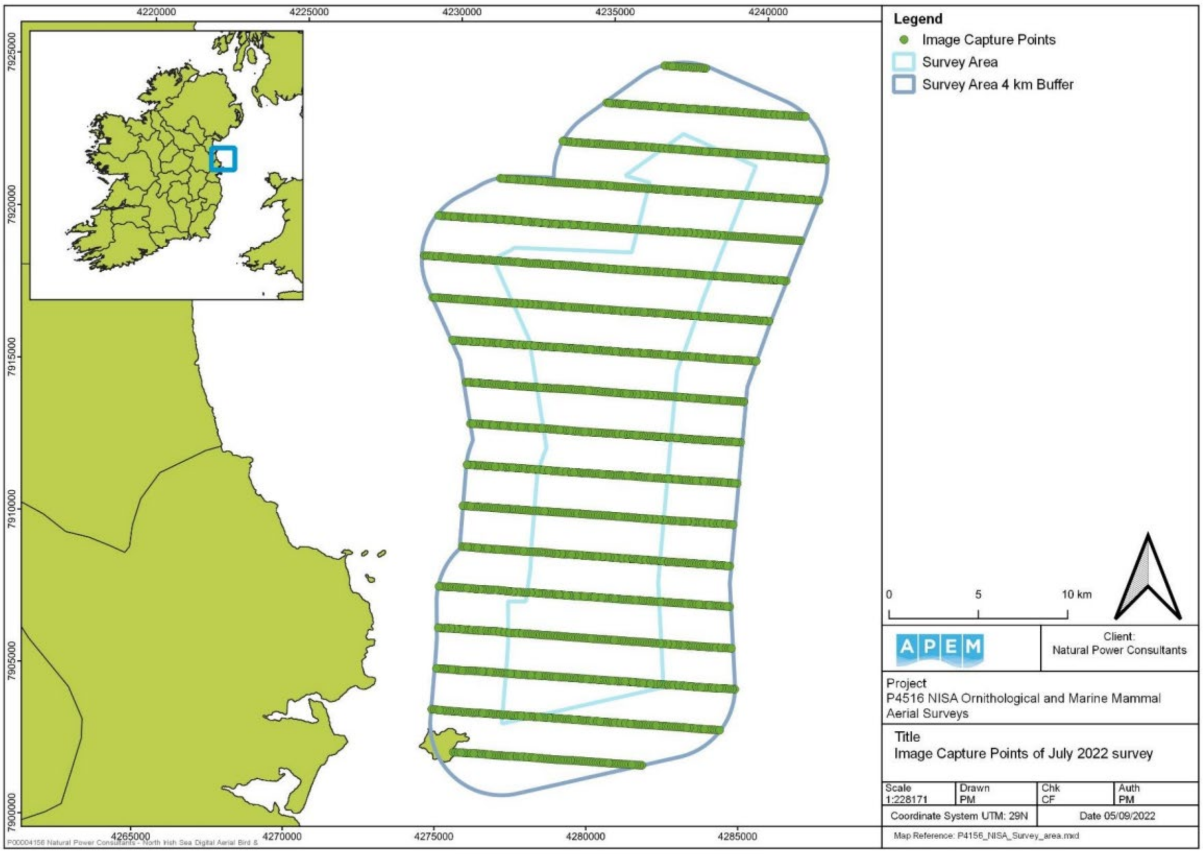

Figure 4 Marine mammal study area – aerial surveys.

Marine mammal encounter rates have been calculated per survey (number of individuals per km^2 survey effort). It is difficult to identify to species level sightings of marine mammals that are below the water surface. As such, these sightings get recorded as "unidentified dolphin/porpoise". The 29 aerial surveys recorded the following species:

- Bottlenose dolphin (n=3, 0.3%)
- Common dolphin (n=116, 11.4%)
- Grey seal (n=23, 2.3%)
- Harbour porpoise (n=575, 56.4%)
- Minke whale (n=2, 0.2%)
- Marine mammal (no ID) (n=24, 2.4%)
- Dolphin/porpoise (no ID) (n=209, 20.5%)
- Dolphin species (no ID) (n=27, 2.6%)
- Seal species (no ID) (n=41, 4.0%)

In total, 1,020 marine mammals were sighted across the 29 months of aerial surveys. Of these, 301 were not categorised to species level (29.5% of the total sightings). Apportioning was used to assign each of the unidentified sightings to a particular species. All unidentified seals were attributed to grey seals (since no harbour seals had been recorded). Unidentified dolphin/porpoise sightings were apportioned using the ratios presented in Table 4. Adjusted numbers of dolphins and harbour porpoise were then used alongside the observations of seals to calculate the ratios to attribute the 'unidentified marine mammal" sightings. As shown in Table 4.

The harbour porpoise density estimates were corrected for availability bias (accounting for animals underwater and not available to be detected) using tag data from Teilmann *et al.* (2013). This means that the resulting harbour porpoise density estimates are "absolute" density estimates. By contrast, no correction for availability bias was used for other marine mammal species, and thus the resulting density estimates are "relative" density estimates, not true "absolute" density estimates. This was due to a lack of data.

Table 4 Proportions used to apportion unidentified marine mammal species recorded using DAS.

Species group	Species	Season	Proportion
Dolphin/porpoise	Common dolphin	Breeding/summer	0.16
	Harbour porpoise		0.84
	Common dolphin	Non-breeding/winter	0.01
	Harbour porpoise		0.99
Marine mammal species	Common dolphin	Breeding/summer	0.15
	Grey seal		0.1
	Harbour porpoise		0.76
	Common dolphin	Non-breeding/winter	0.01
	Grey seal		0.08
	Harbour porpoise		0.9

3.4 ObSERVE

From 2015-2016, offshore aerial surveys were conducted during the summer and winter months in Ireland (Rogan *et al.*, 2018), collecting data on the distributions and abundances of marine mammal species present within the survey area (Figure 5). In 2016, additional inshore/coastal surveys were conducted in both the winter and summer months (Rogan *et al.*, 2018). These surveys represent the first large-scale dedicated line-transect surveys conducted in winter months of cetaceans, and as such provided the first data on inter-seasonal changes in abundance and distribution on a regional scale.

The survey design included a study area consisting of offshore waters around Ireland, both within and beyond Ireland's continental shelf. This study area was initially divided into five strata in 2015, with a further three inshore strata added in 2016. Two zigzag transects were flown within each stratum, with observations recorded and conducted following a standardised protocol designed for aerial surveys. In the case of cetacean sightings, the protocol used was designed using a line-transect methodology, with observer effort restriction to approximately 500 m either side of the aircraft. Two randomly placed transect lines were generated for each stratum. The line-transect positions and start points were changed each year to provide two independent datasets per season per stratum, also providing a more representative coverage of the survey area. In 2015, the total distance flown was 16,802 km within a survey area measuring 297,480 km^2 and in 2016 the distance flown totalled 20,295 km within a survey area measuring 339,377 km^2.

During all four surveys, four observers were on board the aircraft, with two on each side of the aircraft. The aircrafts position was recorded every two seconds through the use of an on-board GPS. Observers recorded all sightings of marine fauna, as well as Beaufort Sea State, cloud cover, glare extent and severity, the corresponding declination angle of the aircraft to the animal sighted, species, sighting time, group size, presence of calves and behaviours observed.

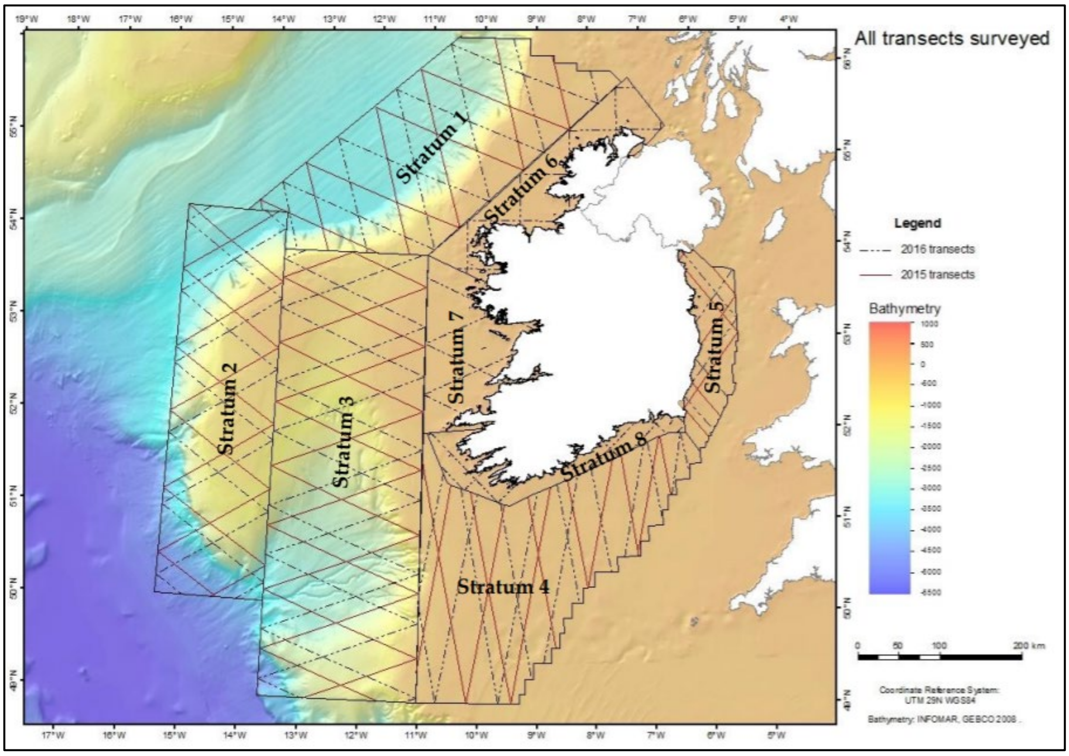

Figure 5 Map of the survey area for the ObSERVE surveys in 2015 and 2016 (Rogan *et al.*, 2018).

Across all of the survey periods, a total of 1,844 cetacean sightings were recorded, comprising of 19 species from an estimated 8,633 individuals. When there was sufficient data collected (60 sightings required for a species/species group) two approaches to estimate abundance were utilised including a design-based method and a model-based method.

The surveys were designed to *"inform the assessment of risk to protected species and their habitats from a range of human activities (e.g., through man-made disturbance or operational interactions)"* (Rogan *et al.*, 2018), and as such, the analysis methodology was designed to achieve the best absolute abundance and density estimates possible, by correcting for biases in Distance sampling methodology. The probability of detecting an animal on the trackline (g(0)) was corrected for using the moderate sightings condition g(0) estimates calculated from the SCANS III surveys (0.279 for porpoise, 0.414 for dolphin species and 0.302 for minke whales), and therefore absolute abundance and density estimates were able to be calculated.

The design-based abundance estimate method consisted of utilising the programme DISTANCE version 7.0 to generate estimated abundances using mark-recapture distance sampling (MRDS) methods. In order to fit the detection functions to the species included in the analyses, all data available were included, consisting of data both on and off-transects in each survey, as well as data from all years and seasons being pooled together. Upon deriving a final detection function for each species, or in some cases, groups of species, individual abundance estimates were calculated. In addition to the design-based abundance estimates, model-based abundance estimates were also calculated using Generalised Additive Models with a set of environmental variables to examine habitat use.

3.5 SCANS

The SCANS surveys consist of SCANS I, II, III and IV which were conducted in 1994, 2005, 2016 and 2022. These are large-scale surveys which have been specifically designed to generate comprehensive estimates of abundance for marine mammal species within European Atlantic waters. Each of these surveys provides equal coverage probability within survey blocks such that each point within a block has the same probability of being surveyed. As a result, an unbiased abundance estimation is generated when extrapolating sample densities to block-wide density estimates (Hammond *et al.*, 2017, Hammond *et al.*, 2021, Gilles *et al.*, 2023).

A key limitation to these surveys is that they are only conducted during the summer months and as a result, are not representative for other seasons in the year. This can be an issue for marine mammal species with seasonal distributions, and there is the potential to overestimate average annual abundances for such species using the SCANS density estimates alone.

To generate an estimation of abundance for marine mammal species sighted during the surveys, only data collected during good and moderate sighting conditions were included. The effective strip width was estimated for good and moderate conditions respectively. Total densities were estimated by dividing the abundance estimates by the area of the associated stratum. Both coefficients of variation (CVs) and 95% confidence intervals (CIs) were estimated using bootstrapping[1] within each stratum. In the case of marine mammal species where sighting and the circle back method was not implemented, the abundance estimates were calculated using conventional line transect methods which assumed a certain detection on the transect line. As a result of this, the estimates generated for these marine mammal species are underestimated to an unknown degree.

3.5.1 SCANS IV

The SCANS IV surveys were conducted from June to October 2022, and comprised a combination of vessel and aerial surveys (Gilles *et al.*, 2023). The main objective of the SCANS IV survey was to estimate small cetacean abundance and density in the North Sea and European Atlantic waters. The surveyed area included the offshore waters of Portugal which were not previously surveyed as part of SCANS, but excluded coastal Norwegian waters north to Vestfjorden that were included in SCANS III and waters to the south and west of Ireland that were included in the ObSERVE 2021/2022

[1] Bootstrapping is a statistical procedure that resamples a single data set to create many simulated samples

project. Species abundance was estimated using the same methodology as for SCANS III (see Hammond *et al.* (2021)).

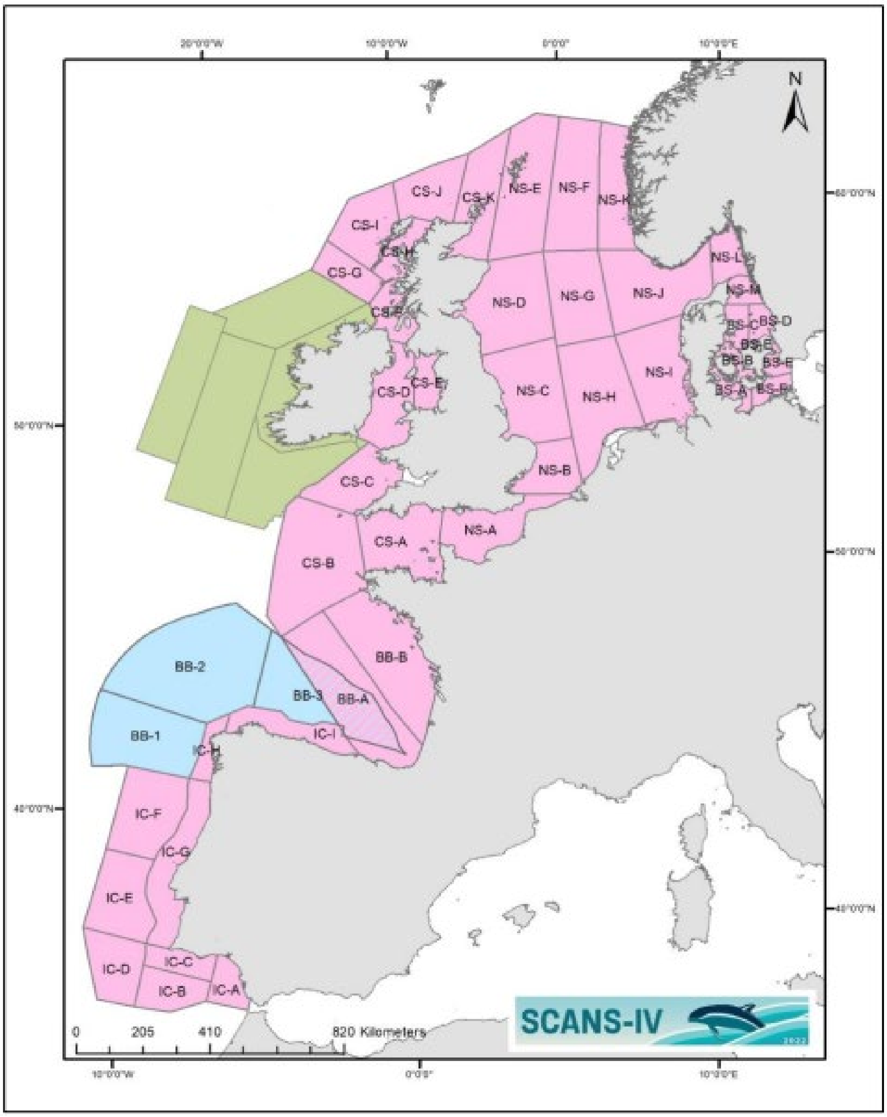

Figure 6 Area covered by SCANS IV survey blocks. pink blocks were surveyed by air and blue blocks were surveyed by ship (Gilles *et al.*, 2023).

The survey blocks used during SCANS IV are presented in Figure 6 and the proposed development is located in SCANS IV block CS-D (formerly block E as per SCANS III). This block contained a surface area of 34,867 km^2 and the surveys concluded a primary search effort of 2,375.2 km and a trailing search effort of 59.2 km. During these surveys, the most common species sighted in block CS-D were harbour porpoise, bottlenose dolphin, common dolphin and minke whale.

3.5.2 SCANS III

During the SCANS III survey in 2016, the shelf waters on the east coast of Ireland were surveyed using aircraft visual survey methods. The aircraft had three scientific crew members on-board, with two observers at bubble windows and a third crew member completing datasheets. The target altitude for the survey was 183 m, with a speed of 167 km/h. Additional data was collected including turbidity, sighting conditions and glare. During the detection of marine mammal species, data recorded included time, declination angle to the detected angle, presence of calves, species identification, behaviour and group size. In order to correct for marine mammals which may have been missed within the transect line, the circle back method was implemented. This approach included the aircraft circling back to resurvey the segment of the transect in which a marine mammal detection was made.

In order to generate an estimation of abundance for marine mammal species sighted during the surveys, only data collected during good and moderate sighting conditions were included. The effective strip width was estimated for good and moderate conditions respectively. Total densities were estimated by dividing the abundance estimates by the area of the associated stratum. Both coefficients of variation (CVs) and 95% confidence intervals (CIs) were estimated through the use of bootstrapping within each stratum. In the case of marine mammal species where sighting and the circle back method was not implemented, the abundance estimates were calculated using conventional line transect methods which assumed a certain detection on the transect line. As a result of this, the estimates generated for these marine mammal species are underestimated to an unknown degree.

As part of SCANS III, the survey data were modelled in relation to spatially linked environmental features to produce density surface maps for the following cetacean species: harbour porpoise, bottlenose dolphin, white-beaked dolphin, common dolphin, striped dolphin, long-finned pilot whale, beaked whale species, minke whale and fin whale (Lacey et al. 2022). The cetacean data used in the models were the same as those obtained in 2016 that were used to provide block specific abundance estimates in Hammond et al. (2021). The environmental covariates used in the density surface modelling were selected due to their potential to explain the additional variability in the cetacean density estimates (for example, depth of the seabed, sea surface temperature (see Lacey et al. (2022) for the full list of environmental covariates). The models were fitted using a spatial resolution of 10 km and predicted onto a 10 x 10 km spatial grid. Using the predicted density estimates from the surface models, density and abundance estimates can be generated for an entire survey area or a defined area within it, such as the proposed development study area.

3.5.3 SCANS II

During the SCANS III surveys (Hammond *et al.*, 2017, Hammond *et al.*, 2021), the east coast of Ireland, including the study area of the proposed development, was assigned as block E. This block contained a surface area of 34,870 km^2 and the surveys concluded a primary search effort of 2,252.7 km and a trailing search effort of 22.5 km. During these surveys, the most common cetacean species sighted in block E included harbour porpoise, bottlenose dolphin, Risso's dolphin and minke whale.

The survey blocks covered in SCANS II differed from those in SCANS III, and so it is not possible to directly compare block specific density estimates between the two surveys. During the SCANS II surveys (Hammond *et al.*, 2013), the entire Irish Sea (including the NISA array area and ECC) was surveyed as block O. This block was 45,417 km^2, of which 2,264 km was surveyed by air. During these surveys, the most common species sighted in block O were harbour porpoise, common dolphins, minke whales and bottlenose dolphins.

3.6 Irish Marine Mammal Atlas

The Irish marine mammal atlas (Wall *et al.*, 2013) collates data collected during the IWDG casual and effort-based sightings scheme from January 2005-2011, the ISCOPE I and II projects, the 2008-2011 ferry surveys programme and the IWDG and GMIT (Galway-Mayo Institute of Technology) marine mammals and megafauna in Irish waters project (PReCAST surveys). Data was collected through the use of vessel surveys and casual sightings which were submitted to an online database and went through a validation process.

Vessel surveys included effort from research vessels, commercial ferries and naval vessels carried out from 2005-2011. During these vessel surveys, environmental data as well as marine mammal sightings were recorded using Logger 2000 software. These surveys were carried out on vessels of opportunity and as a result, marine mammal sightings were not approached as the surveys were conducted in 'passing mode'. Where possible, marine mammal sightings were recorded at species level, with species identification being labelled as definite, probable or possible. In cases where species identification was not possible, these sightings were labelled as 'unidentified dolphin' etc., following criteria established for the IWDG's cetacean sightings database.

Casual sightings utilised from the IWDG online database went through a validation process. Approximately 15% of sighting records included images, which assisted in the validation process. These sightings were also identified at species level where possible, and in cases where species identification was not possible, the above method was replicated, labelling these sightings as 'unidentified whale' etc.

The total survey effort, defined as hours surveyed within sea states 0 to 6 per 50 km^2, was summed up and mapped, as well as the total number of marine mammals counted per 50 km^2, categorised by species. In the case of species with insufficient amounts of data, both effort and sightings for these species were mapped according to season, defined as the astronomical cycle of seasons (spring, summer etc.). In cases where there was insufficient data for a species to map seasonal effort and sightings, all of the data available were combined into a single map. The relative abundance of species was generated as the number of animals recorded per survey hour. A time-based analysis of relative abundance was used as it was concluded to be more suited than an area-based analysis as data from a variety of different platforms which were travelling at different speeds, were being combined (Reid *et al.*, 2003). The survey effort was categorised based on sea state, with lower sea states utilised for cetacean species which were more challenging to detect, and higher sea states utilised for more easily detectable cetacean species. In cases where non-effort related sightings were reported inside a grid square, but no effort-related sightings occurred in that square, the grid square was marked positive for sightings in order to facilitate species distribution mapping, however no relative abundance was calculated for the grid square.

A total of 1,078 days-at-sea were carried out from 2005-2011 within the Irish exclusive economic zone (EEZ) and its adjacent waters (Figure 7). From this, 5,084 hours of survey efforted were completed in reported sea states of 6 or less. In total, 2,557 effort-related sightings and 7,454 non-effort-related sightings across 18 marine mammal species including 2 pinniped species and 16 cetacean species, were included in the analysis.

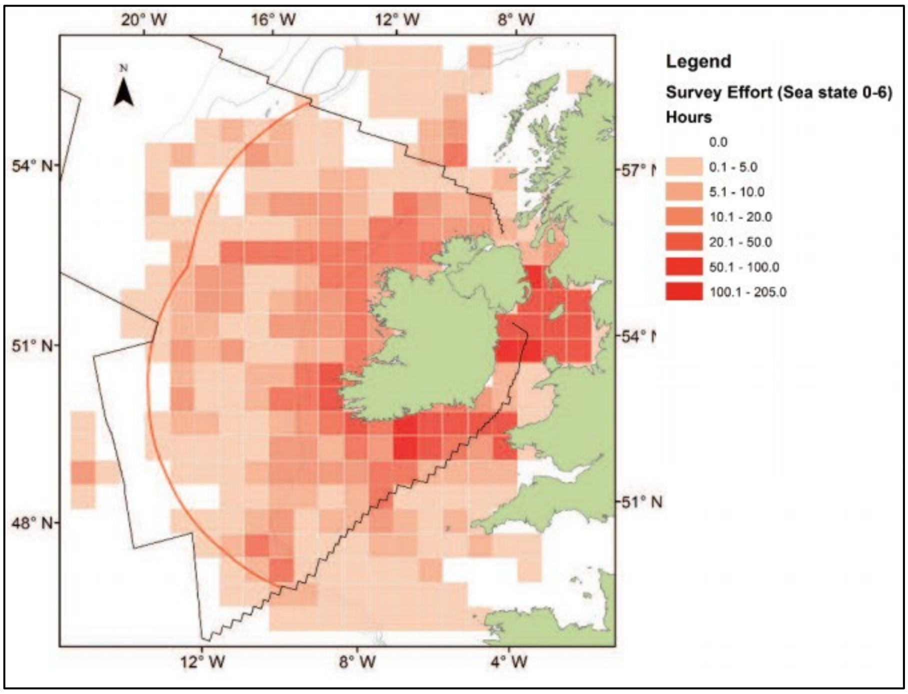

Figure 7 Total survey effort achieved under the IWDG and GMIT monitoring programmes from 2005-2011 (Wall *et al.*, 2013).

3.7 MERP maps

The aim of the MERP project was to produce species distribution maps of cetaceans and seabirds at basin and monthly scales for the purposes of conservation and marine management. A total of 2.68 million km of survey data in the Northeast Atlantic between 1980 and 2018 were collated and standardized. Only aerial and vessel survey data were included where there were dedicated observers and where data on effort, survey area and transect design were available. The area covered by Waggitt *et al.* (2019) comprised an area spanning between Norway and Iberia on a north-south axis, and Rockall to the Skagerrak on an east-west axis. Waggitt *et al.* (2019) predicted monthly densities for each species, 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 (Barry and Welsh, 2002). The outputs of this modelling were monthly predicted density surfaces for 12 cetacean species at a 10 km resolution.

The authors list three key limitations of the data analysis and the resulting distribution maps which require the maps to be interpreted carefully. Firstly, the influence of small or sub-populations on the model is limited, secondly, the model does not account for large changes in populations within the study period and thirdly, although seasonal movement were detected, there were also many instances of seasonal changes in densities without changes in overall distribution. The authors state that because of these limitations, the maps *"should not be used as a representation of absolute densities and fine-scale distributions"* and recommend that instead, they are used as a *"general illustration of relative densities and broad-scale distribution over several decades"*. 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. Given the limitations of the data, these density maps were not considered in this baseline characterisation.

3.8 Distribution and abundance of cetaceans in Wales and its adjacent waters

Marine mammal distributions and abundances were determined from data collated from dedicated aerial and vessel surveys across Wales and adjacent seas, over three decades (1990-2020) (Evans and Waggitt, 2023). For five cetacean species (harbour porpoise, bottlenose dolphin, common dolphin, Risso's dolphin and minke whale), modelling was used for density surface predictions, accounting for variation in detection rates between platforms, and key environmental conditions present during surveys. While the data range spans 30 years the authors consider that *"the distributions of both seabirds and cetaceans in this region are thought to have remained similar across decades"*.

The study area is inclusive of the Irish Sea, Bristol Channel and adjacent Celtic Sea south to the coast of Cornwall. Survey data was screened for typographical and positional errors. This study includes only data from surveys which included essential information to calculate the variations in the surface area surveyed (Table 5). This includes variables such as platform type and height, transect design and recording methods. Density calculations included Effective Strip Width (esw), Line and ESAS transects, strip transects and subsequent adjustments to esw (Evans and Waggitt, 2023). The key environmental variables considered in the modelling included temperature, attenuation, depth, current speed, stratification and seabed roughness.

A total of 443,669 km of survey data was utilised for map production and distribution modelling for cetaceans. Survey effort for cetaceans was greatest in the summer months, particularly July when SCANS and ObSERVE have taken place (Figure 8). Winter surveys were conducted primarily by plane and targeted over coastal waters (Evans and Waggitt, 2023). The authors note that *"survey effort has varied greatly in space and time, with many significant gaps even after the collation of several datasets"* and noted that the primary survey methods changed over time from vessel to aerial surveys which can lead to potential biases in the results.

The data were gridded to give species presence, animal density and the surface area covered per grid cell. Species Distribution Models used the hurdle approach outlined in Waggitt *et al.* (2019), using both a presence-absence model to identify species range and a count model to identify areas of high density within the overall range. GLMs and GEEs were then used to estimate the relationship between survey methods and probability of encounter or density, and to estimate the relationship between animal presence and environmental conditions. The probability of encountering an animal was estimated using a binomial model and animal density was estimated using a Poisson model. The result was a predicted density surface for each species over a 2.5 x 2.5 km grid in the Irish Sea.

Table 5 List of data providers and kilometres of effort surveyed for cetaceans in the study area of Wales and surrounding seas (Evans and Waggitt, 2023).

Data source	Platform Type	No. of km surveyed
Cardigan Bay Marine Wildlife Centre (CBMWC)	Vessel	7,016
Crown Estate	Aerial digital	24,868
ESAS	Aerial visual and Vessel	76,837
Horizon	Vessel	1,716
IWDG	Vessel	65,582
Joint Nature Conservation Committee (JNCC)	Aerial digital and Vessel	2,623
Marine Awareness North Wales (MANW)	Vessel	788
Manx Whale and Dolphin Watch (MWDW)	Vessel	6,331
Natural England	Vessel	1,179
Irish National Parks and Wildlife Service (NPWS)	Vessel	1,283
Irish ObSERVE Surveys	Aerial visual	2,717
ORCA	Vessel	6,313

ORSTED	Aerial digital	6,505
PELTIC	Vessel	3,237
SCANS-I	Vessel	444
SCANS-II	Aerial visual and Vessel	2,627
SCANS-III	Aerial visual	4,254
Sea Watch Foundation (SWF)	Vessel	102,787
Whale and Dolphin Conservation (WDC)	Vessel	1,702
WWT Consulting	Aerial visual	128,672
Total		**447,526**

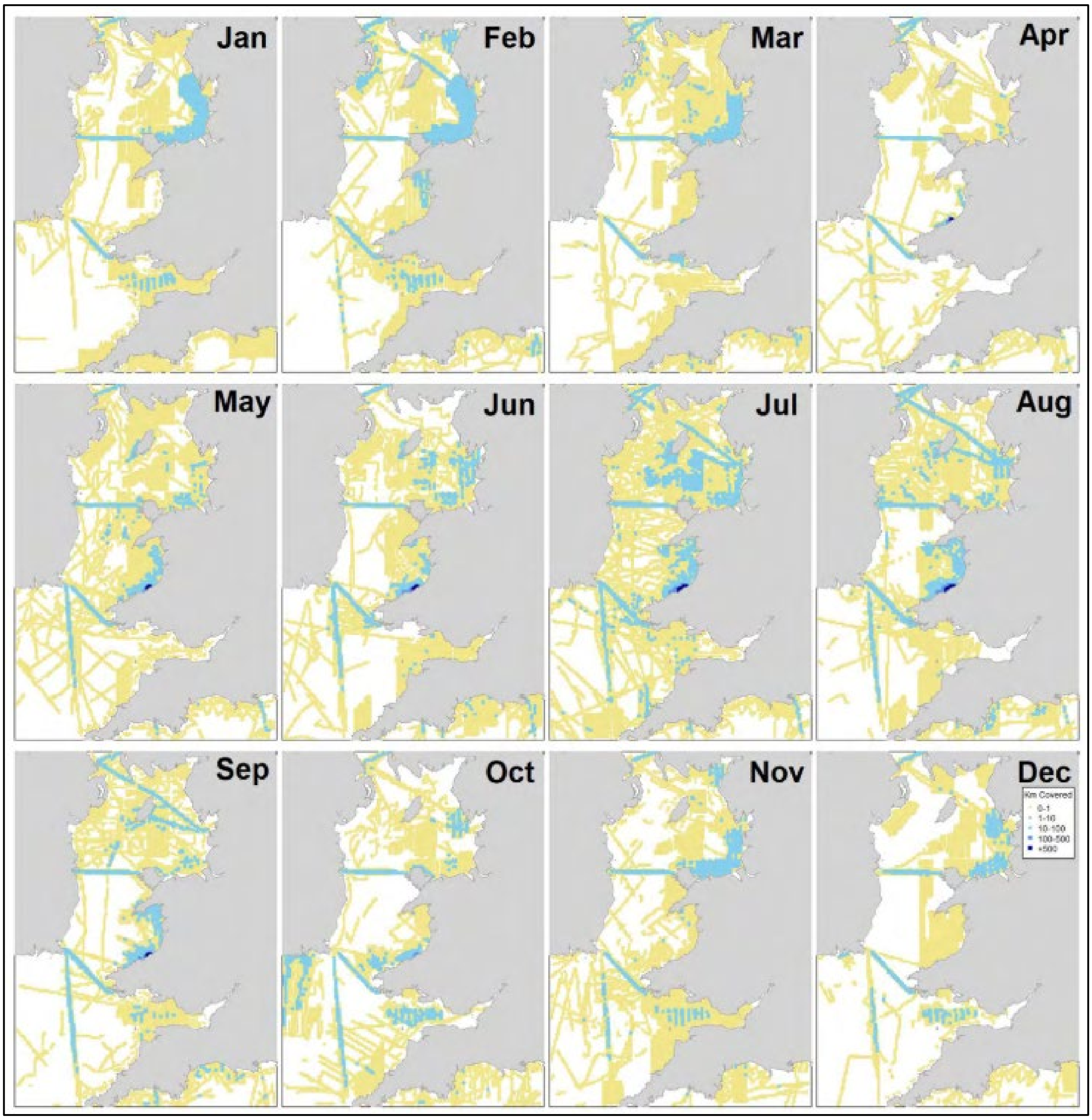

Figure 8 Cetacean survey effort (all providers) by month (Evans and Waggitt, 2023).

3.9 IWDG Surveys

3.9.1 Bottlenose dolphin Photo-ID surveys

A total of eight systematic photo-ID surveys were carried out by the IWDG between July and September 2008 (O'Brien *et al.*, 2009). Data from these surveys were then combined with two other sources including images of bottlenose dolphins obtained from GMIT and images collected by members of the public and IWDG. All of these images combined are referred to as the Irish Coastal Bottlenose Dolphin Catalogue. A total of 120 bottlenose dolphins were compared to determine if matches could be found between them (O'Brien *et al.*, 2009). All images were obtained using high resolution digital cameras, in some cases, images submitted by members of the public were of lower image quality but still deemed usable. Using Adobe Photoshop imaging software, each image was reviewed for unique markings in order to identify individuals. Images were graded using a Q-scale (1-3), in which grade 1 images were categorised as being of good quality, grade 2 were of lesser quality but still usable and grade 3 were of poor quality and as a result, unusable. The distance between re-sightings of individuals was possible to obtain as the latitude and longitude of each sighting had been recorded, this was calculated using Garmin MapSource software. To further explore the movements of individuals in the ICBDC, data comparisons were made between this dataset and two additional datasets, one from the RoI provided by the Shannon Dolphin and Wildlife Foundation and one from the UK, provided by the Sea Watch Foundation.

Berrow *et al.* (2012) conducted an abundance assessment of bottlenose dolphins in the Lower Shannon SAC between July and October 2010. Line transect surveys were carried out on fixed, predetermined routes within the Shannon Estuary from a watercraft. Three transects were carried out each month, totalling to 12 transects in total for this survey. Surveys were only carried out during Beaufort Sea State 2 or less and at a maximum speed of 20 km per hour. Group size was recorded as the total number of individuals present, with the total number of adults, juveniles and calves also being recorded. Photo-ID was utilised during this survey, all images were categorised, and markings were graded on a severity scale from 1-3 (Berrow *et al.*, 2012). All images were also scored for quality, with only good quality images included in the final analysis in order to minimise error in matching images. Abundance estimates were calculated using validated datasets of all sightings/re-sightings of individuals. These datasets were then incorporated into a closed model which included a heterogeneity in capture probability, using MARK and CAPTURE software. This was used to obtain overall population size estimates, taking into account the weighted mean proportion of well-marked individuals and measure of survival/migration obtained from the model.

Whilst this study was not conducted in close proximity to the study area, its inclusion is considered of relevance due to the connectivity between the east and west coast of Ireland populations.

