Dublin Array
Generation for generations

EIAR Volume 4: Offshore Infrastructure Technical Appendices
Appendix 4.3.5-1: Technical Baseline Report – Marine Mammals

Kish Offshore Wind Ltd

RWE SLR GoBe APEM Group

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Dublin Array Offshore Wind Farm

Environmental Impact Assessment Report

Volume 4, Appendix 4.3.5-1: Technical Baseline Report – Marine Mammals

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Glossary

Term	Definition
Array area	The area within which the WTGs and OSP's will be located.
Cetacean	The order Cetacea includes whales, dolphins and porpoises and is collectively known as cetaceans.
EIAR	Environmental Impact Assessment Report – a report to inform an Environmental Impact Assessment.
Haul out	A behaviour associated with pinnipeds temporarily leaving the water for reasons such as reproduction and rest
Management Unit	Marine mammal management units (MUs) are considered to be relevant spatial scales for marine mammal species that represent the best understanding of the structure of biological populations and any ecological differentiation within such populations.
Offshore Export Cable Corridor (Offshore ECC)	Corridor for an export transmission cable from the array to landfall.
PAM	Passive acoustic monitoring (PAM) is used to measure, monitor, and determine the sources of sound in underwater environments. PAM can refer to both Static Acoustic Monitoring (SAM) and towed devices.
Pinnipeds	Fin-footed group of marine mammals which are semi-aquatic. Pinnipeds comprise of the following families: Odobenidae (walrus); Otariidae (eared seals, sea lions, and fur seals); and Phocidae (earless seals). Pinnipeds are more broadly known as "seals
Small Cetacean Abundance in the North Sea and Adjacent Waters (SCANS)	Large scale surveys aimed at estimating the abundance of porpoises and other cetaceans in order to assess the impacts of by-catch. SCANS (1994) and SCANS II (2005), SCANS III (2017) and SCANS VI (2022) have been completed.
Telemetry	Telemetry is the automatic measurement and wireless transmission of data from remote sources

Acronyms

Term	Definition
ARGOS	Advanced Research and Global Conservation Satellite
CI	Confidence Interval
cSAC	Candidate Special Area of Conservation
CV	Coefficient of Variation
CWP	Codling Wind Park
DAS	Digital Aerial Survey
DCCAE	Department of Communications, Climate Action and Environment
ECC	Export Cable Corridor
EEZ	Exclusive Economic Zone

ESW	ESW
ESAS	European Seabirds at Sea
GAM	Generalised Additive Model
GLM	Generalised Linear Models
GEE	Generalised Estimating Equation
GIS	Geographical Information System
GMIT	Galway-Mayo Institute of Technology
GPS	Global Positioning System
GSM	Global System for Mobile Communications
ICBDC	Irish Coastal Bottlenose Dolphin Catalogue
IAMMWG	Inter-Agency Marine Mammal Working Group
IWDG	Irish Whale and Dolphin Group
LAT	Lowest Astronomical Tide
MERP	Marine Ecosystems Research Programme
MRDS	Mark-Recapture Distance Sampling
MU	Management Unit
NIEA	Northern Ireland Environment Agency
NISA	North Irish Sea Array
NMEA	National Marine Electronics Association
PAM	Passive Acoustic Monitoring
PEST	Production Estimation Model
SAC	Special Area of Conservation
SCANS	Small Cetaceans in European Atlantic waters and the North Sea
SCOS	Special Committee on Seals
SDWF	Shannon Dolphin and Wildlife Foundation
SMRU	Sea Mammal Research Unit
SWF	Sea Watch Foundation

1 Introduction

1.1 Overview

1.1.1 Dublin Array Offshore Wind Farm (Dublin Array) is a proposed offshore wind farm on the Kish and Bray Banks. The Kish and Bray Banks are located, approximately 10 km off the east coast of Ireland, immediately south of Dublin city off the coast of Dún Laoghaire and county Wicklow. Dublin Array will be located within an area of approximately 59 km^2, in water depths ranging from 2 metres to 50 metres lowest astronomical tide (LAT).

1.1.2 This document has been prepared by Sea Mammal Research Unit (SMRU) Consulting to support the Environmental Impact Assessment (EIA) for Dublin Array. The following documents should be read alongside this baseline technical report:

- Volume 4, Appendix 4.3.5-2: Dublin Array OWF Marine Mammal Abundance Estimates 2019-2021;
- Volume 4, Appendix 4.3.5-3: Dublin Array OWF Spatial Modelling of Harbour Porpoise; and
- Volume 4, Appendix 4.3.5-4 and 4.3.5-5: Boat based bird and marine mammal survey reports 2019-2020 and 2020-2021.

1.2 Purpose of this report

1.2.1 In order to develop an offshore wind farm 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.

1.2.2 The baseline characterisation provides information not only on the site of the windfarm (i.e., array area, Offshore Export Cable Corridor (Offshore ECC) and temporary occupation area), but is extended beyond the project site over an appropriate area, taking into consideration the scale of movement and population structure for each species. The area considered in the assessment is therefore largely defined by the appropriate species Management Unit (MU). These MUs are defined by the Inter-Agency Marine Mammal Working Group, which is made up of Statutory Nature Conservation Bodies based in the UK. These MUs are not generally utilised in Ireland but are typically used in the absence of an alternative. Notably, the MUs do include Irish waters, and they do incorporate relevant data from Ireland, including Rogan *et al*. (2018). Therefore, they are considered relevant and suitable for this purpose.

1.2.3 The purpose of this baseline characterisation survey and literature review is to identify the most robust abundance and density estimates for each marine mammal species that will be used in the quantitative impact assessment. Therefore, this document provides 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 Dublin Array. The baseline data have been compiled through a combination of a literature reviews and data obtained from site-specific surveys.

1.3 Report structure

1.3.1 This baseline characterisation follows the following report structure:

- Section 2: Methodology – this section outlines the approaches taken in identifying the marine mammal baseline specific to the Dublin Array offshore infrastructure and the wider environment (Section 2.1: Methodology). This describes the data sources that were used to inform the baseline characterisation (Section 2.3: Data sources). For each data source, information is provided on the survey type, the timing of the surveys and any key assumptions and limitations associated with the survey and analysis methods used. No results of the surveys are presented in this section (see receiving environment below);
- Section 3: Receiving environment – outlines the abundance and density data for each marine mammal species that were obtained from the studies included in the data sources section;
- Section 4: Future receiving environment – describes how the environment is anticipated to change in the absence of Dublin Array; and
- Section 5: Data gaps and uncertainties – highlights the key data gaps and uncertainties associated with the baseline characterisation for marine mammals.

2 Methodology

2.1 Approach

2.1.1 Baseline information was gathered by a combination of desk-based review of existing data sources and consideration of site-specific survey data.

2.1.2 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 Dublin Array Offshore Wind Farm Environmental Impact Assessment Scoping Report[1] *(*SLR *et al.* 2020) identified three key marine mammal species across the offshore development area and within the wider context of the Irish Sea: harbour porpoise (*Phocoena phocoena*), harbour seal (*Phoca vitulina*) and grey seal (*Halichoerus grypus*). Other species were mentioned within the scoping report as being recorded across the study area and within the wider Irish Sea, including minke whales (*Balaenoptera acutorostrata*), bottlenose dolphins (*Tursiops truncatus*), Risso's dolphins (*Grampus griseus*) and common dolphins (*Delphinus delphis*) (SLR *et al*. 2020). However, these species were identified as not commonly encountered, and density estimates are considered to be low comparative to the three key species identified.

2.2 Study area

2.2.1 The marine mammal study area (hereafter referred to as the study area) varies depending on the species, considering individual species ecology and behaviour. For all species, the project study area covers the array area and Offshore ECC together, and the operations and maintenance base separately. The study area is further extended over an appropriate area considering the scale of movement and population structure for each species. For each species, the extended area considered in the assessment is largely defined by the appropriate species MU. Cetacean MUs were defined by the Inter-Agency Marine Mammal Working Group (IAMMWG) (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. This approach is widely accepted across the UK for marine mammals.

2.2.2 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 2) for an indication of the local densities of each species. The array area and Offshore ECC are located within the following MUs for each species (and thus these are the species-specific study areas):

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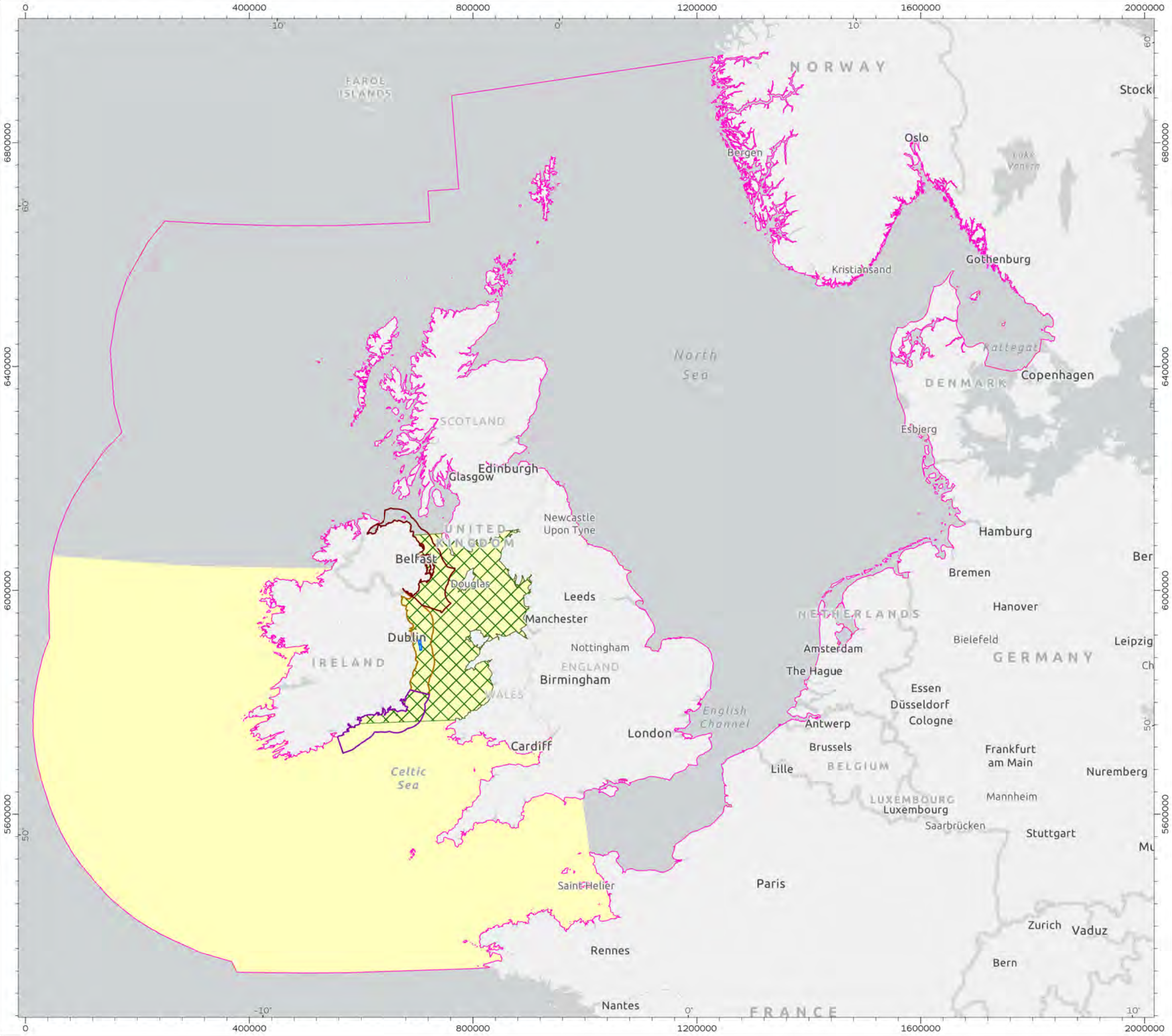
[1] Dublin Array Offshore Wind Farm Environmental Impact Assessment Scoping Report, September 2020. Available: https://dublinarray.com/scoping/

- Harbour porpoise: Celtic and Irish Seas MU;
- Grey seal: East & South-east regions of Republic of Ireland and Northern Ireland[2];
- Harbour seal: East & South-east regions of Republic of Ireland and Northern Ireland;
- Minke whale: Celtic and Greater North Seas MU;
- Bottlenose dolphin: Irish Sea MU;
- Risso's dolphin: Marine Atlantic MU;
- Common dolphin: Celtic and Greater North Seas MU.

2.2.3 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 Dublin Array is outlined in the species-specific paragraphs of Section 3 Receiving Environment. The potential for impacts upon SACs is considered in the Natura Impact Statement (see Habitats Directive Assessments: Part 3 NIS').

2 Note: there are no agreed Management Units for grey and harbour seals at this time and different jurisdictions manage seal populations in different ways. In the absence of a defined MU for seals in east Ireland, this baseline characterisation presents data for the east of Ireland "regions" identified in the Duck and Morris (2019) study on seal haul-out counts for grey seals and those identified in Steinmetz et al. (2022) for harbour seals.



- Array Area
- Bottlenose Dolphin - Irish Sea Management Unit
- Common Dolphin and Minke Whale - Celtic and Greater North Seas Management Unit
- Harbour Porpoise - Celtic and Irish Sea Management Unit
- Grey Seal and Harbour Seal - Northern Ireland Management Unit
- Grey Seal and Harbour Seal - South East RoI Management Unit
- Grey Seal and Harbour Seal - East RoI Management Unit

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MAP NOTES / DATA SOURCES:

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Marine Mammal Study Area (Management Unit) for Each Species

DRAWING NUMBER: 1

PAGE NUMBER: 1 of 1

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PRJ	WGS 1984 UTM Zone 29N		

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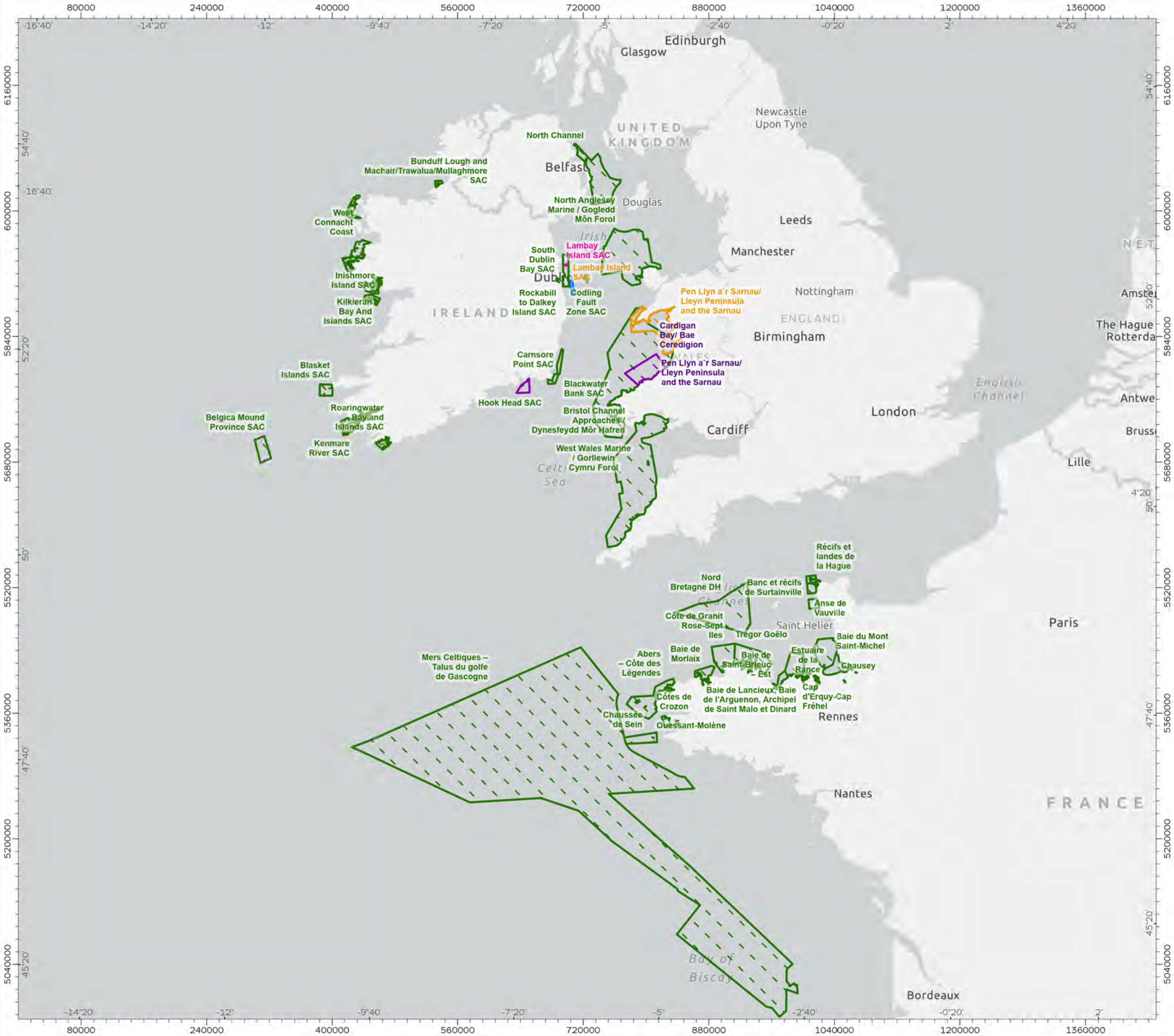

- Array Area
- Bottlenose Dolphin SACs
- Harbour Porpoise SACs
- Grey Seal SACs
- Harbour Seal SACs

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SACs Screened in for AA - Harbour Porpoise and Bottlenose Dolphin

DRAWING NUMBER: 2

PAGE NUMBER: 1 of 1

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0 20 40 60 80 nm

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DATUM WGS 1984 VERTICAL REF LAT
PRJ WGS 1984 UTM Zone 29N

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2.3 Data sources

2.3.1 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 study area. This section details the survey and analysis methodology implemented in each study and the potential limitations associated with these. Therefore, it is considered that the data sources utilised in this report are sufficient to characterise the baseline environment for marine mammals.

2.3.2 The actual results of the surveys in terms of the species presence are detailed in Section 3 Receiving Environment for each species.

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	Vessel based visual line transect surveys	19 surveys between June 2019 and April 2021. Marine mammal Survey Area.
Previous baseline surveys: 2010-2011 (Saorgus Energy Ltd 2012)	Vessel based visual line transect surveys	8 boat-based transect surveys between June 2010 and June 2011
Previous baseline surveys: 2001-2002 (Saorgus Energy Ltd 2012)	Visual boat transect surveys, boat fixed point surveys and aerial surveys	14 boat surveys between September 2001 and September 2002. 7 fixed point surveys September 2001 and May 2002. Vessel: array area +4 km from the banks. Aerial: vessel area +16 km north, 22 km south, 8 km east and 8 km west.
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.
IWDG bottlenose dolphin surveys (O'Brien *et al.* 2009)	Photo ID surveys	8 surveys between July and September 2008. Entire Irish coast.
IWDG bottlenose dolphin surveys (Berrow *et al.* 2012)	Vessel based visual line transect surveys	12 transects (3 per month) between July and October 2010. Lower Shannon candidate Special Area of Conservation.
IWDG Irish Sea surveys (Berrow *et al.* 2011)	Visual and acoustic surveys	2 surveys in August 2011. Inshore surveys in 2 blocks: Block A (northern Irish Sea – including Dublin Array) and Block B (southern Irish Sea).
IWDG SAC surveys (Berrow and O'Brien 2013, O’Brien and Berrow 2016)	Visual and acoustic line transect surveys	1 survey in 2013 and 4 surveys in 2016. Rockabill to Dalkey Island SAC.
IWDG Irish coastal water surveys (Berrow *et al.* 2008)	Vessel based visual line transect surveys and	6 survey days between July-September 2008. 5 sites (North County Dublin, Dublin Bay, Cork coast, Roaringwater Bay cSAC and Galway Bay)

Data source	Type of data	Temporal and spatial coverage
	T-POD[3] acoustic monitoring.	
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.
SCANS IV (Giles *et al*, 2023)	Aerial and vessel visual surveys	June, July and October 2022 All European Atlantic waters. Dublin Array located in block CS-D (formerly block E as per SCANS III)
SCANS III (Hammond *et al*. 2017, Hammond *et al*. 2021)	Aerial and vessel visual surveys	June & July 2016. All European Atlantic waters. Dublin Array 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. Dublin Array located in block O (entire Irish Sea).
Irish marine mammal atlas (Wall *et al*. 2013)	Collation of data from IWDG, the ISCOPE I and II projects, ferry survey programme and the PReCAST surveys.	2005-2011 Irish EEZ.
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.
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 2023)	Maps of sighting rates and indicative density surface maps from aerial and vessel survey data	1990 – 2020 Wales and adjacent seas
Seal counts 2003 (Cronin *et al*. 2004, Cronin *et al*. 2007)	Aerial survey	August 2003. Entire coastline of the Republic of Ireland.
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.

[3] Both T-POD (Timing POrpoise Detector) and C-POD (Continuous POrpoise Detector) are referred to throughout this document. The T-POD has been superseded by the C-POD, however both instruments produce similar results.

Data source	Type of data	Temporal and spatial coverage
Seal at-sea usage (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 telemetry (Cronin *et al*. 2016)	Telemetry tags	Strangford Lough: 33x harbour seals (2006, 2008 & 2010) Raven Point: 19x grey seals 2013 & 2014 Great Blasket Island: 8x grey seals 2009
Seal telemetry data (SMRU 2019)	Telemetry tags	Various tagging datasets collected up to 2019.
Seal haul-out surveys (Berrow et al, 2024)	UAV, boat counts and ground counts	10 sites surveyed between Skerries and Dalkey Island on 16 days between June 2023 and January 2024.

Site specific surveys

2.3.3 As outlined in the Guidance on Marine Baseline Ecological Assessments & Monitoring Activities for Offshore Renewable Energy Projects Part 1 April 2018[4], in cases where there is insufficient data to inform a baseline characterisation, "*field-based surveys should be conducted to gather information relevant to the receiving environment*". As such, baseline characterisation to inform impact assessment at offshore wind farms typically involve a combination of existing data for the site, augmented by one or two years of survey data at the site.

2.3.4 While there is existing robust density data available for marine mammals in the area provided by the two years of ObSERVE survey data (see Section 2.3.13 et seq.) it was determined that the ObSERVE data would benefit from being augmented with one more year of site specific surveys to provide a total of three years of spatially explicit density estimates over the potential impact area. Therefore, in order to fully inform the baseline characterisation of marine mammals at Dublin Array, vessel-based line transect surveys were undertaken (see Figure 3). The aim of the site-specific surveys were to augment the ObSERVE data in order to obtain recent and robust density estimates for the key marine mammal species relevant to Dublin Array. Since the key species in the area were expected to include harbour porpoise as well as seal species, baleen whales and dolphin species, it was determined, in line with the guidance in DCCAE (2018), that line transects with distance sampling was the best standard methodology to enable an estimation of density and abundance for various marine mammal species. The use of Static Acoustic Monitoring (SAM) was considered. However, while this method can provide continuous fine temporal and spatial scale resolution, it is most suitable for harbour porpoise and dolphin species, and not suitable for species such as baleen whales or seal species which do not vocalise reliably. In addition, it can be difficult to differentiate between dolphin species with SAM, and since it was known from previous studies that multiple dolphin species are present in Irish waters, it would not be sufficient to detect "dolphins" without being able to classify to species level, especially considering that the level

[4] https://www.dccae.gov.ie/documents/Guidance%20on%20Marine%20Baseline%20Ecological_part%201.pdf

of protection afforded to different dolphin species differs (e.g. SACs for bottlenose dolphins). The Irish Whale and Dolphin Group (IWDG) have conducted several static Passive Acoustic Monitoring (PAM[5]) deployments in the Dublin area (see Sections 2.3.19 – 2.3.30) and have recorded high levels of porpoise detections (detected on almost every day (see Table 5), therefore there is considered to be sufficient PAM data that exists to identify the presence of porpoise in the area year-round.

2.3.5 In total 19 monthly surveys were conducted during 17 months between June 2019 and January 2020, between May and September 2020, and between December 2020 and April 2021. Line transect distance sampling methods (Buckland *et al*. 2001) were used; where the vessel travelled along pre-determined transects and a minimum of three marine mammal trained observers were onboard. Two searched for animals, with one recording relevant information when an animal, or group of animals, was detected. Observers searched for marine mammals primarily with the naked eye, using binoculars to confirm detection, species identification and group size.

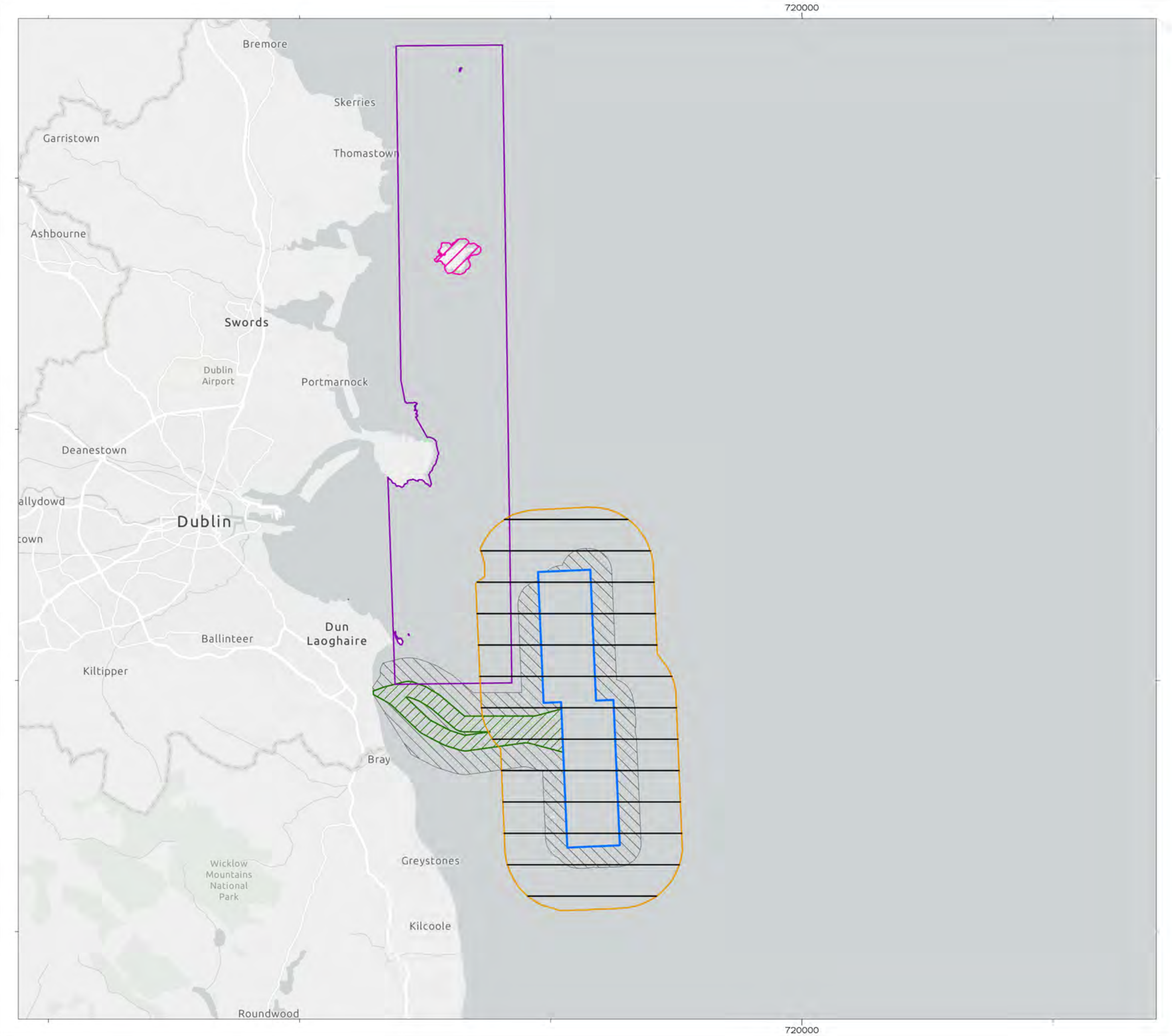
2.3.6 The survey area was a total of 266 km^2 (consisting of the array area plus 4 km buffer as per DCCAE (2018) guidelines), within which there were 13 parallel transects oriented east to west approx. 2 km apart (Figure 3), resulting in 142-160 km of transect lines in total. Transects were covered either in a single survey day, or on two consecutive days. Environmental conditions were recorded along the transects, and observers recorded the distance and angle to each marine mammal detection (as well as other information). Over the 19 surveys, a total of 2,751 km was surveyed on effort, 2,213 km of which was in Beaufort sea state ≤3 (80%). In total five species of marine mammal were sighted: harbour porpoise, minke whales, bottlenose dolphins, common dolphins and grey seals, as well as unidentified dolphins.

2.3.7 In order to obtain abundance and density estimates from the vessel survey data, line transect distance sampling analysis was conducted (Buckland *et al*. 2001). This analysis involves the creation of a detection function (see Buckland *et al.* (2001) for full details on the detection function) which estimates the probability of detecting an animal with increasing distance from the track line. There were sufficient sightings of harbour porpoise and minke whales to fit a detection function in Distance analysis and estimate the relative density and abundance of these two species (Burt and Chudzinska 2021, Chudzinska and Burt 2021) (see Section 3.2 Harbour porpoise and Section 3.5 Minke whale for results for each species respectively).

[5] Passive acoustic monitoring (PAM) is used to measure, monitor, and determine the sources of sound in underwater environments. PAM can refer to both Static Acoustic Monitoring (SAM) and towed devices.

2.3.8 There are two main limitations to this data source. The main limitation is the fact that the Distance analysis assumed perfect detection of marine mammals on the track line. This is a key assumption in Distance analysis, however in reality it is likely to be violated during marine mammal surveys since a) animals can be present on the track line but are underwater and therefore not available for detection and b) animals may display responsive movement away from the track line in the presence of the vessel. It was not possible to correct for this, and 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. This underestimate will likely differ for the two species included here, with the expectation that the underestimate for harbour porpoise will be much larger than for minke whales.

2.3.9 The second limitation of this dataset is the amount of survey effort conducted above Beaufort sea state 2. There have been several studies that have concluded that visual detection of harbour porpoise declines significantly with increasing sea state during visual vessel surveys (Barlow 1988, Palka 1996, Teilmann et al. 2003). Barlow (1988) found that porpoise sightings were significantly higher during ship surveys at Beaufort sea state 0 and 1 compared to Beaufort sea state 2, and Palka (1996) found that harbour porpoise detections were difficult in Beaufort sea states >2. As such, it is often recommended that vessel based visual surveys for harbour porpoise are limited to sea state 2 (e.g., Hammond et al. (2002)). During the Dublin Array site-specific surveys, 1,547 km effort was conducted in Beaufort sea state ≤2 (56%) with an additional 666 km surveyed at sea state 3 (24%) and 538 km surveyed at sea state 4 (20%). Given that the probability of detecting a harbour porpoise decreases above sea state 2, there was considerable effort conducted in conditions that were not ideal for the detection of harbour porpoise (44% above sea state 2) (Chudzinska and Burt 2021).



- Array Area
- Temporary Occupation Area
- Export Cable Corridor
- Lambay Island SAC
- Rockabill to Dalkey Island SAC
- Survey Area
- Transects

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PROJECT TITLE

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Marine Mammal Survey Area

DRAWING NUMBER: 3

PAGE NUMBER: 1 of 1

VER	DATE	REMARKS	DRAW	CHEK	APRD
01	2024-10-04	For Issue	GB	BB	SS

0 2 4 6 8 km

0 1 2 3 4 nm

N

GRID NORTH

SCALE	1:250,000	PLOT SIZE	A3
DATUM	WGS 1984	VERTICAL REF	LAT
PRJ	WGS 1984 UTM Zone 29N		

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Previous baseline surveys

2.3.10 Previous baseline surveys were conducted between 2001 and 2002 by Ecology Consulting. These comprised of visual boat transect surveys (area of 159 km²), boat fixed point surveys (10 locations), and aerial surveys (area of 1,226 km²) (Saorgus Energy Ltd 2012). The boat survey included the array area and the area up to 4 km from the banks, using a line transect design with transects spaced 2 km apart. A total of 14 boat transect surveys were conducted between September 2001 and September 2002. The boat fixed point surveys were conducted at 10 locations, and on seven surveys between September 2001 and May 2002, each point survey lasting for 30 minutes. The aerial transect area extended approximately 16 km north, 22 km south and 8 km east and west of the boat survey area. Marine mammals were sighted on the aerial surveys on 15th March 2002 and 9th April 2002, however observed numbers were low.

2.3.11 An additional eight baseline surveys were conducted between June 2010 and June 2011, using boat based transects with a towed hydrophone (Saorgus Energy Ltd 2012). The survey design comprised of ten 3.3 km transects running east-west across the study area, with a 2 km spacing resulting in a total transect length within the study area of 33 km. Four 3.3 km control transects to the north, south, east and west of the Kish and Bray banks were also surveyed. The surveys comprised of two visual observers, one stationed on each side of the vessel. The hydrophone was not used after the fourth survey (September 2010) as it was determined that the visual sightings were providing sufficient data on marine mammals.

2.3.12 It was not possible to calculate absolute abundance and density estimates from these surveys, and as such only relative estimates of density were provided (porpoise/km). In addition, surveys were not conducted in every month, with no effort conducted through most of the winter, and thus there is limited data to assess any seasonal patterns in the data. These survey data are therefore only used to provide context and a description of the baseline environment at that time.

ObSERVE

2.3.13 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 4). 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.

2.3.14 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 at 20,295 km within a survey area measuring 339,377 km^2.

2.3.15 During all four surveys, four observers were on board the aircraft, with two on each side of the aircraft. The aircraft's position was recorded every two seconds using an on-board Global Positioning System (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.

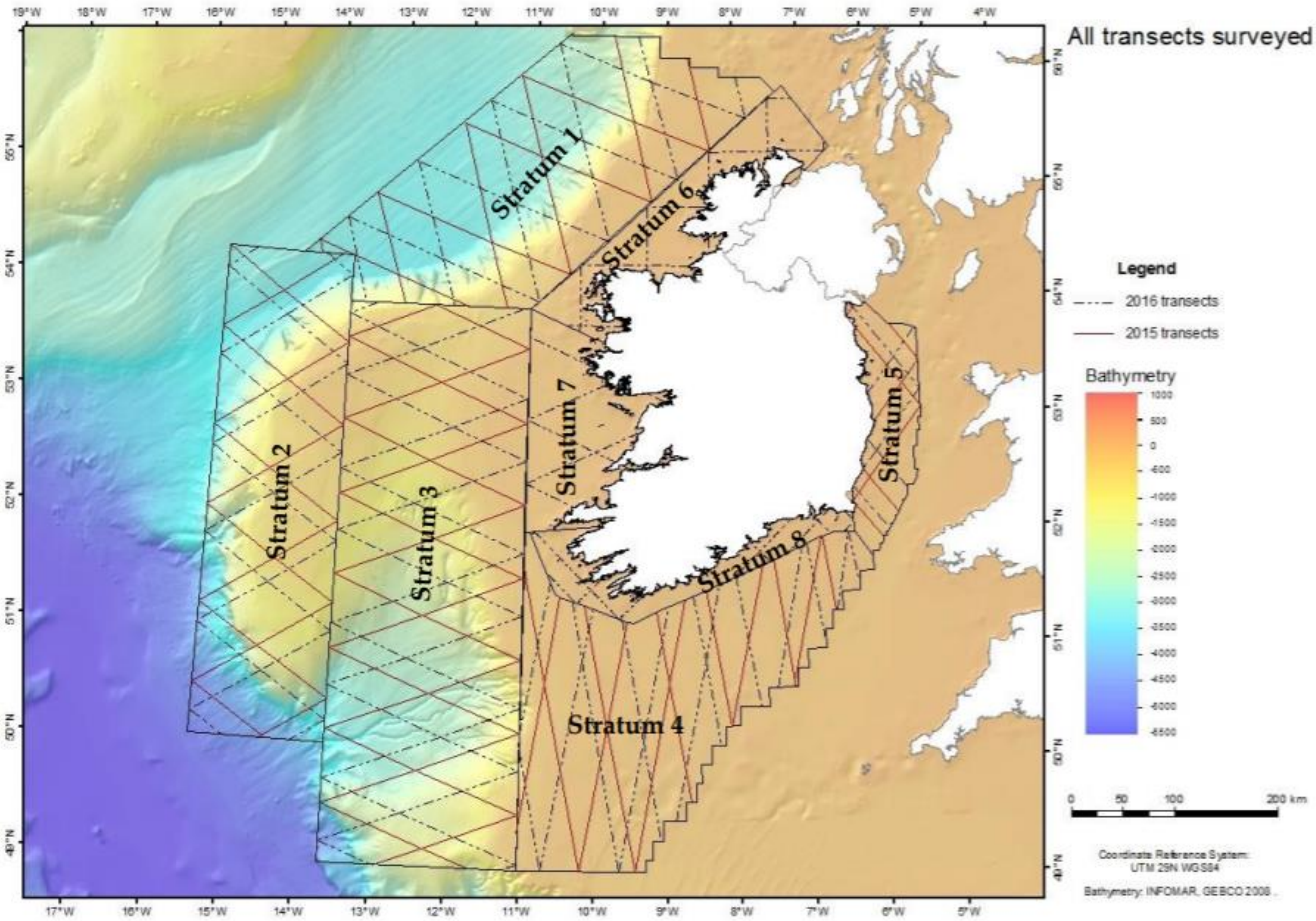


Figure 4 Map of the survey area for the ObSERVE surveys in 2015 and 2016 (Rogan *et al*. 2018).

2.3.16 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.

2.3.17 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 (see paragraph 2.3.8). The probability of detecting an animal on the track line (g(0)) was corrected for using the moderate sightings condition g(0) estimates calculated from the Small Cetaceans in European Atlantic waters and the North Sea (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 could be calculated.

2.3.18 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 (GAMs) with a set of environmental variables to examine habitat use.

Irish Whale and Dolphin Group Surveys

Bottlenose dolphin Photo-ID surveys

2.3.19 A total of eight systematic photo-ID surveys were carried out by the Irish Whale and Dolphin Group (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 the Galway-Mayo Institute of Technology (GMIT) and images collected by members of the public and IWDG. All images combined are referred to as the Irish Coastal Bottlenose Dolphin Catalogue (ICBDC). 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 Photoshop imaging software, each image was reviewed for unique markings 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 Republic of Ireland provided by the Shannon Dolphin and Wildlife Foundation (SDWF) and one from the UK, provided by the Sea Watch Foundation (SWF).

2.3.20 Berrow et al. (2012) conducted an abundance assessment of bottlenose dolphins in the Lower Shannon candidate Special Area of Conservation (cSAC) 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. All images were also scored for quality, with only good quality images included in the final analysis 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, considering the weighted mean proportion of well-marked individuals and measure of survival/migration obtained from the model.

Inshore surveys – Irish Sea

2.3.21 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 5). 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 site of the Dublin Array. 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. 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. 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 using 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.

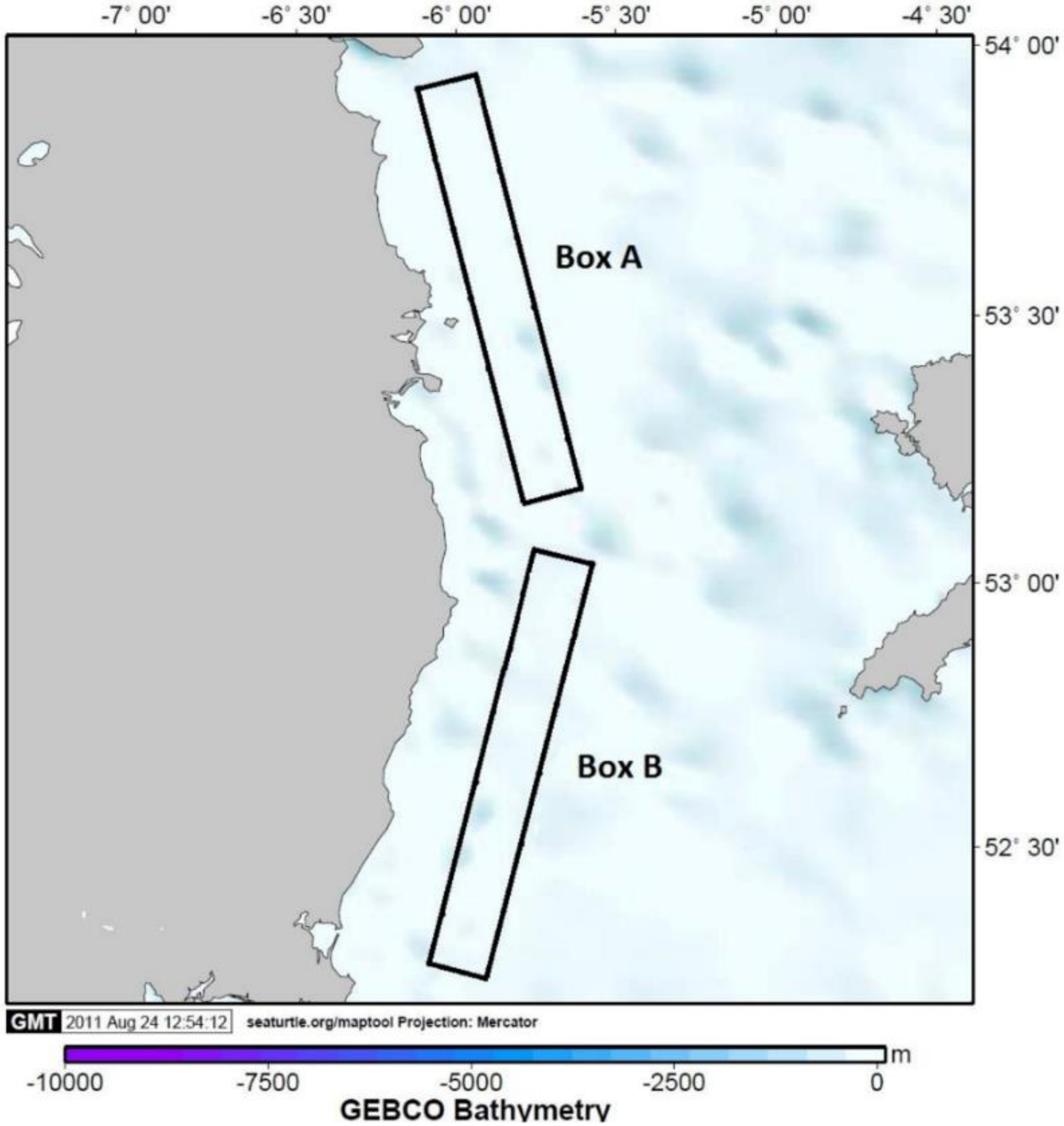


Figure 5 Map of east Ireland showing the locations of survey blocks surveyed for cetaceans in 2011 (Berrow *et al*. 2011)

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

2.3.22 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). 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 6). 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.

2.3.23 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) (Figure 6). 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 transects, sightings, abundance and density were processed via Geographic Information System (GIS) to produce sighting distribution maps.

2.3.24 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.

2.3.25 The main limitation of these surveys is the fact that the Distance analysis assumed perfect detection of marine mammals on the track line [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. This limitation is addressed by taking forward multiple density estimate values for quantitative impact assessment, and not just those derived from boat survey data.

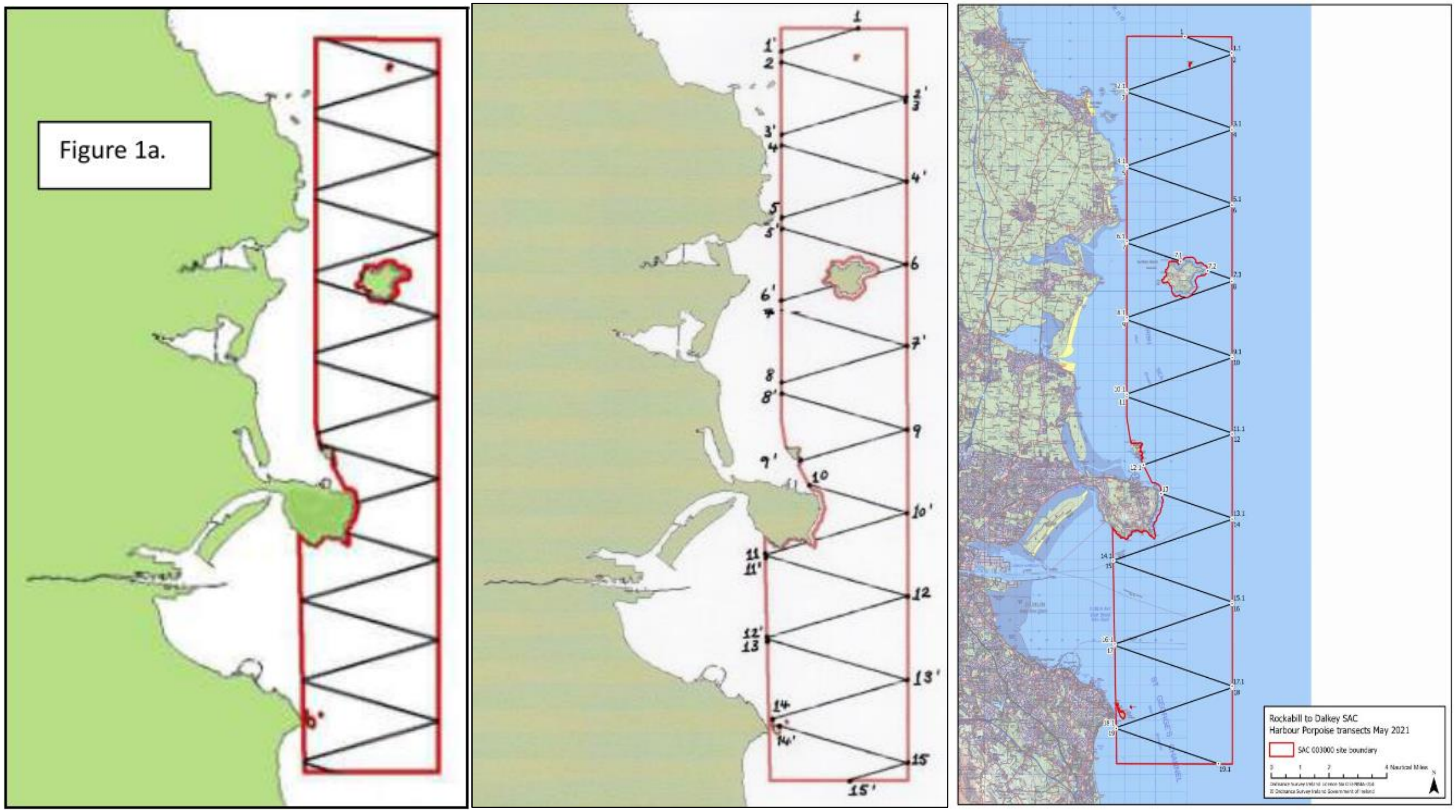


Figure 6 Rockabill to Dalkey Island SAC showing track lines selected for survey coverage in 2013 (left; Berrow and O'Brien 2013), 2016 (middle; O’Brien and Berrow 2016) and 2021 (right; Berrow *et al*. 2021)

Harbour porpoise surveys (2008)

2.3.26 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) (Figure 7). Single vessel line-transect surveys were carried out within or in close proximity to the survey site boundaries along pre-determined routes. 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 track line 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.

2.3.27 Acoustic monitoring was conducted through the static 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 the 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.

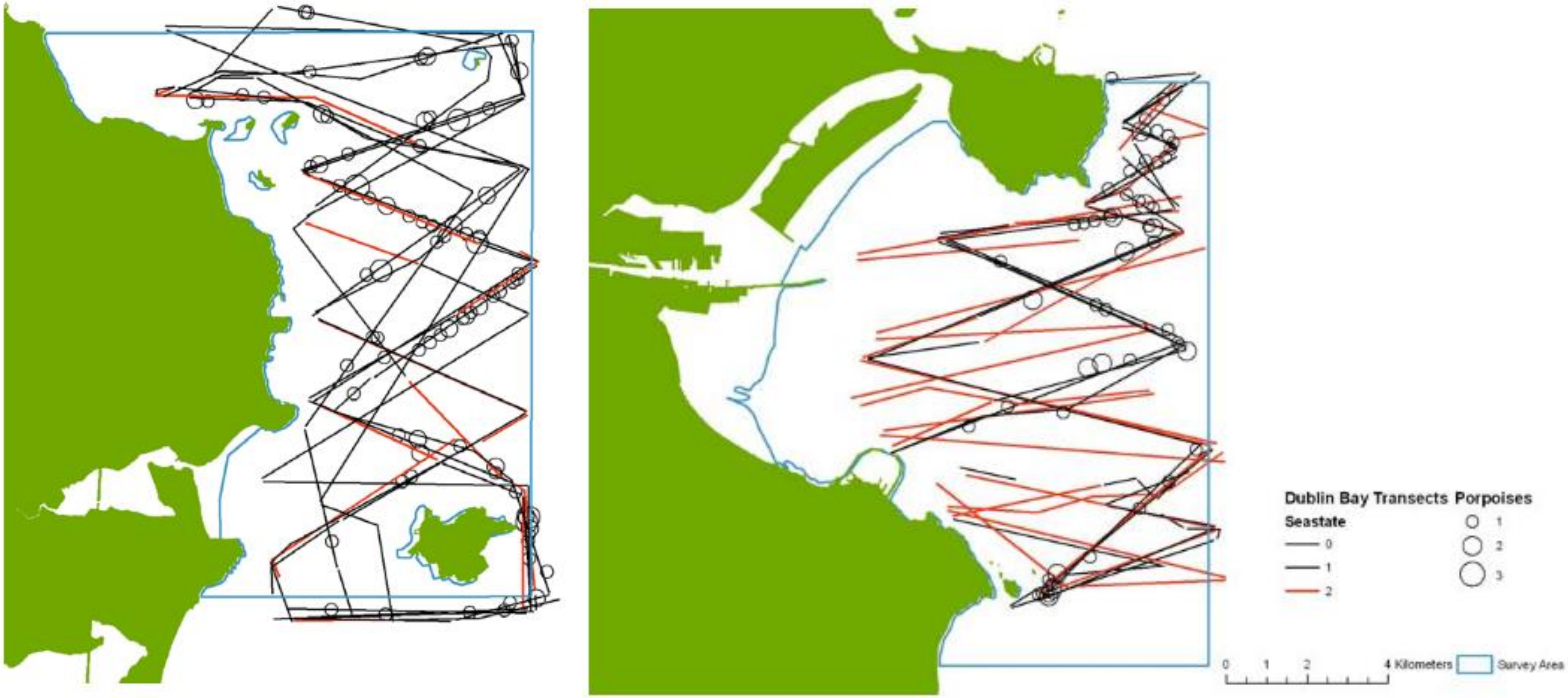


Figure 7 Map showing location of all track lines surveyed and harbour porpoise observed for the North Dublin transects (left) and Dublin Bay Transects (right) (Berrow *et al*. 2008)

Greater Dublin Drainage Project (2015-2017)

2.3.28 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 reticule binoculars.

2.3.29 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 8). 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).

2.3.30 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 9). 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).

