MORGAN AND MORECAMBE OFFSHORE WIND FARMS: TRANSMISSION ASSETS

Environmental Statement

Volume 2, Annex 4.1: Marine mammals technical report - Part 1 of 2

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Glossary

Term	Meaning
ad libitum	No systematic constraints are placed on what is recorded or when during surveys, observer notes down anything visible or relevant.
Applicants	Morgan Offshore Wind Limited (Morgan OWL) and Morecambe Offshore Windfarm Ltd (Morecambe OWL).
Benthic	Species that live on or near the sea bottom, irrespective of the depth of the sea.
Bentho-pelagic	Species living and feeding near the bottom as well as in the pelagic zone.
Demersal	Species that live close to the sea floor.
EIA Scoping Report	A report setting out the proposed scope of the Environmental Impact Assessment process. The Transmission Assets Scoping Report was submitted to The Planning Inspectorate (on behalf of the Secretary of State) for the Morgan and Morecambe Offshore Windfarms Transmission Assets in October 2022.
Environmental Statement	The document presenting the results of the Environmental Impact Assessment process.
Generation Assets	The generation assets associated with the Morgan Offshore Wind Project and the Morecambe Offshore Windfarm include the offshore wind turbines, inter-array cables, offshore substation platforms and platform link (interconnector) cables to connect offshore substations.
Morecambe Offshore Windfarm: Generation Assets	The offshore generation assets and associated activities for the Morecambe Offshore Windfarm.
Morecambe Offshore Windfarm: Transmission Assets	The offshore export cables, landfall and onshore infrastructure required to connect the Morecambe Offshore Windfarm to the National Grid.
Morecambe OWL	Morecambe Offshore Windfarm Ltd is a joint venture between Zero-E Offshore Wind S.L.U. (Spain) (a Cobra group company) (Cobra) and Flotation Energy Ltd.
Morgan and Morecambe Offshore Wind Farms: Transmission Assets	The offshore and onshore infrastructure connecting the Morgan Offshore Wind Project and the Morecambe Offshore Windfarm to the national grid. This includes the offshore export cables, landfall site, onshore export cables, onshore substations, 400 kV grid connection cables and associated grid connection infrastructure such as circuit breaker compounds. Also referred to in this report as the Transmission Assets, for ease of reading.
Morgan Offshore Wind Project: Generation Assets	The offshore generation assets and associated activities for the Morgan Offshore Wind Project.
Morgan Offshore Wind Project: Transmission Assets	The offshore export cables, landfall and onshore infrastructure required to connect the Morgan Offshore Wind Project to the National Grid.
Morgan OWL	Morgan Offshore Wind Limited is a joint venture between bp Alternative Energy investments Ltd. and Energie Baden-Württemberg AG (EnBW).

Term	Meaning
Offshore export cables	The cables which would bring electricity from the Generation Assets to the landfall.
Offshore export cable corridor	The corridor within which the offshore export cables will be located.
Offshore Permanent Infrastructure Area	The area within the Transmission Assets Offshore Order Limits (up to Mean Low Water Springs) where the permanent offshore electrical infrastructure (i.e. offshore export cables) will be located.
Offshore Order Limits	See Transmission Assets Order Limits: Offshore (below).
Offshore Wind Leading Round 4	The Crown Estate auction process which allocated developers preferred bidder status on areas of the seabed within Welsh and English waters and ends when the Agreements for Lease are signed.
Ontogenetic variation	Genetically controlled developmental change.
Teuthophagic	Preys primarily on cephalopods.
Transmission Assets	See Morgan and Morecambe Offshore Wind Farms: Transmission Assets (above).
Transmission Assets Order Limits	The area within which all components of the Transmission Assets will be located, including areas required on a temporary basis during construction and/or decommissioning.
Transmission Assets Order Limits: Offshore	The area within which all components of the Transmission Assets seaward of Mean Low Water Springs will be located, including areas required o a temporary basis during construction and/or decommissioning. Also referred to in this report as the Offshore Order Limits, for ease of reading.
Transmission Assets Scoping Boundary	The term used to define the boundary used at the time the Scoping Report was submitted.

Acronyms

Acronym	Meaning
BAP	Biodiversity Action Plan
BEIS	Department of Business, Energy and Industrial Strategy
CCW	Countryside Council for Wales
CI	Confidence Interval
CIS MU	Celtic and Irish Seas Management Unit
CGNS MU	Celtic and Greater North Seas Management Unit
CMACS	Centre for Marine and Coastal Studies
CMR	Capture, mark, recapture
CV	Coefficient of variance
DEFA	Department of Environment, Food and Agriculture
DSM	Density Surface Model

Acronym	Meaning
EIA	Environmental Impact Assessment
EIRPHOT	Irish and Celtic Sea Database for grey seals
ES	Environmental Statement
EU	European Union
EWG	Expert Working Group
GPS	Global Positioning System
GSD	ground sampling distance
GSRP	Grey Seal Reference Population
HSRP	Harbour Seal Reference Population
IAMMWG	Inter-Agency Marine Mammal Working Group
IDW	Inverse Distance Weighted
INTERREG Programme	Interregional cooperation Programme
IS MU	Irish Sea Management Unit
ISZ	Irish Sea Zone
JCDP	Joint Cetacean Data Programme
JCP	Joint Cetacean Protocol
JNCC	Joint Nature Conservation Committee
MCZ	Marine Conservation Zone
MDZ	Morlais Demonstration Zone
MMEA	Manx Marine Environmental Assessment
MNR	Marine Nature Reserve
MMOb	Marine Mammal Observer
MU	Management Unit
MWDW	Manx Whale and Dolphin Watch
MWT	Manx Wildlife Trust
NERC	Natural Environment Research Council
NNR	National Nature Reserve
NPWS	National Parks and Wildlife Service
NRW	Natural Resources Wales
OSPAR	Oslo and Paris Conventions
PAM	Passive Acoustic Monitoring
PEIR	Preliminary Environmental Information Report
SAC	Special Area of Conservation

Acronym	Meaning
SCANS	Small Cetaceans in the European Atlantic and North Sea Surveys
SCOS	Special Committee on Seals
SDM	Species Distribution Model
SEA	Strategic Environmental Assessment
SEACAMS	Sustainable Expansion of Applied Coastal and Marine Sectors Project
SMRU	Sea Mammal Research Unit
SMU	Seal Management Unit
SNCB	Statutory Nature Conservation Body
SWF	Sea Watch Foundation
T-POD	Timing POrpoise Detector
UK	United Kingdom

Units

Unit	Description
%	Percentage
cm	Centimetre
km^2	Square kilometres
ft	Feet
nm	Nautical mile
ms^{-1}	Metres per second

1 Marine mammal technical report

1.1 Introduction

1.1.1.1 This document forms Volume 2, Annex 4.1 of the Environmental Statement prepared for the Morgan and Morecambe Offshore Wind Farms: Transmission Assets (referred to hereafter as 'the Transmission Assets'). The Environmental Statement (ES) presents the findings of the Environmental Impact Assessment (EIA) process for the Transmission Assets.

1.1.1.2 This document provides a detailed baseline characterisation of the marine mammal ecology for the Transmission Assets and the surrounding area. Data was collated through detailed desktop studies of the existing resources available for marine mammals within the region, incorporating data from third party organisations, to gain a historical perspective.

1.1.1.3 The aim of this technical report is to provide a robust baseline characterisation of the marine mammals likely to be present within the marine mammal study areas, against which the potential impacts of the Transmission Assets can be assessed.

1.2 Methodology

1.2.1 Study area

1.2.1.1 Marine mammals are spatially and temporally variable, therefore for the purposes of the marine mammal baseline characterisation, two study areas have been defined (**Figure 1.1**) which collates areas from sources of information outlined in **section 1.2.4.**

- **Transmission Assets marine mammal study area (hereafter referred to as the study area):** this area is defined as the area encompassing the offshore infrastructure area (the Transmission Assets Order Limits: Offshore, hereafter referred to as the Offshore Order Limits) plus a buffer of 10 to 14 km (**Figure 1.1**). Following the Preliminary Environmental Information Report (PEIR), the size of the Offshore Order Limits has been reduced, so whilst the study area remains the same as for PEIR, the area of the buffer has increased (previously a 10 km buffer). This approach of a 10 km buffer was agreed by the Statutory Nature Conservation Bodies (SNCB) during the Evidence Plan Process. This buffer size was also considered appropriate as it provides better coverage for marine mammals for the purpose of EIA and Habitats Regulations Assessment baseline characterisation, than the existing best practice approach of a 4 km buffer (SNCBs, 2017) (which has been used for marine mammals for EIA for other projects, including the majority of commissioned windfarms in the United Kingdom (UK)).
- **Transmission Assets regional marine mammal study area (hereafter referred to as the regional study area):** marine

mammals are highly mobile and may range over large distances and therefore, to provide a wider context, the desktop review considered the marine mammal ecology, distribution and density/abundance within the Irish Sea and wider Celtic Sea (**Figure 1.1)**.

1.2.1.2 For the quantitative impact assessment species specific populations were considered over a regional scale, within the context of their relevant species Management Units (MU) (**Figure 1.1**). The Inter-Agency Marine Mammal Working Group (IAMMWG, 2023) provided advice on cetacean MUs and the Special Committee on Seals (SCOS) provided advice on seal MUs (SMU) (SCOS, 2020; SCOS 2021; SCOS, 2022). Further details of the relevant species MUs are provided in the species accounts (**section 1.3** and summarised in **section 1.5**).

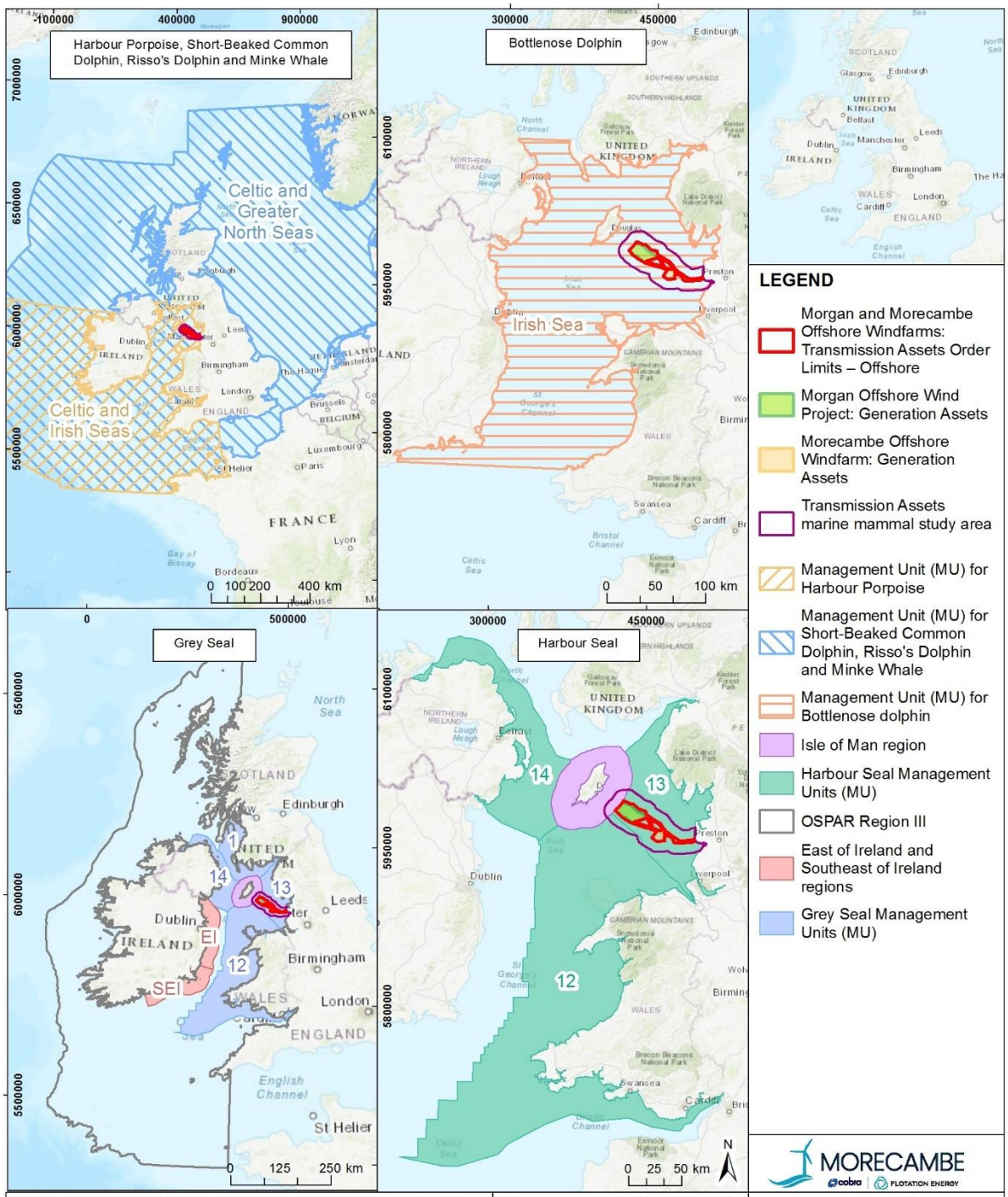


Figure 1.1: Transmission Assets marine mammal study area and relevant species MUs

1.2.1.3 For the purpose of the cumulative assessment and, as agreed with consultees during the Marine Mammals Expert Working Group (EWG) meeting number 1 (see **section 1.2.2**), screening focussed on the Irish Sea extending into the Celtic Sea rather than the entire extent of the largest MU: the Celtic and Greater North Seas MU (CGNS MU). This was to ensure a proportionate approach was taken, focussing on a region within which receptor-impact pathways are likely (since cumulative effects from the Transmission Assets within the Irish Sea were considered unlikely to occur with projects in the North Sea, for example). With respect to grey seal, however, an extended screening area was applied, and included projects within the Oslo and Paris Conventions (OSPAR) Region III.

1.2.2 Consultation

1.2.2.1 A summary of the key comments raised during consultation activities undertaken to date specific to marine mammals is presented in Volume 2, Chapter 4: Marine mammals of the ES, and in the Consultation report (document reference: E1).

1.2.3 Baseline methodology

1.2.3.1 Information on marine mammals within the regional study area (which therefore includes the study area) was collected through a detailed desktop review of existing studies and datasets (see **Table 1.1**).

1.2.3.2 **Sections 1.3.3** to **1.3.9** present species accounts for each species scoped into the impact assessment (and agreed via the scoping process). For each species, the ecology, distribution and occurrence, density and abundance and seasonality is described, utilising the available desktop study data.

1.2.3.3 Two key inputs include the Morgan Offshore Wind Project: Generation Assets Marine Mammal Technical Report and the Morecambe Offshore Windfarm: Generation Assets Marine Mammal Information and Survey Data. These are appended to this technical report in **Appendix A** and **Appendix B** respectively, as they are important sources relevant to this technical report and are identical to those already in the public domain.

1.2.4 Sources of information

Site-specific sources of information

1.2.4.1 This technical report constitutes a standalone report for the Transmission Assets, which uses relevant scientific desktop baseline data within the regional marine mammal study area (see **section 1.2.1**).

1.2.4.2 This technical report includes information on site-specific surveys undertaken for the Generation Assets, which lie within the Transmission assets marine mammal study area (**Figure 1.1**). Within this technical report, these surveys are treated as a desktop data source as they were not collected directly for the Transmission Assets marine mammal study area (discussed in **section 1.2.1**). The site-specific survey for the

Morgan Offshore Wind Project: Generation Assets area is presented in the Morgan Offshore Wind Project: Generation Assets Marine Mammal Technical Report **(Appendix A**). The site-specific data for Morecambe Offshore Windfarm: Generation Assets area is presented in the Morecambe Offshore Windfarm: Generation Assets Marine Mammal Information and Survey Data **(Appendix B**).

Desktop study

1.2.4.3 Information on marine mammals within the regional study area (which therefore includes the study area) was collected through a detailed desktop review of existing studies. These studies are summarised in **Table 1.1** below, with a more detailed overview of each study set out below. Where relevant, detailed information from these data sources are included in species-specific accounts, to inform species-specific baseline characterisations (see **sections 1.3.3** to **1.3.9**).

Table 1.1: Summary of key desktop sources

Title	Source	Year	Author
Morgan Offshore Wind Project: Generation assets Technical Report (this includes APEM aerial digital site surveys)	Morgan Offshore Wind Ltd.	2023 Aerial surveys from April 2021 to March 2023	Morgan Offshore Wind Ltd. (2023)
Morecambe Offshore Windfarm: Generation Assets Marine Mammal Information and Survey Data (this includes HiDef aerial digital site surveys)	Morecambe Offshore Windfarm Ltd.	2023 Aerial surveys from March 2021 to February 2023	Morecambe Offshore Windfarm Ltd. (2023)
Seal Telemetry Data	SMRU	2004 to 2018	Wright and Sinclair (2022)
SCOS Reports	SMRU	1990 to 2022	SMRU
Awel y Môr Offshore Wind Farm surveys	APEM Ltd.	2019 to 2021	Sinclair *et al*. (2021)
Gwynt y Môr Offshore Wind Farm surveys	Centre for Marine and Coastal Studies (CMACS)	2003 to 2005	CMACS Ltd. (2011; 2013); Goddard *et al*. (2017; 2018); Goulding *et al*. (2019)
Rhiannon Wind Farm surveys	Celtic Array Ltd.	2010 to 2013.	Celtic Array Ltd. (2014)
Mona Offshore Wind Project surveys	Mona Offshore Wind Ltd.	2021 to 2023	Mona Offshore Wind Ltd., 2024
Small Cetaceans in European Atlantic Waters and the North Sea (SCANS) surveys	SCANS-I, SCANS-II, SCANS-III and SCANS-IV	1994; 2005; 2016; 2023	Hammond *et al.* (2002; 2017; 2021); Giles *et al.* (2023)

Title	Source	Year	Author
SCANS-III Density Surface Models (DSM)	SCANS-III	Surveys conducted in 2016; modelling conducted in 2022	Lacey *et al*. (2022)
ObSERVE surveys	National Parks and Wildlife Service (NPWS)	2015 to 2017	Rogan *et al.* (2018)
IAMMWG MUs	IAMMWG	2015 to 2023	IAMMWG, 2015; 2022; 2023
Joint Cetacean Protocol (JCP) - JCP Phase III, JCP Phase I	JCP	1994 to 2010	Paxton *et al*. (2016); Paxton and Thomas (2010)
Joint Cetacean Data Programme (JCDP)	Joint Nature Conservation Committee (JNCC)	2022 to 2024	JNCC, 2024
JNCC Report 544: The identification of discrete and persistent areas of relatively high harbour porpoise density in the wider UK marine area	JNCC	1994 to 2011	Heinänen and Skov (2015)
JNCC Report 543: Persistent high occurrence and abundance of harbour porpoise and bottlenose dolphin	JNCC	1965 to 2014	Evans *et al.* (2015)
Distribution maps of cetacean and seabird populations in the north east Atlantic (North East Atlantic Distribution Maps)	Bangor University	1980 to 2018	Waggitt *et al.* (2020)
Atlas of the Marine Mammals of Wales (2012)	Countryside Council for Wales (CCW)	1990 to 2009	Baines and Evans (2012)
Modelled Distribution and Abundance of Cetaceans and Seabirds in Wales and Surrounding Waters (2023) (Welsh Marine Mammal Atlas)	NRW	1990 to 2020	Evans and Wagitt (2023)
Habitat-based predictions of at-sea distribution for grey and harbour seal in the British Isles	Report to Department for Business, Energy and Industrial Strategy (BEIS)	1996 to 2015	Carter *et al*. (2020; 2022)
Manx Whale and Dolphin Watch (MWDW) surveys	MWDW	2006 to 2022	Manley (2021; 2020; 2019); Clark *et al.* (2019; 2018; 2017); Felce and Adams (2016); Felce, (2015); Adams (2017).