3.9.2 Inshore surveys – Irish Sea

Visual and acoustic surveys for cetaceans were carried out in two survey blocks in the Irish Sea to gain information on species distributions, relative abundances and absolute abundances where possible (Berrow *et al.*, 2011) (Figure 9). Single platform line-transect surveys were conducted in the northern Irish Sea in July and in the southern Irish Sea in August 2011. In total, 348 km of survey effort was carried out across these two blocks along 23 track lines, in which 100% of the northern Irish Sea and 79% of the southern Irish Sea were surveyed in sea state 3 or less. Each block was 1,152 km^2 in surface area, with a perimeter of 48 nm by 7 nm and was located approximately between 6 nm and 12 nm offshore on the east coast. Block A covered the array area. One vessel was used to cover both survey blocks during the survey period. For each sighting, the position of the vessel was recorded in LOGGER as well as the angle of the sighting from the track of the vessel and the radial distance of the sighting. In order to obtain absolute abundance estimations, the statistical package

DISTANCE was used to calculate the density of animals within a prescribed area which had been passed through by the vessel. Passive Acoustic Monitoring (PAM) was also conducted using a towed hydrophone approximately 200 m astern of the survey vessel at a depth of c.2 to 5 m beneath the sea surface. An acoustic monitor continuously monitored the incoming audio both visually through the use of audio-spectrograms and aurally using PAMGUARD. Acoustic detections of cetacean vocalisations were noted, described and their time and GPS locations were recorded. The acoustic survey effort track line was recorded using a GPS receiver which provided National Marine Electronics Association (NMEA) data to the PAMGUARD software.

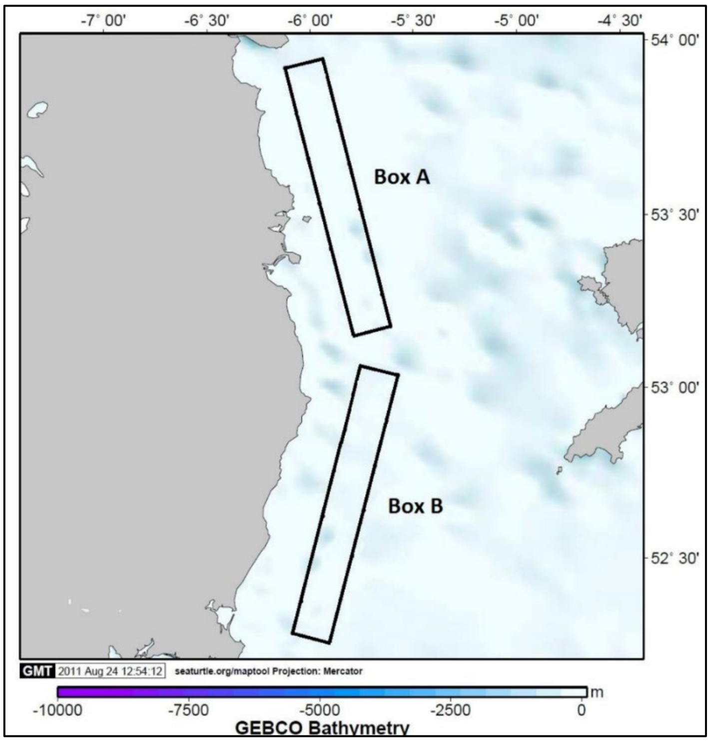

Figure 9 Map of east Ireland showing the locations of survey blocks surveyed for cetaceans in 2011 (Berrow *et al.*, 2011).

3.9.3 Rockabill to Dalkey Island SAC surveys (2013, 2016 & 2021)

A visual and PAM survey of harbour porpoises was carried out in 2013 at two SACs (Rockabill to Dalkey Island SAC, Co Dublin and Roaringwater Bay and Islands SAC, Co Cork) in order to calculate local density and abundance estimates (Berrow and O'Brien, 2013). These surveys were in close proximity to the south and west part of the survey area. Line-transects were utilised for this survey, with an estimated 273.3 km^2 covered for the survey area around the Dublin area coastline (Figure 10). The survey was conducted using a vessel, with conventional single platform line-transect surveys carried out within or in close proximity to the boundaries of the survey sites along pre-determined track lines. All sightings were recorded, however sightings which occurred more than 200 m from the track line (300 m if sea-state 0) were not used in the distance sampling model. During each sighting, the position of the vessel was recorded as well as the angle of the sighting from the track of the vessel, along with the estimated radial distance of the sighted animal from the vessel. Distance sampling was used to obtain density estimates and to calculate an abundance estimate for each site where possible. In this survey, it was assumed that all animals on the track line were accounted for. The overall pooled density and abundance estimates for each site were obtained from all track lines which were surveyed in sea state 2 or less, combined across all days. The data were fitted to a number of models in the DISTANCE software. The recorded data were grouped into equal distance intervals of 0-20 m, 20-40 m up to 180-200 m for most sites. Acoustic data was collected during the survey through the use of a towed hydrophone array which was deployed during visual surveys. Track lines of acoustic survey effort were recorded using a GPS receiver which provided NMEA data for use by the PAMGUARD software. Recordings were made when the designated PAM operator recognised detections either visually through the use of audio-spectrograms or aurally through headphones.

In the summer of 2016 (June to September), line transect surveys were conducted within the Rockabill to Dalkey Island SAC to estimate density and abundance (O'Brien and Berrow, 2016). In total four survey days were conducted, all with Beaufort Sea State ≤2, totalling 506 km of the track line surveyed. During each survey the position of the survey vessel was continuously tracked using a GPS receiver, and survey effort such as environmental conditions were recorded every 15 minutes using LOGGER software. Upon the occurrence of a sighting, the position of the vessel was recorded as well as the angle of the sighting from the track of the vessel, and the estimated radial distance of the sighted animal using LOGGER software. Distance sampling was utilised to obtain a density estimate and to calculate an abundance estimate for each individual survey where possible. During these surveys, it was assumed that all animals on the track line were accounted for. Density was calculated using "day" as the sample regime. The DISTANCE modelling process was used to generate estimates of abundance and density for each survey day. Data including as transects, sightings, abundance and density were processed via GIS to produce sighting distribution maps.

In the summer of 2021 (July and August), line transect surveys were conducted within the Rockabill to Dalkey Island SAC to estimate density and abundance (Berrow *et al.*, 2021). In total six survey days were conducted, all with Beaufort Sea State ≤2, totalling 728 km of the track line surveyed overall. Survey protocols remained the same as those from the 2016 survey.

The main limitation of these surveys is the fact that the Distance analysis assumed perfect detection of marine mammals on the trackline (e.g., g(0)=1). As such, the resulting abundance and density estimates are considered to be relative estimates which will underestimate the absolute abundance and density at the site.

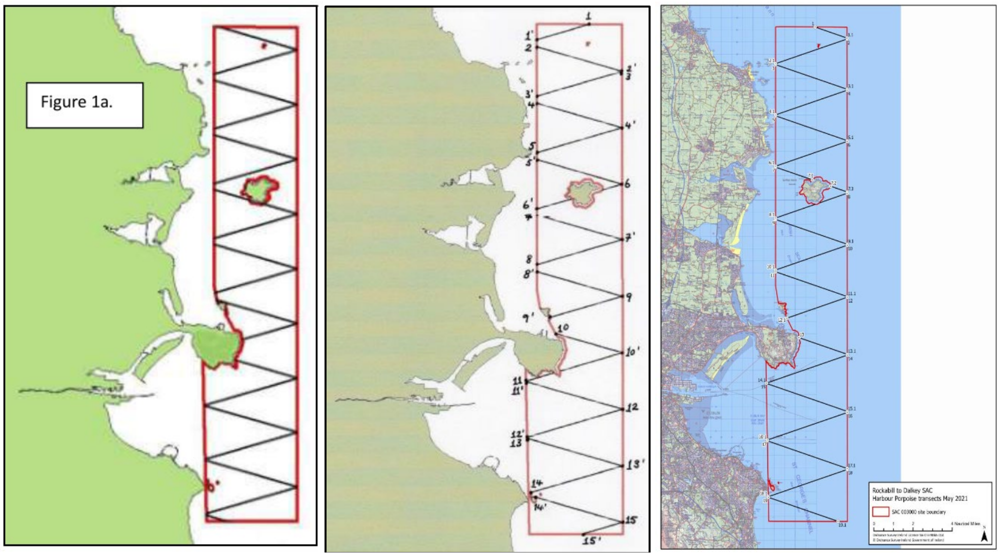

Figure 10 Rockabill to Dalkey Island SAC showing track lines selected for survey coverage in 2013 (left; Berrow and O'Brien, 2013), 2016 (middle; O'Brien and Berrow, 2016) and 2021 (right; Berrow *et al.*, 2021).

3.9.4 Harbour porpoise surveys (2008)

The north county Dublin area (104 km^2) and the Dublin Bay area (116 km^2) was surveyed from July-September in 2008 (Berrow *et al.*, 2008). These surveys were in close proximity to the south and west part of the survey area. Single vessel line-transect surveys were carried out within or in close proximity to the survey site boundaries along pre-determined routes (Figure 11). Distance sampling was utilised to calculate a density estimate and to calculate an abundance estimate of individuals. During these surveys, it was assumed that all harbour porpoises were accounted for along the track line. All sightings were recorded but sightings which occurred over 200 m (300 m if sea state 0) were not included in the distance-model. During each transect the position of the survey vessel was continuously tracked and survey effort data such as environmental conditions were recorded every 15 minutes using LOGGER software. Upon the occurrence of a sighting, the position of the vessel was recorded along with the angle of the sighting from the track of the vessel, and the perpendicular distance of the sighting from the vessel was recorded using LOGGER software. The DISTANCE software programme was used to calculate the density of harbour porpoises present along the track of the vessel, which derived abundance estimates. Only sightings recorded in sea-state 2 or less were included in the analysis. As highlighted previously, the main limitation of this survey is the fact that the Distance analysis assumed perfect detection of marine mammals on the trackline and therefore the resulting abundance and density estimates are considered to be relative estimates which will underestimate the absolute abundance and density at the site.

Acoustic monitoring was conducted through the deployment of T-PODs which consist of a self-contained computer and hydrophone which logs the times and durations of echolocation clicks. The T-PODs were only set to log harbour porpoise clicks, using the generic harbour porpoise settings. Two T-PODs were deployed in Dublin Bay, one T-POD was recovered on the 28th of September however the other T-POD on the south side of Dublin Bay was lost.

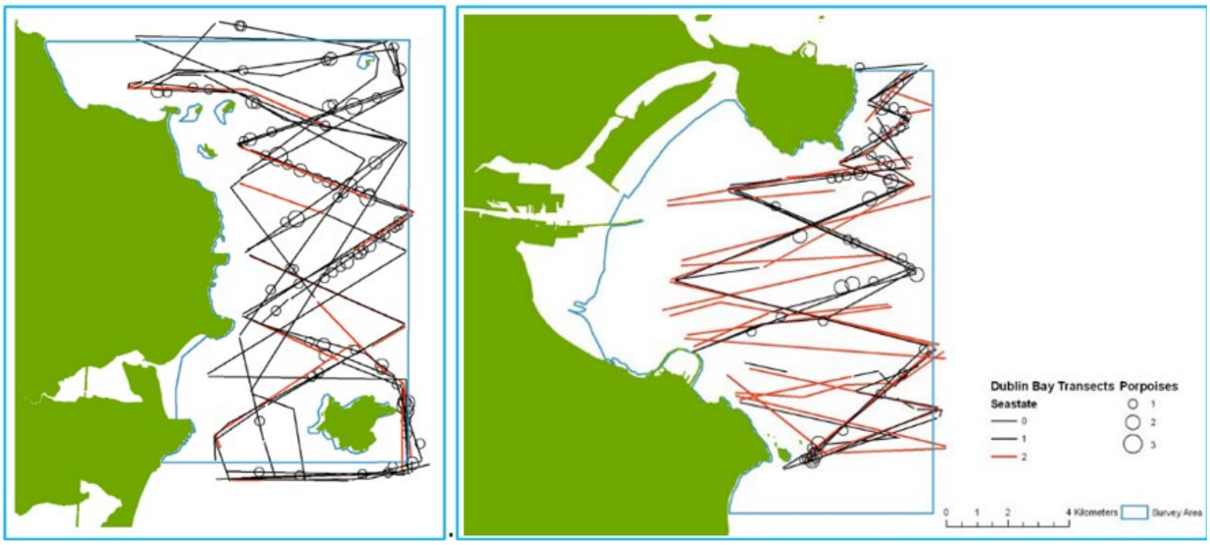

Figure 11 Map showing location of all track lines surveyed and harbour porpoise observed for the North Dublin transects (left) and Dublin Bay Transects (right) (Berrow *et al.*, 2008).

3.9.5 Greater Dublin Drainage Project (2015-2017)

Land-based observations of marine mammals were conducted from the Martello Tower at Loughshinny for six months and from the north-eastern cliffs of Howth Head for 24 months (March 2015-March 2017) (Meade *et al.*, 2017). Each survey lasted 7-8 hours. Two types of visual observations were conducted, including scan sampling and focal follow observations. For each sighting, data including species, group size and location were recorded. The location of each sighting was recorded using a theodolite, or in cases where this was restricted, location was determined by estimating distance (km) and bearing (degrees) from the observation site using reticle binoculars.

Additionally, vessel-based surveys were conducted using conventional single line transect surveys along a pre-determined route. Four routes were used, with surveys 1-4 including the waters off Loughshinny and surveys 5-11 covering the Portmarnock area (Figure 12) and were in close proximity to the south and west part of the survey area. These surveys were conducted every two months and were carried out in sea-state 2 or less and in visibility of ≥6 km. Distance sampling was used to obtain a density estimate and an abundance estimate for the study area where possible. Since it was assumed that all animals were accounted for along the track line (which was likely violated), the resulting abundance and density estimates are considered to be relative estimates which will underestimate the absolute abundance and density at the site.

Static acoustic monitoring was also implemented in this study. Two C-PODS were moored at a site 3 km East of Loughshinny, Co. Dublin, and 6 km North of Lambay Island. Additional deployments took place off Portmarnock, Co. Dublin (Figure 13). C-PODs operate in a passive mode and constantly record for tonal clicks, with all data recorded on an internal secure digital flash card. All data were analysed using only high probability clicks, with both dolphin and porpoise detections extracted as detection positive minutes per day (DPM).

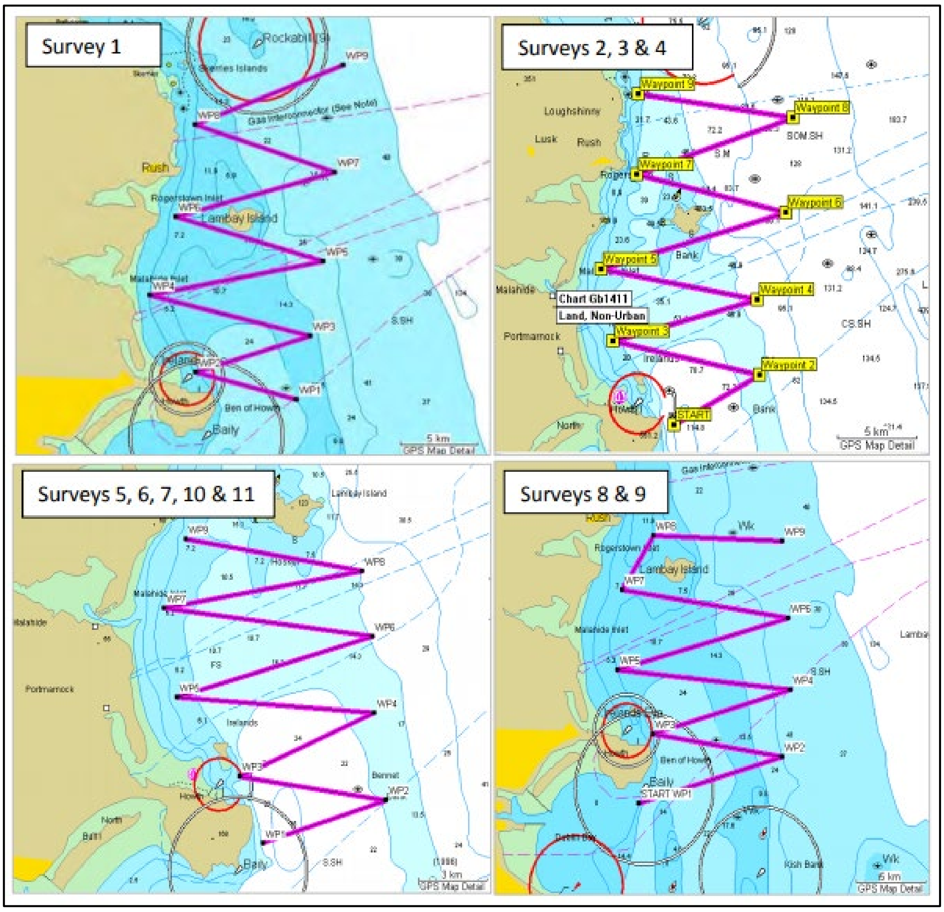

Figure 12 Line Transect Route for boat-based marine mammal surveys (Meade *et al.*, 2017).

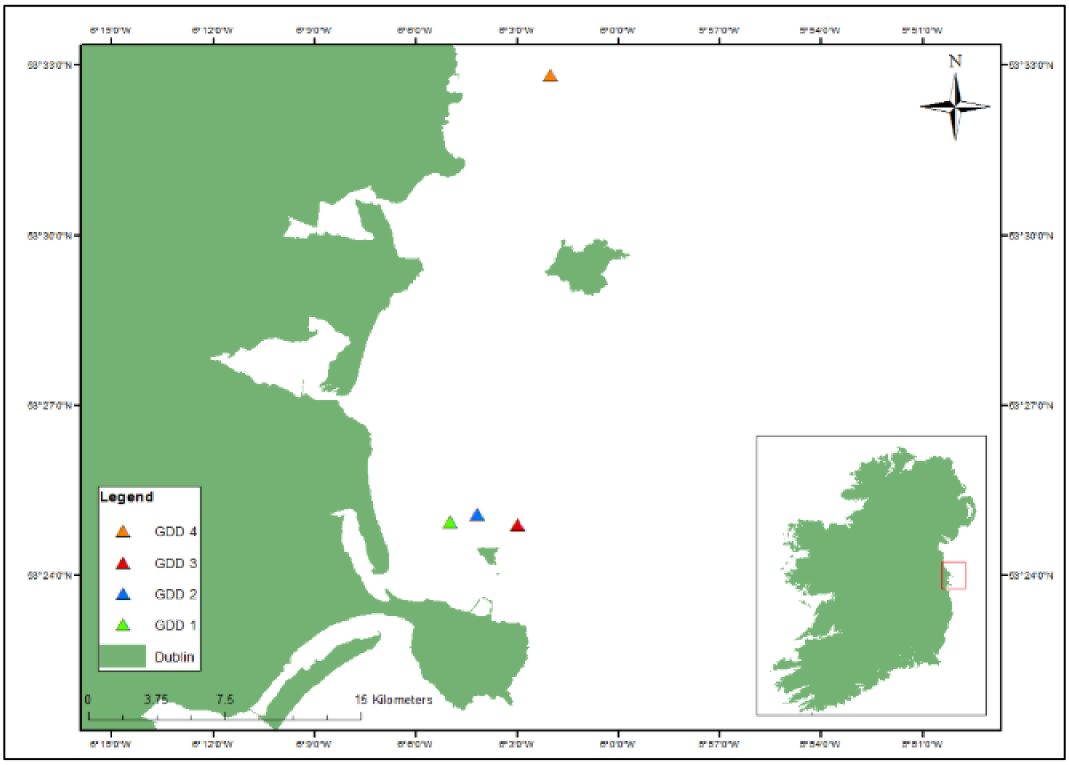

Figure 13 C-PODs locations off Portmarnock (GDD1, GDD2 and GDD3) and Loughshinny (GDD4) (Meade *et al.*, 2017).

3.10 Seal counts

3.10.1 Morris and Duck (2019)

In August 2017 and 2018, Morris and Duck (2019) conducted aerial surveys of harbour and grey seals around Ireland using a multi-camera, gyro-stabilised gimbal fitted externally beneath the cockpit of a helicopter. The gimbal used contained a laser ranger-finder, a colour high definition digital video camera, a mid-wavelength (3-5 µm) thermal-imaging video camera and a digital single-lens reflex camera which was equipped with a 300 mm telephoto lens. Using this equipment, the aerial surveys conducted followed standard SMRU harbour seal survey protocols. Due to these protocols, surveys were restricted to August and early September which is peak harbour seal moult season. Surveys were also restricted to time scales of within two hours either side of low tides occurring between 12:00 and 19:30, with no surveys occurring during periods of moderate, heavy or prolonged rainfall. All intertidal areas were surveyed using thermal imaging. Both colour and thermal-image videos were recorded alongside the digital still images onto computers, with the mapping system, TrakkaMap, recorded detailed flight paths as well as target centre co-ordinates for each photo and video frame. Complete flight tracks were also recorded onto two Garmin Foretrex 401 GPS units. The Irish coastline was split into five nominated regions, including the East coast, with each of these regions being further subdivided into 29 smaller coastal areas. Changes in seal haul-out behaviour between survey years was not accounted for (e.g., weather related influences), and it was assumed that weather did not significantly influence the haul-out behaviour and resulting counts.

The counts obtained represent the number of seals that were onshore at the time of the survey and are an estimate of the minimum size of the population. They do not represent the total size of the local population since a number of seals would have been at sea at the time of the survey. However, telemetry data from tagged seals can be used to scale this estimate to take account of the proportion of animals at sea at the time of survey. It is noted that these data refer to the numbers of seals found within the surveyed areas only at the time of the survey; numbers and distribution may differ at other times of the year. The surveys were conducted in August since this is the period when harbour seals are moulting and is therefore the time of year when the largest numbers of harbour seals are ashore. While grey seals are also counted during these August surveys, 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.

3.10.2 Ó Cadhla et al. (2007)

Ó Cadhla *et al.* (2007) conducted a data review in conjunction with a series of aerial surveys of the Irish coastline in collaboration with the Irish Air Corps during the spring and summer of 2005. These surveys covered five broad areas of the Irish coastline, including the East (site D) which encompassed the coastlines of the following counties: Louth, Meath, Dublin, Wicklow and Wexford (Figure 14). The NISA array area and ECC is located within site D.

These survey locations were discrete identifiable units and were classified according to their potential for grey seal breeding. Due to the relatively small number of survey locations identified in the east coast area, this area was surveyed primarily through the use of ground- and boat-based survey methods. Ground- and boat-based survey methods were implemented for Lambay Island and Ireland's Eye in County Dublin. Both of these sites were included as part of grey seal surveys carried out along the eastern Irish Sea coasts between 1977 and 1999 (Kierly *et al.*, 2000, Lidgard *et al.*, 2001). Boat-based surveys took place for a total of 7 seven pup production surveys at approximate two-week intervals with all live and dead pups counted and classified according to five developmental stages (Kovacs and Lavigne, 1986).

All of the information on pup production in the East coast region was collected in the form of ground counts of living and dead pups. In order to make it comparable, the statistical analysis used to estimate total pup production was the same as that which has been used. This methodology included a production estimation model (PEST) which has been used for UK grey seal pup production estimation since 1984 by SMRU. This model allowed for various parameters such as time to moulting and time to leaving the breeding site to be accounted for in order to produce the most accurate model of fit for the observed counts of pups, as a result, this reduced the error (CV) of each production estimate. Upon the completion of the statistical analysis and total pup production estimates were made available for each breeding colony, ancillary counts of pups were added where applicable. Total pup production estimates were subjected to a multiplication factor of 3.5-4.5 in order to represent the ratio of new-born pups to an increasing all-age population (Harwood and Prime, 1978). This method has been deemed the standard method which has been applied previously in Ireland, due to the absence of additional life history data and limitations of a lack of time-series pup production estimates from key breeding colonies (Ó Cadhla and Strong, 2003).

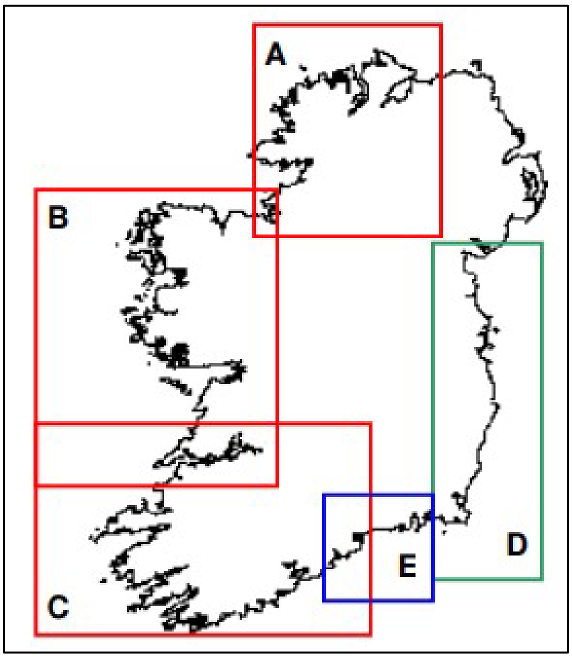

Figure 14 Designated aerial survey sites for grey seal population estimates in the spring and summer of 2005 (Ó Cadhla *et al.*, 2007).

3.10.3 SCOS Northern Ireland MU

The main harbour seal population surveys are carried out when harbour seals are moulting, during the first three weeks of August. The greatest and most consistent numbers of harbour seals are hauled-out ashore during their annual moult. To maximise the proportion of seals likely on shore and to reduce the effects of environmental variables, surveys are restricted to within two hours either side of low tides and are not conducted in the rain. The moult counts represent the number of harbour seals that were on shore at the time of the survey and are a minimum estimate of the size of the population. Note that these data refer to the numbers of seals found within the surveyed areas only at the time of the survey; numbers and distribution are likely to differ at other times of the year (such as the breeding period).

August haul-out counts in the Northern Ireland seal MU have been conducted by SMRU and funded by Northern Ireland Environment Agency (NIEA) in 2002, 2011 & 2018 (Morris & Duck, 2019a) and Marine Current Turbines Ltd in 2006-2008 & 2010 (SMRU Ltd, 2010).

It is estimated that 72% of the total harbour seal population are hauled-out and available to count during August surveys (Lonergan *et al.*, 2013). The harbour seal counts can be scaled by the proportion of seals hauled-out at the time of the counts, providing an estimated population size for a seal MU.

Numbers of grey seals are also counted during the harbour seal August haul out count surveys. Counts of greys seals during the summer months are highly variable, however they provide useful information on the summer and non-breeding season distribution of grey seals. It is estimated that 25.15% (95% CI: 21.45-29.07%) of the total grey seal population are hauled-out and available to count during the August haul-out count surveys (Russel and Carter, 2021) and, therefore, the total number of grey seals in the population for any given count period can be estimated by using the proportion of seals hauled-out.

3.11 Seal telemetry

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 and more frequent locations.

SMRU have tagged a total of 33 harbour seals in Strangford Lough in Northern Ireland (12 in 2006, 10 in 2008 and 11 in 2010). In addition to this, 13 juvenile harbour seals were tagged in 2019-20, but the data have yet to be processed and are not available for use yet (pers. comm. Dr Mark Jessopp, University College Cork). No grey seals have been tagged by SMRU in Northern Ireland.

There have been few grey seal telemetry studies conducted in the Republic of Ireland. These include:

- 19 grey seals tagged with Fastloc/GSM tags at haul-outs at Raven Point, Wexford Harbour Co. Wexford, southeast Ireland in March 2013 (n=9) and 2014 (n=10) (Cronin *et al.*, 2016). Six of the tags malfunctioned and so only 11 seals were successfully tracked. The tags operated for 3-4 months (mean 97 days) resulting in 1,074 days of data from the 11 seals, with up to 12 locations per seal per day;
- 8 grey seals were tagged at Great Blasket Island in February 2009 (Cronin *et al.*, 2011, Cronin *et al.*, 2013b). The tags operated for 7-8 months (mean duration 226 days), in total 1,813 days of data were collected from the 8 seals;
- Additionally, 10 male grey seals were tagged on the Blaskets in March 2011 and 2012, and 10 in Inishkeas in 2019, however, most of these tags failed, resulting in very few tracks available. As such they have not been published or reported upon and so cannot be included in this baseline characterisation (pers. comm. Dr Mark Jessopp, University College Cork).

3.12 Seal at-sea density

The UK Department for Business, Energy and Industrial Strategy 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 (Figure 15). To estimate the at-sea distribution, a habitat modelling approach was used, 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 (Figure 16) 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 (Russell *et al.*, 2015); therefore, using the SCOS 2020 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 individual grey seals (Carter *et al.*, 2020). It is estimated that harbour seals spend 83.4% of their time at sea on average (Russell *et al.*, 2015); therefore, using the SCOS 2020 best estimate of the harbour seal population size in the British Isles (SCOS, 2020), the total at-sea population size for the British Isles is estimated to be ~42,800 individual harbour seals (Carter *et al.*, 2020).

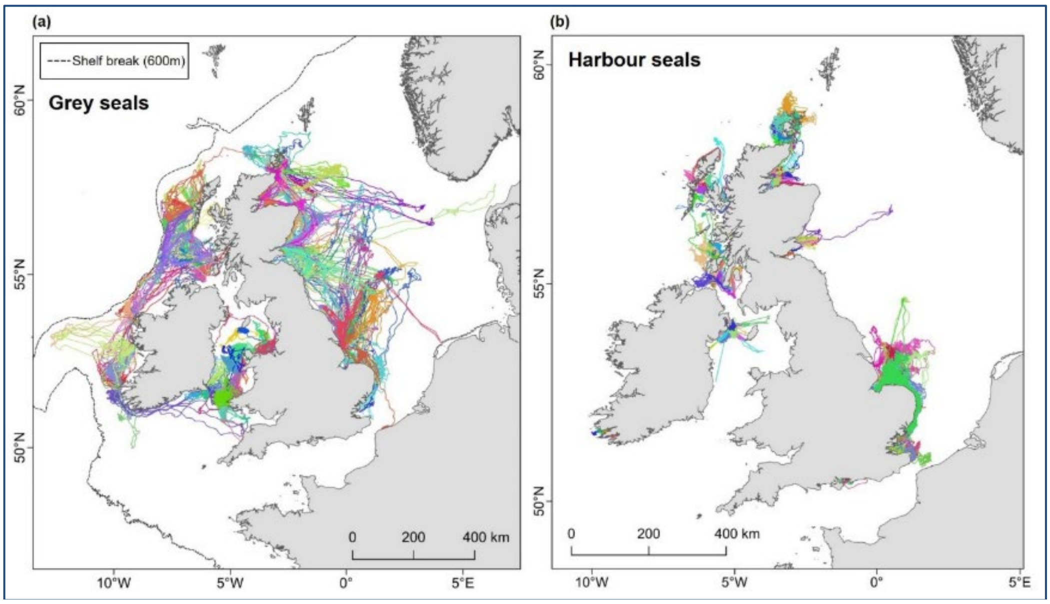

Figure 15 GPS tracking data for (a) grey and (b) harbour seals available for habitat preference models (Carter *et al.*, 2020).

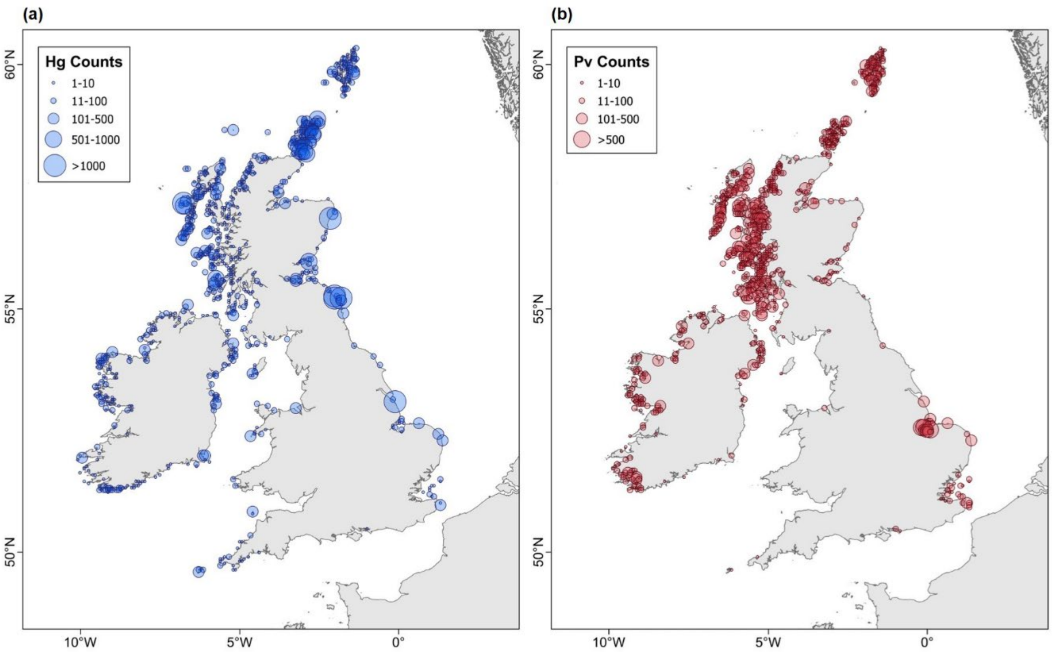

Figure 16 Most recent available August count data for (a) grey and (b) harbour seals per 5 km x 5 km haul-out cell used in the distribution analysis (Carter *et al.*, 2020).

3.13 Other OWFs

Previous site specific surveys conducted at nearby locations include Oriel, Dublin Array, Codling Wind Park and Arklow Bank Wind Park and, therefore, species sighted during these surveys are considered of relevance.

3.13.1 Oriel Wind farm

The site-specific survey data for Oriel are yet to be published and thus information on the site-specific surveys cannot be detailed at this time and thus, information from the Oriel EIA Scoping Report shall be used to outline the marine mammal baseline at this development {RPS, 2019 #9864}. The EIA scoping report lists the following surveys at Oriel:

- Baseline boat-based survey data for marine mammals and results of the acoustic monitoring survey (four C-POD locations within the Foreshore Licence area)

Marine mammal surveys undertaken to inform the Original EIS.No information on the species sighted was presented in the EIA Scoping Report.

3.13.2 Codling Wind Park

At Codling Wind Park, data is available for monthly site-specific visual vessel surveys which were conducted between April 2013 – March 2014 and again in Oct 2018 – Oct 2019 (Codling Wind Park Limited, 2020). During the 2013-14 surveys, 542 individuals of seven species of marine mammal were recorded, and during the 2018-19 surveys 309 individuals of five species of marine mammals were recorded, with harbour porpoise being the most commonly sighted species.

3.13.3 Dublin Array

The site-specific survey data for Dublin Array are yet to be published and thus information on the site-specific surveys cannot be detailed at this time and thus, information from the Dublin Array Scoping Report shall be used to outline the marine mammal baseline at this development (SLR *et al.*, 2020).

As part of the Dublin Array EIA Scoping Report, a review of existing data sources indicated that the key species likely to be present within the proposed Dublin Array and its surrounding area were:

- Harbour porpoise;
- Bottlenose dolphin;
- Risso's dolphin;
- Common dolphin;
- Minke whale;
- Grey seal; and
- Harbour seal.

Each of the species identified as likely present within the Dublin Array (SLR *et al.*, 2020) are part of the same MUs as those likely present within the array area.

3.13.4 Arklow Bank Wind Park

The Arklow Bank Wind Park conducted monthly site-specific vessel transect surveys between July 1996 and March 1997, and June 2000 and June 2009 for Arklow Bank Wind Park 1 and digital aerial surveys in March 2018 and February 2020 for Arklow Bank Wind Park 2. Surveys recorded harbour porpoise, Risso's dolphin and seals (RPS, 2020).