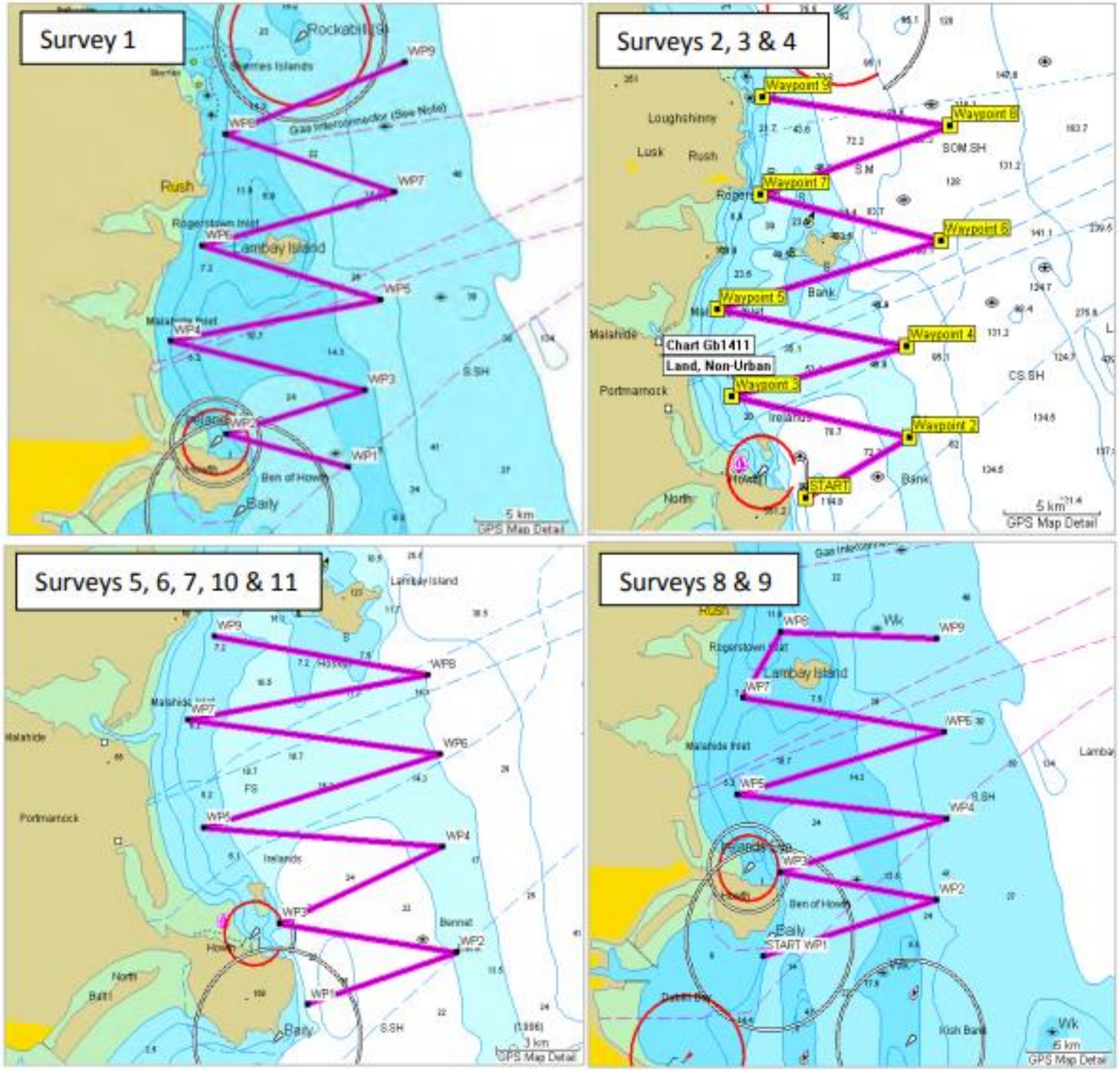


Figure 8 Line Transect Route for boat-based marine mammal surveys (Meade *et al*. 2017)

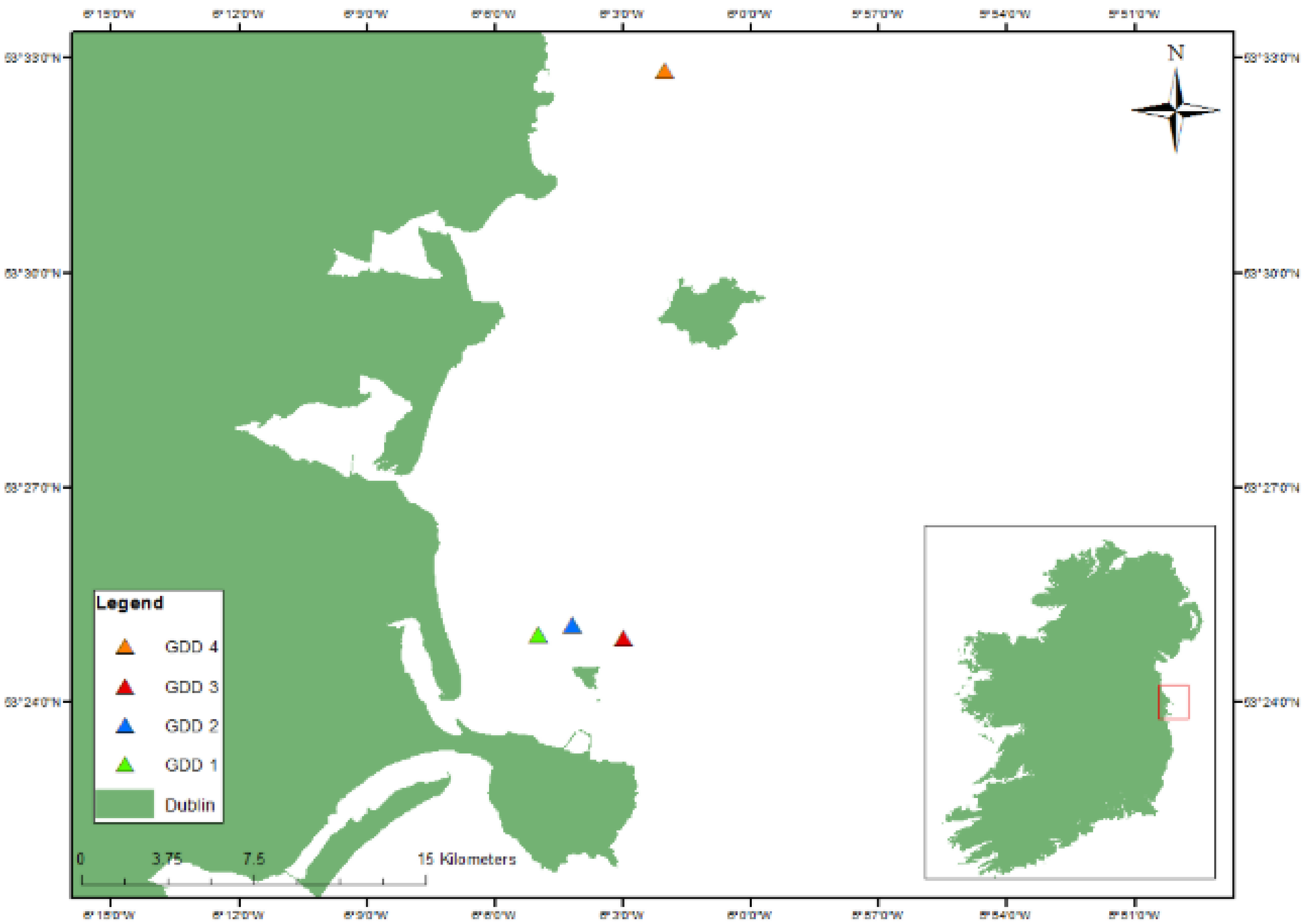


Figure 9 C-PODs locations off Portmarnock (GDD1, GDD2 and GDD3) and Loughshinny (GDD4) (Meade *et al*. 2017)

SCANS

2.3.31 The SCANS surveys relevant to this report 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).

2.3.32 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.

2.3.33 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[6] 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 rate on the transect line. As a result of this, the estimates generated for these marine mammal species are underestimated to an unknown degree.

SCANS IV

2.3.34 The SCANS IV surveys were conducted from June to October 2022, and comprised a combination of vessel and aerial surveys. 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 project. Species abundance was estimated using the same methodology as for SCANS III (see Hammond et al. (2021)).

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

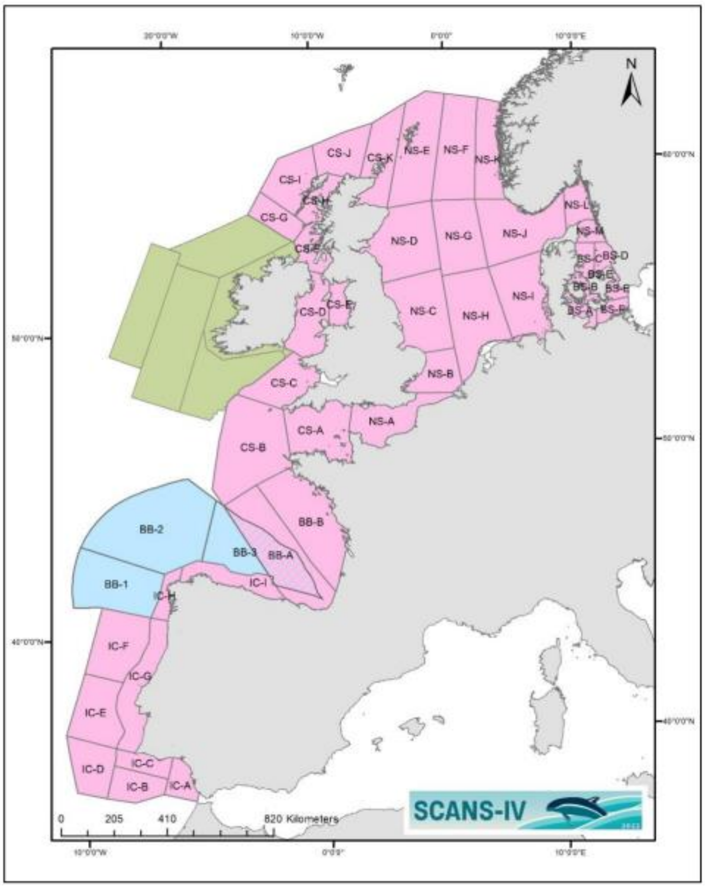


Figure 10 Area covered by SCANS IV survey blocks*

* Pink blocks were surveyed by air and blue blocks were surveyed by ship (Gilles et al. 2023)

2.3.35 The survey blocks used during SCANS IV are presented Figure 10 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.

SCANS III

2.3.36 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: 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 Dublin Array site.

2.3.37 During the SCANS III surveys (Hammond *et al*. 2017), the east coast of Ireland, including the area of Dublin Array, 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.

SCANS II

2.3.38 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 Dublin Array area) 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 porpoises, common dolphins, minke whales and bottlenose dolphins.

Irish Marine Mammal Atlas

2.3.39 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 marine mammals and megafauna in Irish waters project (PReCAST surveys). Data were collected using vessel surveys and casual sightings which were submitted to an online database and went through a validation process.

2.3.40 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 used labels such as 'unidentified dolphin', following criteria established for the IWDG's cetacean sightings database.

2.3.41 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, using labels such as 'unidentified whale'.

2.3.42 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, autumn, winter). In cases where there was insufficient data for a species to map seasonal effort and sightings, all 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 to facilitate species distribution mapping, however no relative abundance was calculated for the grid square.

2.3.43 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 11). 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 two pinniped species and 16 cetacean species, were included in the analysis.

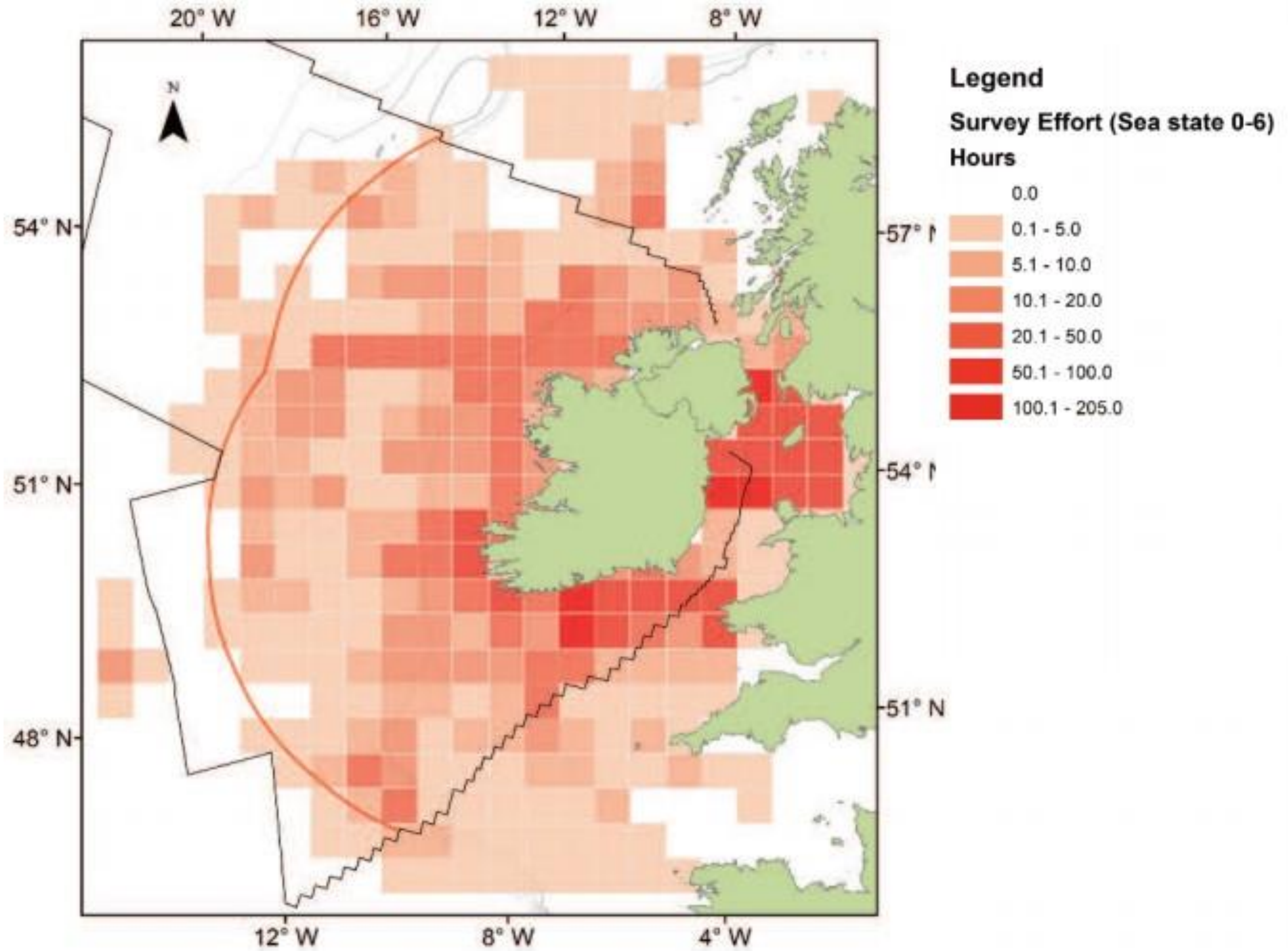


Figure 11 Total survey effort achieved under the IWDG and GMIT monitoring programmes from 2005-2011 (Wall *et al*. 2013).

Other Irish Offshore Wind Farms (OWFs)

Codling Wind Park (CWP)

2.3.44 The ‘Codling Wind Park is located a minimum of 3 km to the south of the Dublin Array Project, and therefore the site-specific surveys conducted for Codling Wind Park (CWP) are of relevance to the marine mammal baseline characterisation for Dublin Array.

2.3.45 For CWP, monthly site-specific visual vessel (Figure 12 & Figure 13) and Digital Aerial Surveys (DAS) (Figure 14) were conducted and density estimations were derived for multiple marine mammal species (Natural Power 2023). The species which were sighted during the survey campaigns for CWP and for which site-specific density estimations to be used in the quantitative impact assessment could be derived, were as follows (Codling Wind Park Limited 2024):

- Harbour porpoise;
- Common dolphin;
- Minke whale; and
- Risso’s dolphin.

2.3.46 Bottlenose dolphin, grey seal and harbour seal were also included in the quantitative impact assessment, although site-specific density estimations could not be derived for these species (Codling Wind Park Limited 2024) and thus, density estimates from alternative data sources were used.

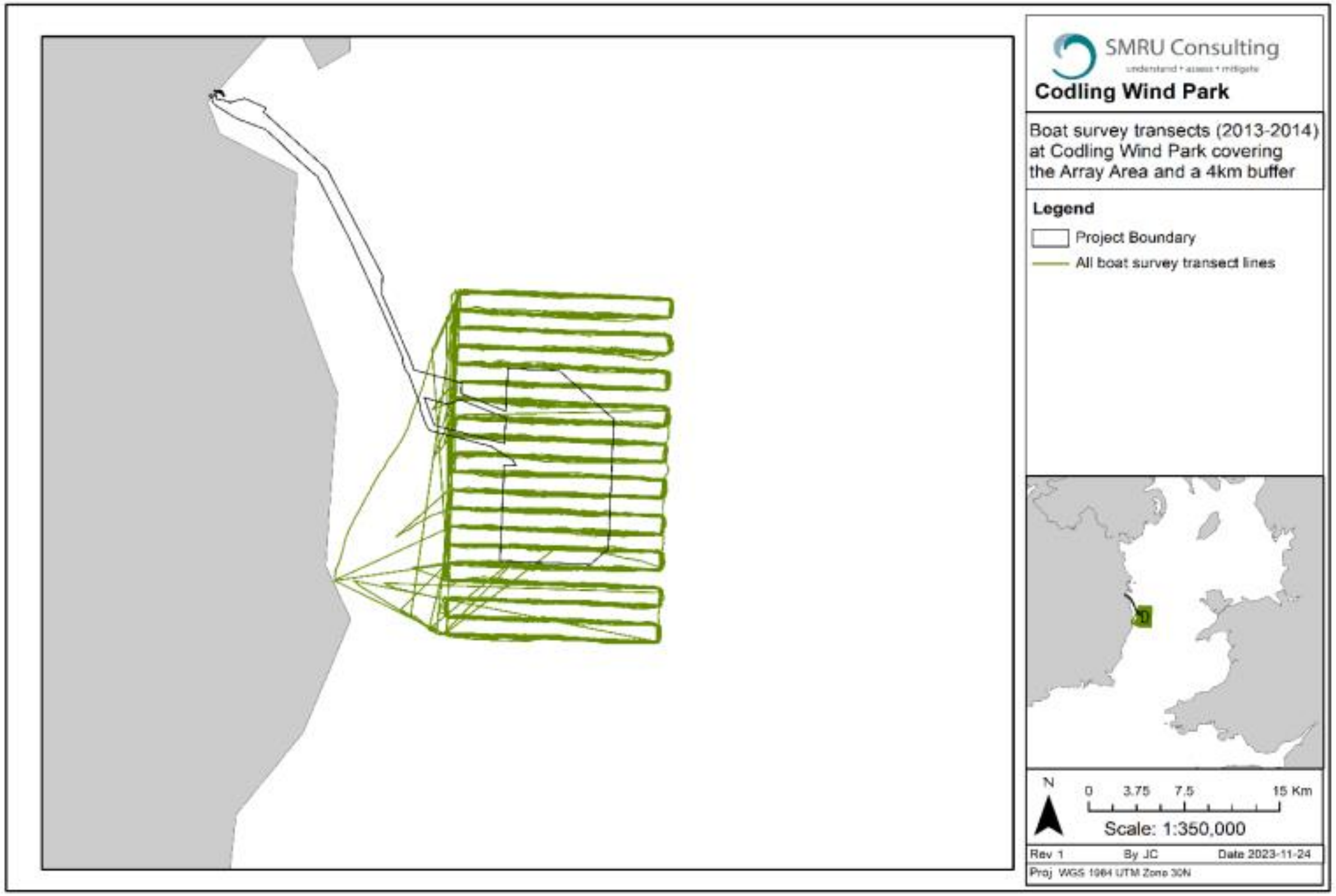


Figure 12 Codling Wind Park boat survey transects (20) followed during each boat survey between April 2013 and April 2014 (Clarkson and Sinclair 2024).

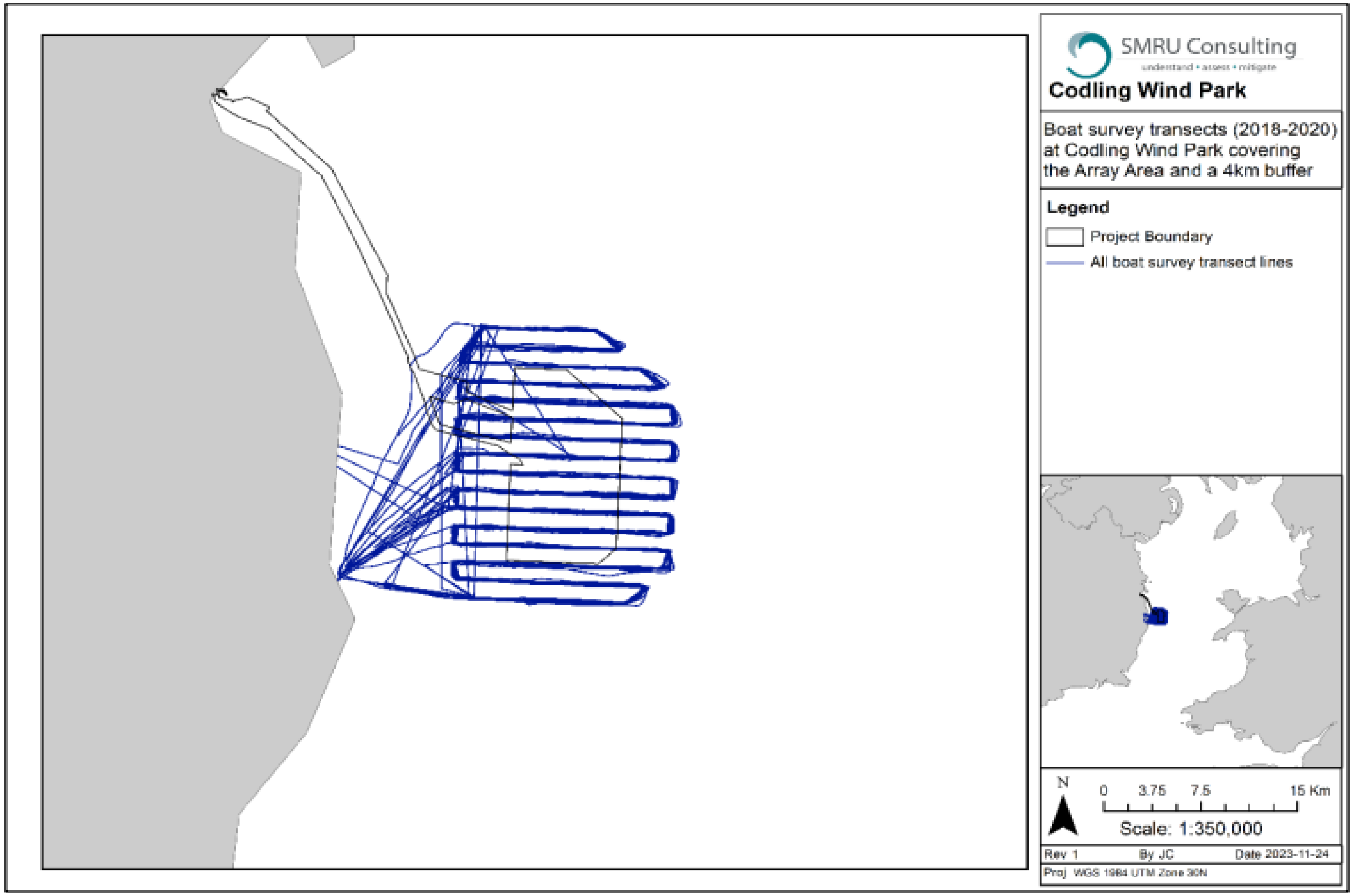


Figure 13 Codling Wind Park boat survey transects (6) followed during each boat survey between October 2018 and January 2020 (Clarkson and Sinclair 2024).

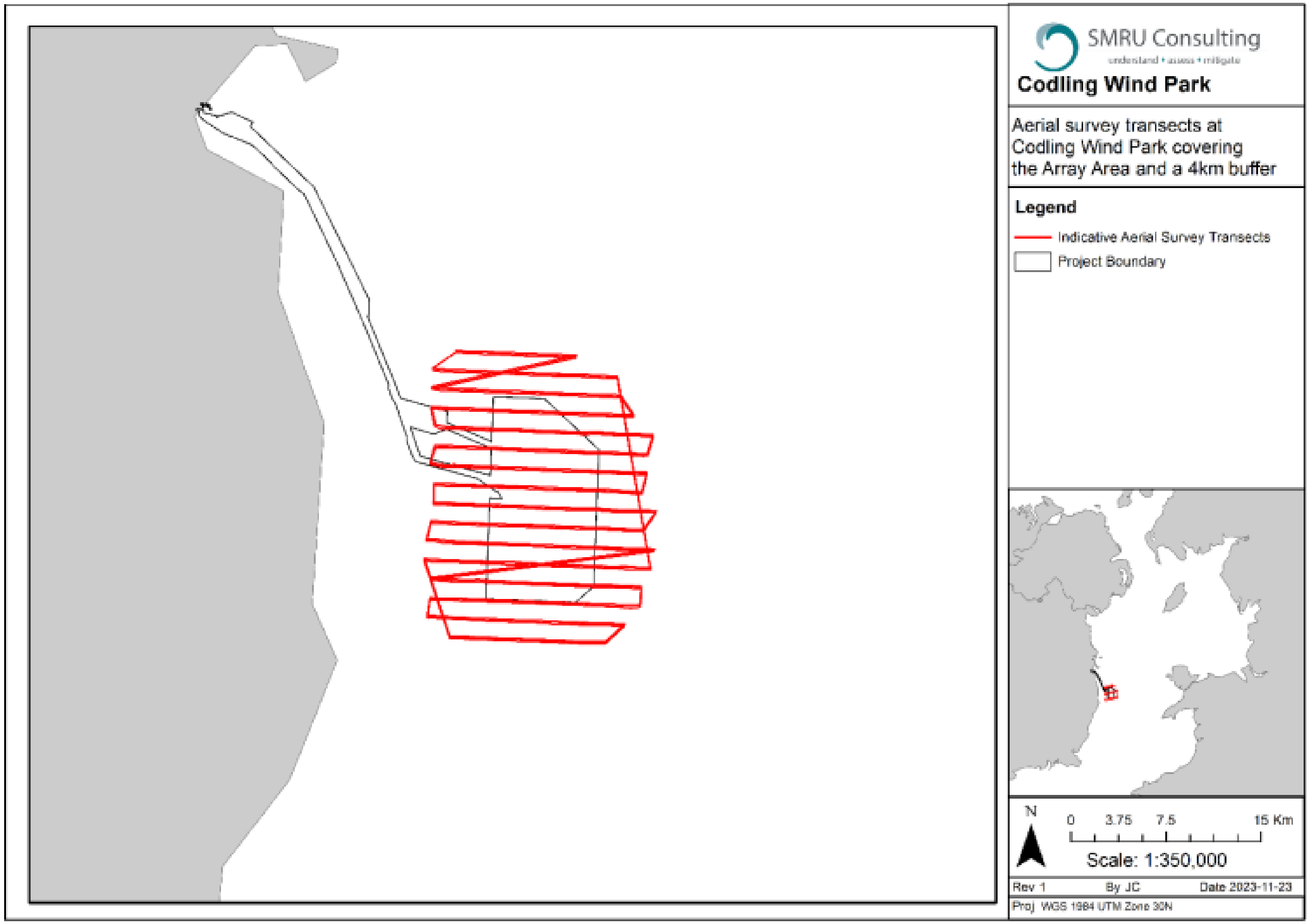


Figure 14 Indicative aerial survey transects lines from a DAS undertaken at CWP Project on 29/05/2023. The same transect lines were followed for all 24 DAS at Codling Wind Park (Clarkson and Sinclair 2024).

Arklow Bank Wind Park[7]

Arklow Bank Wind Park 2

2.3.47 The Arklow Bank Wind Park 2 is located ~26 km south of the Dublin Array Project, and therefore the site-specific surveys conducted for Arklow Bank Wind Park 2 are of relevance to the marine mammal baseline characterisation for Dublin Array. Monthly site-specific digital aerial surveys were conducted between March 2018 and February 2020 (with an additional survey in April 2020). The survey area consisted of the Lease Area plus a 4 km buffer and also extended to the north of the Array Area to include Wicklow Head and to the west to cover the area inshore of Arklow Bank up to and including the coastline (Figure 15).

2.3.48 A review of the site-specific surveys and other data sources concluded the presence of the following marine mammals within the Arklow Bank Wind Park 2 development area, each of which were included in the quantitative impact assessment (SSE Renewables 2024):

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

2.3.49 Only harbour porpoise had site-specific density estimates taken forward for the quantitative impact assessment (SSE Renewables 2024). For all other species, density estimates from alternative data sources were used.

Arklow Bank Wind Park 1

2.3.50 Data were also collated for the Arklow Bay Wind Park 1 between July 1996 and March 1997, and June 2000 and June 2009. These vessel based transect surveys were conducted within the Arklow Bank Wind Park 1 array area plus a 5 km buffer (called "The Box study area" in Figure 16). Marine mammals were recorded as part of the seabird surveys following standard European Seabirds at Sea (ESAS) methodology.

2.3.51 The Arklow Bank Wind Park 1 recorded the following species: harbour porpoise, Risso's dolphin and seals (likely grey seals) (RPS 2020).

[7] Arklow Bank projects are referred to as Phase 1 and Phase 2, this is not to be confused with Phase 1 and Phase 2 Projects under the Irish Offshore Wind planning system

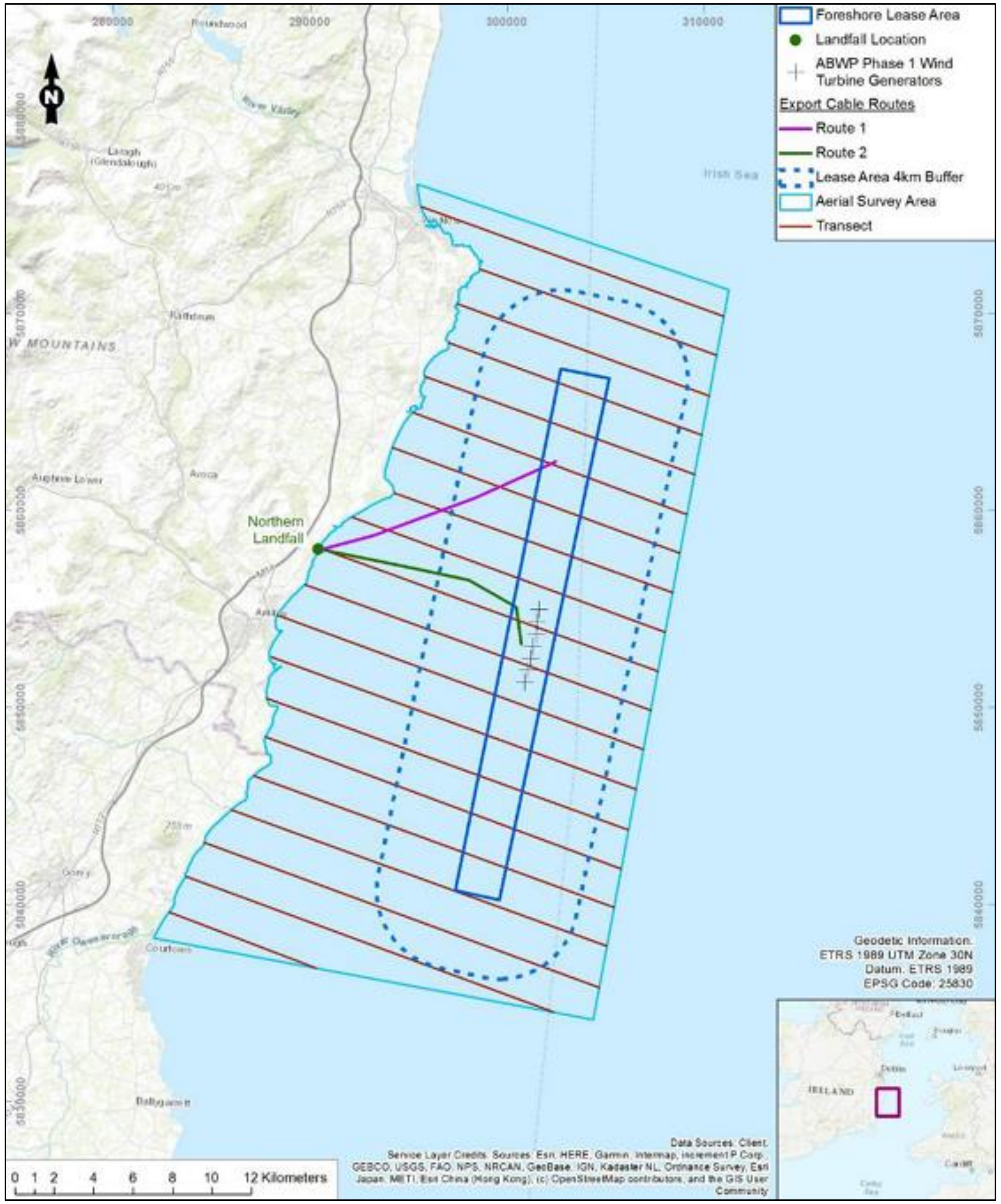


Figure 15 Study area for Arklow Bank Wind Park 2 marine mammal aerial surveys 2018-2020 (RPS 2020)

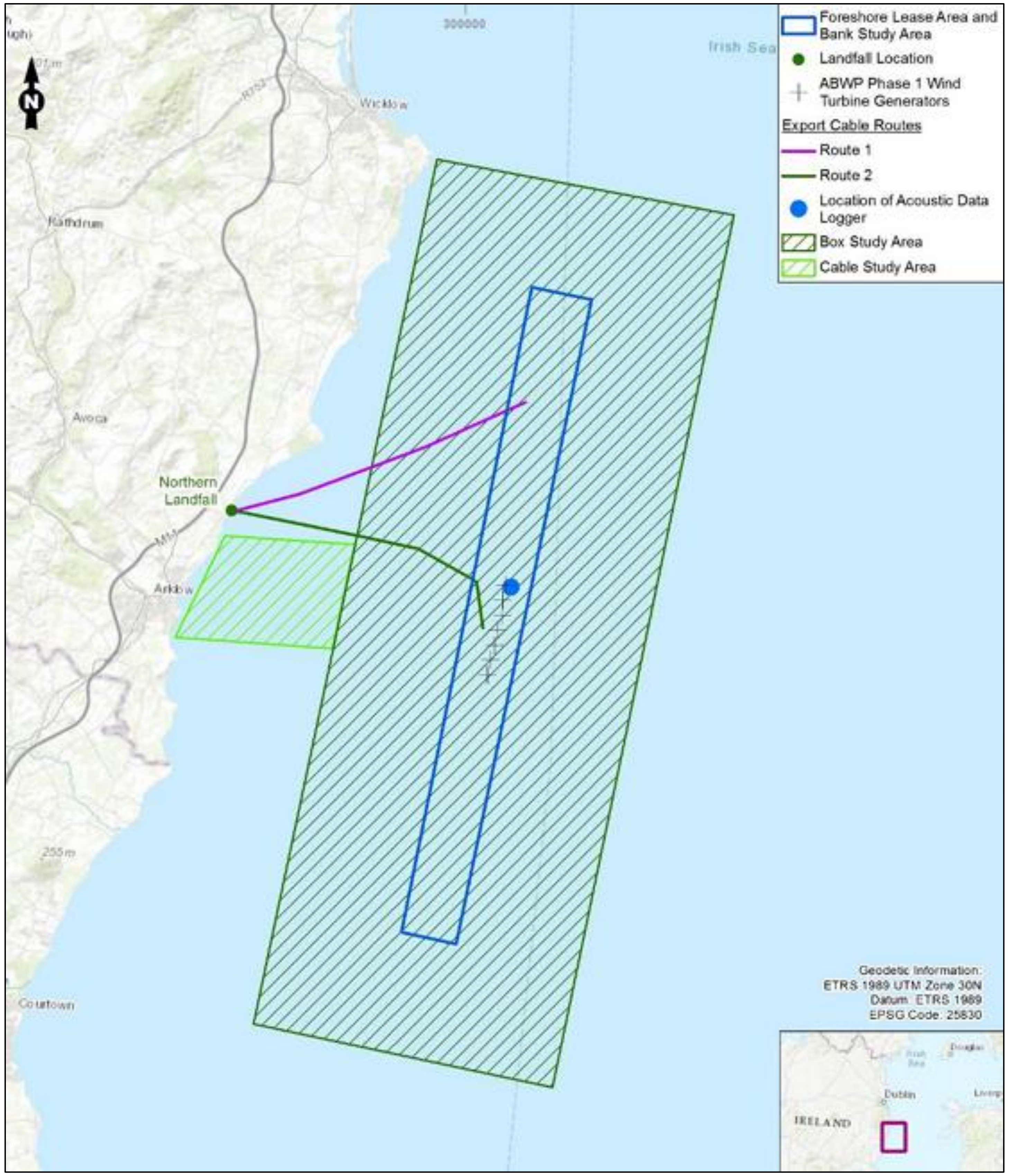


Figure 16 Study area for Arklow Bank Wind Park 1 marine mammal boat-based surveys 2000-2009 (RPS 2020)

North Irish Sea Array (NISA)

2.3.52 The North Irish Sea array (NISA) is located ~22 km north of the Dublin Array Project. The NISA marine mammals EIAR chapter published in 2024 identified 6 main marine mammal species of interest within the development area, each of which were quantitatively assessed (ARUP 2024). These were:

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

2.3.53 Each of the species identified as present within the NISA development area are part of the same management units (MUs) as those likely present within the Dublin Array development area. Both boat (Figure 17) and aerial marine mammal (Figure 18) surveys were undertaken as part of NISA (ARUP 2021) and density estimates were derived for each species where possible.

2.3.54 Harbour porpoise, bottlenose dolphin and common dolphin only were site-specific density estimates taken forward for the quantitative impact assessment (ARUP 2024). For all other species, density estimates from alternative data sources were used.

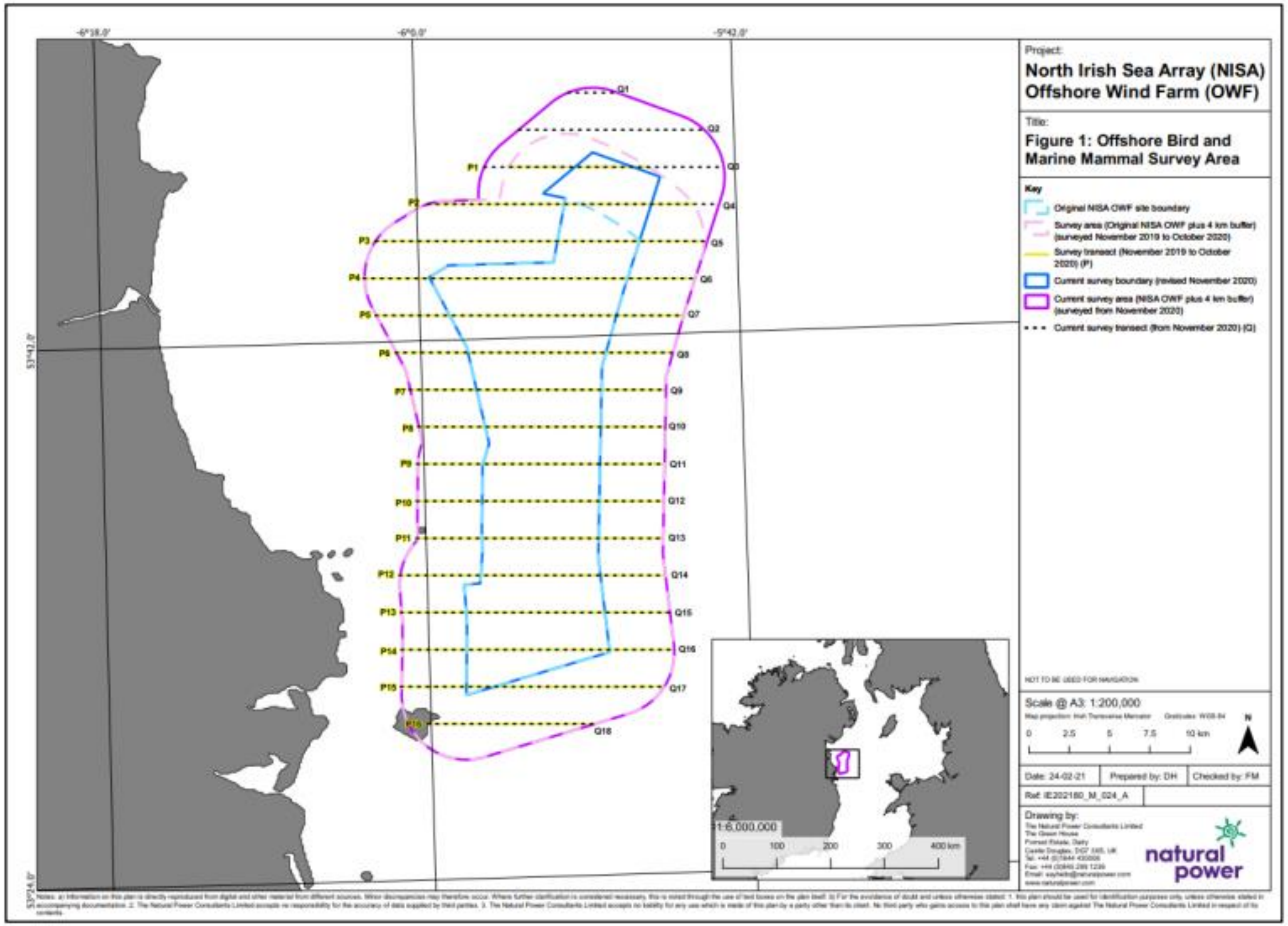


Figure 17 NISA site-specific marine mammal study area – vessel survey transects (Sinclair and Clarkson 2024).

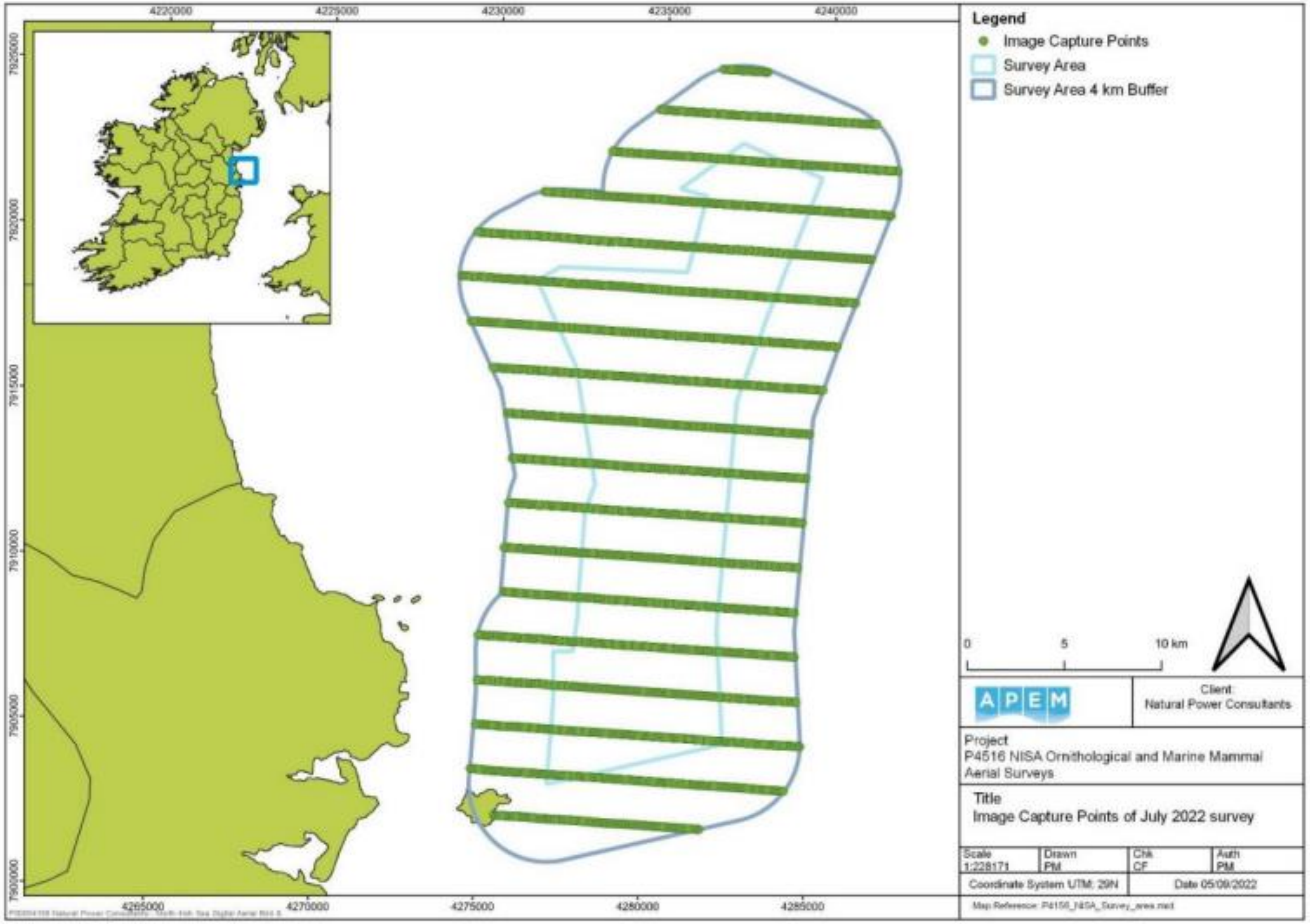


Figure 18 NISA site-specific marine mammal study area – digital aerial survey transects (Sinclair and Clarkson 2024).

Oriel Windfarm

2.3.55 The Oriel Windfarm is located ~65 km north of the Dublin Array Project. The Oriel Windfarm marine mammals EIAR chapter published in 2024 identified 6 main marine mammal species of interest within the development area, each of which were quantitatively assessed (RPS 2024a). These were:

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

2.3.56 As part of the site-specific survey campaign for Oriel, both boat-based and aerial visual surveys were undertaken (Figure 19). Each of the species identified as present within the Oriel development area are part of the same management units (MUs) as those likely present within the Dublin Array development area. Harbour porpoise and minke whale only were site-specific density estimates taken forward for the quantitative impact assessment (RPS 2024a). For all other species, density estimates from alternative data sources were used.

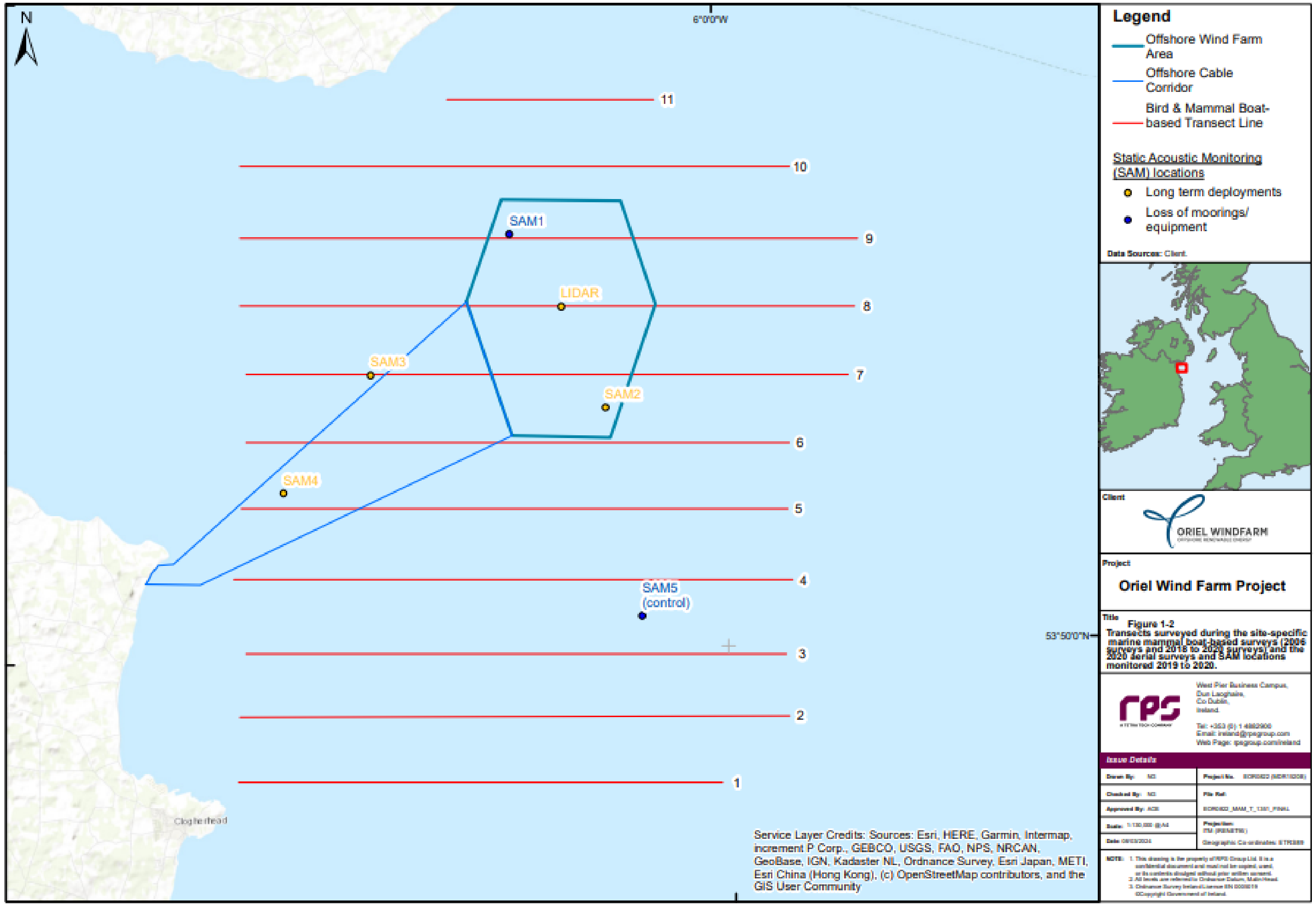


Figure 19 Oriel Offshore Windfarm: transects surveyed during the site-specific marine mammal boat-based surveys (2006 surveys and 2018 to 2020 surveys) and the 2020 aerial surveys and SAM locations monitored 2019 to 2020 (RPS 2024b).

Marine Ecosystems Research Programme

2.3.57 The aim of the MERP project (Marine Ecosystems Research Programme)[8] was to produce species distribution maps of cetaceans and seabirds over specific marine basins, for each month of the year 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 the MERP report (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.

2.3.58 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.

[8] https://www.pml.ac.uk/Research/Projects/Marine_Ecosystems_Research_Programme_(MERP)

Distribution and abundance of cetaceans in Wales and its adjacent waters

2.3.59 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*".

2.3.60 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 2). 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.

2.3.61 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 20). 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 notes that the primary survey methods changed over time from vessel to aerial surveys which can lead to potential biases in the results.