Title	Source	Year	Author
Manx Wildlife Trust (MWT) surveys. • Seal pup surveys on Calf of Man. • Opportunistic land sightings. • Seal haul-out survey data. • Calf of Man Seal survey reports 2017 to 2021.	MWT	• 2017 to 2021. • 2016 to 2022. • 2017. • 2017 to 2021.	Data provided by MWT.
Walney Nature Reserve surveys	Cumbria Wildlife Trust	1981 to 2023.	Data from Cumbria Wildlife Trust.
Anglesey-based surveys	Various sources	2002 to 2018.	Shucksmith *et al*. (2009), Jacobs (2018); Veneruso and Evans (2012); Pesante *et al*. (2008); Duckett (2018); Evans *et al*. (2015).
Cardigan Bay surveys	CCW / Natural Resource Wales (NRW)	• 2005 to 2007. • 2011. • 2011 to 2013. • 2016 to 2018.	Pesante *et al.* (2008); Veneruso and Evans (2012); Feingold and Evans (2014); Duckett (2018).
Manx Marine Environmental Assessment (MMEA)	Isle of Man Government	2018.	Howe (2018a; 2018b).

Morgan Offshore Wind Project: Generation Assets

1.2.4.4 The Morgan Offshore Wind Project: Generation Assets ES presented site-specific surveys by APEM Ltd., covering the Morgan Offshore Wind Project: Generation Assets plus a buffer of 10 km to 13.3 km. The total area surveyed was 1,387 km^2. Monthly surveys commenced in April 2021 and were completed in March 2023, to give two years of baseline data. Full details of the aerial survey method are given in Appendix A of the Morgan Offshore Wind Project: Generation Assets Marine Mammal Technical Report (**Appendix A**). Summary statistics were produced to describe the data for each of the key species or species groups within the Morgan Aerial Survey dataset.

1.2.4.5 A total of 509 marine mammals were recorded over the two years of survey. Harbour porpoise accounted for the highest number of sightings identified to species level (n = 345, based on raw count data) across the Morgan Aerial Survey Area (as described in the Morgan Offshore Wind Project: Generation Assets Marine Mammal Technical Report, **Appendix A**) and was recorded in all survey months. Grey seal accounted for the second highest number of sightings (n = 34) and was recorded in all months except October and November 2021; May to August 2022; October 2022; and December 2022. Bottlenose dolphin was encountered in one survey month (two sightings in June 2021: one group of eight animals, plus one solo individual). Short-beaked common dolphin were sighted in three of the 24 months of survey (July,

September and October 2022) (n = 35, based on raw count data). Risso's dolphin, minke whale and harbour seal were not encountered during 24 months of the Morgan Aerial survey. There were a number of cetacean sightings ('dolphin species', 'dolphin/porpoise') that could not be assigned to species level, which had lower sightings (n = 63) and frequency than identified harbour porpoise. Similarly, there were a small number of sightings classified as 'seal species' and 'marine mammal species' due to the issue of identifying to species level from aerial survey data.

1.2.4.6 Harbour porpoise abundance in the Morgan Aerial Survey Area was estimated to be highest in the summer bio-season (April to September) (n = 303), and for grey seal (including animals identified as "seal species" and "phocids") numbers peaked in the non-pupping season (December to July) (n = 180).

1.2.4.7 There was no clear spatial pattern in distribution for any of the species in the Morgan Aerial Survey Area, although some higher concentrations of harbour porpoise and harbour porpoise pooled with "porpoise species", were visible in the estimated density plots in the north of the survey area, particularly in the summer bio-season.

1.2.4.8 Grey seal were found at a higher concentration along the north east boundary of the Morgan Aerial Survey Area.

1.2.4.9 Density estimates were calculated for harbour porpoise and grey seal only, as these were the only species for which confirmed sightings numbers were sufficient to do so. The approach to estimating densities is set out in **Appendix A**. Density estimates are discussed in the relevant subsections of **section 1.3.**

Morecambe Offshore Windfarm: Generation Assets

1.2.4.10 The Morecambe Offshore Windfarm: Generation Assets ES presented site-specific aerial survey data by HiDef Aerial Surveying Limited ('HiDef"). High resolution aerial digital still imagery was collected for marine megafauna (combined with ornithology surveys) over the survey area of 651 km^2, which included the windfarm site and a 4 to 10 km buffer. The buffer extended 10 km to the north and east due to proximity to Liverpool Bay Special Protection Area for birds.

1.2.4.11 The monthly digital aerial surveys commenced in March 2021, extending over 24 months. The surveys were conducted along a series of strip transects (31 strip transects at 1 km spacing) across the windfarm site and buffer every month for 24 months. It should be noted that due to weather January 2023 surveys were missed and therefore two surveys were flown in February 2023 (labelled February (1) 2023 and February (2) 2023 in **Appendix B**). Full details of the digital aerial survey methodology are presented in the Morecambe Offshore Windfarm: Generation Assets Mammal Information and Survey Data (**Appendix B**).

1.2.4.12 A total of 1,069 marine mammals were recorded over the two years of survey. The survey results indicate harbour porpoise was the most abundant marine mammal species present within the survey area,

which was recorded in all 24 months and across the entire survey area. Grey seal accounted for the second highest number of sightings (n = 42) and was recorded in all months except March 2021, September 2021, January 2022, July 2022 and October 2022. Harbour seal were recorded in July 2021 (n = 1); short-beaked common dolphin were recorded in August 2022 (n = 32); and bottlenose dolphin were recorded in February 2023 (n = 2). No other sightings were able to be classified to species level. There were a number of sightings ('dolphin species', 'seal species', 'cetacean species') that could not be assigned to species level (n = 67).

1.2.4.13 Density estimates were calculated for harbour porpoise and grey seal only, as these were the only species for which confirmed sightings numbers were sufficient to do so. The approach to estimating densities is set out in **Appendix B**. Density estimates are discussed in the relevant subsections of **section 1.3.**

Seal telemetry data (SMRU)

1.2.4.14 Seal telemetry data was obtained from SMRU for the four SMUs spanning the Irish sea (North West England, Wales, South West Scotland and Northern Ireland, see **Figure 1.1**).

1.2.4.15 SMRU has deployed individual telemetry tags on grey seal and harbour seal in the UK since 1988 and 2001, respectively. The telemetry tags transmit data on seal locations with the tag duration (number of days) varying between individual deployments. Telemetry data are particularly useful as they provide information on seal movement patterns away from their haul-out sites, provide data on the foraging behaviour of seals at sea and demonstrate connectivity between areas.

1.2.4.16 There are data from two types of telemetry tag, which differ by their data transmission methods. Data transmission can be through the Argos satellite system (Argos tags) or Global Positioning System (GPS) phone tags which combine GPS quality locations with transmission of data using the Global System for Mobile communication phone network. Both types of transmission result in location estimate but vary in spatial and temporal resolution (GPS have better location accuracy and more frequent transmission locations). Data is then stored in databases and 'cleaned' according to methods described in Russell *et al.* (2011).

1.2.4.17 This technical report presents an analysis of existing telemetry data, used to inform descriptions of the movements of harbour seal and grey seal within the four relevant SMUs (North West England, Wales, South West Scotland and Northern Ireland) that cover the regional study area. Further details of seal movements are included in the relevant species accounts sections (**section 1.3.8** for grey seal and **section 1.3.9** for harbour seal).

Special Committee on Seals (SCOS) Reports

1.2.4.18 SMRU carries out annual surveys of harbour seal and grey seal in Scotland and on the east coast of England, to contribute to the Natural Environment Research Council's (NERC) statutory obligation under the

Conservation of Seals Act 1970 through provision of scientific advice on matters related to the management of seal populations to the UK Government. SMRU surveys, as well as surveys by a number of other organisations (including NatureScot, Natural England, the Countryside Council for Wales (CCW), now NRW, the National Trust and the Lincolnshire Wildlife Trust) have formed (and continue to form) the routine monitoring of seal populations around the UK. The annually submitted 'Advice', which includes information on recent changes in grey seal and harbour seal numbers, can be found in the SCOS reports (discussed further in **sections 1.3.8 and 1.3.9**).

1.2.4.19 Seals are widely distributed around the UK coast and most surveys are carried out from the air by either light aircraft or helicopter. Surveys record seals hauled-out onshore and it is possible to differentiate between the two species using their thermal profiles and their group structure onshore. Due to differences in the breeding behaviour of harbour and grey seal the two species are surveyed at different times in their annual cycle. While grey seal are counted on all harbour seal surveys, harbour seal are very rarely seen on any of the grey seal breeding colony surveys.

Harbour seal

1.2.4.20 Harbour seal tend to be dispersed when breeding and, to an extent, aggregate when moulting so the main harbour seal surveys are carried out during their annual moult in August. The moult counts obtained represent the number of harbour seal that were onshore (not those in the sea) at the time of the survey and are an estimate of the minimum size of the population. Harbour seal count data from August moult census surveys were available from 1996 to 2019. SMRU also conducts surveys of harbour seal during the breeding season in June and July in only a small number of areas. There were no harbour seal breeding surveys conducted in the four SMUs that cover the regional study area (**Figure 1.1**).

Grey seal

1.2.4.21 Grey seal counts are obtained from the same August harbour seal moult surveys. However, during August, grey seal distribution is highly variable, and these counts are a snapshot of local summer distribution but are not a reliable census of population size. The data does, however, provide useful information on the summer and non-breeding season distribution of grey seal.

1.2.4.22 Grey seal aggregate at traditional colonies when breeding during the autumn and early winter months. Main breeding colonies are therefore surveyed annually between mid-September and late November to estimate the numbers of grey seal pups born at each colony, although since 2010 most colonies switched to biennial surveys. The grey seal pup production database contains data from 1989 to 2019 and includes 74 breeding colonies (though not all colonies have been surveyed since 1989 and some smaller colonies are surveyed more sporadically than others).

1.2.4.23 There are no regularly monitored grey seal breeding colonies within the South West Scotland MU. In the Wales MU, grey seal are counted using aerial, ground and vessel-based surveys due to hauling out in caves and 'cryptic habitats'. NRW monitors grey seal partly through the maintenance of the Irish and Celtic Sea photo ID database for grey seal, named EIRPHOT. In the North West England MU, the Cumbria Wildlife Trust and Walney Bird Observatory record grey seal haul-out counts at South Walney and have provided SMRU with counts at low tide since 2015. The area has been considered a pupping site since 2015. In Northern Ireland, the National Trust monitors the grey seal haul-outs at Strangford Lough. There are no haul out sites or breeding colonies within the Offshore Order Limits.

Awel y Môr Offshore Wind Farm surveys

1.2.4.24 Monthly digital aerial surveys were conducted by APEM, to collect data on the abundance and distribution of marine mammals to characterise the baseline to inform the EIA for the Awel Y Môr Offshore Wind Farm (Sinclair *et al.*, 2021). One survey per month was carried out for two years, from March 2019 to February 2021. Surveys were only undertaken under suitable conditions (where the cloud base was over 1,700 ft, visibility was higher than 5 km, wind speed below 30 knots and sea state at a maximum of four). Where poor weather conditions prevented surveys, they were conducted at the next available time (with a minimum of seven days required between data collection months).

1.2.4.25 The surveys covered the Awel Y Môr Offshore Wind Farm array area (**Figure 1.2**), plus a 4 km buffer to the north of the site and an 8 km buffer to the south of the site (these areas were informed by post-construction species surveys from Gwynt y Môr Offshore Wind Farm). It consisted of a gridded survey design with data collected from east to west with a 4 km spacing, leading to 10% coverage using 2 cm ground sampling distance (GSD) imagery captured at 1,700 ft. High altitudes were chosen to allow for clearance of the 500 ft proposed wind turbines to facilitate consistent monitoring in the post-construction phase. The 2 cm GSD was chosen to allow for identification of the majority of marine megafauna, but to minimise disturbance.

1.2.4.26 Over the two years of surveys, there were 152 marine mammal sightings. The majority of sightings were classified as unknown "dolphin/porpoise" (49%), 27 sightings were harbour porpoise (18%), six sightings were classified as unidentified dolphins (4%) and 38 sightings were seals (25%). The remaining sightings were classified as "unidentified marine mammals". The survey aimed to identify species-specific density estimates for the site, but identification rates were low and thus not suitable for providing density estimates.

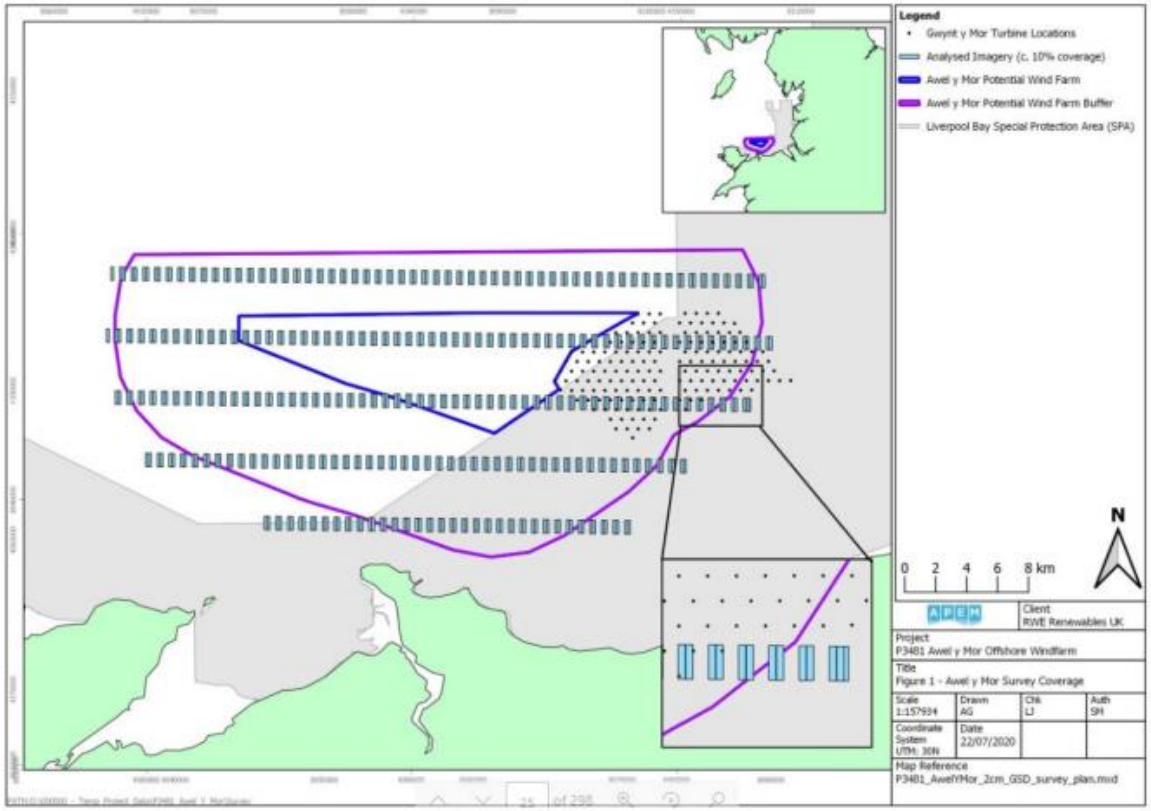


Figure 1.2: Marine mammal survey area for Awel y Môr Offshore Windfarm (Sinclair *et al.,* 2021)

Gwynt y Môr Offshore Wind Farm

1.2.4.27 Boat and land-based visual surveys were carried out for the initial Gwynt y Môr Offshore Wind Farm EIA in 2003 and 2004, and towed and static acoustic monitoring carried out between 2004 and 2005. Baseline monitoring was carried out using digital aerial surveys and visual marine mammal sightings data was recorded from vessels involved in windfarm related activity (CMACS Ltd., 2011). Four winter aerial surveys were carried out between October 2010 and March 2011, and one summer survey in July 2010.

1.2.4.28 Neither survey identified animals to species level, and datasets were not sufficient to generate abundance or density estimates. However, a pod of bottlenose dolphin and two harbour porpoises were observed in baseline benthic surveys. During construction, Gwynt y Môr Offshore Wind Farm implemented marine mammal mitigation and associated monitoring between 8 May 2012 and 5 April 2013 (CMACS Ltd., 2013).

1.2.4.29 Post construction, 17 digital aerial surveys were conducted between July 2016 and March 2019. Surveys covered the array area, buffer and wider area (Goddard *et al.,* 2017; Goddard *et al.,* 2018; Goulding *et al.,* 2019). A total of 110 marine mammals were recorded, including 63 grey seal and four harbour porpoises (other categories were non-species specific).

Rhiannon Wind Farm surveys

1.2.4.30 Rhiannon Wind Farm was the first of the three Potential Development Areas to be taken forward within the Irish Sea Zone (ISZ), for the EIA, and which included marine mammal surveys (Celtic Array Limited, 2014). Whilst the project was halted in 2014 due to complex ground conditions, the final report on aerial and boat based surveys were undertaken to collect data to establish baseline use of the ISZ is available.

1.2.4.31 Twelve digital video aerial surveys were flown by HiDef between 25 April 2012 and 1 March 2013 (Celtic Array Limited, 2014). Between April 2012 and October 2012, surveys were flown using a rig comprising four standard HiDef cameras with sensors set to a resolution of 2 cm Ground Sample Distance. Each camera sampled a strip of 50m width, separated from the next camera by 50 m, thus providing a combined sampled width of 200 m within a 350 m overall strip. In November 2012 the surveys were flown using a rig comprising four HiDef Gen II cameras with sensors again set to a resolution of 2cm Ground Sample Distance. Each camera sampled a strip of 125 m width, separated from the next camera by approx. 20 m.