4 Harbour porpoise

The harbour porpoise is the most widely distributed and most common cetacean species in the waters of Britain and Ireland (NPWS, 2019). They occur in all parts of the British and Irish continental shelf and are recorded year-round within most of their range (Figure 17). The conservation status of harbour porpoise in Irish waters has been categorised as Favourable (NPWS, 2019).

The Inter Agency Marine Mammal Working Group (IAMMWG) identified MUs for harbour porpoise and provided recommended abundance estimates for each MU. The proposed development is located within the Celtic and Irish Seas MU, where the most recent estimate of abundance for harbour porpoises is 62,517 (CV: 0.13, 95% CI: 48,324 – 80,877) (IAMMWG, 2023) based on data collected during SCANS III and the ObSERVE surveys (Rogan *et al.*, 2018, Hammond *et al.*, 2021). The previous estimate of abundance for harbour porpoises was 104,695 (CV: 0.32, 95% CI: 55,774 – 193,065) (IAMMWG, 2015) based on data collected during SCANS II and the CODA surveys (Macleod *et al.*, 2009, Hammond *et al.*, 2013).

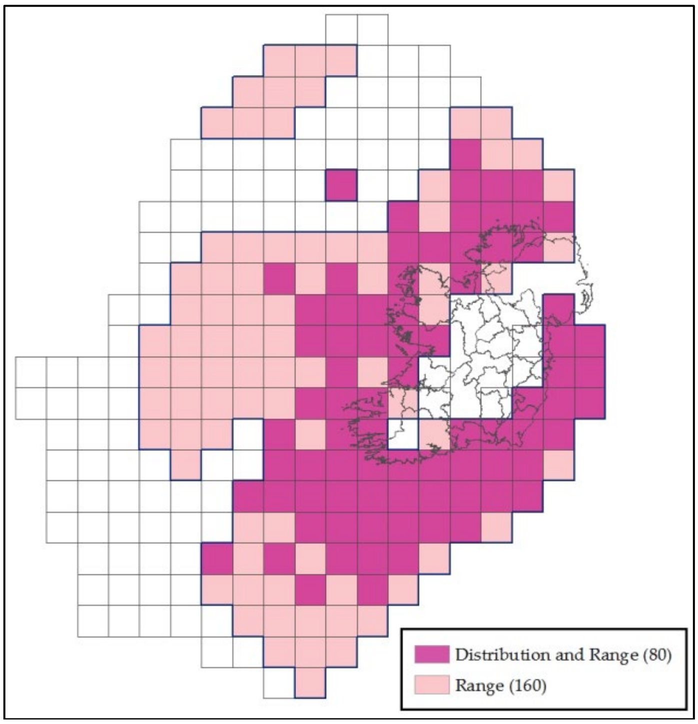

Figure 17 The range and distribution of harbour porpoise in Irish waters (NPWS, 2019).

4.1 Proposed development: Site-specific surveys

4.1.1 Vessel surveys

Harbour porpoises were sighted in all vessel-based surveys (Table 6). No density estimate was calculated, but these data confirm harbour porpoise presence year-round and were used to apportion the unidentified sightings from the aerial surveys.

Table 6 Harbour porpoise sightings during the proposed development site-specific baseline vessel surveys.

Month	Survey Type	Dedicated marine mammal surveyors?	Sightings
Nov 2019	Vessel	yes	9
Jan 2020	Vessel	yes	30
Mar 2020	Vessel	yes	22

Aug 2020	Vessel	no	8
Jun 2021	Vessel	yes	9
Jul 2021	Vessel	yes	7

4.1.2 Aerial surveys

In the 29 months of site-specific aerial surveys, a total of 575 harbour porpoise (56.4% of all marine mammal sightings) and 209 dolphin/porpoise (20.5% of all marine mammal sightings) were sighted. The sightings of un-identified marine mammals were apportioned using speciated records across the DAS dataset (Natural Power, 2022). The sightings were also corrected for availability bias using the Teilmann *et al.* (2013) tag data. This means that the resulting density estimates are absolute density estimates.

Harbour porpoise sightings were highly variable across surveys, with between 0 and 66 individual porpoise sighted per survey day. The average density estimate (apportioned and corrected) across the 29 surveys was 0.38 porpoise/km^2, however density varied seasonally, with highest density estimates in the autumn and winter months (0.49 and 0.54 porpoise/km^2 respectively) compared to spring and summer months (0.33 and 0.22 porpoise/km^2 respectively) (Table 7).

Table 7 Harbour porpoise sightings during the proposed development site-specific baseline aerial surveys. The absolute density estimates (#/km^2) are corrected for availability bias and un-identified sightings apportioned.

Survey	Month	Sightings (raw)	Absolute density (corrected and apportioned)	Density Confidence Intervals
1	May-20	2	0.08	0.04 - 0.17
2	Jun-20	4	0.18	0.10 - 0.35
3	Jul-20	0	0.03	0.01 - 0.11
4	Aug-20	0	0.15	0.03 - 0.88
5	Sep-20	8	0.24	0.10 - 0.56
6	Oct-20	10	0.65	0.30 - 1.39
7	Nov-20	5	0.70	0.39 - 1.29
8	Dec-20	8	0.59	0.39 - 0.88
9	Feb-21	6	0.31	0.19 - 0.50
10	Mar-21	46	0.82	0.55 - 1.22
11	Apr-21	8	0.10	0.02 - 0.52
12	May-21	39	0.50	0.29 - 0.86
13	Jun-21	3	0.07	0.02 - 0.18
14	Jul-21	3	0.10	0.03 - 0.33
15	Aug-21	66	1.00	0.61 - 1.62
16	Sep-21	11	0.19	0.04 - 0.89
17	Oct-21	52	0.90	0.48 - 1.72
18	Nov-21	46	0.90	0.54 - 1.49
19	Dec-21	47	0.74	0.48 - 1.14
20	Jan-22	37	0.58	0.34 - 0.99
21	Feb-22	21	0.46	0.21 - 0.98
22	Mar-22	9	0.25	0.09 - 0.71
23	Apr-22	36	0.51	0.32 - 0.80
24	May-22	10	0.08	0.07 - 0.09
25	Jun-22	7	0.06	0.05 - 0.07
26	Jul-22	14	0.10	0.09 - 0.12
27	Aug-22	37	0.29	0.28 - 0.30

28	Sep-22	24	0.19	0.18 - 0.20
29	Oct-22	16	0.14	0.13 - 0.15
Average	**All**	**All months**	**0.38**	
Average	**Spring**	**Mar, Apr, May**	**0.33**	
Average	**Summer**	**Jun, Jul, Aug**	**0.22**	
Average	**Autumn**	**Sep, Oct, Nov**	**0.49**	
Average	**Winter**	**Dec, Jan, Feb**	**0.54**	

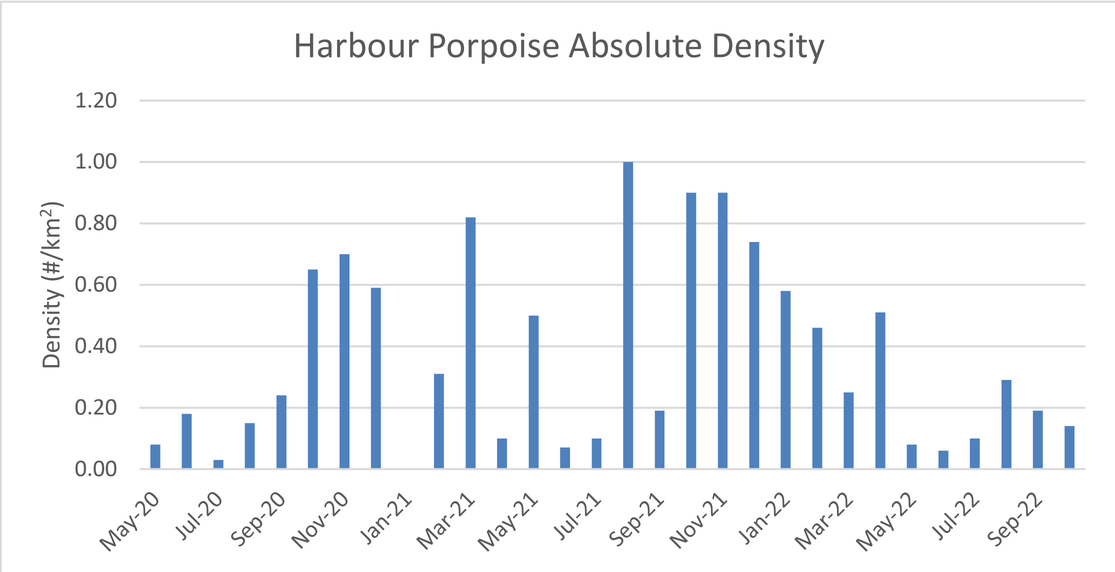

Figure 18 Harbour porpoise absolute density estimates (corrected and apportioned) across the 29 aerial surveys.

4.2 ObSERVE

Across both ObSERVE survey years (2015 and 2016), there was a total of 296 sightings of harbour porpoises across the survey areas (Rogan *et al.*, 2018). These individuals were primarily sighted in neritic waters across the continental shelf and Irish Sea (Figure 19), with no sightings in stratum 2. The majority of sightings were recorded as single individuals, however mean group size of harbour porpoises was higher during winter months at 1.7 individuals, in comparison to summer months at 1.3 individuals (Figure 20). In relation to the estimated abundances of harbour porpoises within the survey areas, the results concluded that these individuals had higher summer abundances (Season 1 and 3) compared to winter abundances (Season 2 and 4). Within survey stratum 5, in which proposed development is located, the harbour porpoise density estimate was highest in summer, where estimates reached 1.046 and 0.942 for design-based and model-based density estimates respectively (Table 8).

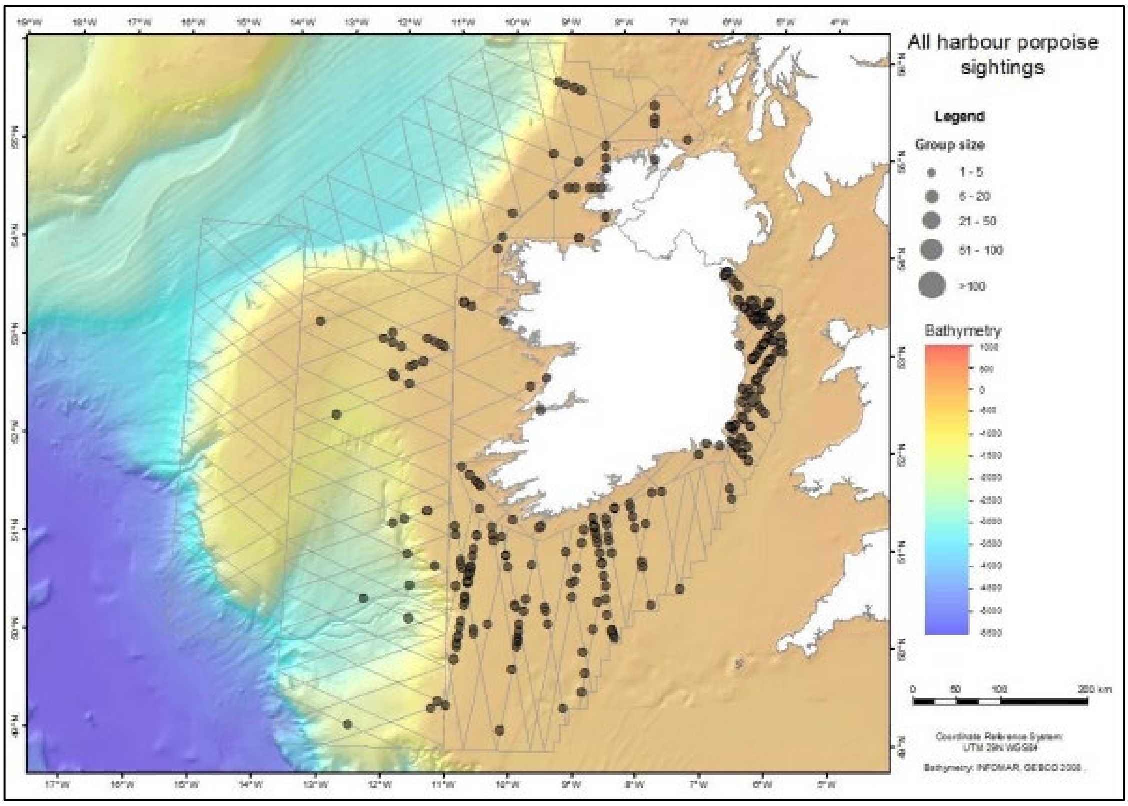

Figure 19 All harbour porpoise sightings from the ObSERVE surveys from 2015-2016 (Rogan *et al.*, 2018).

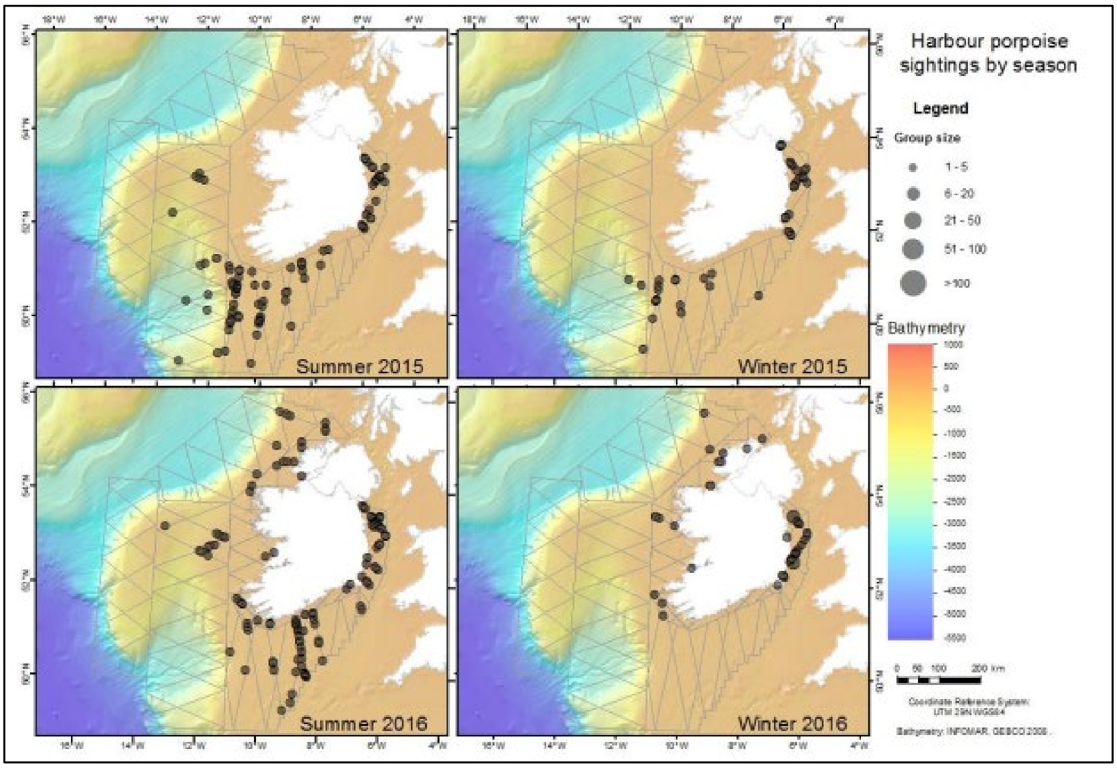

Figure 20 Seasonal harbour porpoise sightings from the ObSERVE surveys from 2015-2016 (Rogan *et al.*, 2018).

Table 8 Harbour porpoise groups, design-based and model-based density (#/km²) and abundance estimates for stratum 5 of the ObSERVE surveys (Rogan *et al.*, 2018).

	Corrected design based estimates				Corrected model based estimates			
Season	Density	Abundance	Lower CI	Upper CI	Density	Abundance	Lower CI	Upper CI
1	0.696	7,734	5,247	11,398	0.675	7,495	4,789	11,729
2	0.867	9,636	5,633	16,482	NA			
3	1.046	11,624	8,725	15,486	0.942	10,466	7,923	13,816
4	0.924	10,263	7,555	13,942	NA			

4.3 Distribution and abundance of cetaceans in Wales and its adjacent waters

Harbour porpoises were modelled throughout the Irish Sea and Bristol Channel, with varying distribution patterns (Figure 19). The third quarter, July – September, had peak densities as this is the breeding season for this species. In general, porpoise showed preferences for coastal areas. The modelled outputs below indicate that the main areas of high density are inclusive of the outer part of Cardigan Bay, the eastern Irish coastal area (particularly from south Dublin to Waterford), west Pembrokeshire in Wales, and the area between north Anglesey and the Isle of Man. Using the maximum density per cell across all months, the estimated density in the array area is 0.3-0.4 porpoise/km^2 (Figure 22).

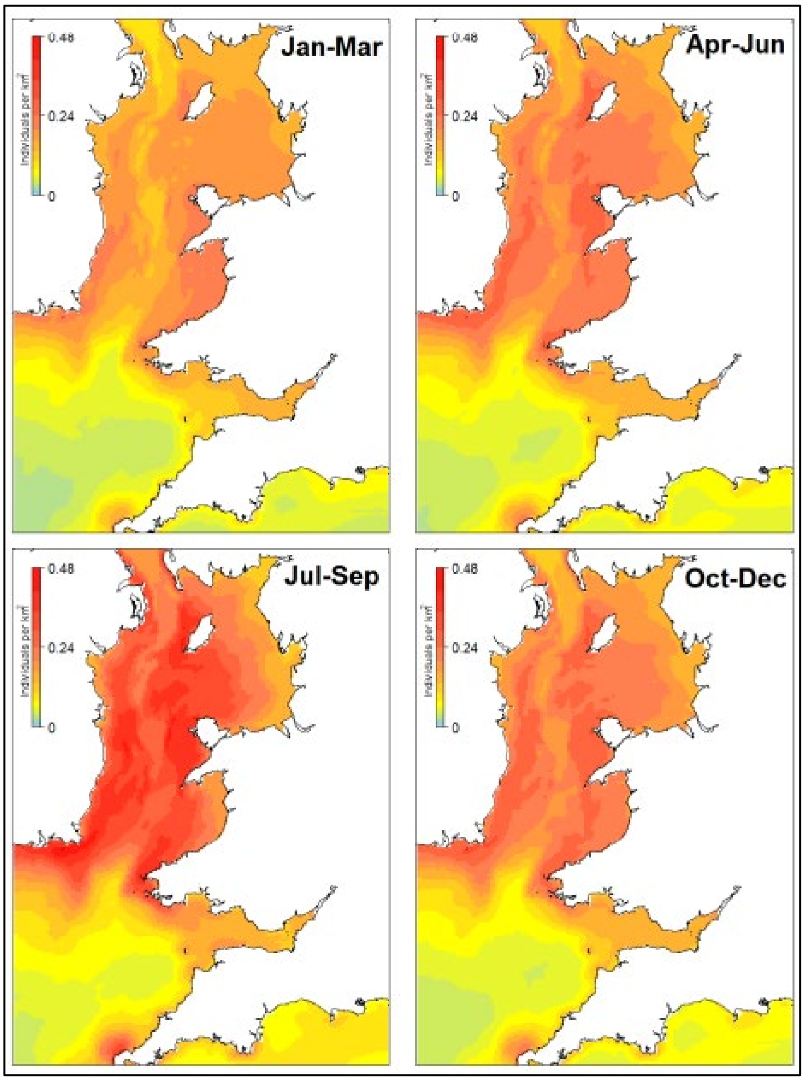

Figure 21 Harbour porpoise modelled densities by quarter, measured as the mean density per cell across months per season (Evans and Waggitt, 2023).

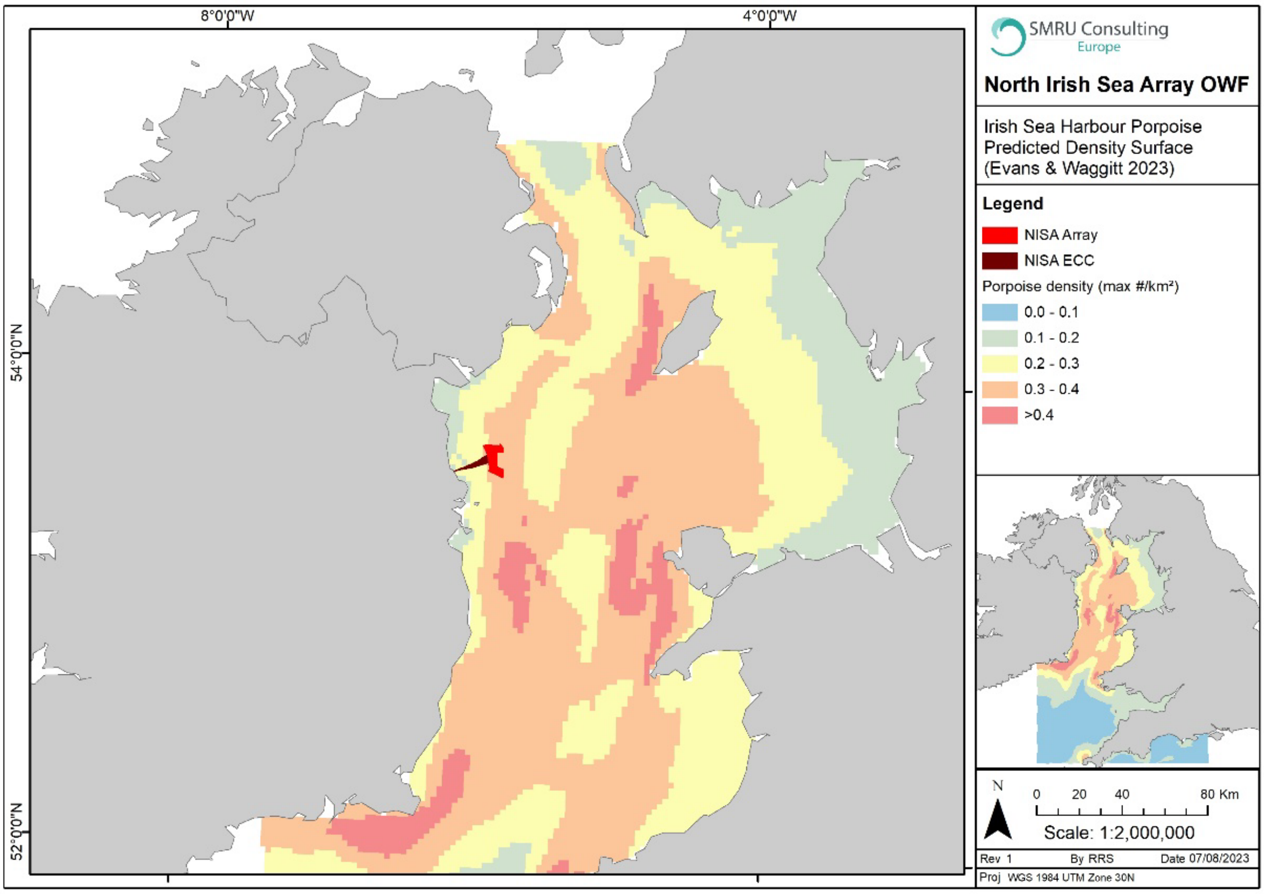

Figure 22 Harbour porpoise modelled densities (maximum density per cell across months) (Evans and Waggitt, 2023).

4.4 SCANS

During the SCANS III survey effort in 2016, harbour porpoises were surveyed through the use of aerial survey techniques in the block E, covering the East coast of Ireland (Hammond *et al.*, 2017, Hammond *et al.*, 2021). Results from this survey conclude that harbour porpoises in block E had an estimated abundance of 8,320 individuals with lower and upper CIs of 4,643 and 14,354 respectively. Density estimates for this block were concluded to be 0.239 porpoise/km^2.

The SCANS II used different survey blocks to SCANS III, and the proposed development is located within SCANS II survey block O (which covered the whole Irish Sea). Harbour porpoise were sighted throughout SCANS II survey block O, resulting in a block wide abundance estimate of 15,230 porpoise (CV 0.35) and a uniform density across the survey block of 0.335 porpoise/km^2 (CV 0.35) (Hammond *et al.*, 2013).

When comparing the harbour porpoise density surface between the 2005 and 2016 surveys, the authors stated the following: *"The most noticeable difference between the modelled distributions is that the high density predicted in the Celtic Sea (southwest of Britain and Ireland) in 2005 is not predicted in 2016. However, part of the Celtic Sea was surveyed by ObSERVE instead of SCANS-III in 2016 and high densities of harbour porpoise were predicted in this area in the summers of 2015 and 2016 (Rogan et al. 2018). In addition, high harbour porpoise density was predicted to the west of Ireland (Rogan et al. 2018). One explanation for the lower predicted density of harbour porpoises in the Celtic Sea in SCANS-III in 2016 could therefore be a distributional shift into Irish waters covered by the ObSERVE surveys."* (Lacey *et al.*, 2022). Therefore, the lower densities of harbour porpoise in the

Irish Sea may not represent a population decline, but rather a shift in distribution to the west of Ireland.

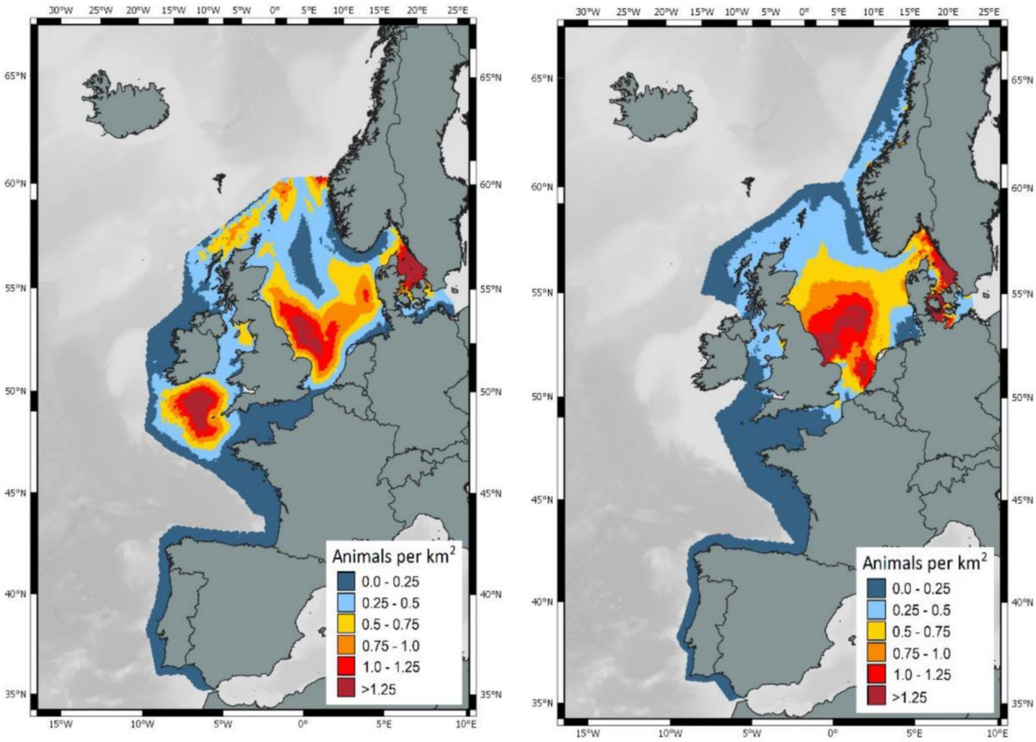

Figure 23 Predicted surfaces of estimated density for harbour porpoise in SCANS-II (2005) [left] SCANS-III (2016) [right] (Lacey *et al.*, 2022).

The SCANS III data was used to obtain predicted density surfaces (Lacey *et al.*, 2022). This shows that the predicted SCANS III harbour porpoise distribution across the MU is not uniform, with higher densities found in the northeast of the Irish Sea. Densities of harbour porpoise in the vicinity of the NISA array area and ECC are relatively low with values below 0.50 harbour porpoise/km^2 (Figure 24).

The SCANS IV used different survey block names to SCANS III. The proposed development is located within SCANS IV survey block CS-D (which covered the whole Irish Sea). Harbour porpoise were sighted throughout SCANS IV survey block CS-D, resulting in a block wide abundance estimate of 9,773 porpoise (95% CI: 4,764 – 18,125) and a uniform density across the survey block of 0.2803 porpoise/km^2 (CV 0.316).

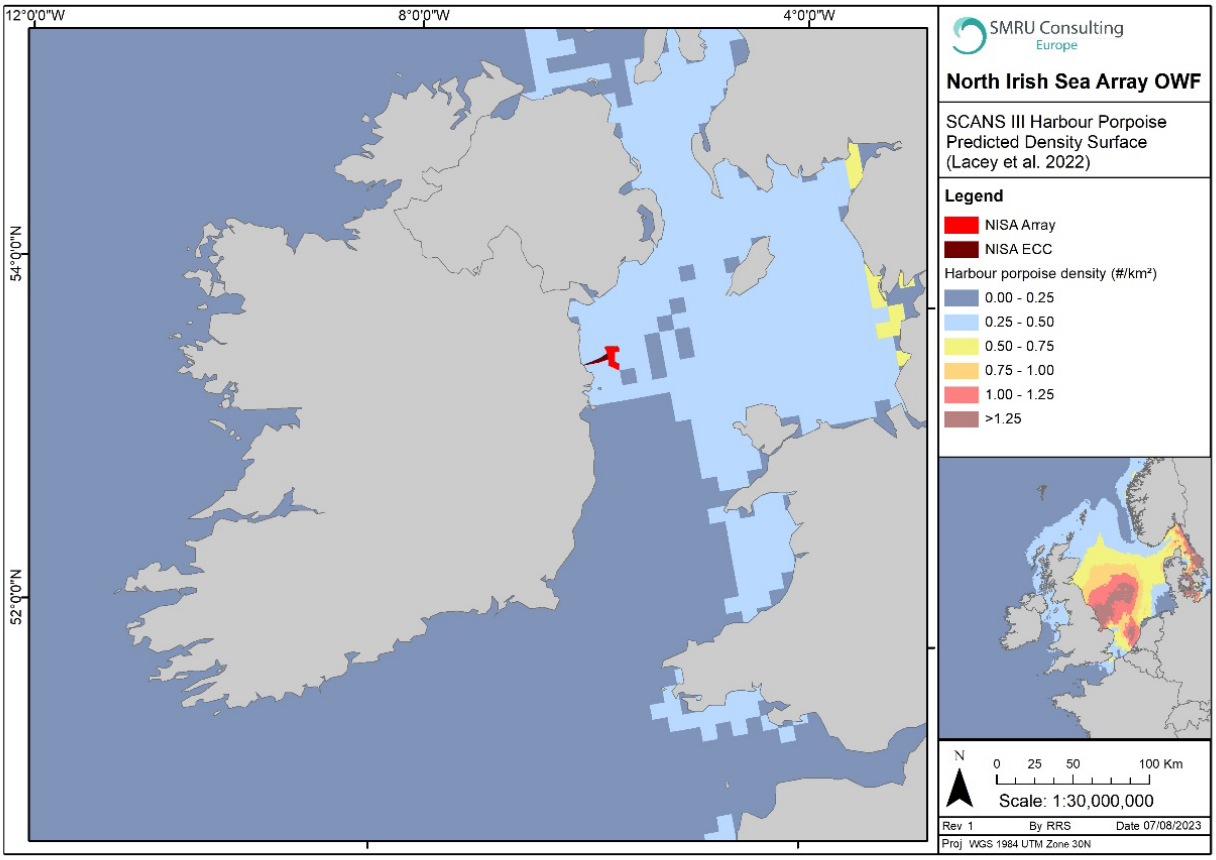

Figure 24 Predicted surface for harbour porpoise in SCANS III. Data from Lacey et al. (2022).

4.5 IWDG Surveys

4.5.1 Berrow et al. 2008: North County Dublin area

Within the North County Dublin area, the 2008 summer abundance estimates over the six survey days was 2.03 porpoise/km^2, which was higher than that estimated for the Dublin Bay area, where the summer abundance estimates over the six survey days was 1.19 porpoise/km^2 (Berrow *et al.*, 2008). The static PAM locations at Dublin Bay (Howth Head), Roaringwater Bay (Sherkin Island and Castlepoint) and Cork (Galley Head and Old Head) recorded harbour porpoise on every day of the deployment between July, August and September (with the exception of August at Roaringwater Bay where only 70% of the days had porpoise detections). The T-POD at Howth Head in Dublin Bay recorded much higher detection rates compared to the other sites, with detections of harbour porpoise occurring on between 74 to 81% of the hours monitored (Table 9). This data confirms the presence of porpoise and identifies high detection rates in the Dublin area in the summer months.

Table 9 Monthly distribution of acoustic data from T-PODs (Berrow *et al.*, 2008).

Location	Month	No. days deployed	Encounters per month	% of days with porpoise detections	% Porpoise Positive Hours	Total Porpoise Positive Minutes	Porpoise Positive Minutes per hour
Howth Hd	July	19	852	100	81	3891	8.9
	Aug	12	969	100	79	4336	15.6
	Sept	16	911	100	74	5491	13.5
Castlepoint	Jul	22	231	100	33	540	1.0
	Aug	31	296	100	29	667	0.9
	Sept	10	84	100	24	172	0.8
Sherkin Island	July	9	154	100	48	109	0.6
	Aug	14	193	71	39	598	2.1
	Sept	-	-	-	-	-	-
Galley Head	July	22	151	100	25	372	0.8
	Aug	20	209	100	32	550	1.2
	Sept	21	257	100	34	692	1.4
Old Head of Kinsale	July	-	-	-	-	-	-
	Aug	11	76	100	27	130	0.6
	Sept	11	135	100	39	266	1.0

4.5.2 Berrow et al. 2011: inshore Irish Sea surveys

The inshore Irish Sea surveys conducted in 2011 (Berrow *et al.*, 2011) concluded that harbour porpoise were the most frequently sighted cetacean species, with 57 sightings in block A (89 individuals) and 14 sightings in block B (22 individuals; Figure 25). The authors calculated a density estimate for porpoise in the northern Irish Sea (block A) of 1.585 porpoise/km^2 (SE 0.219) (which is almost identical to that estimated by the 2016 SAC surveys), however, there were too few sightings in block B to do the same for the southern Irish Sea. The surveys sighted both adults, juveniles and calves, resulting in an estimate of 14.7% of the population being considered to be sub-adults.