2.3.62 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. Generalised Linear Models (GLMs) and Generalised Estimating Equations (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 2 List of data providers and kilometres of effort surveyed for cetaceans in the study area of Wales and surrounding areas (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
European Seabirds at Sea (ESAS)	Aerial visual and Vessel	76,837
Horizon	Vessel	1,716
Irish Whale and Dolphin Group	Vessel	65,582
Joint Nature Conservation Committee	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**

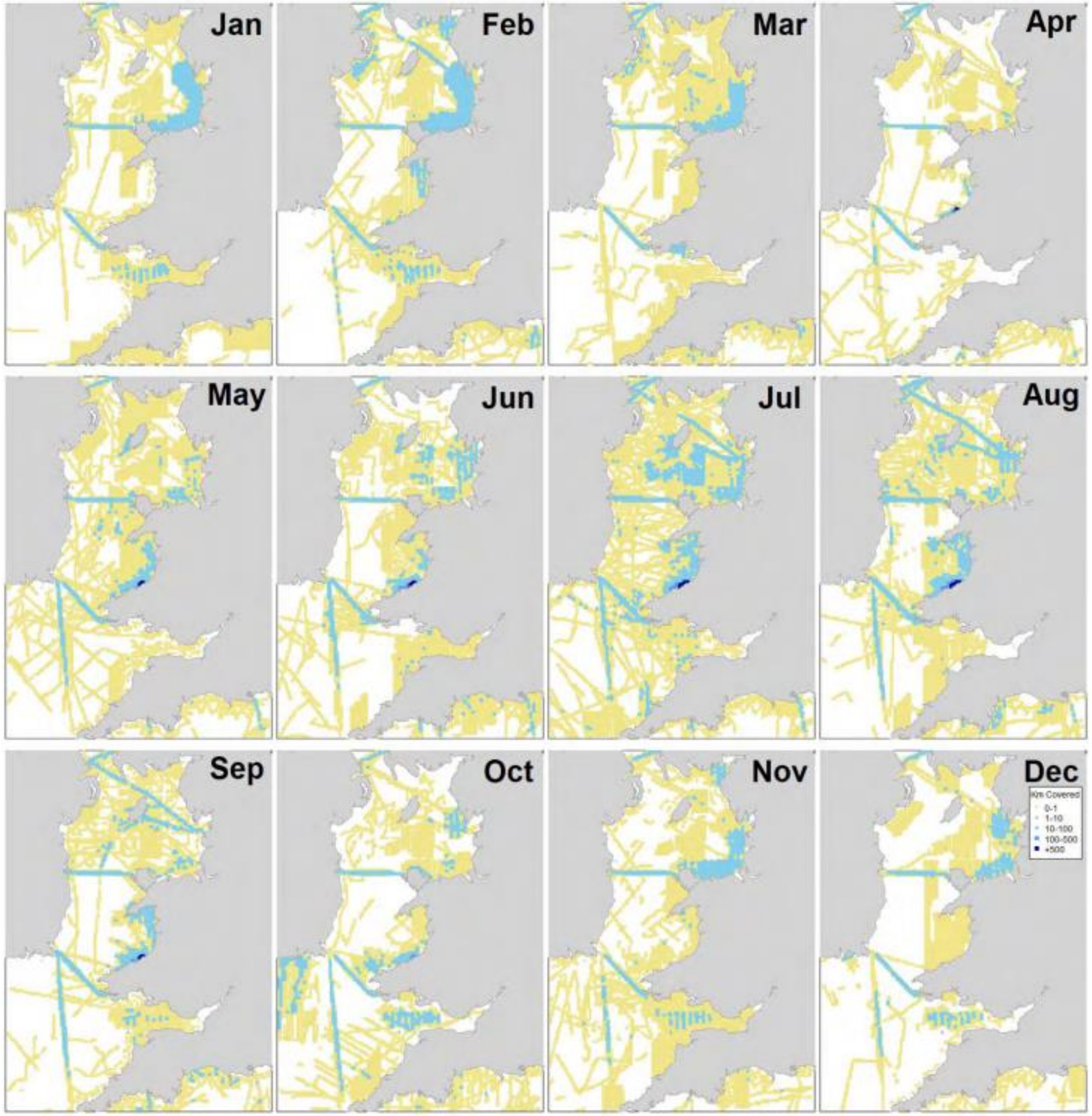


Figure 20 Cetacean survey effort (all providers) by month (Evans and Waggitt 2023)

Seal haul-out counts

2.3.63 Both harbour and grey seals have been surveyed in Irish coastlines using haul-out counts, a popular scientific method for estimating the abundances and distributions of pinniped species across the globe. Harbour and grey seals are known to be distributed all around the Irish coast (Cronin et al. 2004, Ó Cadhla et al. 2005, Cronin et al. 2007, Ó Cadhla 2007, Ó Cadhla et al. 2007), with grey seals in higher abundances on the west and southwest coastlines and scarce on the eastern coastlines, with only 22 individuals reported in 2007 by Ó Cadhla and Strong (2007).

Cronin *et al* (2004, 2007)

2.3.64 Cronin *et al*. (2004) and Cronin *et al*. (2007) examined harbour seal populations in 2003 using aerial survey methods, specifically, through the use of a thermal imager and a camcorder, allowing for a non-thermal image of the coast to be displayed on a second monitor alongside its corresponding thermal image. Harbour and grey seals were identified at species level through examining the thermal profile of each individual seal, using the spatial structure of the haul-out group being surveyed or using binoculars.

2.3.65 Aerial surveys began at Lough Foyle, Co. Donegal as a starting point, with the flight path of the surveys covering the entire coastline of the Republic of Ireland in an anti-clockwise direction, finishing at Carlingford Lough, Co. Louth (Figure 21). Surveys took place approx. 500 m from the coastline at an altitude of 215 m. During these surveys, seal counts were recorded in real time alongside the locations of each recording. In addition to aerial survey methods, ground survey methods were implemented using 'ground-truthing' sites which were defined as pre-selected, known and accessible sites (Figure 21). At these sites, observers recorded ground counts of harbour seal haul-outs across periods of minimum four hours. In most cases, these counts were carried out in hourly intervals, usually two hours prior to low tide and two hours after low tide while a simultaneous count was carried out during aerial surveys.

2.3.66 Data collected from both aerial surveys and ground-truthing sites were compared to assess the accuracy of the aerial survey methods in terms of determining both group size and species composition of seal haul-out groups. From this, a corrected total number of grey and harbour seal counts from the haul-out sites was used which yielded minimum counts for both species in the Republic of Ireland in 2003. This harbour seal data was further combined with harbour seal counts from 2002 in a survey of Northern Ireland, allowing for an overall minimum population estimate to be calculated for the whole island. The haul-out distribution and counts were conveyed graphically using the ARCVIEW GIS software, enabling the creation of maps demonstrating both the locations and subsequent estimated group sizes of harbour seals during all haul-outs in 2003. Grey seal distributions were also overlapped on a separate map to allow for visualisation of interspecific patterns in both the distribution and habitat use of seal species in the Republic of Ireland.

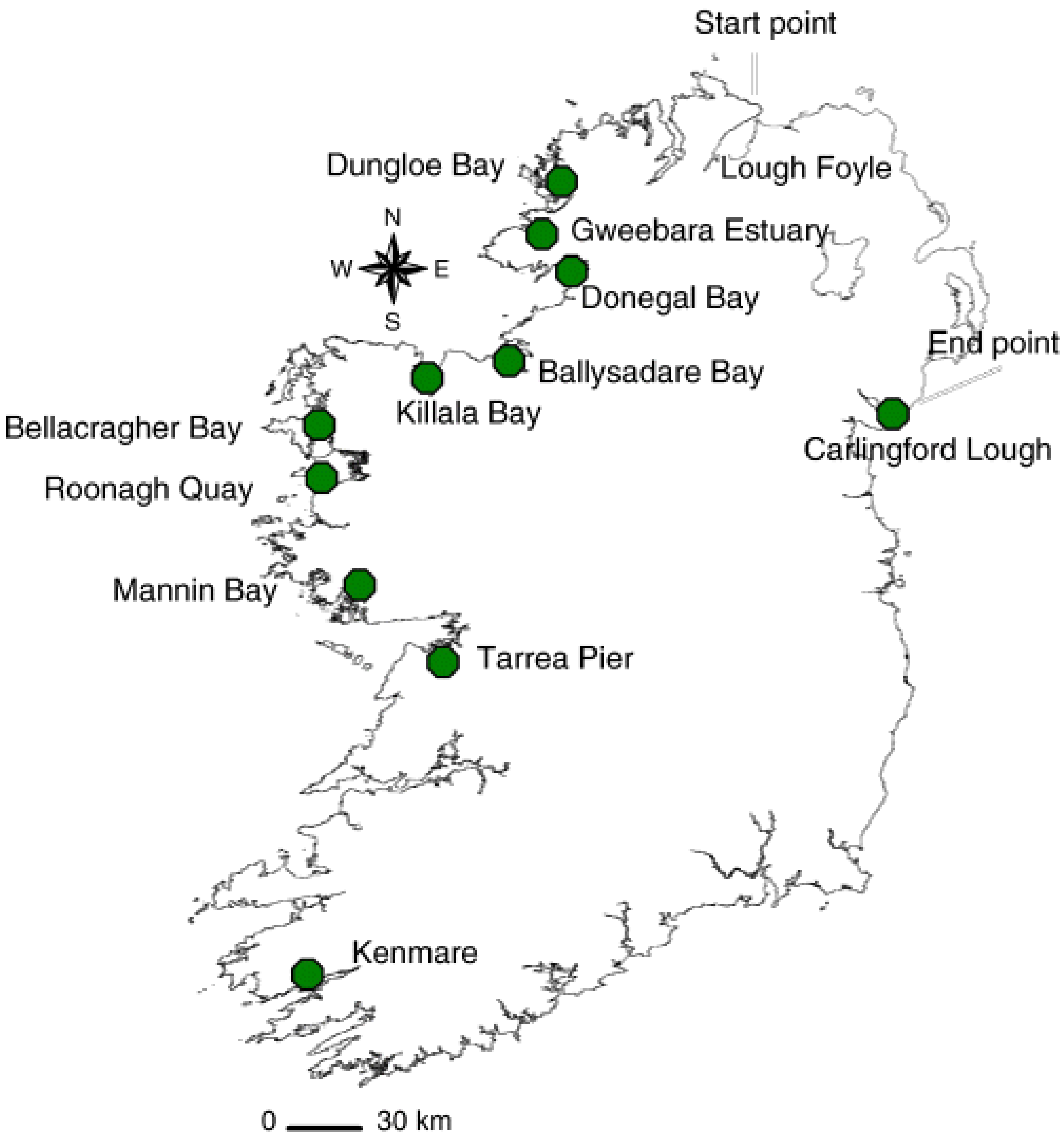


Figure 21 Ground-truthing sites and start and end points of the combined aerial/ground survey of the Republic of Ireland and Carlingford Lough, Co. Down, August 2003 (Cronin *et al*. 2007)

Ó Cadhla *et al*. (2007) and Ó Cadhla et al. (2013)

2.3.67 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 which encompassed the coastlines of the following counties: Louth, Meath, Dublin, Wicklow and Wexford (Figure 22). 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 using 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 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).

2.3.68 All information on pup production in the East coast region was collected in the form of ground counts of living and dead pups. To make it comparable, the statistical analysis used to estimate total pup production was the same as that which has been used in other regions across the Republic of Ireland. 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 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).

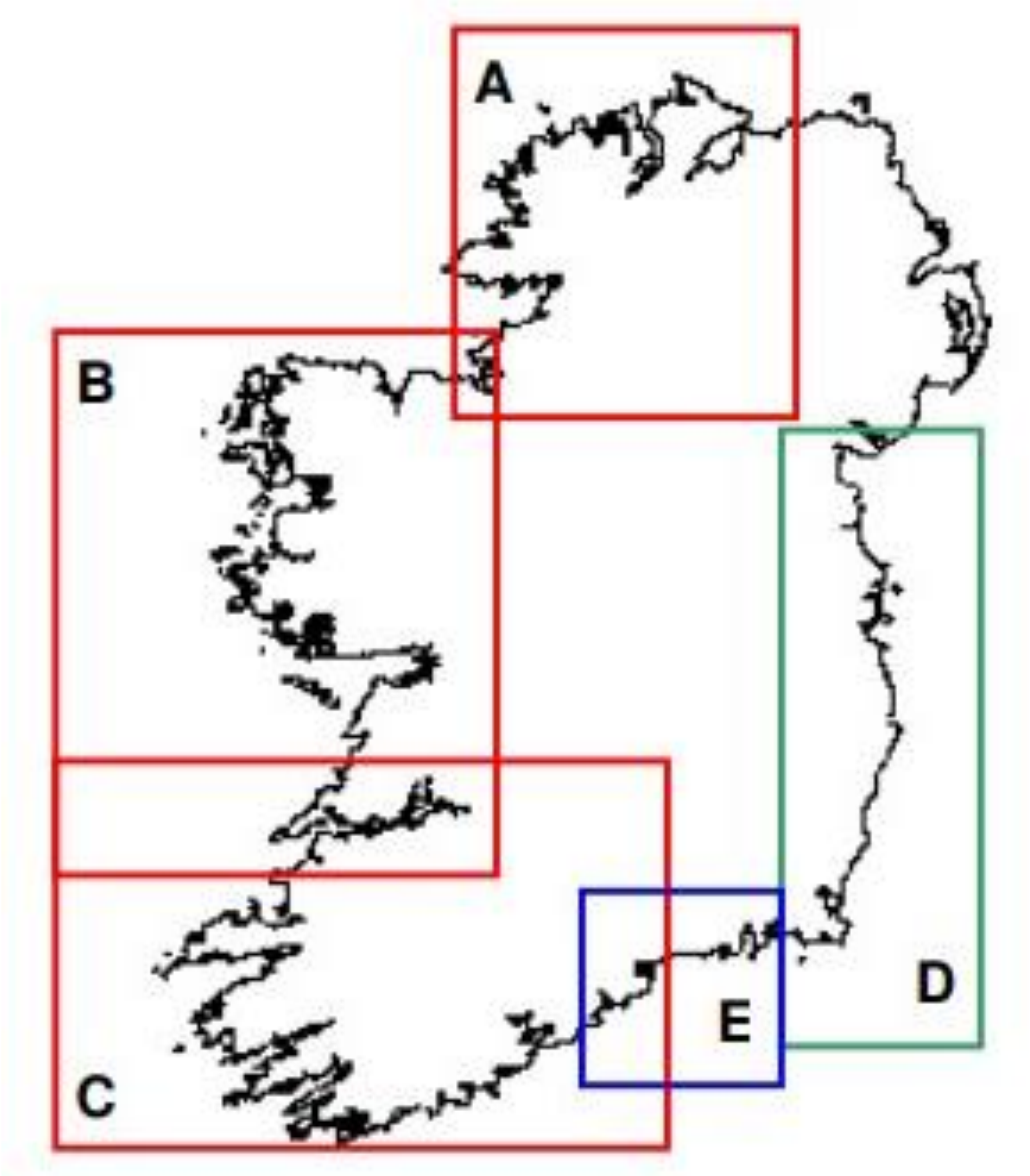


Figure 22 Designated aerial survey sites for grey seal population estimates in the spring and summer of 2005 (O'Cadhla *et al*., 2007)

2.3.69 Following the first assessed comprehensive national survey by Ó Cadhla et al. (2007), the monitoring of all key populations for grey seals in Ireland continued during repeat regional surveys in 2009, 2011 and 2012. The work undertaken was presented in Ó Cadhla et al. (2013). The main findings presented in Ó Cadhla et al. (2013) provides an update to the results reported in Ó Cadhla et al. (2007) for seven main breeding sites:

- Sturrall (near Glen Head) to Maghera in south-west Co. Donegal;
- Inishkea island group (a.k.a. Inishkea Group) off north-west Co. Mayo;
- Inishshark, Inishgort and associated islands off north-west Co. Galway;
- Islands around Slyne Head, Co. Galway;
- Blasket Islands, Co. Kerry;
- Saltee Islands, Co. Wexford; and
- Lambay Island and Ireland’s Eye, Co. Dublin.

Morris & Duck (2019)

2.3.70 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 (see Morris and Duck (2019) Section 2: Methods). 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.

2.3.71 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.

Berrow et al (2024)

2.3.72 Berrow et al (2024) conducted surveys of haul-out sites close to Dublin Port between June 2023 and January 2024 during period with increased construction activity in the area related to Dublin Port's Masterplan 2040. These surveys included sites within Dublin Bay (Bull Island, Sandy Cove and the Dalkey & Maidens Islands) as well as other sites north of the Dublin Bay area (Skerries, Smugglers Cove, Rush Head, Lambay Island and Irelands Eye) (Figure 23).

Figure 23 Sites surveyed between Skerries and Dalkey Island (adapted from Berrow et al. 2024).

2.3.73 Berrow et al (2024) conducted surveys of haul-out sites close to Dublin Port between June 2023 and January 2024 during period with increased construction activity in the area related to Dublin Port's Masterplan 2040. Across the surveyed area, grey seals were more abundant that harbour seals. The maximum number of grey seals counted in a month was 326 grey seals in October 2023 (Figure 24). Of the sites within Dublin Bay, a maximum of 79 grey seals were counted at Dalkey Island in Nov 2023, a maximum of 4 were counted in Sandy Cove and a maximum of 25 were counted at Bull Island. Grey seals were counted in highest numbers on Lambay Island and Ireland's Eye. The number of seals counted in the Dublin Bay and adjacent waters (Skerries to Dalkey Islands) were consistent with those counted in 2017 (Morris and Duck, 2019). Accounting for seals at sea at the time of the survey, the local abundance of grey seals in the survey area (Skerries to Dalkey Islands) was estimated as >1,250. Despite the high levels of vessel activity associated with the major infrastructure redevelopment at Dublin Port, there is no evidence of a change in grey seal haul-out usage in the area. In fact, the haul-out site closest to the construction activity (Bull Island) showed a continued increase in haul-out usage during this period.

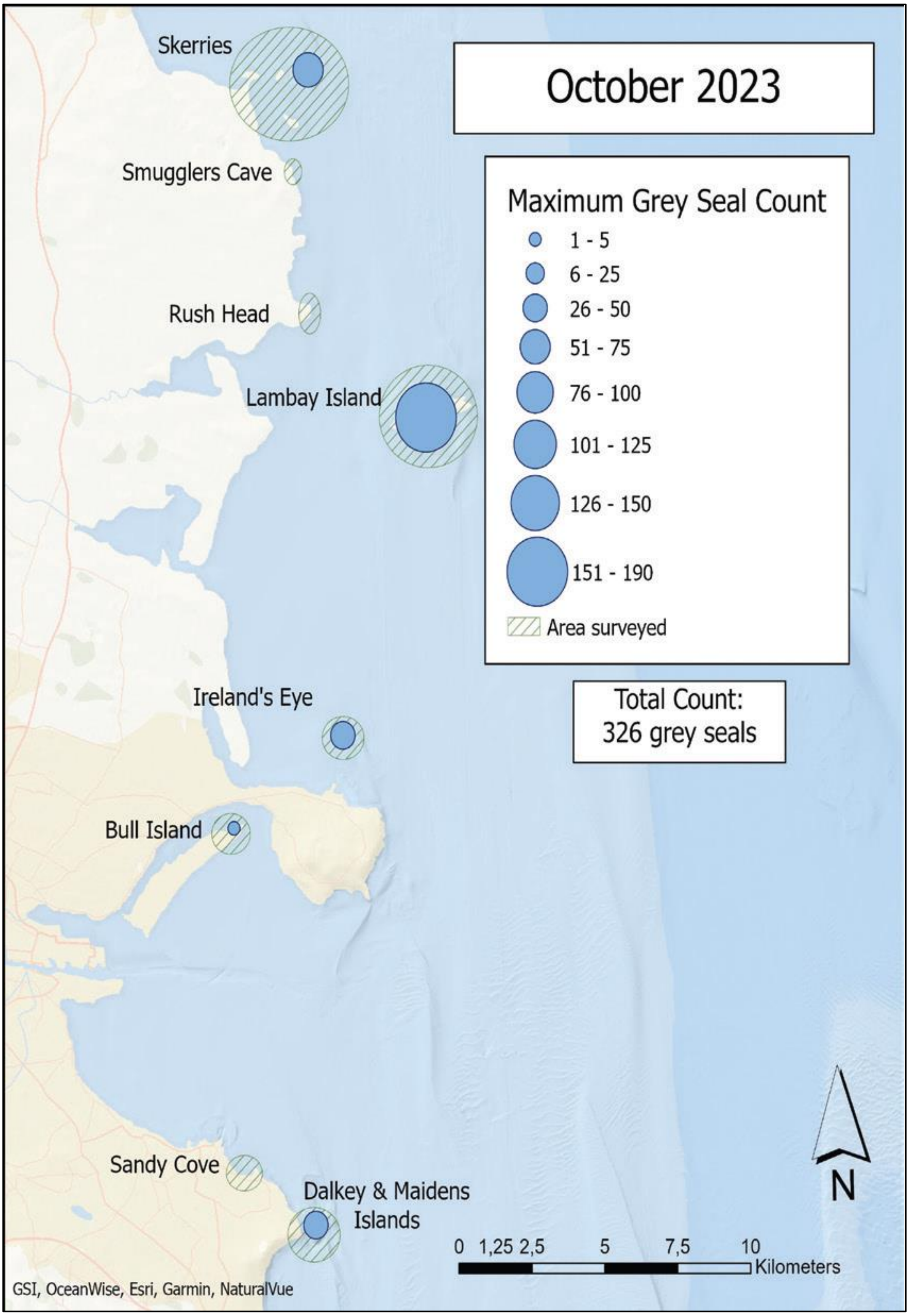


Figure 24 Counts of grey seals at sites surveyed in October 2023 (Berrow et al., 2024).

Special Committee on Seals (SCOS) Northern Ireland MU

2.3.74 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 distributions are likely to differ at other times of the year (such as the breeding period).

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

2.3.76 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.

2.3.77 Numbers of grey seals are also counted during the harbour seal August haul-out count surveys. Counts of grey 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 25.12% (95% CI: 21.45 – 19.07%) 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.

Seal at-sea density

2.3.78 The seal at-sea usage maps were created to predict the at-sea density of seals in order to inform impact assessments and marine spatial planning. The original SMRU seal density maps were produced as a deliverable of Scottish Government Marine Mammal Scientific Support Research Programme (MMSS/001/01) and were published in Jones *et al*. (2015). These maps included data from the Republic of Ireland as well as UK and France. The maps have since been revised to include new seal telemetry and haul-out count data and modifications have been made to the modelling process (Russell *et al*. 2017), however this new analysis only used tag data from seals tagged in UK waters (no data from seals tagged in the Republic of Ireland - although some of the individuals tagged in the UK subsequently hauled out in the Republic of Ireland). The analysis uses telemetry data from 270 grey seals and 330 harbour seals tagged in the UK between 1991 – 2015, and haul-out count data from 1996 - 2015 (in the UK, and the Republic of Ireland) to produce maps of estimated at-sea density with associated uncertainty. The combined at-sea usage and haul-out data were scaled to the population size estimate from 2015.

2.3.79 A key limitation of the at-sea usage maps is that there was a lot of "null usage" in the data, where only a subset of all available haul-out sites were visited by a tagged animal. For haul-out sites where no animal had been tagged, or where no tagged animal had visited, it had to be assumed that usage declined monotonically with distance from the haul-out which meant that potential hotspots around these haul-outs will have been missed.

2.3.80 Given the limitations of the at-sea usage maps, and the fact that the grey seal at-sea usage maps were informed mainly by old, low resolution tracking data, 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, Carter et al. 2022). Telemetry data from 114 grey seals and 239 harbour seals were included in the analysis (Figure 25). 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 26) were then used to generate predictions of seal distribution at sea from all known haul-out sites in the UK and the Republic of Ireland. 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 current 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 current 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).

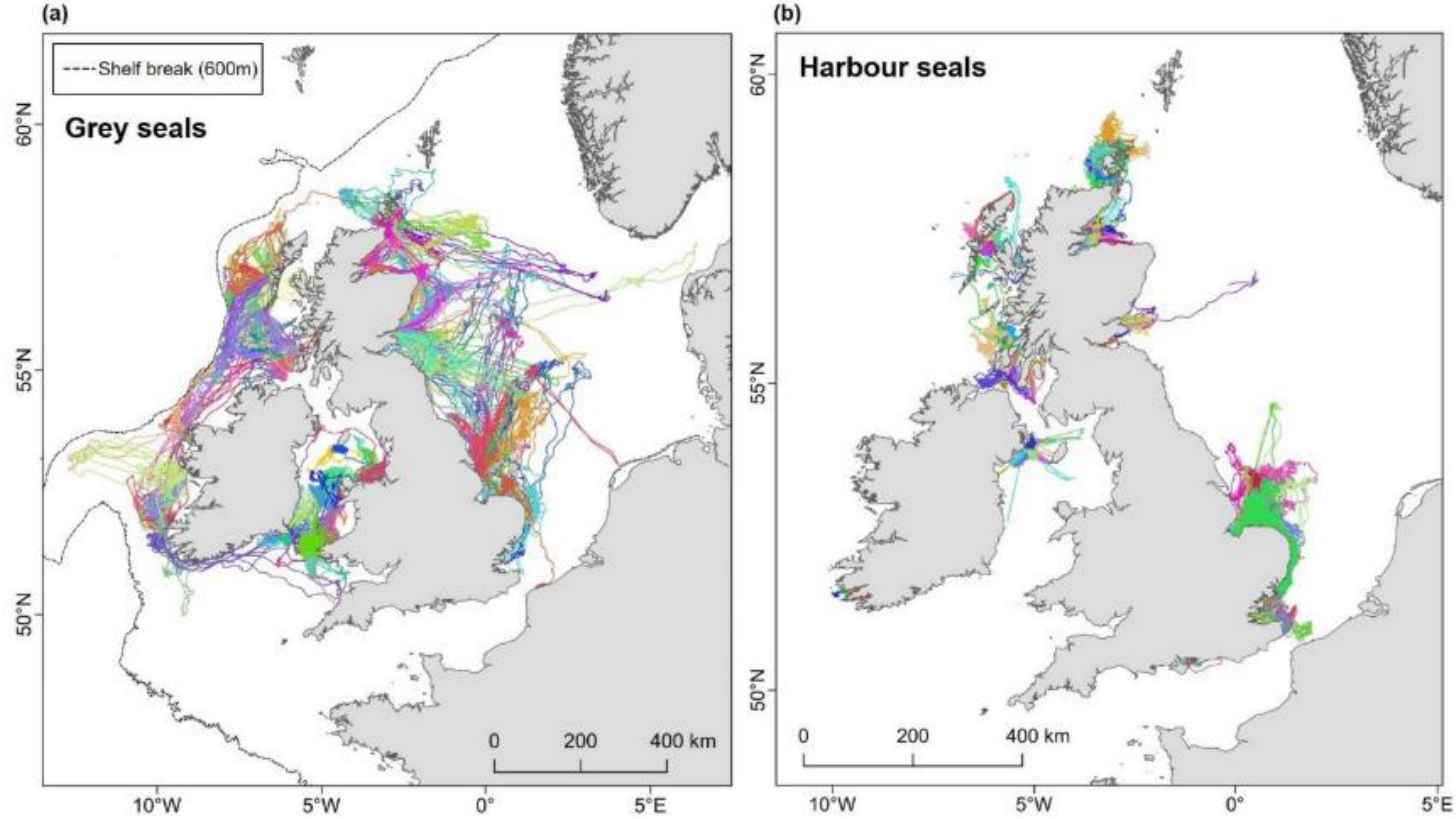


Figure 25 GPS tracking data for (a) grey and (b) harbour seals available for habitat preference models (Carter *et al*. 2020). Each colour represents the movements of each individually tracked seal.

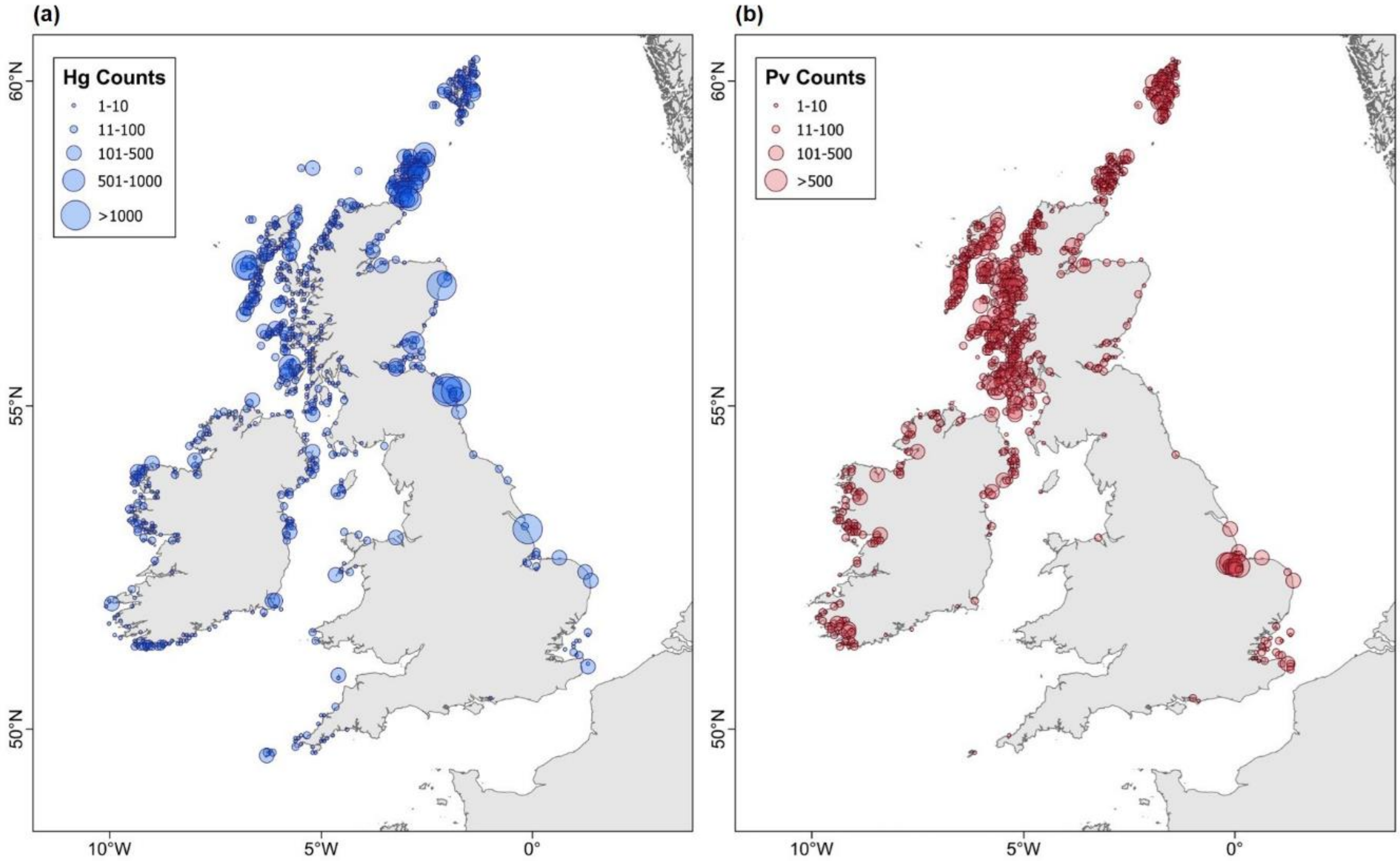


Figure 26 Most recent available August count data for (a) grey and (b) harbour seals per 5 km x 5 km haul-out cell used in the distribution analysis (Carter *et al*. 2020)

Seal telemetry

2.3.81 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.

2.3.82 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). An additional 13 juvenile harbour seals were tagged in 2019-20 at the same location, 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, though they have been tagged in the W England and Wales MU.

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

- 19 grey seals tagged with Fastloc/Global System for Mobile Communications (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 three to four 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; and
- Additionally, 10 male grey seals were tagged on the Blaskets in March 2011 and 2012, and 10 on the 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 Receiving Environment

3.1.1 This section of the baseline characterisation provides detail on the results of the abundance and density estimates obtained for each marine mammal species from the data sources outlined above.

3.1.2 Each of the surveys considered in the data sources have been conducted and analysed using different methods. Given the variability in marine mammal presence on a day-to-day scale, none of the density estimates can be considered to accurately reflect “true density” and the assumptions behind the density estimates and the level of confidence in those estimates should be considered when proposing density estimates to be used within an impact assessment.

3.1.3 The range of density estimates, and the degree of seasonal and spatial variation observed do provide an indication of the range of potential density across the site and impact footprint however. Therefore, where a range of density estimates are provided, a precautionary method has been adopted and the most recent and the most robust and reliable density estimates have been taken forward for use in the quantitative impact assessment.

3.2 Harbour porpoise

3.2.1 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 27). The conservation status of harbour porpoise in Irish waters has been categorised as Favourable (NPWS 2019).

3.2.2 The IAMMWG identified MUs for harbour porpoise and provided recommended abundance estimates for each MU (IAMMWG 2022, 2023). Dublin Array is located within the Celtic and Irish Seas MU, where the estimate of abundance for harbour porpoises is 62,517 (CV: 0.13, 95% CI: 48,324 – 80,877) based on data collected during SCANS III and the ObSERVE surveys (Hammond *et al*. 2017, Rogan *et al*. 2018, Hammond *et al*. 2021).

3.2.3 Within the Celtic and Irish Seas MU there are several SACs for harbour porpoise (Table 3 and Figure 2), including the Rockabill to Dalkey Island SAC which is in close proximity to the Dublin array area (~1.7 km) and has slight overlap with the ECC at its southern boundary.

Table 3 Harbour porpoise SACs located within the Celtic and Irish Seas MU

SAC name	Approx. minimum swimming distance to Dublin array area
Rockabill to Dalkey Island SAC	1.7 km
North Anglesey Marine SAC	38 km
West Wales Marine SAC	76 km
North Channel SAC	100 km
Bristol Channel Approaches SAC	~215 km
Roaringwater Bay and Islands SAC	~345 km
Blasket Islands SAC	~465 km

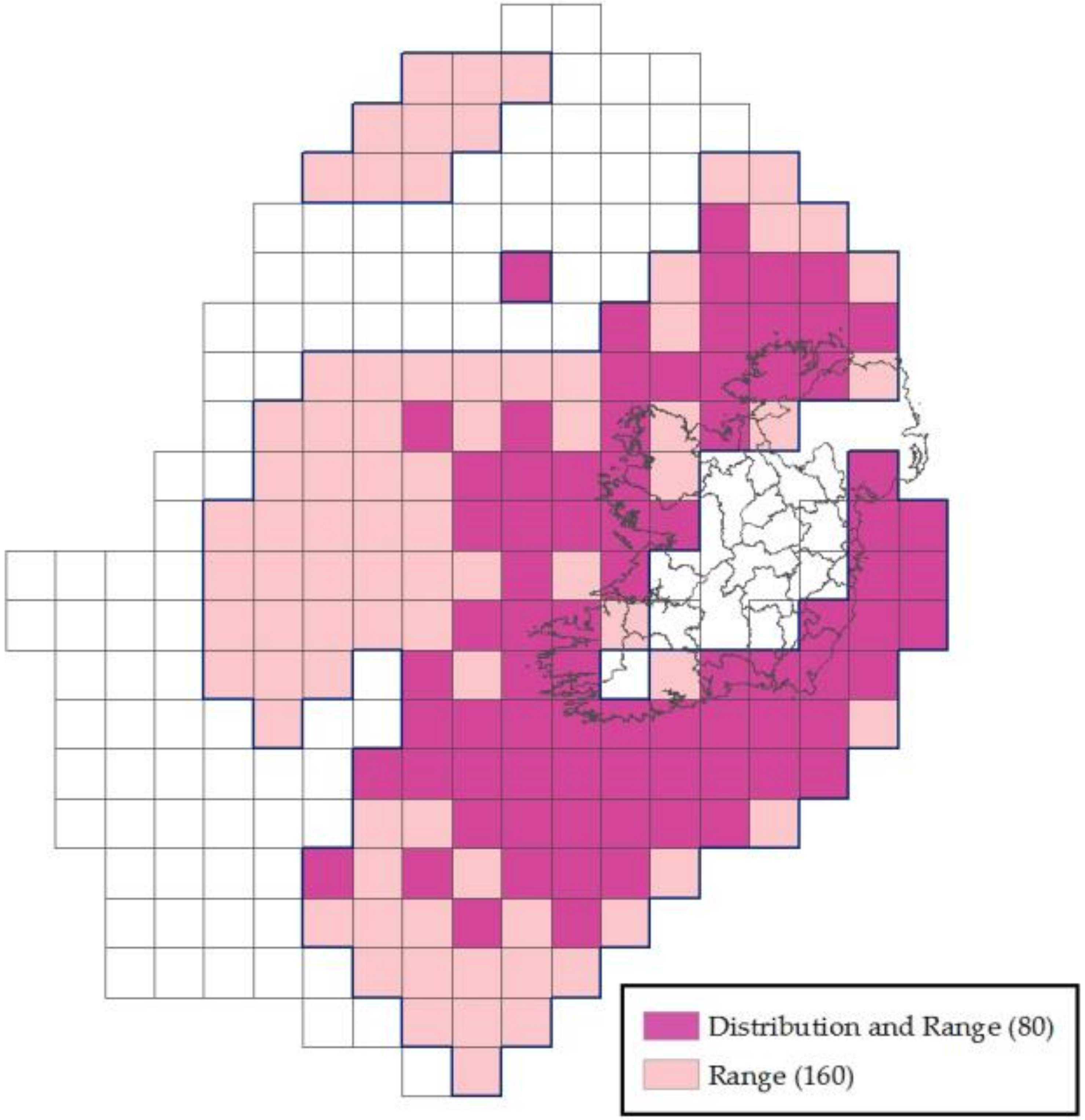


Figure 27 The range and distribution of harbour porpoise in Irish waters (NPWS 2019)

Site-specific surveys (2019-2021)

3.2.4 Harbour porpoise was the most sighted marine mammal during the 19 site-specific surveys, with 135 groups (213 individuals) being recorded. The average abundance was 55 porpoise within the Survey Area throughout the 19 surveys. Porpoise were sighted throughout the survey area, and spatial modelling showed that density estimates were generally higher on the south-eastern side of the Survey Area (Figure 28 and Figure 29). While sightings rates and resulting density estimates were high in November 2019 and September 2020, overall, there was no evidence of a seasonal pattern in the sightings (Figure 30).

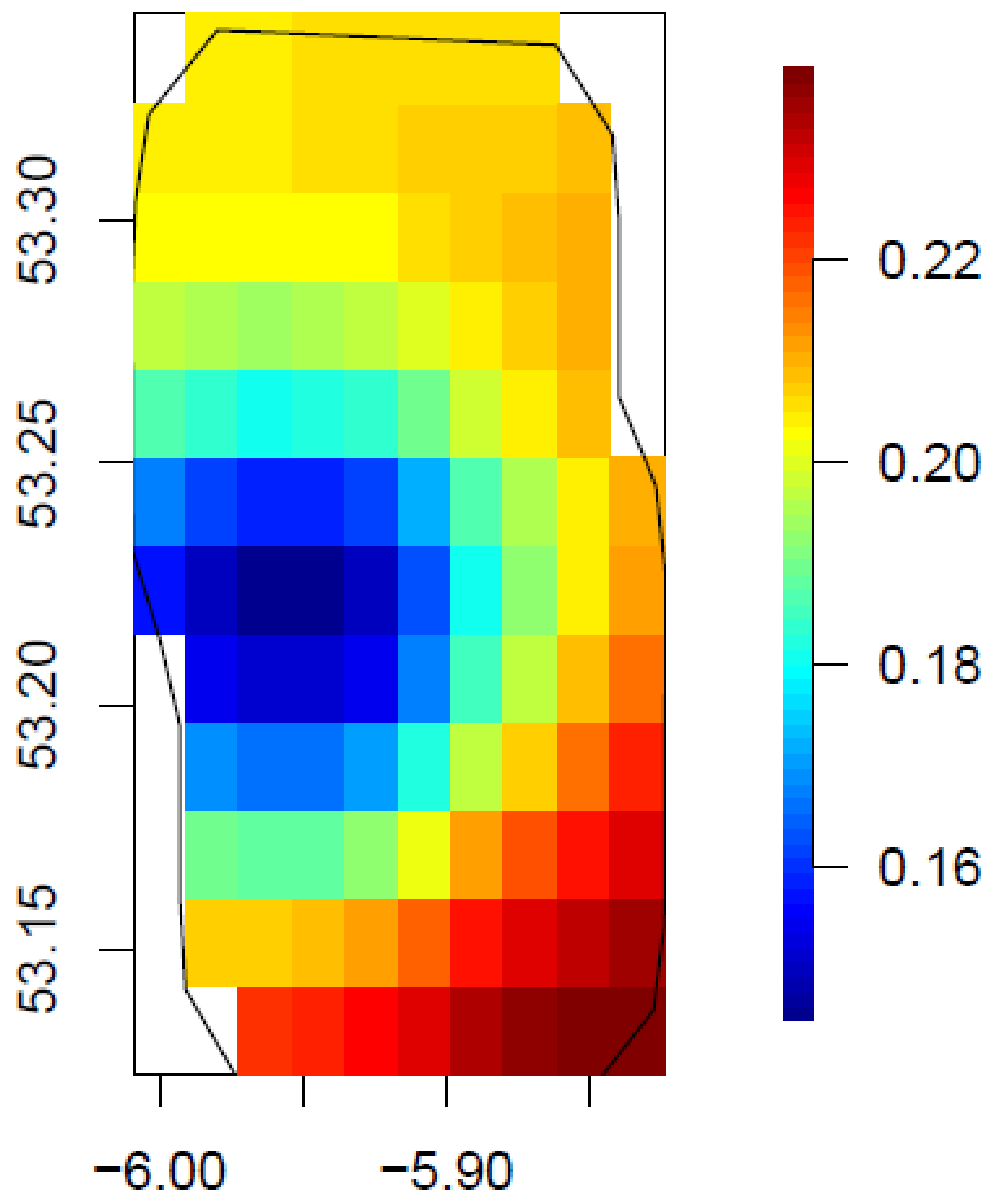


Figure 28 Average harbour porpoise density (#/km^2) across the Dublin Array survey area using sightings obtained in Beaufort sea state ≤3 (Burt and Chudzinska 2021).

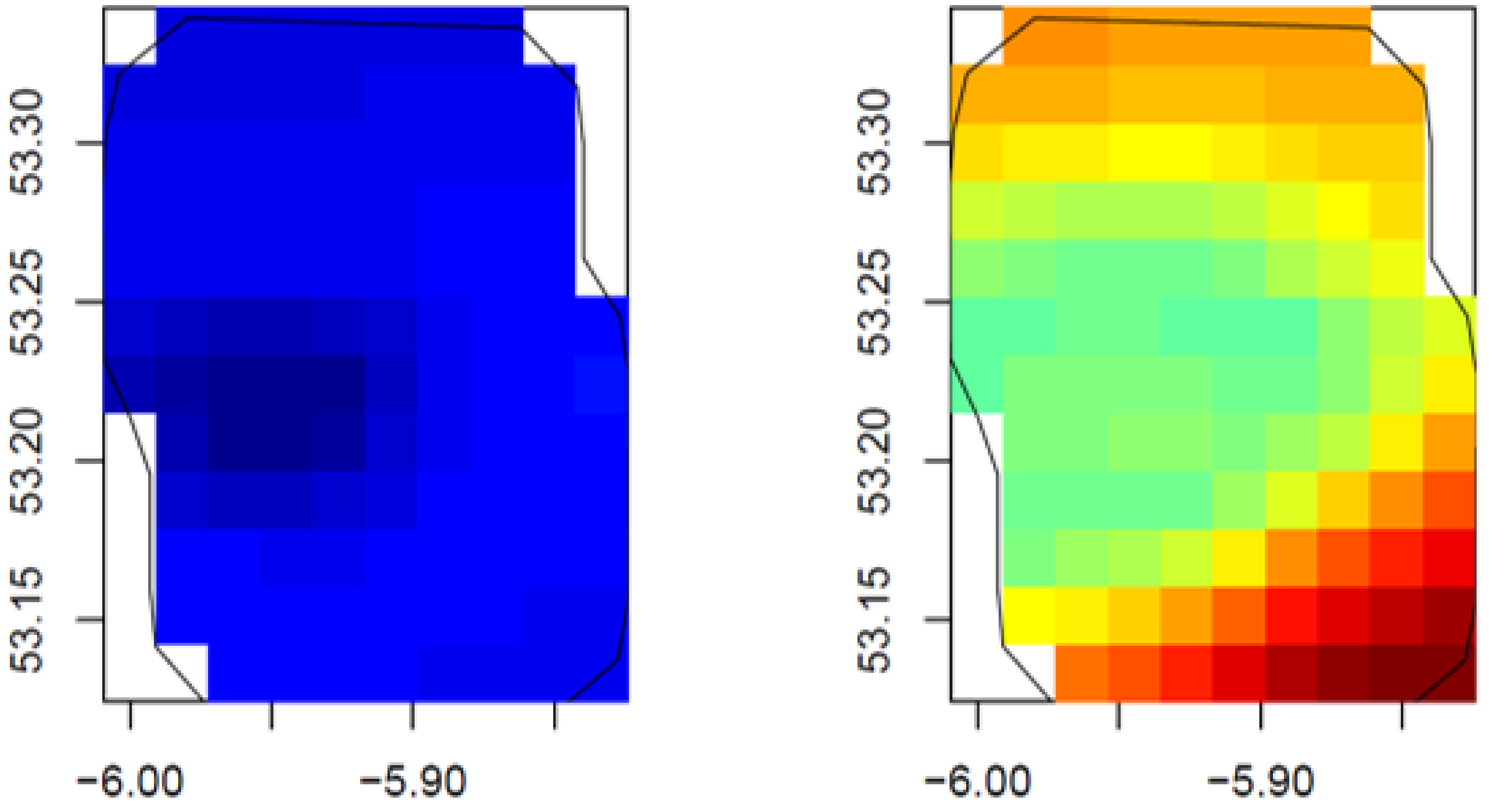


Figure 29 95% CI for the estimated density surface using sightings obtained in Beaufort sea state ≤3 (#/km²); lower (a) and upper (b) interval (Burt and Chudzinska 2021)

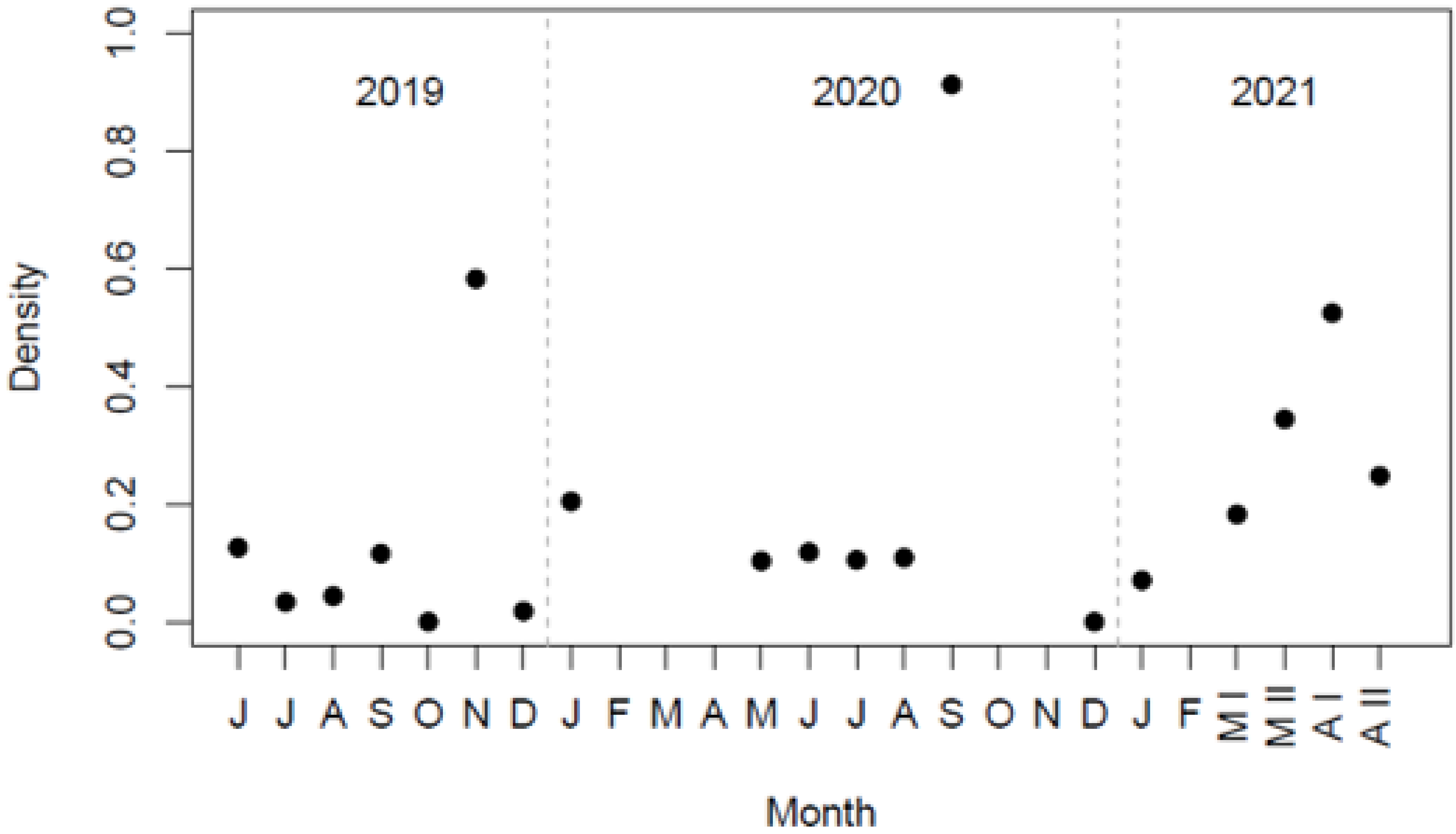


Figure 30 Harbour porpoise density estimates for Beaufort sea state ≤3 (Chudzinska and Burt 2021)

3.2.5 The sightings data were analysed for search effort and sightings in Beaufort sea state ≤3. While harbour porpoise were detected out to a maximum perpendicular distance of 2,208 m from the vessel, the data were truncated to 500 m in order to avoid a long tail in the detection function. Surveys resulted in a total of 101 sightings of harbour porpoise groups during 2,213 hours of survey effort (Table 4). The average harbour porpoise density estimate across all surveys in Beaufort sea state ≤3 was 0.2076 porpoise/km^2, with the highest density of 0.9123 porpoise/km^2 estimated in September 2020 (Table 4). It is important to note that these density estimates may underestimate the true harbour porpoise density since it was assumed that detection on the track line was certain (an assumption which is often violated in marine mammal surveys).

Table 4 Summary of results for harbour porpoise in Beaufort sea state ≤3. Search effort (km), number of groups (n), individual density (D animals/km^2) and individual abundance (N) (Chudzinska and Burt 2021)

Survey	Effort	n	D	N[9]
Jun-19	135	3	0.126	34
Jul-19	106.5	1	0.03345	9
Aug-19	93.5	1	0.04377	12
Sep-19	145.3	3	0.1158	31
Oct-19	89.22	0	0	0
Nov-19	159.5	23	0.5824	155
Dec-19	113	1	0.0181	5
Jan-20	150.6	8	0.2044	54
May-20	143.2	5	0.1032	27
Jun-20	120.7	3	0.1181	31
Jul-20	121.2	3	0.1051	28
Aug-20	123.5	2	0.1089	29
Sep-20	65.87	7	0.9123	243
Dec-20	61.19	0	0	0
Jan-21	101.2	2	0.0704	19
Mar-21 (1)	54.16	1	0.1824	49
Mar-21 (2)	143.6	11	0.3442	92
Apr-21 (1)	143.4	17	0.5243	140
Apr-21 (2)	141.9	10	0.2478	66

[9] Individual abundance is rounded to nearest whole number

Previous baseline surveys

3.2.6 The most common marine mammal recorded during the 2001-2002 surveys of Dublin Array and the Kish and Bray banks was the harbour porpoise, with 57 sightings in March and 49 in the April survey. It was not possible to calculate a density estimate with these data.

3.2.7 Likewise, harbour porpoise was the marine mammal most commonly recorded during the 2010-2011 surveys. A total of 32 sightings (comprising 46 individuals) were made in the eight months surveyed. The highest number of sightings was recorded in February (n=9), while the lowest was in August and March (n=0). The highest number of individuals recorded was 13 in February (Figure 31). The relative abundance of harbour porpoise (porpoise/km) was highest on the southernmost transect (0.42 porpoise/km) and averaged 0.13 porpoise/km across the 10 study area transects. The sea conditions were not ideal during the August survey and no porpoise were detected. However, no porpoise were detected on the hydrophones either, which suggests that porpoises were either not present or were present and not vocalising. No surveys were conducted in October, November, December, April or May, and as such, there is limited ability to confidently identify any seasonal patterns in the detection data.