1.2.4.32 Only harbour porpoise was present in the ISZ on a consistent basis (sighted in 11 out of the 12 months of survey, with a total of 227 individuals) though a pod of short-beaked common dolphin *Delphinus delphis* was recorded in July (six individuals) and grey seal were recorded in February and March (seven individuals).

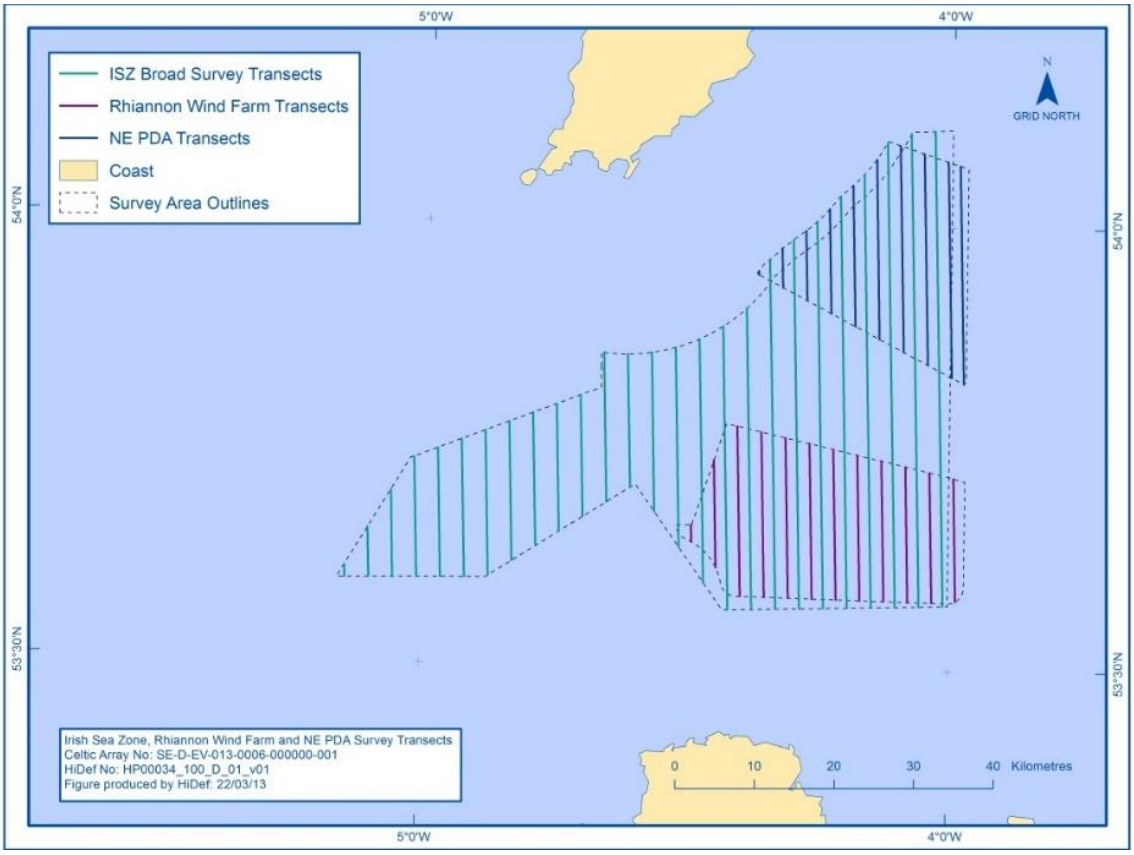


Figure 1.3: Location of aerial survey transects within the ISZ, proposed Rhiannon Wind Farm and NE Potential Development Area

1.2.4.33 Boat surveys comprised a series of 17 transects at a 3.7 km spacing, from 21 March 2010 to 13 April 2012 (**Figure 1.4**). Visual surveys comprised a single dedicated Marine Mammal Observer (MMOb) at a deck height of 7 m above the sea surface. Marine mammal species (identified to species level) recorded during boat-based visual surveys included harbour porpoise (516 individuals (44 of which were recorded as calves/juveniles), including grey seal (66 individuals), minke whale (21 individuals), bottlenose dolphin (13 individuals), Risso's dolphin (18 individuals) and short-beaked common dolphin (8 individuals). No harbour seal was recorded. Where data allowed, Distance analysis was undertaken to estimate density and abundance of individual species, and the only species for which sufficient data were available was harbour porpoise.

1.2.4.34 Acoustic surveys were also used to detect echolocation clicks, with a hydrophone towed at a depth of 7 m. The hydrophone array consisted of a 250 m tow/data cable followed by four potted hydrophone elements and a depth sensor. A total of 310 acoustic detections were identified as harbour porpoise. Harbour porpoise were the only species with sufficient detections to allow density and abundance estimation. Two sets of density estimates were presented for acoustic data, one using all detections classified as either good or moderate and a second set using only those detections classified as good.

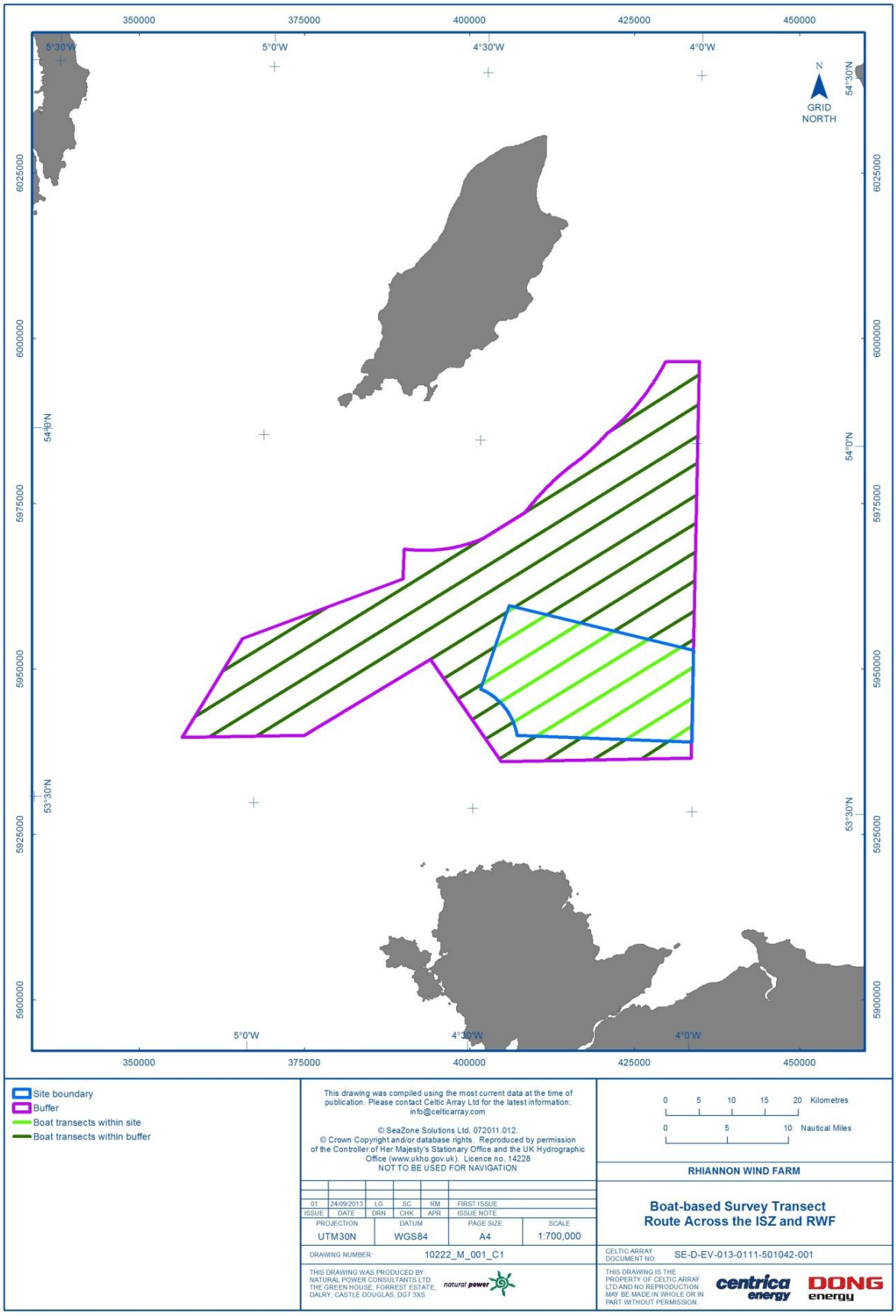


Figure 1.4: Location of transects traversed during boat-based surveys of the ISZ (Natural Power, 2013)

Mona Offshore Wind Project

1.2.4.35 For Mona Offshore Wind Project (Mona Offshore Wind Ltd, 2024), the Mona Aerial Survey Area was surveyed by APEM Ltd, covering a total area of 1,447 km^2. Surveys started in March 2020 and ended in February 2022, carried out monthly to give two years of baseline data. The aerial surveys used a grid-based collection method to collect 30% of the sea surface area and analysed at least 14% of the Mona Aerial Survey Area (Mona Offshore Wind Ltd, 2024).

1.2.4.36 A total of 404 marine mammals were recorded over the two years of survey. Harbour porpoise accounted for the highest number of individuals identified to species level across the Mona Aerial Survey Area, and was recorded in all survey months except for July, November and December 2020. Grey seal accounted for the second highest number of sightings but were not recorded in every month over the survey period. For other sightings identified to species level – bottlenose dolphin, Risso's dolphin and harbour seal, both the number and frequency of sightings were low. Bottlenose dolphin were encountered in two months of the year (June 2021 and January 2022), Risso's dolphin were encountered in just one month of the year (November 2020) and one harbour seal was encountered in March 2020 only.

1.2.4.37 Modelling of the Mona aerial survey data allowed absolute estimates of mean abundance, densities and confidence intervals (CI) to be given for grey seal and for harbour porpoise for the Mona Aerial Survey Area. Low sighting occurrences for other species meant modelling of densities was not possible (Mona Offshore Wind Ltd, 2024).

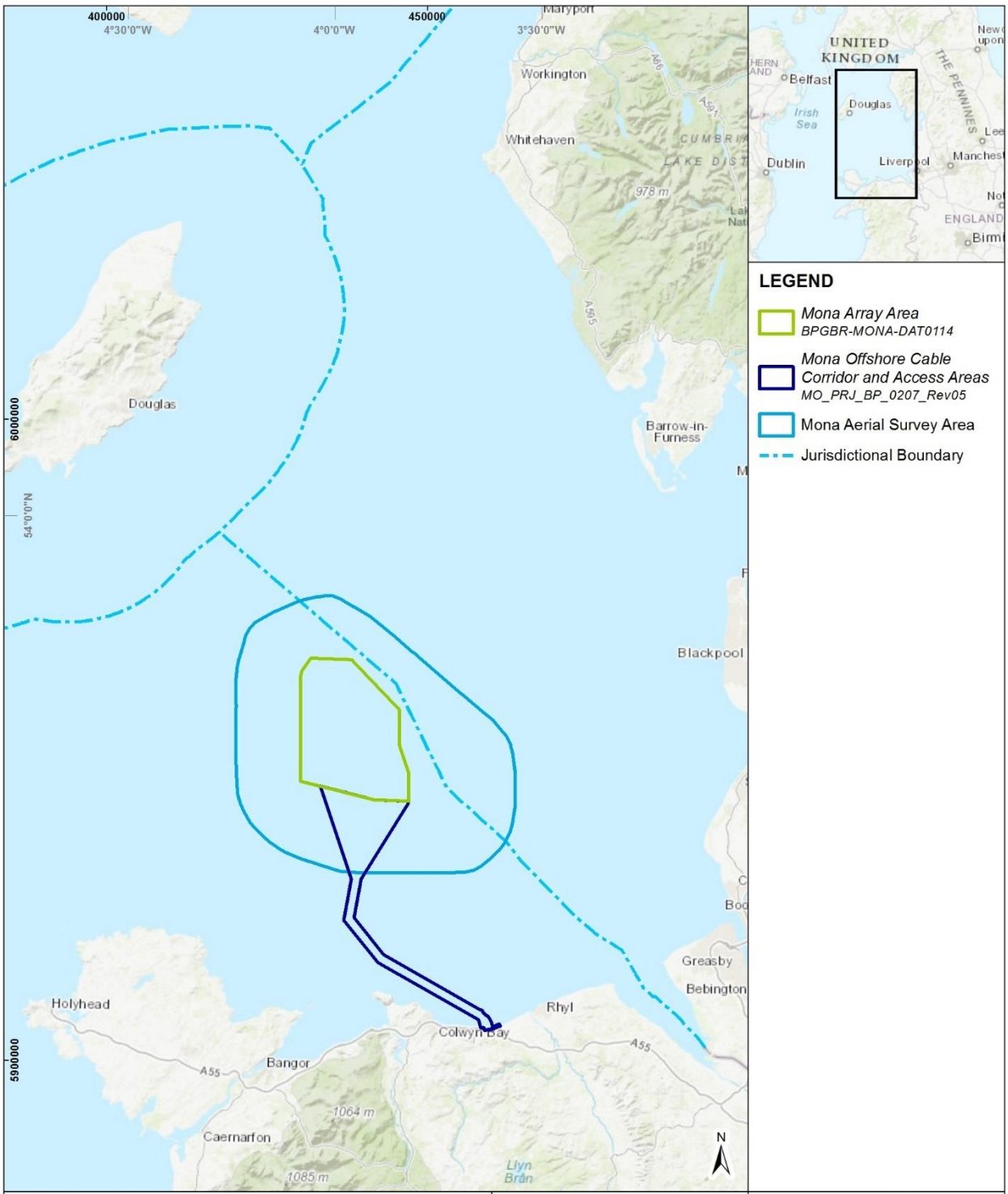


Figure 1.5 Mona marine mammal Aerial Survey Area from Mona Offshore Wind Ltd. (2024)

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

SCANS-I, SCANS-II,SCANS-III and SCANS-IV survey extents

1.2.4.38 The main objective of SCANS surveys was to estimate small cetacean abundance and density in the North Sea and European Atlantic continental shelf waters. The SCANS-I surveys were completed in 1994 (Hammond *et al.*, 2002), SCANS-II in July 2005 (Hammond *et al.*, 2012), SCANS-III in July 2016 (Hammond *et al.*, 2017; 2021) and SCANS-IV in September 2022 (Giles *et al.,*2023), and all comprised both vessel and aerial surveys. Both methodologies were designed to correct for availability and detection bias to allow the estimation of absolute abundance.

1.2.4.39 SCANS-I surveys did not overlap the Transmission Assets but did cover the Celtic Sea to the south of the Transmission Assets (block A) (**Figure 1.6**), however the most recent three SCANS surveys do overlap the Transmission Assets. The Transmission Assets fall within SCANS-II block O (**Figure 1.7**), SCANS-III block F (with survey block E adjacent) (**Figure 1.8**), and SCANS-IV block CS-E (**Figure 1.9**); (all surveyed by aircraft).

1.2.4.40 The aerial transects in SCANS-II covered 15,802 km in good or moderate conditions in an area of 364,371 km^2 (Hammond *et al.*, 2013). For SCANS-II block O, the survey area was 45,417 km^2 with a total survey effort of 2,264 km.

1.2.4.41 In 2016, the SCANS-III aerial survey total search effort was 51,286.7 km and covered a surface area of 1,208,744 km^2 (Hammond *et al.*, 2021). SCANS-III block F has a surface area of 12,322 km^2 with 619.8 km surveyed under primary effort whilst block E has an area of 34,870 km^2, with 2,252.7 km surveyed under primary effort. The original SCANS-III data was published in the Hammond *et al.* (2017) report, which has been revised following the discovery of some analytical errors and the updated version, Hammond *et al.* (2021), is used in this technical report.

1.2.4.42 In 2022 the SCANS-IV aerial survey total search effort was 71,651.9 km and covered a surface area of 1,467,358 km^2. The Transmission Assets lie within SCANS-IV block CS-E which has a surface area of 12,274 km^2, with 740.8 km surveyed under primary effort. SCANS-IV block CS-D lies adjacent and has a surface area of 34,867 km^2, with 2,375.2 km surveyed under primary search effort. Both blocks were surveyed between 28 June 2022 and 15 August 2022.