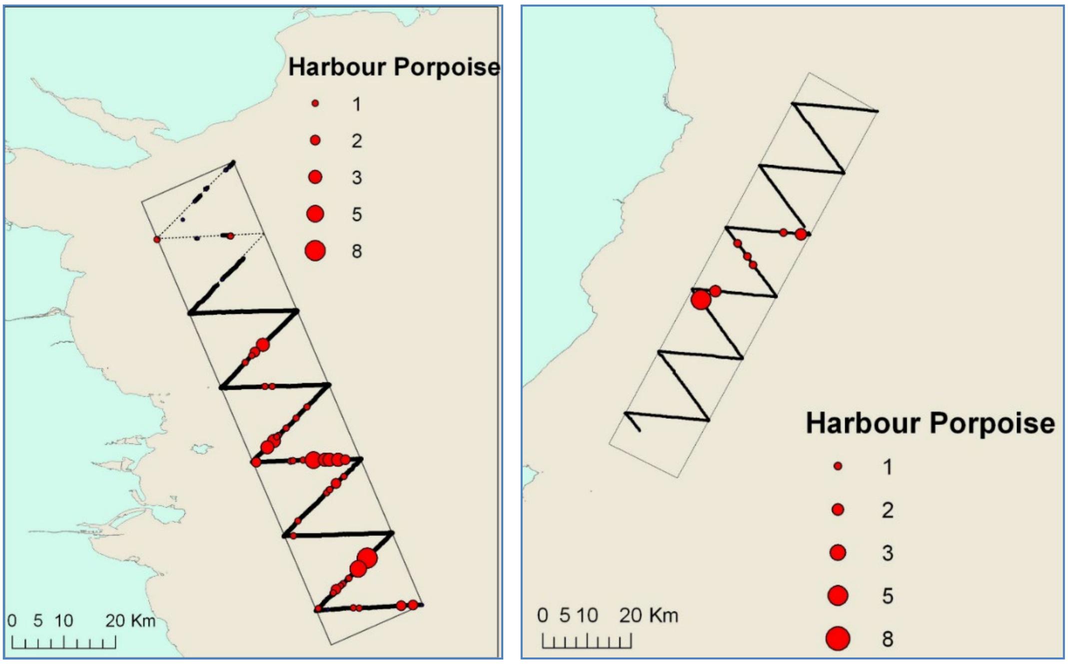

Figure 25 Sighting records of harbour porpoise in Block A (left) and B (right) (Berrow *et al.*, 2011).

4.5.3 (Meade *et al.*, 2017): Greater Dublin Drainage project

The visual and static PAM surveys conducted as part of the Greater Dublin Drainage project also identified harbour porpoise in the area year round (Meade *et al.*, 2017). A total of 23 land-based surveys were conducted between March 2015 and March 2017 at Howth Head, where harbour porpoise were detected on 83% of the survey days (consisting of 167 sightings, totalling 293 individuals, including juvenile and calves). Sightings were highest between August and January 2015 and August and October 2016. A total of 897 km of trackline was surveyed between April 2015 to January 2017 (11 surveys), with harbour porpoise being detected on every survey day (with a peak in sightings in November 2015 and August 2016). Harbour porpoise density estimates from the transect surveys ranged between 0.61 to 2.29 porpoise/km^2, with a mean density of 1.312 porpoise/km^2 (Meade *et al.*, 2017). Porpoise were sighted throughout the survey area (Figure 26). The static PAM at the three locations in Portmarnock were deployed for between 530 and 556 days per site over the 2015-2017 deployment period. The devices recorded high levels of porpoise detections (porpoise were detected on 94-100% of the days), with highest detection rates across the autumn and winter months and during the hours of darkness (including dawn and dusk) (Meade *et al.*, 2017).

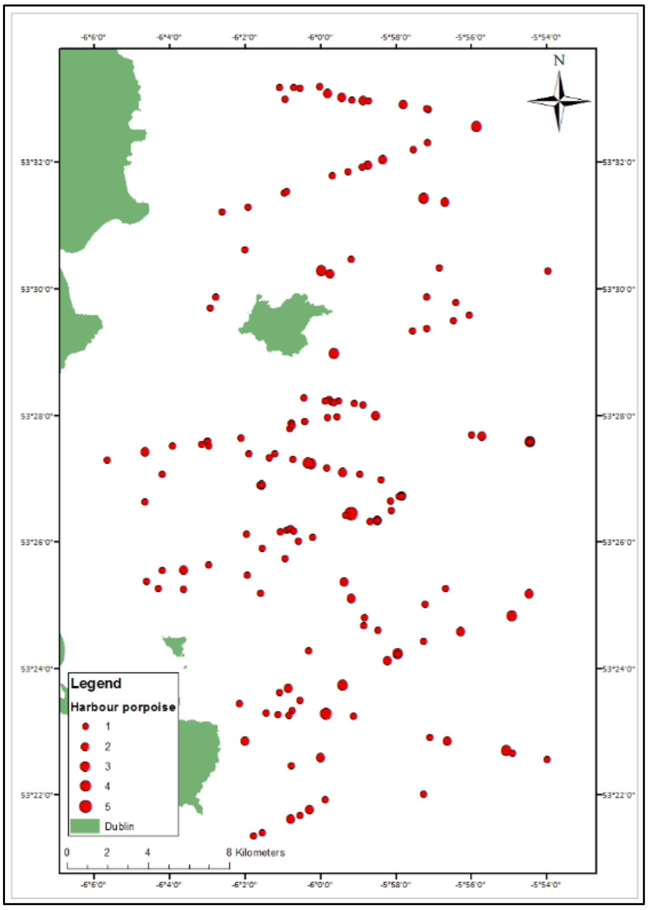

Figure 26 Distribution of harbour porpoise recorded during boat-based surveys conducted as part of the Greater Dublin Drainage project (Meade *et al.*, 2017).

4.5.4 (O'Brien and Berrow, 2016): 2016 SAC survey

In the summer of 2016 (Jun-Sep), line transect surveys were conducted within the Rockabill to Dalkey Island SAC to estimate density and abundance (O'Brien and Berrow, 2016). In total, four survey days were conducted, all with Beaufort sea state ≤2, totalling 506 km of trackline surveyed and 152 sightings totalling 246 individual porpoise (Figure 27). The density estimates for each survey ranged between 1.37 porpoises/km^2 to a maximum of 1.87 porpoises/km^2, with an overall pooled density of 1.55 ±0.17 porpoises/km2 (CV: 0.10). These density estimates within the SAC were very similar to those obtained in 2013 (1.44 ±0.09 porpoise/km2, CV: 0.06) (Berrow and O'Brien, 2013) which suggests that the summer population within the SAC was stable between these two timepoints.

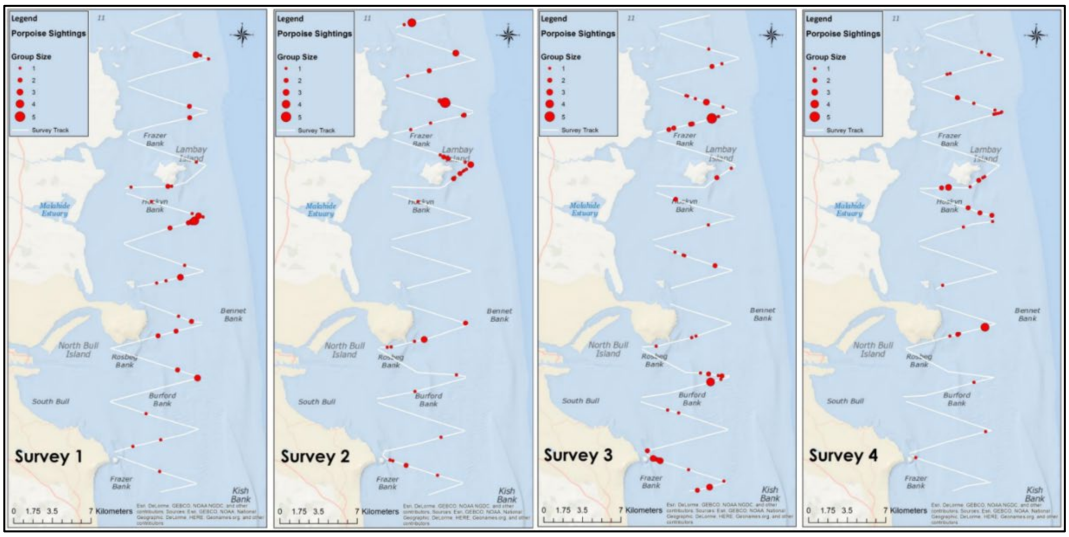

Figure 27 Locations of harbour porpoise sightings and corresponding group sizes recorded during each one-day survey of Rockabill to Dalkey Island SAC in 2016 (O'Brien and Berrow, 2016).

4.5.5 Berrow *et al.* (2021): 2021 SAC survey

In the summer of 2021 (Sep-Aug), line transect surveys were conducted within the Rockabill to Dalkey Island SAC to estimate density and abundance. In total, six survey days were conducted, all with Beaufort sea state ≤2, totalling 728 km of trackline surveyed and 137 sightings totalling 181 individual porpoise. The density estimates for each survey ranged between 0.50 porpoises/km^2 to a maximum of 0.98 porpoises/km^2, with an overall pooled density of 0.83 ±0.14 porpoises/km^2.

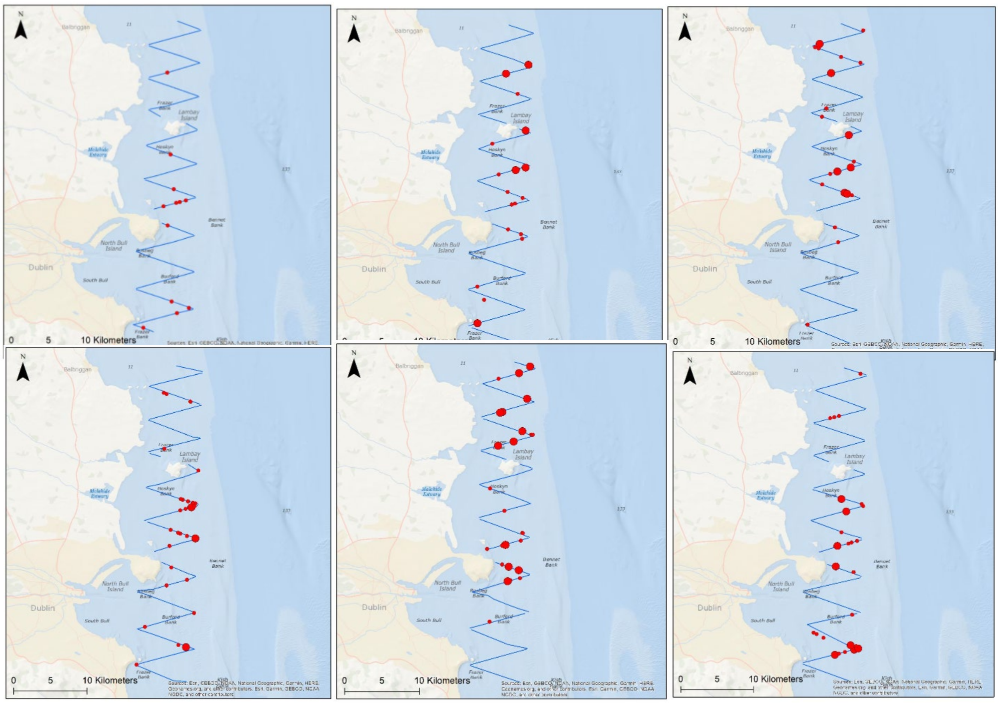

Figure 28 Track-lines and distribution of harbour porpoise sightings (Berrow *et al.*, 2021).

4.5.6 Summary

Harbour porpoise density estimates in the SAC, North County Dublin and Dublin Bay area were similar between 2008, 2013 and 2016. However, the density estimate from the 2021 SAC survey was only ~44% of that reported in 2013 and 2016 (Table 10 and Figure 29). The authors state that "*This does not necessarily imply a decline in overall population size but perhaps changes in distribution and habitat use at a local scale*" (Berrow *et al.*, 2021).

Table 10 Density, abundance and group size estimates for harbour porpoise within Rockabill to Dalkey Island SAC from 2008 to 2021 (Berrow *et al.*, 2021).

Area	Year	Density	SE	CV	Reference
SAC	2021	0.83	0.14	0.17	(Berrow *et al.*, 2021)
SAC	2016	1.55	0.17	0.10	(O'Brien and Berrow, 2016)
SAC	2013	1.44	0.09	0.09	(Berrow and O'Brien, 2013)
North County Dublin	2008	2.03	-	0.23	(Berrow *et al.*, 2008)
Dublin Bay	2008	1.19	-	0.24	(Berrow *et al.*, 2008)

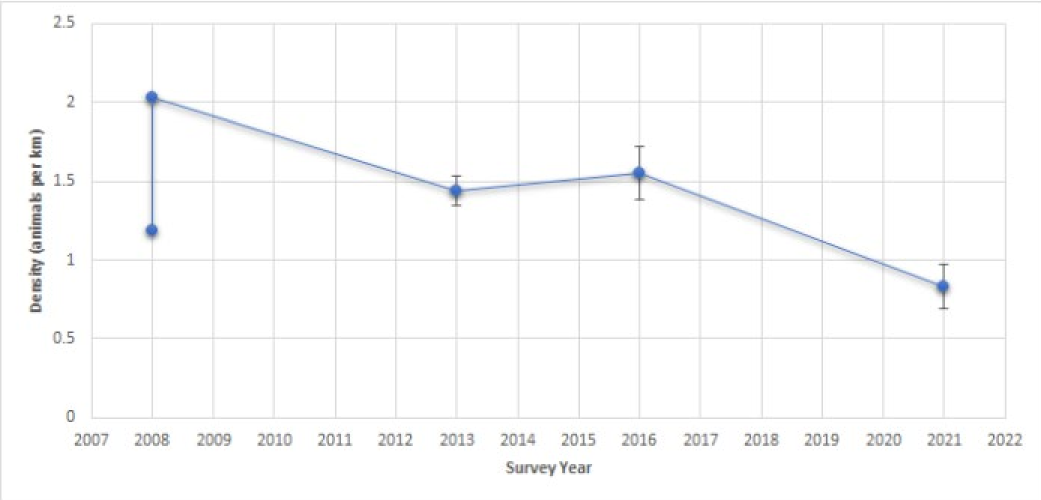

Figure 29 Changes in the recorded density of harbour porpoises in the Rockabill to Dalkey Island SAC over time (Berrow *et al.*, 2021).

4.6 Irish Marine Mammal Atlas

The highest relative abundances of harbour porpoises around Ireland occurred in the Irish sea, with the highest relative abundances recorded in the western half of the central Irish Sea (Figure 30). In the Irish sea, harbour porpoises were recorded year-round, with comparatively little seasonal variation in their relative abundances in the Irish Sea.

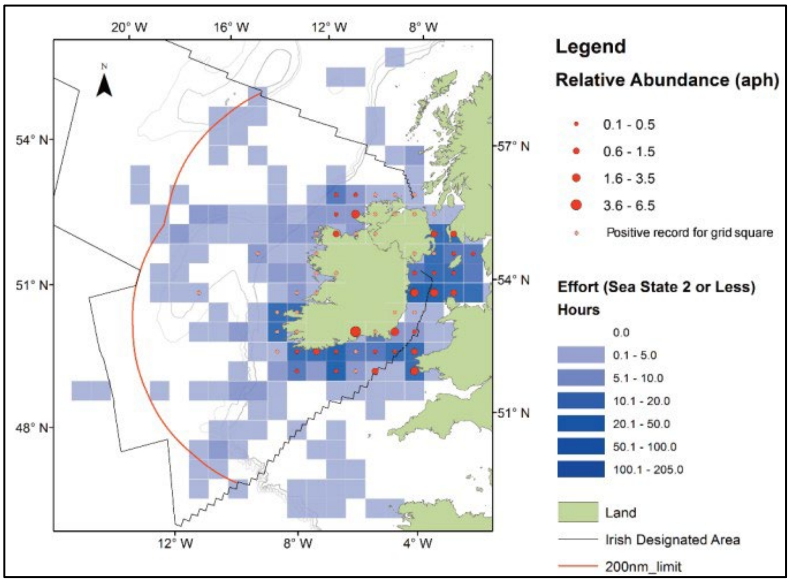

Figure 30 Relative abundance of harbour porpoises from the Irish marine mammal atlas (Wall *et al.*, 2013).

4.7 Other OWFs

Harbour porpoise were the most commonly sighted species during Codling Wind Park surveys and were also observed during Arklow Bank Wind Park 1 and 2 surveys (Codling Wind Park Limited, 2020, RPS, 2020).

For the Dublin Array, harbour porpoise were identified as one of the main species of interest within the Dublin Array EIA Scoping Report (SLR *et al.*, 2020). Although boat site-specific marine mammal surveys have been undertaken as part of the Dublin Array project (SLR *et al.*, 2020), these data are yet to be published and site-specific density estimates are not yet available.

4.8 Seasonality

In the British Isles, it is estimated that the breeding season typically occurs between June and September, with births predominantly in June (Lockyer, 1995). They are considered a slowly reproducing species as they give birth only once a year and therefore are dependent on a successful breeding season (Kesselring *et al.*, 2017). Dynamic energy budget modelling has shown that female porpoise are expected to be most vulnerable to disturbance (reduction in food intake) between the time the calf is born until it is able to acquire at least some food independently (June – Sept inclusive) (Harwood *et al.*, 2020). The population will, therefore, be more vulnerable to disturbance during this breeding and early lactation season.

Data from the sources analysed indicates the potential for harbour porpoise presence all year round. Sightings during the site-specific aerial surveys were highly variable, but predicted density estimates were higher in the autumn and winter months compared to spring and summer months (Table 7). Conversely, several surveys conducted (e.g., Berrow *et al.*, 2008, Rogan *et al.*, 2018) found density and abundance to be higher during the summer months.

4.9 Summary

There have been several studies of harbour porpoise in the Irish Sea and in the vicinity of the proposed development. This has resulted in a range of density estimations for the area (Table 11). The site-specific survey data are considered the best representation of harbour porpoise density in the NISA array area. However, given the range of density estimates available and the different areas covered by the density estimates, a range will be taken forward to the quantitative impact assessment. This will include: the site-specific survey estimate, the SCANS IV uniform density estimate, the SCANS III density surface estimate and the Evans and Waggitt (2023) density surface.

Table 11 Summary of the harbour porpoise density data.

Data source	Reference	Density (#/km^2)
Site specific surveys	**Natural Power and APEM**	**Average: 0.38**
SCANS IV block CS-D	**Gilles *et al.* (2023)**	**0.2803**
SCANS III block E	Hammond *et al.* (2021)	0.239
SCANS III density surface	**Lacey *et al.* (2022)**	**Grid cell specific** 0.25-0.50 in the vicinity of NISA array area and ECC
SCANS II block O	Hammond *et al.* (2013)	0.335
ObSERVE summer stratum 5	Rogan *et al.* (2018)	Season 1: 0.696 Season 3: 1.046
ObSERVE winter stratum 5	Rogan *et al.* (2018)	Season 2: 0.867 Season 4: 0.924
Welsh and Irish Sea distribution	**Evans and Waggitt (2023)**	**Grid cell specific** 0.3-0.4 in NISA array area
IWDG Irish Sea Block A	Berrow *et al.* (2011)	1.585
IWDG North County Dublin	Berrow *et al.* (2008)	2.03
IWDG Dublin Bay	Berrow *et al.* (2008)	1.19
IWDG Rockabill to Dalkey Island SAC (2021)	Berrow *et al.* (2021)	0.83
IWDG Rockabill to Dalkey Island SAC (2016)	O'Brien and Berrow (2016)	1.55
IWDG Rockabill to Dalkey Island SAC (2013)	Berrow and O'Brien (2013)	1.474

5 Bottlenose dolphins

Bottlenose dolphins are described as being *"one of the most frequently recorded and familiar cetaceans occurring in Ireland"*, occurring in group sizes between 3 and 30 in coastal waters, and larger groups of hundreds of individuals in offshore waters (NPWS, 2019) (Figure 31). The species has been assessed as having a Favourable overall conservation status in Irish waters (NPWS, 2019). The proposed development is located within the Irish Sea MU for bottlenose dolphins, where there is an estimated abundance of 293 bottlenose dolphins (CV: 0.54, 95% CI: 108 - 793) (IAMMWG, 2023) based on data collected during SCANS III and the ObSERVE surveys (Rogan *et al.*, 2018, Hammond *et al.*, 2021).

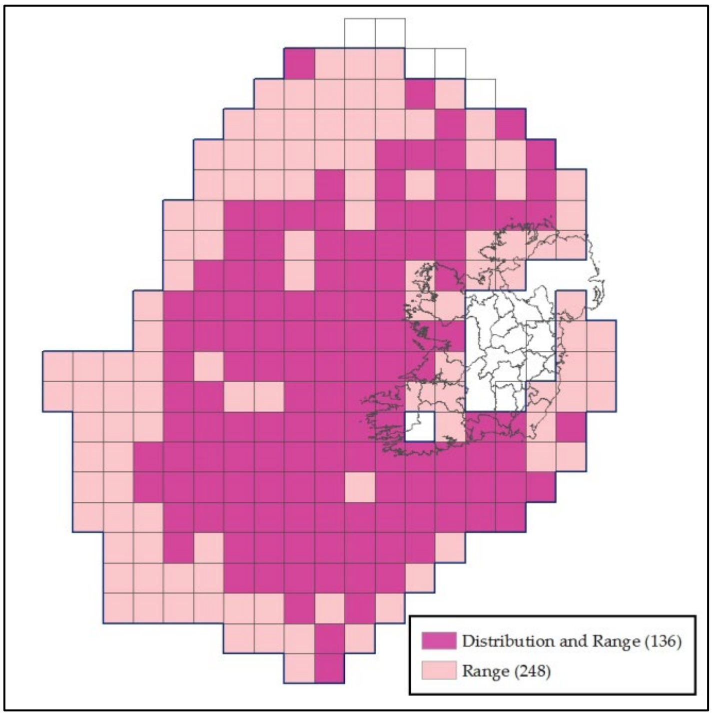

Figure 31 - The range and distribution of bottlenose dolphins in Irish waters (NPWS, 2019).

Previous research, combining genetic and photo-ID data has concluded that a high degree of site fidelity for bottlenose dolphins in Irish waters is present amongst Ireland's coastal populations (Nykänen *et al.*, 2018, Nykänen *et al.*, 2020). However, studies have also found that bottlenose dolphins can undertake movements of up to a few hundred kilometres around Ireland (O'Brien *et al.*, 2009). There has also been some evidence of movement from the Atlantic to the North Sea, with these long-distance movements reported by Robinson *et al.* (2012) suggesting confirmation of individual exchange between previously considered discrete populations in the UK and Ireland. Further to this research, movements of bottlenose dolphins have been recorded from the East of Scotland, with individuals from known populations here also being sighted in Irish coastal waters. Due to this, it must be considered that the west coast population of bottlenose dolphins in the RoI may demonstrate connectivity to individuals found on the east coast.

Within the Irish Sea MU there are three SACs for bottlenose dolphins, both located within Welsh waters: Cardigan Bay SAC, the Lleyn Peninsula and the Sarnau SAC (Figure 2). Given the evidence for connectivity between the Irish west coast population and the east coast, it is also necessary to consider potential connectivity and the potential for impacts to occur for the Lower River Shannon SAC and the West Connacht Coast SAC.

5.1 Proposed development: Site-specific surveys

5.1.1 Vessel surveys

No bottlenose dolphins were sighted in any of the vessel-based surveys.

5.1.2 Aerial surveys

In the 29 months of aerial surveys, a total of 3 bottlenose dolphins (0.3% of all marine mammal sightings), 27 dolphin sp. (32.6% of all marine mammal sightings) and 209 dolphin/porpoise (20.5% of all marine mammal sightings) were sighted. The sightings of un-identified marine mammals were apportioned using speciated records across the DAS dataset (Natural Power, 2022). However, no correction has been made for availability bias, meaning that the resulting estimates are relative density estimates, not absolute density estimates.

Bottlenose dolphin relative density estimates were on average 0.002 dolphins/km^2 across the 29 surveys, ranging from 0.000 dolphins/km^2 in the winter to 0.004 in the spring dolphins/km^2 (Table 12).

Table 12 Bottlenose dolphin sightings during the NISA site-specific baseline aerial surveys. The relative density estimate has used apportioning for the un-identified species, but has not been corrected for availability bias.

	Month	Sightings (raw)	Relative density (apportioned)	Density LCI & UCI
1	May 2020	0	0.00	0.00 - 0.09
2	Jun 2020	0	0.02	0.00 - 0.12
3	Jul 2020	0	0.00	0.00 - 0.00
4	Aug 2020	0	0.00	0.00 - 0.00
5	Sep 2020	0	0.00	0.00 - 0.00
6	Oct 2020	1	0.02	0.00 - 0.66
7	Nov 2020	0	0.00	0.00 - 0.00
8	Dec 2020	0	0.00	0.00 - 0.00
9	Feb 2021	0	0.00	0.00 - 0.00
10	Mar 2021	0	0.00	0.00 - 0.00
11	Apr 2021	0	0.00	0.00 - 0.00
12	May 2021	2	0.03	0.01 - 0.08
13	Jun 2021	0	0.00	0.00 - 0.03
14	Jul 2021	0	0.00	0.00 - 0.00
15	Aug 2021	0	0.00	0.00 - 0.00
16	Sep 2021	0	0.00	0.00 - 0.00
17	Oct 2021	0	0.00	0.00 - 0.05
18	Nov-21	0	0.00	0.00 - 0.00
19	Dec-21	0	0.00	0.00 - 0.00
20	Jan-22	0	0.00	0.00 - 0.00
21	Feb-22	0	0.00	0.00 - 0.00
22	Mar-22	0	0.00	0.00 - 0.00
23	Apr-22	0	0.00	0.00 - 0.00
24	May-22	0	0.00	0.00 - 0.00
25	Jun-22	0	0.00	0.00 - 0.00
26	Jul-22	0	0.00	0.00 - 0.00
27	Aug-22	0	0.00	0.00 - 0.00
28	Sep-22	0	0.00	0.00 - 0.00
29	Oct-22	0	0.00	0.00 - 0.00

	Month	Sightings (raw)	Relative density (apportioned)	Density LCI & UCI
Average	All	All months	0.002	
Average	Spring	Mar, Apr, May	0.004	
Average	Summer	Jun, Jul, Aug	0.002	
Average	Autumn	Sep, Oct, Nov	0.003	
Average	Winter	Dec, Jan, Feb	0.000	

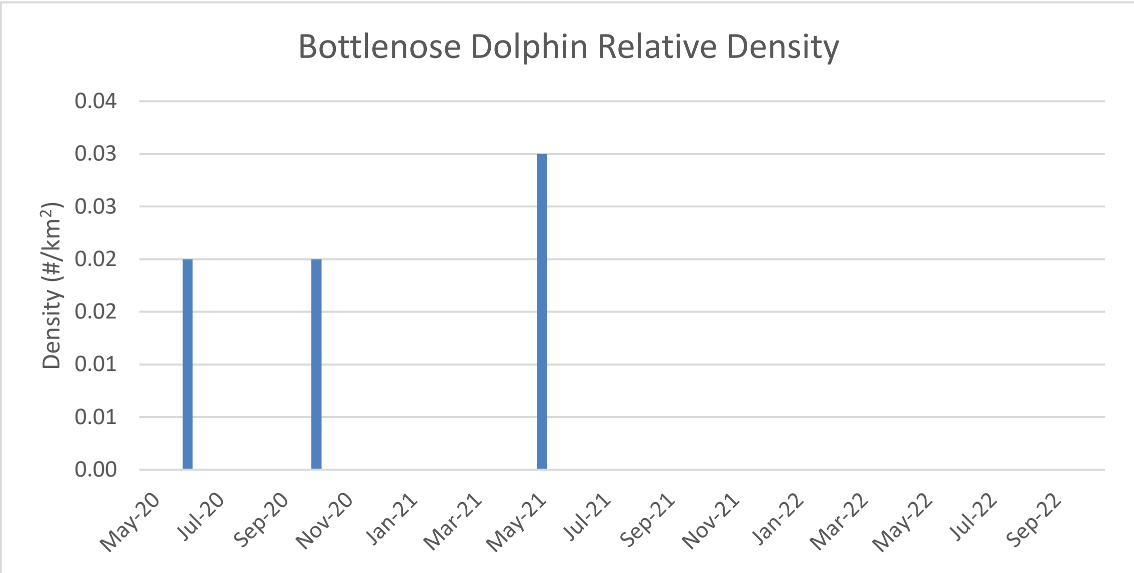

Figure 32 Bottlenose dolphin relative density estimates across the 29 aerial surveys

5.2 ObSERVE

Bottlenose dolphin sightings during the ObSERVE surveys were mainly located in the west and the south of Ireland (Figure 33). Bottlenose dolphins were only sighted in the ObSERVE strata 5 in season 4 (winter 2016), where the resulting design-based estimate was 0.036 dolphins/km^2 and the model-based estimate was 0.020 dolphins/km^2 (Rogan *et al.*, 2018).

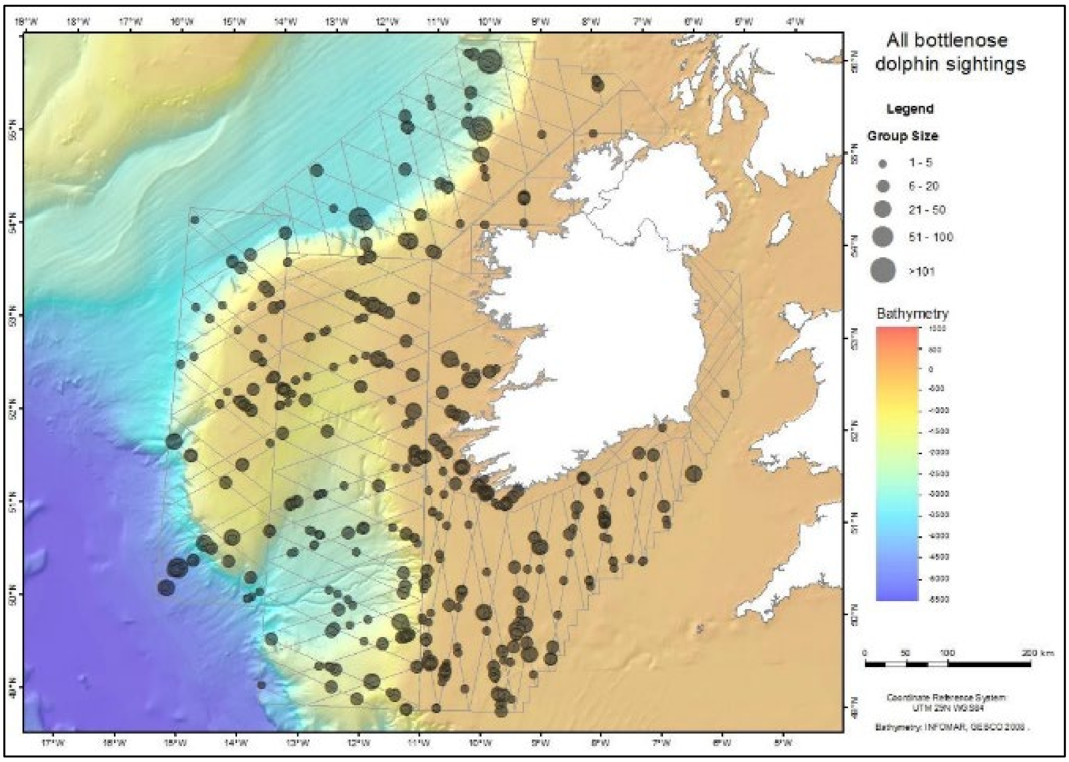

Figure 33 All bottlenose dolphin sightings from the ObSERVE surveys from 2015-2016 (Rogan *et al.*, 2018).

5.3 SCANS

The SCANS III survey effort for the east coast of Ireland, assigned as block E, concluded an estimated abundance of 288 individuals in 2016, with lower and upper CIs of 0 and 664 respectively. The estimated density of bottlenose dolphins within this block was reported at 0.008 dolphins/km^2 (Hammond *et al.*, 2017, Hammond *et al.*, 2021).

Bottlenose dolphins were also sighted in the SCANS II block O, though only in the eastern Irish Sea, off Wales and northwest England. This resulted in a block wide abundance estimate of 235 dolphins (CV 0.75) and a uniform density across the survey block of 0.0052 dolphins/km^2 (CV 0.75) (Hammond *et al.*, 2013).

The density surfaces obtained from the SCANS III data show the predicted bottlenose dolphin distribution across the MU is not uniform, with higher densities found in the southwest of the MU (Lacey *et al.*, 2022). Densities of bottlenose dolphin in the vicinity of NISA array area and ECC are relatively low with values below 0.05 bottlenose dolphin/km^2 towards the coastline (Figure 34). While the SCANS III bottlenose dolphin density surface provides some information on bottlenose dolphin distribution within the Irish Sea (higher in the coastal waters of east Ireland), the density surface is incompatible with the Irish Sea MU population size estimate of 293 bottlenose dolphins (IAMMWG, 2023). If the grid cells within the Irish Sea MU are summed, then the number of bottlenose dolphins present in the Irish Sea MU according to the Lacey *et al.* (2022) density surface is 1,069 bottlenose dolphins. This is over three times higher than the MU abundance estimate advised by IAMMWG (2023). If the Lacey *et al.* (2022) density surface is to be used in a quantitative impact assessment to predict the number of bottlenose dolphins impacted, then the Irish Sea MU population has to be assumed to be 1,069 bottlenose dolphins, or else more dolphins could be predicted to be impacted than there are in the MU population if it is assumed to be 293.

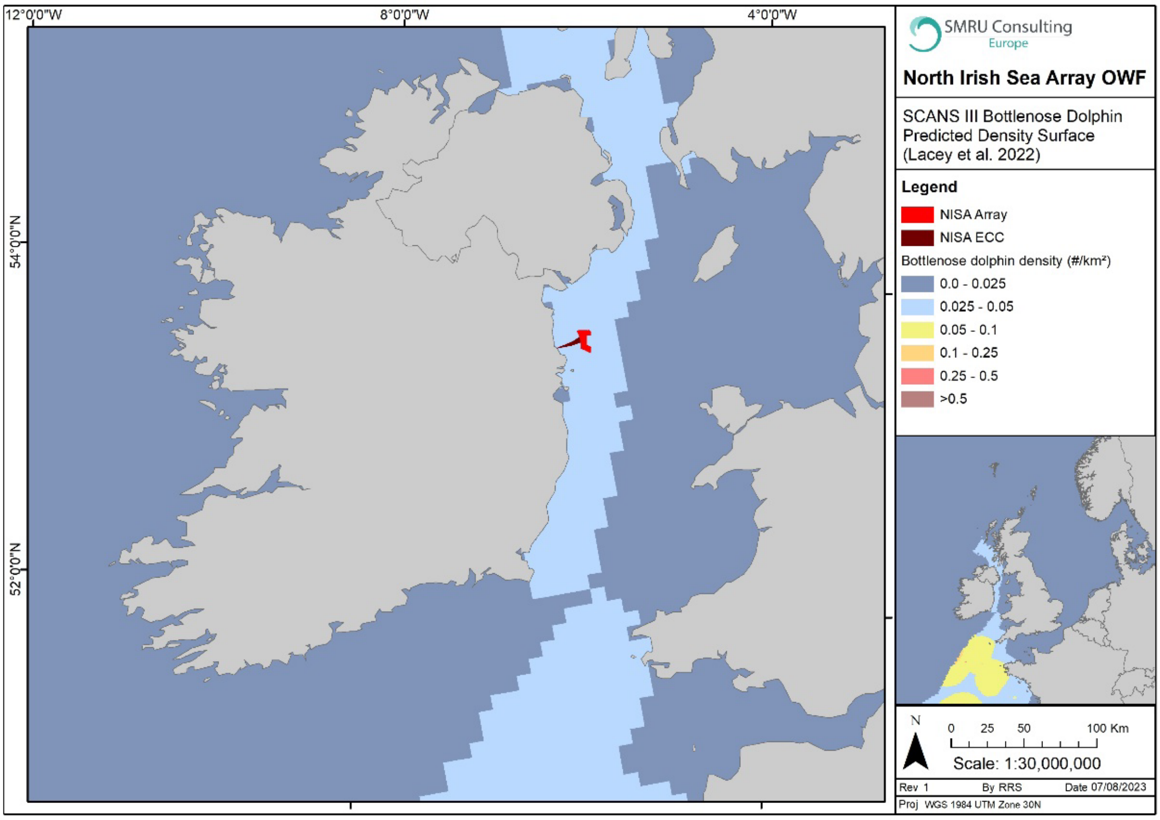

Figure 34 Predicted surfaces of estimated density for bottlenose dolphin in SCANS III. Data from Lacey et al. (2022).