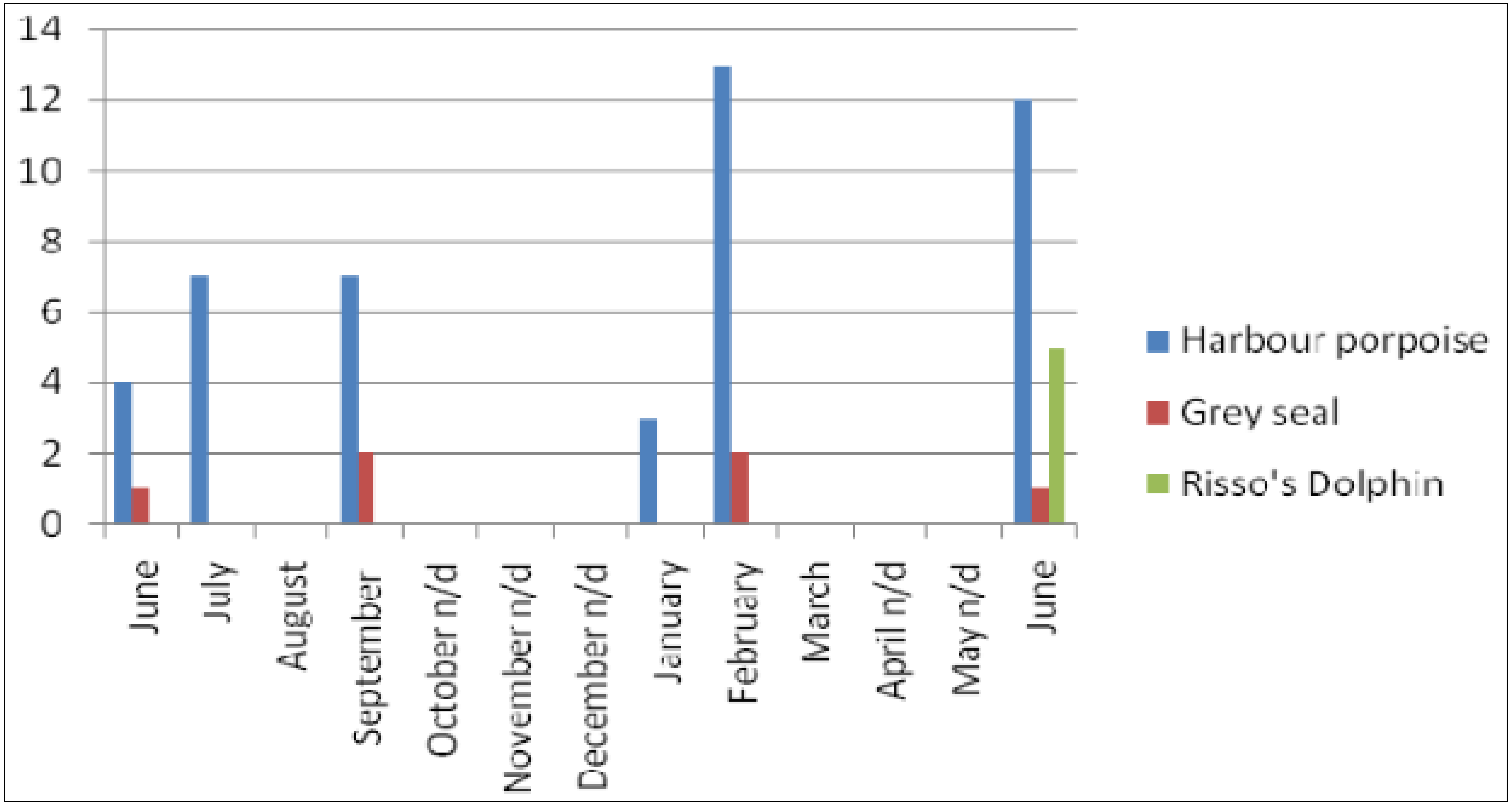


Figure 31 Number of individuals recorded per monthly survey 2010-2011 (n/d= no data – not surveyed) (Saorgus Energy Ltd 2012)[10].

[10] Available at: https://assets.gov.ie/110441/46fc9c90-420e-4259-a433-ebbdb34c6d28.pdf

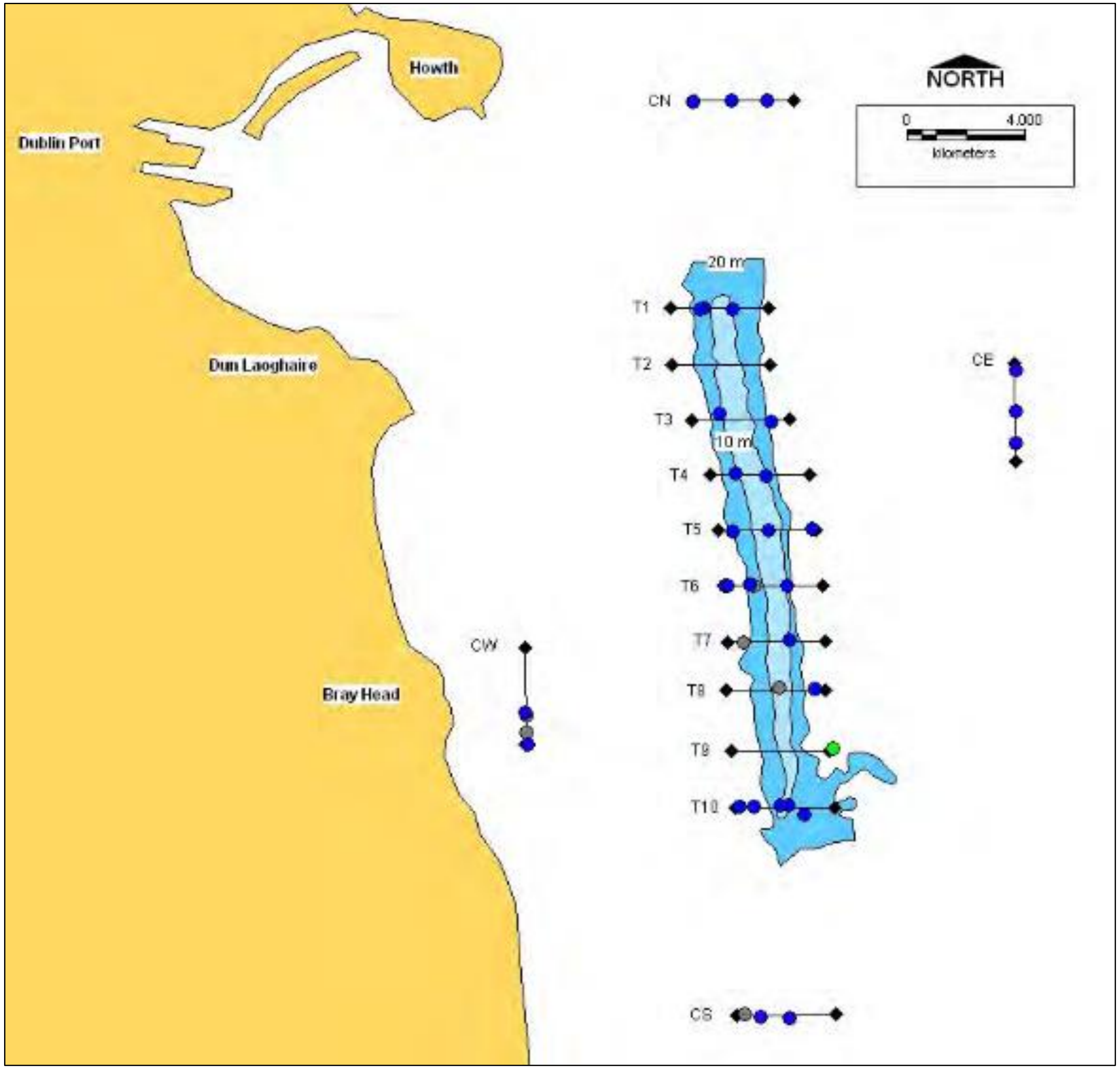


Figure 32 Distribution of ‘on transect’ sightings during 2010-2011 boat-based marine mammal surveys (● = harbour porpoise, ● = grey seal, ● = Risso’s dolphin) (Saorgus Energy Ltd 2012).

IWDG surveys

Berrow *et al*. 2008: North County Dublin area

3.2.8 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 5). This data confirms the presence of porpoise and identifies high detection rates in the Dublin area in the summer months.

Table 5 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

Berrow *et al*. 2011: inshore Irish Sea surveys

3.2.9 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 33). 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.

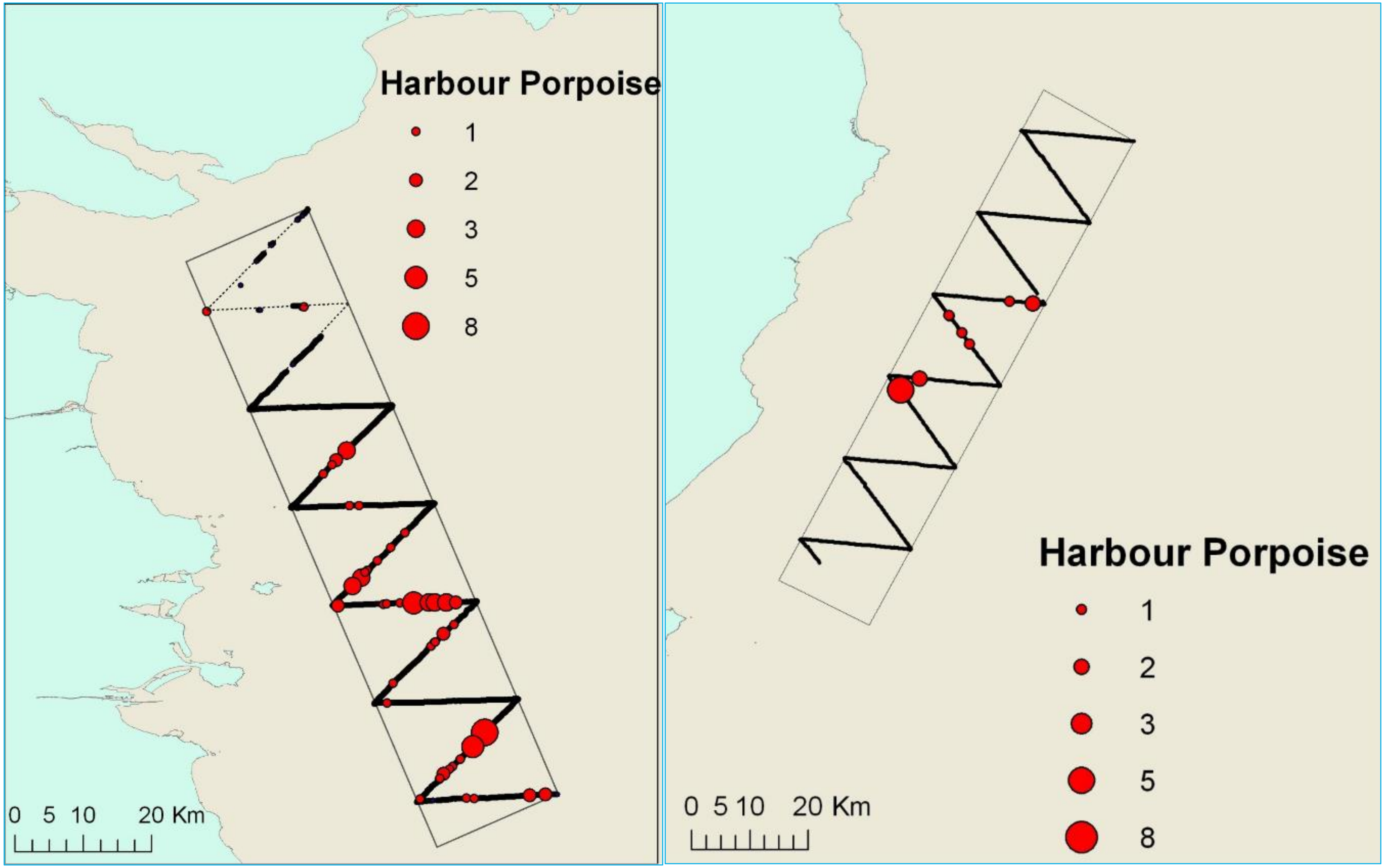


Figure 33 Sighting records of harbour porpoise in Block A (left) and B (right) (Berrow *et al*. 2011).

O’Brien and Berrow 2016: 2016 SAC survey

3.2.10 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 track line surveyed and 152 sightings, totalling 246 individual porpoise (Figure 32). 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/km^2 (CV: 0.10). These density estimates within the SAC were very similar to those obtained in 2013 (1.44 ±0.09 porpoise/km^2, CV: 0.06) (Berrow and O'Brien 2013) which suggests that the summer population within the SAC is stable.

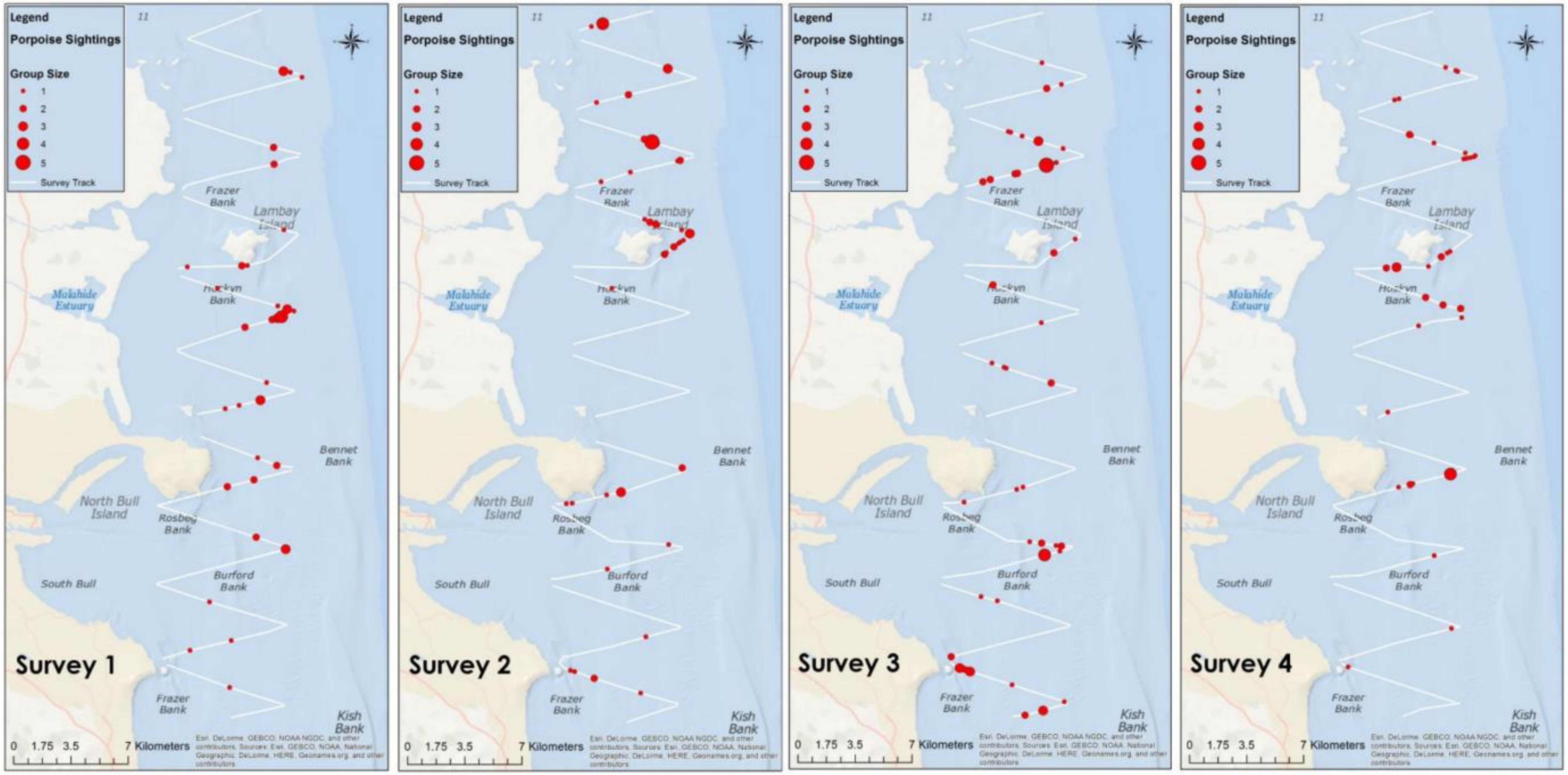


Figure 34 Locations of harbour porpoise sightings and corresponding group sizes recorded during each one-day survey of Rockabill to Dalkey Island SAC in 2016 (O'Brien and Berrow 2016).

Meade *et al*. 2017: Greater Dublin Drainage project

3.2.11 The visual and static PAM surveys conducted as part of the Greater Dublin Drainage project[11] 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 tracking 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 33). 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).

[11] https://www.gddapplication.ie/planning-sites/greater-dublin-drainage/environmental-documents

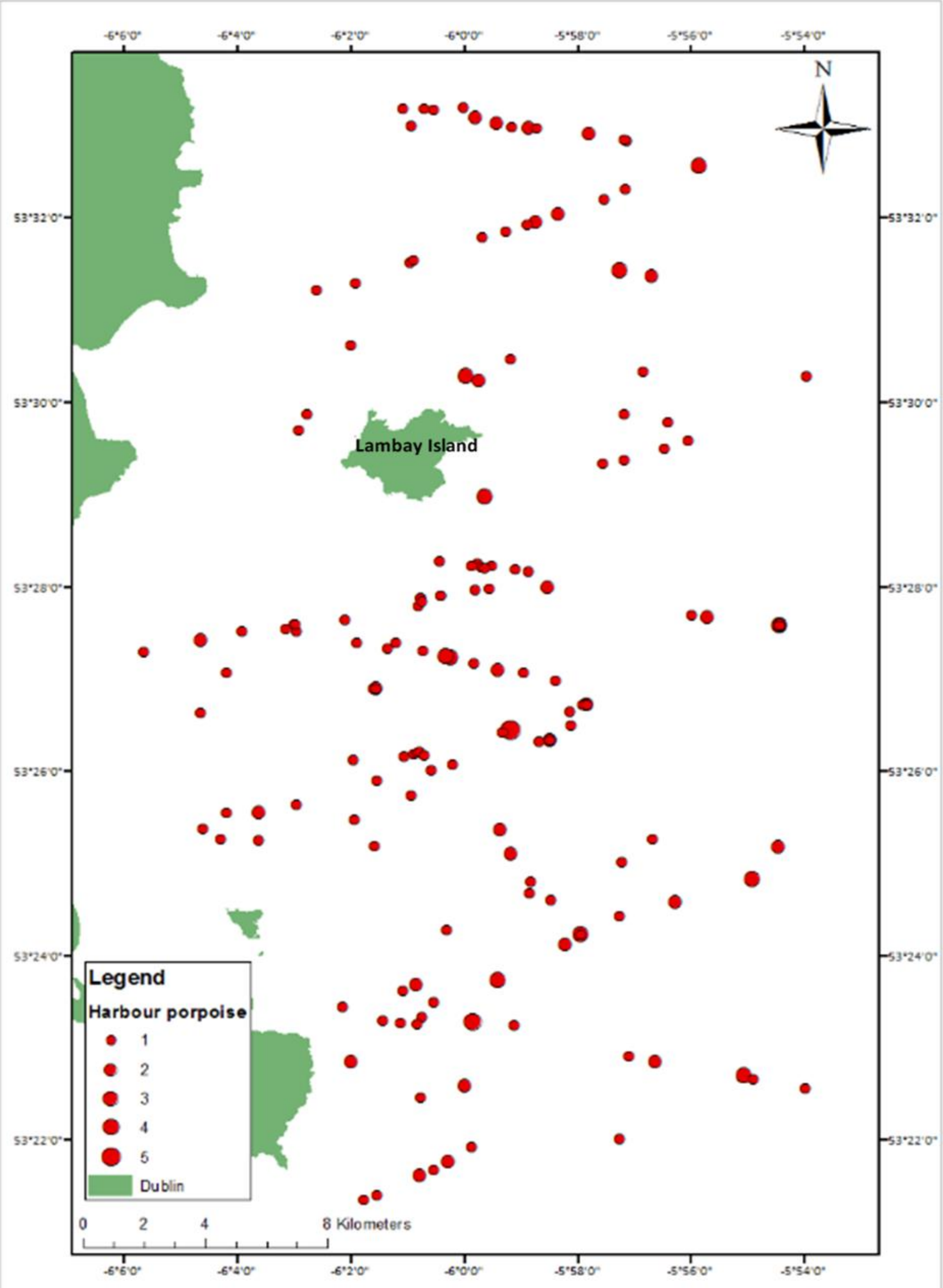


Figure 35 Distribution of harbour porpoise recorded during boat-based surveys conducted as part of the Greater Dublin Drainage project (Meade *et al*. 2017).

Berrow *et al*. 2021: 2021 SAC survey

3.2.12 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 track line 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.

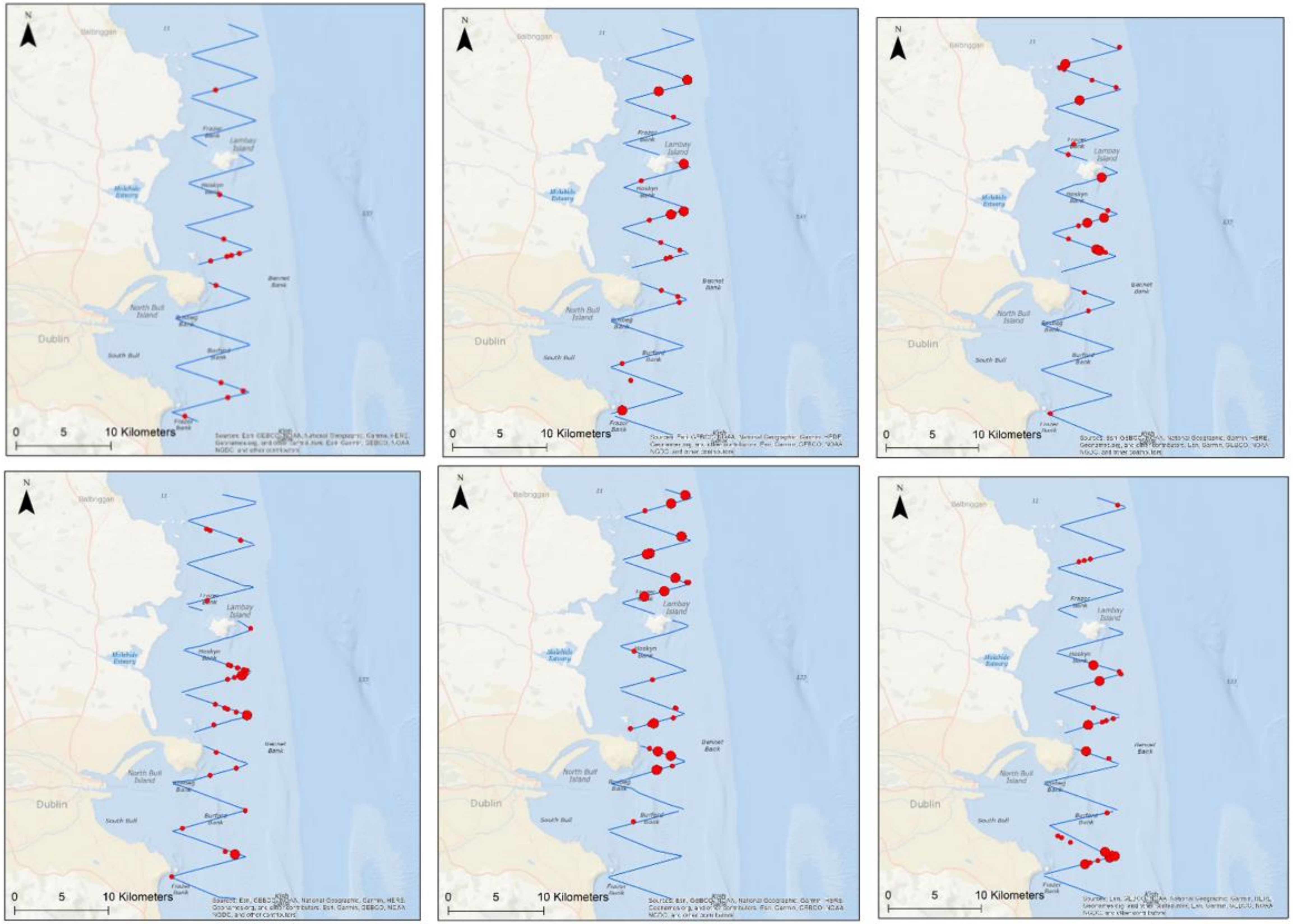


Figure 36 Track-lines and distribution of harbour porpoise sightings (Berrow *et al*. 2021).

Summary of IWDG surveys

3.2.13 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 6 and Figure 34). 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 6 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)

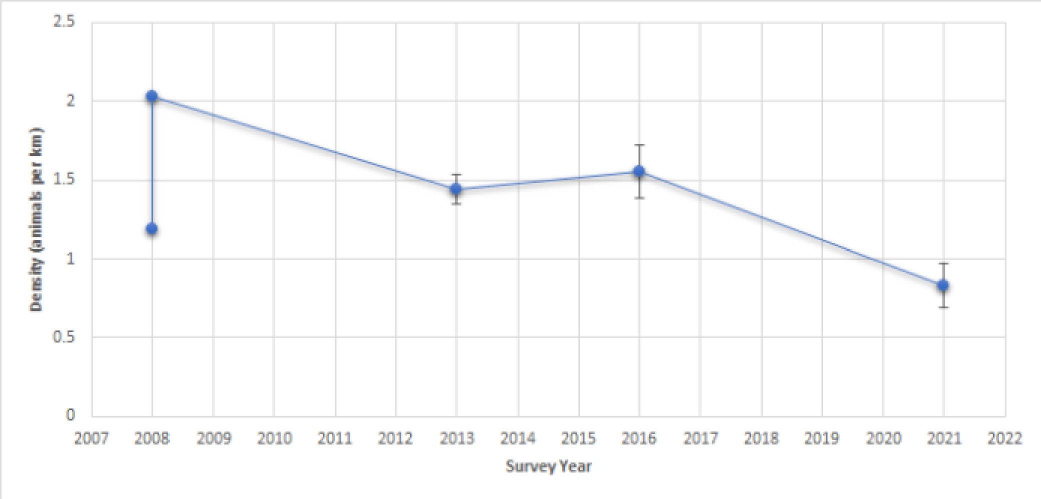


Figure 37 Changes in the recorded density of harbour porpoises in the Rockabill to Dalkey Island SAC over time (Berrow *et al*. 2021).

ObSERVE

3.2.14 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 34), 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 35). 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 Dublin Array 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 7).

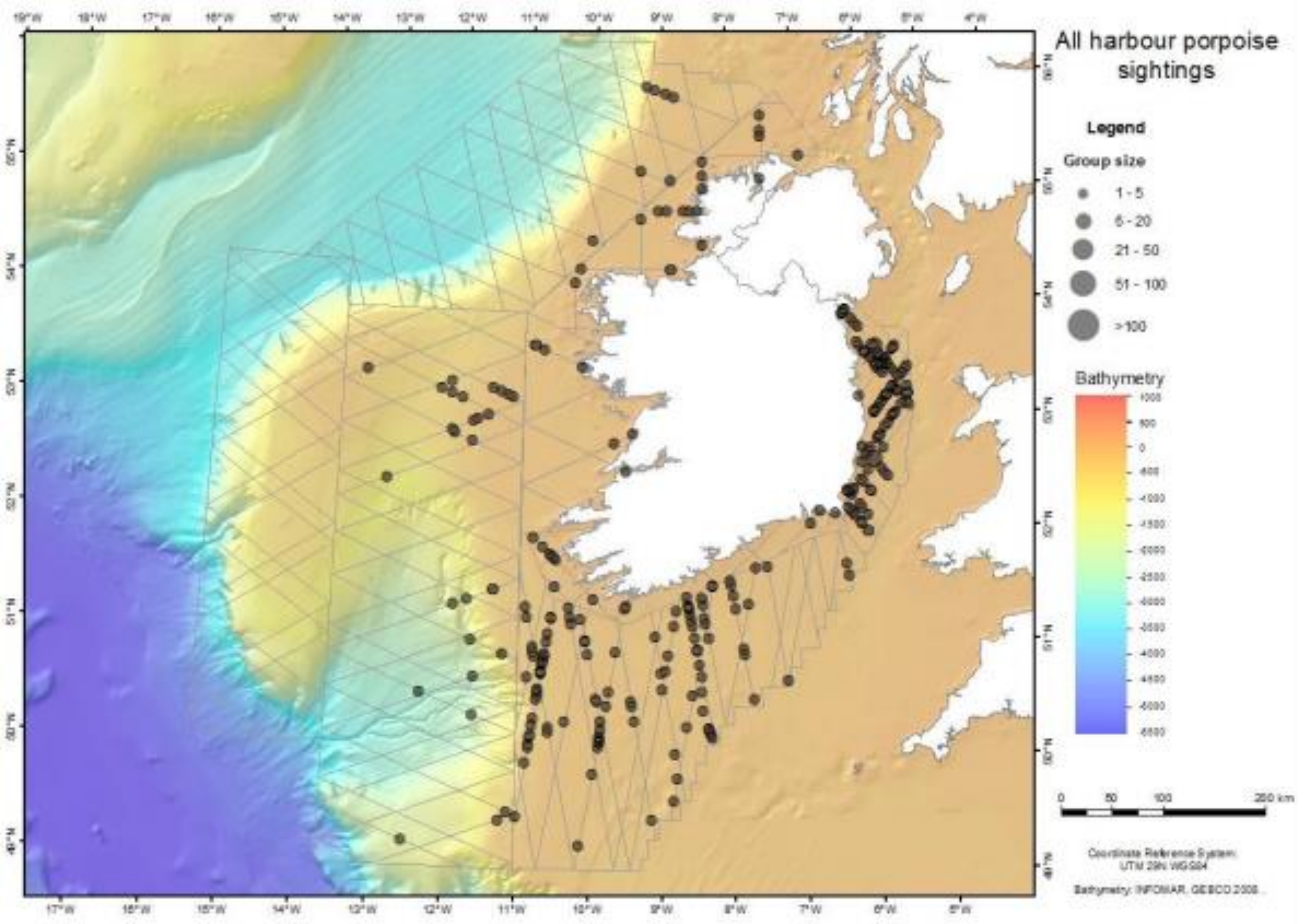


Figure 38 All harbour porpoise sightings from the ObSERVE surveys from 2015-2016 (Rogan *et al*. 2018)

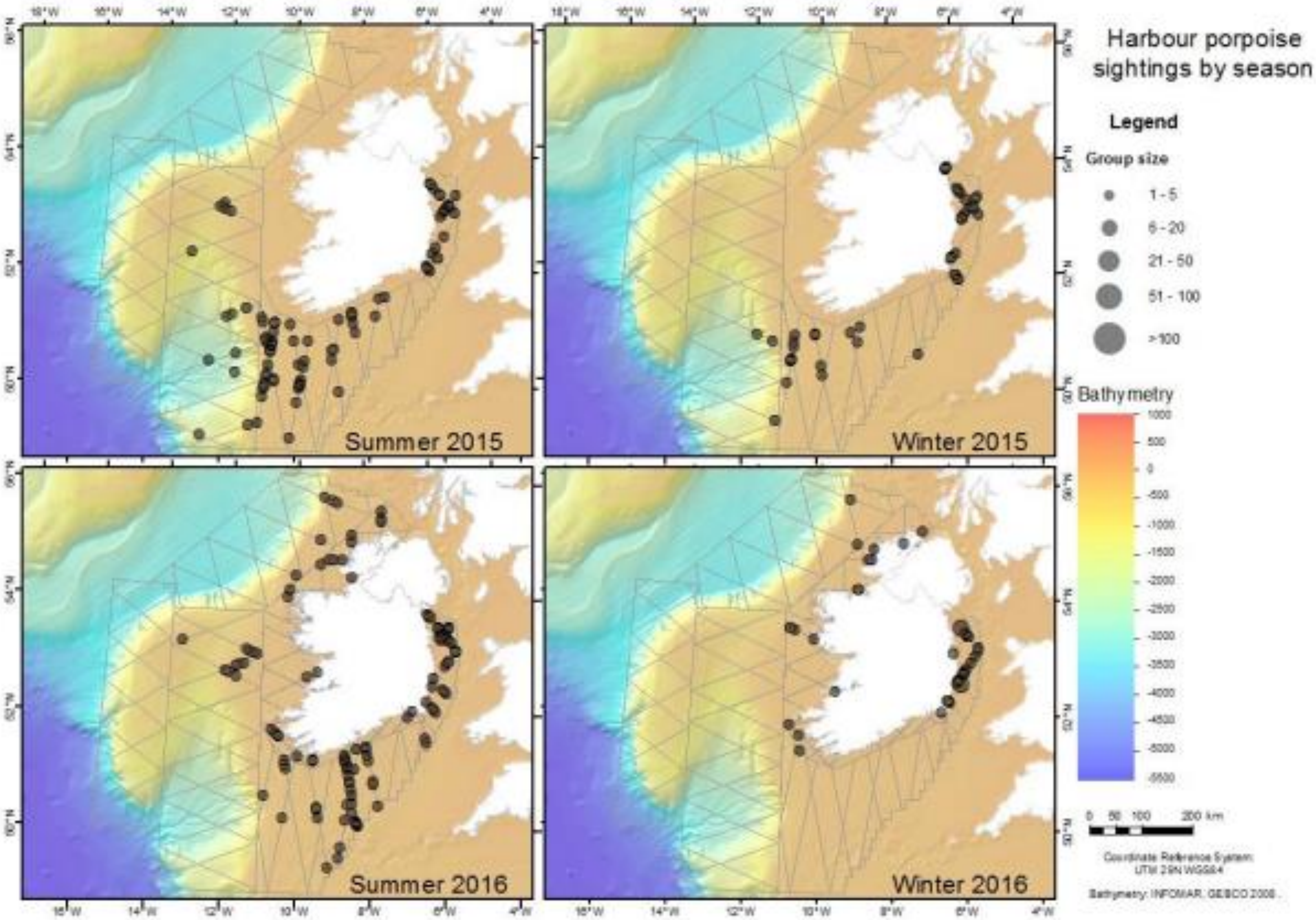


Figure 39 Seasonal harbour porpoise sightings from the ObSERVE surveys from 2015-2016 (Rogan *et al*. 2018).

Table 7 Harbour porpoise groups, design-based and model-based density (#/km^2) and abundance estimates for stratum 5 of the ObSERVE surveys (Rogan *et al*. 2018).

Season	Density	Abundance	Lower CI	Upper CI	Density	Abundance	Lower CI	Upper CI
1	0.696	7734	5247	11398	0.675	7495	4789	11729
2	0.867	9636	5633	16482	NA			
3	1.046	11624	8725	15486	0.942	10466	7923	13816
4	0.924	10263	7555	13942	NA			

Distribution and abundance of cetaceans in Wales and its adjacent waters

3.2.15 Harbour porpoises were modelled throughout the Irish Sea and Bristol Channel, with varying distribution patterns (Figure 36). 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 with high tidal energy (Baines and Evans 2012, Isojunno et al. 2012, Evans et al. 2015). 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 Dublin array area is 0.39 porpoise/km^2 (Figure 37).

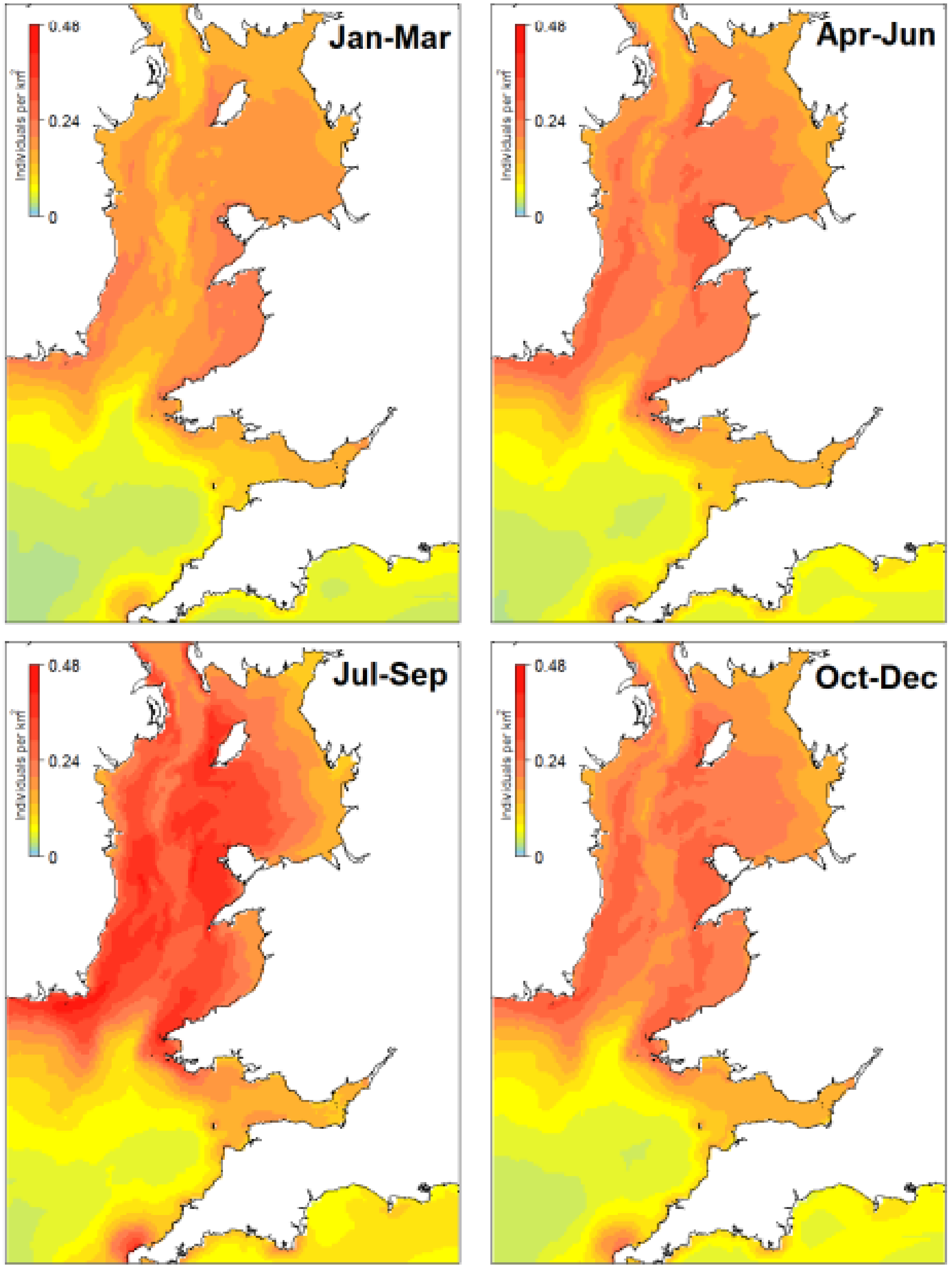
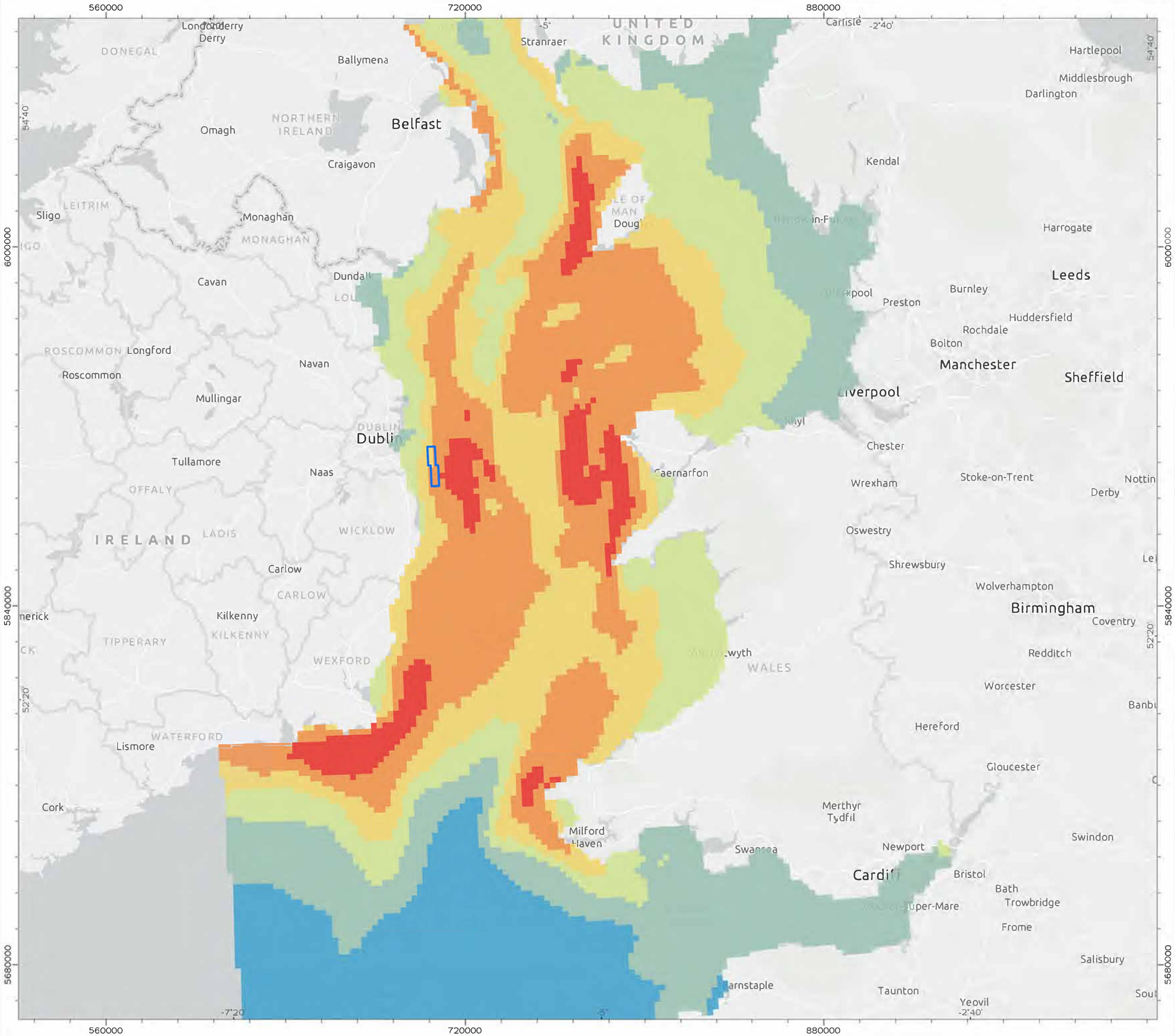


Figure 40 Harbour porpoise modelled densities by quarter, measured as the mean density per cell across months per season (Evans and Waggitt 2023).



Array Area

Evans & Waggit 2023 Density Surface

Harbour Porpoise Density (#/km²)

- 0.04 - 0.12
- 0.12 - 0.19
- 0.19 - 0.26
- 0.26 - 0.33
- 0.33 - 0.4
- 0.4 - 0.48

DRAWING STATUS

FINAL

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PROJECT TITLE

Dublin Array

DRAWING TITLE

Harbour Porpoise Predicted Density Surface (Evans & Waggitt, 2023)

DRAWING NUMBER: **41**

PAGE NUMBER: **1 of 1**

VER	DATE	REMARKS	DRAW	CHEK	APRD
01	2024-10-04	For Issue	GB	BB	SS

0 15 30 45 60 km

0 7.5 15 22.5 30 nm

N

SCALE 1:1,750,000 PLOT SIZE A3

DATUM WGS 1984 VERTICAL REF LAT

PRJ WGS 1984 UTM Zone 29N

GoBe APEM Group

Dublin Array Generation for generations

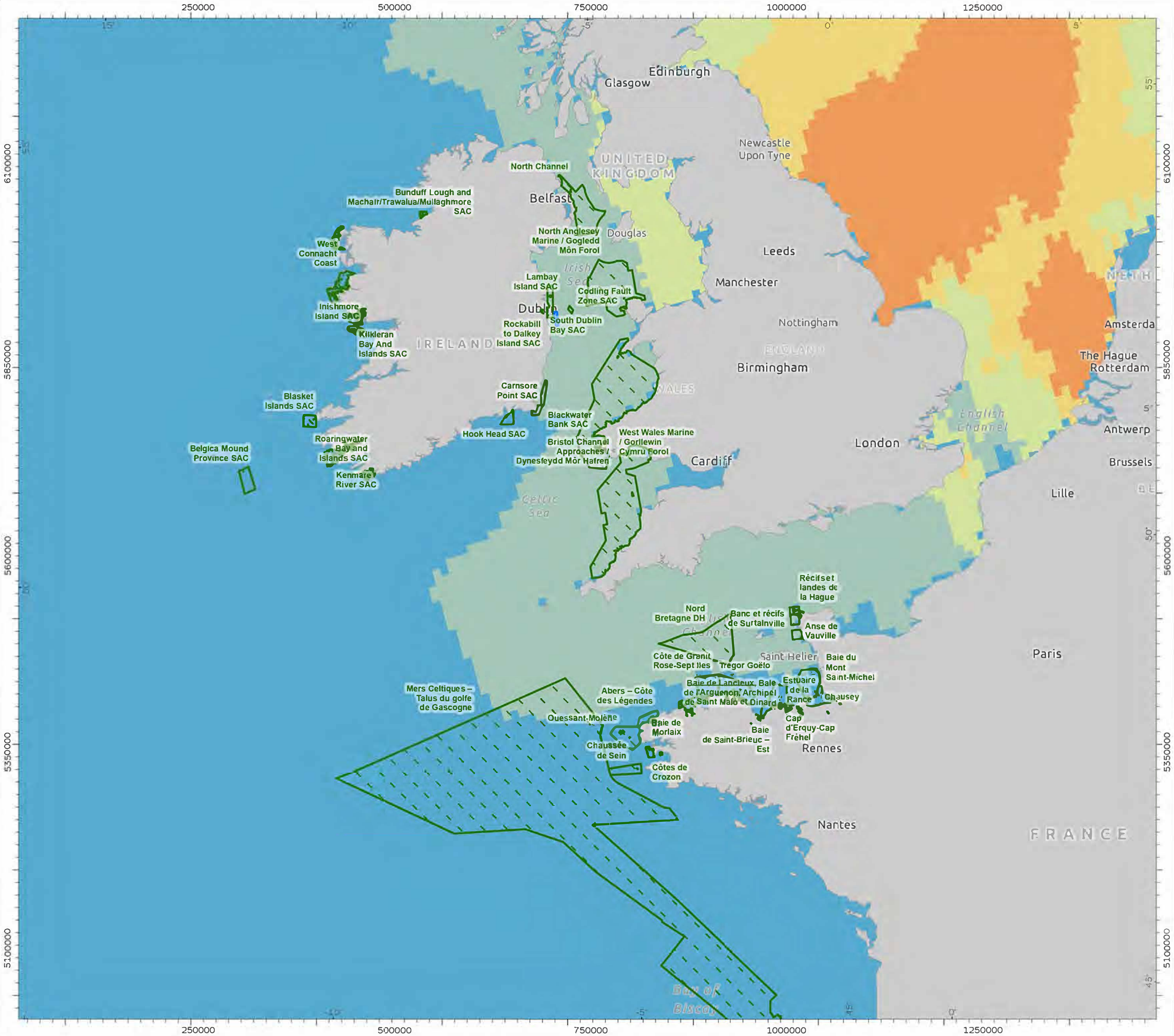
Kish Offshore Wind Limited - Bray Offshore Wind Limited

SCANS

3.2.16 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). 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.

3.2.17 Dublin Array 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).

3.2.18 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 Dublin array are relatively low with values below 0.50 harbour porpoise/km^2 (Figure 35).



Array Area

Harbour Porpoise SACs

Lacey *et al.*, 2020 SCANS III Density Surface

Harbour Porpoise Density (#/km²)

0 - 0.12

0.12 - 0.36

0.36 - 0.65

0.65 - 1.03

1.03 - 2.43

DRAWING STATUS

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PROJECT TITLE

Dublin Array

DRAWING TITLE

Predicted Surfaces of Estimated Density for Harbour Porpoise in SCANS III Data (Lacey *et al.*, 2022)

DRAWING NUMBER: 42

PAGE NUMBER: 1 of 1

VER	DATE	REMARKS	DRAW	CHEK	APRD
01	2024-10-04	For Issue	GB	BB	SS

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0 20 40 60 80 nm

SCALE 1:5,800,000 PLOT SIZE A3

DATUM WGS 1984 VERTICAL REF LAT

PRJ WGS 1984 UTM Zone 29N

GoBe APEM Group

Dublin Array Generation for generations

Kish Offshore Wind Limited - Bray Offshore Wind Limited

3.2.19 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). 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).

Irish Marine Mammal Atlas

3.2.20 The highest relative abundances of harbour porpoises around Ireland were located in the Irish Sea, with the highest relative abundances recorded in the western half of the central Irish Sea (Figure 35). In relation to seasonal variation for this species in the Irish sea, harbour porpoises were recorded year-round, with comparatively little seasonal variation in their relative abundances in the Irish sea.

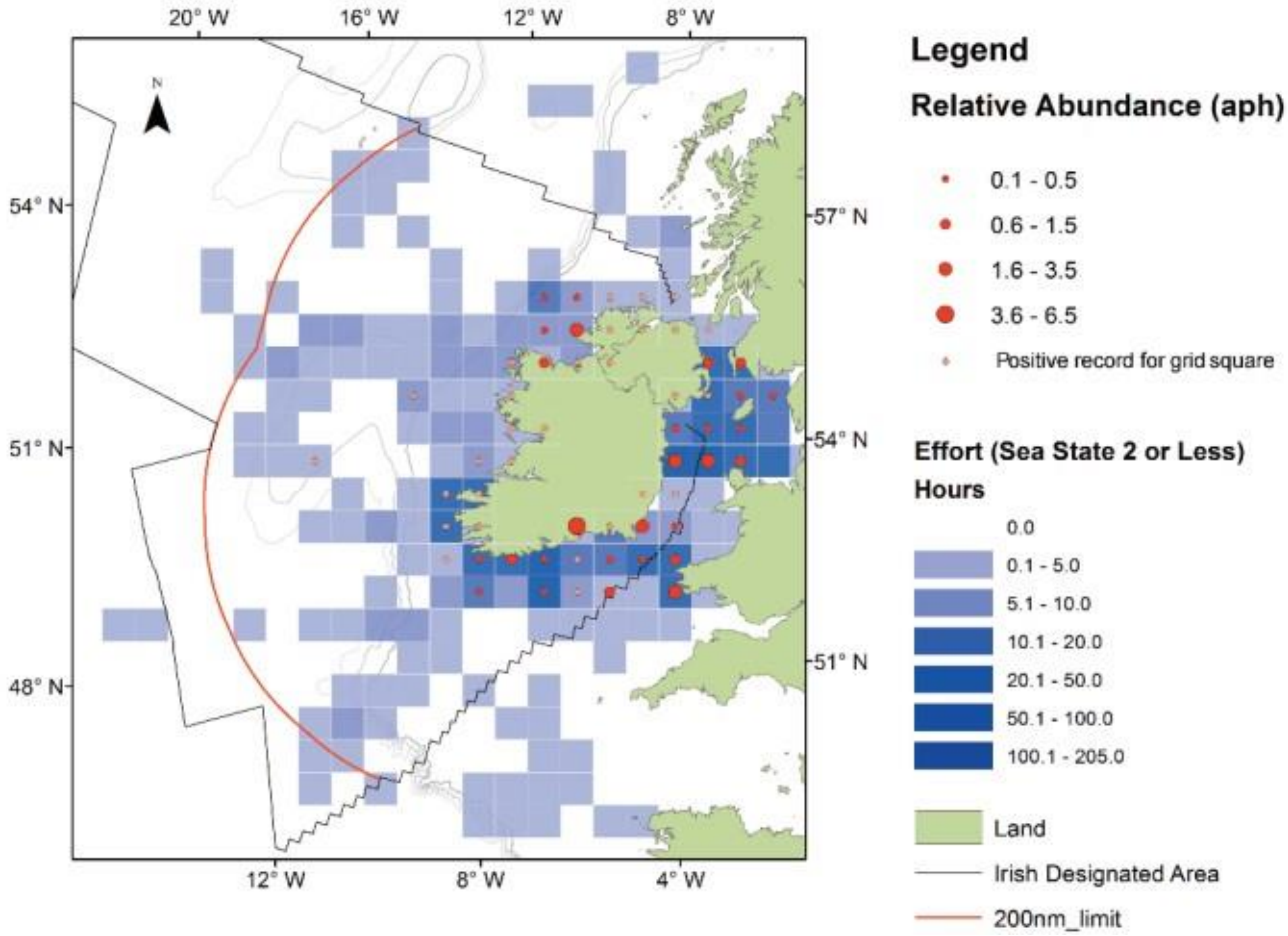


Figure 43 Relative abundance of harbour porpoises from the Irish marine mammal atlas (Wald *et al*., 2013).