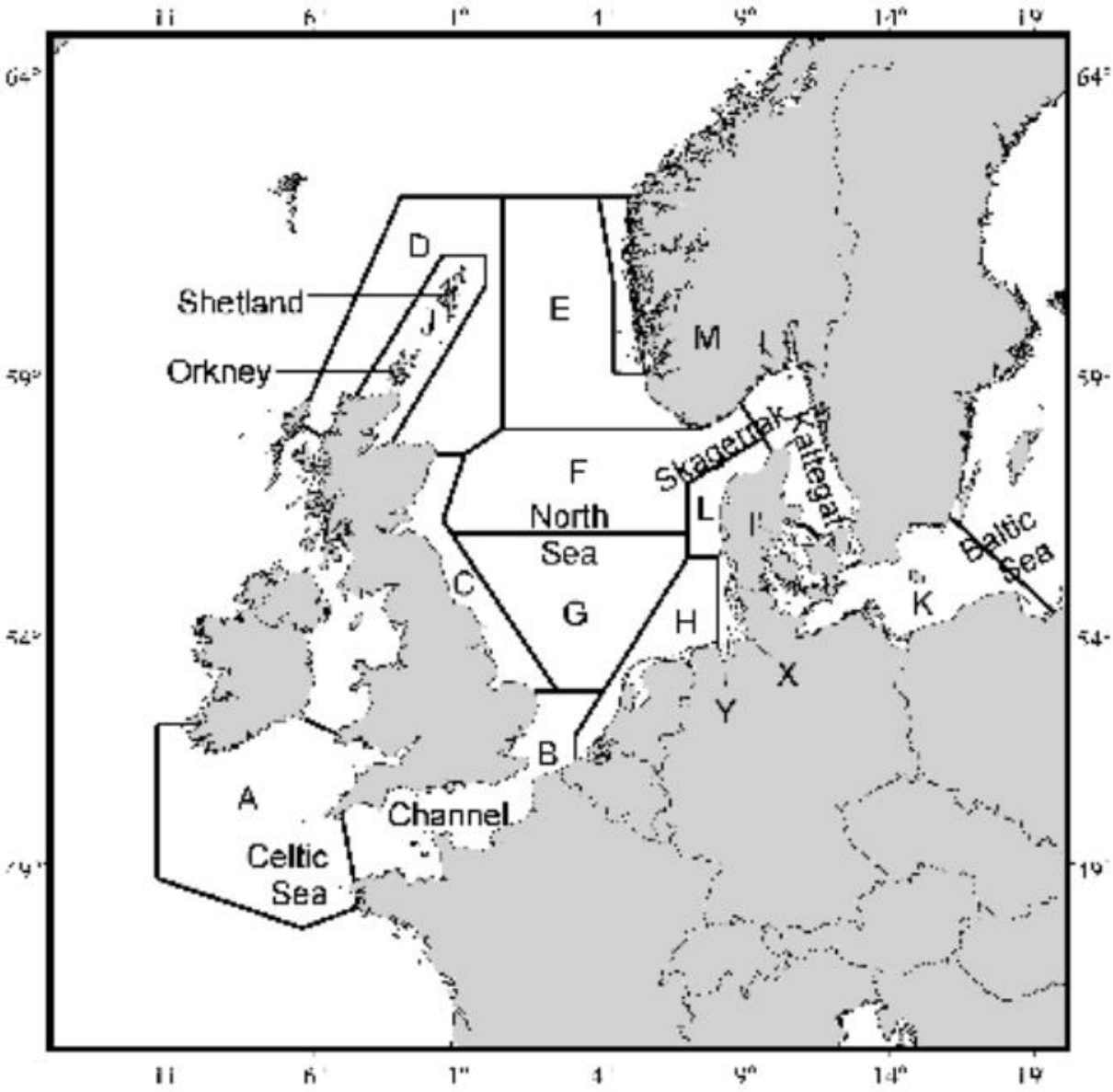


Figure 1.6: Area covered during the SCANS-I survey in 1994 (from Hammond *et al.*, 2002)

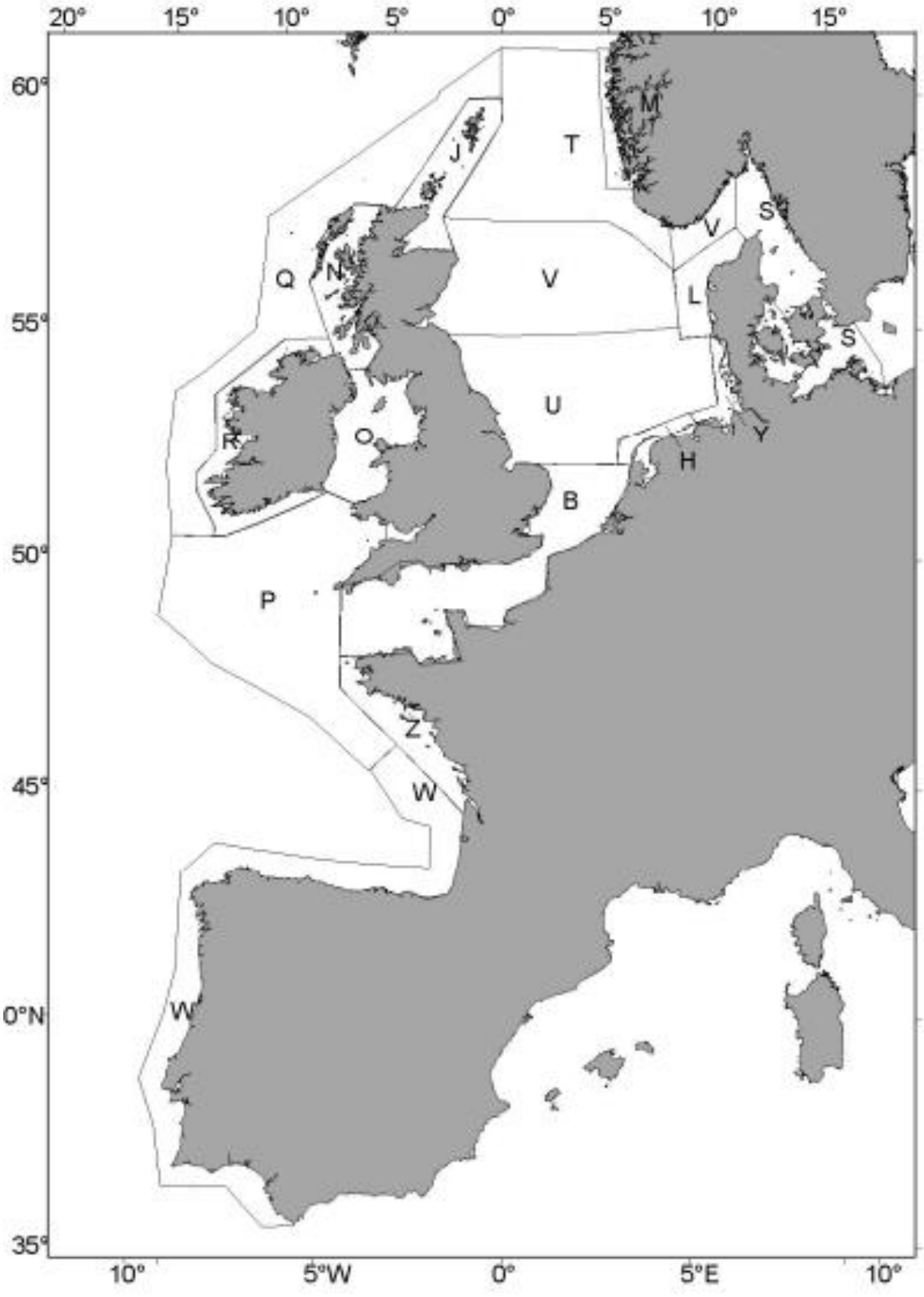


Figure 1.7: Survey blocks for SCANS-II surveys in 2005 (from Hammond *et al.*, 2013)

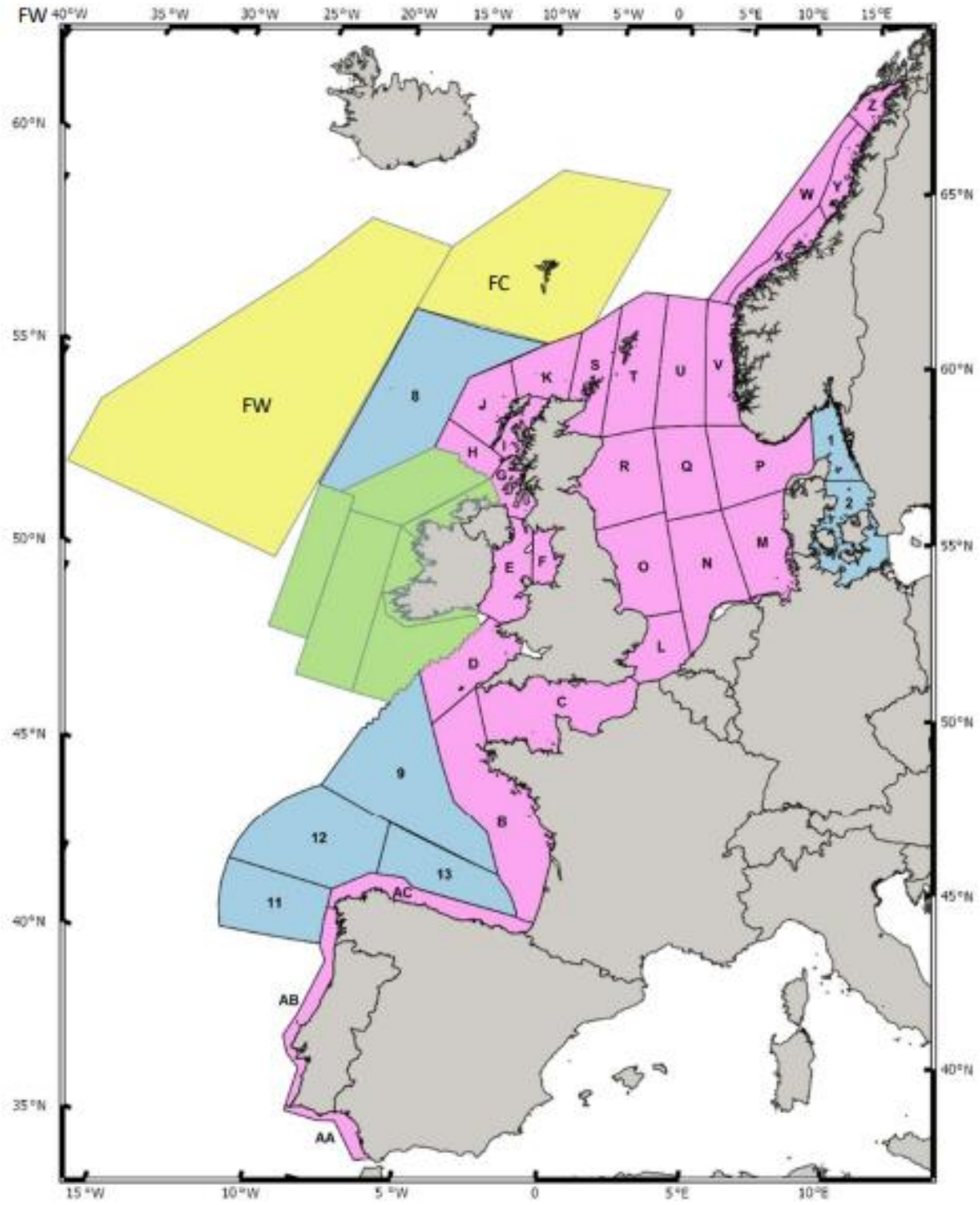


Figure 1.8: SCANS-III blocks surveyed in 2016. Pink blocks surveyed by aerial surveys (from Hammond *et al.,* 2021)

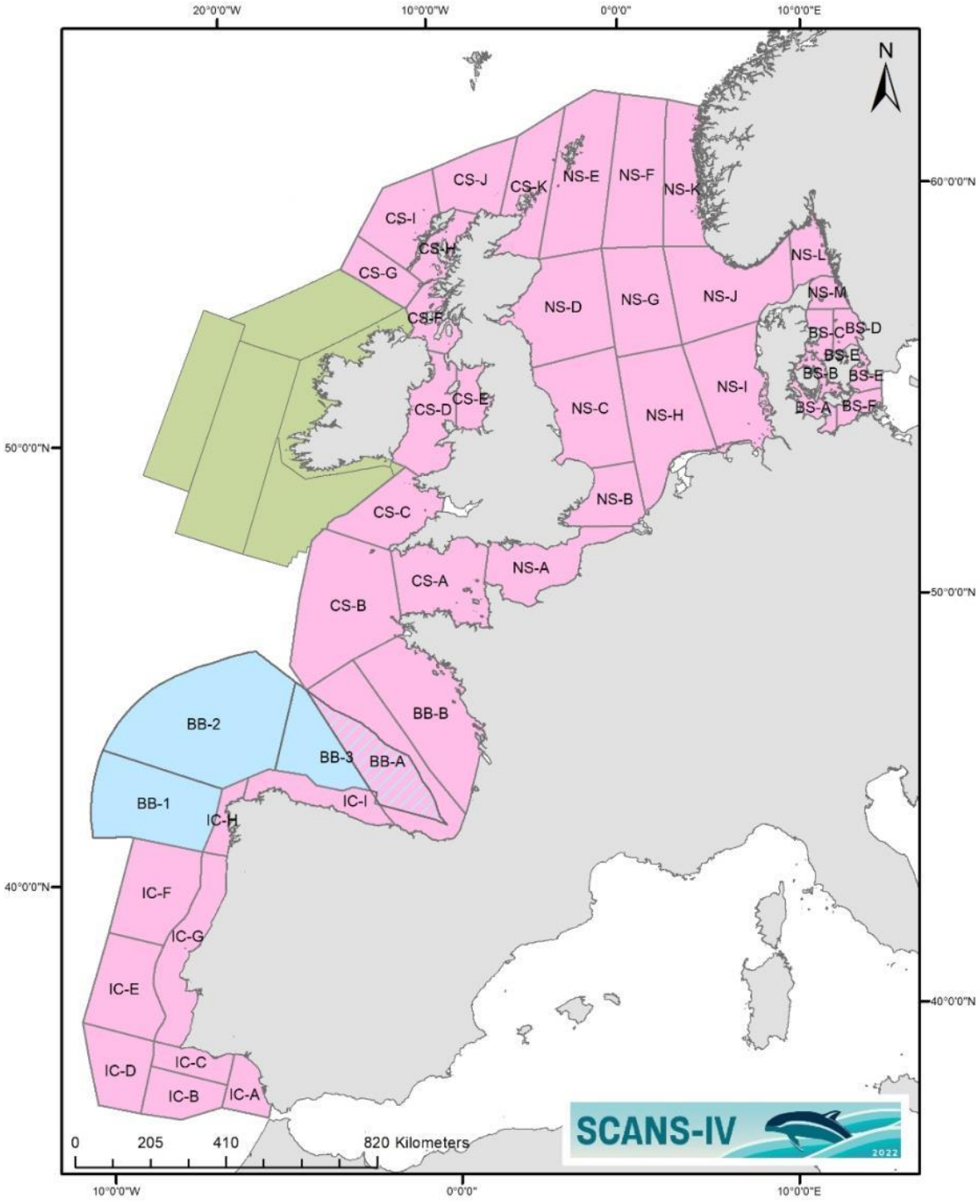


Figure 1.9: SCANS-IV blocks surveyed in 2022. Pink blocks surveyed by aerial surveys (from Gilles *et al.,* 2023)

SCANS-III density surface modelling (DSM)

1.2.4.43 Although a primary aim of SCANS-III was to provide robust large-scale estimates of cetacean abundance (Hammond *et al*., 2021), SCANS-III information was also used to provide information on summer distribution by modelling the data in relation to spatially linked environmental

features to generate density surface maps. Lacey *et al.* (2022) presents DSM for those cetacean species for which sufficient data were obtained during SCANS-III, which includes harbour porpoise, bottlenose dolphin, common dolphin *Delphinus delphis* and minke whale *Balaenoptera acutorostrata*. The cetacean data used in the analysis were the same as those used to obtain design based estimates of abundance in Hammond *et al.* (2021).

1.2.4.44 The modelling used environmental covariates (which were selected as having the potential to explain additional variability in cetacean density) including depth, slope, aspect, distance from the coast, topography, sea level anomaly and sea surface temperature. The spatial resolution of the fitted models was approximately 10 km and the spatial resolution of the model predictions was 10 x 10 km cells.

1.2.4.45 Maps showing surfaces of predicted density and estimated coefficient of variation (CV) of predicted density were produced for each species for SCANS-III, with patterns of predicted density influenced by model covariates, fitted smooth functions and spatial variation in the values of the covariates in the prediction grid. Lower CVs are generally associated with areas of higher density and thus confidence in predictions in areas of low density is poorer, with magnitude of CV influenced by model fit. To note the density surfaces are for summer distributions only, as this is when SCANS-III was carried out. The maps allow density surfaces to be overlaid with the study area for mean density outputs and are discussed within relevant species sections.

ObSERVE surveys

1.2.4.46 Aerial surveys were conducted between 2015 and 2017 in the offshore waters of Ireland, with the aim of investigating occurrence, distribution and abundance of key marine species (Rogan *et al.,* 2018). The surveys for cetaceans consisted of line-transects with observer effort concentrated within approximately 500 m either side of the aircraft.

1.2.4.47 The Transmission Assets is located closest to Stratum 5 (**Figure 1.10**) the only strata in the Irish Sea, which covers only the west Irish coastal waters of the Irish Sea. Species-specific sightings, density distributions and abundance estimates were given for the entire survey area as well as by stratum and season. Per species, sightings were pooled over all strata and all seasons to fit a single detection function, rather than attempting to fit separate functions per season. This approach assumes that there are no regional, seasonal or inter-annual differences in observer ability or species behaviour in any of the strata flown.

1.2.4.48 Nineteen species of cetaceans were sighted over two years, with 1,844 sightings, comprising an estimated 8,633 individuals. Seasonal and inter-annual differences in distribution were evident for some cetacean species. Harbour porpoises were recorded over a large spatial area during the summer months but a more coastal distribution was indicated in winter months. In contrast, bottlenose dolphins were less frequently seen in coastal waters during the winter than in summer. Sightings and density surface modelling highlighted the importance to these species

of the continental shelf margin, and also the Porcupine Basin (located 200 km west of the Irish mainland) in both seasons.

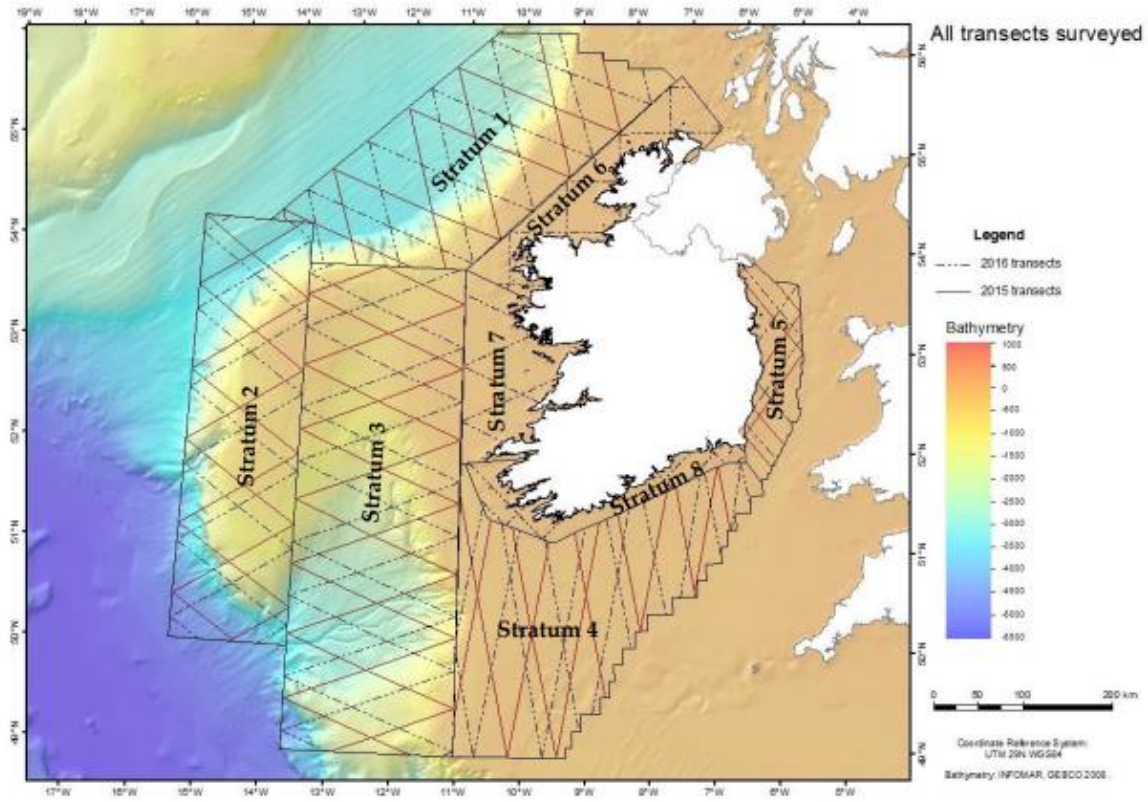


Figure 1.10: ObSERVE aerial transect lines flown in summer and winter 2015 and 2016 (from Rogan *et al.,* 2018)

Inter-Agency Marine Mammal Working Group (IAMMWG) MUs

1.2.4.49 In 2015, the IAMMWG defined MUs for the seven most common cetacean species found in UK waters (IAMMWG, 2015): harbour porpoise, bottlenose dolphin, short-beaked common dolphin, white-beaked dolphin *Lagenorhynchus albirostris*, Atlantic white-sided dolphin *Lagenorhynchus acutus*, Risso's dolphin and minke whale. Abundance estimates were calculated for each species within their respective MUs using the most recent data available at the time, notably estimates from the SCANS-II.