The SCANS IV used different survey block names to SCANS III, and Dublin Array is located within SCANS IV survey block CS-D (which covered the whole Irish Sea). Bottlenose dolphins were sighted throughout SCANS IV survey block CS-D, resulting in a block wide abundance estimate of 8,199 (95% CI: 3,595 – 15,158) and a uniform density across the survey block of 0.2352 dolphins/km^2 (CV 0.353) (Gilles *et al.*, 2023). It is important to highlight here the significant differences between the SCANS III and SCANS IV results for the abundance of bottlenose dolphins in the Irish Sea. SCANS III estimates there to be a total of 288 bottlenose dolphins in the Irish Sea, while SCANS IV estimates there to be 8,326 bottlenose dolphins in the Irish Sea (Table 13). The difference in bottlenose sightings between SCANS III and SCANS IV are shown in Table 13, where there were significantly more bottlenose dolphin sightings throughout the Irish Sea in SCANS IV. The SCANS IV report states the following with regards to bottlenose dolphins: *"The bottlenose dolphin is a species for which European Atlantic waters are at the edge of a wider North Atlantic range. There is no information on abundance in the central North Atlantic but the differences in distribution and abundance estimates between 2005/07, 2016 and 2022 may reflect bottlenose dolphins responding to interannual spatial variation in prey availability across the wider range. Data from the 2022 ObSERVE2 survey, when available, will add to understanding of the variation in distribution and abundance of bottlenose dolphin in European Atlantic waters seen between SCANS-IV and previous surveys."* (Gilles *et al.*, 2023). The current recommended population estimate for the Irish Sea MU is 293 bottlenose dolphins (IAMMWG, 2023) based on data from SCANS III and ObSERVE. The abundance estimate of 8,326 bottlenose dolphins in the Irish Sea using the SCANS IV density estimates is therefore completely incompatible with the current Irish Sea MU population size estimate of 293. Therefore, it is not possible to use the SCANS IV density estimate in a quantitative impact assessment unless the Irish Sea MU abundance estimate is assumed to be 8,326 instead of 293.

Table 13 Number of bottlenose dolphins estimated to be in the Irish Sea using SCANS III (Hammond *et al.*, 2017, Hammond *et al.*, 2021) and SCANS IV estimates (Gilles *et al.*, 2023).

	SCANS III	SCANS IV
West Irish Sea block	E	CS-D
Area west Irish Sea block (km^2)	34,870	34,867
Density in west Irish Sea block (#/km^2)	0.0082	0.2352
Abundance in west Irish Sea block (95% CIs)	288 (0 – 664)	8,199 (3,595 - 15,158)
East Irish Sea block	F	CS-E
Area east Irish Sea block (km^2)	12,322	12,274
Density in east Irish Sea block (#/km^2)	0	0.0104
Abundance in east Irish Sea block (95% CIs)	0	127 (3 – 353)
Total bottlenose dolphins in Irish Sea	**288**	**8,326**

5.4 Distribution and abundance of cetaceans in Wales and its adjacent waters

Bottlenose dolphins were modelled throughout the Irish Sea and Bristol Channel, with consistent distribution patterns (Figure 35). The third quarter, July – September, had peak densities at Cardigan Bay. The modelled outputs below indicate that the main areas of high density are inclusive of Cardigan Bay and west Anglesey, with some densities in a concentrated area on the southwest coast of England. The densities predicted for the east coast of the ROI were comparatively very low. Using the maximum density per cell across all months, the estimated density in the array area is at most 0.0066 dolphins/km^2 (Figure 36).

As noted for the SCANS surveys, the Evans and Waggitt (2023) maximum density surface is not compatible with the Irish Sea MU population size estimate of 293 bottlenose dolphins (IAMMWG, 2023). If the grid cells within the Irish Sea MU are summed, then the number of bottlenose dolphins present in the Irish Sea MU according to the Evans and Waggitt (2023) maximum density surface is 496 bottlenose dolphins. This is over 1.5 times higher than the MU abundance estimate advised by IAMMWG (2023). If the Evans and Waggitt (2023) maximum density surface is to be used in a quantitative impact assessment to predict the number of bottlenose dolphins impacted, then the Irish Sea MU population has to be assumed to be 496 bottlenose dolphins, or else more dolphins could be predicted to be impacted than there are in the MU population if it is assumed to be 293.

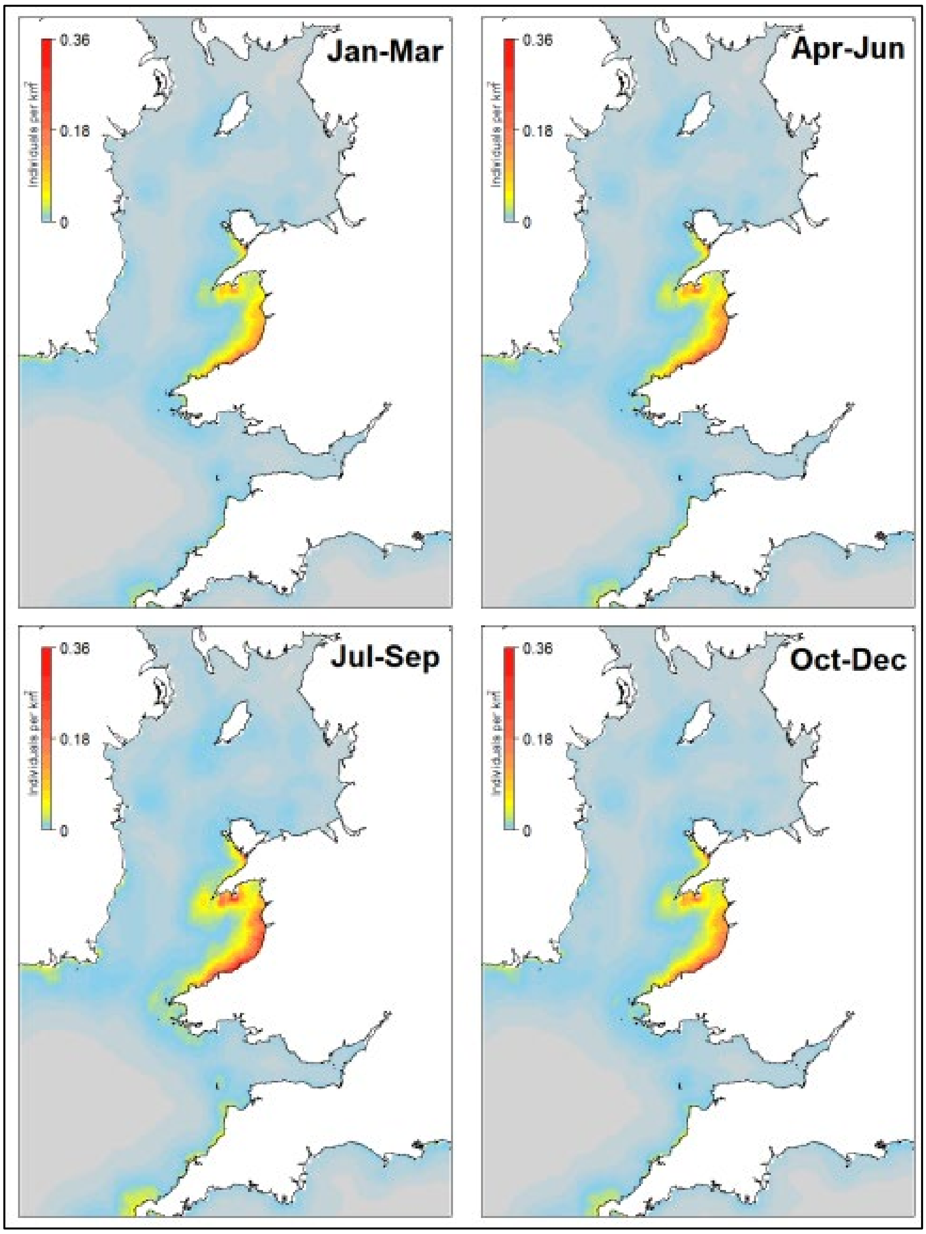

Figure 35 Bottlenose dolphin modelled densities by quarter (Evans and Waggitt, 2023).

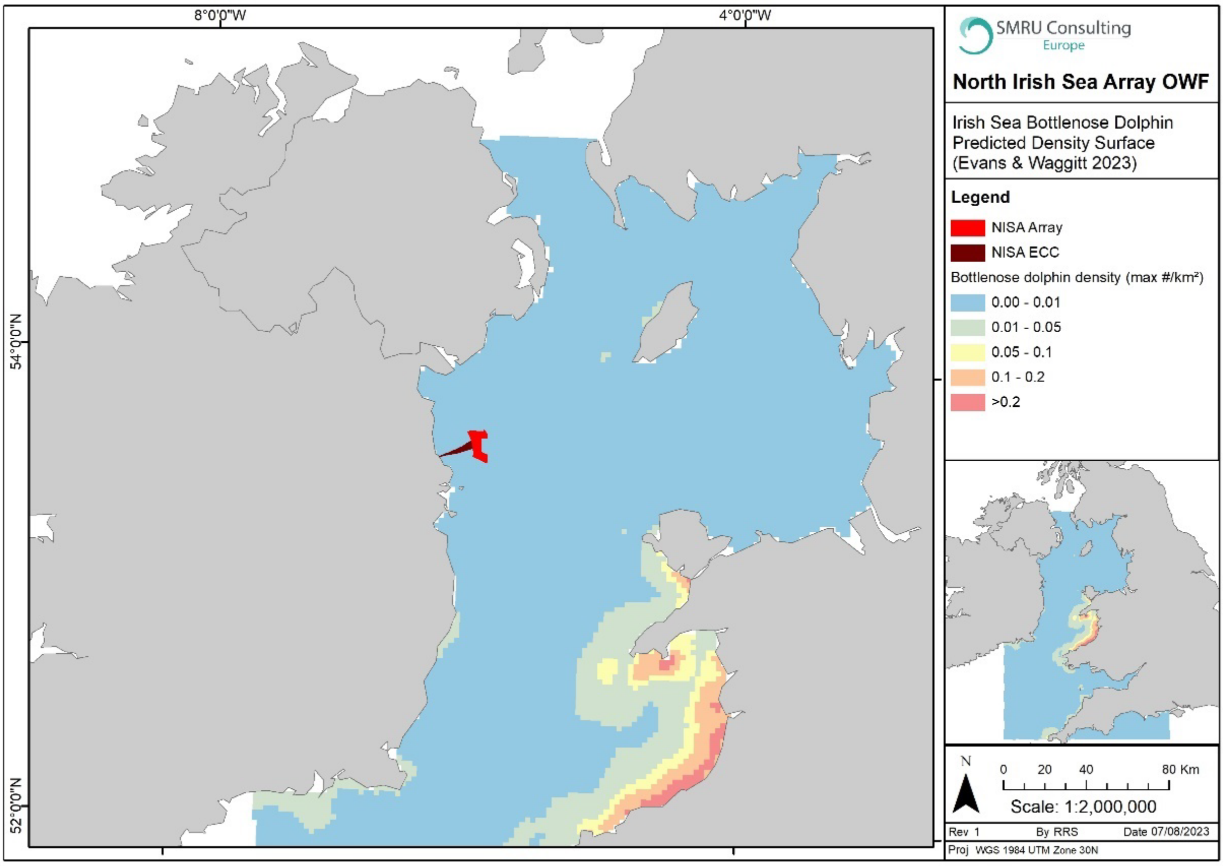

Figure 36 Bottlenose dolphin modelled densities (maximum density per cell across months) (Evans and Waggitt, 2023).

5.5 IWDG Surveys

No bottlenose dolphin sightings were reported on the east coast of Ireland during the IWDG surveys considered in this baseline characterisation (Berrow *et al.*, 2008, O'Brien *et al.*, 2009, Berrow *et al.*, 2011, Berrow *et al.*, 2012, O'Brien and Berrow, 2016).

5.6 Irish Marine Mammal Atlas

Bottlenose dolphins were sighted off all Irish coasts, with evidence that an offshore ecotype of bottlenose dolphins exists in Irish waters (Mirimin *et al.*, 2011). While the highest relative abundances of these individuals were reported to be in the offshore waters in the west of Ireland, small densities of bottlenose dolphins were reported along the east coast (Figure 37). There was insufficient data available for this species to report on the seasonal variation in bottlenose dolphin relative abundance. However, these animals were reported in Irish waters year-round. Mother-calf pairs of bottlenose dolphins are primarily reported in Irish waters during the summer months (Berrow *et al.*, 2012).

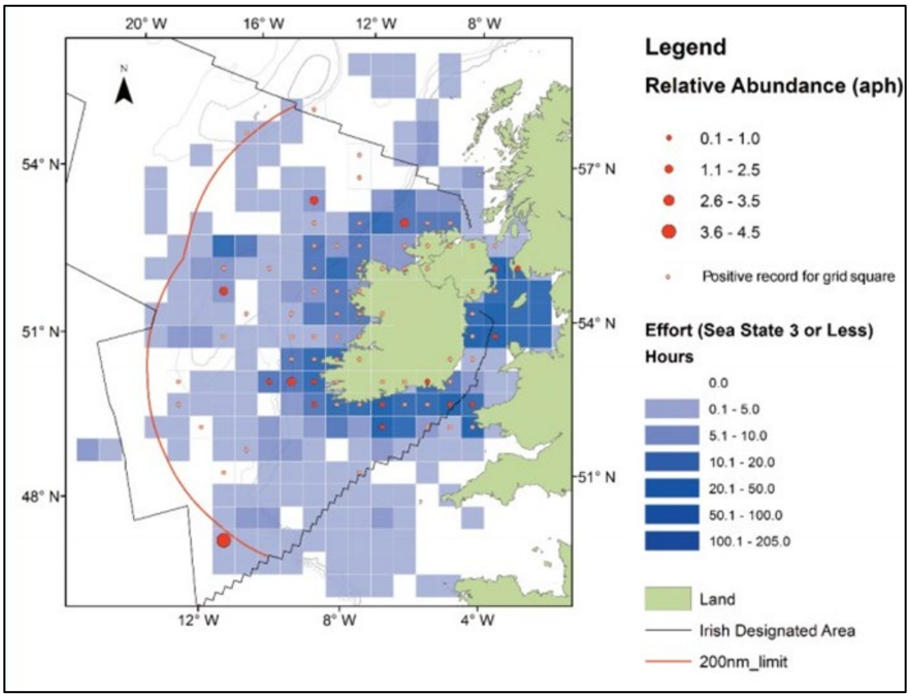

Figure 37 Relative abundance of bottlenose dolphins from the Irish marine mammal atlas (Wall *et al.*, 2013).

5.7 Other OWFs

Bottlenose dolphins were not observed during site-specific surveys for Codling Wind Park or Arklow Bank Wind Park 1 and 2.

For the Dublin Array, bottlenose dolphins were identified as one of the main species of interest within the Dublin Array EIA Scoping Report (SLR *et al.*, 2020). Although boat site-specific marine mammal surveys have been undertaken as part of the Dublin Array project (SLR *et al.*, 2020), these data are yet to be published and site-specific density estimates are not yet available.

5.8 Seasonality

Bottlenose dolphins in the Shannon Estuary are known to calve from June to September (Baker *et al.*, 2017) and, similarly, in Cardigan Bay the majority of bottlenose dolphin calves are born between July and September (Norman *et al.*, 2015). As connectivity has been shown between the east and west coast of Ireland populations, as well as the potential for connectivity with the Cardigan Bay population, it is anticipated that any calving in the vicinity of the proposed development would occur during this time period.

Whilst insufficient data was available for the studies conducted in the vicinity of the proposed development as to infer seasonal presence, bottlenose dolphins have been sighted all year round in Irish waters (Berrow *et al.*, 2012) and they are known to exhibit a high degree of site fidelity (Nykänen *et al.*, 2018, Nykänen *et al.*, 2020). Therefore, it is likely that they could be present during their breeding and calving season.

5.9 Summary

There are a few surveys that have recorded bottlenose dolphins in the vicinity of the proposed offshore development area, (the SCANS surveys, the ObSERVE surveys and surveys undertaken at other OWF sites). The density estimates from all surveys was fairly low, ranging between 0.00 to <0.5 dolphins/km^2 (Table 14). A range of density estimates will be taken forward to the quantitative impact assessment to reflect the uncertainty in bottlenose dolphin density in the NISA area and the wider Irish Sea. These will include the site-specific density estimate, the SCANS IV uniform density estimate, the SCANS III density surface and the Evans and Waggitt (2023) density surface.

Table 14 Bottlenose dolphin density estimates (dolphins/km^2).

Data source	Reference	Density estimate
Site specific surveys	**Natural Power and APEM**	**0.002**
SCANS IV block CS-D	**Gilles et al. (2023)**	**0.2352**
SCANS III block E	Hammond *et al.* (2021)	0.008
SCANS III density surface	**Lacey *et al.* (2022)**	**Grid cell specific** 0.25-0.50 in the vicinity of the NISA array area and ECC
SCANS II block O	Hammond *et al.* (2013)	0.005
ObSERVE summer stratum 5	Rogan *et al.* (2018)	0
ObSERVE winter stratum 5	Rogan *et al.* (2018)	Season 2: 0 Season 4: 0.02
Welsh and Irish Sea distribution	**Evans and Waggitt (2023)**	**Grid cell specific** 0.0066 in the NISA array area

6 Risso's dolphin

Risso's dolphin occurrence is described as *"wide and frequent… throughout Irish waters"*, sighted in both the continental shelf and slope as well as the margins of deeper ocean basins (NPWS, 2019) (Figure 38). The species has been assessed as having a Favourable overall conservation status in Irish waters (NPWS, 2019). The IAMMWG recommend a single Celtic and Greater North Seas MU for Risso's dolphin where the estimate of abundance is 12,262 (CV: 0.46, 95% CI: 5,227 – 28,764) (IAMMWG, 2023) based on data collected during SCANS III and the ObSERVE surveys (Rogan *et al.*, 2018, Hammond *et al.*, 2021).

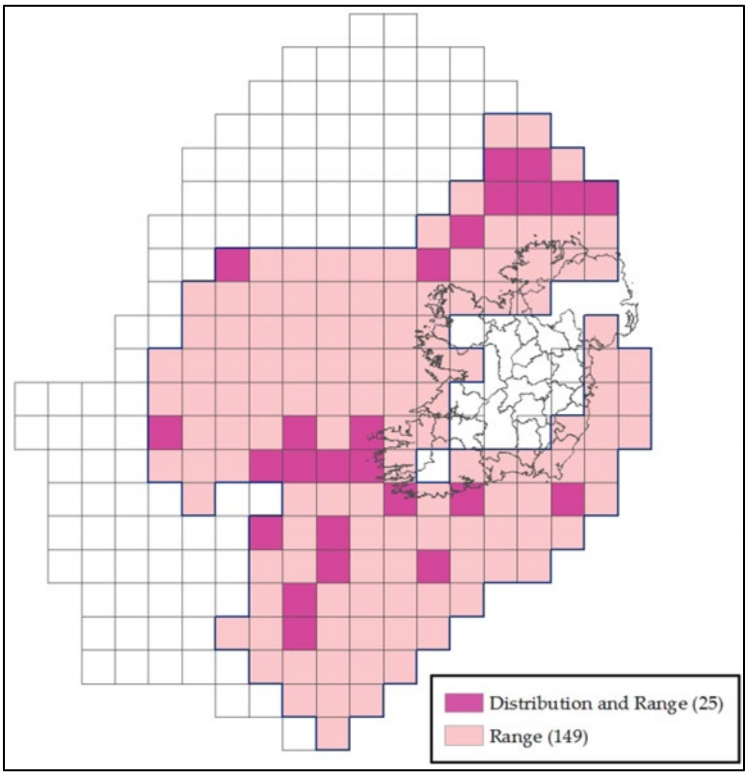

Figure 38 The range and distribution of Risso's dolphins in Irish waters (NPWS, 2019).

6.1 Proposed development: Site-specific surveys

6.1.1 Vessel surveys

No Risso's dolphins were sighted in the site specific vessel baseline surveys.

6.1.2 Aerial surveys

No Risso's dolphins were sighted in the site specific aerial baseline surveys.

6.2 ObSERVE

Risso's dolphin sightings during the ObSERVE surveys were low across all surveys and strata (Figure 39). Risso's dolphins were only sighted in the ObSERVE stratum 5 during the season 1 survey (summer 2015) which resulted in a design-based density estimate of 0.003 dolphins/km^2. However, this single sighting was located in the south of the stratum and not in the north of the stratum so was not in the vicinity of the NISA array area.

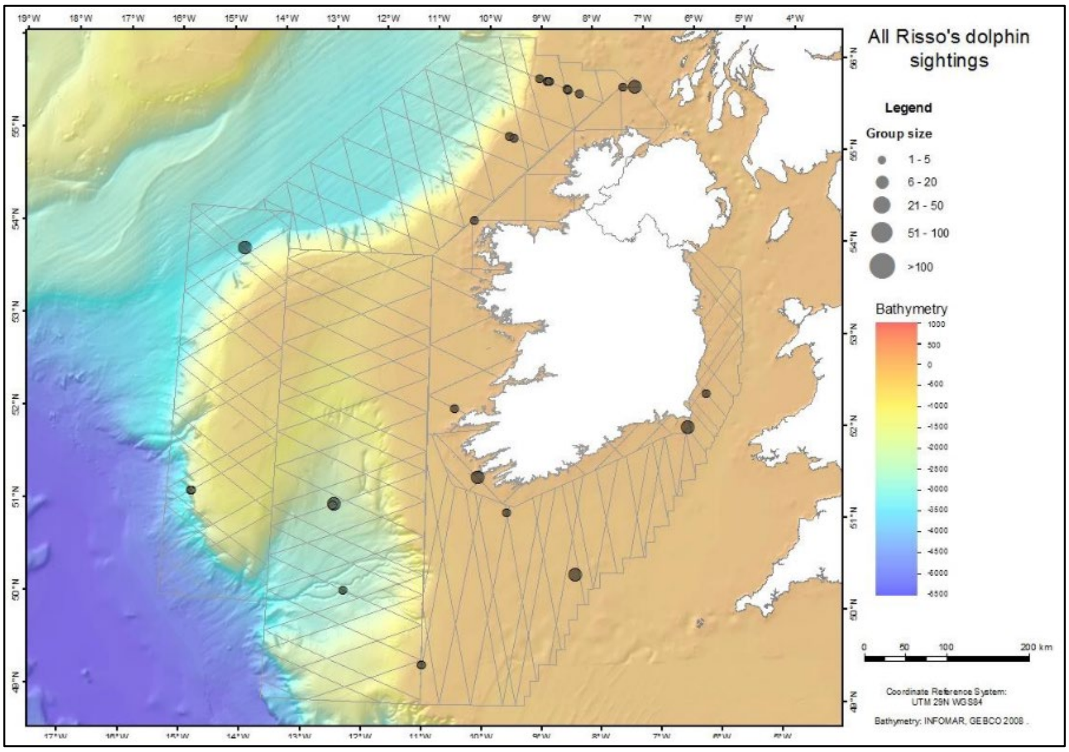

Figure 39 All Risso's dolphin sightings from the ObSERVE surveys from 2015-2016 (Rogan *et al.*, 2018).

6.3 Distribution and abundance of cetaceans in Wales and its adjacent waters

Risso's dolphin were modelled throughout the Irish Sea and Bristol Channel, with varying distribution patterns (Figure 36). The third quarter, July – September, had peak densities. The modelled outputs below indicate that the main areas of higher density are inclusive of the Irish Sea from July – September, particularly the southeast coast of the Republic of Ireland, the Isle of Man, and the southwest coast of England. Using the maximum density per cell across all months, the estimated density in the NISA array area is up to 0.007 dolphins/km^2.

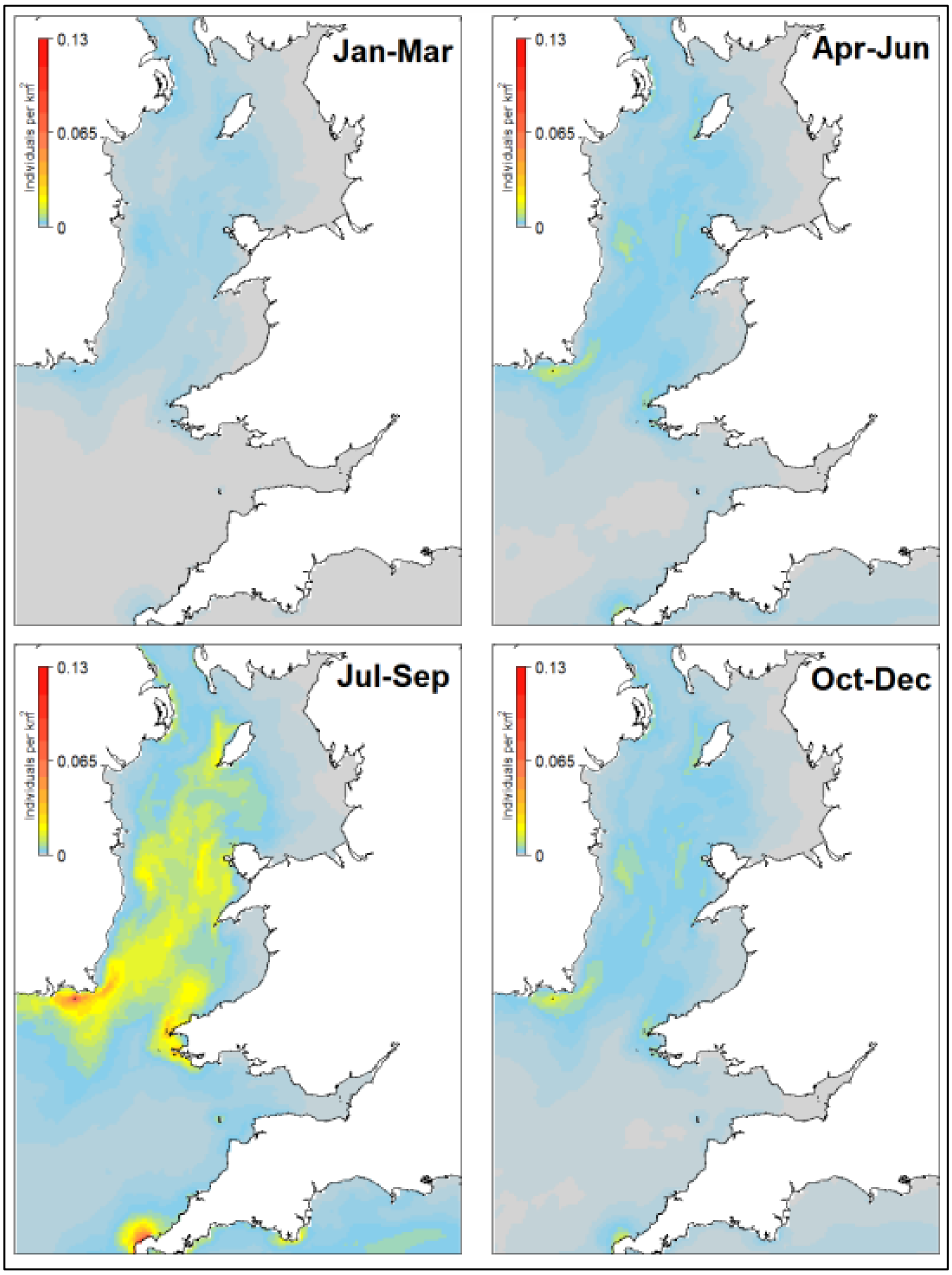

Figure 40 Risso's dolphin modelled densities by quarter (Evans and Waggitt, 2023).

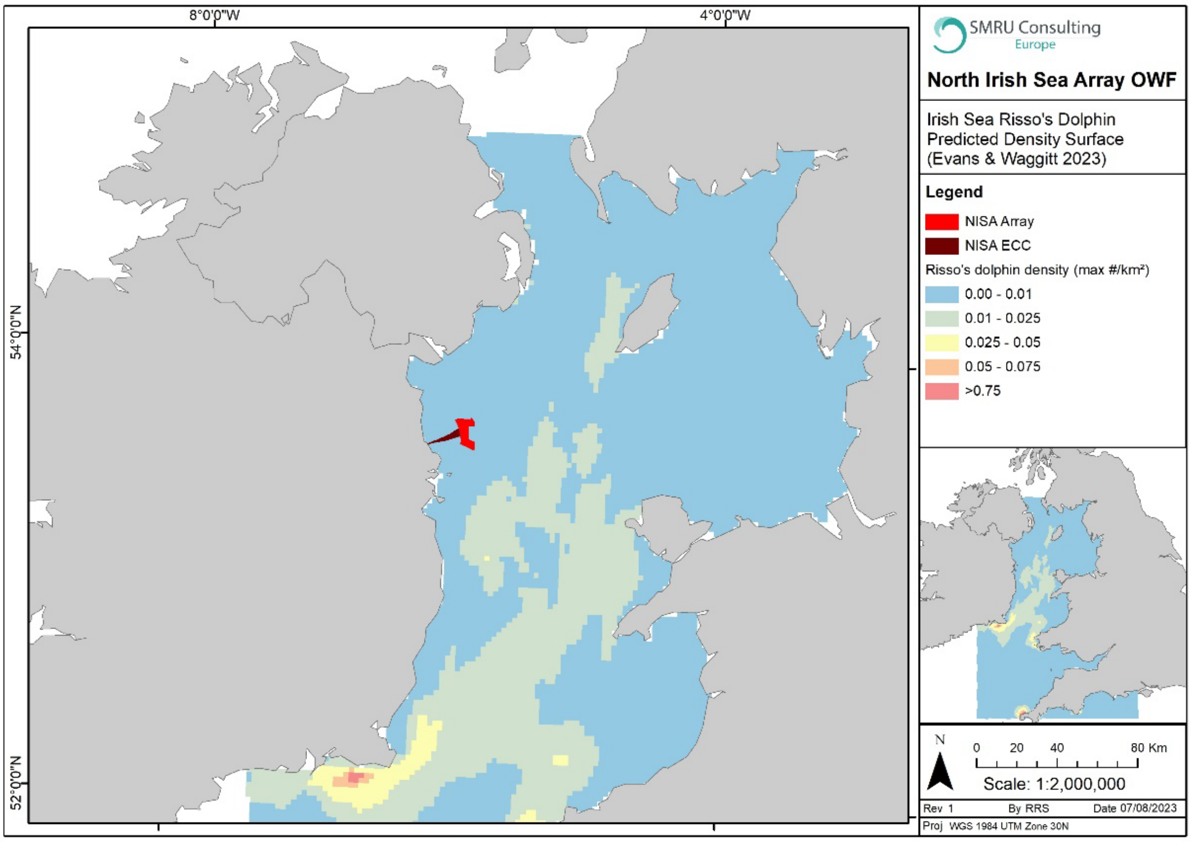

Figure 41 Risso's dolphin modelled densities (maximum density per cell across months) (Evans and Waggitt, 2023).

6.4 SCANS

Risso's dolphin sightings around Ireland were low during the SCANS III surveys (Figure 42). Risso's dolphin estimated abundance for block E, the East coast of Ireland, was reported to be 1,090 individuals during the SCANS III surveys in 2016, with lower and upper CIs of 0 and 2,843 respectively. Density estimates for this species within block E was reported at 0.031 animals/km^2 (Hammond *et al.*, 2017, Hammond *et al.*, 2021). No Risso's dolphins were reported in SCANS II block O for the Irish Sea (Hammond *et al.*, 2013).

Risso's dolphins were not included in the SCANS III predicted density surface modelling.

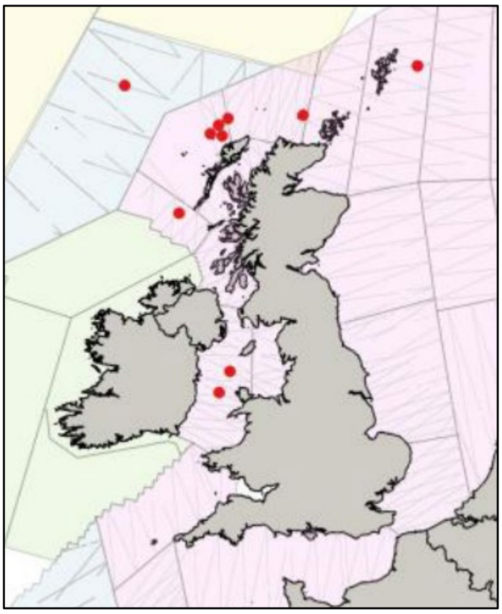

Figure 42 Distribution of Risso's dolphin sightings during SCANS III (Hammond *et al.*, 2017).

The SCANS IV used different survey block names to SCANS III, and Dublin Array is located within SCANS IV survey block CS-D (which covered the whole Irish Sea). Risso's dolphin were sighted throughout SCANS IV survey block CS-D, resulting in a block wide abundance estimate of 75 (95% CI: 2 – 259) and a uniform density across the survey block of 0.0022 dolphins/km^2 (CV 1.012) (Gilles *et al.*, 2023).

6.5 IWDG Surveys

No Risso's dolphin sightings were reported during the IWDG surveys on the east coast of Ireland considered in this baseline characterisation (Berrow *et al.*, 2008, O'Brien *et al.*, 2009, Berrow *et al.*, 2011, Berrow *et al.*, 2012, O'Brien and Berrow, 2016).

6.6 Irish Marine Mammal Atlas

Risso's dolphins were reported around the entire Irish coast, with highest relative abundances reported to be off the southwest and southeast coasts (Figure 43) (Wall *et al.*, 2013). These individuals were sighted in Irish waters from April – November, with a peak in sightings during the summer months. Sightings of young calves in some groups suggested that calving may also be occurring in Irish waters. This species was largely absent in Irish shelf waters from December – March.

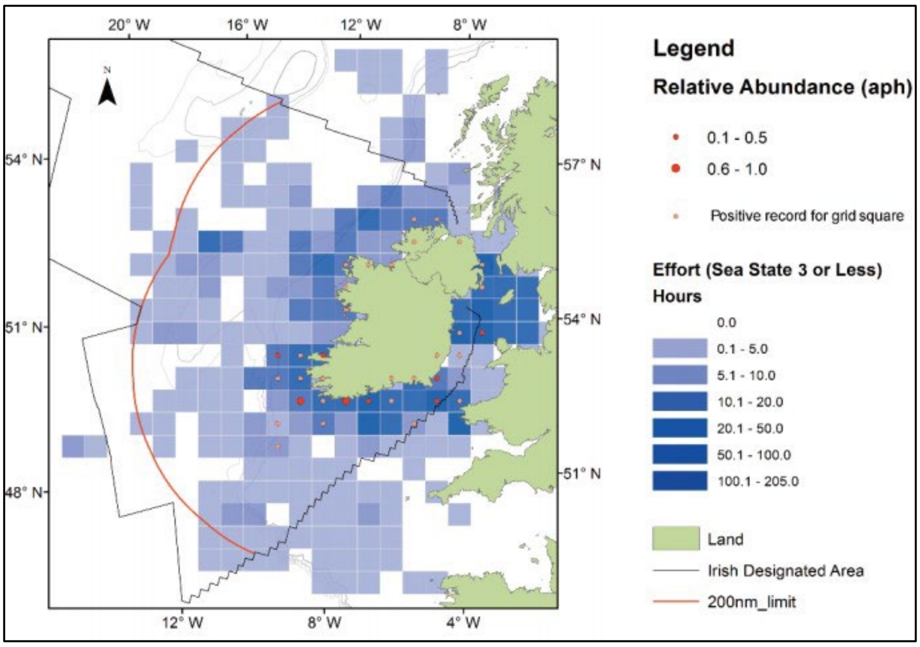

Figure 43 Relative abundance of Risso's dolphins from the Irish marine mammal atlas (Wall *et al.*, 2013).