Other OWFs

3.2.21 At CWP, harbour porpoise was the most commonly sighted cetacean during site-specific surveys. Density estimations for harbour porpoise were derived by modelling both boat-based survey and aerial survey data (Natural Power 2023). The density surface average using both boat and DAS data was 0.1225 porpoises per km^2 across the survey area.

3.2.22 At Arklow Bank, the presence of harbour porpoise was confirmed during site-specific DAS. A total of 263 harbour porpoise individuals were sighted during the surveys (sighted during 23 out of 25 surveys) resulting in a density estimate of 0.38 porpoise per km^2 (SSE Renewables 2024).

3.2.23 In the 29 months of site-specific DAS for NISA, 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 average density estimate (apportioned and corrected) across the 29 surveys was 0.38 porpoise/km^2 (ARUP 2024).

3.2.24 Site-specific modelled estimates of harbour porpoise density at Oriel estimated a monthly average density of 0.57 porpoise/km^2 (RPS 2024a).

Seasonality

3.2.25 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[12] 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) and further dynamic energy budget modelling conducted specifically for the Dublin Array identified the most sensitive period as the latter half of July (see Habitats Directive Assessments: Part 3 NIS). The population will, therefore, be more vulnerable to disturbance during this breeding and early lactation season.

[12] Dynamic energy budget modelling provides a mechanistic framework that predicts the consequences of an organism's acquisition of environmental resources for energy demanding traits

3.2.26 Data from the sources analysed indicate the potential for harbour porpoise presence all year round. The 19 site specific surveys (2019-2021) were conducted in all months of the year with the exception of February; of the 11 months of the year when surveys were conducted, all had at least one harbour porpoise group sighting except for October. These site specific surveys estimated peak abundance and density during the winter and spring months with November 2019 having the highest density (0.9123 porpoise/km^2) and estimated abundance (243). However, other surveys conducted (e.g. Berrow *et al*. 2008, Rogan *et al*. 2018) found density and abundance to be higher during the summer months. It is, therefore, likely that harbour porpoise may be present in the vicinity of Dublin Array during the breeding season.

Harbour porpoise summary

3.2.27 In summary, there have been several studies of harbour porpoise in the Irish Sea and in the vicinity of Dublin Array, resulting in a range of density estimates for the area, from 0.239 porpoise/km^2 (SCANS III block E) to 2.03 porpoise/km^2 (IWDG North County Dublin) (Table 8). The site-specific survey data are considered the best representation of harbour porpoise density in Dublin Array, and also represents the most recent data. 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 and the Evans and Waggitt (2023) density surface.

Table 8 Harbour porpoise density estimates (porpoise/km^2)[13]

Data source	Reference	Density estimate
Site specific surveys	Burt (2020), (Chudzinska and Burt 2021)	0.2076
SCANS IV block CS-D	Gilles et al. (2023)	0.2803
SCANS III density surface	Lacey *et al*. (2022)	Grid cell specific Max <0.5 in the Dublin array area
SCANS III block E	Hammond *et al*. (2017)	0.239
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 Max 0.39 in the Dublin array area
IWDG Irish Sea Block A	Berrow *et al*. (2011)	1.585
IWDG North County Dublin	Berrow *et al*. (2008)	2.03

[13] Densities taken forward for assessment are shaded in blue.

Data source	Reference	Density estimate
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
CWP site-specific density estimate	Codling Wind Park Limited (2024)	0.1225
Arklow Bank site-specific density estimate	SSE Renewables (2024)	0.38
NISA site-specific density estimate	ARUP (2024)	0.38
Oriel site-specific density estimate	RPS (2024a)	0.57

3.3 Harbour seal

3.3.1 Harbour seals occur throughout Irish waters (Figure 44), in estuarine, coastal and fully marine areas. They have been assessed as having a Favourable conservation status in Irish waters (NPWS 2019). There are two harbour seal SACs on the east coast of the Republic of Ireland: Lambay Island SAC and the Slaney River Valley SAC (Figure 26). In addition, there are two SACs on the east coast of Northern Ireland: Murlough SAC and Strangford Lough SAC.

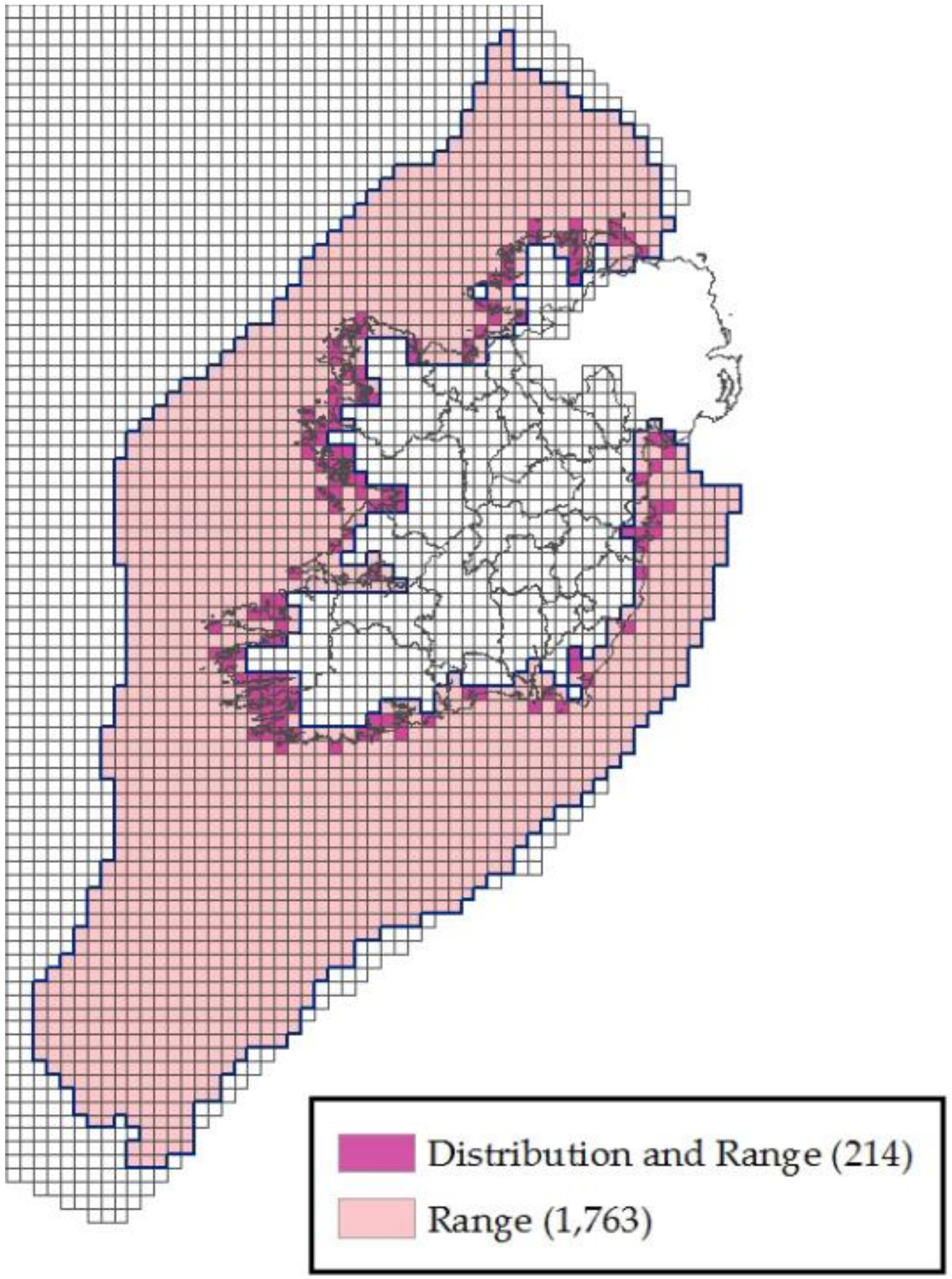


Figure 44 The range and distribution of grey seals in Irish waters (NPWS 2019).

Irish Marine Mammal Atlas

3.3.2 Harbour seal sightings recorded during vessel surveys were rare, with just two sightings reported during the survey period of 2005-2011 (Figure 45). 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.

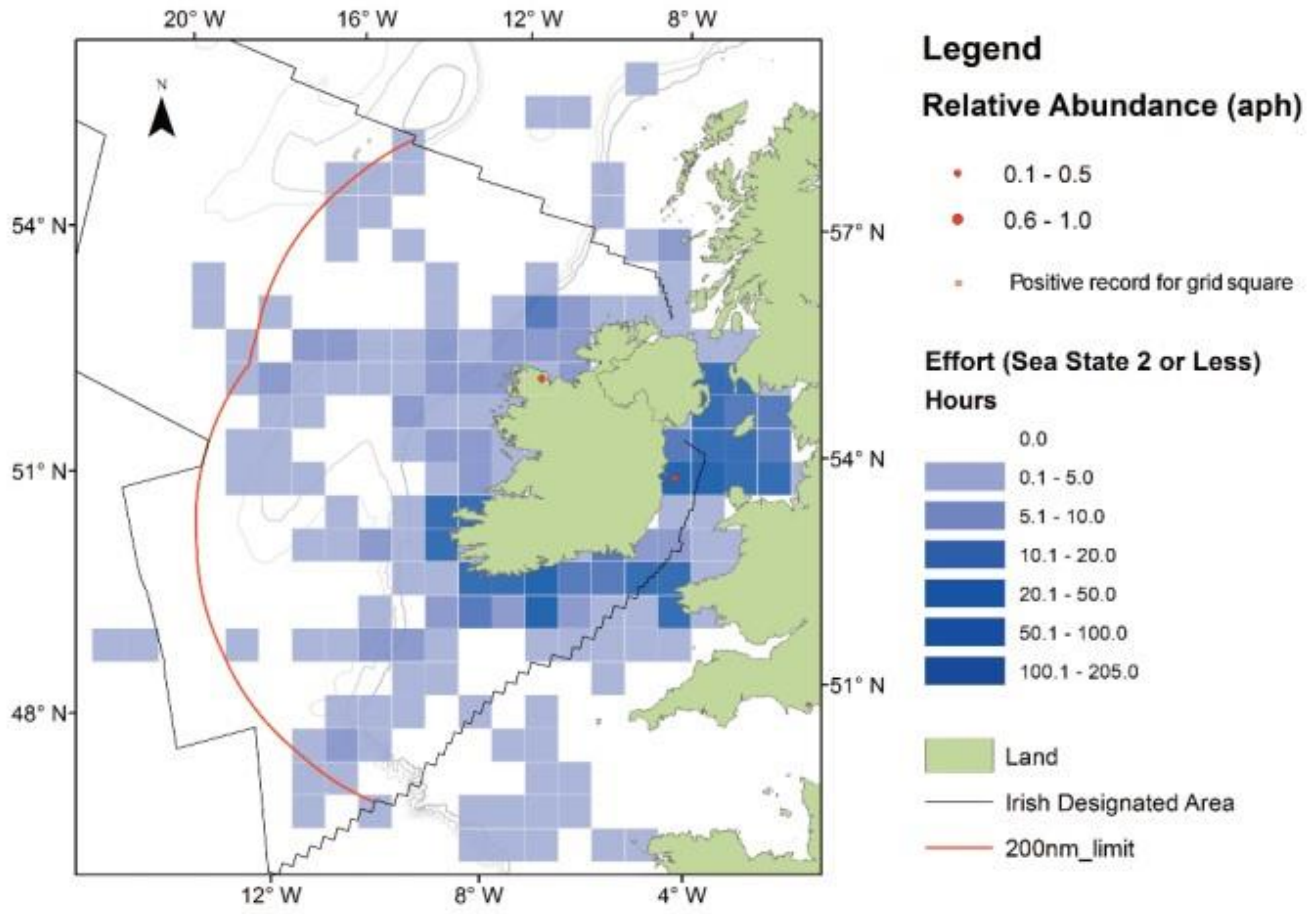


Figure 45 Relative abundance of harbour seals from the Irish marine mammal atlas (Wald *et al*., 2013)

Management Unit (MU)

3.3.3 Until recently, it had been assumed that all harbour seals in Irish waters were part of the same population, and thus MU. However, a recent study of harbour seal genetics has shown that there are genetically distinct populations in Irish waters and that three MUs should be considered for harbour seals in Irish waters: East Ireland (EI), North-west & Northern Ireland (NWNI), and South-west Ireland (SWI) (Steinmetz *et al*. 2023). The “EI” MU as defined by Steinmetz et al. (2023) consists of both the East Ireland and South-east Ireland regions (as defined by combined Morris and Duck (2019) (Figure 50)). As the Dublin array is located within the East region of the Republic of Ireland but is also close to the Northern Ireland MU and the South-east Ireland region, the relevant reference population against which to assess the impacts of the Dublin array is thus a combination of the east regions of the Republic of Ireland (i.e, the EI MU as defined by Steinmetz et al. (2023)) and the Northern Ireland MU.

Haul-out Counts

3.3.4 Dublin Array is located within the EI region of the Republic of Ireland but is also relatively close to the Northern Ireland MU. The relevant reference population against which to assess the impacts of the Dublin array is thus a combination of the east regions of the Republic of Ireland (East and South-East Ireland as per Morris and Duck (2019)) and the NWNI MU.

3.3.5 Cronin *et al*. (2004) estimated the minimum population estimates for harbour seals in the Republic of Ireland to be 2,905 individuals in 2003. The study concluded an abundance of 34 harbour seals across the three haul-out sites surveyed in county Dublin, equating to 1% of the total population within the Republic of Ireland.

3.3.6 Morris and Duck (2019) reported on the numbers (Table 9) and distribution of harbour seals in Ireland (Figure 50), with a total of 131 harbour seals in the East Ireland of the surveys in 2017/18, an increase compared to a count of 90 in 2011/12 and 123 in 2003. In the South-east region, a total of 34 harbour seals in 2017/18 were reported, a decrease from the 53 harbour seals reported in 2011/12. An overall total of 4,007 harbour seals was reported for Ireland as a whole in 2017/18, significantly less than that reported for grey seals. This 2017/18 overall count of harbour seals was 14.8% higher than the 2011/12 count in which 3,489 harbour seals were reported. This increase in total counts is equivalent to a 2.3% annual increase across a six-year period.

3.3.7 The total August counts for the East (131) and South-east regions (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 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 9 Harbour seal counts in the Republic of Ireland from 2003 – 2018 (Morris & Duck, 2019)

		Harbour seal counts		
	Area	**2003**	**2011/12**	**2017/18**
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
TOTAL	**all**	**141**	**143**	**165**

Table 10 Harbour seal August haul-out counts in the Northern Ireland MU (SCOS 2023)

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

3.3.8 Berrow et al (2024) conducted surveys of haul-out sites close to Dublin Port between June 2023 and January 2024 during period with increased construction activity in the area related to Dublin Port's Masterplan 2040. Across the surveyed area, grey seals were more abundant that harbour seals. The maximum number of harbour seals counted in a month was 117 harbour seals in July 2023 (Figure 46). Of the sites within Dublin Bay, no harbour seals were counted at Dalkey Island, only 3 were counted in total at Sandy Cove and a maximum of 19 were counted at Bull Island. Harbour seals were counted in highest numbers on Lambay Island and at Rush Head. The number of seals counted in the Dublin Bay and adjacent waters (Skerries to Dalkey Islands) were consistent with those counted in 2017 (Morris and Duck, 2019). Accounting for seals at sea at the time of the survey, the local abundance of harbour seals in the survey area (Skerries to Dalkey Islands) was estimated as >115. Despite the high levels of vessel activity associated with the major infrastructure redevelopment at Dublin Port, there is no evidence of a change in harbour seal haul-out usage in the area.

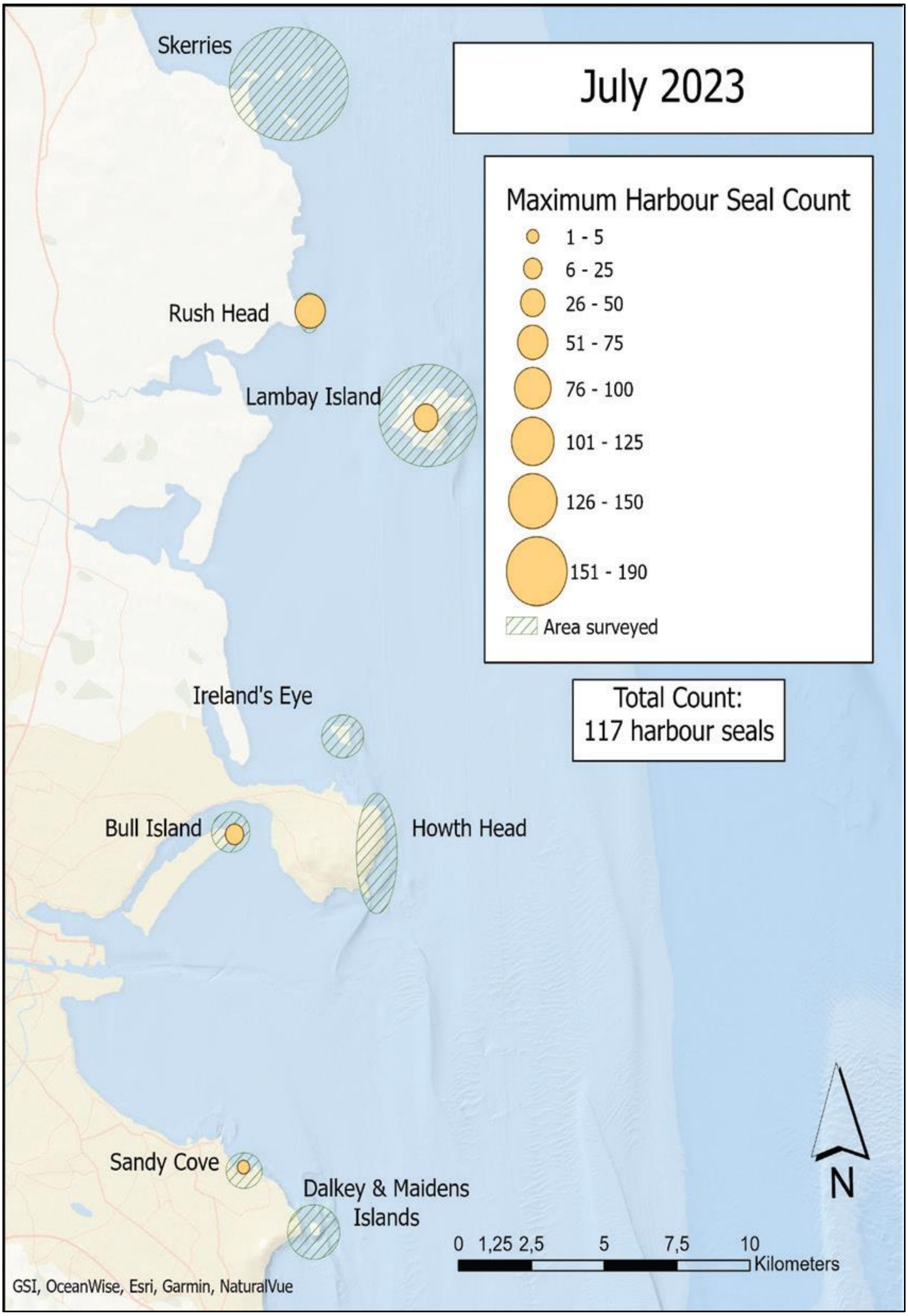


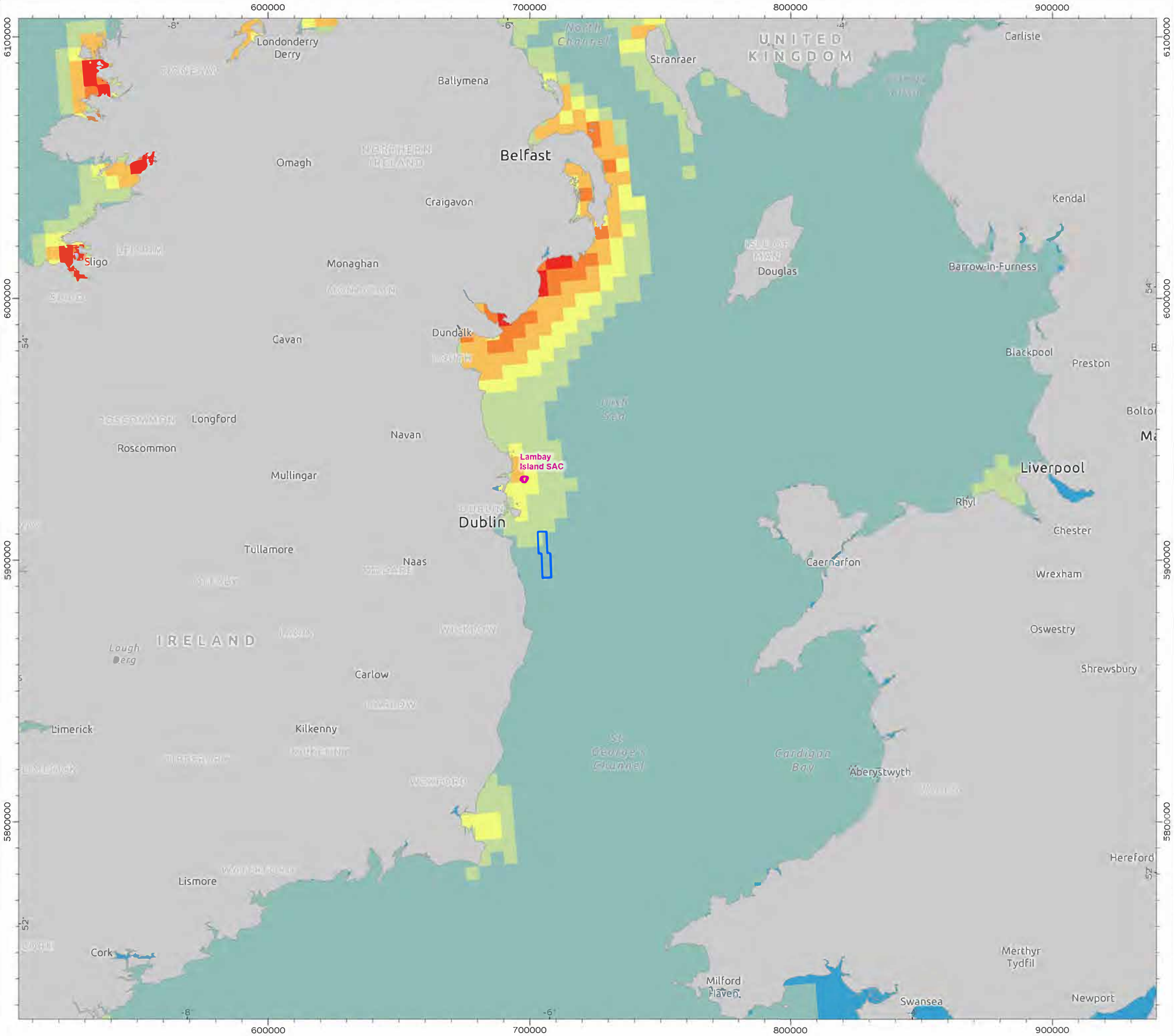
Figure 46 Counts of harbour seals at sites surveyed in July 2023 (Berrow et al., 2024).

Telemetry

3.3.9 There have been no harbour seal tagging studies conducted in the Republic of Ireland 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 47). The track data from these seals showed limited movement into the Republic of Ireland 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 Dublin Array (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).

At-sea density

3.3.10 As expected given the low numbers of haul-out counts in the east coast of the Republic of Ireland, estimated harbour seal at-sea density estimates are very low in Dublin Array (both the windfarm area and export cable corridor), where density estimates reach a maximum of 1.384 seals per cell, which equates to 0.055 harbour seals/km^2 (Figure 48). By comparison, at-sea density estimates are slightly higher around the Lambay Island SAC (0.19 seals/km^2) and considerably higher in the Murlough SAC in Northern Ireland (2.17 seals/km^2).



Array Area

Harbour Seal SACs

Harbour Seal At-Sea Distribution (Carter *et al.*, 2020)

% At-Sea Population per Cell

- 0
- 0 - 0.001
- 0.001 - 0.005
- 0.005 - 0.01
- 0.01 - 0.025
- 0.025 - 0.05
- >0.05

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PROJECT TITLE

Dublin Array

DRAWING TITLE

Harbour Seal Habitat Preference at-sea Density Estimates (Carter *et al.*, 2022)

DRAWING NUMBER: **47**

PAGE NUMBER: **1 of 1**

VER	DATE	REMARKS	DRAW	CHEK	APRD
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0 6 12 18 24 nm

SCALE 1:1,500,000 | PLOT SIZE A3 | DATUM WGS 1984 | VERTICAL REF LAT | PRJ WGS 1984 UTM Zone 29N

GoBe APEM Group

Dublin Array — Generation for generations — Kish Offshore Wind Limited - Bray Offshore Wind Limited

Site-specific surveys (2019-2021)

3.3.11 Over the 13 months of site-specific surveys, there were no harbour seal sightings, though there were two sightings of harbour/grey seals that could not be identified to species level. This very low sightings rate aligns with the low-density estimates predicted to be present at Dublin Array from the habitat preference at-sea density estimates.

IWDG Surveys

3.3.12 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 47). 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 Dublin Array site.

3.3.13 Again, these very low sightings rates align with the very low sightings rates in the site-specific surveys and the low-density estimates predicted to be present at Dublin Array from the habitat preference at-sea density estimates.

Seasonality

3.3.14 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 time 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.

Harbour seal summary

3.3.15 Though no harbour seals were sighted during the site specific surveys, the Lambay Island SAC is within 20 km of Dublin Array, which is within the typical foraging range of harbour seals (40-50 km from their haul-out sites, SCOS 2019). Therefore, there is potential for harbour seals in the vicinity of Dublin Array that may be impacted. 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 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 (Figure 47) are taken forward for impact assessment for Dublin Array.

3.4 Grey seal

3.4.1 Grey seals occur throughout Irish waters (Figure 48) 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 two grey seal SACs on the east coast of the Republic of Ireland: 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 list 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.

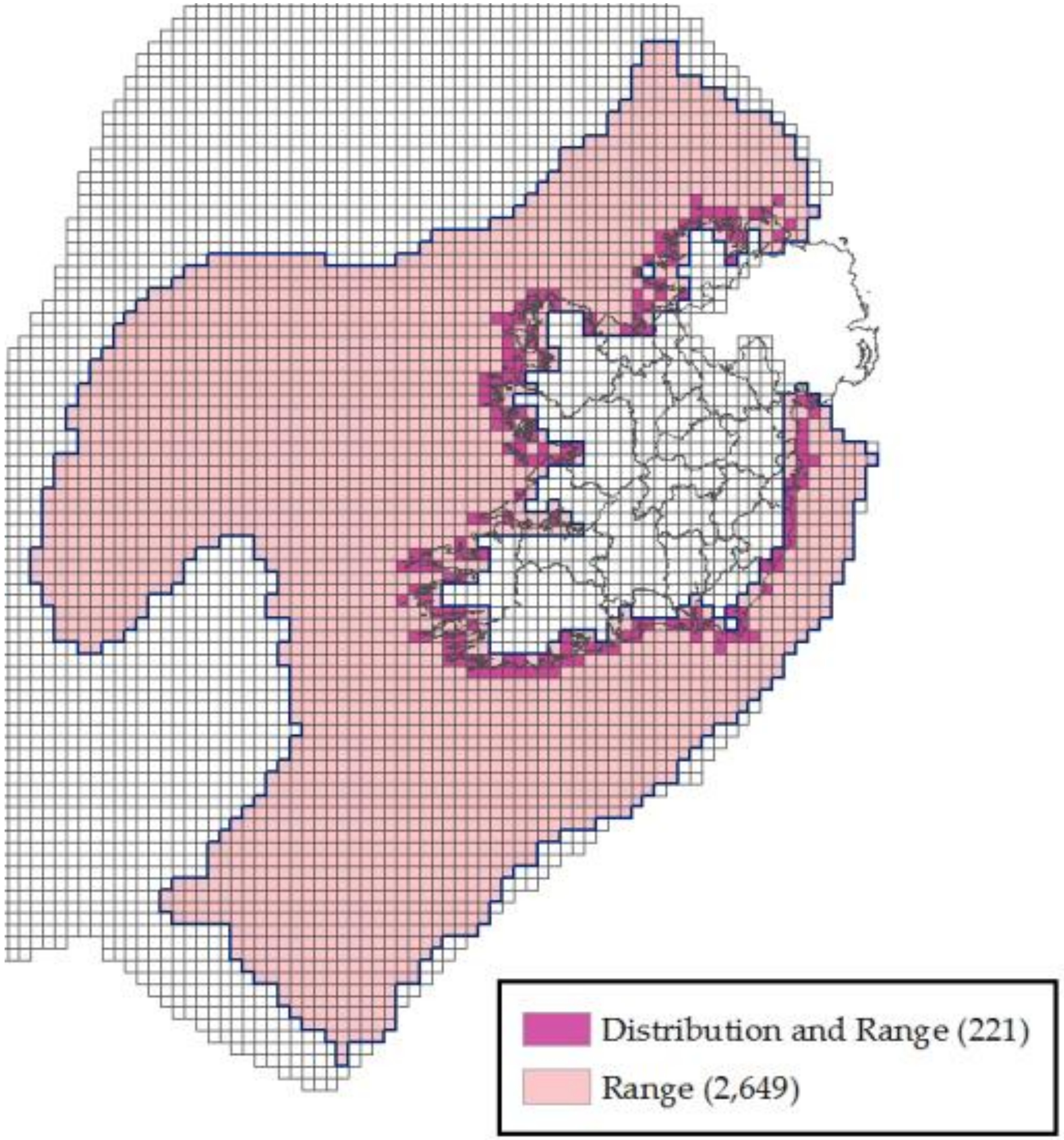


Figure 48 The range and distribution of grey seals in Irish waters (NPWS 2019)

Irish Marine Mammal Atlas

3.4.2 Grey seals are present off all Irish coasts and were reported at low relative abundances[14] throughout the Irish Sea, with these individuals being predominantly sighted in inshore waters (Figure 49). In terms of seasonal variation, grey seals were reported year-round in Irish waters.

[14] Relative species abundance is a component of biodiversity and is a measure of how common or rare a species is relative to other species in a defined location or community. Relative abundance is the percent composition of an organism of a particular kind relative to the total number of organisms in the area (Hubbell 2001).

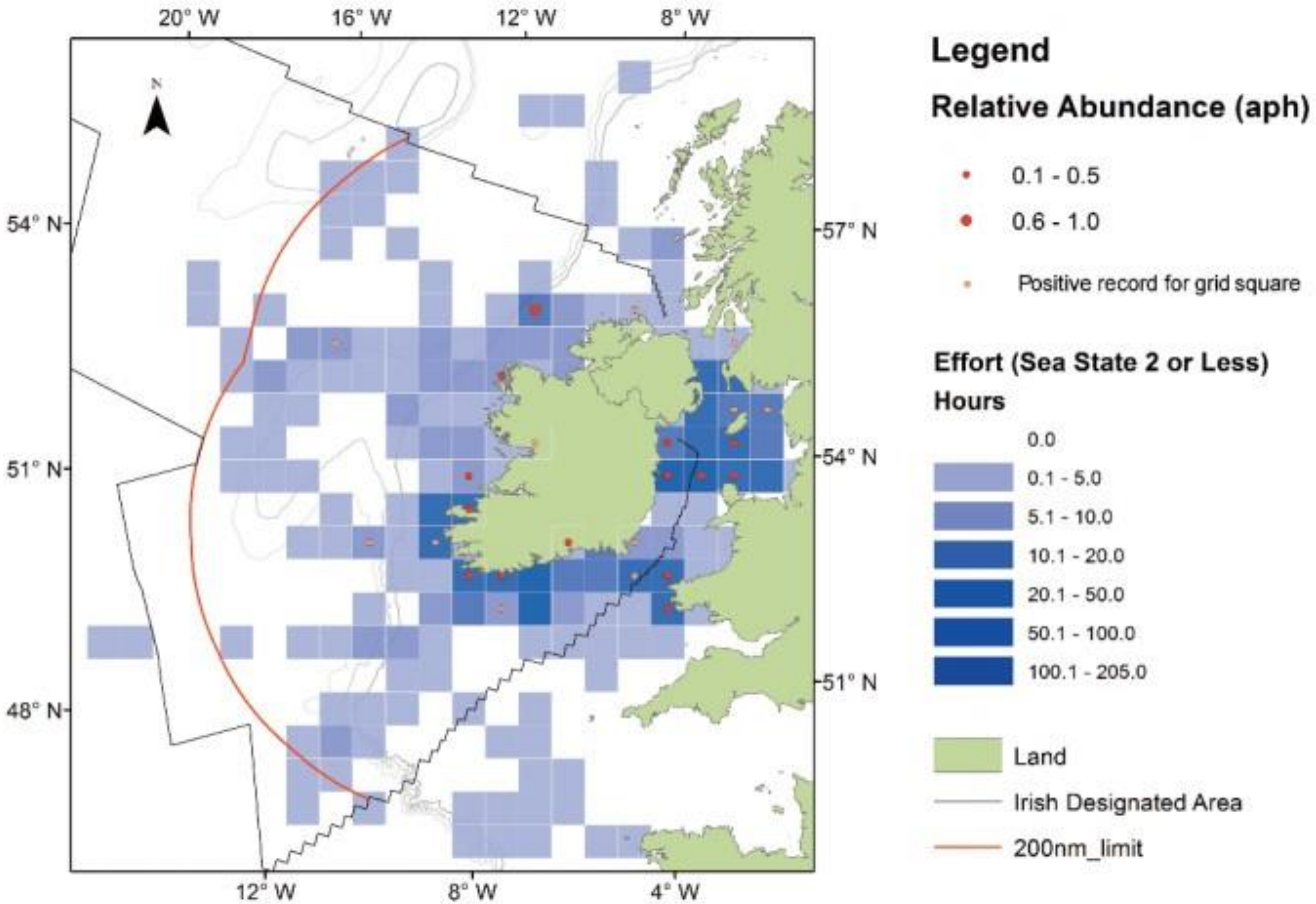


Figure 49 Relative abundance of grey seals from the Irish marine mammal atlas (Wall *et al*., 2013)

Haul-out Counts

3.4.3 Dublin Array is located within the EI region of the Republic of Ireland but is also relatively close to the Northern Ireland MU. The relevant reference population against which to assess the impacts of the Dublin array is thus a combination of the east regions of the Republic of Ireland (East and South-East Ireland as per Morris and Duck (2019)) and the NWNI MU.

3.4.4 Cronin *et al*. (2004) recorded a total of 1,287 grey seals in the Republic of Ireland, with low abundances along the Dublin coastline. While these surveys concluded grey seal presence in Ireland, it also highlighted an absence of a population estimate for this species throughout the island.

3.4.5 Ó Cadhla *et al*. (2007) estimated a total of 1,574 grey seal pups to have been born in the Republic of Ireland 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 four 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.

3.4.6 Morris and Duck (2019) reported on the numbers (Table 11) and distributions of grey seals in Ireland (Figure 50), with a total of 3,698 grey seals in 2017/18, an increase in grey seal counts compared to 2011/12 in which 2,964 grey seals were reported. The 2017/18 total was concluded to be the highest on record for grey seals in the summer months, with this total being 25% higher than that of 2011/12, equivalent to a 3.8% annual increase over a period of six years. The study also concluded that at this time, there was in the order of 2.5 to 3.5 times more grey seals than harbour seals in Ireland, with these findings concurring with population figures collected in Ireland since 2005 (Ó Cadhla et al. 2013). Grey seal counts on the east coast of Ireland reached a peak of 418 for the 2017/18 survey, higher than the previous total of 223 in this region in 2011/12 and 262 in 2003. Counts for this species in the South-east region of Ireland increased over time also, with 189 individuals reported in 2003, 239 in 2011/12 surveys and 550 grey seals in the most recent surveys of 2017/18.

3.4.7 The most recent 2021 August haul-out counts (Table 11) 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.

3.4.8 Due to the wide spatial range of this species, the East (418) and South-east (556) regions of the Republic of Ireland, and Northern Ireland (549), have been included as the relevant MU for grey seals against which to assess the impacts of Dublin Array. 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) to provide an estimate of the total population (hauled-out and at-sea at the time of the count). The combined 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).

3.4.9 As noted previously, these population estimates may not be representative of grey seal abundance and distributions year-round, though they do represent an estimate outside of the breeding and moult periods.

Table 11 Grey seal counts in the Republic of Ireland from 2003 – 2018 (Morris & Duck, 2019)

		Grey seal counts		
Region	**Area**	**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 12 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

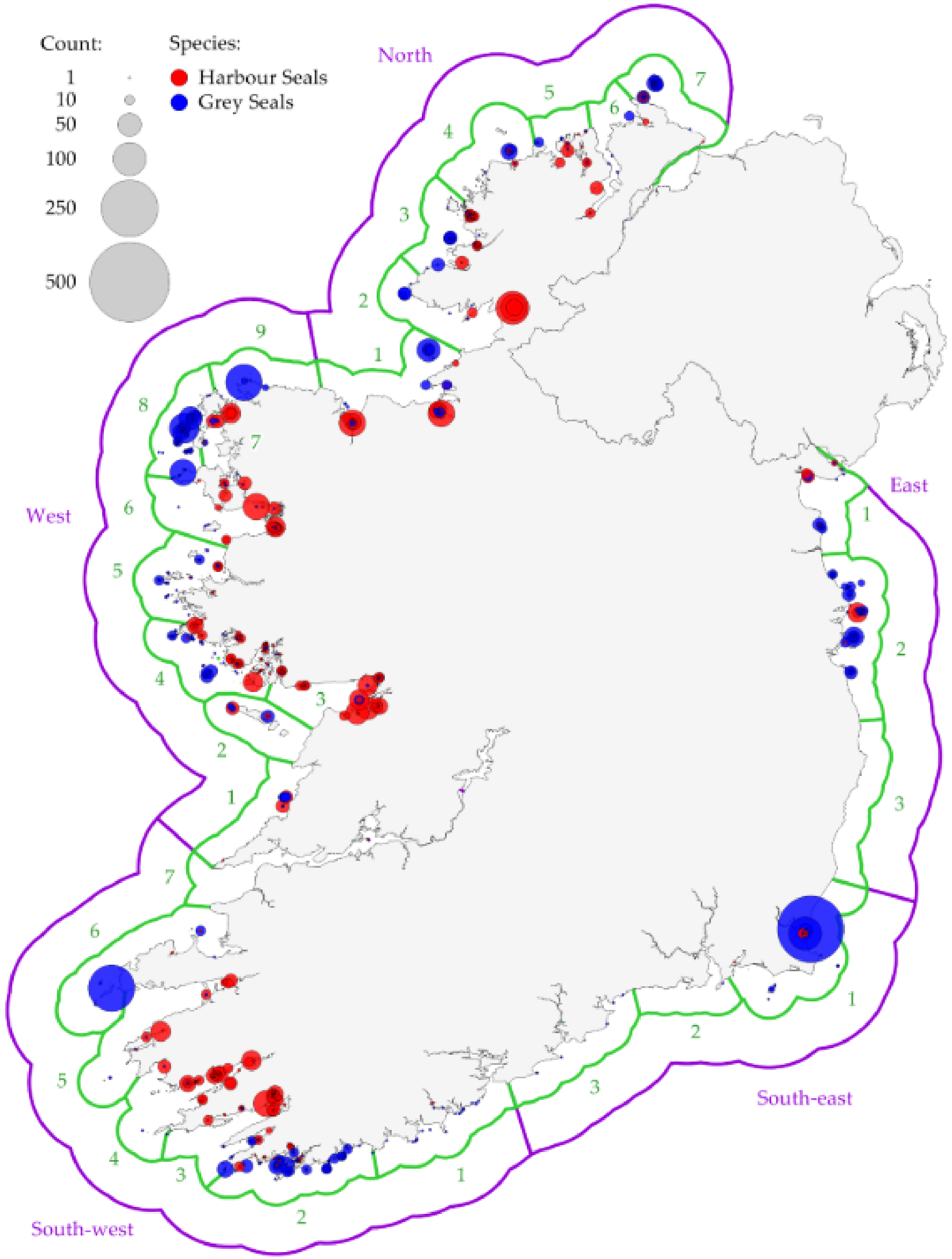


Figure 50 Numbers and distribution of Harbour Seals (red circles) and Grey Seals (blue circles) in Ireland in August 2017 and August 2018. The displayed symbol size represents the recorded group size with count guides given in the Legend (top left) (Morris & Duck, 2019).

Telemetry

3.4.10 Telemetry data for grey seals tagged in UK waters have shown connectivity between the east coast of the Republic of Ireland, Northern Ireland, Wales, southwest England and the southwest coast of Scotland (Figure 51). Within a 100 km buffer of the array area, there is telemetry data from 43 grey seals, 42 of which were tagged in the West England and Wales MU and one tagged in the West Scotland MU. The tracklines of these individual seals show the movement patterns of individual seals and thus the possibly connectivity of seals using various haul-out and at-sea locations between the Dublin Array and the Lambay Island SAC, the Saltee Islands SAC, Lleyn Peninsula and the Sarnau SAC, the Cardigan Bay SAC and the Pembrokeshire Marine SAC (Figure 51). However, since no grey seals have been tagged at haul-out sites close to the Dublin Array, the level of connectivity between the project site and with each SAC specifically, is unknown.

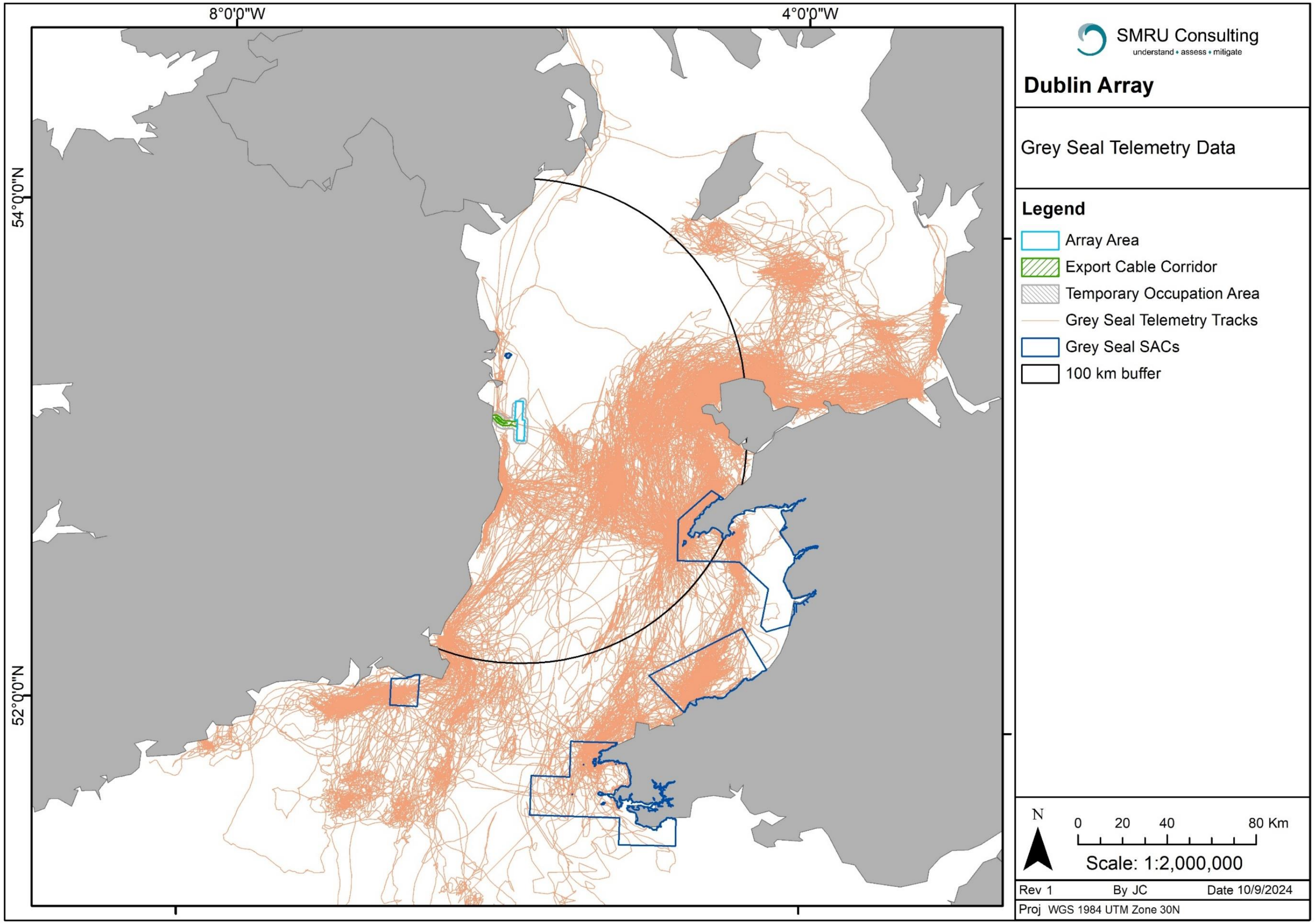


Figure 51 Grey seal telemetry data – 43 grey seals with telemetry tracks within the 100 km buffer of the Dublin Array array area.

3.4.11 Telemetry data from eight grey seals tagged on the Great Blasket Island have shown movement along the west coast of the Republic of Ireland, Northern Ireland and the Inner and Outer Hebrides in Scotland (Figure 52) (Cronin et al. 2011, Cronin et al. 2013b). These telemetry data do not show any movement between the west and east coast of the Republic of Ireland, however, with such a small sample size it is not possible to conclude no connectivity.

3.4.12 While there is no telemetry data for grey seals tagged at the Lambay Island SAC, given its proximity to Dublin Array, and the typical foraging range of grey seals (~50 km (Cronin et al. 2013b)), it is likely that there is connectivity between Dublin Array and the Lambay Island SAC (i.e., seals from the Lambay Island SAC could be present within the Dublin Array area).

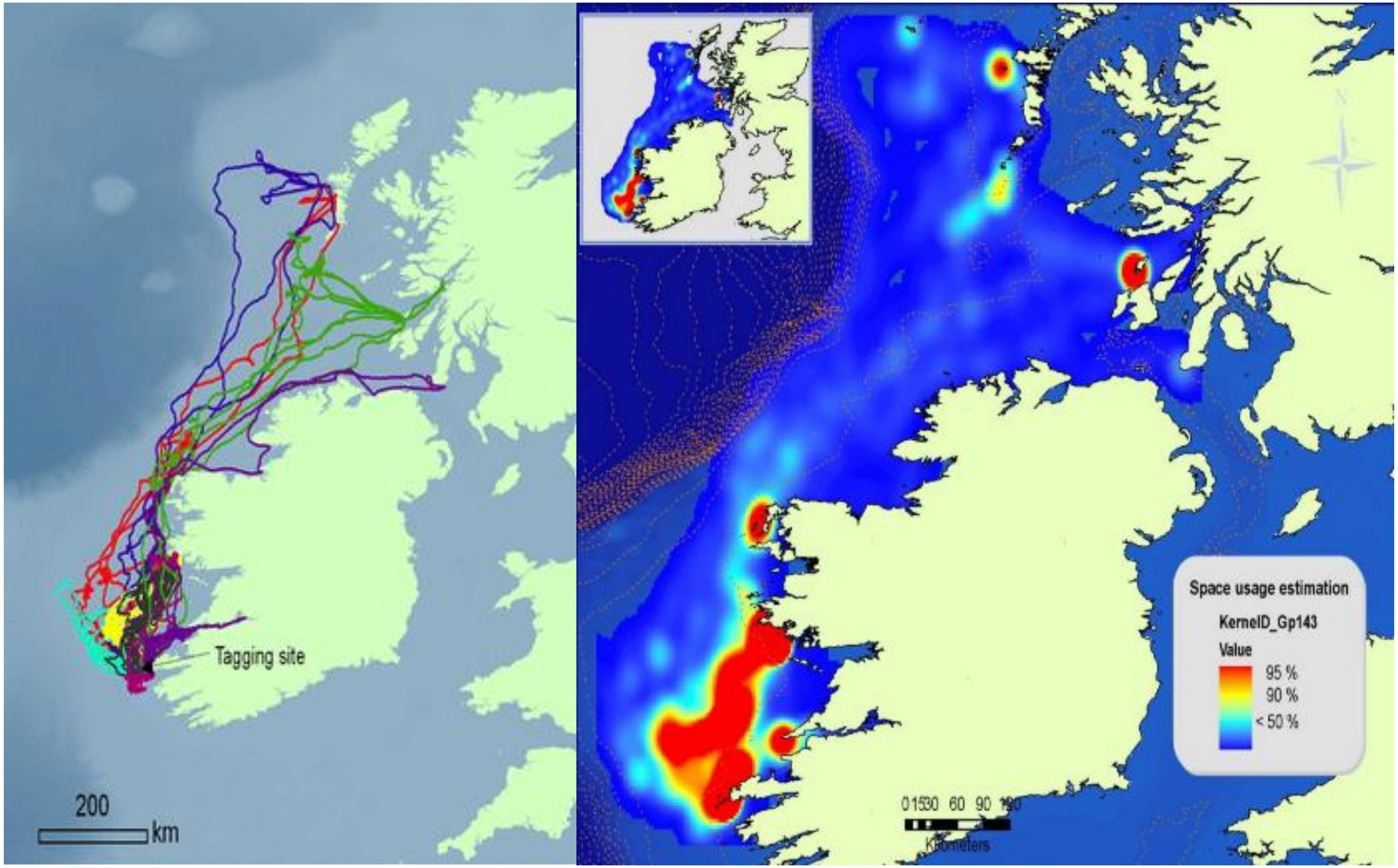
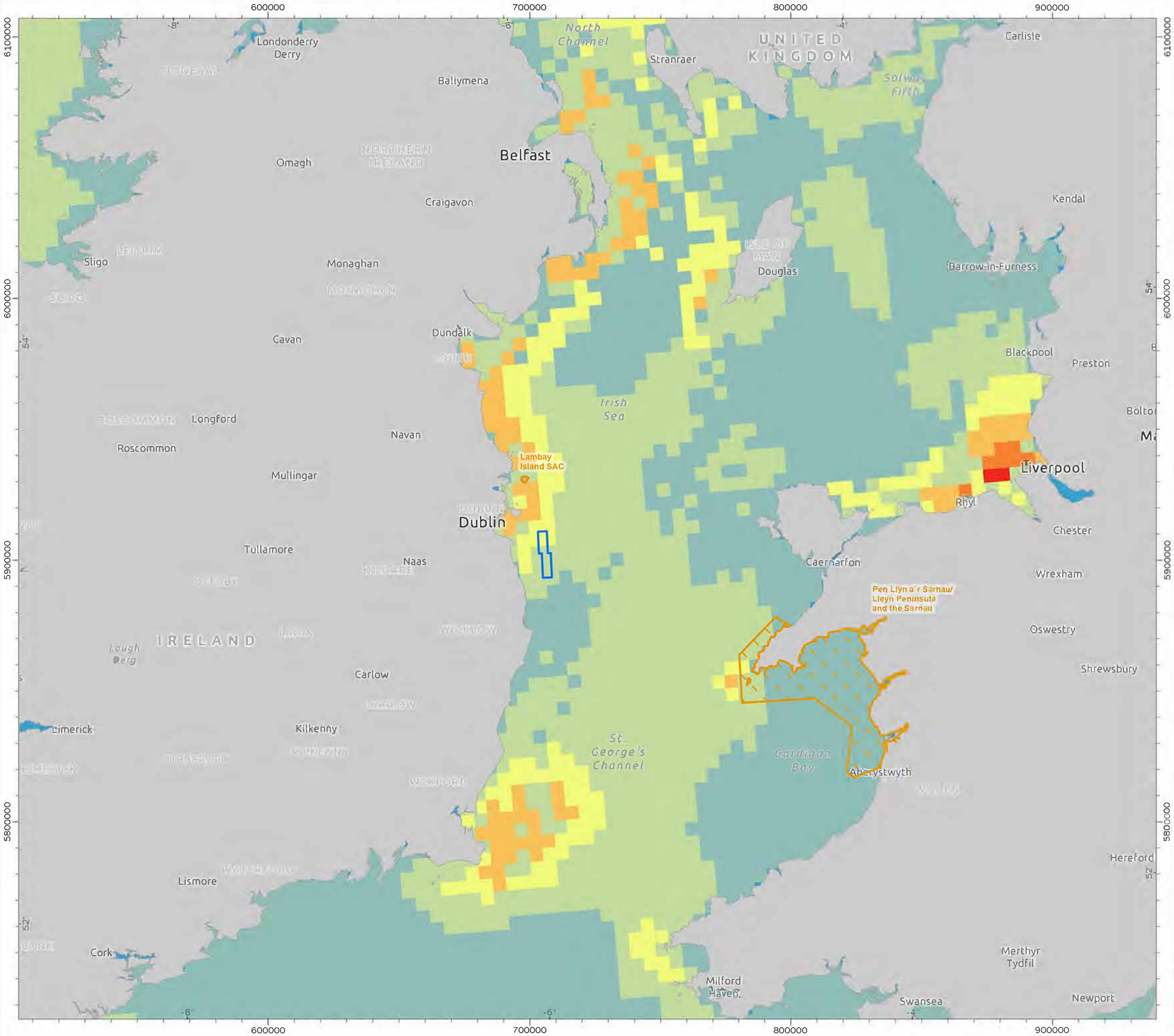


Figure 52 Left: Tracks of 8 female grey seals tagged with GPS/GSM tags between February and December 2009 (Cronin *et al*. 2013b). Right: Space use of all 8 tagged grey seals (Cronin *et al*. 2011).