1.2.4.50 In an update to the 2015 IAMMWG report, the most recent abundance estimates for key marine mammal species in the UK and their MUs used the most up-to-date data available as of February 2021 (IAMMWG, 2022). The data was largely derived from SCANS-III (Hammond *et al.,* 2017) and the ObSERVE Programme (Rogan *et al*., 2018). The IAMMWG also reviewed information published since 2015 to determine if there was sufficient evidence to warrant a change to any of the MU boundaries (IAMMWG, 2023). All MUs for harbour porpoise, short-beaked common dolphin, Risso's dolphin and minke whale remain unchanged, and the Irish Sea MU (IS MU) for bottlenose dolphin remains unchanged.

Joint Cetacean Protocol (JCP) Phase III

1.2.4.51 The JCP Phase III analysis included 38 data sources, with data from at least 542 distinct survey platforms (ships and aircraft) conducted to estimate spatial and temporal patterns of abundance of seven species of cetacean over a 17 years period (1994 to 2010) (Paxton *et al.,* 2016). Approximately 1.09 million km^2 of effort is included, covering the region from 48° N to c. 64° N and from the continental shelf edge west of Ireland to the Kattegat in the east. Species of cetacean included in the study were harbour porpoise, minke whale, bottlenose dolphin, short-beaked common dolphin, Risso's dolphin, white-beaked dolphin and Atlantic white-sided dolphin.

1.2.4.52 Density surface models were used to predict species density over a fine scale grid of 25 km^2 resolution for one day in each season in each survey year. The data were divided into regions and seasonal estimates of abundance given for winter (January to March), spring (April to June), summer (July to September) and autumn (October to December). Subsets of the grid were used to produce abundance estimates for four large regions and 19 areas of commercial interest. The study area is situated within the "Irish Sea area of special commercial interest", covering an area of 8,227 km^2 (Paxton *et al.*, 2016).

1.2.4.53 Temporal trends were estimated for each region by estimating an average summer abundance for each of three time periods, corresponding with the European Union (EU) Habitats Directive reporting periods (1994 to 2000, 2001 to 2006 and 2007 to 2010).

1.2.4.54 The report provides maps of density for species, numerical estimates of abundance for particular species-location combinations, and rates of change between reporting periods.

Joint Cetacean Protocol (JCP) Phase One

1.2.4.55 The JCP data resource (see **paragraph 1.2.4.51**) was initially utilised to fit density surface models for the Irish Sea area only (Paxton and Thomas, 2010). Using data compiled from surveys between 1980 and 2008 seasonal density surfaces estimates were successfully predicted for harbour porpoise, minke whale, bottlenose dolphin, common dolphin and Risso's dolphin.

Joint Cetacean Data Programme (JCDP)

1.2.4.56 The Joint Cetacean Data Programme launched in 2022, aiming to collate existing cetacean monitoring datasets in the UK and wider north east Atlantic waters. The data portal collates cetacean data collected at-sea via ship-based or aerial observer/digital methodologies. Datasets submitted are standardised to ensure commonality between datasets, according to the JDCP Data Standard. Publicly available data within the Irish Sea for inclusion in this technical report at the time of writing (March 2024) contained SCANS-I, SCANS-II and SCANS-III data, which is previously discussed in **paragraph 1.2.4.38**.

JNCC Report 544: The identification of discrete and persistent areas of relatively high harbour porpoise density in the wider UK marine area

1.2.4.57 Heinänen and Skov (2015) conducted a detailed analysis of 18 years of survey data on harbour porpoise around the UK between 1994 and 2011, held in the JCP database. The objective of this analysis was to identify 'discrete and persistent areas of high density' that might be considered important for harbour porpoise, with the ultimate goal of determining Special Areas of Conservation (SACs) for the species. The approach involved building predictive models using corrected sightings rates analysed with respect to topographic, hydrodynamic and anthropogenic covariates, to generate predicted distribution maps of density estimates for the waters around the UK. The analysis grouped data into three subsets: 1994 to 1999, 2000 to 2005 and 2006 to 2011 to account for uneven survey effort and analysed summer (April to September) and winter (October to March) data separately to explore whether distribution patterns were different between seasons.

1.2.4.58 Due to the uneven survey effort over the modelled period, there was a large degree of uncertainty in modelled distributions. Additionally, the analysis presented in Heinänen and Skov (2015) relied on extensive extrapolation of survey data over space and time. Any such extrapolation is sensitive to the covariates used in models and makes the assumption that these relationships hold outside of the surveyed areas.

JNCC Report 543: Analysis of long-term effort-related land-based observations to identify whether coastal areas of harbour porpoise and bottlenose dolphin have persistent high occurrence and abundance

1.2.4.59 A study by Evans *et al.* (2015) for JNCC analysed a long-term dataset of land-based observations from 1965 at 678 sites around the UK, with the aim of identifying persistent high areas of abundance and occurrence for harbour porpoise and bottlenose dolphin. Over 74,000 hours of land-based watches and 50,000 sightings of bottlenose dolphin and harbour porpoise were observed from 678 sites around the UK coast. The modelled coastal distributions showed bottlenose dolphin are concentrated around west Wales and east Scotland, whilst harbour porpoise were much more evenly distributed. There was very little overlap between species.

North East Atlantic Distribution Maps (2020)

1.2.4.60 Waggitt *et al.* (2020) produced distribution maps of cetacean and seabird populations in the north east Atlantic. The study collated 2.68 million km of diverse survey data between 1980 and 2018 to maximise spatial and temporal coverage. The study then used detection functions to estimate variation in the surface area covered among these surveys to standardise measurements of effort and animal densities. Finally, Species Distribution Models (SDM) were used to predict comprehensive

distribution maps of these taxa in the north east Atlantic at 10 km resolution.

1.2.4.61 Twelve cetacean species were modelled which included harbour porpoise, bottlenose dolphin, short-beaked common dolphin, Risso's dolphin and minke whale. It is important to highlight that this study focused on the offshore ecotype of bottlenose dolphin to avoid confounding influences hindering the development of SDM for either ecotype, noting that the bottlenose dolphin found in the IS MU are the inshore ecotype.

Atlas of Marine Mammals of Wales (2012)

1.2.4.62 The Atlas of the Marine Mammals of Wales collected data from 16 projects to assess the distribution of marine mammals in the Irish Sea (St George's Channel to the greater part of the Bristol Channel) (Baines and Evans, 2012). The database comprised 216,031 km of effort from vessel and aerial surveys and 13,399 hours of land-based effort, spanning 20 years from 1990 to 2009. The project database comprised 32,986 cetacean sightings totalling 99,085 individuals of 12 species (harbour porpoise, bottlenose dolphin, short-beaked common dolphin, Risso's dolphin, minke whale, fin whale *Balaenoptera physalus*, white-beaked dolphin, Atlantic white-sided dolphin, long-finned pilot whale *Globicephala melas*, humpback whale *Megaptera novaeangliae* and northern bottlenose whale *Hyperoodon ampullatus)*. Whilst the database has good broad scale information on the distribution of marine mammals in Irish waters, it does have several limitations. The authors acknowledge that the data is between 11 and 30 years old and survey coverage was inadequate in many areas.

Welsh Marine Mammal Atlas (2023)

1.2.4.63 A new version of the Atlas of the Marine Mammals of Wales was commissioned by NRW in 2020 and maps marine species distribution and abundance using habitat-based modelling (Evans and Waggitt, 2023). Modelled densities were provided at 2.5 km resolution for those species sufficiently common enough to allow robust modelling, which included five cetacean species (harbour porpoise, bottlenose dolphin, short-beaked common dolphin, Risso's dolphin and minke whale) and 13 seabird species.

1.2.4.64 Densities were derived using data from vessel, aerial visual and aerial digital observation platforms between 1990 and 2020 and were collated and analysed for an area encompassing the Irish Sea, Bristol Channel and that part of the Celtic Sea commonly referred to as the Celtic Deep, south as far as a line drawn west of Lands End in Cornwall.

1.2.4.65 Sighting rates were also determined for the five species (**paragraph 1.2.4.63**) as well as less common cetaceans and birds, which included striped dolphin, white-beaked dolphin, Atlantic white-sided dolphin, killer whale, long-finned pilot whale, fin whale and humpback whale.

1.2.4.66 Evans and Waggitt (2023) recommended that distribution patterns are taken from the full 30-year data set. Average density estimates for the

study area for harbour porpoise and bottlenose dolphin were provided by NRW during Marine Mammal EWG consultation, taken from the annual composite map which shows the maximum density whenever it occurred over the 30 years of data for each cell (Evans and Waggitt, 2023). Therefore, density estimates are precautionary as this is the highest value observed for each cell at any one point in time.

Habitat-based predictions of at-sea distribution for grey and harbour seal in the British Isles

1.2.4.67 Carter *et al.* (2022) have produced the most recent revised estimated at-sea distribution usage maps for both grey and harbour seal based on habitat association modelling. The study uses an extensive high-resolution GPS tracking dataset containing 114 grey and 239 harbour seal to model habitat preference and generate at-sea distribution estimates for the entire UK and Ireland populations of both species. Previous studies predicted seal distribution, but no study has previously used habitat preference to generate distribution estimates for the whole of the UK and Ireland. Given the regional differences in population dynamics (Thompson *et al.,* 2019, Thomas *et al.,* 2019), diet (Gosch *et al.,* 2019, Wilson and Hammond, 2019) and foraging trip characteristics (Huon *et al.,* 2021) updated distribution estimates were required for the entire populations for both species, based on regional habitat preference.

1.2.4.68 Past usage maps (Russell *et al.,* 2017) contained telemetry data from 270 grey seal and 330 harbour seal tagged within the UK only and incorporated count data between 1996 and 2015. The subsequent Carter *et al.* (2020) maps incorporate an additional 100 GPS telemetry tags deployed on grey seal at sites where recent tracking data were lacking.

1.2.4.69 Carter *et al.* (2022) at sea usage maps represent the number of grey and harbour seal estimated to be in the water in each 5 x 5 km grid cell at any given time, based upon habitat-based models. Values in the Carter *et al.* (2022) report were presented as spatial predictions of relative density, but absolute densities can be calculated based on population scalars presented in the Supplementary material (S7.4) of Carter *et al.* (2022). There were concerns about accuracy of scalars used for previous at-sea usage maps (Russell *et al.,* 2016; Lonergan *et al.* 2013), but updated scalars for Carter *et al.* (2022) were derived from telemetry data. The overall UK and Ireland population size was estimated using the first scalar (the total number of seals counted on most recent surveys was assumed to represent 72% of the harbour seal population, and 25.15% of the grey seal population (SCOS, 2021)) and this was converted to the at-sea population using the second scalar, which is the mean percentage of time spent at-sea during the season (82.36% for harbour seal and 86.16% for grey seal (SCOS, 2021)). Carter *et al.* (2022) acknowledges that the scalars used do not reflect regional variation in seal behaviour and scalars are given as population mean estimates, and thus there is uncertainty around these estimates.

1.2.4.70 Given the above, results of the analysis of densities presented in Carter *et al.* (2022) are to be taken as approximate estimates, rather than definitive numbers.

Manx Whale and Dolphin Watch (MWDW) surveys

1.2.4.71 MWDW have conducted vessel-based marine mammal surveys throughout Manx territorial waters, with 88 trips carried out between 2007 and 2021 to survey cetaceans. This totalled 11,975.3 km of surveys, most of which were conducted in the summer months between May and September each year. Harbour porpoise, short-beaked common dolphin, bottlenose dolphin, Risso's dolphin and minke whale were reported during these surveys. There were 961 cetacean sightings, of which 769 were of harbour porpoise (80%) (Manley (2021; 2020; 2019); Clark *et al.* (2019; 2018; 2017); Felce and Adams (2016); Felce (2015)). The most recent report (Manley, 2021) presents data for 2021 surveys (including trips on vessels of opportunity) conducted between May and September, surveying 346 km. Harbour porpoise was the most observed cetacean species as in previous years, representing 36 (75 individuals) of the 47 cetacean sightings. Effort-based land surveys have also been carried out since 2006, at seven survey sites, throughout the year when the sea state is Beaufort scale 3 or less and data is presented as cetacean-positive intervals (15-minute interval where a cetacean is sighted). Data includes species, total number of individuals in the group, group composition, behaviour, direction of movement and distance and angle of the group from the observers. Species observed included harbour porpoise, Risso's dolphin, bottlenose dolphin, short-beaked common dolphin and minke whale and the highest sighting rates for cetaceans were July and August.

1.2.4.72 Public sighting data is also available by MWDW, with sightings reported from 2006 to 2015. This data is opportunistic from various platforms such as boat or land and lacks information on survey effort and environmental conditions. Species reported includes bottlenose dolphin, short-beaked common dolphin, Risso's dolphin, minke whale and harbour porpoise.

1.2.4.73 Opportunistic and effort based sighting data from 2006 to 2022 was requested from MWDW for harbour porpoise, bottlenose dolphin, Risso's dolphin, short-beaked common dolphin and minke whale, presented in **Figure 1.11**. Harbour porpoise were sighted as recently as 2022 (14 January 2022), and 409 were sighted in 2021. For other species sightings in 2021 included 7,164 bottlenose dolphin, 703 short-beaked common dolphin, 338 Risso's dolphin and 45 minke whale (MWDW, 2022). Other cetaceans such as fin whale and humpback whale have been recorded in MWDW datasets.

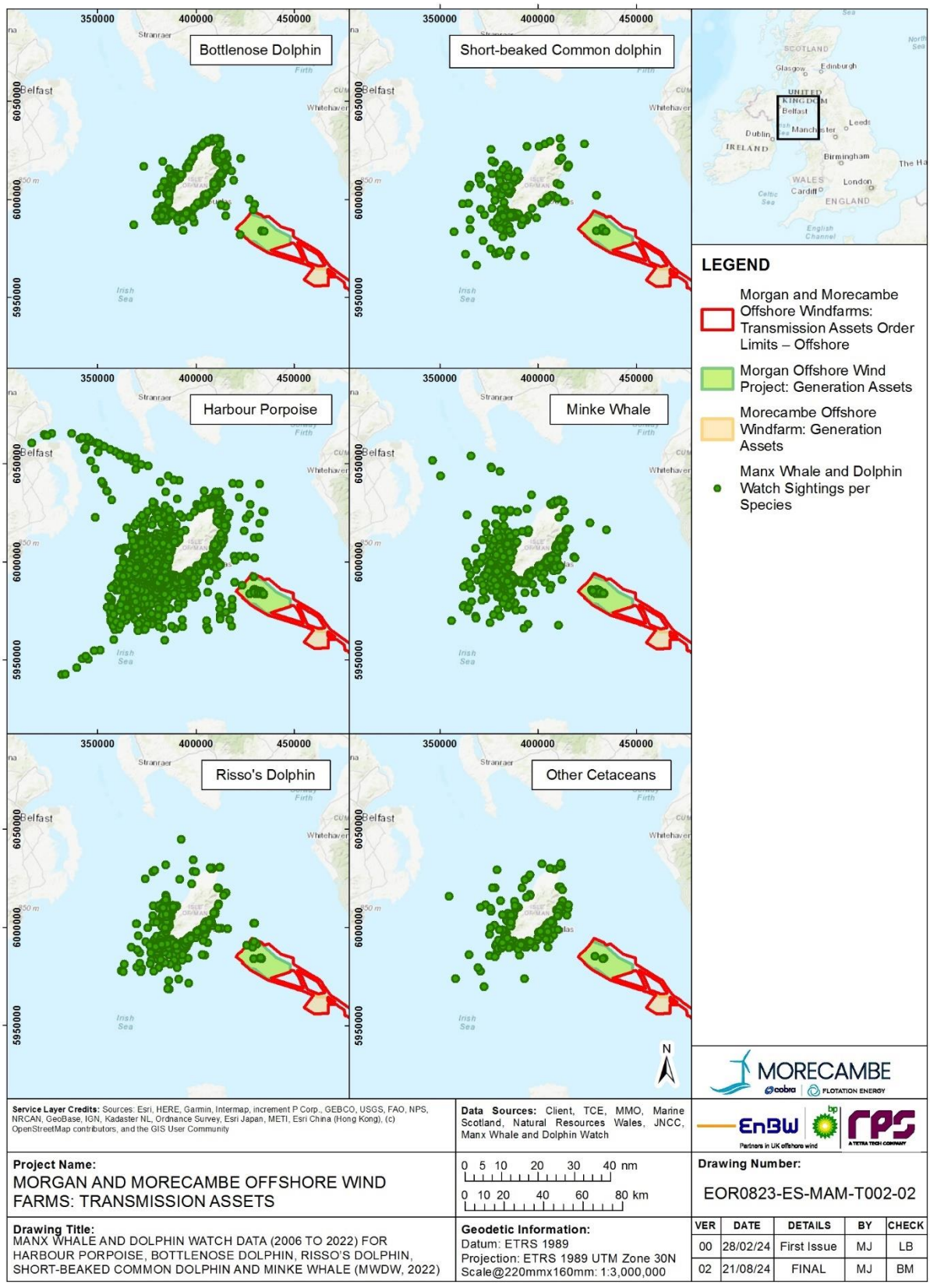


Figure 1.11: Manx Whale and Dolphin Watch data (2006 to 2022) for harbour porpoise, bottlenose dolphin, Risso's dolphin, short-beaked common dolphin and minke whale (MWDW, 2022)

Manx Wildlife Trust (MWT) surveys

1.2.4.74 MWT holds data on seal species around the Isle of Man. Data was provided by MWT for seal pup surveys carried out annually on the Calf of Man (2017 to 2021) (**Figure 1.12**). They also provided opportunistic land sightings from 2017 to 2022 (**Figure 1.13**) and a dedicated seal haul out survey in 2017 (**Figure 1.14**) for the Isle of Man.