6.7 Other OWFs

Risso's dolphin were observed during the nearby Arklow Bank Wind Park 1 and 2 surveys (RPS, 2020), however, no density estimation was provided.

For the Dublin Array, Risso's dolphins were identified as one of the main species of interest within the Dublin Array EIA Scoping Report (SLR *et al.*, 2020). Although boat site-specific marine mammal surveys have been undertaken as part of the Dublin Array project (SLR *et al.*, 2020), these data are yet to be published and site-specific density estimates are not yet available.

6.8 Seasonality

Although the surveys examined have not indicated Risso's dolphin are likely to be present in the vicinity of the proposed development, they would be most vulnerable to disturbance during the breeding season. The knowledge of the reproduction and breeding of Risso's dolphins is still limited, although studies in other regions have indicated it is typically during the summer and autumn months (Chen *et al.*, 2011).

6.9 Summary

As there were no Risso's dolphins recorded during the site-specific surveys, nor were they sighted in the IWDG surveys of the east coast of Ireland, Risso's dolphins have been scoped out of the impact assessment for the proposed development. In addition, as Risso's dolphins were not sighted in SCANS II block O, sighted only in very low numbers in SCANS III block E and again sighted only in low numbers during ObSERVE surveys for stratum 5, there is long-term evidence for the low likelihood of Risso's dolphin presence within the proposed development.

7 Short-beaked common dolphin

Common dolphins are the most frequently recorded dolphin species in Irish waters, occurring in group sizes ranging from a few individuals to over a thousand individuals in the open sea (NPWS, 2019). They have a wide distribution and occur in both coastal and offshore waters off Ireland

(Figure 44). The species has been assessed as having an overall Favourable conservation status in Irish waters (NPWS, 2019). The IAMMWG recommend that a single Celtic and Greater North Seas MU is appropriate for common dolphins (IAMMWG, 2023). The abundance estimate for the MU is 102,656 (CV: 0.29, 95% CI: 58,932 – 178,822) based on data collected during SCANS III and the ObSERVE surveys (Rogan *et al.*, 2018, Hammond *et al.*, 2021).

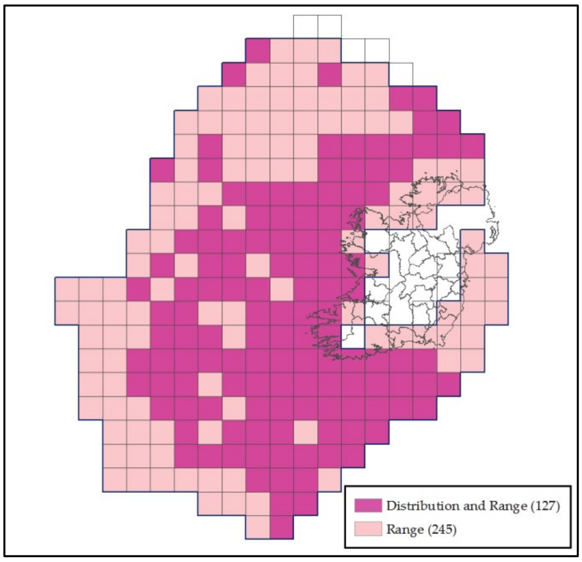

Figure 44 The range and distribution of short-beaked common dolphin in Irish waters (NPWS, 2019).

7.1 Proposed development: Site-specific surveys

7.1.1 Vessel surveys

Common dolphins were sighted in three of the vessel-based surveys. No density estimate was calculated, but these data confirm common dolphin presence year-round and were used to apportion the unidentified sightings from the aerial surveys.

Table 15 Common dolphin sightings during the NISA site-specific baseline vessel surveys.

Month	Survey Type	Dedicated marine mammal surveyors?	Sightings
Nov 2019	Vessel	yes	0
Jan 2020	Vessel	yes	20
Mar 2020	Vessel	yes	0
Aug 2020	Vessel	no	0
Jun 2021	Vessel	yes	15
Jul 2021	Vessel	yes	41

7.1.2 Aerial surveys

In the 29 months of aerial surveys, a total of 116 common dolphins (116% of all marine mammal sightings), 27 dolphin sp. (2.6% of all marine mammal sightings) and 209 dolphin/porpoise (20.5% of all marine mammal sightings) were sighted. The sightings of un-identified marine mammals were apportioned using speciated records across the DAS dataset (Natural Power, 2022). However, no correction has been made for availability bias, meaning that the resulting estimates are relative density estimates, not absolute density estimates, due to a lack of data.

Common dolphin sightings were highly variable across surveys, with between 0 and 30 individual common dolphins sighted per survey day. The average relative density estimate across the 29 surveys was 0.04 dolphins/km^2, however density was variable across seasons, with highest density estimates in the autumn (0.09 dolphins/km^2) months (Table 16).

Table 16 Common dolphin sightings during the NISA site-specific baseline aerial surveys. The relative density estimate has used apportioning for the un-identified species, but has not been corrected for availability bias.

Month	Sightings (raw)	Relative density (apportioned)	Density Confidence Intervals
May-20	0	0.00	0.00 - 0.00
Jun-20	0	0.00	0.00 - 0.00
Jul-20	0	0.00	0.00 - 0.00
Aug-20	0	0.03	0.00 - 0.21
Sep-20	2	0.14	0.07 - 0.25
Oct-20	0	0.07	0.01 - 0.38
Nov-20	0	0.02	0.00 - 0.72
Dec-20	1	0.02	0.00 - 0.45
Feb-21	0	0.00	0.00 - 0.00
Mar-21	9	0.14	0.05 - 0.38
Apr-21	2	0.03	0.01 - 0.11
May-21	0	0.00	0.00 - 0.00
Jun-21	0	0.00	0.00 - 0.00
Jul-21	0	0.00	0.00 - 0.00
Aug-21	22	0.18	0.07 - 0.48
Sep-21	30	0.24	0.05 - 1.07
Oct-21	6	0.05	0.01 - 0.17
Nov-21	2	0.02	0.01 - 0.03
Dec-21	0	0.00	0.00 - 0.05
Jan-22	0	0.00	0.00 - 0.00
Feb-22	0	0.00	0.00 - 0.05
Mar-22	0	0.00	0.00 - 0.04
Apr-22	7	0.06	0.05 - 0.07
May-22	0	0.00	0.00 - 0.00
Jun-22	18	0.14	0.13 - 0.15
Jul-22	0	0.00	0.00 - 0.03
Aug-22	0	0.00	0.00 - 0.04
Sep-22	15	0.12	0.11 - 0.13
Oct-22	2	0.03	0.02 - 0.04
Average	**All**	**All months**	**0.04**
Average	**Spring**	**Mar, Apr, May**	**0.03**
Average	**Summer**	**Jun, Jul, Aug**	**0.04**
Average	**Autumn**	**Sep, Oct, Nov**	**0.09**
Average	**Winter**	**Dec, Jan, Feb**	**0.00**

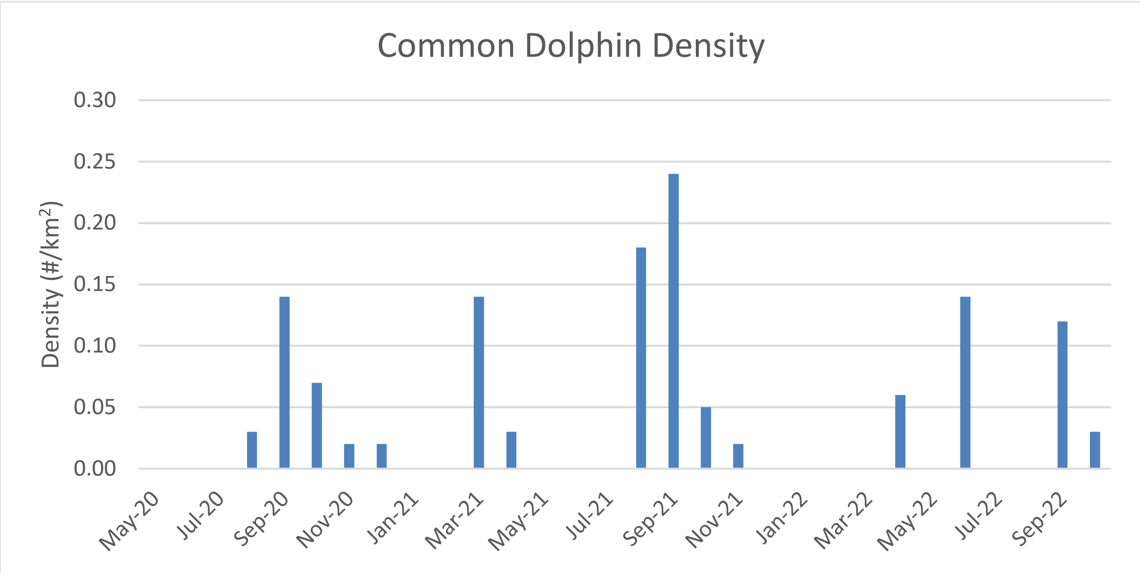

Figure 45 Common dolphin relative density estimates across the 29 aerial surveys.

7.2 ObSERVE

During the ObSERVE surveys, common dolphins were mainly sighted in deeper waters, to the west and south of Ireland. No common dolphins were sighted in stratum 5 in the Irish Sea during any of the ObSERVE surveys (Figure 46).

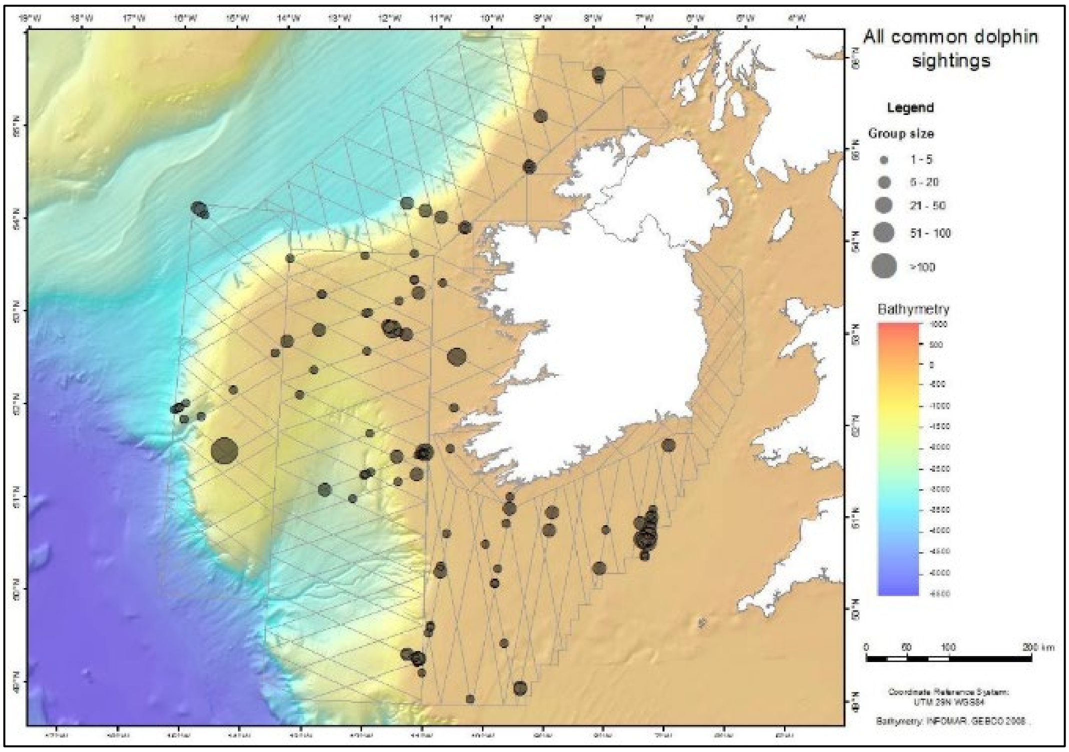

Figure 46 All common dolphin sightings from the ObSERVE surveys from 2015-2016 (Rogan *et al.*, 2018).

7.3 Distribution and abundance of cetaceans in Wales and its adjacent waters

Short-beaked common dolphin were modelled throughout the Irish Sea and Bristol Channel, with consistent distribution patterns (Figure 46). The third quarter, July – September, had peak densities.

The modelled outputs below indicate that the main areas of high density are inclusive of the south coast of the ROI, the southwest coast of England, and the southwest coast of Wales. Using the maximum density per cell across all months, the estimated density in the NISA array area is up to 0.028 dolphins/km^2.

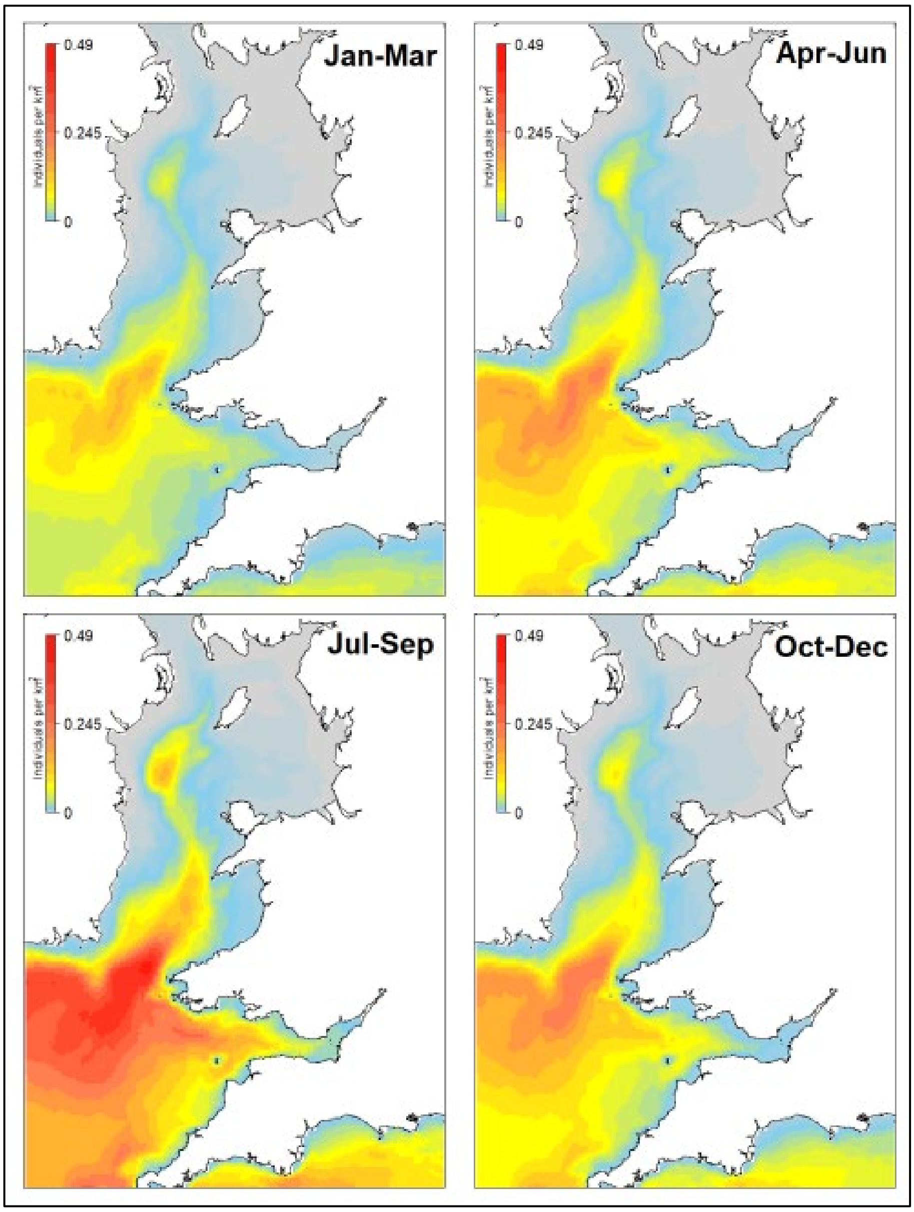

Figure 47 Common dolphin modelled densities by quarter (Evans and Waggitt, 2023).

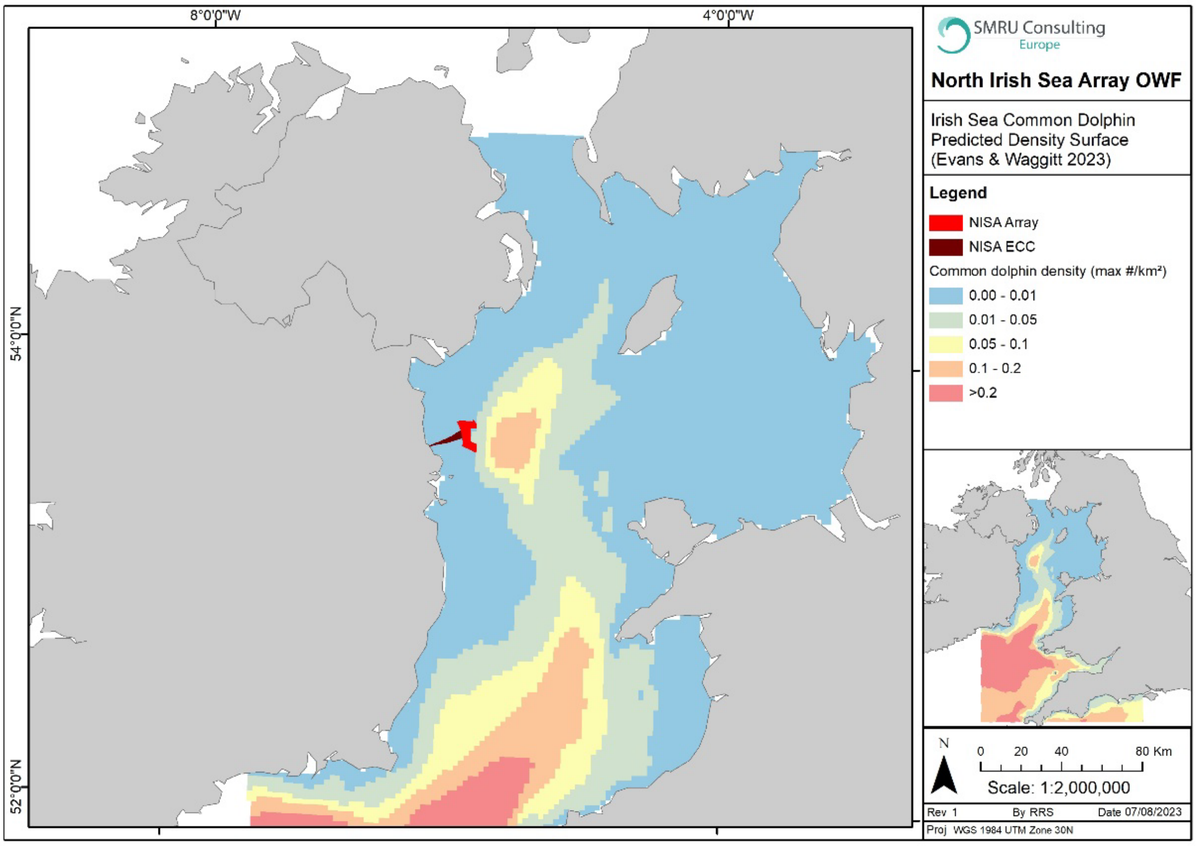

Figure 48 Common dolphin modelled densities (maximum density per cell across months) (Evans and Waggitt, 2023).

7.4 SCANS

No common dolphins were sighted in SCANS III block E (Hammond *et al.*, 2021).

The SCANS II used different survey blocks to SCANS III, and the proposed development is located within SCANS II survey block O (which covered the whole Irish Sea). Common dolphins were sighted within SCANS II survey block O, though with sightings concentrated in the southern Irish Sea. This resulted in a block wide abundance estimate of 826 dolphins (CV 0.78) and a uniform density across the survey block of 0.018 dolphins/km^2 (CV 0.78) (Hammond *et al.*, 2013).

The SCANS III data shows the predicted common dolphin distribution across the MU is not uniform, with higher densities found in the southwest of the MU (Lacey et al. 2022). Densities of common dolphin in the vicinity of NISA array area and ECC are low with values below 0.07 common dolphin/km^2 (Figure 49).

The SCANS IV used different survey block names to SCANS III, and Dublin Array is located within SCANS IV survey block CS-D (which covered the whole Irish Sea). Common dolphin were sighted throughout SCANS IV survey block CS-D, resulting in a block wide abundance estimate of 949 (95% CI: 32 – 2,990) and a uniform density across the survey block of 0.0272 dolphins/km^2 (CV 0.814) (Gilles *et al.*, 2023).

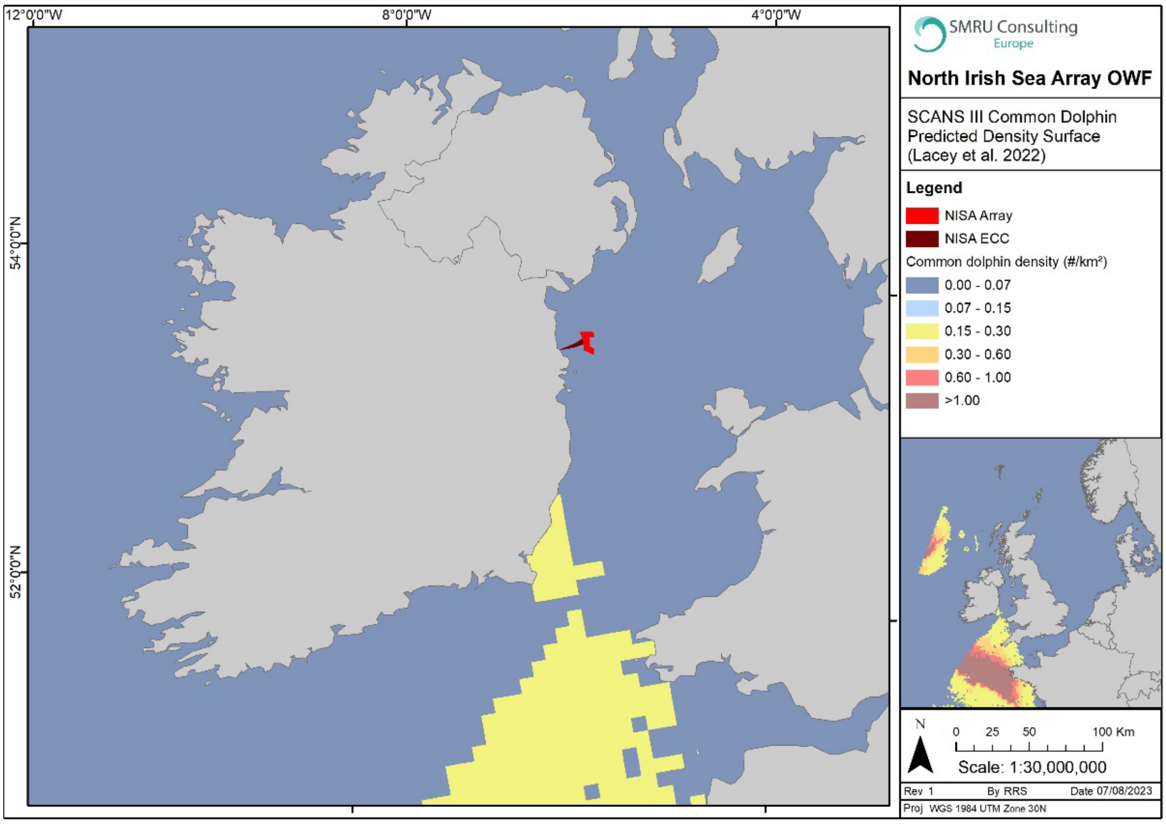

Figure 49 Predicted surfaces of estimated density for common dolphin in SCANS III. Data from Lacey et al. (2022).

7.5 IWDG Surveys

No common dolphin sightings were reported on the east coast of Ireland during the IWDG surveys considered in this baseline characterisation (Berrow *et al.*, 2008, O'Brien *et al.*, 2009, Berrow *et al.*, 2011, Berrow *et al.*, 2012, O'Brien and Berrow, 2016).

7.6 Irish Marine Mammal Atlas

Short-beaked common dolphin sightings were reported in all offshore waters of the Irish Shelf, with the majority of high densities concluded to be within the south and southwest coastal areas. However, there were sightings reported within the Irish Sea (Figure 50). While short-beaked common dolphins were reported in Irish waters year-round, densities in the western central Irish Sea have indicated that seasonal variation is present in this area, with higher densities of these animals from late spring to autumn, and this species becoming largely absent during the winter.

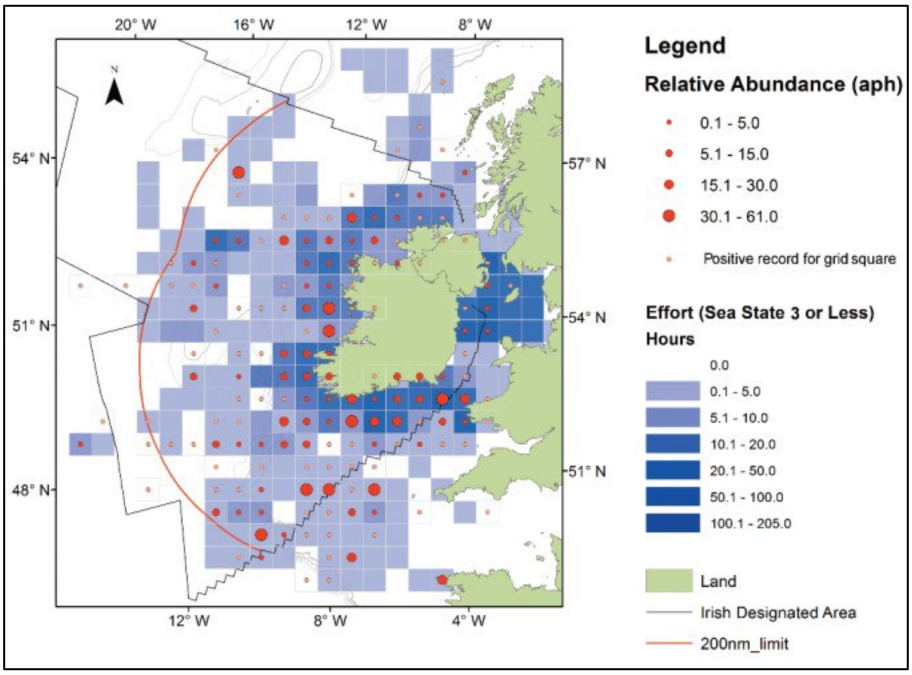

Figure 50 Relative abundance of short-beaked common dolphins from the Irish marine mammal atlas (Wall *et al.*, 2013).

7.7 Other OWFs

Short-beaked common dolphin were observed during Codling Wind Park surveys from 2013-2014 (Codling Wind Park Limited, 2020). Short-beaked common dolphins were not observed during site specific surveys for Arklow Bank Wind Park 1 and 2.

For the Dublin Array, common dolphins were identified as one of the main species of interest within the Dublin Array EIA Scoping Report (SLR *et al.*, 2020). Although boat site-specific marine mammal surveys have been undertaken as part of the Dublin Array project (SLR *et al.*, 2020), these data are yet to be published and site-specific density estimates are not yet available.

7.8 Seasonality

Short-beaked common dolphins have been reported in Irish waters year-round (Wall *et al.*, 2013). Common dolphins produce calves during the summer months, typically from May to August (Robinson *et al.*, 2010) and therefore calves and breeding individuals may be observed in the vicinity of the proposed development.

7.9 Summary

There are a few surveys that present common dolphins in the vicinity of the offshore development area (including the site-specific aerial surveys, the SCANS surveys, the ObSERVE surveys and surveys undertaken at other OWF sites) (Table 17). It is important to consider not only the site-specific survey data, but also density estimates for much wider areas that are more suited to potential larger scale disturbance impacts. Therefore, a range of density estimates will be taken forward to the quantitative impact assessment. These include the proposed development site-specific survey estimate, the SCANS IV uniform density estimate, the SCANS III density surface and the Evans and Waggitt (2023) density surface.

Table 17 Common dolphin density estimates (dolphins/km^2)

Data source	Reference	Density estimate
Site specific surveys	**Natural Power and APEM**	**0.04**
SCANS IV block CS-D	**Gilles et al. (2023)**	**0.0272**
SCANS III block E	Hammond *et al.* (2021)	0
SCANS III density surface	**Lacey *et al.* (2022)**	**Grid cell specific** 0.0-0.07 in the vicinity of NISA array and ECC
SCANS II block O	Hammond *et al.* (2013)	0.018
ObSERVE summer stratum 5	Rogan *et al.* (2018)	0
ObSERVE winter stratum 5	Rogan *et al.* (2018)	0
Welsh and Irish Sea distribution	**Evans and Waggitt (2023)**	**Grid cell specific** 0.028 in NISA array area

8 Minke whale

Minke whales are observed throughout Irelands coastal and offshore waters, and both the continental slope and shelf (Figure 51). The species has been assessed as having an overall Favourable conservation status in Irish waters (NPWS, 2019). The IAMMWG recommend that a single Celtic and Greater North Seas MU is appropriate for minke whales, for which the abundance estimate is 20,118 minke whales (CV: 0.18, 95% CI: 14,061 – 28,786) (IAMMWG, 2023) based on data collected during SCANS III and the ObSERVE surveys (Rogan *et al.*, 2018, Hammond *et al.*, 2021).

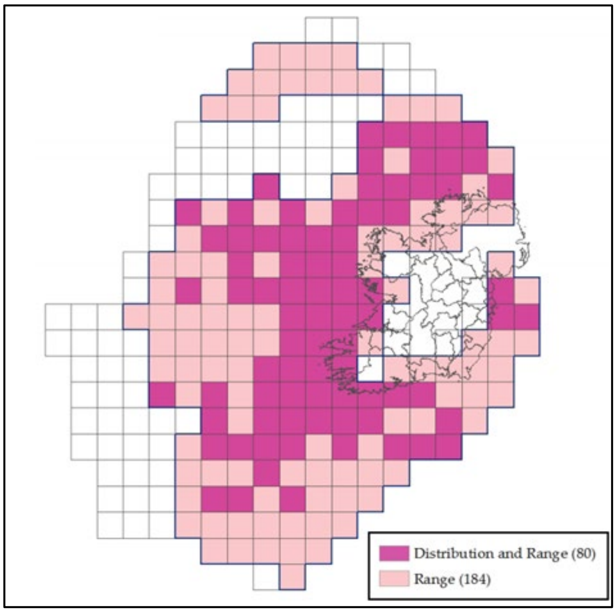

Figure 51 The range and distribution of minke whales in Irish waters (NPWS, 2019).

8.1 Proposed development: Site-specific surveys

8.1.1 Vessel surveys

A total of 11 minke whales were sighted during the site-specific vessel surveys, all of them in June and July 2021. No density estimate was calculated.

8.1.2 Aerial surveys

In the 29 months of aerial surveys, a total of 2 minke whale sighting were recorded. These were in July 2020 and October 2021. There were insufficient data to obtain a density estimate for minke whales.

8.2 ObSERVE

Minke whales were the most frequently sighted mysticete species during the ObSERVE surveys from 2015-2016 (Rogan *et al.*, 2018). Almost all sightings were single individuals, with one sighting of a mother-calf pair of minke whales. These individuals were sighted in neritic waters, in all strata and in the Irish Sea (Figure 52). Observations from these surveys concluded that there was inter-seasonal variation present for minke whales in the survey area, with coastal distributions of these individuals increasing during the summer in comparison to winter months, suggesting that a seasonal inshore to offshore movement pattern may be occurring for minke whales in the survey area (Figure 53). There was a high use of coastal waters by minke whales in the summer months, however findings suggest that the Irish Sea appears to be unfavourable for minke whales in the winter period (Figure 53).

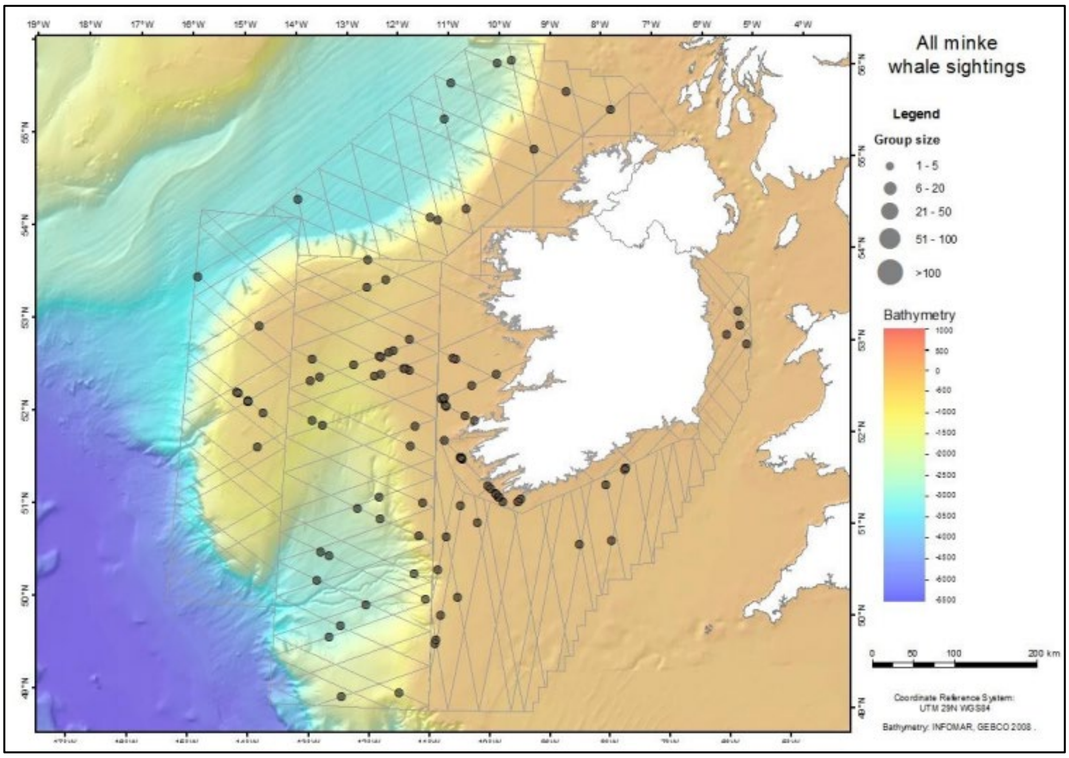

Figure 52 All minke whale sightings from the ObSERVE surveys from 2015-2016 (Rogan *et al.*, 2018).