At-sea density

3.4.13 The at-sea habitat preference maps predict low densities of grey seals within Dublin Array (up to 0.59 grey seals/km^2), with higher estimates within the ECC compared to the array area (Figure 53). Densities are higher slightly to the north of Dublin Array, around the Lambay Island SAC where densities reach a maximum of 1.25 grey seals/km^2 (Carter et al. 2020, Carter et al. 2022).



Array Area

Grey Seal SACs

Grey Seal At-Sea Distribution (Carter *et al.*, 2020)

% At-Sea Population per Cell

- 0
- 0 - 0.001
- 0.001 - 0.005
- 0.005 - 0.01
- 0.01 - 0.025
- 0.025 - 0.05
- >0.05

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PROJECT TITLE

Dublin Array

DRAWING TITLE

Grey Seal Habitat Preference at-sea Density Estimates (Carter *et al.*, 2022)

DRAWING NUMBER: **53**

PAGE NUMBER: **1 of 1**

VER	DATE	REMARKS	DRAW	CHEK	APRD
01	2024-10-04	For Issue	GB	BB	SS

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0 6 12 18 24 nm

N

SCALE	1:1,500,000	PLOT SIZE	A3
DATUM	WGS 1984	VERTICAL REF	LAT
PRJ	WGS 1984 UTM Zone 29N		

GoBe APEM Group

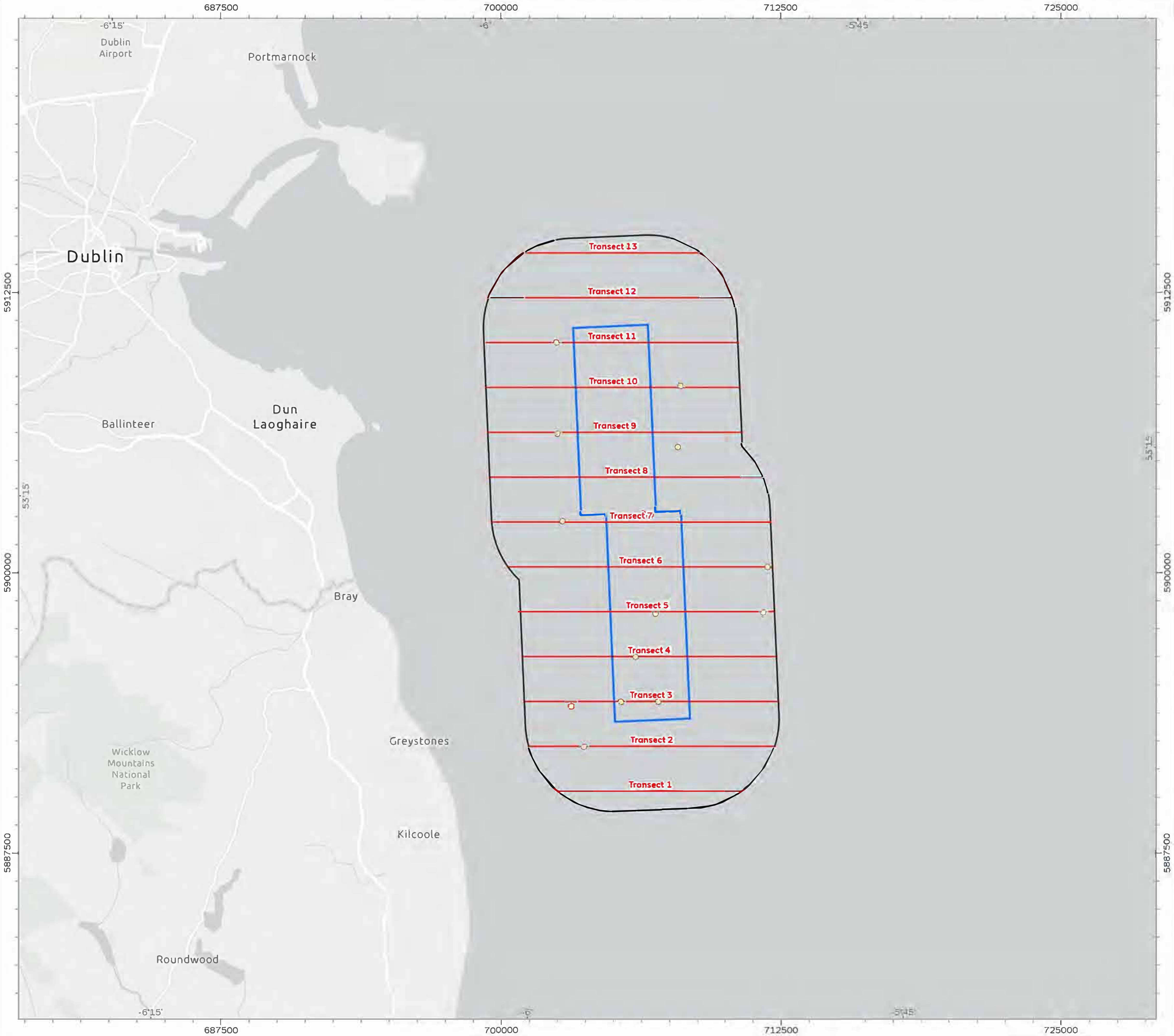
Dublin Array Generation for generations

Kish Offshore Wind Limited - Bray Offshore Wind Limited

Site-specific surveys (2019-2021)

3.4.14 Over the 13 months of site-specific surveys, there were a total of 14 grey seal sightings, distributed throughout the survey area (Figure 54). In addition to this there were two sightings of harbour/grey seals in the south of the survey area, where species identification was not possible. There were an insufficient number of sightings to calculate a density estimate for grey seals.

3.4.15 During the previous baseline surveys conducted in 2010-2011, six grey seals were sighted. Again, this confirms the presence of grey seals in Dublin Array, but no density estimate was able to be calculated given the low number of sightings.



Array Area

4km Survey Buffer

Transects

Number of Sightings (June 2019 to September 2020)

● 1

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PROJECT TITLE

Dublin Array

DRAWING TITLE

Distribution of Grey Seal Sightings within the Dublin Array Survey Area

DRAWING NUMBER: 54

PAGE NUMBER: 1 of 1

VER	DATE	REMARKS	DRAW	CHEK	APRD
01	2024-10-04	For Issue	GB	BB	SS

0 1.5 3 4.5 6 km

0 0.8 1.5 2.3 3 nm

SCALE 1:175,000 PLOT SIZE A3

DATUM WGS 1984 VERTICAL REF LAT

PRJ WGS 1984 UTM Zone 29N

GoBe

Dublin Array

Kish Offshore Wind Limited - Bray Offshore Wind Limited

IWDG Surveys

3.4.16 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 two 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 55).

3.4.17 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.

3.4.18 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 two grey seals reported in block A and two in block B. For both blocks, the mean group size was one. For block A, the estimated relative abundance of grey seals was estimated at 0.01 individuals/km (Figure 64). For block B, the estimated relative abundance of grey seals was reported at 0.014 individuals/km.

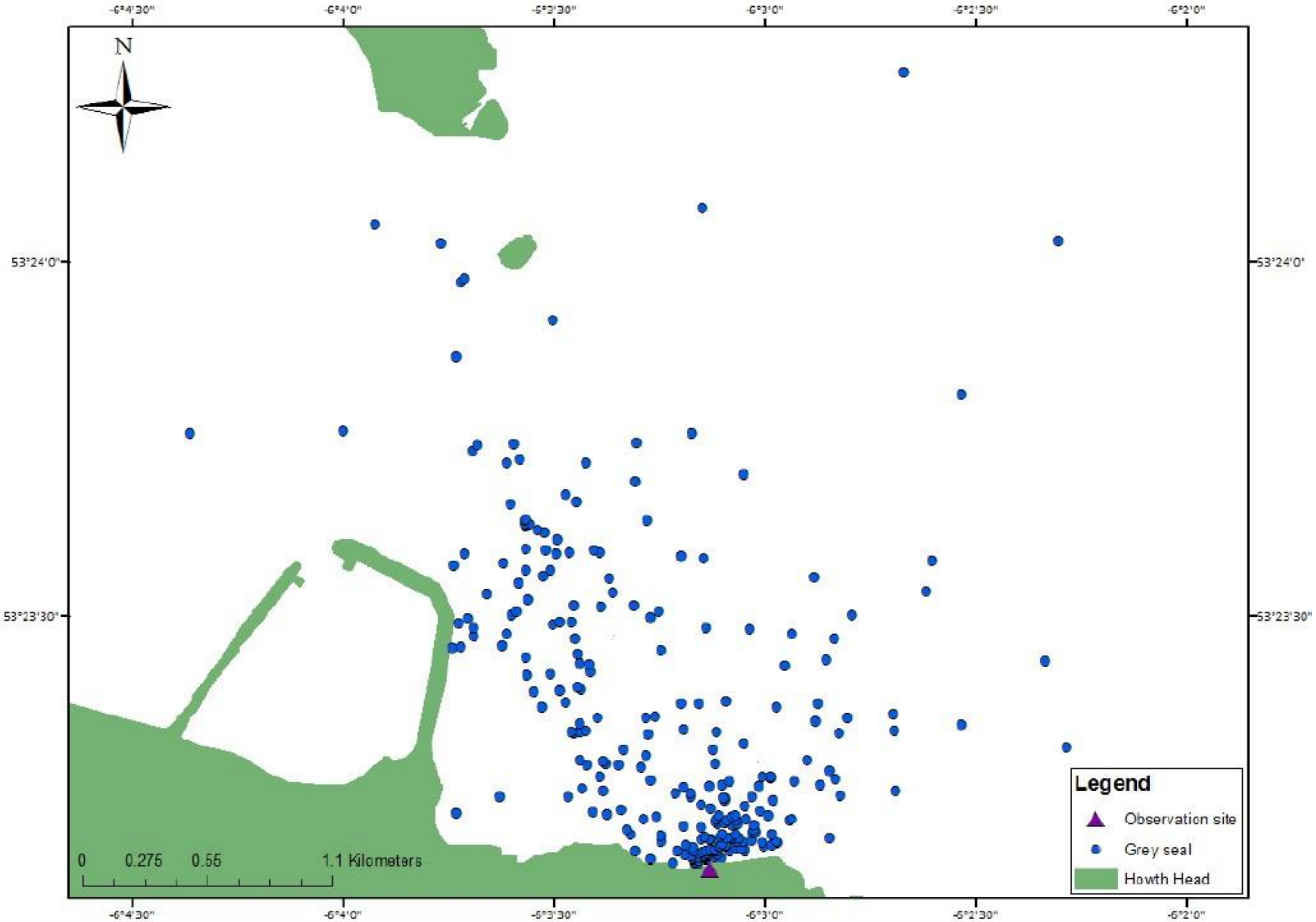


Figure 55 Distribution of grey seal sightings off Howth Head (Meade *et al*. 2017)

Seasonality

3.4.19 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 disturbance close to haul out sites during these months. Outside of the breeding season, seals will exhibit a much wider spatial variation.

Grey seal summary

3.4.20 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 taken forward for impact assessment for Dublin Array.

3.5 Minke whale

3.5.1 Minke whales are observed throughout Ireland's coastal and offshore waters, and both the continental slope and shelf (Figure 56). 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 (IAMMWG 2022, 2023), for which the abundance estimate is 20,118 minke whales (CV: 0.18, 95% CI: 14,061 – 28,786) based on data collected during SCANS III and the ObSERVE surveys (Hammond *et al*. 2017, Rogan *et al*. 2018).

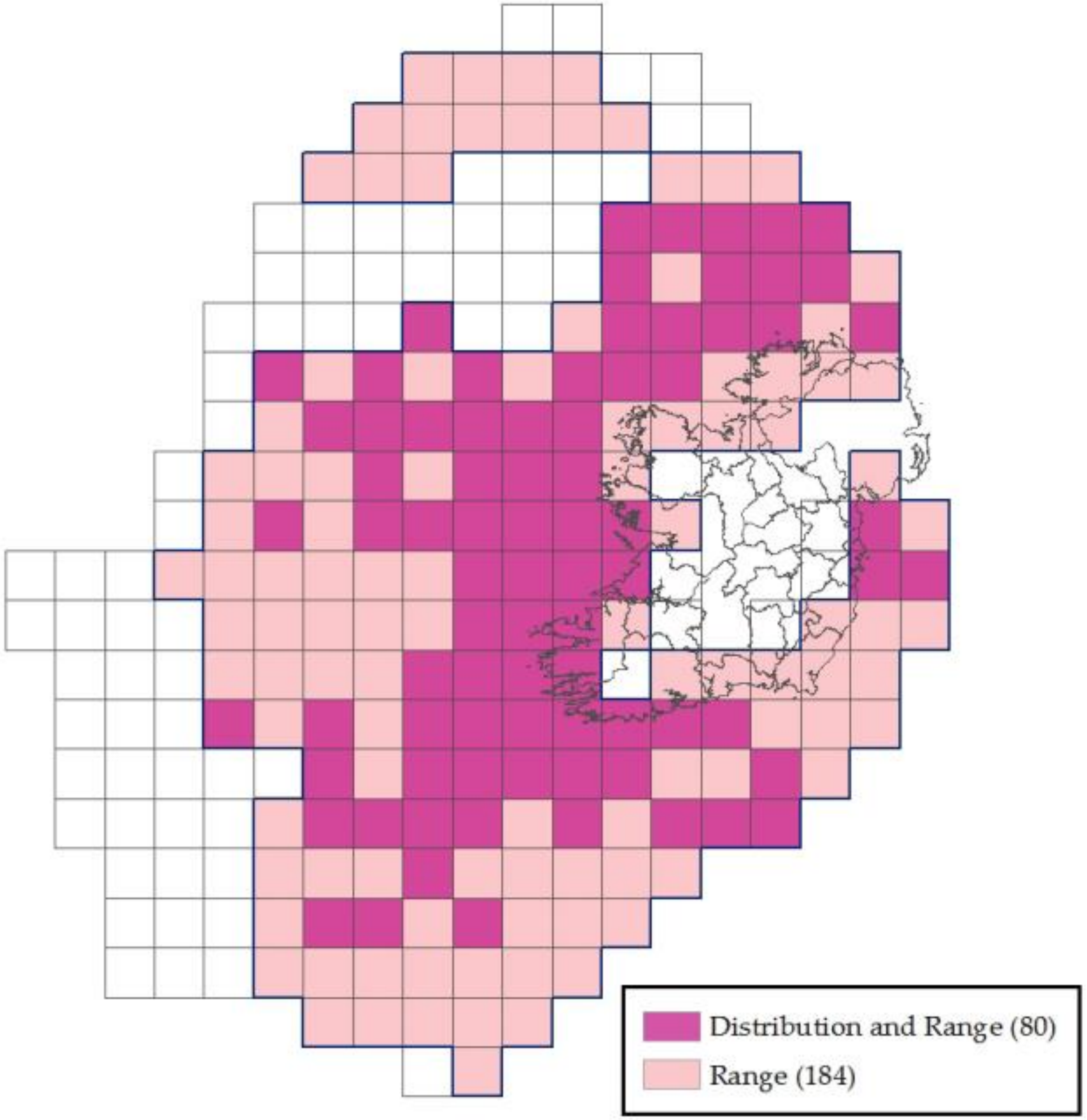
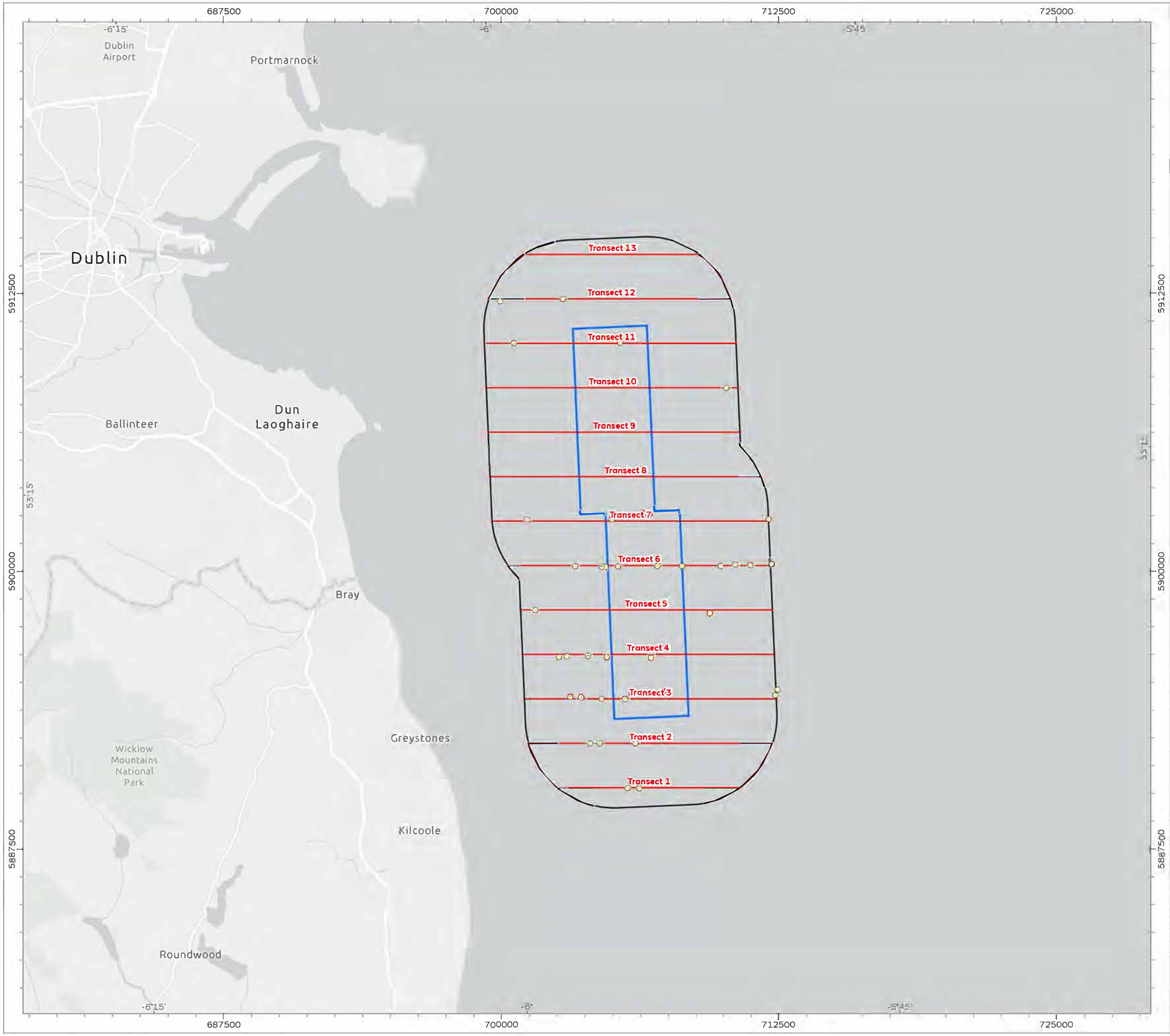


Figure 56 The range and distribution of minke whales in Irish waters (NPWS 2019).

Site-specific surveys (2019-2021)

3.5.2 A total of 50 minke whales were sighted during the Dublin Array site-specific surveys, all of which were sighted in the spring and summer months of March 2021 (n=1), April 2021 (n=21), May 2020 (n=25), June 2019 (n-=1) and July 2020 (n=2). Sightings were made throughout the survey area, but with more sightings in the southern half of the area (Figure 57). The maximum distance for minke whale sightings was 3,000 m, with sightings truncated at 1,000 m in the distance analysis and data recorded in Beaufort sea state ≤3 were included. This resulted in density estimates per survey between 0 and 0.1871 whales/km^2 and an average of 0.01581 whales/km^2 over all 19 surveys.



Array Area

4km Survey Buffer

Transects

Number of Sightings (June 2019 to September 2020)

1

DRAWING STATUS

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PROJECT TITLE

Dublin Array

DRAWING TITLE

Distribution of Minke Whale Sightings within the Dublin Array Survey Area

DRAWING NUMBER: 57

PAGE NUMBER: 1 of 1

VER	DATE	REMARKS	DRAW	CHEK	APRD
01	2024-10-04	For Issue	GB	BB	SS

0 1.5 3 4.5 6 km

0 0.8 1.5 2.3 3 nm

N

SCALE	1:175,000	PLOT SIZE	A3
DATUM	WGS 1984	VERTICAL REF	LAT
PRJ	WGS 1984 UTM Zone 29N		

Kish Offshore Wind Limited - Bray Offshore Wind Limited

ObSERVE

3.5.3 Minke whales were the most frequently sighted mysticete species during the ObSERVE surveys from 2015-2016. Almost all sightings were single individuals, with one sighting of a mother-calf pair of minke whales. These individuals were sighted in neritic[15] waters, in all strata and in the Irish Sea (Figure 59). 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 for minke whales in the survey area (Figure 59). 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 59).

3.5.4 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 Dublin Array 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 13).

[15] relating to or denoting the shallow part of the sea near a coast and overlying the continental shelf

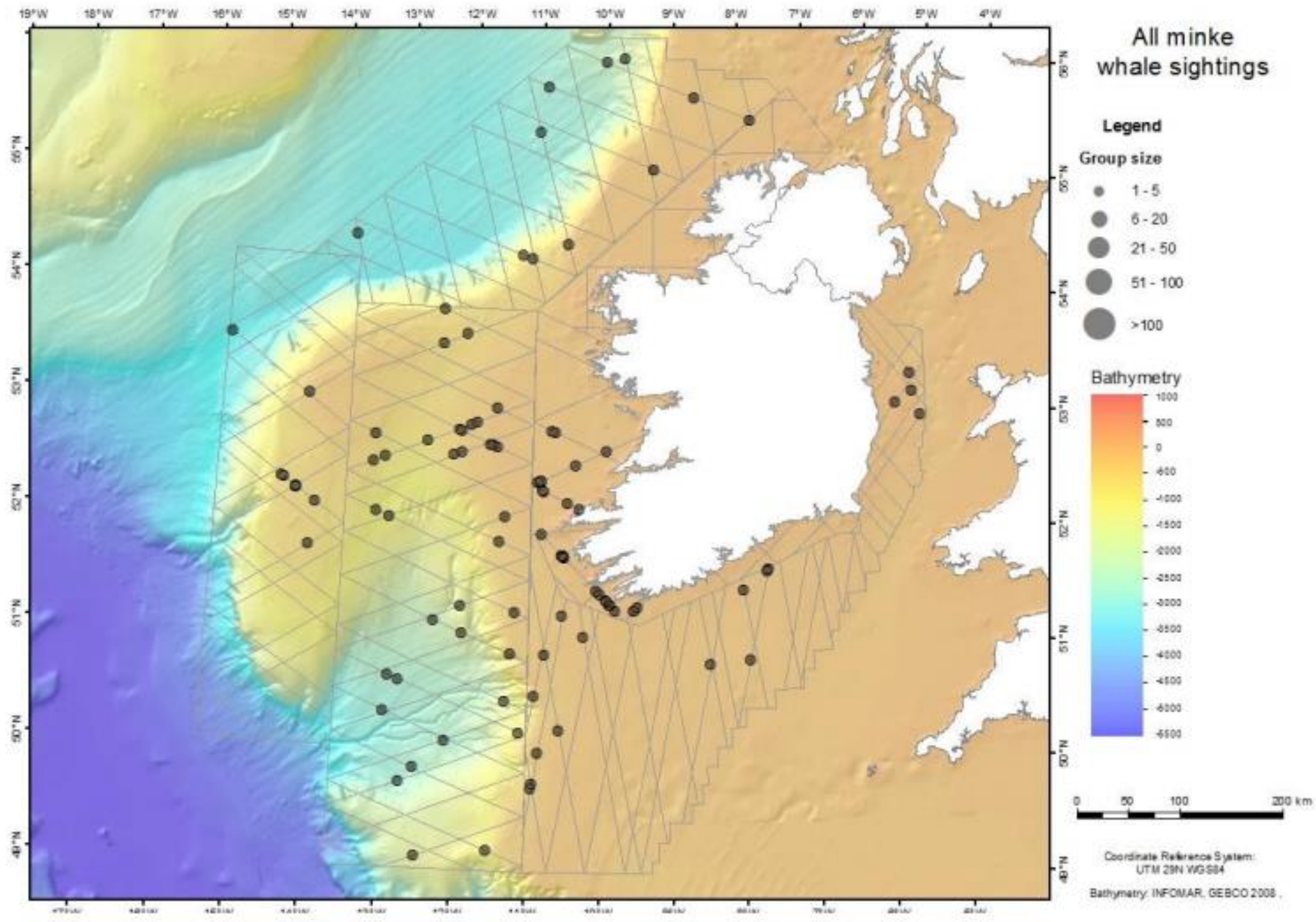


Figure 58 All minke whale sightings from the ObSERVE surveys from 2015-2016 (Rogan *et al*. 2018)

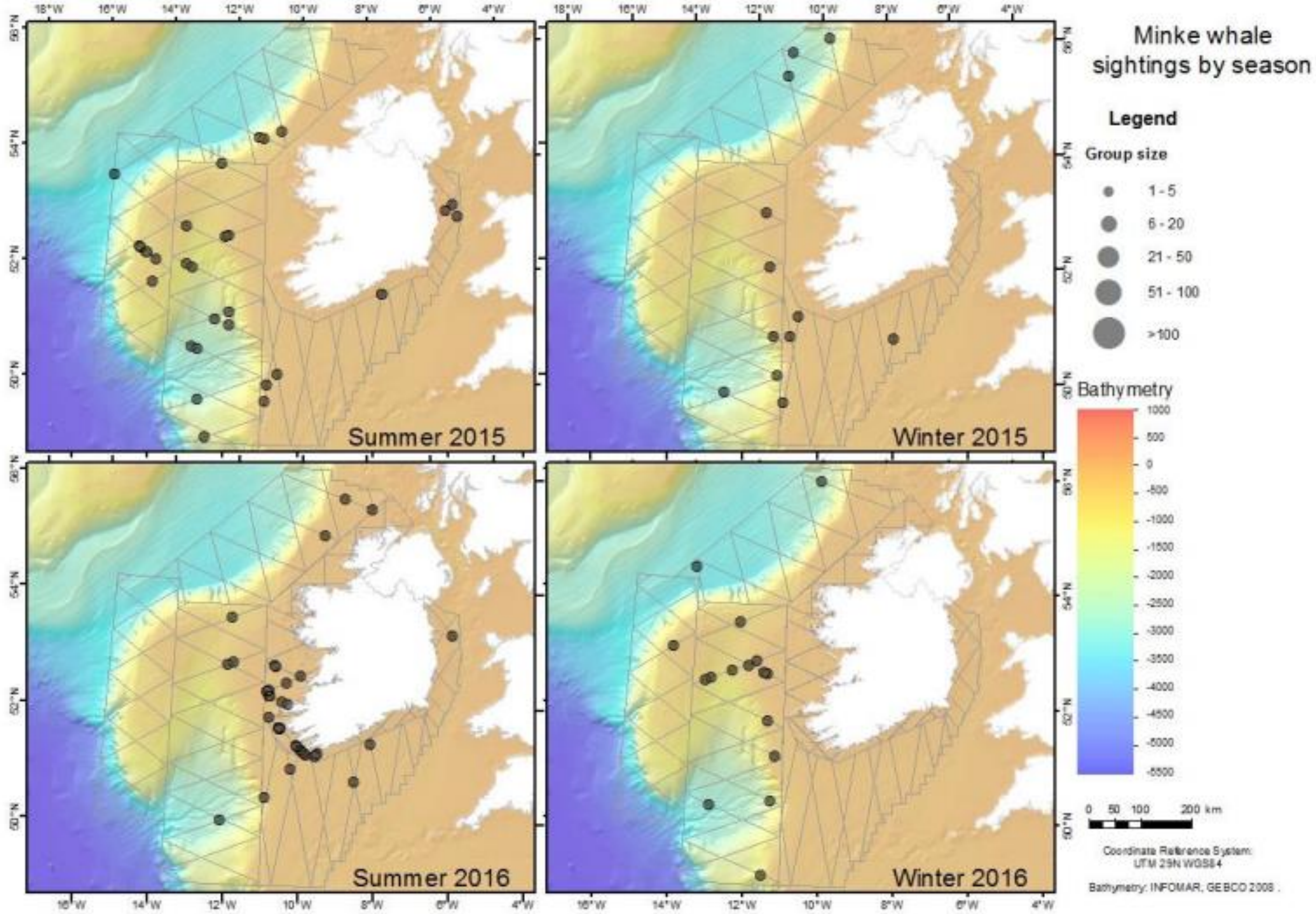


Figure 59 Seasonal sightings of minke whales from the ObSERVE surveys from 2015-2016 (Rogan *et al*. 2018).

Table 13 Minke whale groups, mean group size, density and corrected design-based estimates for stratum 5 of the ObSERVE surveys (Rogan *et al*. 2018).

Season	Stratum	Groups	Mean group size	Density (#/km^2)	Density (#/km^2)	Abundance	Lower CI	Upper CI
1	S5	3	1	0.014	0.045	494.7	221.5	1105.0
3	S5	1	1	0.005	0.016	180.1	58.6	552.9

Distribution and abundance of cetaceans in Wales and its adjacent waters

3.5.5 Minke whales were modelled throughout the Irish Sea and Bristol Channel, with varying distribution patterns (Figure 60) (Evans and Waggitt 2023). 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 Dublin Array area is up to 0.012 whales/km^2 (Figure 61).

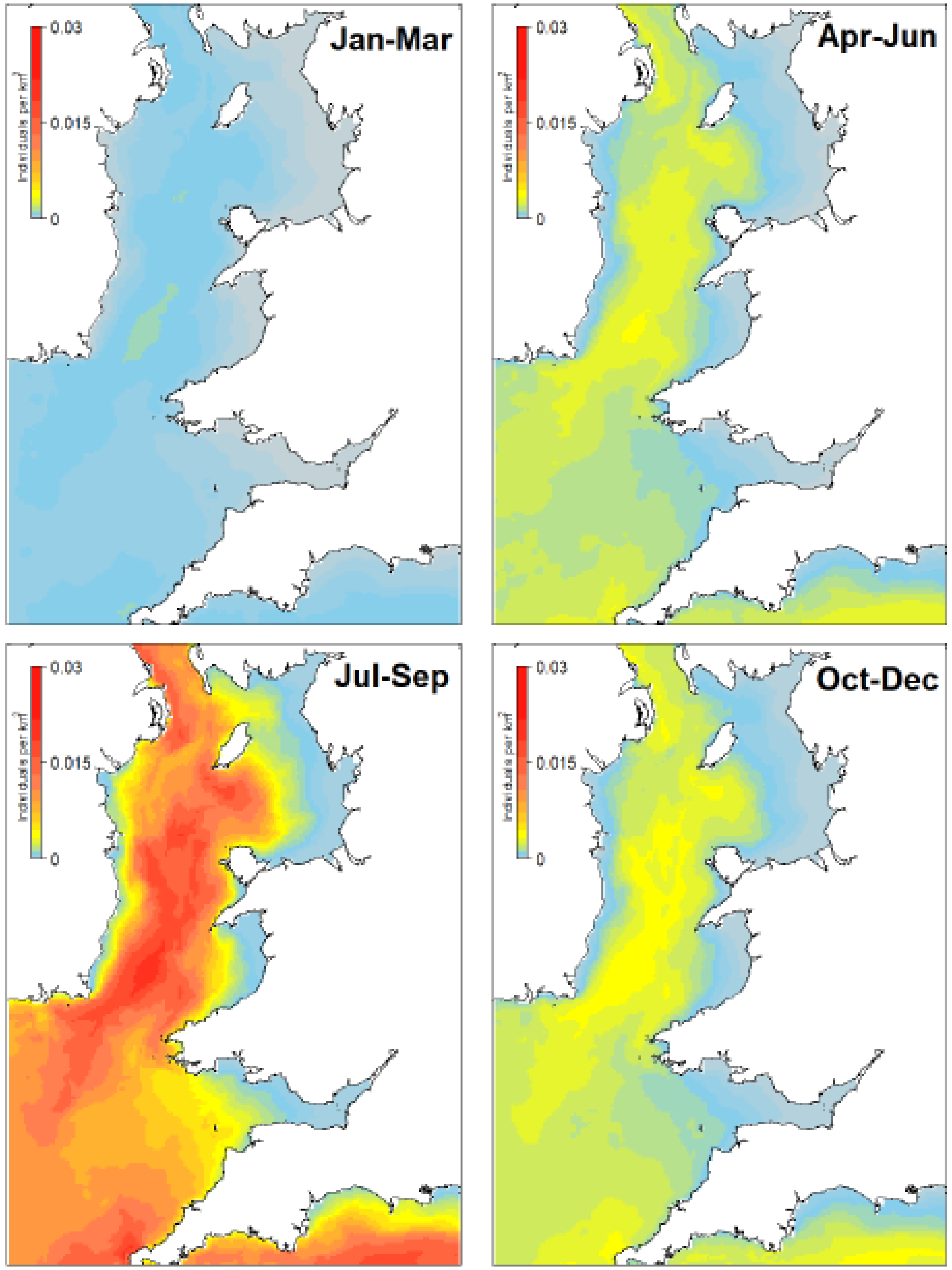
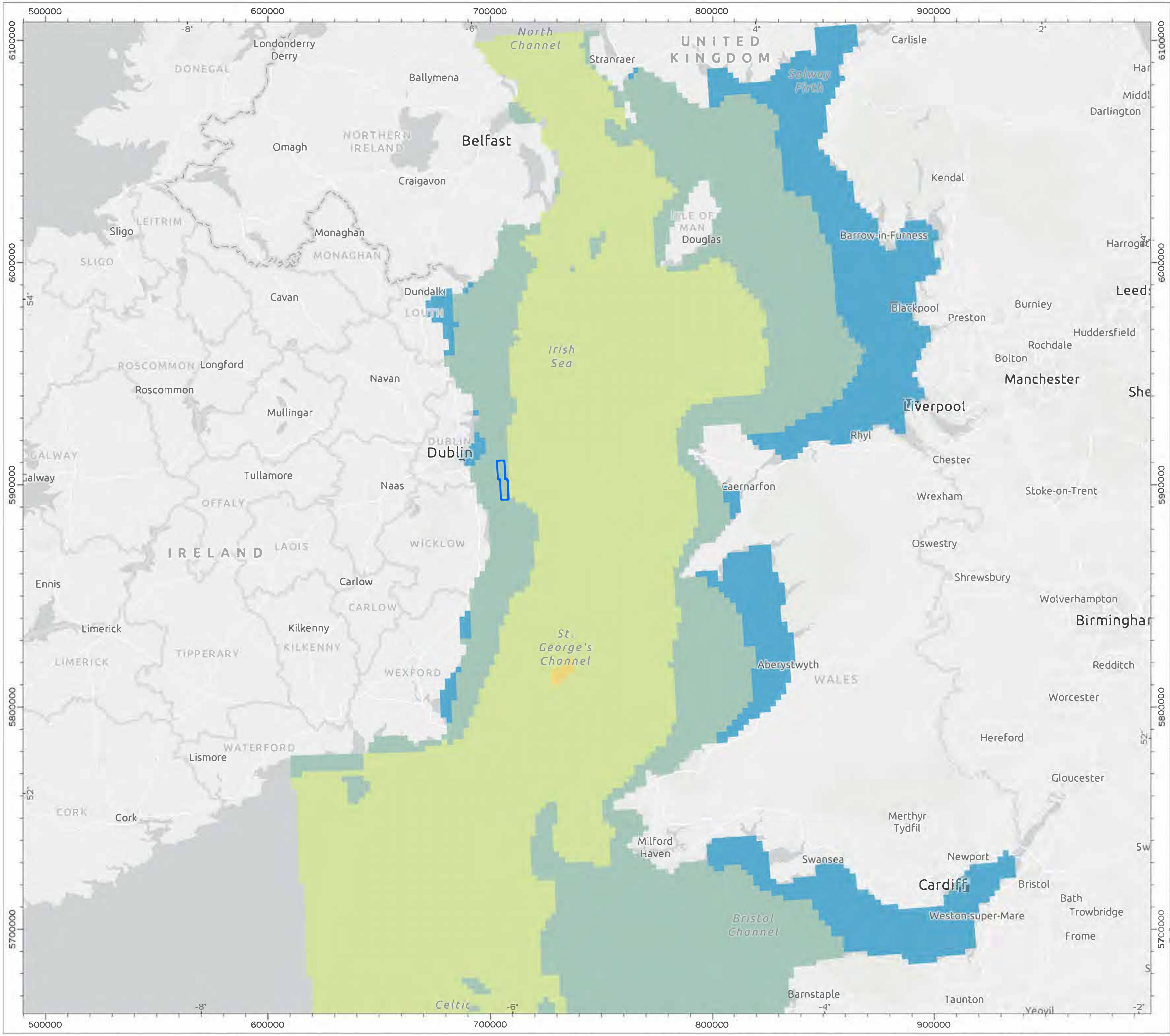


Figure 60 Minke whale modelled densities by quarter (Evans and Waggitt 2023)



Array Area

Evans & Waggit 2023 Density Surface

Minke Whale Density (#/km²)

- 0 - 0.001
- 0.001 - 0.1
- 0.01 - 0.025
- 0.025 - 0.05

DRAWING STATUS

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PROJECT TITLE

Dublin Array

DRAWING TITLE

Minke Whale Modelled Densities (Maximum Density per Cell Across Months), Evans and Waggit, 2023

DRAWING NUMBER: 61

PAGE NUMBER: 1 of 1

VER	DATE	REMARKS	DRAW	CHEK	APRD
01	2024-10-04	For Issue	GB	BB	SS

0 15 30 45 60 km
0 7.5 15 22.5 30 nm

N

SCALE	1:1,750,000	PLOT SIZE	A3
DATUM	WGS 1984	VERTICAL REF	LAT
PRJ	WGS 1984 UTM Zone 29N		

GoBe APEM Group

Dublin Array Generation for generations

Kish Offshore Wind Limited - Bray Offshore Wind Limited

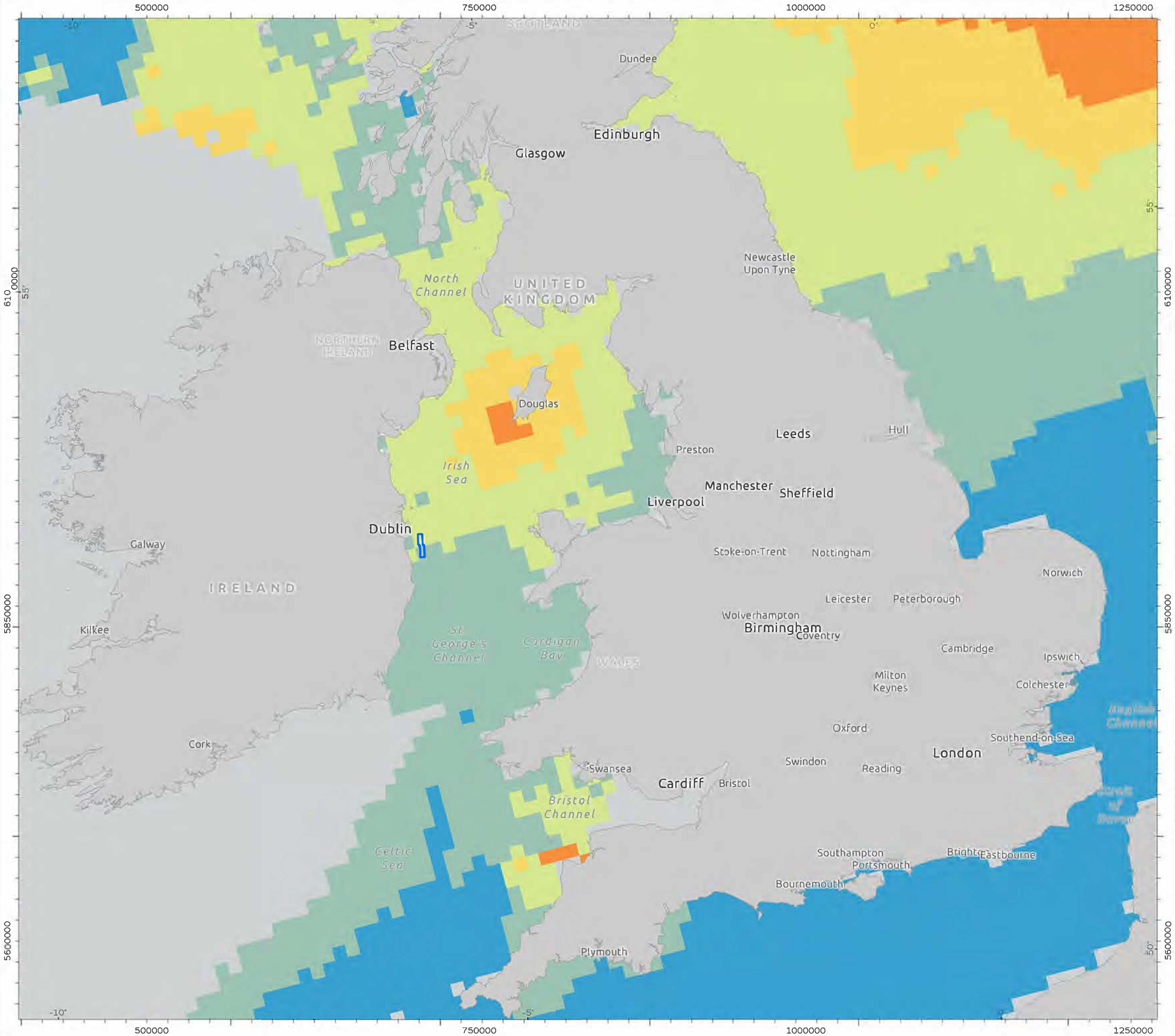
SCANS

3.5.6 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). The abundance estimate for these individuals was concluded at 603 individuals, with lower and upper confidence intervals (CIs) of 134 and 1,753 respectively. Density estimates for minke whales within this block was reported to be 0.017 animals/km^2.

3.5.7 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).

3.5.8 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 the array area and ECC are relatively low with values below 0.02 minke whale/km^2 (Figure 62).

3.5.9 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 whale 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).



Array Area

Lacey *et al.*, 2020 SCANS III Density Surface

Minke Whale Density (#/km²)

- 0 - 0.008
- 0.008 - 0.017
- 0.017 - 0.026
- 0.026 - 0.034
- 0.034 - 0.043

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PROJECT TITLE

Dublin Array

DRAWING TITLE

Predicted Surfaces of Estimated Density for Minke Whale in SCANS III Data (Lacey et al., 2022)

DRAWING NUMBER: 62

PAGE NUMBER: 1 of 1

VER	DATE	REMARKS	DRAW	CHEK	APRD
01	2024-10-04	For Issue	GB	BB	SS

0 20 40 60 80 km

0 10 20 30 40 nm

N

SCALE 1:3,000,000 | PLOT SIZE A3

DATUM WGS 1984 | VERTICAL REF LAT

PRJ WGS 1984 UTM Zone 29N

GoBe APEM Group

Dublin Array Generation for generations

Kish Offshore Wind Limited - Bray Offshore Wind Limited

IWDG surveys

3.5.10 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 63). No minke whales were recorded during the land-based surveys at Howth Head.

3.5.11 During the IWDG Inshore Irish Sea surveys (Berrow *et al*. 2011), minke whales were reported in both block A (Dublin area) and B (south coast). For block A, the estimated relative abundance of minke whales was estimated at 0.03 individuals/km (Figure 64). For block B, the estimated relative abundance of minke whales was reported at 0.149 individuals/km.

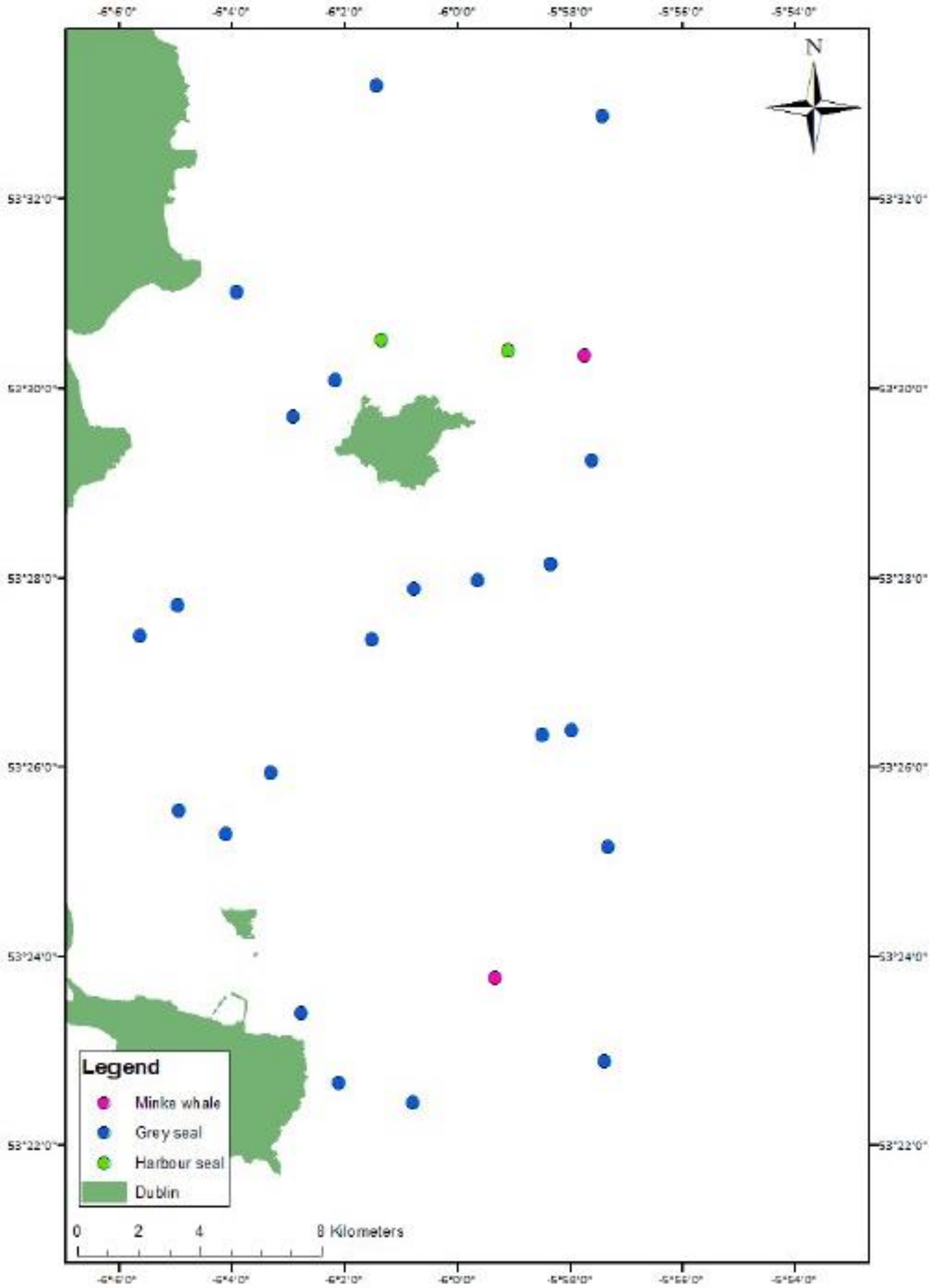


Figure 63 Distribution of seal and minke whale sightings recorded during vessel-based surveys (Meade *et al*. 2017)

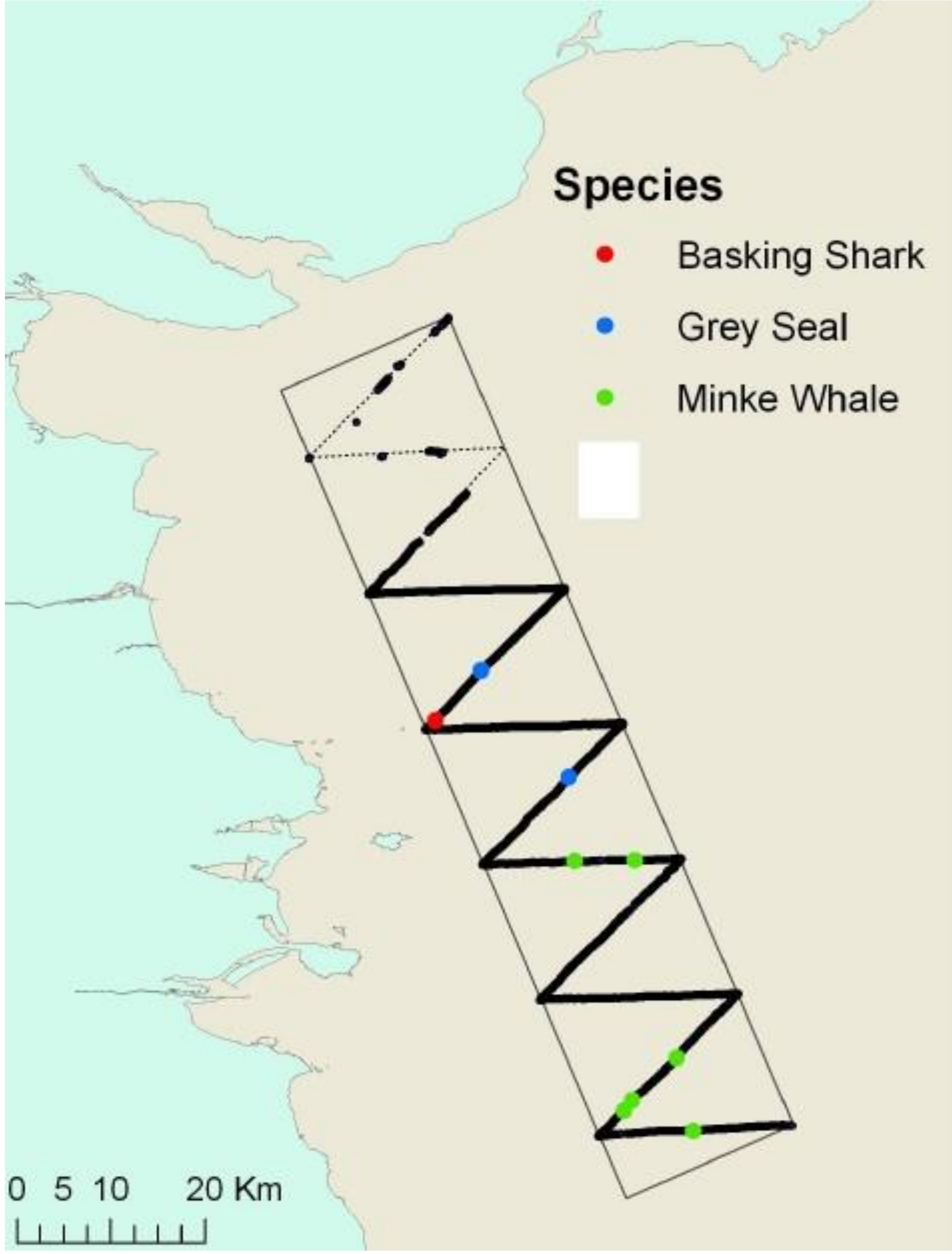


Figure 64 Sighting records of minke whale, grey seal and basking shark in Block A (Berrow *et al*. 2011).