1.2.4.75 For the Calf of Man surveys, for the six weeks of each pupping season, two seal surveyors were based on the Calf of Man to complete observational surveys of seal pup numbers and general grey seal abundance at 12 sites around the island.

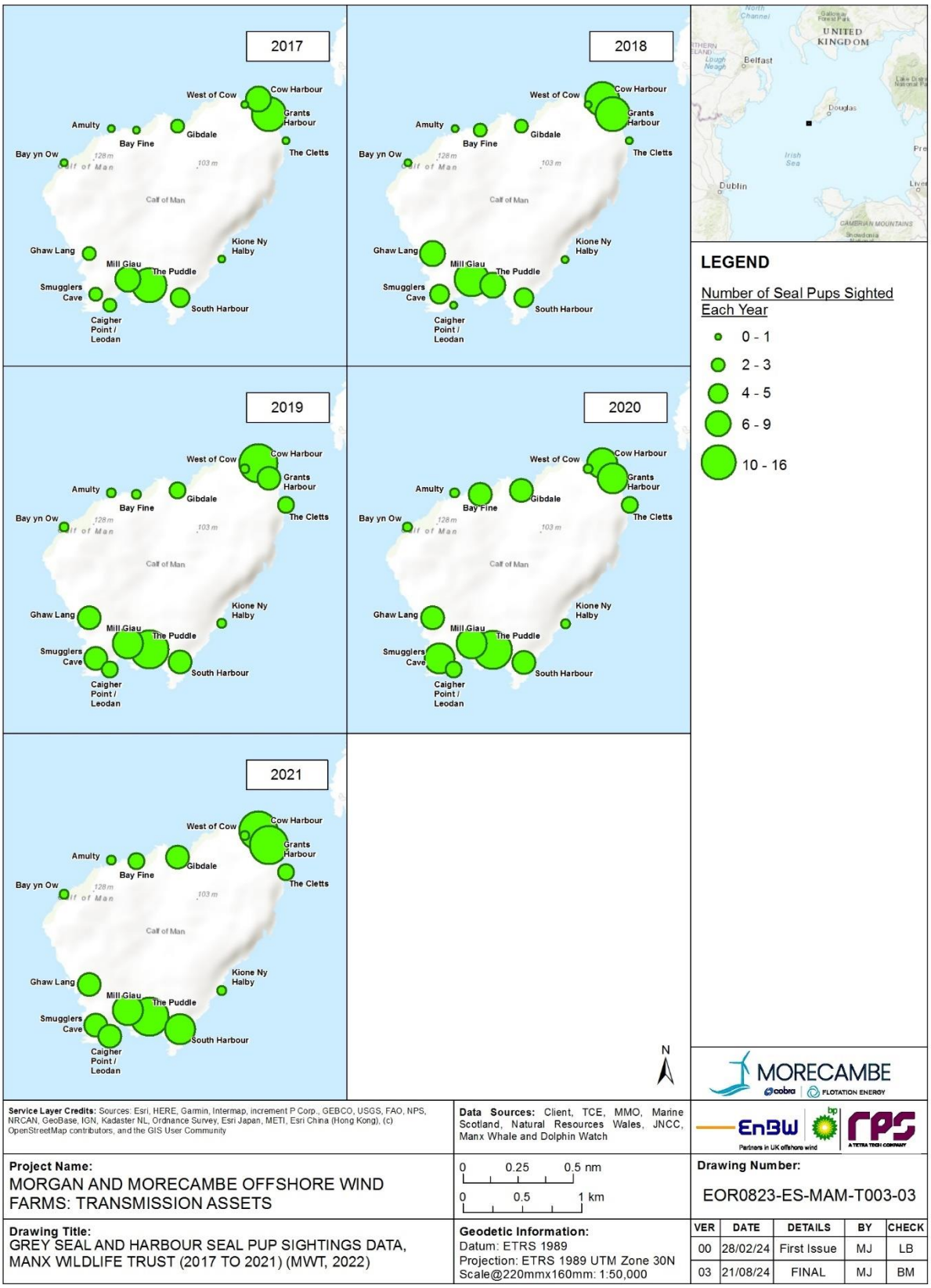


Figure 1.12: Grey seal and harbour seal pup sightings data, Manx Wildlife Trust (2017 to 2021) (MWT, 2022)

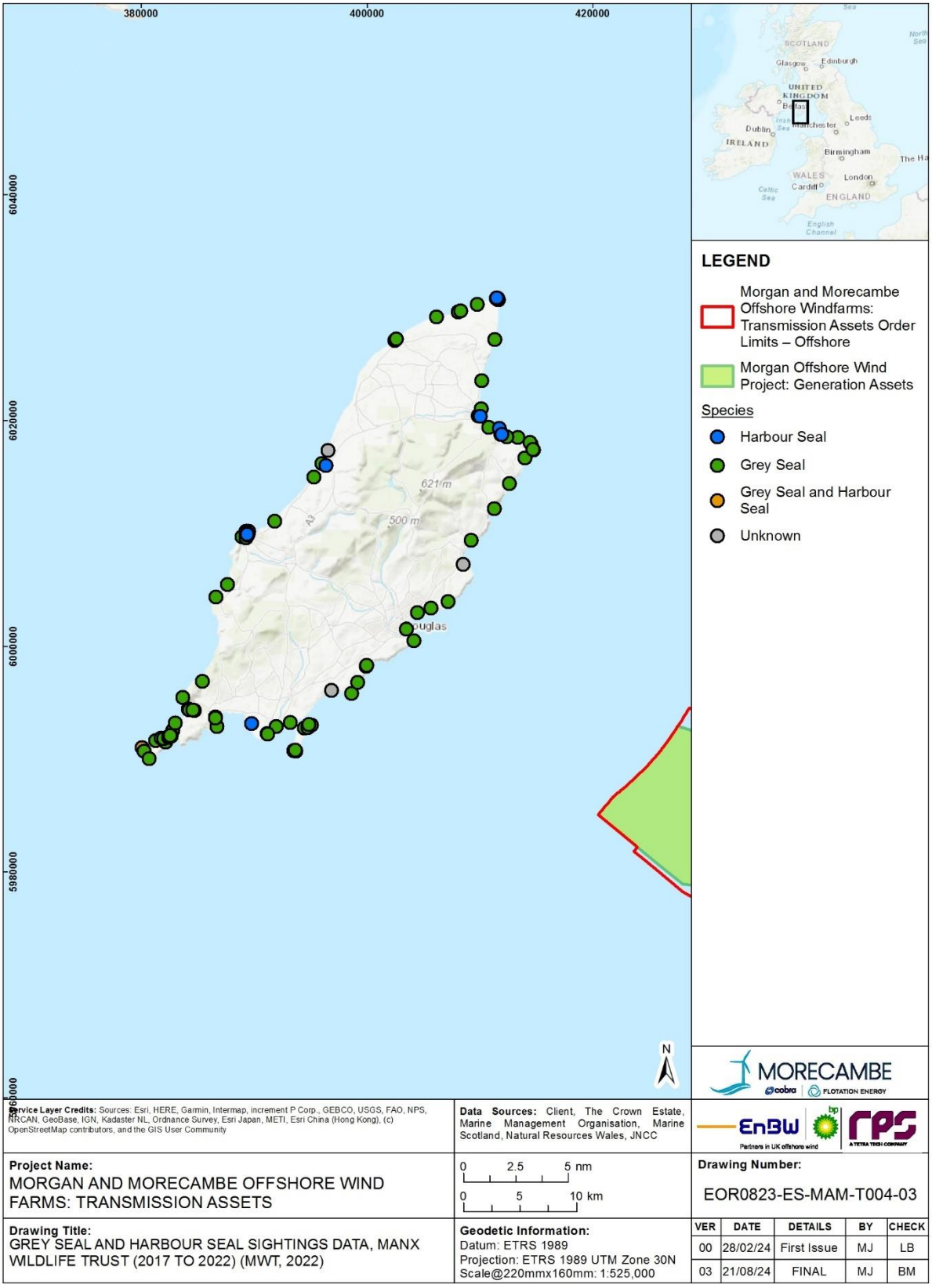


Figure 1.13: Grey seal and harbour seal sightings data, Manx Wildlife Trust (2017 to 2022) (MWT, 2022)

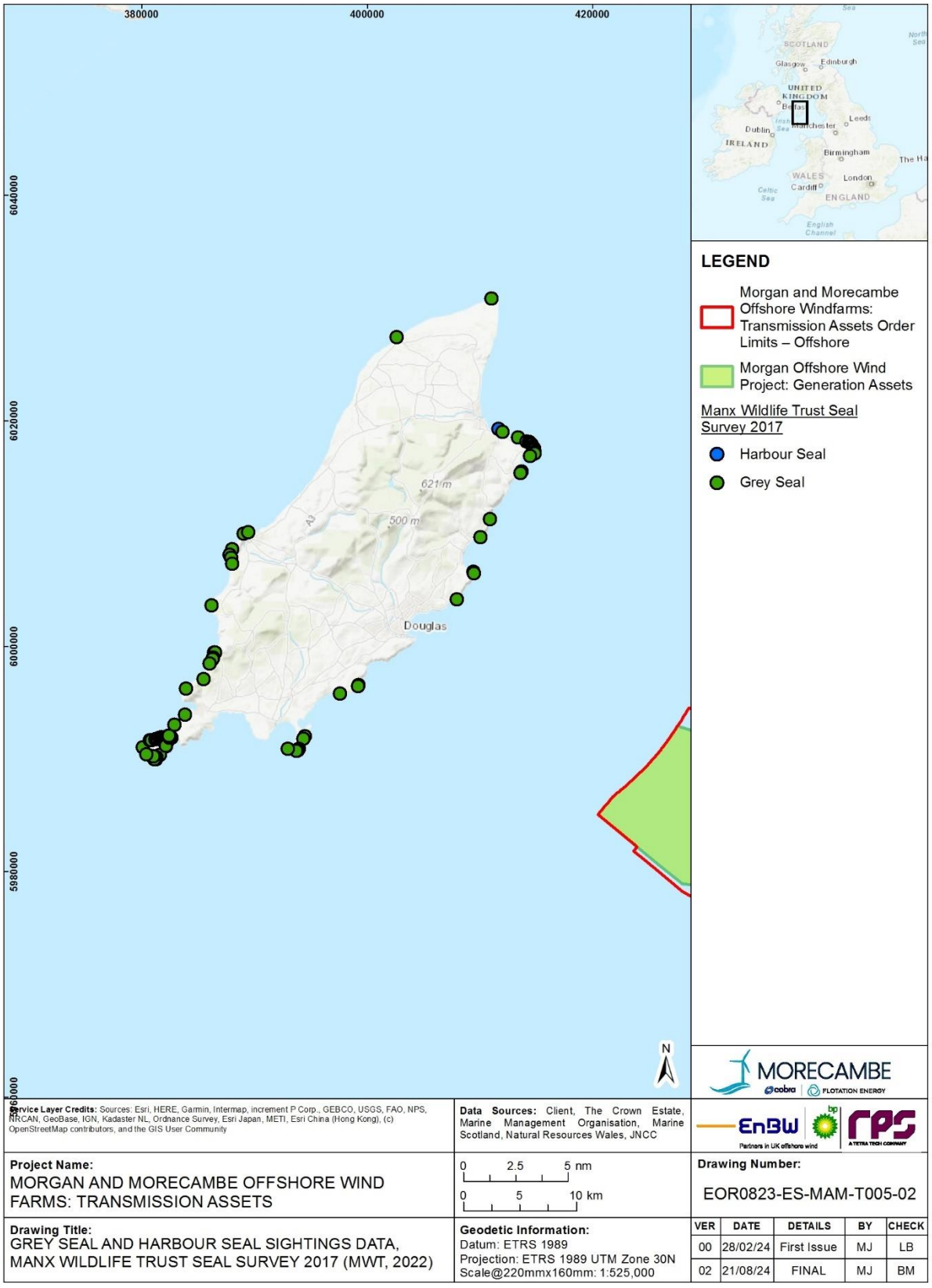


Figure 1.14: Grey seal and harbour seal sightings data, Manx Wildlife Trust seal survey 2017 (MWT, 2022)

Walney Nature Reserve

1.2.4.76 Cumbria Wildlife Trust provided data on grey seal counts at South Walney Nature Reserve, undertaken every two weeks from September to March from 1981 to 2023. South Walney is the only known grey seal breeding site in the North West England MU (SCOS, 2021). Records show that highest numbers of grey seal are usually seen in late January and February, with pups being born on the reserve generally from mid-September to mid-October. Figure 1.15 shows that a general increase in grey seal sightings has been observed at Walney Nature Reserve over the ~ 40-year period (**Figure 1.15**).

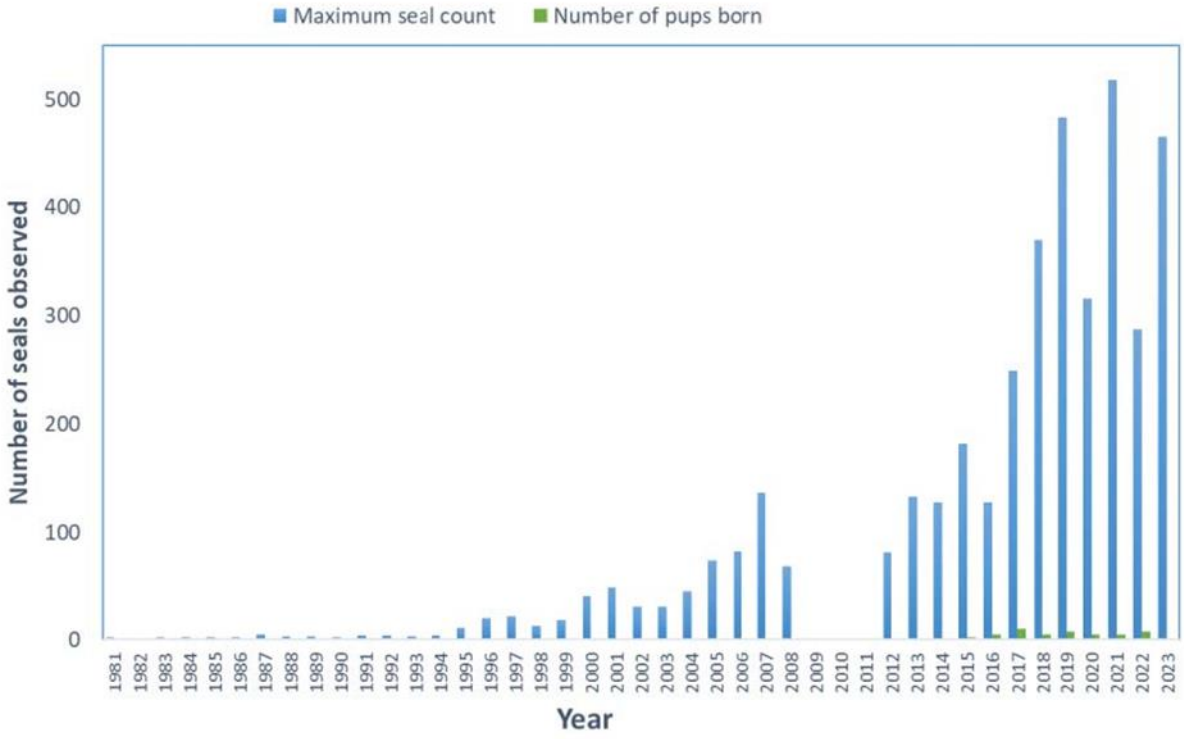


Figure 1.15: Historical maximum count data from South Walney Nature Reserve for maximum seal count observed during annual surveys between September to March (blue) and number of pups born per year (green)

Anglesey based surveys

1.2.4.77 Several studies have been conducted off the coast of Anglesey. A three year research study to estimate abundance and density of harbour porpoise off the north coast of Anglesey was carried out between May and September in the years 2002 to 2004 (Shucksmith *et al.,* 2009) (**Figure 1.16**). Abundance and densities were estimated using distance-based sampling techniques but were limited to summer only estimates for coastal waters. Harbour porpoise densities were highest at Point Lynas and South Stack.

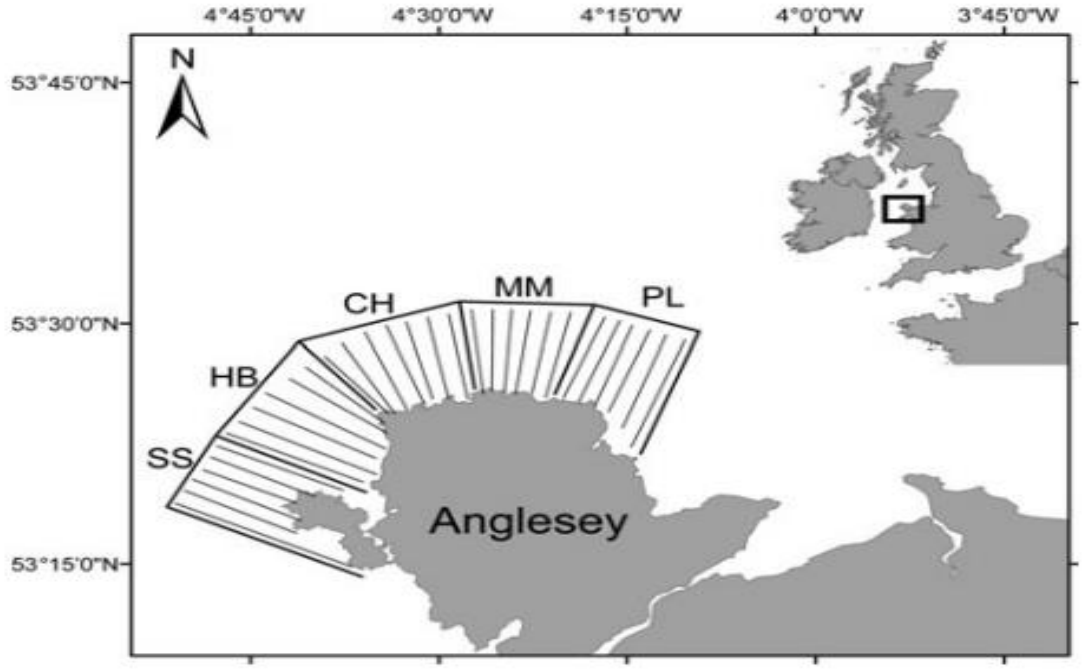


Figure 1.16: The study area of north coast of Anglesey split in to the five sectors with the transect lines (from Shucksmith *et al.,* 2009)

1.2.4.78 A project on behalf of the Welsh Government was undertaken to research marine mammals at tidal rapid sites in Wales between Autumn 2009 and 2010, and to collect data relevant to assessing risks if tidal turbines were installed at these sites (Gordon *et al.,* 2011). Study sites were off the Skerries and South Stacks in north west Anglesey and Pembrokeshire. This was conducted using visual and acoustic surveys and visual observations from shore. A telemetry study of grey seal using high resolution fastloc GPS and depth tags was also carried out. Tags were attached to newly weaned pups at breeding beaches close to tidal rapid sites in the autumn of 2009 and 2010. The majority of visual sighting data comprised harbour porpoise sightings, with a few bottlenose dolphin, short-beaked common dolphin and grey seal sightings. Towed acoustic surveys showed that harbour porpoise densities were high in both study areas, whilst substantial numbers of short-beaked common dolphin were also detected visually and acoustically in the study area off the Bishops and Clerks west of Pembrokeshire. The telemetry study suggested young seals are making extensive use of high tidal current areas around their breeding beaches.