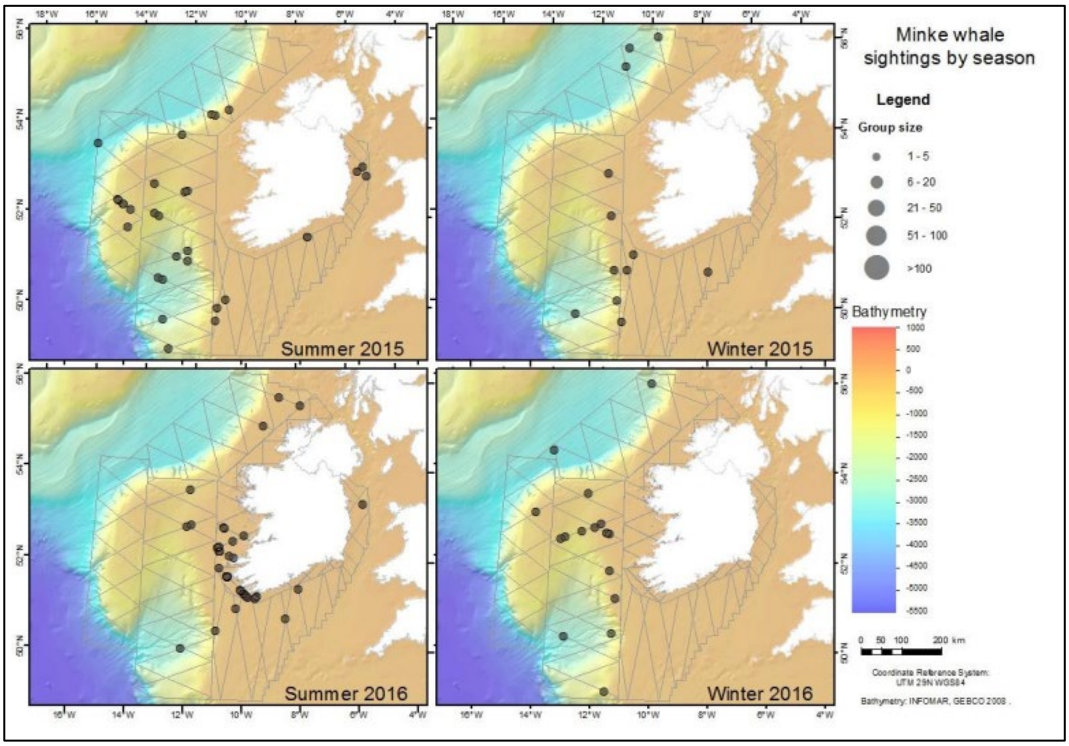

Figure 53 Seasonal sightings of minke whales from the ObSERVE surveys from 2015-2016 (Rogan *et al.*, 2018).

Across the survey area, estimated abundances for minke whales was higher in the summer months (seasons 1 and 3), with estimates 3.4 times higher than in the winter months (seasons 2 and 4) in 2015, and 1.6 times higher in the summer months than the winter months in 2016-17. Within strata 5, in which the proposed development is located, minke whales were only sighted in the summer surveys, resulting in corrected density estimates between 0.016 and 0.045 whales/km^2 (Table 18).

Table 18 Minke whale groups, mean group size, density (#/km^2) and corrected design-based estimates for stratum 5 of the ObSERVE surveys (Rogan *et al.*, 2018).

Design-based estimate					Corrected design-based estimates			
Season	Stratum	Groups	Mean group size	Density	Density	Abundance	Lower CI	Upper CI
1	S5	3	1	0.014	0.045	494.7	221.5	1,105.0
3	S5	1	1	0.005	0.016	180.1	58.6	552.9

8.3 Distribution and abundance of cetaceans in Wales and its adjacent waters

Minke whales were modelled throughout the Irish Sea and Bristol Channel, with varying distribution patterns (Figure 53). Minke whale densities are highly seasonal. The third quarter, July – September, had peak densities, whilst the first quarter, January – March, had scarce densities. The modelled outputs below indicate that the main areas of high density are inclusive of the Irish Sea (St George's Channel westwards from Pembrokeshire across the Celtic Deep to Co. Wexford, and Co. Dublin), Isle of Man, Bristol Channel and the Celtic Sea. Using the maximum density per cell across all months, the estimated density in the NISA array area is up to 0.011 whales/km^2 (Figure 55).

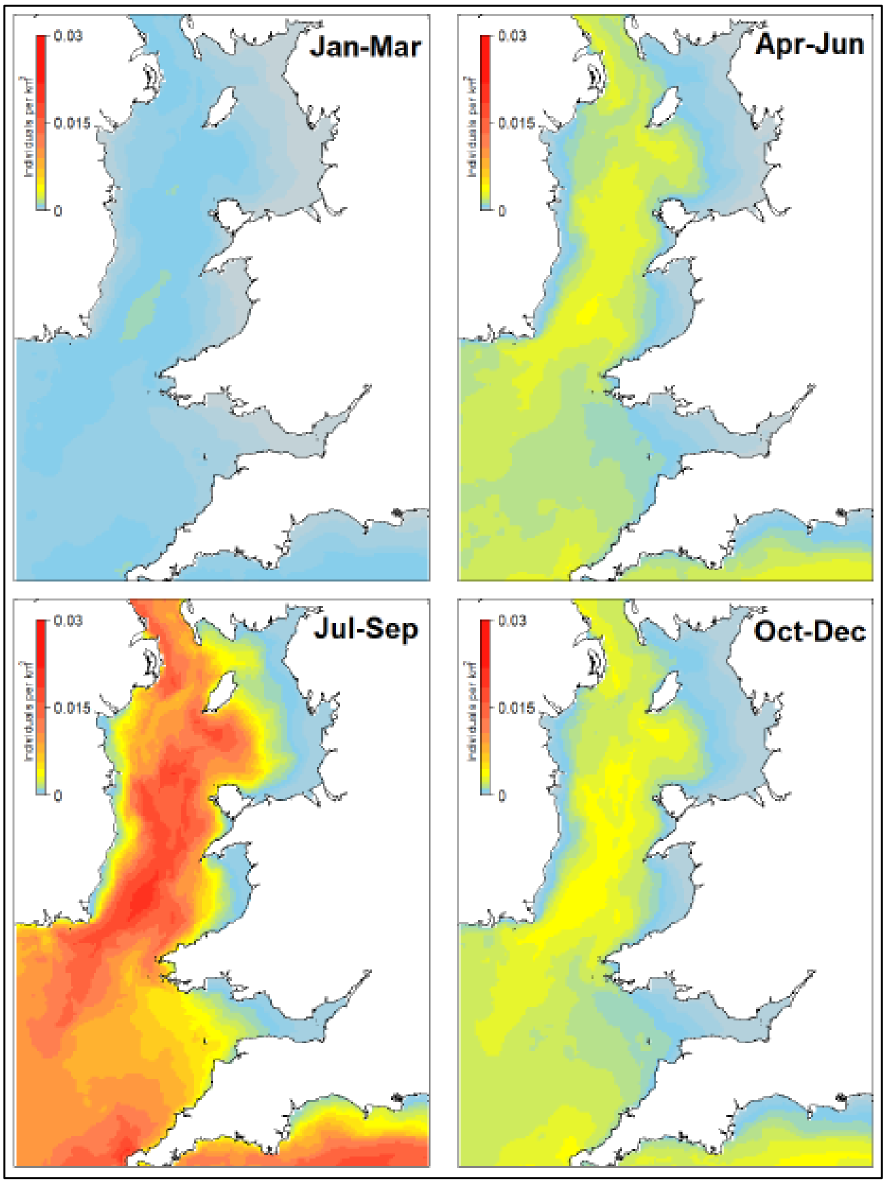

Figure 54 Minke whale modelled densities by quarter (Evans and Waggitt, 2023).

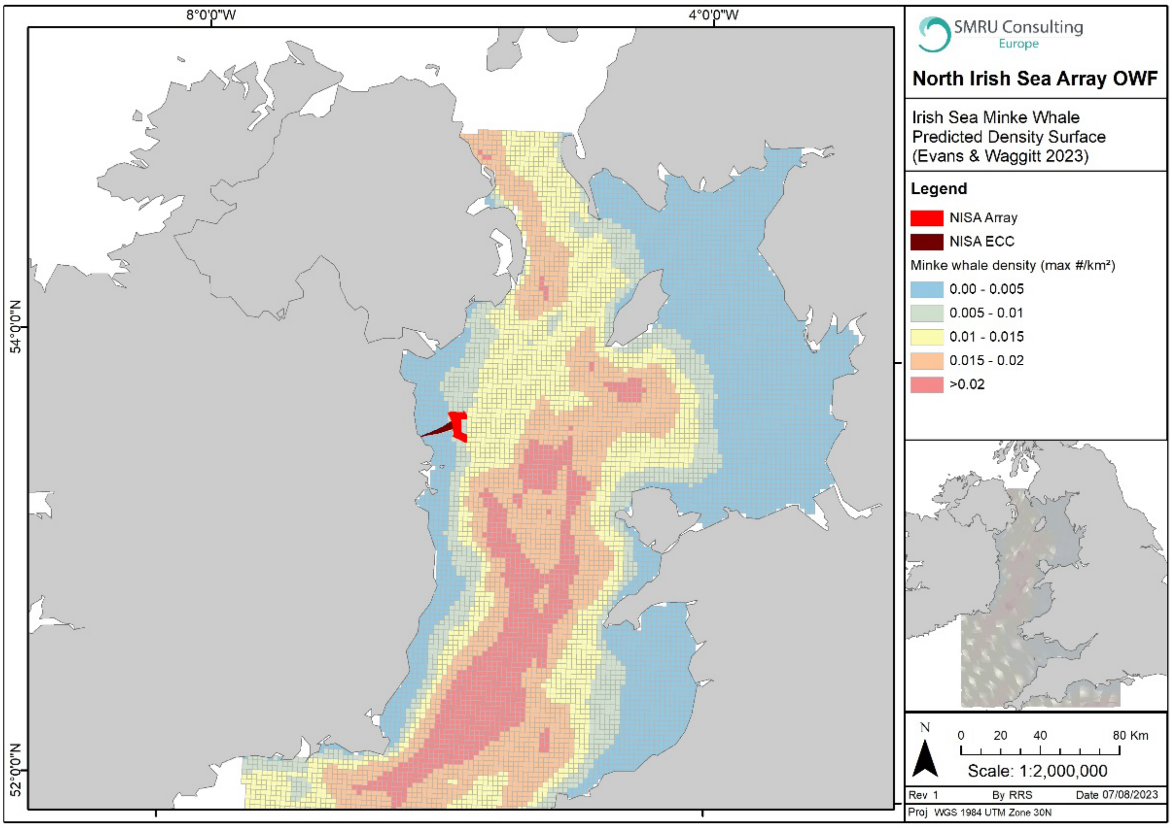

Figure 55 Minke whale modelled densities (maximum density per cell across months) (Evans and Waggitt, 2023).

8.4 SCANS

Minke whales were sighted during the SCANS III surveys on the East coast of Ireland, assigned block E, during the 2016 aerial surveys (Hammond *et al.*, 2017, Hammond *et al.*, 2021). The abundance estimate for these individuals was concluded at 603 individuals, with lower and upper CIs of 134 and 1,753 respectively. Density estimates for minke whales within this block was reported to be 0.017 animals/km^2.

Minke whales were also sighted in the SCANS II block O, resulting in a block wide abundance estimate of 1,070 whales (CV 0.91) and a uniform density across the survey block of 0.024 whales/km^2 (CV 0.91) (Hammond *et al.*, 2013).

The density surfaces obtained from the SCANS III data show the predicted minke whale distribution across the MU is not uniform, with higher densities generally found in the northeast of the North Sea (Lacey et al. 2022). Densities of minke whale in the vicinity of NISA array area and ECC are relatively low with values between 0.01-0.05 minke whale/km^2 (Figure 56).

The SCANS IV used different survey block names to SCANS III, and Dublin Array is located within SCANS IV survey block CS-D (which covered the whole Irish Sea). Minke whales were sighted throughout SCANS IV survey block CS-D, resulting in a block wide abundance estimate of 477 (95% CI: 85 – 1,425) and a uniform density across the survey block of 0.0137 minke whale/km^2 (CV 0.632).

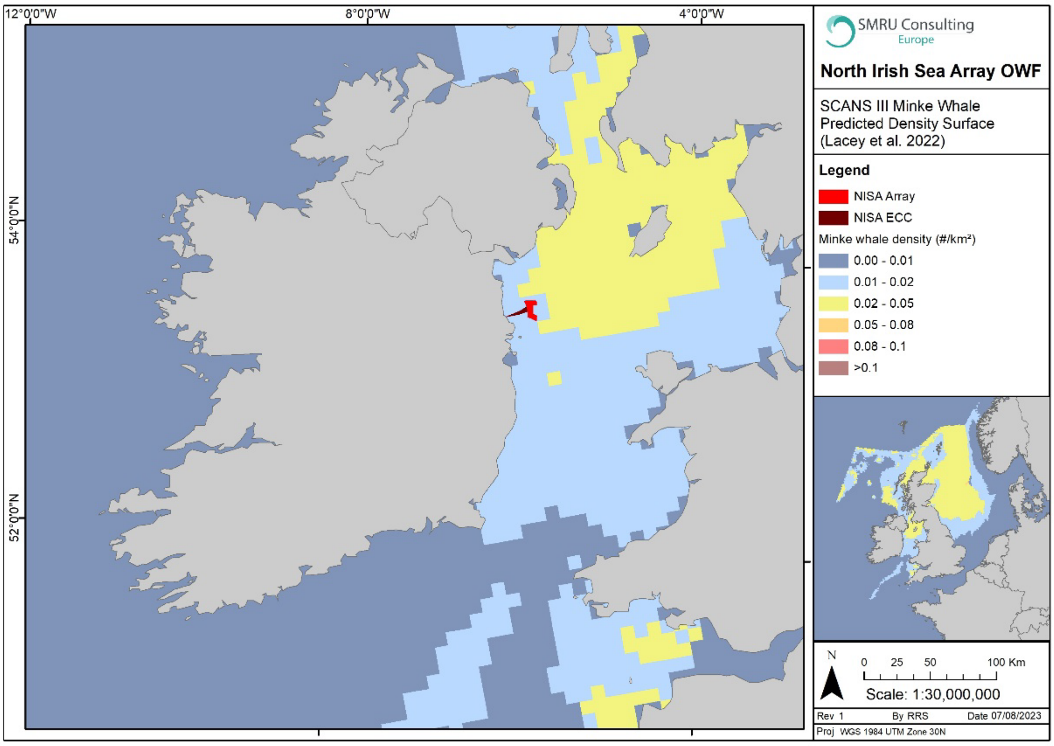

Figure 56 Predicted surfaces of estimated density for minke whale in SCANS III. Data from Lacey et al. (2022).

8.5 IWDG Surveys

During the Greater Dublin Drainage Project IWDG vessel-based marine mammal surveys (Meade *et al.*, 2017) a total of two minke whales were sighted, one in June 2015 and one in August 2016 (Figure 57). No minke whales were recorded during the land-based surveys at Howth Head.

During the IWDG Inshore Irish Sea surveys, minke whales were reported in both block A (Dublin area) and B (south coast) (Berrow *et al.*, 2011). For block A, the estimated relative abundance of minke whales was estimated at 0.03 individuals/km (Figure 58). For block B, the estimated relative abundance of minke whales was reported at 0.149 individuals/km.

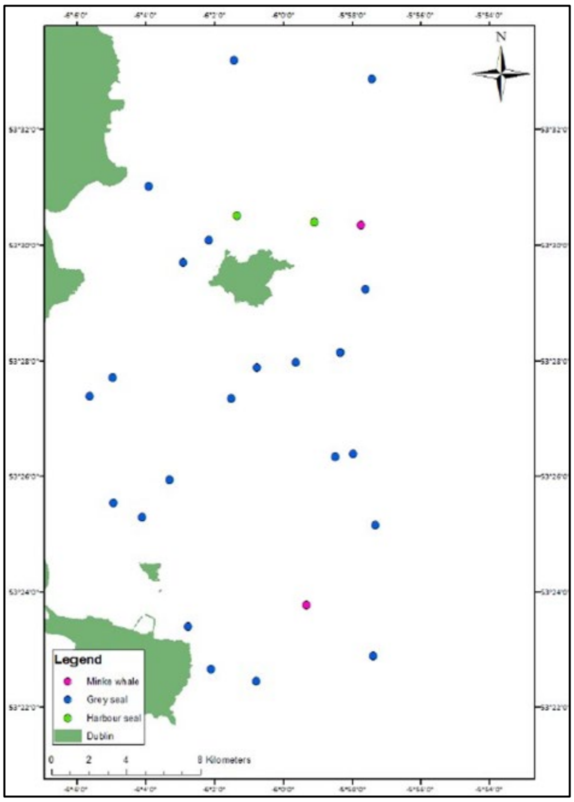

Figure 57 Distribution of seal and minke whale sightings recorded during vessel-based surveys (Meade *et al.*, 2017).

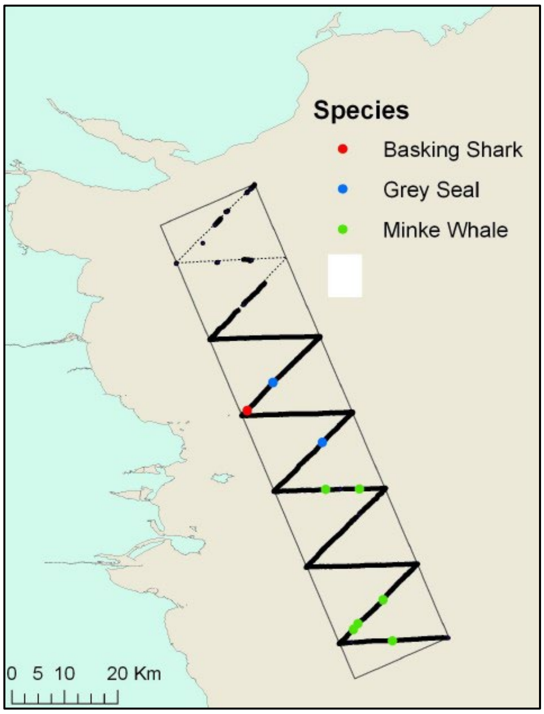

Figure 58 Sighting records of minke whale, grey seal and basking shark in block A (Berrow *et al.*, 2011).

8.6 Irish Marine Mammal Atlas

Minke whales were reported off all Irish coasts, with the majority of sightings occurring in shallow waters (<200 m) over the Irish shelf (Figure 59). Relative abundances were concluded to be relatively low for this species, reflective of the fact that the vast majority of sightings involved single animals rather than groups. During active foraging, minke whales were infrequently seen in groups of 2/3 and loose feeding aggregations of up to 7 individuals. There was some seasonal variation present, with highest relative abundances of this species recorded in the western Irish Sea in Spring. This peak in relative abundance was concluded to be due to foraging, with concentrations of pelagic schooling fish present in the area (Wall *et al.*, 2013).

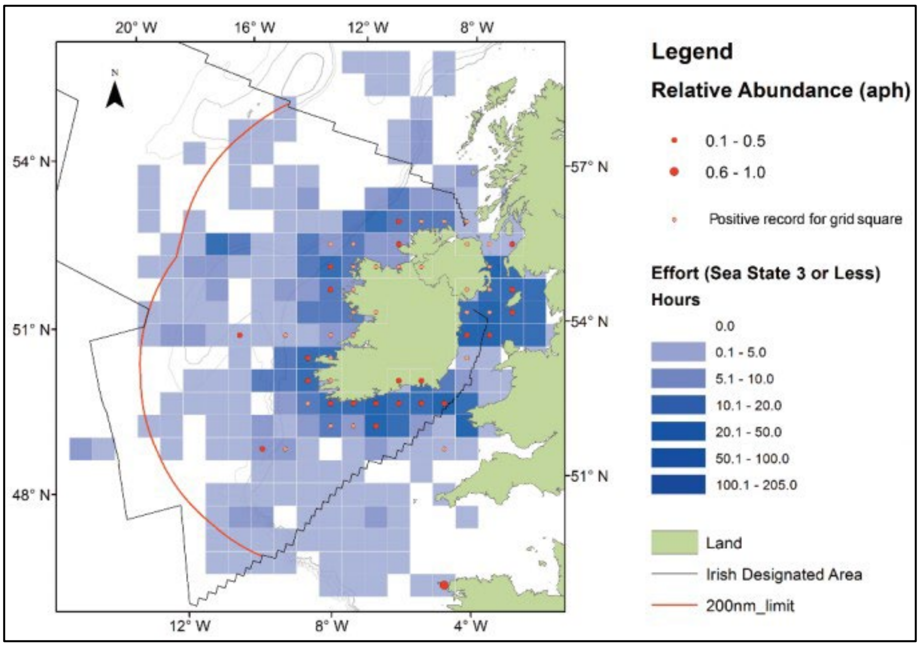

Figure 59 Relative abundance of minke whales from the Irish marine mammal atlas (Wall *et al.*, 2013).

8.7 Other OWFs

Minke whales were observed during Codling Wind Park surveys from 2013-2014 (Codling Wind Park Limited, 2020).

For the Dublin Array, minke whales were identified as one of the main species of interest within the Dublin Array EIA Scoping Report (SLR *et al.*, 2020). Although boat site-specific marine mammal surveys have been undertaken as part of the Dublin Array project (SLR *et al.*, 2020), these data are yet to be published and site-specific density estimates are not yet available.

8.8 Seasonality

Minke whales are known to exhibit a degree of seasonal variation in their presence in the Irish Sea, with sightings occurring more frequently during the summer months in the vicinity of the proposed development (Rogan *et al.*, 2018). Minke whale are known to perform seasonal migrations between high latitude feeding grounds in the summer and low latitude area for breeding and calving in the winter months (Risch *et al.*, 2014) and their increased presence in the summer months supports this migration pattern. Therefore, minke whale present in the vicinity of the proposed development will most likely be undertaking feeding behaviour in this region.

8.9 Summary

In summary, there have been a few studies of minke whales in the Irish Sea and in the vicinity of the the offshore development area. While there are a range of density estimates available (Table 19), all data sources have shown that minke whales are present in significantly higher densities in the summer months. It is important to consider not only the site-specific survey data, but also density estimates for much wider areas that are more suited to potential larger scale disturbance impacts. Therefore, a range of density estimates will be taken forward to the quantitative impact assessment. These include the SCANS IV uniform density estimate, the SCANS III density surface and the Evans and Waggitt (2023) density surface.

Table 19 Minke whale density estimates (whales/km^2).

Data source	Reference	Density estimate
Site specific surveys	Natural Power and APEM	Not estimated
SCANS IV block CS-D	**Gilles et al. (2023)**	**0.0137**
SCANS III block E	Hammond *et al.* (2021)	0.017
SCANS II block O	Hammond *et al.* (2013)	0.024
SCANS III density surface	**Lacey *et al.* (2022)**	**Grid cell specific** 0.01-0.05 in the vicinity of NISA array area and ECC
ObSERVE summer stratum 5	Rogan *et al.* (2018)	Season 1: 0.045 Season 3: 0.016
Welsh and Irish Sea distribution	**Evans and Waggitt (2023)**	**Grid cell specific** 0.011 in NISA array area

9 Harbour seal

Harbour seals occur throughout Irish waters in estuarine, coastal and fully marine areas (Figure 60). They have been assessed as having a Favourable conservation status in Irish waters (NPWS, 2019). There are 2 harbour seal SACs on the east coast of the Republic of Ireland: Lambay Island SAC and the Slaney River Valley SAC. In addition, there are two SACs on the east coast of Northern Ireland: Murlough SAC and Strangford Lough SAC (Figure 2).

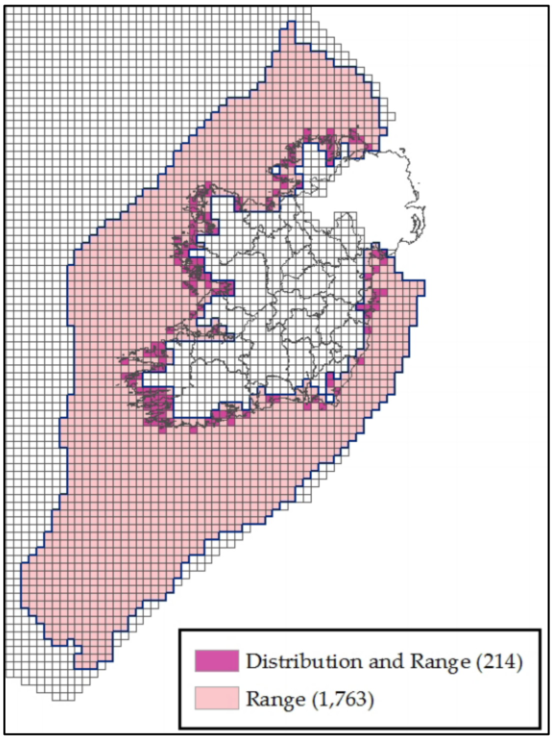

Figure 60 The range and distribution of harbour seals in Irish waters (NPWS, 2019).

9.1 Proposed development: Site-specific surveys

9.1.1 Vessel surveys

Harbour seals were sighted on only one of the vessel-based site-specific surveys.

9.1.2 Aerial surveys

In the 29 months of aerial surveys, no harbour seals were sighted. Irish Marine Mammal Atlas

Harbour seal sightings recorded during vessel surveys were rare, with just two sightings reported during the survey period of 2005-2011 (Figure 61). This is reflective of the fact that harbour seals tend to forage in close proximity to their haul-out site, not undertaking offshore movements (Tollit *et al.*, 1998). In terms of seasonal variation, there was insufficient data available to assess both temporal changes in distribution and relative abundance, with both sightings of harbour seals being reported in May.

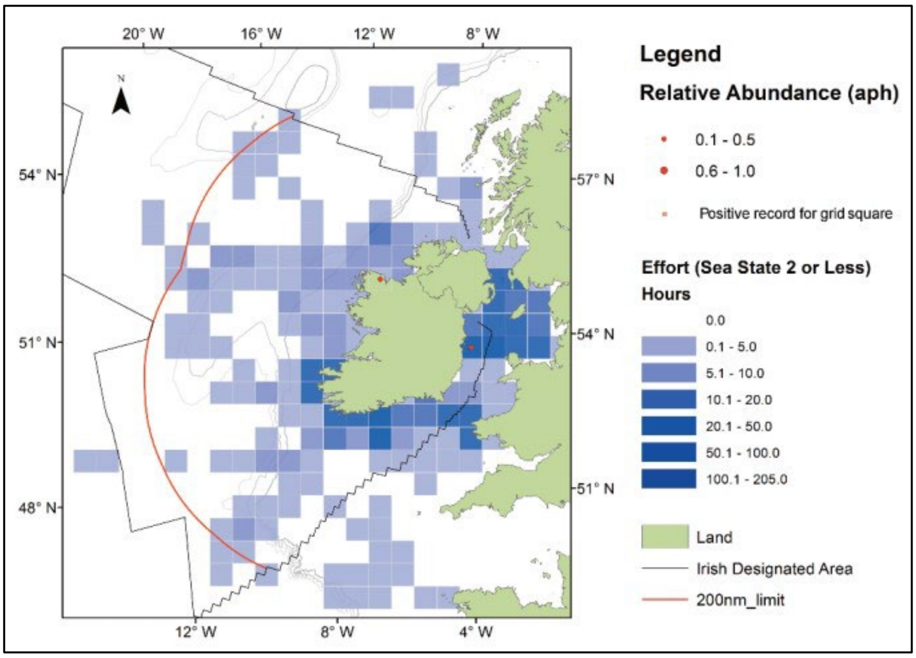

Figure 61 Relative abundance of harbour seals from the Irish marine mammal atlas (Wall *et al.*, 2013).

9.2 Pup Counts

There are very few harbour seal pup survey data for the RoI and Northern Ireland in recent years, and thus there is little information on the locations of harbour seal breeding sites at this time.

Of the few pup counts that have been undertaken for harbour seals in the RoI, these studies date back to the 1970s – 1990s (Summers *et al.*, 1980, Smiddy, 1998, Wilson and Montgomery-Watson, 2002). As the data presented in these studies are now outdated, they have not been presented here to prevent the inclusion of data which is not indicative of the current environment.

For Northern Ireland, it has been indicated that the maximum number of harbours seal counts for pups are not as well reflected as they could be when observing the number surveys that have been undertaken (Culloch *et al.*, 2018). It has therefore been recommended that more frequent surveys which focus on harbour seal pup production are undertaken (Culloch *et al.*, 2018).

9.3 Haul-out counts

The offshore development area is located within the East region of the RoI but is close to the Northern Ireland MU. The relevant reference population against which to assess the impacts of NISA is thus a combination of the east regions of RoI and the Northern Ireland MU.

Morris and Duck (2019) reported on the number (Table 20) and distribution of hauled-out harbour seals in RoI (Figure 62). A total of 131 seals were counted in the East region and 34 in the Southeast region. The most recent 2021 August counts for harbour seals in the Northern Ireland MU is 818 individuals (SCOS, 2023). It was noted that concerningly, counts of harbour seals in all areas surveyed in 2021, were all substantially lower than counts in recent years. It has also been reported that Northern Ireland harbour seal counts are continuing to decline slowly (Table 21).

The total August counts for the East region (131), South-east region (34) and the Northern Ireland MU (818) can be scaled by the estimated proportion of animals hauled-out at the time of the survey (0.72, 95% CI 0.54 – 0.88) (Lonergan et al. 2013). The combined harbour seal count totals 983 harbour seals with a resulting population estimate of 1,365 harbour seals in the reference population (95% CI: 1,117 – 1,820).

Table 20 Harbour seal counts in the Republic of Ireland from 2003 – 2018 (Morris and Duck, 2019).

Region	Area	Harbour seal counts		
		2003	2011/12	2017/18
East	1	89	61	61
East	2	34	29	70
East	3	0	0	0
South-east	1	17	49	33
South-east	2	0	0	0
South-east	3	1	4	1

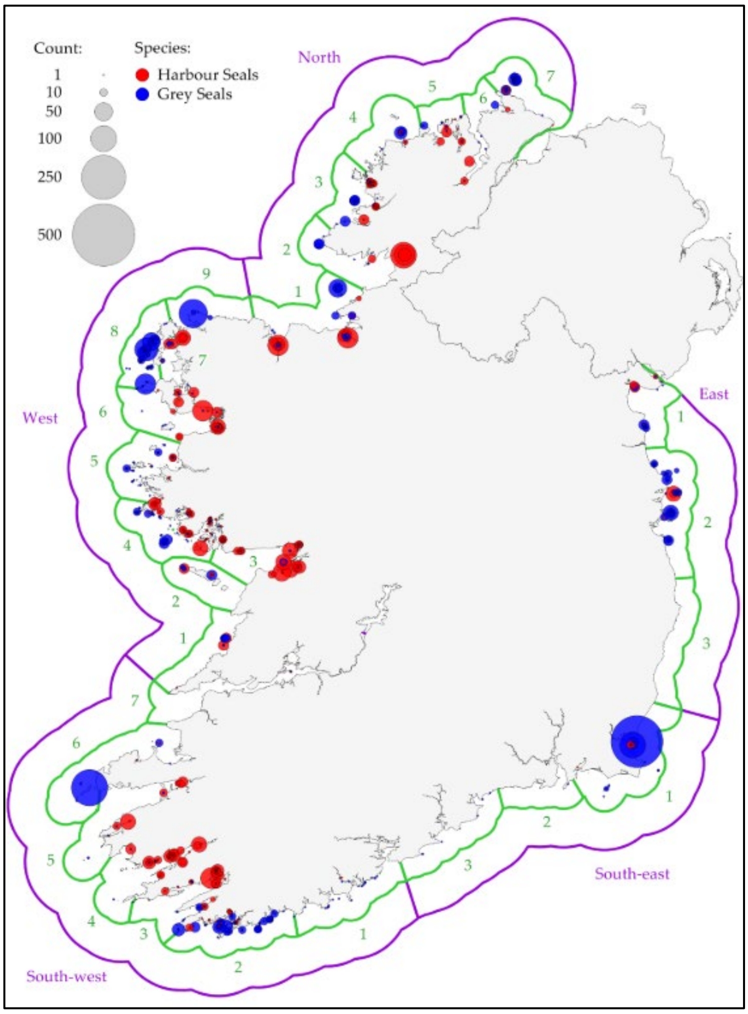

Figure 62 Numbers and distribution of harbour seals (red circles) and grey seals (blue circles) in Ireland in August 2017 and August 2018. The displayed symbol size represents the recorded group size with count guides given in the legend (top left).

Table 21 Harbour seal August haul-out counts in the Northern Ireland MU (SCOS, 2023).

	2000-2006	2007-2009	2011-2015	2016-2019	2021
Northern Ireland	1,176	1,101	948	1,062	818

9.4 Telemetry

There have been no harbour seal tagging studies conducted in the RoI to date. However, there have been several tagging events in Strangford Lough in Northern Ireland (12 in 2006, 10 in 2008 and 12 in 2010) which were included in the dataset used for the seal habitat preference maps (Figure 15). The track data from these seals showed limited movement into the RoI EEZ in the Irish Sea, with most tracks remaining in the vicinity of Strangford Lough as well as out into the UK part of the Irish Sea, both north and south of the Isle of Man. These telemetry data do not indicate any connectivity between the Strangford Lough SAC and the proposed development (however the 2019-20 telemetry data have yet to be processed and as such it is not known if these additional data show any different movement patterns).

9.5 At-sea density

Harbour seal density in the Irish Sea is generally low, with higher densities associated with the SACs: Strangford Lough, Murlough, Lambay Island and Slaney River Valley (Figure 63). Given the proximity of NISA array area and ECC to the Lambay Island SAC and the Murlough SAC, densities in the vicinity of the project are higher compared to the Irish Sea in general, with density estimates for the cells adjacent to the Lambay Island SAC reaching up to 0.25 harbour seals/km^2 (extracted from Carter *et al.*, 2020).

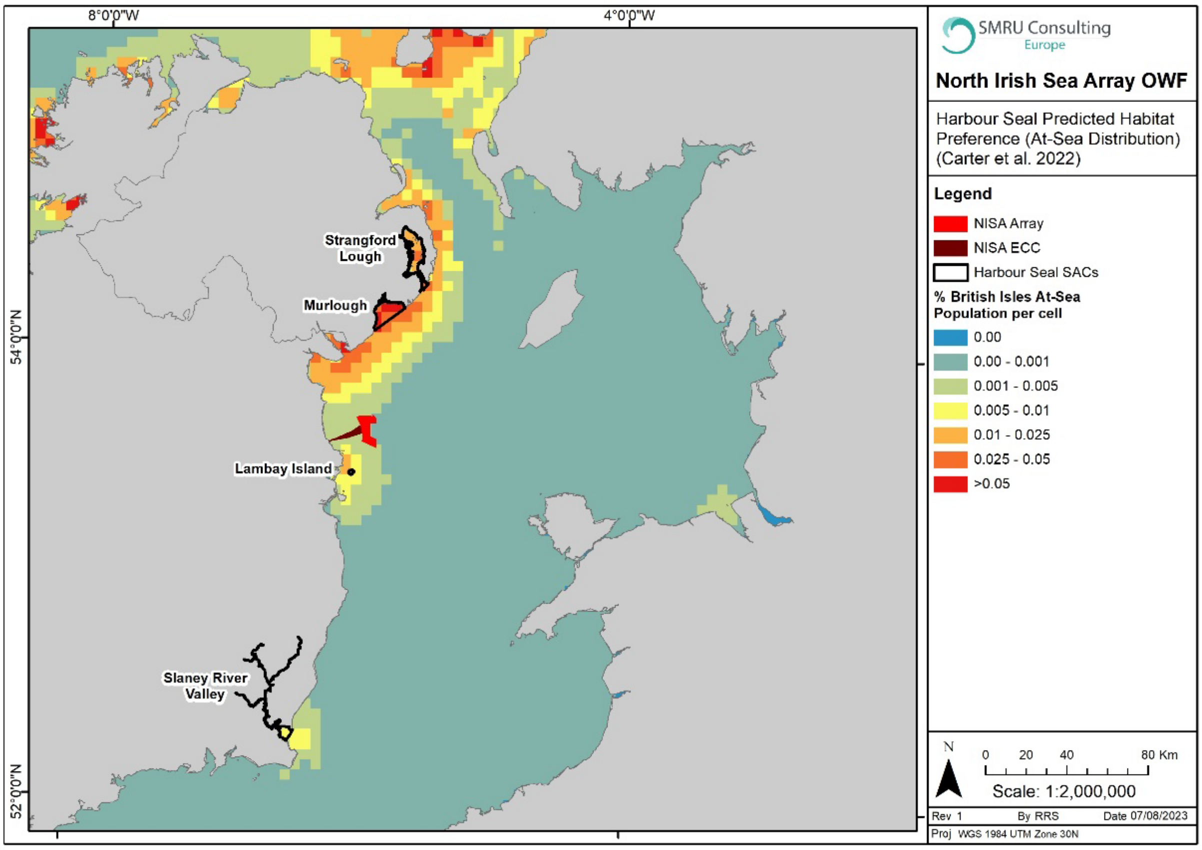

Figure 63 At-sea distribution of harbour seals from haul-outs in the British Isles in 2018 (Carter *et al.*, 2020).