Irish Marine Mammal Atlas

3.5.12 Minke whales were reported off all Irish coasts, with the majority of sightings occurring in shallow waters (<200 m) over the Irish shelf (Figure 65). Relative abundances were concluded to be 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 two to three and loose feeding aggregations of up to seven 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.

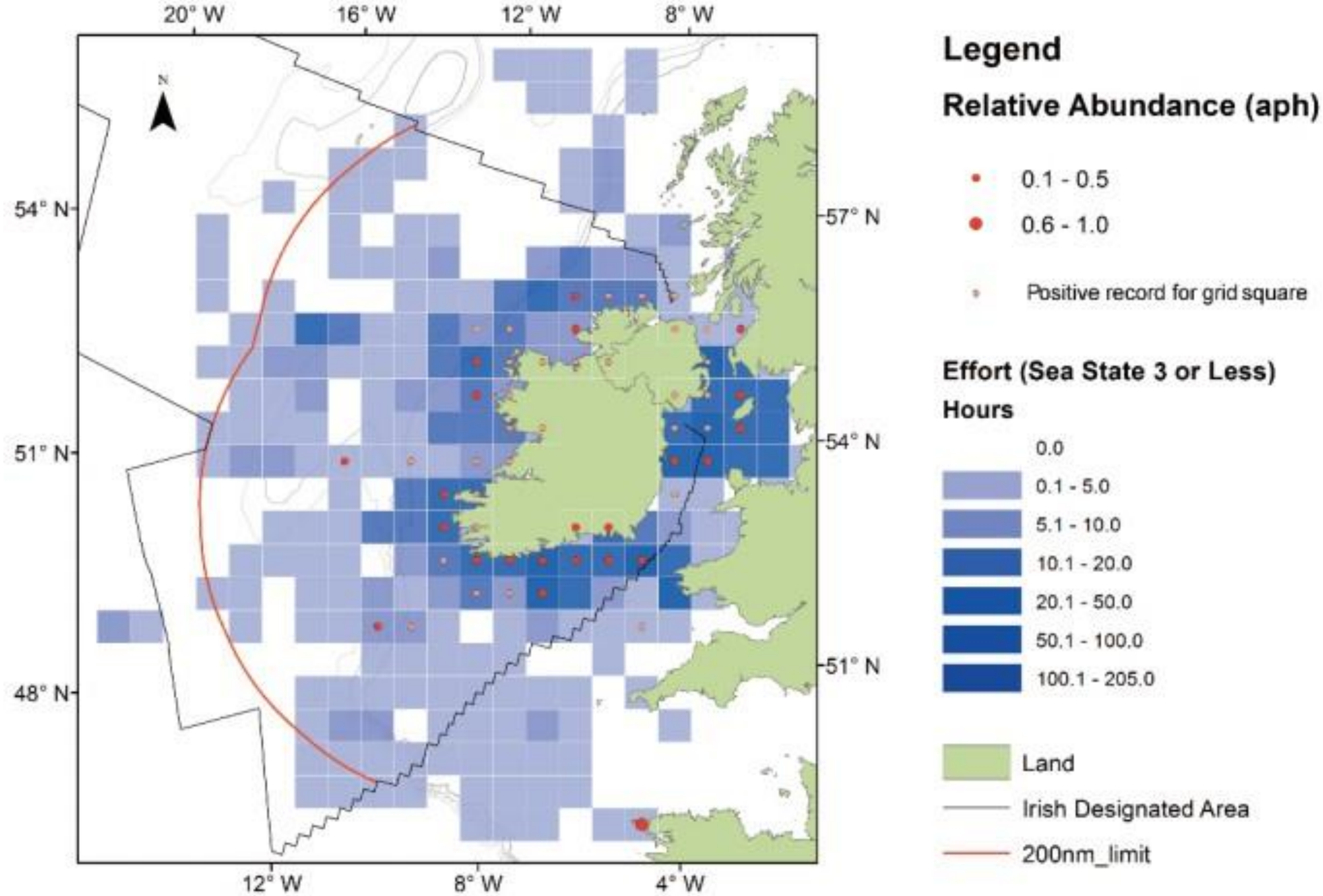


Figure 65 Relative abundance of minke whales from the Irish marine mammal atlas (Wall *et al*., 2013).

Other OWFs

3.5.13 Site-specific density estimations at CWP for minke whales were derived by modelling the boat-based survey data only as no sightings of minke whale were made during aerial surveys (Natural Power 2023). Based on the five observations of minke whale made during boat surveys, the density estimate calculated was 0.0019 whales/km^2 (Codling Wind Park Limited 2024).

3.5.14 Site-specific modelled estimates at Oriel provided a monthly average of 0.04 animals per km^2 (RPS 2024a).

3.5.15 No site-specific density estimate was provided for minke whale at Arklow Bank or NISA.

Seasonality

3.5.16 Minke whales 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 Dublin Array (Rogan *et al*. 2018, Chudzinska and Burt 2021). 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 Dublin Array will most likely be undertaking feeding behaviour in this region.

Minke whale summary

3.5.17 In summary, there have been a few studies of minke whales in the Irish Sea and in the vicinity of Dublin Array. While there are a range of density estimates available (Table 14), all data sources have shown that minke whales are present in the spring/summer months. While minke whales were sighted in six of the 19 site-specific surveys, most sightings occurred in one month, resulting in an average density estimate for that month of 0.1871 whales/km^2. 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 ObSERVE stratum 5 estimate, the SCANS IV uniform density estimate, the SCANS III density surface and the Evans and Waggitt (2023) density surface.

Table 14 Minke whale density estimates (whales/km^2)[16]

Data source	Reference	Density estimate
Site specific surveys	Burt (2020), (Chudzinska and Burt 2021)	Max: 0.1871 Average: 0.01581
Welsh and Irish Sea distribution	Evans and Waggitt (2023)	Grid cell specific Max 0.012 in array area
SCANS IV block CS-D	Gilles et al. (2023)	0.0137

[16] Densities taken forward for assessment are shaded in blue.

Data source	Reference	Density estimate
SCANS III density surface	Lacey *et al*. (2022)	Grid cell specific <0.02 in the Dublin array area
SCANS III block E	Hammond *et al*. (2017)	0.017
SCANS II block O	Hammond *et al*. (2013)	0.024
ObSERVE summer stratum 5	Rogan *et al*. (2018)	Season 1: 0.045 Season 3: 0.016
CWP site-specific density estimate	Codling Wind Park Limited (2024)	0.0019
Oriel site-specific density estimate	RPS (2024a)	0.04

3.6 Bottlenose dolphin

3.6.1 Bottlenose dolphins are described as being "*one of the most frequently recorded and familiar cetaceans occurring in Ireland*", occurring in group sizes between three and 30 in coastal waters, and larger groups of hundreds of individuals in offshore waters (NPWS 2019) (Figure 66). The species has been assessed as having a Favourable overall conservation status in Irish waters (NPWS 2019). Dublin Array 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) based on data collected during SCANS III and the ObSERVE surveys (Hammond *et al*. 2017, Rogan *et al*. 2018, IAMMWG 2022).

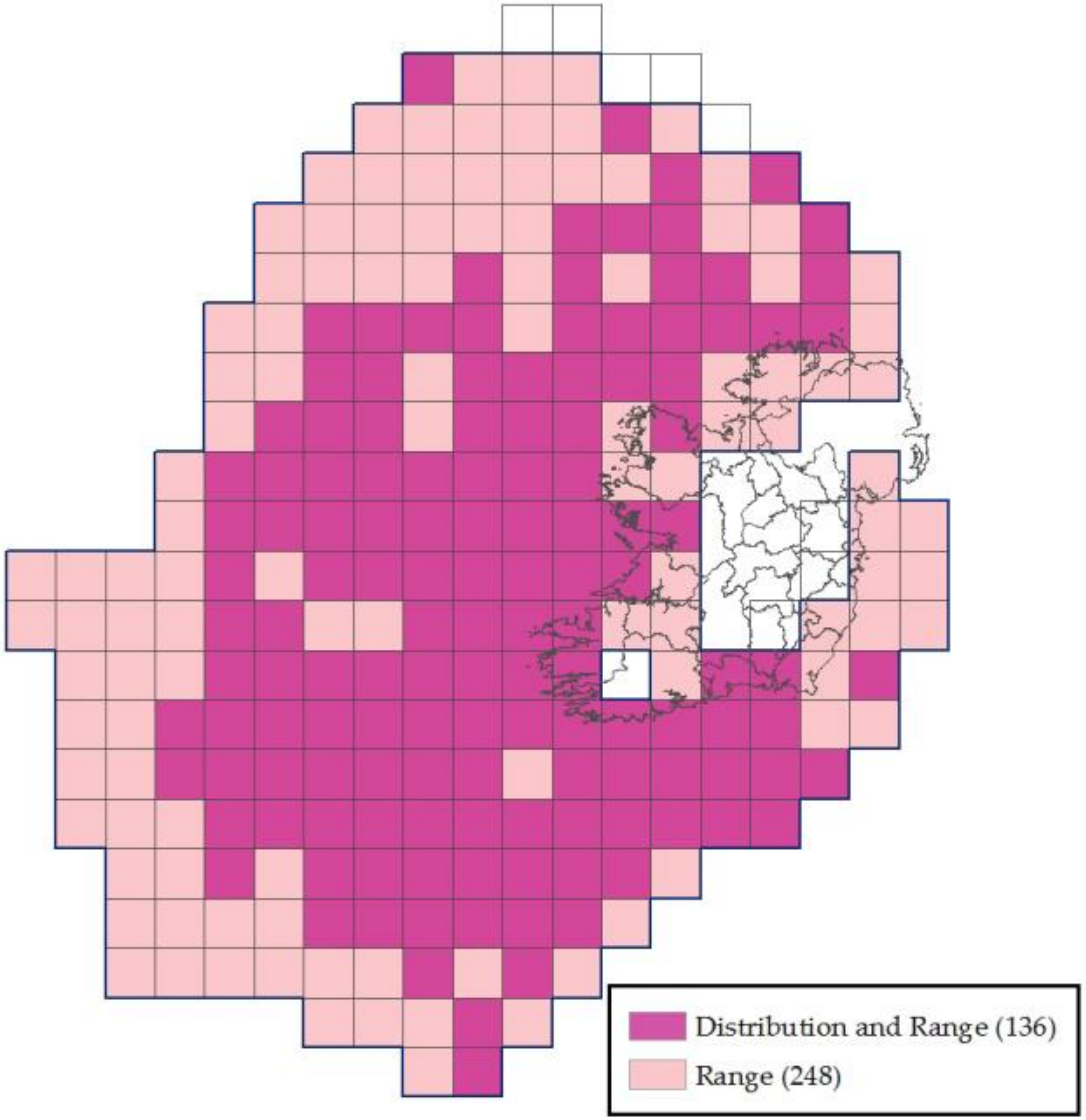


Figure 66 The range and distribution of bottlenose dolphins in Irish waters (NPWS 2019).

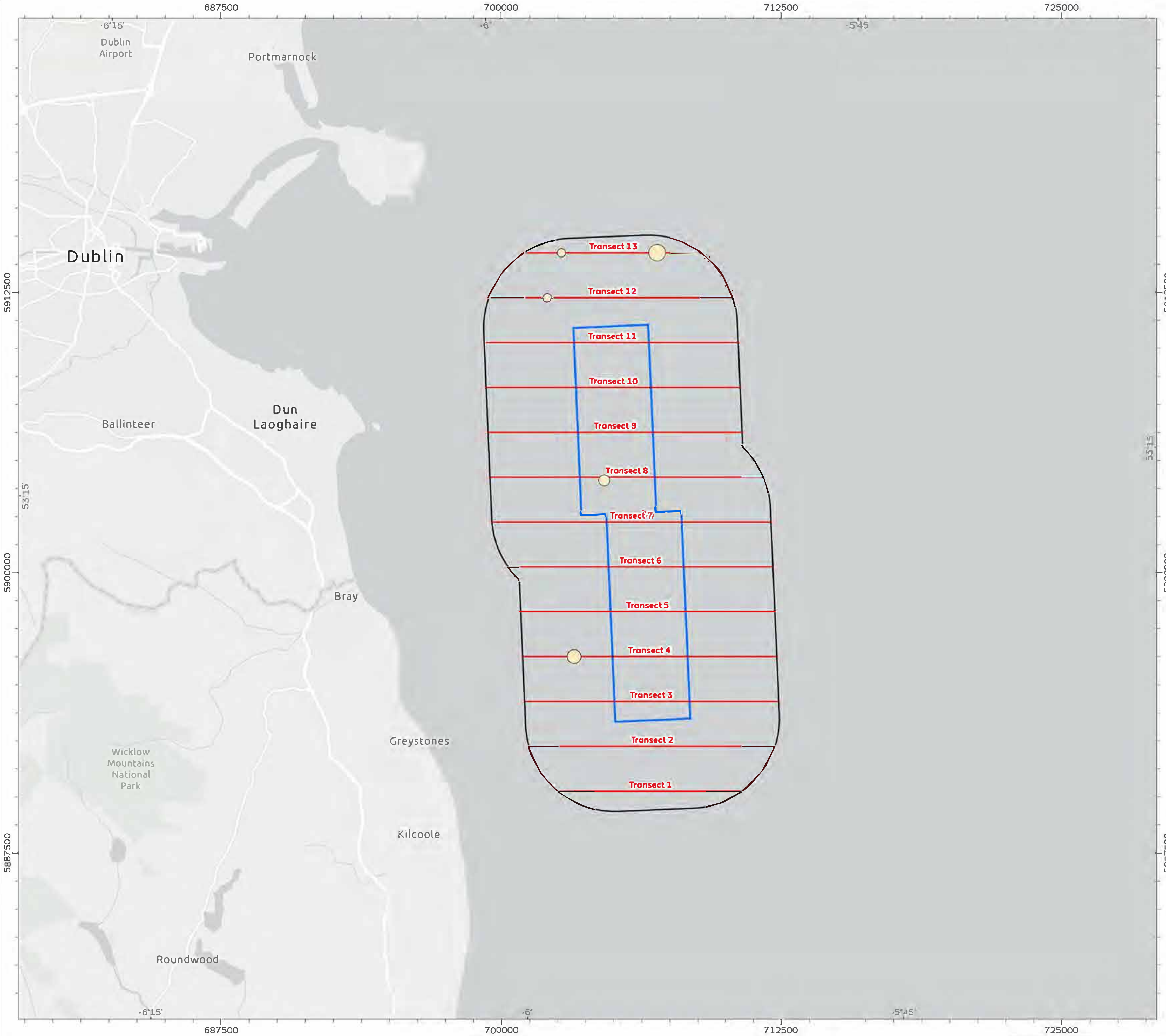
3.6.2 Previous research, combining genetic and photo-ID data has concluded that a high degree of site fidelity for bottlenose dolphins in Irish waters is present amongst Ireland's coastal populations (Nykänen *et al*. 2018, Nykänen *et al*. 2020). However, studies have also found that bottlenose dolphins 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[17]. Due to this, it must be considered that the west coast population of bottlenose dolphins in the Republic of Ireland may demonstrate connectivity to individuals found on the east coast.

3.6.3 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.

Site-specific surveys (2019-2021)

3.6.4 A total of four groups (12 individuals) of bottlenose dolphins were sighted during the site-specific surveys, all in June 2019 (Figure 67). None were sighted on any other survey date, and therefore there were an insufficient number of sightings to calculate a density estimate for the survey area.

[17] https://www.abdn.ac.uk/lighthouse/blog/international-sightings/



Array Area
4km Survey Buffer
Transects
Number of Sighting (June 2019 to September 2020)
1
2
3
7

DRAWING STATUS
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PROJECT TITLE
Dublin Array

DRAWING TITLE
Distribution of Bottlenose Dolphin Sightings within the Dublin Array Survey Area

DRAWING NUMBER: **67**
PAGE NUMBER: **1 of 1**

VER	DATE	REMARKS	DRAW	CHEK	APRD
01	2024-10-04	For Issue	GB	BB	SS

0 1.5 3 4.5 6 km
0 0.8 1.5 2.3 3 nm

N

SCALE	1:175,000	PLOT SIZE	A3
DATUM	WGS 1984	VERTICAL REF	LAT
PRJ	WGS 1984 UTM Zone 29N		

Dublin Array
Generation for generations
Kish Offshore Wind Limited - Bray Offshore Wind Limited

ObSERVE

3.6.5 Bottlenose dolphin sightings during the ObSERVE surveys were mainly located in the west and the south of Ireland (Figure 68). 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).

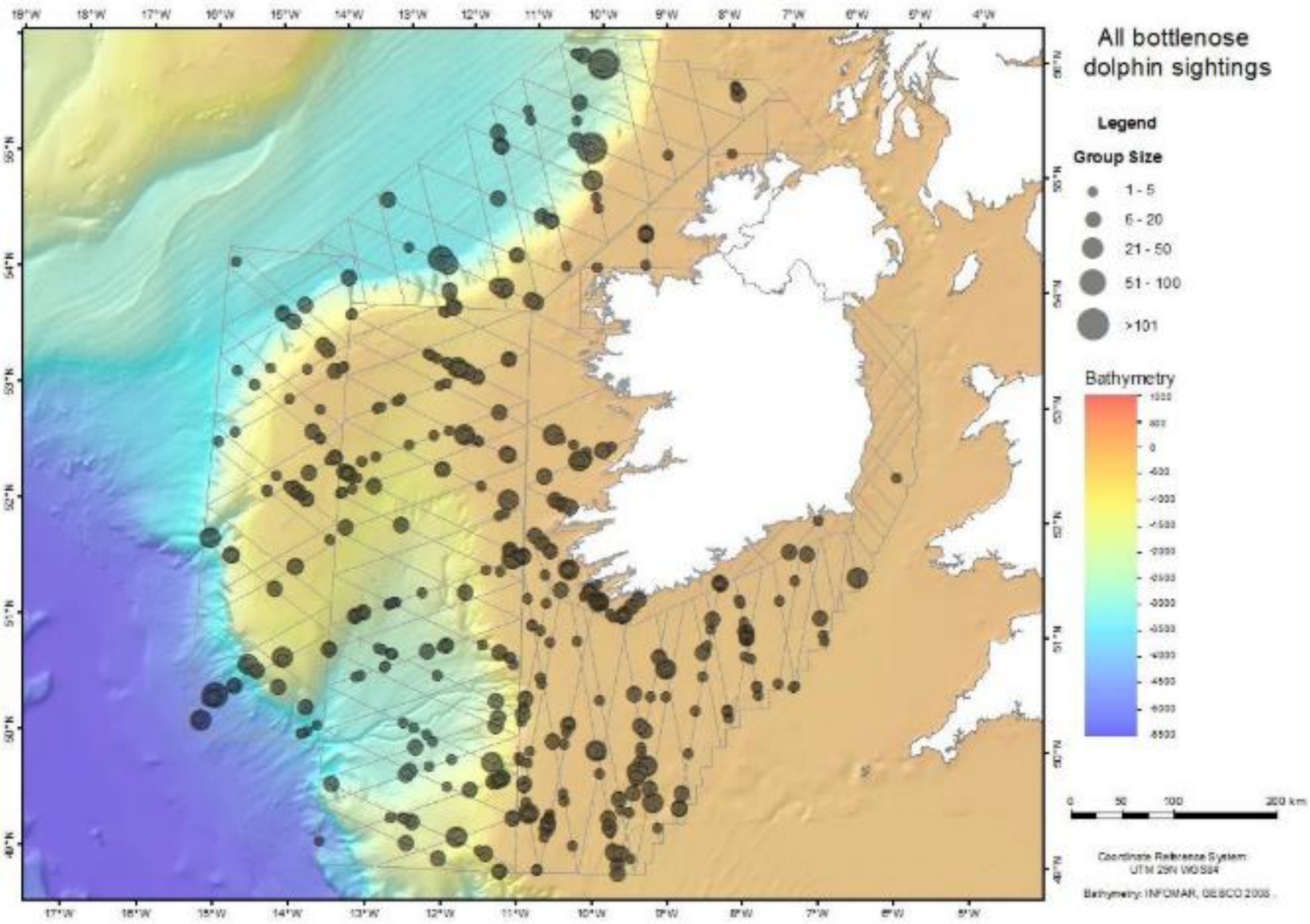


Figure 68 All bottlenose dolphin sightings from the ObSERVE surveys from 2015-2016 (Rogan *et al*. 2018).

Distribution and abundance of cetaceans in Wales and its adjacent waters

3.6.6 Bottlenose dolphins were modelled throughout the Irish Sea and Bristol Channel, with consistent distribution patterns (Figure 69). 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 Republic of Ireland were comparatively very low. Using the maximum density per cell across all months, the estimated density at the Dublin Array area is 0.001 dolphins/km^2 (Figure 70).

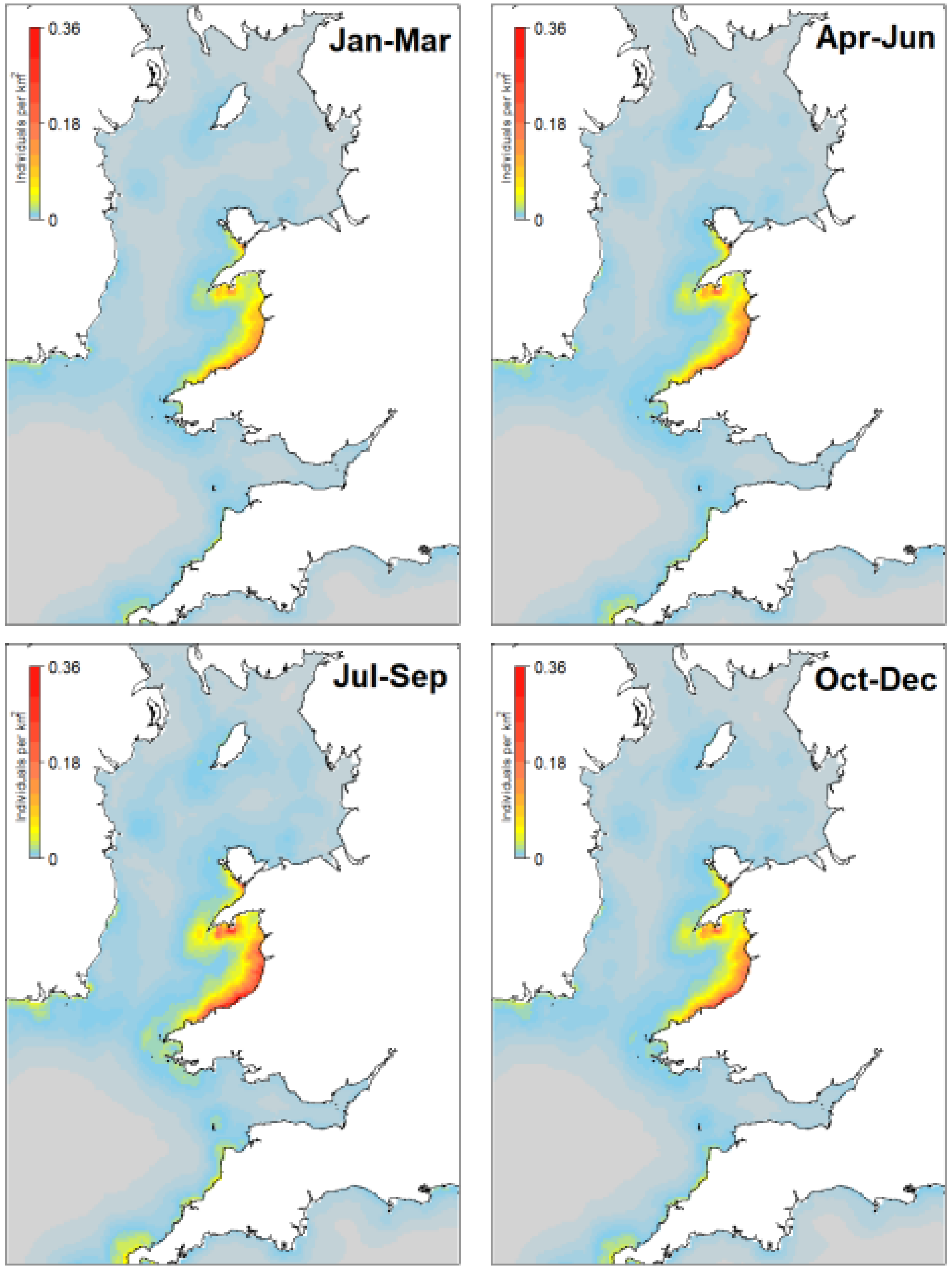
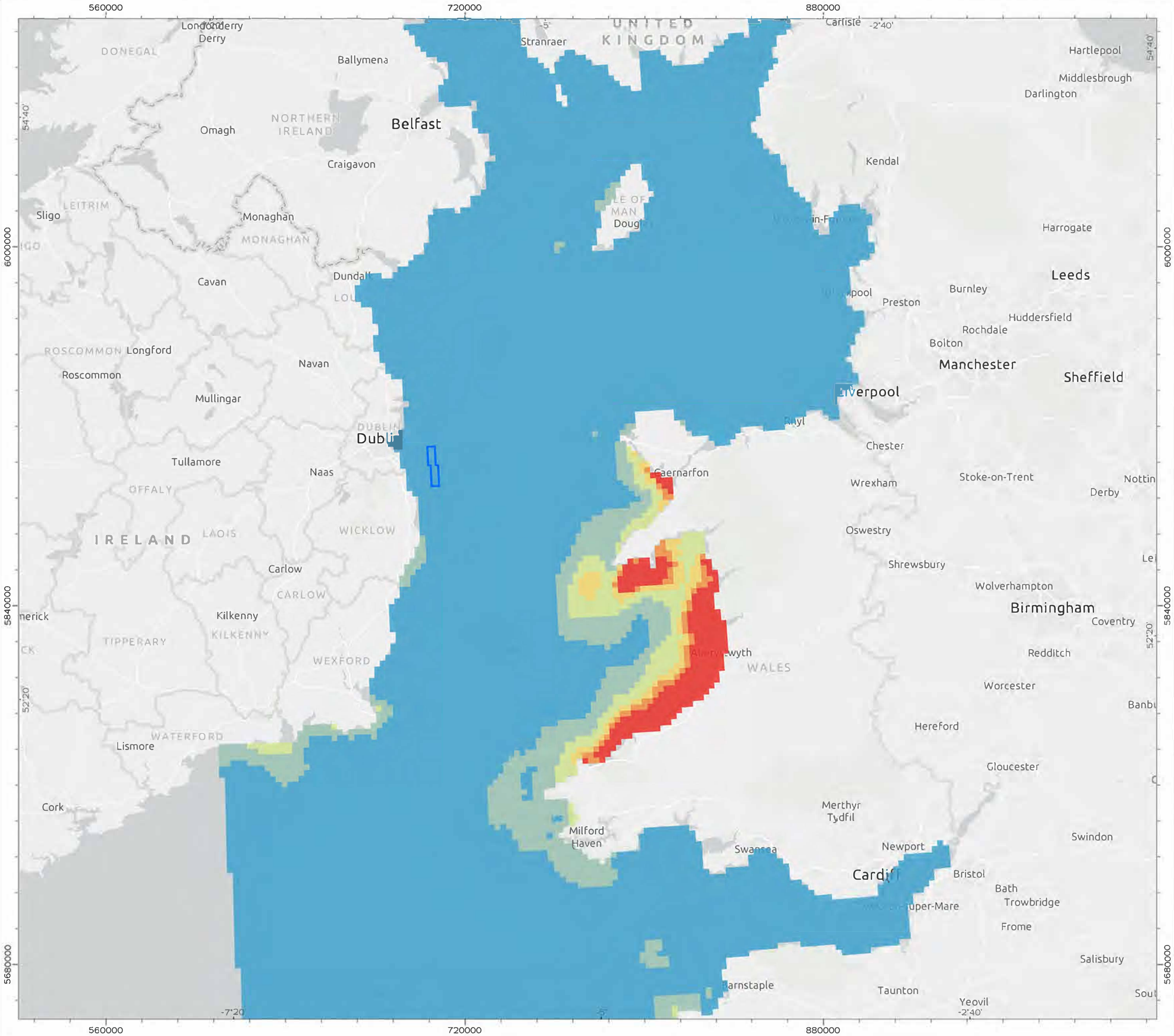


Figure 69 Bottlenose dolphin modelled densities by quarter (Evans and Waggitt 2023)



Array Area

Evans & Waggit 2023 Density Surface

Bottlenose Dolphin Density (#/km²)

- 0 - 0.01
- 0.01 - 0.025
- 0.025 - 0.05
- 0.05 - 0.075
- 0.075 - 0.1
- >0.1

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PROJECT TITLE

Dublin Array

DRAWING TITLE

Bottlenose Dolphin Predicted Density Surface (Evans & Waggitt, 2023)

DRAWING NUMBER: 70

PAGE NUMBER: 1 of 1

VER	DATE	REMARKS	DRAW	CHEK	APRD
01	2024-10-04	For Issue	GB	BB	SS

0 15 30 45 60 km
0 7.5 15 22.5 30 nm

N

SCALE	1:1,750,000	PLOT SIZE	A3
DATUM	WGS 1984	VERTICAL REF	LAT
PRJ	WGS 1984 UTM Zone 29N		

GoBe APEM Group

Dublin Array Generation for generations

Kish Offshore Wind Limited - Bray Offshore Wind Limited

SCANS

3.6.7 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).

3.6.8 Bottlenose dolphins were also sighted in the SCANS II block O, though only in the eastern Irish Sea, off Wales and North-west 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).

3.6.9 The predicted 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 the Dublin Array are relatively low with values below 0.05 bottlenose dolphins/km^2 towards the coastline (Figure 71).

3.6.10 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).

Array Area

Lacey *et al.*, 2020 SCANS III Density Surface

Bottlenose Dolphin Density (#/km²)

- 0 - 0.01
- 0.01 - 0.025
- 0.025 - 0.05
- 0.05 - 0.075

DRAWING STATUS

FINAL

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PROJECT TITLE

Dublin Array

DRAWING TITLE

Predicted Surfaces of Estimated Density for Bottlenose Dolphin in SCANS III Data (Lacey *et al.*, 2022)

DRAWING NUMBER: 71

PAGE NUMBER: 1 of 1

VER	DATE	REMARKS	DRAW	CHEK	APRD
01	2024-10-04	For Issue	GB	BB	SS

0 20 40 60 80 km
0 10 20 30 40 nm

N

SCALE 1:3,000,000 | PLOT SIZE A3
DATUM WGS 1984 | VERTICAL REF LAT
PRJ WGS 1984 UTM Zone 29N

GoBe

Dublin Array
Generation for generations
Kish Offshore Wind Limited - Bray Offshore Wind Limited

IWDG surveys

3.6.11 No bottlenose dolphin sightings were reported on the east coast of Ireland during the IWDG surveys considered in this baseline characterisation.

Irish Marine Mammal Atlas

3.6.12 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 72). 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).

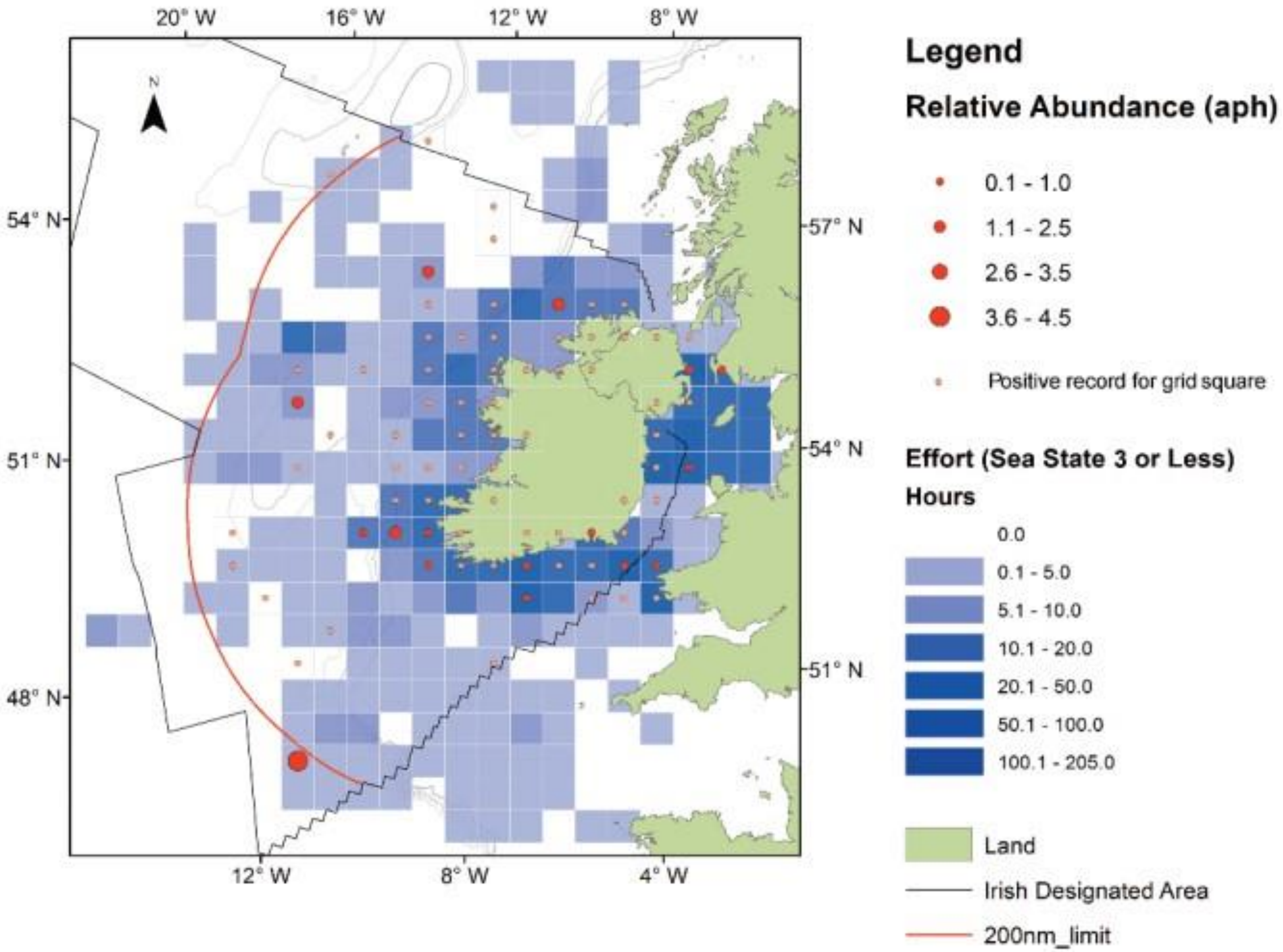


Figure 72 Relative abundance of bottlenose dolphins from the Irish marine mammal atlas (Wall *et al*., 2013).

Other OWFs

3.6.13 In the 29 months of site-specific DAS for NISA, bottlenose dolphin 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 (ARUP 2024).

3.6.14 No site-specific density estimate was provided for bottlenose dolphins at CWP, Arklow Bank or Oriel.

Seasonality

3.6.15 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 Dublin Array would occur during this time period.

3.6.16 Whilst insufficient data was available for the studies conducted in the vicinity of the Dublin Array 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.

Bottlenose dolphin summary

3.6.17 There are a few surveys that have recorded bottlenose dolphins in the vicinity of Dublin Array, including the site-specific surveys, the SCANS surveys and the ObSERVE surveys. The density estimates from all surveys was fairly low, ranging between 0.00 and 0.02 dolphins/km^2 (Table 15). There were insufficient sightings of bottlenose dolphins to calculate a density estimate from the site-specific surveys. Given that the SCANS III modelled density surface shows a difference in bottlenose dolphin densities between the coast and the offshore waters of the Irish Sea, it is necessary to consider a combined density estimate approach for the quantitative impact assessment. Therefore, the impact assessment will use the SCANS IV uniform density estimate, in addition to the SCANS III density surface and the Evans and Waggitt (2023) density surface.

Table 15 Bottlenose dolphin density estimates (dolphins/km^2)[18]

Data source	Reference	Density estimate
Site specific surveys	Burt (2020)	Not calculated
Welsh and Irish Sea distribution	Evans and Waggitt (2023)	Grid cell specific Max 0.001 in the Dublin array area

[18] Densities taken forward for assessment are shaded in blue.

Data source	Reference	Density estimate
SCANS IV block CS-D	Gilles et al. (2023)	0.2352
SCANS III density surface	Lacey *et al*. (2022).	0.025-0.05
SCANS III block E	Hammond *et al*. (2017)	0.008
SCANS II block O	Hammond *et al*. (2013)	0.005
ObSERVE summer stratum 5	Rogan *et al*. (2018)	Season 1: None sighted Season 3: None sighted
ObSERVE winter stratum 5	Rogan *et al*. (2018)	Season 2: None sighted Season 4: 0.02 (model-based) Season 4: 0.036 (design-based)
NISA site-specific density estimate	ARUP (2024)	0.002

3.7 Risso's dolphin

3.7.1 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). The species has been assessed as having a Favourable overall conservation status in Irish waters (NPWS 2019) (Figure 73). The IAMMWG recommend a single Celtic and Greater North Seas MU for Risso's dolphin where the estimate of abundance for Risso's dolphins is 12,262 (CV: 0.46, 95% CI: 5,227 – 28,764) (IAMMWG 2022, 2023) based on data collected during SCANS III and the ObSERVE surveys (Hammond *et al*. 2017, Rogan *et al*. 2018, Hammond *et al*. 2021).

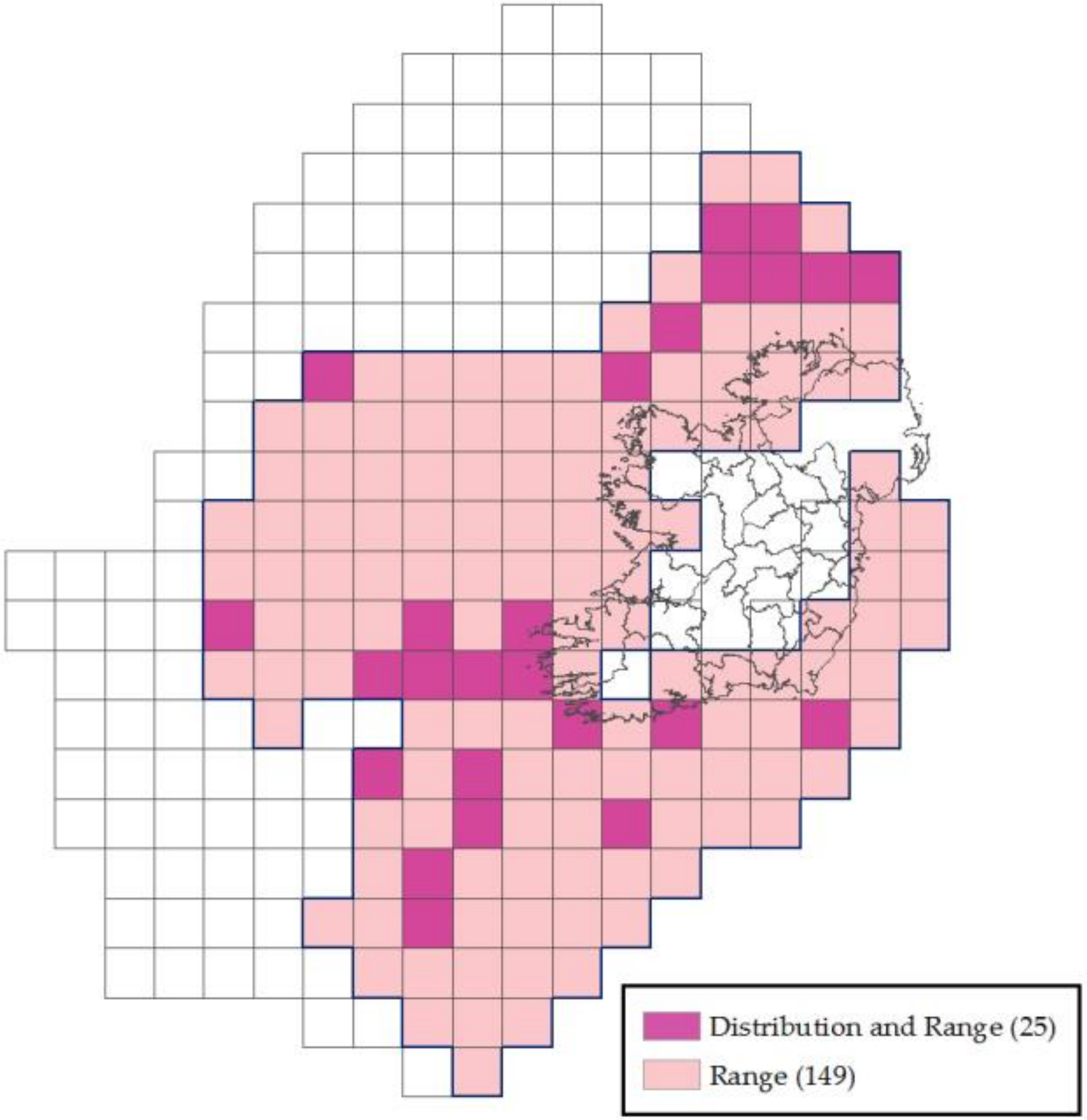


Figure 73 The range and distribution of Risso's dolphins in Irish waters (NPWS 2019).

Site-specific surveys (2019-2021)

3.7.2 No Risso's dolphins were sighted in any of the site-specific surveys.

ObSERVE

3.7.3 Risso's dolphin sightings during the ObSERVE surveys were low across all surveys and strata (Figure 74). 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 (Figure 74) and not in the vicinity of Dublin Array.

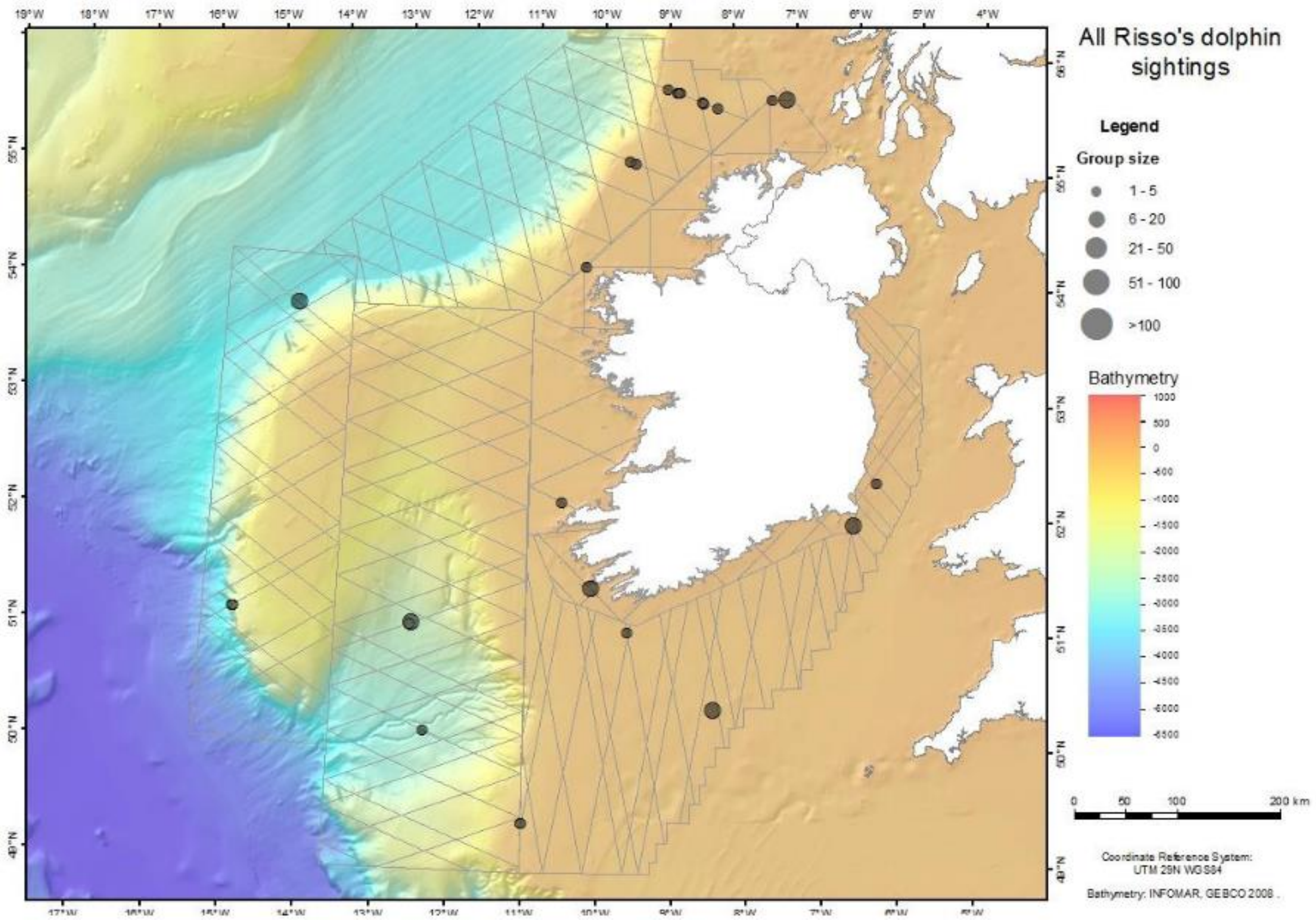


Figure 74 All Risso's dolphin sightings from the ObSERVE surveys from 2015-2016 (Rogan *et al*. 2018).

Distribution and abundance of cetaceans in Wales and its adjacent waters

3.7.4 Risso's dolphin were modelled throughout the Irish Sea and Bristol Channel, with varying distribution patterns (Figure 75). 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 Dublin array area is 0.017 dolphins/km^2 (Figure 76).