1.2.4.79 Several surveys are available for informing baselines for the Horizon Nuclear Power Wyldfa Newydd Project and Morlais Demonstration Zone (MDZ) project. Around the north of Anglesey, visual boat-based line-transect surveys were undertaken between 2016 and 2017 (21 surveys across 14 months) to give abundance and density estimates to inform the baseline characterisation for the Horizon Nuclear Power Wylfa Newydd Project (Jacobs, 2018). Between May and August 2016 marine mammal sightings were recorded by trained European Seabirds at Sea surveyors, however after this the methodology was altered to include dedicated MMObs providing continuous survey effort, recording bearings and distances to sightings.

1.2.4.80 For the baseline for MDZ, boat based dedicated visual marine mammal surveys were carried out by Natural Power (24 surveys between November 2016 and October 2018) and additional boat and acoustic surveys targeting marine mammals were carried out by Sustainable Expansion of Applied Coastal and Marine Sectors Project (SEACAMS) (18 surveys between Jan 2015 and Dec 2016). The surveys targeted the MDZ area off the west of Holy Island (**Figure 1.17**). Harbour porpoise, bottlenose dolphin, Risso's dolphin and grey seal were observed during the surveys.

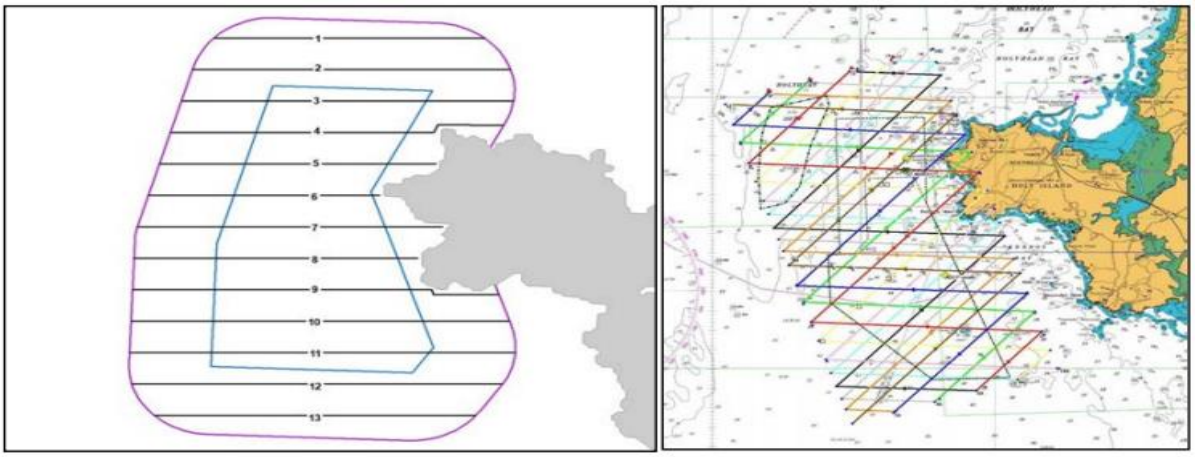


Figure 1.17: Survey transects for MDZ (from Royal Haskoning DHV, 2019)

Cardigan bay surveys

1.2.4.81 Cardigan Bay has been a focus of research for bottlenose dolphin and harbour porpoise due to known high densities of both species within this region. Cardigan Bay is in the south west of the Irish Sea, to the south of the study area. Sea Watch Foundation (SWF) carried out research work on behalf of the CCW to investigate abundance and life history of bottlenose dolphin in Cardigan Bay. A total of 76 line boat-based transect surveys specifically targeting marine mammals were carried out in Cardigan Bay between April 2005 and December 2007. These were used to calculate abundance estimates for bottlenose dolphin and harbour porpoise (Pesante *et al.,* 2008), but grey seal was recorded in surveys also.

1.2.4.82 Subsequently in 2011, Veneruso and Evans (2012) carried out another research study for CCW to monitor bottlenose dolphin and harbour porpoise populations in Cardigan Bay, to provide preliminary information on the condition of both species in Cardigan Bay and Pen Llŷn a'r Sarnau SACs. 15 line-transect boat surveys were carried out in 2011 using a distance sampling approach covering 1,993 km, as well as dedicated *ad libitum* surveys between May and July 2011 covering 1,706 km in Cardigan Bay SAC.

1.2.4.83 Further field research by SWF, for NRW, was carried out between 2011 and 2013 to provide information on the condition of bottlenose dolphin and harbour porpoise in Cardigan Bay including both the Cardigan Bay and Pen Llŷn a'r Sarnau SACs and offshore areas (Feingold and

Evans, 2014). Dedicated line-transect boat surveys were carried out in Cardigan Bay between July and October 2011, and between April and October in 2012 and 2013. A total of 83 line transect surveys were conducted, amounting to over 10,000 km of effort in favourable conditions and abundance was estimated for bottlenose dolphin and harbour porpoise in Cardigan Bay SAC and all of Cardigan Bay.

1.2.4.84 A later study on connectivity within and beyond Cardigan Bay SAC by bottlenose dolphin (Duckett, 2018) used SWF data (encounters and individual photo ID records) from 2006 to 2018 to report on the status of individuals in North Wales, and to compile information to advise policymakers on the potential creation of an additional SAC in North Wales.

Manx Marine Environmental Assessment (MMEA)

1.2.4.85 The MMEA forms part of a wider, holistic approach towards the management and sustainable development of Manx territorial waters. The MMEA, initiated in 2011 was undertaken to bring together technical information for Manx territorial waters. This project commenced on 15 September 2011 and following best practice examples from elsewhere and involving a wide range of key marine user groups and marine experts, local information was compiled and made publicly accessible. The MMEA presents technical information on cetaceans (Howe, 2018a) and seals (Howe, 2018b), among other marine receptors.

1.3 Baseline characterisation

1.3.1 Legislation

1.3.1.1 The regional study area includes SACs designated for marine mammals. SACs are marine protected areas in the UK, designated under the Conservation of Habitats and Species Regulations 2017 in England and Wales (including the adjacent territorial sea), which have been updated by the Conservation of Habitats and Species (Amendment) (EU Exit) Regulations 2019. Changes to the 2017 regulations in the 2019 Regulations includes the creation of a national site network within the UK territory comprising the protected sites already designated under the Nature Directives, and any further sites designated under these Regulations. The 2017 Regulations (Regulation 9(1)), as amended by the 2019 Regulations, require the Secretary of State and Welsh Ministers to secure compliance with the requirements of the Nature Directives.

1.3.1.2 In Scotland the European Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora, known as the Habitats Directive, is translated into legal obligations by the Conservation (Natural Habitats, etc.) Regulations 1994; updated in 2019 as a result of the UK leaving the EU. In Northern Ireland, to ensure The Conservation (Natural Habitats, etc.) Regulations (Northern Ireland) 1995 are operable after the end of the EU transition period, changes were made by The Conservation (Natural Habitats, etc.)

(Amendment) (Northern Ireland) (EU Exit) Regulations 2019). The Conservation of Offshore Marine Habitats and Species Regulations 2017 remain relevant to the UK offshore area more than 12 nautical miles (nm) from land. The Transmission Assets span the offshore area to land and therefore transverses this boundary.

1.3.1.3 Under these regulations, the UK Government and devolved administrations are required to establish a network of important high-quality conservation sites that will make a significant contribution to conserving the habitats and species identified in Annexes I and II, respectively, of the Habitats Directive. The listed habitat types and species are those considered to be most in need of conservation at a European level (excluding birds).

1.3.1.4 Qualifying features for SACs within the Irish Sea include Annex II species harbour porpoise, bottlenose dolphin, grey seal and harbour seal.

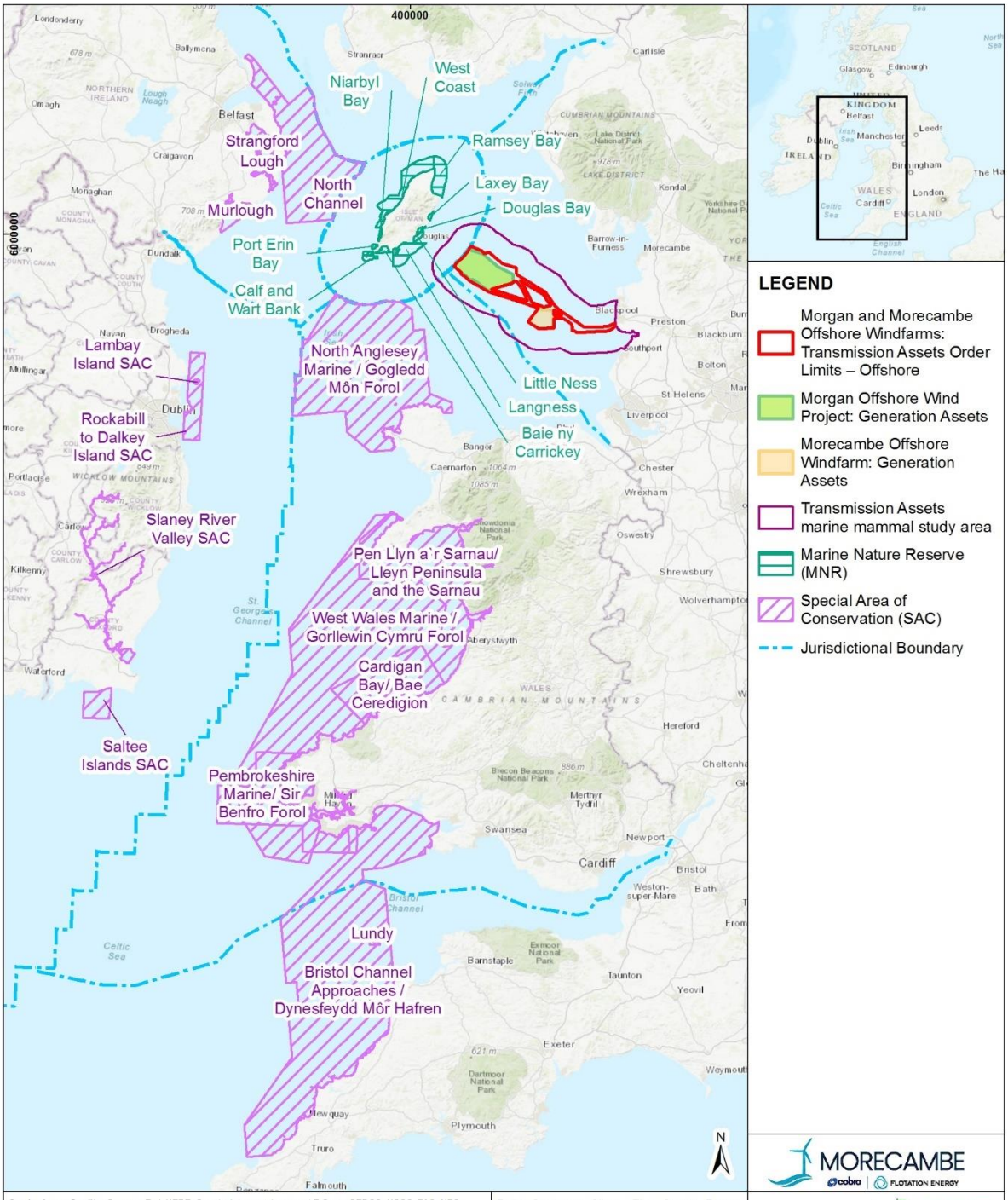
1.3.1.5 For the Isle of Man, the Wildlife Act 1990 is the primary wildlife protection legislation and sets out schedules of Manx species of animal and plant that are protected by law from injury or disturbance. It also establishes the legal protection of Areas of Special Scientific Interest and National Nature Reserves (NNR). This list of species was revised in 2004, and the Act itself received some amendment under the Agriculture (Miscellaneous Provisions) Act in 2008. The regional study area also includes Marine Nature Reserves (MNR), designated by the Isle of Man under the Wildlife Act 1990. Designation features for the MNRs includes harbour porpoise, Risso's dolphin, bottlenose dolphin, grey seal and harbour seal.

1.3.1.6 SACs and MNRs designated for the protection of marine mammals within the regional study area are presented in **Table 1.2** and **Figure 1.18** and relevant protected marine mammal species which have the potential to occur within the study area are presented in **Table 1.3**.

Table 1.2: SACs and MNRs designated for the protection of marine mammals within the regional study area

Designated site	Distance to Offshore Order Limits (marine route) (km)	Features
SACs		
North Anglesey Marine/Gogledd Môn Forol SAC	28.5	Harbour porpoise *Phocoena phocoena*
North Channel SAC	62.8	Harbour porpoise *Phocoena phocoena*
Strangford Lough SAC	93.6	Harbour seal *Phoca vitulina*
Murlough SAC	98.5	Harbour seal *Phoca vitulina*
West Wales Marine/Gorllewin Cymru Forol SAC	110.9	Harbour porpoise *Phocoena phocoena*
Pen Llŷn a`r Sarnau/Llŷn Peninsula and the Sarnau SAC	119.4	Bottlenose dolphin *Tursiops truncatus*
		Grey seal *Halichoerus grypus*
Rockabill to Dalkey Island SAC	123.5	Harbour porpoise *Phocoena phocoena*
Lambay Island SAC	130.5	Harbour seal *Phoca vitulina*
		Grey seal *Halichoerus grypus*
Cardigan Bay/Bae Ceredigion SAC	188.4	Bottlenose dolphin *Tursiops truncatus*
		Grey seal *Halichoerus grypus*
Slaney River Valley SAC	234.1	Harbour seal *Phoca vitulina*
Pembrokeshire Marine/Sir Benfro Forol SAC	237.5	Grey seal *Halichoerus grypus*
Saltee Islands SAC	260.2	Grey seal *Halichoerus grypus*
Bristol Channel Approaches/Dynesfeydd Môr Hafren SAC	301.3	Harbour porpoise *Phocoena phocoena*
Lundy SAC	336.0	Grey seal *Halichoerus grypus*
MNRs		
Langness MNR	16.8	Harbour seal *Phoca vitulina*
		Grey seal *Halichoerus grypus*
		Harbour porpoise *Phocoena phocoena*
		Risso's dolphin *Grampus griseus*
Little Ness MNR	20.5	Harbour porpoise *Phocena phocoena*
		Bottlenose dolphin *Tursiops truncatus*
		Minke whale *Balaenoptera acutorostrata*
		Risso's dolphin *Grampus griseus*
Douglas Bay MNR	22.3	Bottlenose dolphin *Tursiops truncatus*

Designated site	Distance to Offshore Order Limits (marine route) (km)	Features
		Risso's dolphin *Grampus griseus*
Laxey Bay MNR	22.4	Harbour porpoise *Phocoena phocoena*
		Minke whale *Balaenoptera acutorostrata*
		Bottlenose dolphin *Tursiops truncatus*
Ramsey Bay MNR	26.5	Harbour seal *Phoca vitulina*
		Grey seal *Halichoerus grypus*
Baie Ny Carrickey MNR	30.3	Risso's dolphin *Grampus griseus*
		Harbour porpoise *Phocoena phocoena*
		Bottlenose dolphin *Tursiops truncatus*
Calf and Wart Bank MNR	35.8	Risso's dolphin *Grampus griseus*
		Harbour porpoise *Phocoena phocoena*
Port Erin Bay MNR	40.2	Harbour porpoise *Phocoena phocoena*
Niarbyl MNR	45.0	Harbour porpoise *Phocoena phocoena*
		Grey seal *Halichoerus grypus*
West Coast MNR	50.2	Harbour porpoise *Phocoena phocoena*
		Harbour seal *Phoca vitulina*
		Grey seal *Halichoerus grypus*



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Data Sources: Client, The Crown Estate, Marine Management Organisation, Marine Scotland, Natural Resources Wales, JNCC

Project Name:
MORGAN AND MORECAMBE OFFSHORE WIND FARMS: TRANSMISSION ASSETS

0 20 40 nm
0 25 50 km

Drawing Number:
EOR0823-ES-MAM-T006-03

Drawing Title:
SITES DESIGNATED FOR THE PROTECTION OF MARINE MAMMALS WITHIN THE REGIONAL STUDY AREA

Geodetic Information:
Datum: ETRS 1989
Projection: ETRS 1989 UTM Zone 30N
Scale@220mmx160mm: 1:3,000,000

VER	DATE	DETAILS	BY	CHECK
00	28/02/24	First Issue	MJ	LB
03	21/08/24	FINAL	MJ	BM

Figure 1.18: Sites designated for the protection of marine mammals within the regional study area

Table 1.3: Relevant protected marine mammal species which have the potential to occur within the study area

Marine Mammal species	Protection legislation
Bottlenose dolphin *Tursiops truncatus*	Annex II of the Habitats Directive. European Protected Species under Annex IV of the European Commission Habitats Directive. Species of principal importance in England under the NERC Act 2006 UK Biodiversity Action Plan (BAP) priority species that continues to be regarded as conservation priorities in the subsequent UK Post-2010 Biodiversity Framework. Schedules 5 and 6 of the Wildlife and Countryside Act 1981.
Harbour porpoise *Phocoena phocoena*	Annex II of the Habitats Directive. European Protected Species under Annex IV of the European Commission Habitats Directive. OSPAR convention List of Threatened and/or Declining Species. Species of principal importance in England under the NERC Act 2006. UK BAP priority species that continues to be regarded as conservation priorities in the subsequent UK Post-2010 Biodiversity Framework. Schedules 5 and 6 of the Wildlife and Countryside Act 1981.
Grey seal *Halichoerus grypus*	Annexes II and V of the Habitats Directive. Conservation of Seals Act 1970.
Harbour seal *Phoca vitulina*	Annexes II and V of the Habitats Directive. Species of principal importance in England under the NERC 2006 Act. UK BAP priority species that continues to be regarded as conservation priorities in the subsequent UK Post-2010 Biodiversity Framework. Conservation of Seals Act 1970.
Minke whale *Balaenoptera acutorostrata*	Species of principal importance in England under the NERC 2006 Act. UK BAP priority species that continues to be regarded as conservation priorities in the subsequent UK Post-2010 Biodiversity Framework. European Protected Species under Annex IV of the European Commission Habitats Directive. Schedule 5 of the Wildlife and Countryside Act 1981.
Short beaked common dolphin *Delphinus delphis*	Species of principal importance in England under the NERC 2006 Act. UK BAP priority species that continues to be regarded as conservation priorities in the subsequent UK Post-2010 Biodiversity Framework. European Protected Species under Annex IV of the European Commission Habitats Directive. Schedules 5 and 6 of the Wildlife and Countryside Act 1981.
Risso's dolphin *Grampus griseus*	Species of principal importance in England under the NERC 2006 Act. UK BAP priority species that continues to be regarded as conservation priorities in the subsequent UK Post-2010 Biodiversity Framework. European Protected Species under Annex IV of the European Commission Habitats Directive. Schedule 5 of the Wildlife and Countryside Act 1981.