9.6 IWDG surveys

The vessel-based marine mammal surveys carried out by Meade *et al.* (2017) for the Greater Dublin Drainage Project recorded a total of two harbour seals, one in April 2015 and one in August 2015 (Figure 57). No harbour seals were recorded during the land-based surveys at Howth Head. During the IWDG Inshore Irish Sea surveys (Berrow *et al.*, 2011), a single harbour seal was reported in block B (south coast), resulting in an estimate of 0.007 seals/km. No harbour seals were sighted in Block A which included the NISA array area.

Again, this very low sightings rate aligns with the low density estimates predicted to be present at the proposed development from the habitat preference at-sea density estimates.

9.7 Other OWFs

Harbour seals were observed during Codling Wind Park surveys from 2013-2014 (Codling Wind Park Limited, 2020). Unidentified seals were observed during the nearby Arklow Bank Wind Park 1 and 2 surveys. However, it was considered most likely that these were grey seals rather than harbour seals as no harbour seals were observed (RPS, 2020).

For the Dublin Array, harbour seals were identified as one of the main species of interest within the Dublin Array EIA Scoping Report (SLR *et al.*, 2020). Although boat site-specific marine mammal surveys have been undertaken as part of the Dublin Array project (SLR *et al.*, 2020), these data are yet to be published and site-specific density estimates are not yet available.

9.8 Seasonality

Harbour seal pupping occurs during the summer months, primarily in June and July (Arso Civil *et al.*, 2018, SCOS, 2021). Moulting most frequently occurs during August (SCOS, 2021) following pupping, although seals in active moult have been observed in southwest Ireland from June to November (Cronin *et al.*, 2013a). During the breeding season and whilst moulting, grey seals spend longer periods of times hauled out on land (SCOS, 2021), resulting in a higher density of seals on land. They may, therefore, be more vulnerable to activity being conducted close to haul out sites during these months. Outside of the breeding season, seals will exhibit a wider spatial variation.

9.9 Summary

Although the literature does not indicate harbour seal sightings at the proposed development, the Lambay Island SAC is within 20 km of the proposed development, which is within the typical foraging range of harbour seals (40-50 km from their haul-out sites; SCOS, 2019). Therefore, it is likely that there may be harbour seals in the vicinity of the proposed development that may be impacted. For this reason, harbour seals are to remain scoped into the proposed development impact assessment. There have been several studies on harbour seal abundance and distribution at haul-outs around Ireland, however there is uncertainty in at-sea density estimates as there is both a lack of telemetry data in Irish waters. Given that there is no alternative, it is recommended that the at-sea density estimates obtained from the habitat preference maps are used in the impact assessment for the proposed development.

10 Grey seal

Grey seals occur throughout Irish waters (Figure 64), and those in Ireland are considered to be part of a meta-population that also inhabits adjacent jurisdictions (NPWS, 2019). They have a Favourable conservation status with an increasing trend in Irish waters (NPWS, 2019). There are 2 grey seal SACs on the east coast of the RoI: Lambay Island SAC and the Saltee Islands SAC (Figure 2). In addition, there are three SACs in the UK part of the Irish Sea that lists grey seals as a qualifying feature but not the primary reason for site selection: Cardigan Bay SAC, Lundy SAC and Lleyn Peninsula and the Sarnau SAC.

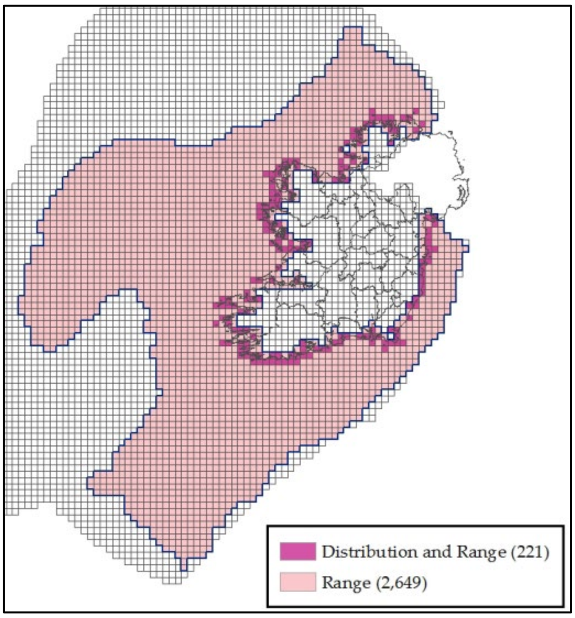

Figure 64 The range and distribution of grey seals in Irish waters (NPWS, 2019).

10.1 Proposed development: Site-specific surveys

10.1.1 Vessel surveys

Grey seals were sighted on four of the vessel-based site-specific surveys. No density estimate was calculated.

10.1.2 Aerial surveys

In the 29 months of aerial surveys, 23 grey seals were sighted (2.3% of all marine mammal sightings). Additionally, there were 41 sightings of unidentified seals (4.0% of all marine mammal sightings) which were all assumed to be grey seals. Grey seals were sighted year round, with an average density of 0.02 seals/km^2 (Table 22, Figure 65). No correction has been made for availability bias, meaning that the resulting estimates are relative density estimates, not absolute density estimates.

Table 22 Grey seal sightings during the NISA site-specific baseline aerial surveys. The relative density estimate has used apportioning for the un-identified species, but has not been corrected for availability bias.

	Month	Sightings (raw)	Relative density (apportioned)	Density Confidence Intervals
1	May 2020	0	0.00	0.00 - 0.00
2	Jun 2020	0	0.00	0.00 - 0.00
3	Jul 2020	0	0.00	0.00 - 0.00
4	Aug 2020	0	0.00	0.00 - 0.00
5	Sep 2020	0	0.00	0.00 - 0.06
6	Oct 2020	1	0.04	0.02 - 0.11
7	Nov 2020	1	0.04	0.01 - 0.13
8	Dec 2020	0	0.05	0.02 - 0.12
9	Feb 2021	1	0.03	0.01 - 0.08
10	Mar 2021	1	0.03	0.01 - 0.10
11	Apr 2021	0	0.02	0.00 - 0.07
12	May 2021	1	0.02	0.01 - 0.07

13	Jun 2021	0	0.01	0.00 - 0.04
14	Jul 2021	0	0.00	0.00 - 0.00
15	Aug 2021	6	0.07	0.03 - 0.18
16	Sep 2021	0	0.01	0.00 - 0.05
17	Oct 2021	0	0.00	0.00 - 0.02
18	Nov-21	1	0.02	0.01 - 0.03
19	Dec-21	0	0.00	0.00 - 0.05
20	Jan-22	1	0.02	0.01 - 0.03
21	Feb-22	0	0.02	0.01 - 0.03
22	Mar-22	6	0.07	0.06 - 0.08
23	Apr-22	2	0.04	0.03 - 0.05
24	May-22	0	0.00	0.00 - 0.00
25	Jun-22	0	0.01	0.00 - 0.03
26	Jul-22	1	0.01	0.00 - 0.03
27	Aug-22	0	0.00	0.00 - 0.00
28	Sep-22	1	0.01	0.00 - 0.03
29	Oct-22	0	0.01	0.00 - 0.03
Average	**All**	**All months**	**0.02**	
Average	**Spring**	**Mar, Apr, May**	**0.03**	
Average	**Summer**	**Jun, Jul, Aug**	**0.01**	
Average	**Autumn**	**Sep, Oct, Nov**	**0.02**	
Average	**Winter**	**Dec, Jan, Feb**	**0.02**	

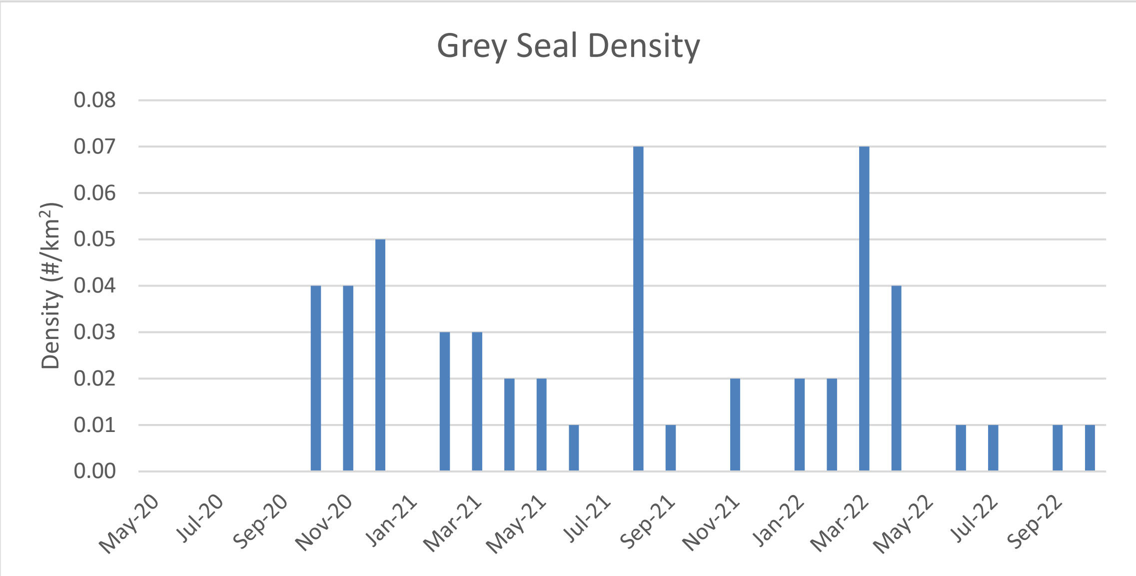

Figure 65 Grey seal relative density estimates across the 29 aerial surveys.

10.2 Irish Marine Mammal Atlas

Grey seals are present off all Irish coasts and were reported at low relative abundances throughout the Irish sea, with these individuals being predominantly sighted in inshore waters (Figure 66). In terms of seasonal variation, grey seals were reported year-round in Irish waters.

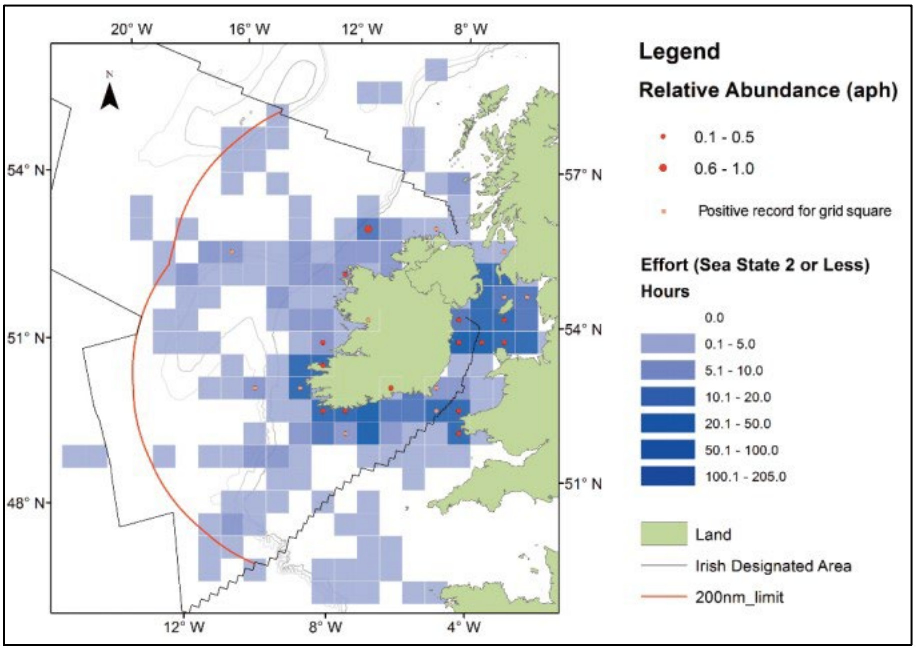

Figure 66 Relative abundance of grey seals from the Irish marine mammal atlas (Wall *et al.*, 2013).

10.3 Pup counts

Ó Cadhla *et al.* (2007) estimated a total of 1,574 grey seal pups to have been born in the RoI during the 2005 breeding season. Ground survey results from Lambay Island & Ireland's Eye concluded a minimum pup production of 58 pups and an all-age population size of 203-261. Pup production for these islands was also concluded to have occurred primarily on Lambay Island, with only 4 pups reported to have been born on Ireland's Eye in 2005. The distribution of pup counts on Lambay Island was strongly aggregated amongst three bays on the south coast of the island. Certain cave sites which have been previously documented by other studies were not included in this study due to safety restrictions, as a result, Ó Cadhla *et al.* (2005) concluded that the pup production estimates reported for both of these islands are likely to be lower than the true figure.

Grey seal pup production was approximately 250 pups for Northern Ireland, equating to a total 2022 population estimate of 500 individuals (SCOS, 2023).

10.4 Haul-out counts

The proposed development is located within the East region of the RoI but is close to the Northern Ireland MU. The relevant reference population against which to assess the impacts of the proposed development is thus a combination of the East regions of RoI and the Northern Ireland MU.

Morris and Duck (2019) reported on the number (Table 23) and distribution of hauled-out grey seals in RoI (Figure 62). A total of 418 grey seals were counted in the East region and 556 in the Southeast region.

The most recent 2021 August haul-out counts (Table 24) for grey seals in Northern Ireland is 549 individuals (SCOS, 2023). It has been reported that trends for SACs were also generally less favourable than trends for the associated wider regions which encompass this species.

The total August counts for the East region (418), South-east region (556) and the Northern Ireland MU (549) can be scaled by the estimated proportion of animals hauled-out at the time of the survey (25.15%, 95% CI 21.45% - 29.07%) (SCOS, 2022). The combined grey seal count totals 1,523 grey seals with a resulting population estimate of 6,056 grey seals in the reference population (95% CI: 5,239 – 7,100).

Table 23 Grey seal counts in the Republic of Ireland from 2003 – 2018 (Morris and Duck, 2019).

Region	Area	Grey seal counts		
		2003	2011/12	2017/18
East	1	39	48	83
East	2	211	172	335
East	3	12	03	0
South-east	1	189	239	550
South-east	2	0	0	1
South-east	3	0	4	5

Table 24 Grey seal August haul-out counts in the Northern Ireland MU (SCOS, 2023).

	2000-2006	2007-2009	2011-2015	2016-2019	2021
Northern Ireland	272	243	468	505	549

10.5 Telemetry

Telemetry data for grey seals tagged in UK waters have shown connectivity between the east coast of the RoI, Northern Ireland, Wales, Southwest England and the southwest coast of Scotland (Figure 15). In proximity to the NISA array area, there is telemetry data from 26 grey seals, 25 of which were tagged in the West England and Wales MU and 1 tagged in the West Scotland MU (note, this is not presented in a figure since some of the data has not yet been publicly released). These data also show connectivity between the proposed development and the Lambay Island SAC, the Saltee Islands SAC, Lleyn Peninsula and the Sarnau SAC, the Cardigan Bay SAC and the Pembrokeshire Marine SAC. However, since no grey seals have been tagged in the vicinity of the proposed development, the level of connectivity with each SAC is unknown.

Telemetry data from 8 grey seals tagged on the Great Blasket Island have shown movement along the west coast of the RoI, Northern Ireland and the Inner and Outer Hebrides in Scotland (Figure 67) (Cronin *et al.*, 2011, Cronin *et al.*, 2013b). These telemetry data do not show any movement between the west and east coast of RoI, however with such a small sample size it is not possible to conclude no connectivity.

While there is no telemetry data for grey seals tagged at the Lambay Island SAC, given its proximity to the proposed development, and the typical foraging range of grey seals, it is likely that there is connectivity between the proposed development and the Lambay Island SAC.

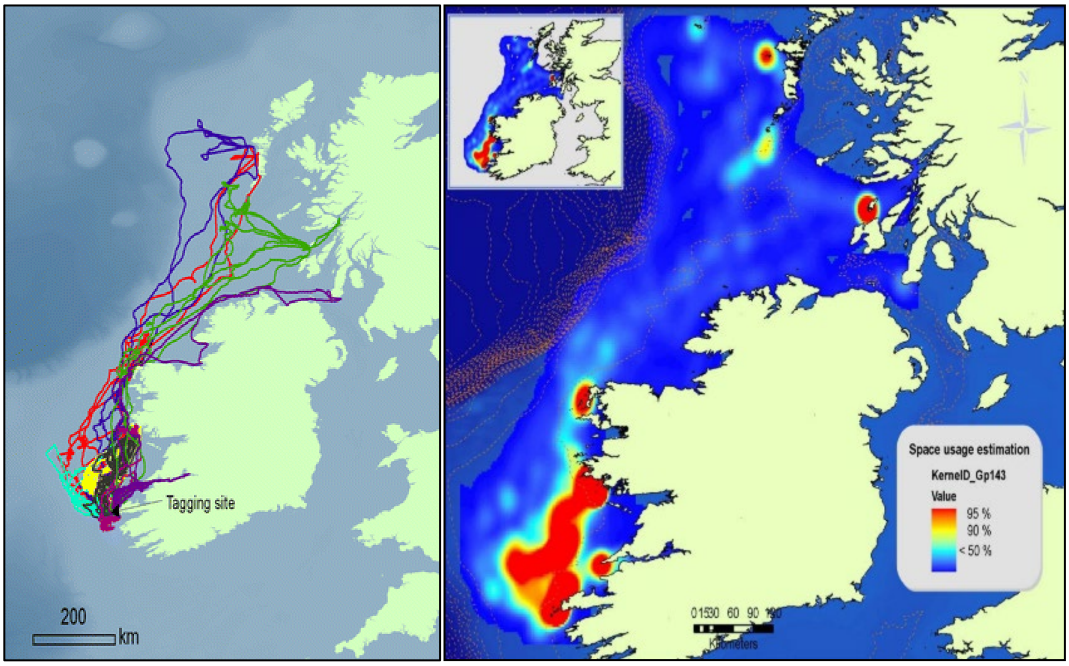

Figure 67 Left: Tracks of 8 female grey seals tagged with GPS/GSM tags between February and December 2009 (Cronin *et al.*, 2013b). Right: Space use of all 8 tagged grey seals (Cronin *et al.*, 2011).

10.6 At-sea density

Grey seals in the Irish Sea are widespread, with higher densities in the vicinity of key haul-out sites and SACs (Figure 68). Given the proximity of the NISA array area and ECC to the Lambay Island SAC, densities in the vicinity of the project are higher compared to the Irish Sea in general, with density estimates for the cells adjacent to the Lambay Island SAC and the NISA ECC reaching up to 1.25 grey seals/km^2 (extracted from Carter et al. 2020).

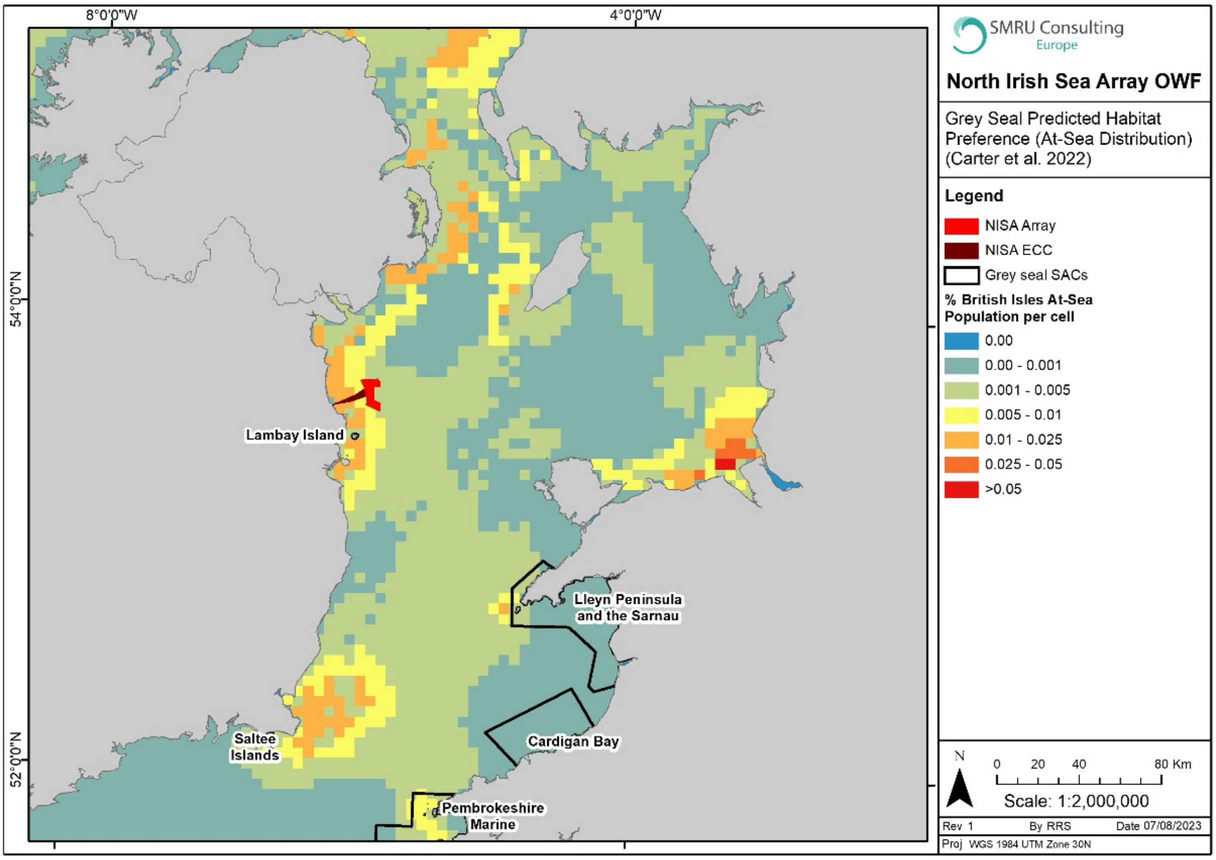

Figure 68 At-sea distribution of grey seals from haul-outs in the British Isles in 2018 (Carter *et al.*, 2020).

10.7 IWDG surveys

During the Greater Dublin Drainage Project IWDG land-based marine mammal surveys (Meade *et al.*, 2017), a total of 325 grey seals were recorded, with 323 of these individuals recorded to be adults and 2 of them juveniles. Overall, the sightings had an average group size of one individual. The sighting rate for grey seals was highest in April 2015, with high numbers of grey seals also reported in September 2015, January 2016 and October 2016. Grey seal distributions were shown to be more westerly in the survey area, with peaks in foraging activity recorded in close proximity to the northern cliffs of Howth Head (Figure 69).

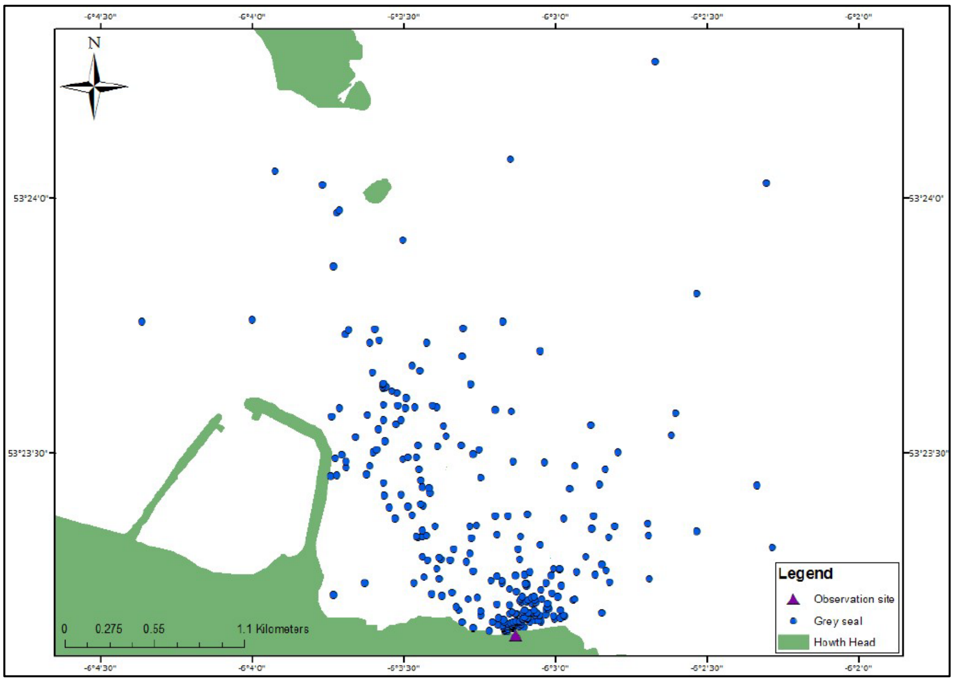

Figure 69 Distribution of grey seal sightings off Howth Head (Meade *et al.*, 2017).

In addition, the vessel-based marine mammal surveys carried out by Meade *et al.* (2017) for the Greater Dublin Drainage Project recorded a total of 25 grey seals between April 2015 and January 2017 (Figure 57).

During the IWDG Inshore Irish Sea surveys (Berrow *et al.*, 2011), grey seals were reported in both block A (Dublin area) and B (south coast), with 2 grey seals reported in block A and 2 in block B. For both blocks, the mean group size was 1. For block A, the estimated relative abundance of grey seals was estimated at 0.01 individuals/km^2 (Figure 58). For block B, the estimated relative abundance of grey seals was reported at 0.014 individuals/km^2.

10.8 Other OWFs

Grey seals were observed during Codling Wind Park surveys from 2013-2014 (Codling Wind Park Limited, 2020). Unidentified seals were also observed during the nearby Arklow Bank Phase 1 and 2 surveys and were considered most likely to be grey seals (RPS, 2020).

10.9 Seasonality

Grey seal pups are typically born between August and December. Following pupping, the pups will suckle for 17 to 23 days and, once weaned, will remain in the breeding colony for a further two to three weeks. Once the adult females have finished lactation, mating will then occur, before heading back out to sea (SCOS, 2021). Grey seals also undertake an annual moult between December and April (SCOS, 2021). During the breeding season and whilst moulting, grey seals spend longer periods of times hauled out on land, resulting in a higher density of seals on land and typically forage within 100 km of haul out sites (SCOS, 2021). They may, therefore, be more vulnerable to activity being conducted close to haul out sites during these months. Outside of the breeding season, seals will exhibit a much wider spatial variation.

10.10 Summary

There have been several studies on grey seal abundance and distribution at haul-outs around Ireland, however there is a lack of at-sea density estimates due to a lack of telemetry data in Irish waters. Given that there is no alternative, it is recommended that the at-sea density estimates obtained from the habitat preference maps are used in the impact assessment for the proposed development.

11 Future receiving environment

It is challenging to predict the future trajectories of marine mammal populations. There is no appropriate monitoring at the right temporal or spatial scales to really understand the baseline dynamics of some marine mammal populations, including all cetacean species included in this assessment. The data available suggests that, apart from harbour porpoise, all other marine mammal populations included in this assessment are relatively stable. This is reflected in the most recent species conservation assessments where all marine mammal species included in this baseline characterisation were classified as having a Favourable overall conservation status (Table 25), with grey seals noted as having an increasing trend (NPWS, 2019).

While harbour porpoise were assessed as having a Favourable conservation status in Irish waters (NPWS, 2019), large scale surveys (SCANS III and ObSERVE combined) have estimated a decline in harbour porpoise abundance in the Celtic and Irish Seas MU, from an estimate of 98,807 (CV: 0.3, 95% CI: 57,315 – 170,336) in 2005 to 62,517 (CV: 0.1395% CI: 48,316 – 80,864) in 2016 (IAMMWG, 2021). The 2016 abundance estimate is therefore only 63% of the 2005 estimate, which represents a significant decline in abundance for this MU. The reason for this decline is not specified or speculated about in IAMMWG (2021). However, the IAMMWG is yet to incorporate the SCANS IV data into these trend estimations, as the ObSERVE surveys (i.e., ObSERVE2) are also scheduled to be updated. The SCANS IV report will also be updated to include results from ObSERVE2, and both reports shall be used to update the IAMMWG MU abundance estimates.

Table 25 Marine mammal conservation assessments (NPWS, 2019).

Species	Conservation status
Harbour porpoise	The Overall Status of harbour porpoise in Ireland remains Favourable. This overall result is the same as the previous two NPWS assessments.
Bottlenose dolphin	The Overall Status of bottlenose dolphin in Ireland remains Favourable. This overall result is the same as the previous two NPWS assessments.
Common dolphin	The Overall Status of harbour porpoise in Ireland remains Favourable. This overall result is the same as the previous two NPWS assessments.
Risso's dolphin	The Overall Status of Risso's dolphin in Ireland is assessed as Favourable, given current knowledge of the species' population size, distribution, ecology and prevailing pressures on the species. This overall result is different from the previous two assessments, in which the status was assessed as Unknown, and it represents a significant improvement in knowledge of the conservation status of the species.
Minke whale	The Overall Status of minke whale in Ireland remains Favourable, given current knowledge of the species' population size, distribution, ecology and prevailing pressures on the species. This overall result is the same as in the previous two NPWS assessments.
Harbour seal	The Overall Status of the harbour seal in Ireland is considered to be Favourable, given the current knowledge of the species' population size, distribution, ecology and prevailing pressures on the species.
Grey seal	Given the current state of knowledge of the species' distribution, population,

	ecology and prevailing pressures, the Overall Status is Favourable with an increasing trend.

The baseline environment is expected to continue to change as a result of global trends such as climate change. The potential impacts of climate change on marine mammals has previously been reviewed and synthesised by Evans and Bjørge (2013), but they concluded that this topic remains poorly understood.

Since then, numerous studies have, and are being undertaken to understand the potential impacts of climate change on marine mammals. Building upon the work by Evans and Bjørge (2013), Martin *et al.* (2023) provided a further review on climate change impacts on marine mammals around the UK and Ireland, highlighting for marine mammals, impacts are likely to present themselves in the form of geographic range shifts (Kaschner *et al.*, 2011, Nøttestad *et al.*, 2015, Ramp *et al.*, 2015, Williamson *et al.*, 2021) resulting from a reduction of suitable habitats; changes to predator-prey dynamics and thus, food-web alterations (Nøttestad *et al.*, 2015, Ramp *et al.*, 2015); and increased potential for prevalence of disease amongst marine mammal populations through the introduction of novel diseases (Blanchet *et al.*, 2021, SCOS, 2022). Whilst Martin *et al.* (2023) provides an overview of what is, and what could happen to marine mammal populations arounds the UK and Ireland, the review does not into the specifics for each of the species discussed in this baseline report and thus there still remains some uncertainty around the potential impacts of climate change.

To address species-specific impacts of climate change however, van Beest *et al.* (2022) assessed spatiotemporal changes in habitat suitability and inter-specific overlap among grey seals, harbour seals and harbour porpoise co-occurring in the southwestern Baltic Sea, including the Danish Straits. The study model estimated changes in total area size and overlap of habitat suitability for each species between 1997–2020 and 2091–2100. Overall, the model output suggested that habitat suitability of Baltic Sea grey seals will decline over space and time, driven by changes in sea surface salinity and a loss of currently available haul-out sites following sea-level rise in the future (van Beest *et al.*, 2022). A similar, although weaker, effect was observed for harbour seals, while suitability of habitat for harbour porpoises was predicted to increase slightly over space and time (van Beest *et al.*, 2022). Although this study was specific to the Baltic Sea and not UK and Irish waters, it suggested that there is the potential for species to respond differently the climate change, and that there may be divergent shifts in habitat suitability and thus a redistribution of species which influence food-web dynamics (Nøttestad *et al.*, 2015, Ramp *et al.*, 2015) and ecosystem functioning (Blanchet *et al.*, 2021, van Beest *et al.*, 2022).

Whilst species specific studies arising from the UK are lacking, the annual SCOS Advice on Matters Related to the Management of Seal Populations reports have recently reviewed the latest scientific information available on current environmental impacts seals face due to climate change in the UK. The reports concluded that whilst distributions of currently preferred prey are shifting northwards, there is little information on the relationships between environmental drivers and seal population dynamics and it is therefore unlikely that cause and effect will be reliably assigned to specific aspects of climate change with respect to changes in seal population dynamics (SCOS, 2022). In addition, one PhD student at the Sea Mammal Research Unit (SMRU) is exploring the effects of climate change on seals in the UK. Specifically, this exploration investigates how changes in sea surface temperatures and sea levels may potentially impact the distribution of grey seals in the North Sea. This research is ongoing however, and unfortunately no results are available to be shared at this time.

12 Data gaps or uncertainties

Specific limitations of each data source are outlined in section 3: Data Sources. These include limitations such as the lack of fine spatial and temporal scales surveyed and the fact that many of the areas surveyed did not directly overlap with the proposed development survey area. However, they do provide a good indication of the species present in the vicinity of the offshore development area and are complimented by the site-specific surveys which provide a more contemporary estimate at both fine temporal and spatial scale.

The key data limitations with the baseline data are the high spatial and temporal variation in marine mammal abundance and distribution in any particular area of the sea. For this reason, a precautionary approach has been taken, where the most robust and reliable density estimates have been taken forward for use in the quantitative impact assessment in order to be precautionary.

13 Summary

Given the difference in survey scale between the data sources examined, there are several instances where a wide range of density estimates are available for each species within the vicinity of the proposed development and in the species-specific MU. Where this occurs, a precautionary approach has been taken, where the most robust and reliable density estimates have been taken forward for use in the quantitative impact assessment. Table 26 provides a summary of the species-specific MU size and density estimates that are recommended for use in the quantitative impact assessment for the proposed development.

Table 26 Marine mammal MU and density estimates taken forward to quantitative impact assessment.

Species	MU	MU size	MU source	Density (#/km^2)	Density source
Harbour porpoise	Celtic and Irish Sea	62,517	IAMMWG (2023)	0.38	NISA DAS
				0.2803	SCANS IV (Gilles *et al.*, 2023)
				Grid cell specific	SCANS III density surface (Lacey *et al.*, 2022)
					Irish Sea density surface (Evans and Waggitt, 2023)
Bottlenose dolphin	Irish Sea	293	IAMMWG (2023)	0.002	NISA DAS
		8,326		0.2352	SCANS IV (Gilles *et al.*, 2023)
		1,069		Grid cell specific	SCANS III density surface (Lacey *et al.*, 2022)
		496			Irish Sea density surface (Evans and Waggitt, 2023)
Risso's dolphin	Scoped out				
Common dolphin	Celtic and Greater North Sea	102,656	IAMMWG (2023)	0.04	NISA DAS
				0.0272	SCANS IV (Gilles *et al.*, 2023)
				Grid cell specific	SCANS III density surface (Lacey *et al.*, 2022)
					Irish Sea density surface (Evans and Waggitt, 2023)
Minke whale	Celtic and Greater North Sea	20,118	IAMMWG (2023)	0.0137	SCANS IV (Gilles *et al.*, 2023)
				Grid cell specific	SCANS III density surface (Lacey *et al.*, 2022)
					Irish Sea density surface (Evans and Waggitt, 2023)
Harbour seal	Southeast & East RoI & Northern Ireland MU	1,365	Morris and Duck (2019) and SCOS (2023)	Grid cell specific	Carter *et al.* (2020)

Grey seal	Southeast & East RoI & Northern Ireland MU	6,056	Morris and Duck (2019) and SCOS (2023)	Grid cell specific	Carter *et al.* (2020)

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