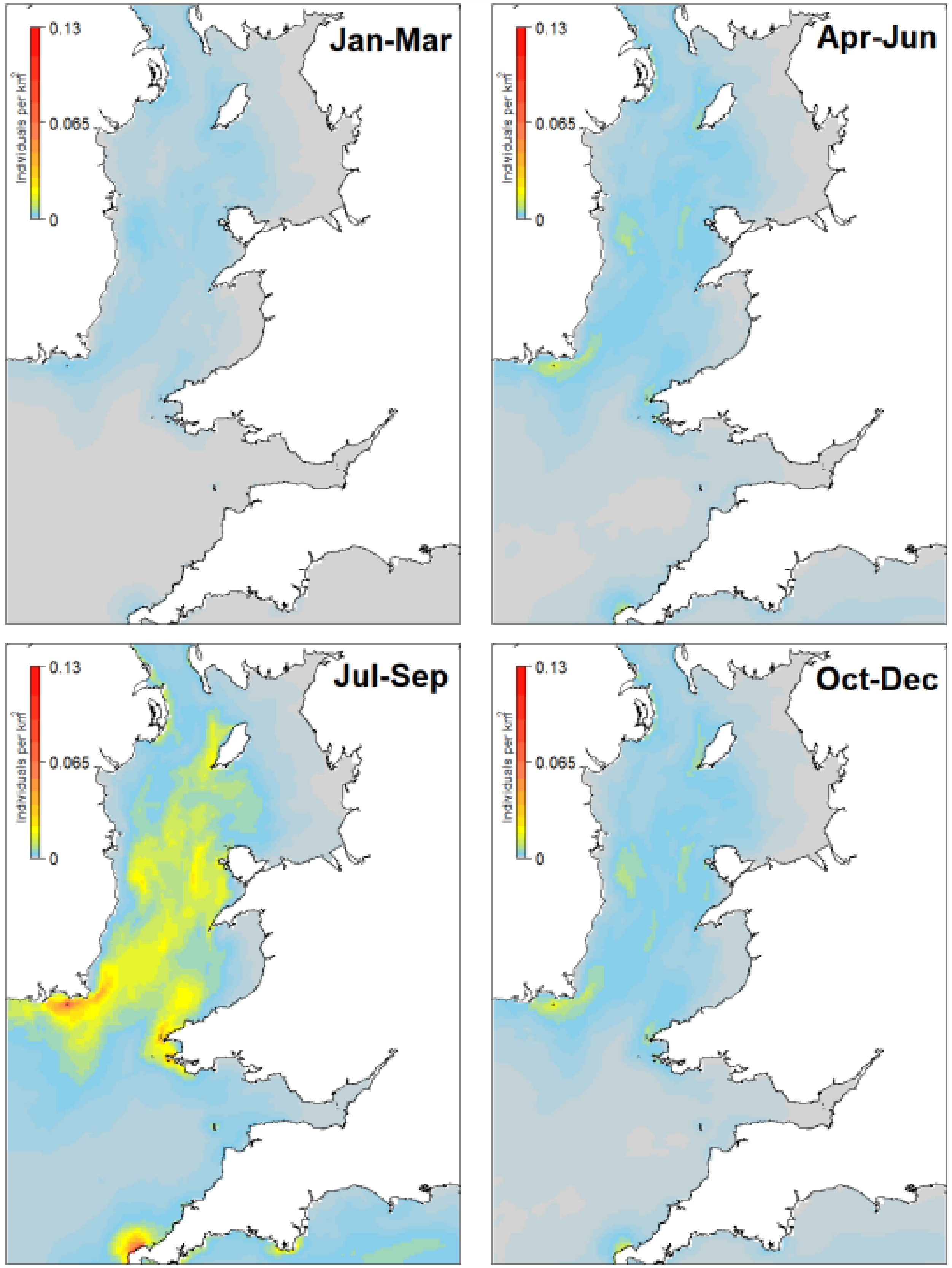
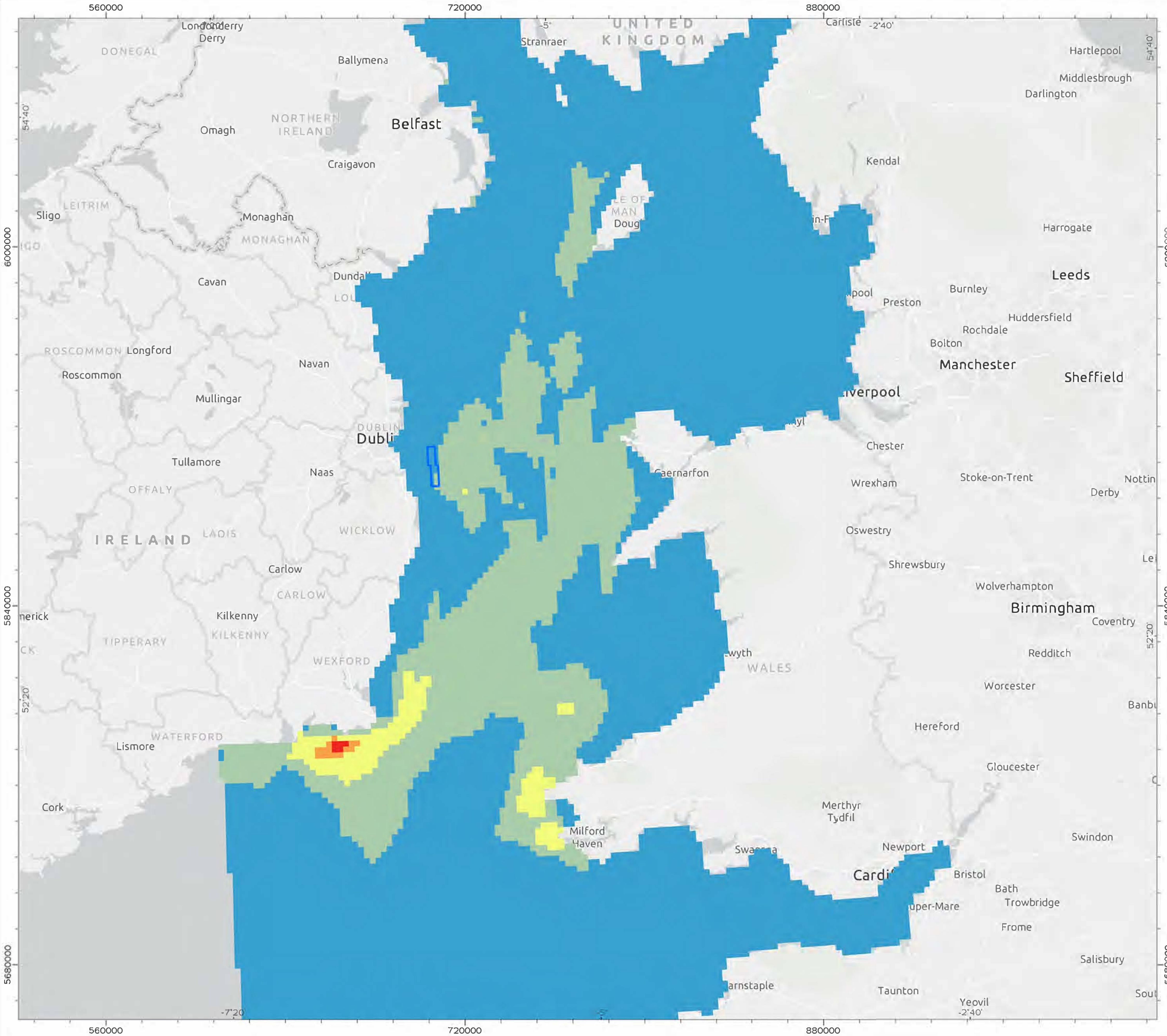


Figure 75 Risso's dolphin modelled densities by quarter (Evans and Waggitt 2023)



Array Area

Evans & Waggit 2023 Density Surface

Rissos Dolphin Density (#/km²)

- 0 - 0.010
- 0.010 - 0.025
- 0.025 - 0.050
- 0.050 - 0.075
- >0.075

DRAWING STATUS

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PROJECT TITLE

Dublin Array

DRAWING TITLE

Rissos Dolphin Predicted Density Surface (Evans & Waggitt, 2023)

DRAWING NUMBER: **76**

PAGE NUMBER: **1 of 1**

VER	DATE	REMARKS	DRAW	CHEK	APRD
01	2024-10-04	For Issue	GB	BB	SS

0 15 30 45 60 km
0 7.5 15 22.5 30 nm

N

SCALE	1:1,750,000	PLOT SIZE	A3
DATUM	WGS 1984	VERTICAL REF	LAT
PRJ	WGS 1984 UTM Zone 29N		

GoBe APEM Group

Dublin Array Generation for generations

Kish Offshore Wind Limited - Bray Offshore Wind Limited

SCANS

3.7.5 Risso's dolphin sightings around Ireland were low during the SCANS III surveys (Figure 77). 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). No Risso's dolphins were reported in SCANS II block O for the Irish Sea (Hammond *et al*. 2013).

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

3.7.7 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/km2 (CV 1.012) (Gilles *et al*. 2023).

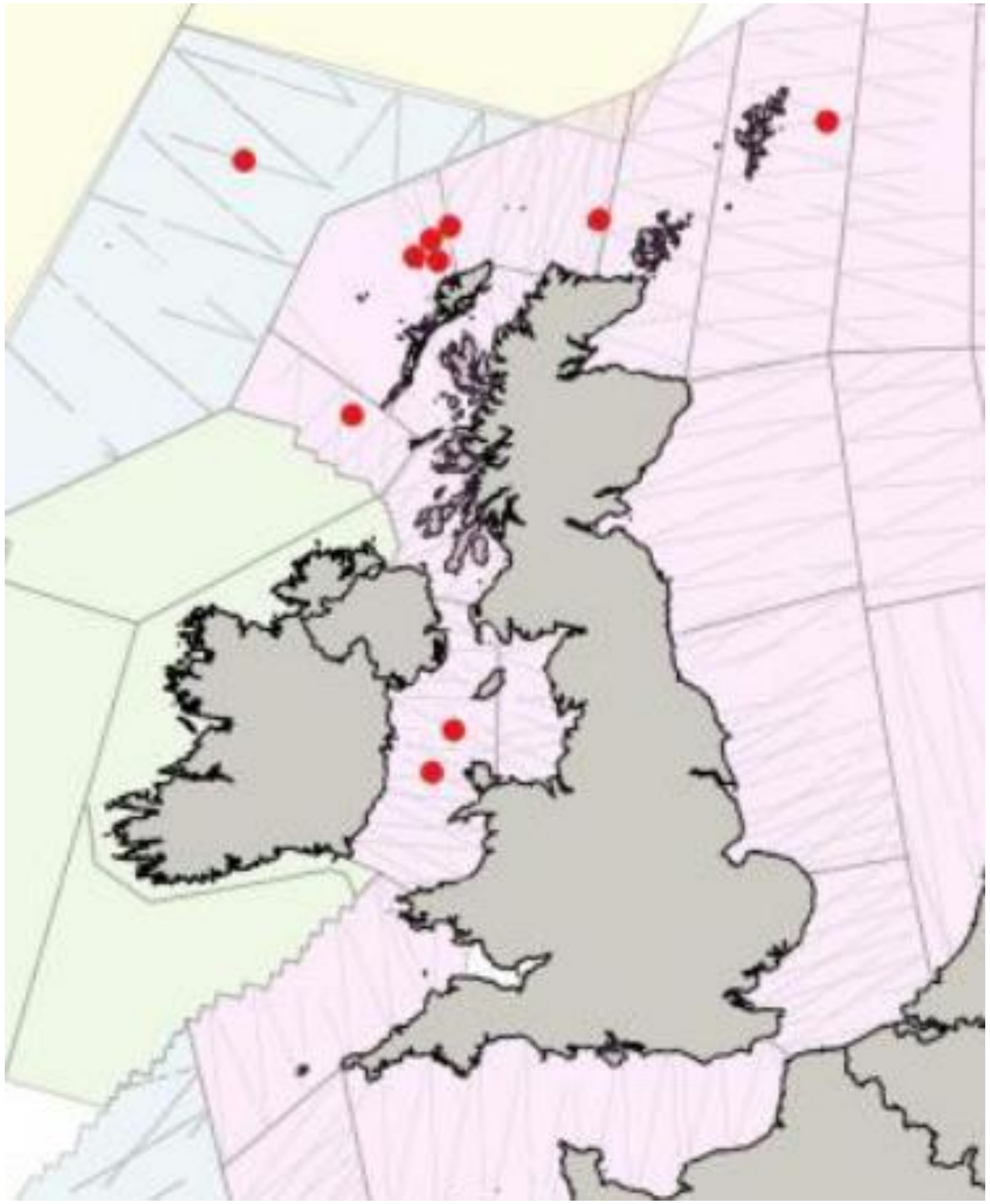


Figure 77 Distribution of Risso's dolphin sightings (red dots) during SCANS III (Hammond *et al*. 2017).

IWDG surveys

3.7.8 No Risso's dolphin sightings were reported during the IWDG surveys on the east coast of Ireland considered in this baseline characterisation.

Irish Marine Mammal Atlas

3.7.9 Risso's dolphins were reported around the entire Irish coast, with highest relative abundances reported to be off the south west and south east coasts (Figure 78) (Wall *et al*. 2013). These individuals were sighted in Irish waters between 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 between December – March.

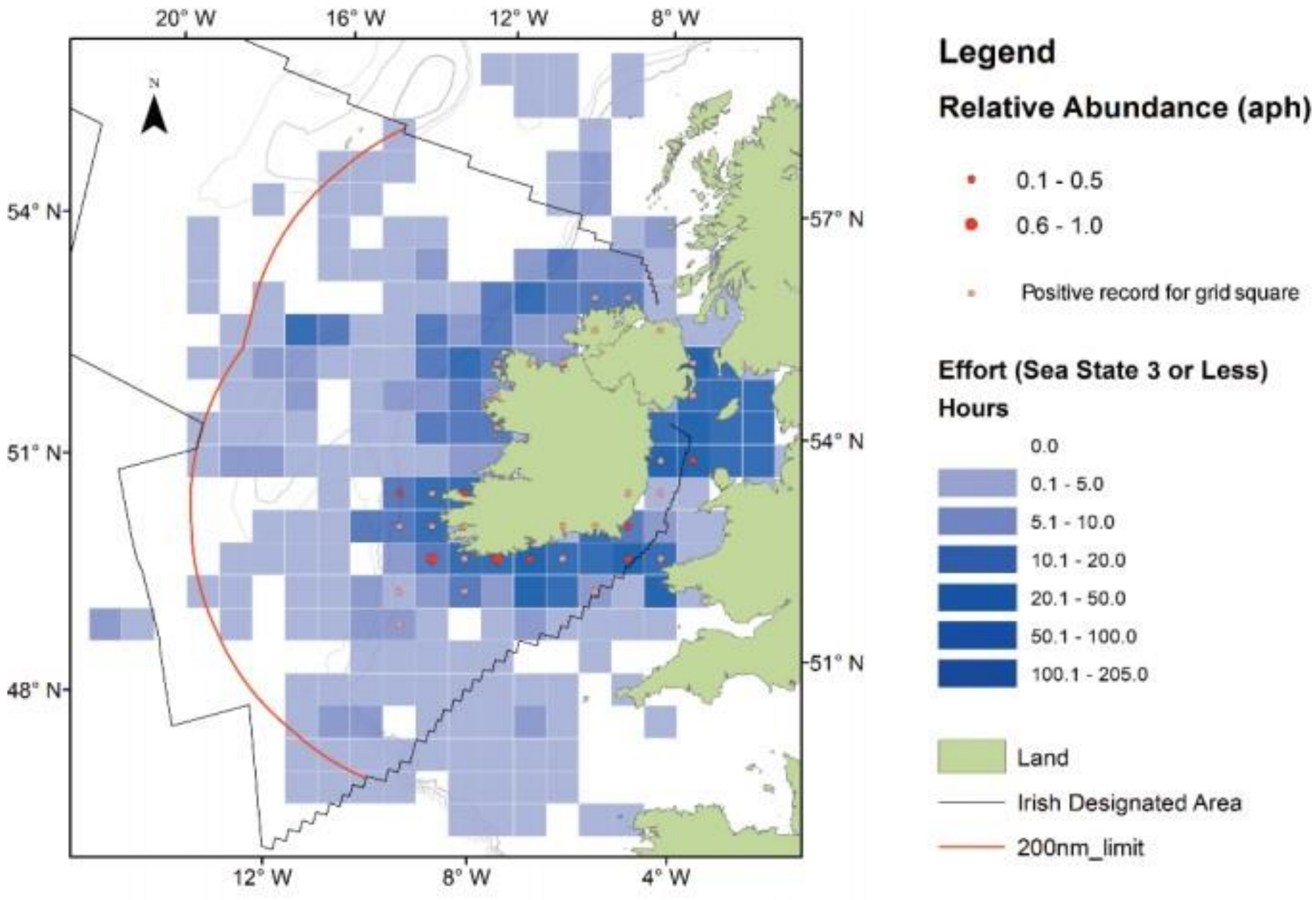


Figure 78 Relative abundance of Risso's dolphins from the Irish marine mammal atlas (Wall *et al*., 2013).

Other OWFs

3.7.10 No Risso's dolphins were recorded during any of the aerial CWP Project site-specific baseline surveys, although two sightings of Risso's dolphin were observed in the 2013-2014 boat-based surveys (May & July 2013). The density surface estimate was calculated as 0.0008 dolphins/km^2 (Codling Wind Park Limited 2024).

3.7.11 No site-specific density estimate was provided for Risso's dolphins at Arklow Bank, NISA or Oriel.

Seasonality

3.7.12 Although the surveys examined have not indicated that Risso's dolphin are likely to be present in the vicinity of Dublin Array, if they were present, 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).

Risso's dolphin summary

3.7.13 Since no Risso's dolphins were sighted during the site-specific surveys (2019-2021), nor were they recorded in the IWDG surveys of the east coast of Ireland, nor were they sighted in SCANS II block O and only very low numbers in SCANS III block E, SCANS-IV block CS-D, and in the ObSERVE surveys for stratum 5, it is recommended that they are scoped out of impact assessment for Dublin Array.

3.8 Short-beaked common dolphin

3.8.1 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 79). 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 2022, 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 (Hammond *et al*. 2017, Rogan *et al*. 2018, Hammond *et al*. 2021).

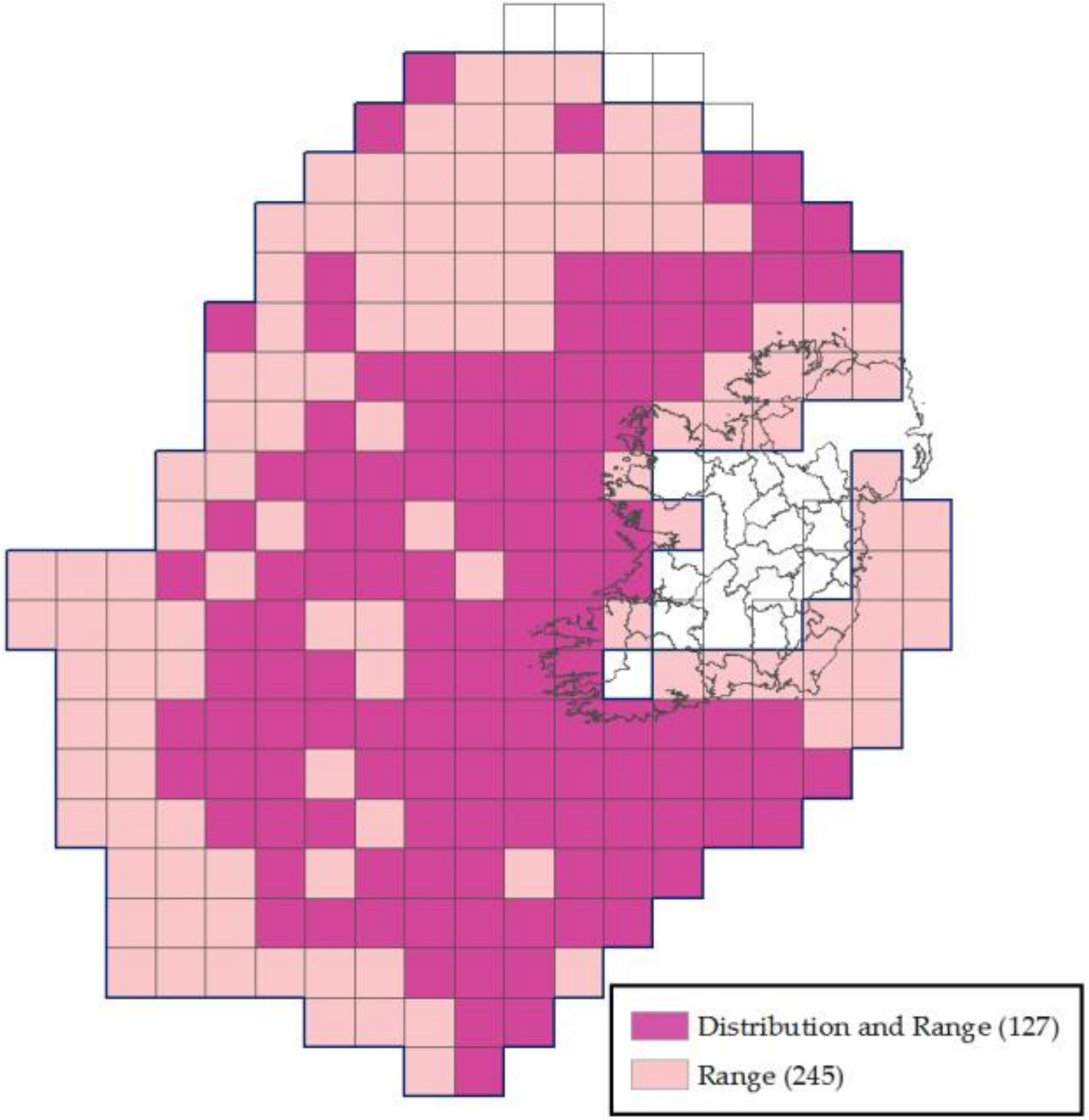
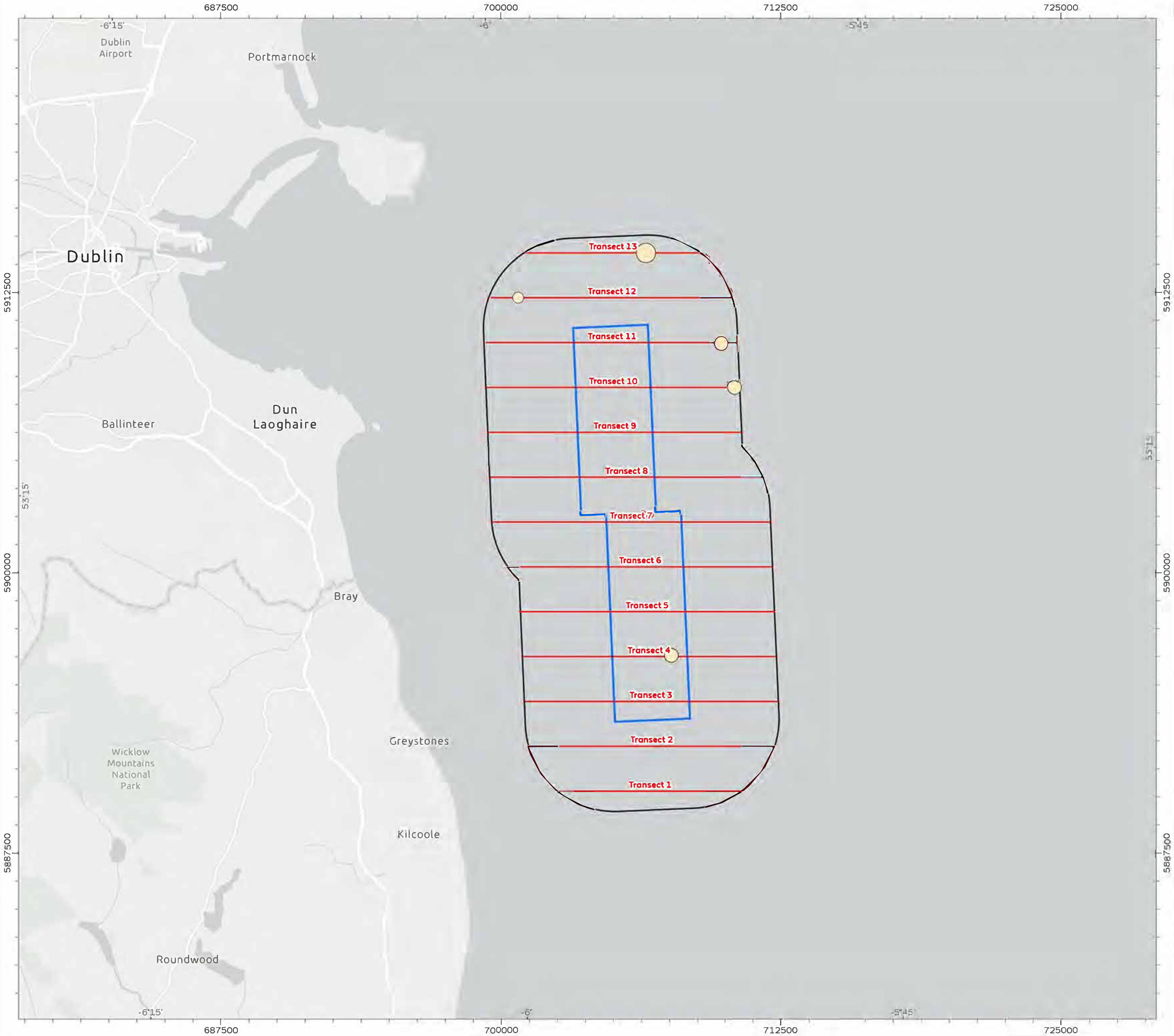


Figure 79 The range and distribution of common dolphins in Irish waters (NPWS 2019).

Site-specific surveys (2019-2021)

3.8.2 A total of five groups (21 individuals) of common dolphins were sighted during the site-specific surveys, with three groups in June 2019, one group in Oct 2019 and one group in July 2020 (Figure 80). None were sighted on any other survey day and as such, there were insufficient data to calculate a density estimate for common dolphins from the site-specific surveys.



Array Area
4km Survey Buffer
Transects
Number of Sightings (June 2019 to September 2020)
2
3
10

DRAWING STATUS
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PROJECT TITLE
Dublin Array

DRAWING TITLE
Distribution of Common Dolphin Sightings within the Dublin Array Survey Area

DRAWING NUMBER: 80
PAGE NUMBER: 1 of 1

VER	DATE	REMARKS	DRAW	CHEK	APRD
01	2024-10-04	For Issue	GB	BB	SS

0 1.5 3 4.5 6 km
0 0.8 1.5 2.3 3 nm

N

SCALE 1:175,000 PLOT SIZE A3
DATUM WGS 1984 VERTICAL REF LAT
PRJ WGS 1984 UTM Zone 29N

GoBe
Dublin Array
Generation for generations
Kish Offshore Wind Limited - Bray Offshore Wind Limited

ObSERVE

3.8.3 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 81).

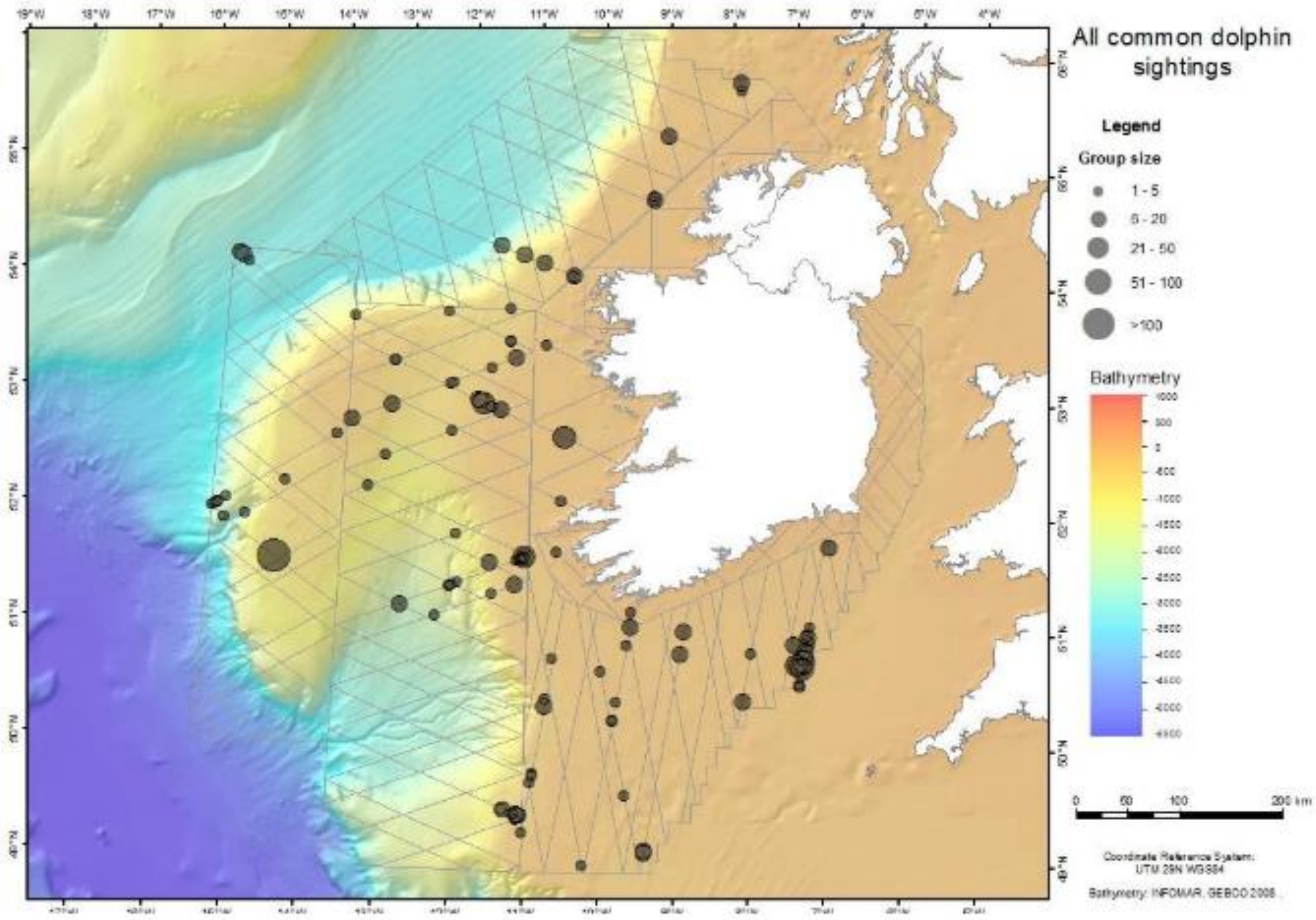


Figure 81 All common dolphin sightings from the ObSERVE surveys from 2015-2016 (Rogan *et al*. 2018).

Distribution and abundance of cetaceans in Wales and its adjacent waters

3.8.4 Short-beaked common dolphins were modelled throughout the Irish Sea and Bristol Channel, with consistent distribution patterns (Figure 82). 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 Republic of Ireland, 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 Dublin array area is 0.0004 dolphins/km^2 (Figure 83).

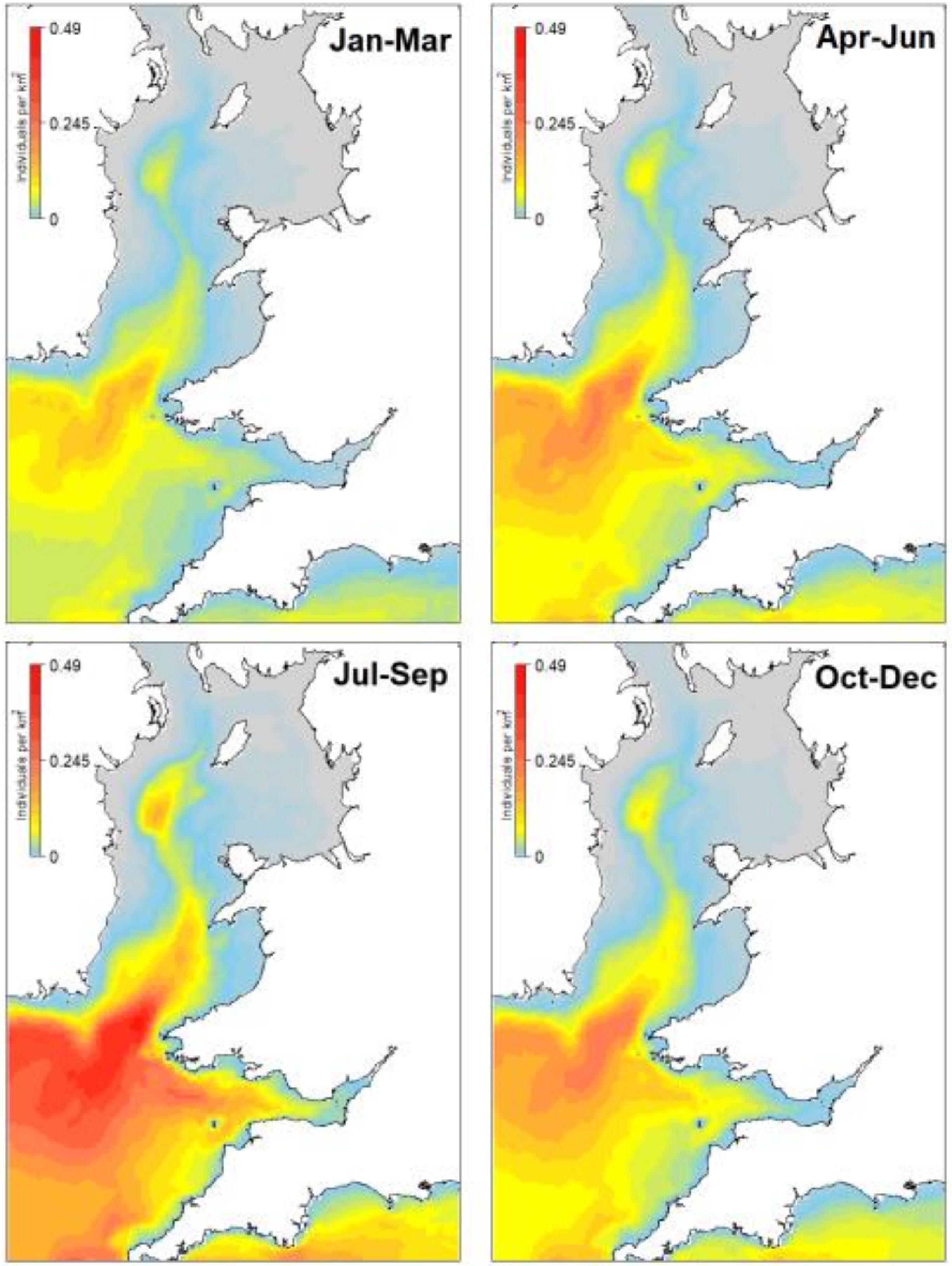
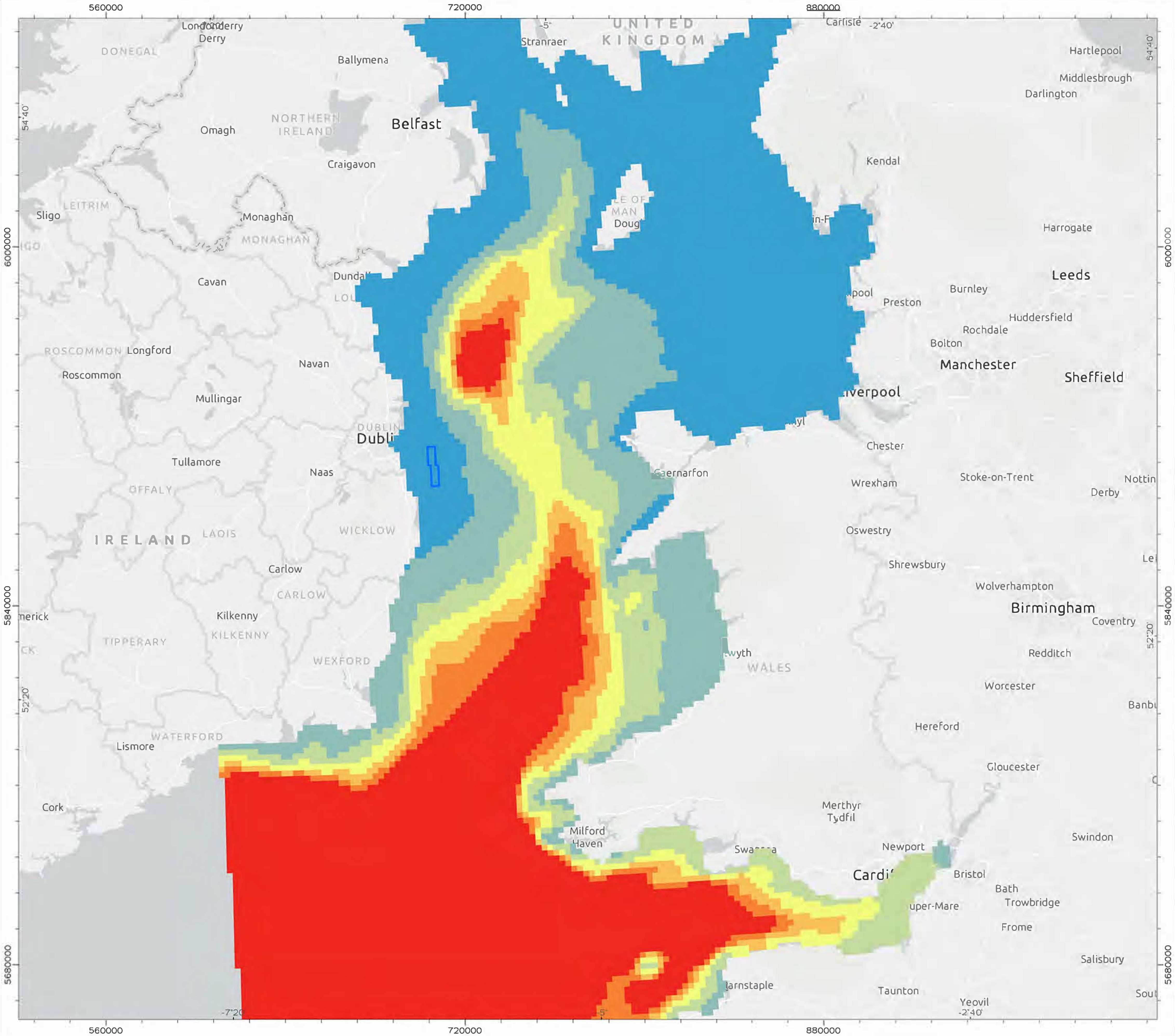


Figure 82 Common dolphin modelled densities by quarter (Evans and Waggitt 2023)



Array Area

Evans & Waggit 2023 Density Surface

Common Dolphin Density (#/km²)

- 0 - 0.001
- 0.001 - 0.01
- 0.01 - 0.025
- 0.025 - 0.05
- 0.05 - 0.075
- 0.075 - 0.1
- >0.1

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PROJECT TITLE

Dublin Array

DRAWING TITLE

Common Dolphin Predicted Density Surface (Evans & Waggitt, 2023)

DRAWING NUMBER: 83

PAGE NUMBER: 1 of 1

VER	DATE	REMARKS	DRAW	CHEK	APRD
01	2024-10-04	For Issue	GB	BB	SS

0 15 30 45 60 km

0 7.5 15 22.5 30 nm

N

SCALE	1:1,750,000	PLOT SIZE	A3
DATUM	WGS 1984	VERTICAL REF	LAT
PRJ	WGS 1984 UTM Zone 29N		

GoBe APEM Group

Dublin Array Generation for generations

Kish Offshore Wind Limited - Bray Offshore Wind Limited

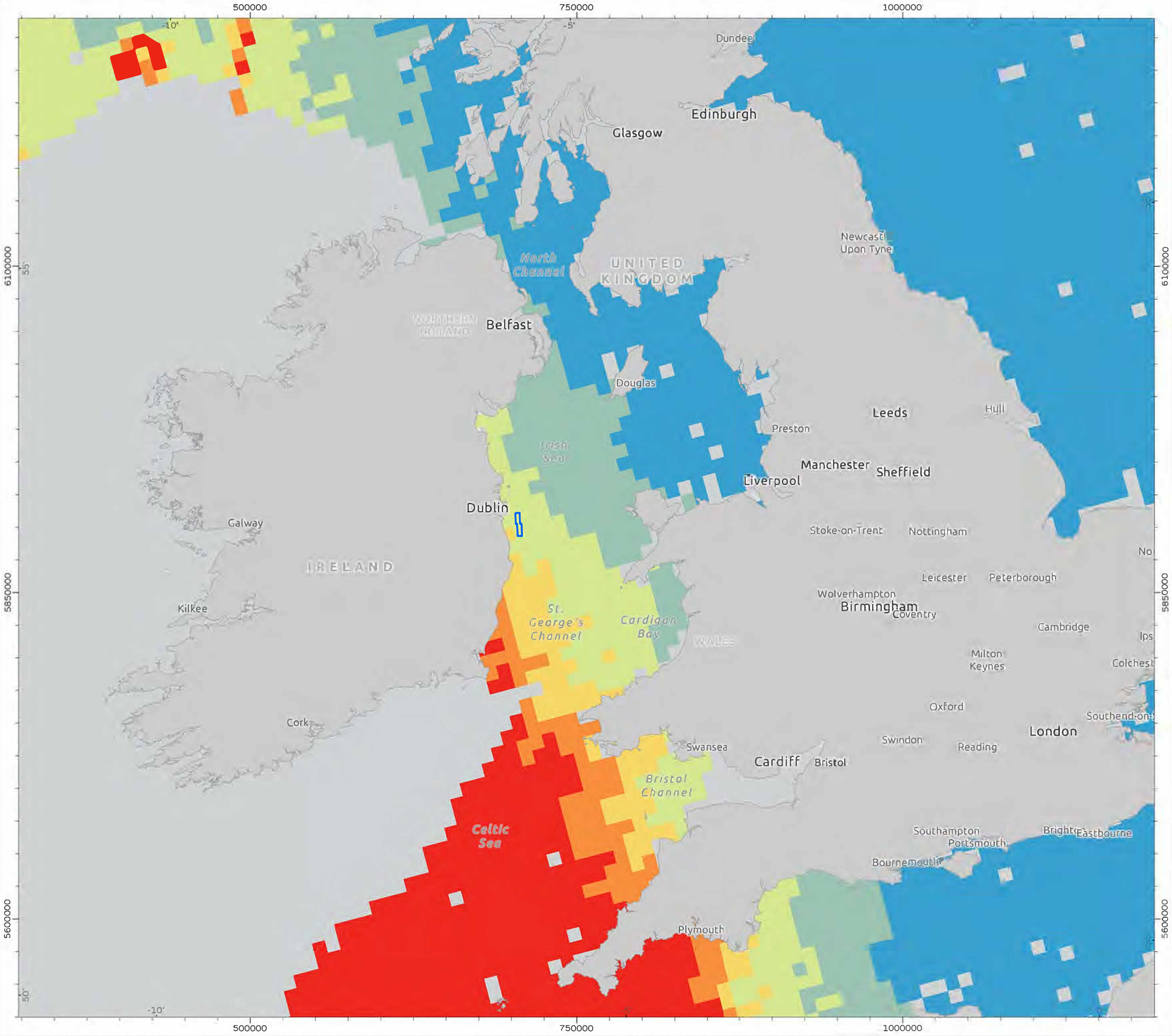
SCANS

3.8.5 No common dolphins were sighted in SCANS III block E (Hammond *et al*. 2017).

3.8.6 The SCANS II used different survey blocks to SCANS III, and the Dublin Array Project 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 sightings were 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).

3.8.7 The SCANS III data shows that 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 Dublin Array are low with values below 0.07 common dolphin/km^2 (Figure 84).

3.8.8 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).



Array Area

Lacey *et al.*, 2020 SCANS III Density Surface

Common Dolphin Density (#/km^2)

- 0 - 0.001
- 0.001 - 0.0025
- 0.0025 - 0.005
- 0.005 - 0.0075
- 0.0075 - 0.01
- >0.01

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PROJECT TITLE

Dublin Array

DRAWING TITLE

Predicted Surfaces of Estimated Density for Common Dolphin in SCANS III Data (Lacey *et al.*, 2022)

DRAWING NUMBER: 84

PAGE NUMBER: 1 of 1

VER	DATE	REMARKS	DRAW	CHEK	APRD
01	2024-10-04	For Issue	GB	BB	SS

0 25 50 75 100 km

0 12.5 25 37.5 50 nm

N

SCALE	1:3,000,000	PLOT SIZE	A3
DATUM	WGS 1984	VERTICAL REF	LAT
PRJ	WGS 1984 UTM Zone 29N		

GoBe APEM Group

DublinArray Generation for generations

Kish Offshore Wind Limited - Bray Offshore Wind Limited

IWDG surveys

3.8.9 No common dolphin sightings were reported on the east coast of Ireland during the IWDG surveys considered in this baseline characterisation.

Irish Marine Mammal Atlas

3.8.10 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 85). 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.

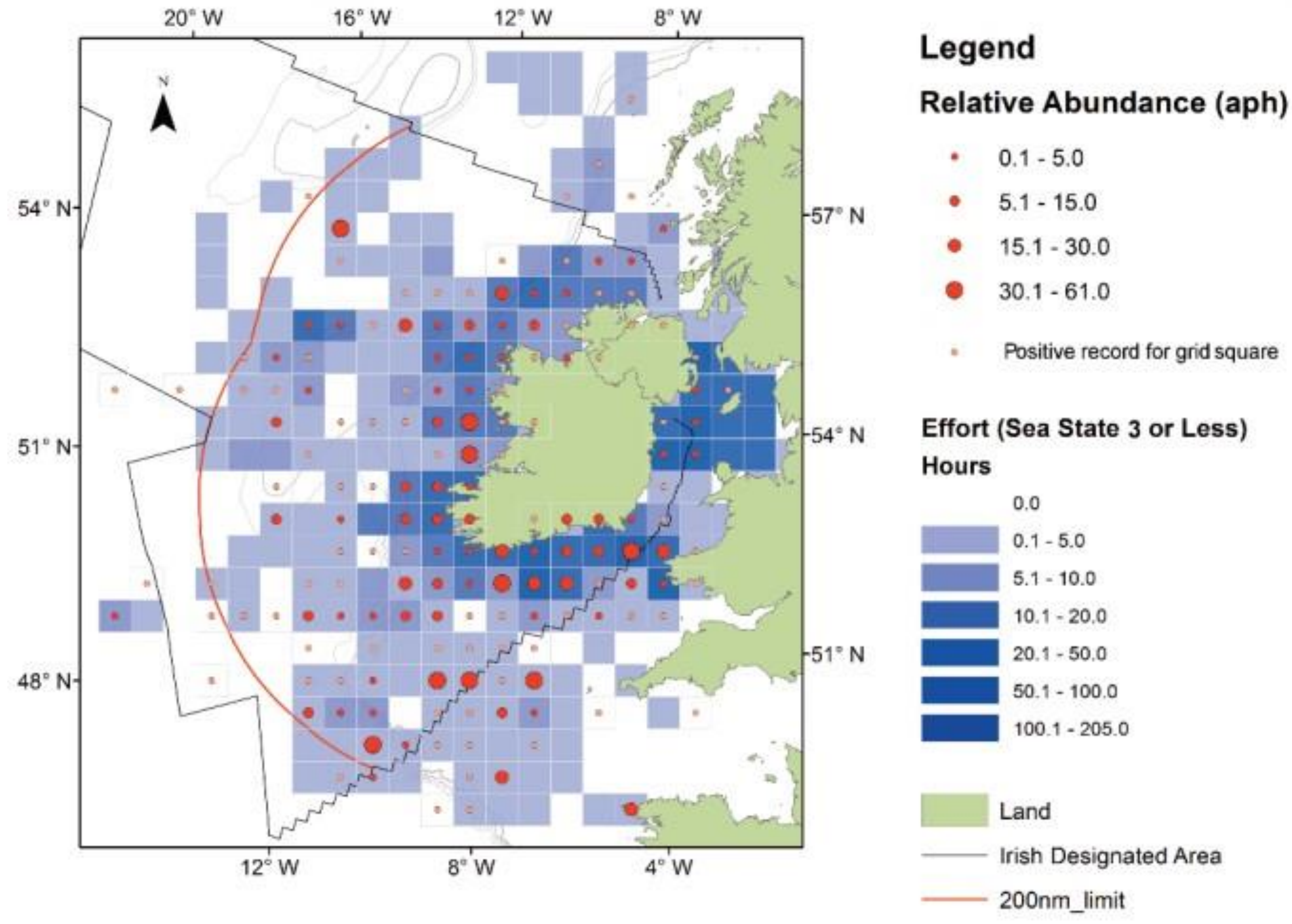

Figure 85 Relative abundance of short-beaked common dolphins from the Irish marine mammal atlas (Wall *et al.*, 2013).

Other OWFs

3.8.11 At CWP, density estimations for common dolphin were derived by modelling both boat-based survey and aerial survey data (Natural Power 2023). During 2013-2014 boat-based surveys, no common dolphins were sighted, whilst during the 2018-2020 boat-based surveys, six common dolphins were recorded, giving a density estimate of 0.0026 dolphins/km^2. By comparison, during the 2020-2022 aerial surveys, 82 common dolphins were recorded giving a density estimate of 0.2810 dolphins/km^2 (Codling Wind Park Limited 2024).

3.8.12 In the 29 months of site-specific DAS for NISA, common dolphin sightings were highly variable, with between 0 and 30 individual common dolphins sighted per survey day. The average density estimate (apportioned and corrected) across the 29 surveys was 0.04 dolphins/km^2 (ARUP 2024).

Seasonality

3.8.13 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 Dublin Array.

Common dolphin summary

3.8.14 While available density estimates for common dolphins in the vicinity of Dublin Array are somewhat lacking, they were sighted during the site-specific surveys and so need to be included in the Dublin Array impact assessment. A range of density estimates will be taken forward to the quantitative impact assessment. These include: the SCANS IV estimate, in addition to the SCANS III density surface and the Evans and Waggitt (2023) density surface.

Table 16 Common dolphin density estimates (dolphins/km^2)[19]

Data source	Reference	Density estimate
Site specific surveys	Burt (2020)	Not calculated
Welsh and Irish Sea distribution	Evans and Waggitt (2023)	Grid cell specific Max 0.0004 in the Dublin array area
SCANS IV block CS-D	Gilles et al. (2023)	0.0272
SCANS III density surface	Lacey *et al*. (2022)	0.07 in array area
SCANS III block E	Hammond *et al*. (2017)	0
SCANS II block O	Hammond *et al*. (2013)	0.018
ObSERVE summer stratum 5	Rogan *et al*. (2018)	None sighted

[19] Densities taken forward for assessment are shaded in blue.

Data source	Reference	Density estimate
CWP site-specific DAS density estimate	Codling Wind Park Limited (2024)	0.2810
CWP site-specific boat-based density estimate	Codling Wind Park Limited (2024)	0.0026
NISA site-specific density estimate	ARUP (2024)	0.04

4 Future receiving environment

4.1.1 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 report. The data available suggests that, apart from harbour porpoise, all other marine mammal populations included in this report 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 18), with grey seals noted as having an increasing trend (NPWS 2019).

Table 17 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 common dolphin in Ireland remains Favourable. This overall result is the same as the previous NPWS assessment.
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	The Overall Status is Favourable with an increasing trend.

4.1.2 While harbour porpoise were assessed as having a Favourable conservation status in Irish waters (NPWS 2019), the latest 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. There is the potential that this decline could theoretically be driven by unsustainable levels of porpoise bycatch in the southwest UK and Irish waters, particularly from the gillnet fishery (though this is not confirmed). Porpoise bycatch estimates for the ICES Celtic and Irish Seas Assessment Unit is 1.1 – 2.4% of the current best population estimate (ICES 2018), which is in excess of ASCOBANS reference points (Calderan and Leaper 2019). To help address this, the UK Cetacean Bycatch Focus Group has agreed to trial additional methods to try to reduce bycatch in this area.

4.1.3 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.

4.1.4 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.

4.1.5 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).

4.1.6 Whilst species specific studies arising from the UK and Ireland 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.

5 Data gaps or uncertainties

5.1.1 Specific limitations of each data source are outlined in Section 2.3: 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 Dublin Array. However, they do provide a good indication of the species present in the vicinity of Dublin Array and are complimented by the site-specific surveys which provide a more contemporary estimate at both fine temporal and spatial scale.

5.1.2 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 a range of density estimates are recommended to be used in the Dublin Array impact assessment.

6 Summary

6.1.1 Specific limitations of each data source are outlined in Section 2.3. 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 Dublin Array offshore survey area. However, they do provide a good indication of the species present in the vicinity of the array area and offshore ECC and are complimented by the site-specific surveys which provide a more contemporary estimate at both fine temporal and spatial scale.

6.1.2 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 Dublin Array and in the species-specific MU. Where this occurs, the most robust and reliable density estimates have been taken forward for use in the quantitative impact assessment in order to be precautionary. Table 18 provides a summary of the species-specific MU size and density estimates that are recommended for use in the quantitative impact assessment for Dublin Array.

Table 18 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 Seas	62,517	IAMMWG (2023)	0.2076	Chudzinska and Burt (2021)
				0.2803	Gilles et al. (2023)
				Grid cell specific[20]	Lacey *et al*. (2022)
				Grid cell specific[21]	Evans and Waggitt (2023)
Harbour seal	E & SE regions of the Republic of Ireland, and Northern Ireland MU	1,365	Scaled count from Morris and Duck (2019)	Grid cell specific[22]	Carter *et al*. (2020), Carter *et al*. (2022)
Grey seal	E & SE regions of the Republic of Ireland & Northern Ireland MU	6,056	Scaled count from Morris and Duck (2019) & SCOS (2023)	Grid cell specific[23]	Carter *et al*. (2020), Carter *et al*. (2022)
Minke whale	Celtic and Greater North Seas	20,118	IAMMWG (2023)	0.045	Rogan *et al*. (2018)
				0.0137	Gilles et al. (2023)
				Grid cell specific[24]	Lacey *et al*. (2022)
				Grid cell specific[25]	Evans and Waggitt (2023)
Bottlenose dolphin	Irish Sea	293	IAMMWG (2023)	0.2352	Gilles et al. (2023)
				Grid cell specific[26]	Lacey *et al*. (2022)
				Grid cell specific[27]	Evans and Waggitt (2023)
Risso's dolphin	Scoped out				
Common dolphin	Celtic and Greater North Seas	102,656	IAMMWG (2023)	0.0272	Gilles et al. (2023)
				Grid cell specific[28]	Lacey *et al*. (2022)
				Grid cell specific[29]	Evans and Waggitt (2023)

[20] Maximum density across cells within the array area = <0.5 porpoise/km^2
[21] Maximum density across cells within the array area = 0.39 porpoise/km^2
[22] average density across cells within the array area and Offshore ECC = 0.017 harbour seals/km^2
[23] average density across cells within the array area and Offshore ECC = 0.048 grey seals/km^2
[24] Maximum density across cells within the array area = <0.02 minke whales/km^2
[25] Maximum density across cells within the array area = 0.012 minke whales/km^2
[26] Maximum density across cells within the array area = 0.001 dolphins/km^2
[27] Maximum density across cells within the array area = <0.05 dolphins/km^2
[28] Maximum density across cells within the array area = 0.07 dolphins/km^2
[29] Maximum density across cells within the array area = 0.0004 dolphins/km^2

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