SACs

North Anglesey Marine/Gogledd Môn Forol SAC

1.3.1.7 The North Anglesey Marine SAC extends north and west from the coast of Anglesey (JNCC, 2022a) (**Figure 1.18**). The landward boundary of the SAC follows the mean low water mark from Holy Island round to Dulas Bay and covers 3,249.49 km^2. The Annex II species, harbour porpoise, is a primary reason for selection of this site.

North Channel SAC

1.3.1.8 North Channel SAC is located along the east coast of Northern Ireland (**Figure 1.18**) and has been identified as an important winter area for harbour porpoise, supporting an estimated 1.2% of the UK Celtic and Irish Seas MU(CIS MU) population. This SAC has an area of 1,604 km^2 and supports areas where large groups of up to 100 harbour porpoise individuals have been sighted and is thus designated for harbour porpoise. Eighteen years of survey data collated through the Joint Cetacean Protocol (JCP, 2022) were analysed to identify areas with persistently high harbour porpoise occurrence. The modelled outputs of this analysis demonstrated that the North Channel SAC persistently contains densities of porpoises which are within the top 10% of those for the CIS MU (IAMMWG, 2015) during winter, and thus defined the SAC boundaries (Heinänen and Skov, 2015).

Strangford Lough SAC

1.3.1.9 Strangford Lough is a large (150 km^2) marine inlet on the east coast of County Down in the north west Irish Sea (**Figure 1.18**). Almost land-locked, Strangford Lough is separated from the Irish Sea by the Ards Peninsula to the east and is bounded to the south by the Lecale coast. It is connected to the open sea by the Strangford Narrows. It is designated for harbour seal, for which the area is considered to support a significant number, with the minimum population declared at the time of designation as 210 animals.

Murlough SAC

1.3.1.10 Murlough SAC covers an area of 119.02 km^2 and adjoins Dundrum Bay including the shallow waters of the Bay (**Figure 1.18**). The beach area at Ballykinler is important as a haul-out area for harbour seal and therefore the SAC has been designated for this species.

West Wales Marine/Gorllewin Cymru Forol SAC

1.3.1.11 West Wales Marine SAC is located off the coast of Wales from the Llŷn peninsula in the north, to Pembrokeshire in the south west (**Figure 1.18**), comprising an entirely marine area of 7,376.14 km^2 (JNCC, 2022b). This SAC overlaps a number of other SACs including parts of Pembrokeshire Marine SAC and the Pen Llŷn a'r Sarnau SAC and encompasses the entire Cardigan Bay SAC. The whole West Wales

Marine SAC has been identified as an area of importance for harbour porpoise in summer, and a smaller section at the south of the site (Cardigan Bay area) has been identified as important winter habitat this species. Survey data collated through the JCP (2022) were analysed to identify areas with persistently high harbour porpoise occurrence. The modelled outputs of this analysis demonstrate that the West Wales Marine SAC occurs within the top 10% of persistent high-density areas for harbour porpoise in UK waters for both winter and summer seasons (Heinänen and Skov, 2015).

Pen Llŷn a`r Sarnau/Llŷn Peninsula and the Sarnau SAC

1.3.1.12 Llŷn Peninsula and the Sarnau SAC is situated in north west Wales (**Figure 1.18**). The boundary extends from Nefyn on the north coast of Llŷn and includes parts of the seashore and the waters and seabed around the Llŷn Peninsula, in north Cardigan Bay and along the Meirionnydd coast to Clarach in Ceredigion south of the Dyfi estuary. The SAC covers 1,460.12 km^2 and is designated for bottlenose dolphin and grey seal (CCW, 2009). Bottlenose dolphin is considered of significant importance within the Llŷn Peninsula and the Sarnau SAC even though they do not appear to form a semi-resident group within the sea area encompassed by this site (as they do in Cardigan Bay). The Pen Llŷn and Bardsey Island grey seal population is the largest breeding colony in the north of Wales. The SAC contains a number of important pupping sites for the grey seal concentrated around the north west of the SAC including Bardsey Island. Persistent breeding seals in the SAC are part of a wider population that extends to South West Wales and to the south east and east Irish coasts, and possibly beyond the Irish Sea. In the SAC the main period of pup production in North Wales is in September to October, but with some activity from early August to the end of November.

Rockabill to Dalkey Island SAC

1.3.1.13 Rockabill to Dalkey Island SAC is situated in the west Irish Sea. Covering an area of 272.9 km^2, the site extends southward of Rockabill, in a strip approximately 7 km wide and 40 km in length, running adjacent to Howth Head, and crossing Dublin Bay to Frazer Bank in South Co. Dublin (NPWS, 2022b) (**Figure 1.18**). The area is designated for harbour porpoise and represents a key habitat within the Irish Sea. The species occurs year-round within the site and comparatively high group sizes have been recorded. The site also supports common seal and grey seal, and bottlenose dolphin, minke whale, fin whale, killer whale, Risso's dolphin and common dolphin have all been recorded in the area.

Lambay Island SAC

1.3.1.14 Lambay Island, in the west Irish Sea, is a large (2.5 km^2) inhabited island lying 4 km off Portrane on the north County Dublin coast (**Figure 1.18**) (NPWSa, 2022). Lambay Island supports the principal breeding colony of grey seal on the east coast of Ireland, numbering between 196 and 252 seals, across all age cohorts. The site also contains regionally significant numbers of harbour seal, of which up to 47 individuals have been counted. Both species occur all year round, and intertidal shorelines, coves and caves of the Island are used by resting and moulting seals. The SAC is designated for both grey seal and harbour seal.

Cardigan Bay/Bae Ceredigion SAC

1.3.1.15 Cardigan Bay SAC extends from Ceibwr Bay in Pembrokeshire to Aberarth in Ceredigion and seaward almost 20 km (**Figure 1.18**), covering an area of 958.57 km^2 (JNCC, 2022c). The SAC is designated for bottlenose dolphin and grey seal. Cardigan Bay is one of two coastal areas in the UK where bottlenose dolphin has been most frequently recorded and are seen year-round. The dolphins of Cardigan Bay are highly mobile, and the resident population is estimated at between 100 to 300 individuals in Cardigan Bay (NRW, 2018a). The dolphins appear to use the inshore waters of Cardigan Bay for both feeding and reproduction, and in the summer months calves and juveniles are often observed with adult individuals or groups.

1.3.1.16 Grey seal present within Cardigan Bay do not form a discrete population but are centred (in terms of abundance) on Cardigan Bay and are considered part of the South West England and Wales MU. Tracking data show that individual's transit to France, the west coast of Scotland and Ireland (NRW, 2018a).

Slaney River Valley SAC

1.3.1.17 Slaney River Valley in the west Irish Sea comprises the freshwater stretches of the River Slaney as far as the Wicklow Mountains (**Figure 1.18**), covering an area of 60.18 km^2 and supports regionally significant numbers of harbour seal (NPWS, 2022c). This Annex II species occurs year-round in Wexford Harbour where several sandbanks are used for breeding, moulting and resting activity. At least 27 harbour seal regularly occur within the site.

Pembrokeshire Marine/Sir Benfro Forol SAC

1.3.1.18 Pembrokeshire Marine SAC, in the south east Irish Sea, extends from just north of Abereiddy on the north Pembrokeshire coast to just east of Manorbier in the south (**Figure 1.18**). The site includes the inshore waters of the islands of Ramsey, Skomer, Grassholm, Skokholm, the Bishops and Clerks and The Smalls, covering an area of 1,380.39 km^2 and is designated for grey seal (JNCC, 2022d).

1.3.1.19 Pembrokeshire in South West Wales is representative of grey seal colonies in the south west part of the breeding range in the UK. It is the largest breeding colony on the west coast of England and Wales, representing over 2% of annual UK pup production (NRW, 2018b).

Saltee Islands SAC

1.3.1.20 Saltee Islands SAC comprises the Saltees Islands and surrounding waters, with the islands located between 4 and 5 km off the south Wexford coast (**Figure 1.18**), covering an area of 158 km^2. Great Saltee has a breeding population of grey seal, for which it is designated, which has been estimated at 571 to 744 individuals in 2005 (NPWS, 2022d). A one-off moult count in 2007 gave a figure of 246 individual (NPWS, 2022d).

Bristol Channel Approaches SAC

1.3.1.21 Bristol Channel Approaches SAC spans the Bristol Channel between the north Cornwall coast into Carmarthen Bay in Wales (**Figure 1.18**), covering an area of 5,850 km^2, and is designated for harbour porpoise (JNCCe). The site is estimated to support 4.7% of the CIS MU population. Harbour porpoise is present within the site year round, but during the winter there are persistently higher densities of harbour porpoise compared to the surrounding MU. The SAC encompasses Lundy Marine Conservation Zone (MCZ).

Lundy SAC

1.3.1.22 Lundy SAC is located in the Western Channel and Celtic Sea (**Figure 1.18**), and covers an area of 3,070.95 km^2, with 99% of the area covering marine habitat. It is designated for grey seal, with a resident population of approximately 180 grey seal (Landmark Trust, 2022).

Marine Nature Reserves

Langness MNR

1.3.1.23 Langness MNR is one of the largest Manx MNR reserves at 88.67 km^2 and extends from Castletown in the south up to Santon Head in the north, encompassing the Langness peninsula and Derbyhaven Bay (**Figure 1.18**). The MNR was designated in 2018 for harbour seal, grey seal, harbour porpoise and Risso's dolphin (Department of Environment, Food and Agriculture (DEFA), 2018).

Littleness MNR

1.3.1.24 Little Ness MNR is 10 km^2 and extends from Douglas Bay in the north, to Little Ness in the south and out to one nautical mile. Whilst the designation features of this MNR do not include cetaceans (Isle of Man Government, 2022a), it is an important cetacean area and corresponds to a permanent site for MWDW land-based surveys (see **Figure 1.18**)

and given all cetacean species are protected in Manx waters, Little Ness has been included

Douglas Bay MNR

1.3.1.25 Douglas Bay MNR is 4.54 km^2 and extends inshore from Onchan Head to Douglas Head (**Figure 1.18**), excluding the inner harbour area. Despite being a busy commercial port, the area is regularly used by bottlenose dolphin and Risso's dolphin, and thus was designated in 2018 for these two species (Isle of Man Government, 2022a).

Laxey Bay MNR

1.3.1.26 Laxey Bay MNR is 3.97 km^2 and was designated in 2018, extending inshore from Carrick Roayrt to Clay Head (**Figure 1.18**). It is designated for harbour porpoise, bottlenose dolphin, and minke whale (DEFA, 2018).

Ramsey Bay MNR

1.3.1.27 Ramsey Bay MNR is one of the largest MNRs in the UK, with an area of 96.98 km^2 spans the north east of the coast from the Point of Ayre to Maughold Head (**Figure 1.18**). It was designated in 2011 for harbour and grey seal species (Isle of Man Government, 2022a).

Baie Ny Carrickey MNR

1.3.1.28 Baie ny Carrickey MNR covers an area of 11.37 km^{2}and spans the territorial sea between Black Head and Scarlett Stack (Isle of Man Government, 2022b) (**Figure 1.18**). It was designated in 2018 for harbour porpoise, Risso's dolphin and bottlenose dolphin.

Calf and Wart Bank MNR

1.3.1.29 Calf and Wart Bank MNR is located off the south west coast of the Isle of Man (**Figure 1.18**), encompassing the Calf of Man with an area of 20.15 km^2. It was designated in 2018 for harbour porpoise and Risso's dolphin.

Port Erin MNR

1.3.1.30 Port Erin MNR extends to the west coast of the Isle of Man (**Figure 1.18**) and covers an area of 4.34 km^2. It was designated in 2018 for harbour porpoise.

Niarbyl MNR

1.3.1.31 Niarbyl MNR is located on the west coast of the Isle of Man, spanning from Elby Point to the headland of Fleshwick Bay east to the coastline (**Figure 1.18**), with an area of 5.66 km^2. It was designated in 2018 for harbour porpoise and grey seal.

West Coast MNR

1.3.1.32 West Coast MNR is the largest MNR, spanning an area of 184.82 km^2. This designation, spanning the length of the coast from the Point of Ayre to Niarbyl (**Figure 1.18**), is important for harbour porpoise, grey seal and harbour seal.

1.3.2 Overview

1.3.2.1 The Irish Sea is an important area for marine mammals, with 24 species of cetacean sighted to date in Irish waters (O'Brien *et al.*, 2009) and two species of pinniped. Seven species are known to occur regularly in this region; harbour porpoise, short-beaked common dolphin, bottlenose dolphin, Risso's dolphin, minke whale, grey seal and harbour seal. These key species are taken forward to the impact assessment (as agreed via EWG consultation) and detailed species accounts are given in relevant sections **1.3.3** to **1.3.9**. Other species are occasional or rare visitors to the area and include fin whale, sei whale *Balaenoptera borealis*, sperm whale *Physeter macrocephalus*, northern bottlenose whale *Hyperoodon ampullatus*, Sowerby's beaked whale *Mesoplodon bidens*, white-beaked dolphin *Lagenorhynchus albirostris*, Atlantic white-sided dolphin *Lagenorhynchus acutus*, striped dolphin *Stenella coeruleoalba* and killer whale *Orcinus orca* (**Table 1.4**).

1.3.2.2 The occurrence of cetacean species is often unpredictable due to their highly mobile nature and the distribution of marine mammals in the Irish Sea is patchy. Harbour porpoise is sighted throughout the area, whilst Risso's dolphin and common dolphin are sighted towards the south of the Irish Sea. Bottlenose dolphin sightings are highest in the Cardigan Bay SAC compared to the rest of the Irish Sea. Harbour seal individuals are concentrated along the coast of Northern Ireland and in the Firth of Clyde, whilst grey seal extensively use areas of the south Irish Sea, the north of St George's Channel, and Liverpool Bay (Hammond *et al.*, 2005a). Wales, south east Ireland and the north west English coast (South Walney and Dee Estuary) support important haul-out sites for grey seal and individuals from these areas may form a separate population from the grey seal found to the north off west Scotland and to the south off Cornwall and France. Harbour seal haul out along the north east coast of Ireland.

Table 1.4: Summary of cetacean and pinniped species found in the regional study area. Sources: Reid *et al.* (2003); O'Brien *et al.* (2009); Baines and Evans (2012); Waggitt *et al.* (2020); and Carter *et al.* (2022)

Species	Occurrence in the Irish Sea	Description of species distribution
Toothed Whales, Dolphins and Porpoises		
Harbour porpoise *Phocoena phocoena*	Abundant	Widespread in cold and temperate north west European shelf waters, and abundant throughout the Irish Sea. Common inshore species found in high densities in the Irish Sea. Highest relative abundances in the west half of the central Irish Sea (Wall *et al.*, 2013). High predicted relative densities in both winter and summer in the Irish Sea (Waggitt *et al.,* 2020).
Bottlenose dolphin *Tursiops truncatus*	Common	Near-global distribution, widely distributed in the North Atlantic and occurs year-round throughout the Irish Sea near-shore. Predominately coastal distribution (though low densities have been recorded offshore). Concentrations of resident populations in Cardigan Bay and off the coast of Co. Wexford. Seasonal differences in dispersion have been noted (e.g. dolphins in summer occurring mainly in small groups near the coast, centred upon Cardigan Bay, dispersing more widely and generally northwards, where they may form very large groups in winter).
Risso's dolphin *Grampus griseus*	Common	Worldwide distribution, and in north west Europe appears to be continental shelf species. Clusters regularly seen in the Irish Sea, with a relatively localised distribution, forming a wide band running south west to north east that encompasses west Pembrokeshire, the west end of the Llŷn Peninsula and Anglesey in Wales, the south east coast of Ireland in the west, and waters around the Isle of Man in the north.
Short-beaked common dolphin *Delphinus delphis*	Common	Most numerous offshore cetacean species in the temperate north east Atlantic. Widespread and abundant, centred upon the Celtic Deep at the south end of the Irish Sea, where water depths range from 50 to 150 metres. High-density area extends eastwards towards the coast and islands of west Pembrokeshire. Elsewhere in the Irish Sea, the species occurs at low densities mainly offshore, in a central band that extends northwards towards the Isle of Man.
Atlantic white-sided dolphin *Lagenorhynchus acutus*	Occasional	Occur in cold and temperate waters of the North Atlantic, typically in deep waters along the continental shelf, with fewer numbers around Ireland, and is rare in the Irish Sea.
Killer whale *Orcinus orca*	Occasional	Largely distributed in the north of the North Sea off the north west of Scotland, but occasionally seen around the Isle of Man and St George's Channel.
White-beaked dolphin *Lagenorhynchus albirostris*	Occasional	Abundant and widespread around the coast of the British Isles from the North Sea, across to the west of Scotland and down to west Ireland but also occurs occasionally off the south of Ireland and in the Irish Sea.

Species	Occurrence in the Irish Sea	Description of species distribution
Beluga whale *Delphinapterus leuca*	Rare	Arctic and sub-arctic species but few sightings off north west Scotland, around the Northern Isles and in the North Sea.
False killer whale *Pseudorca crassidens*	Rare	Warm water species preferring deep offshore waters in tropical and sub-tropical waters but few sightings in the UK.
Long-finned pilot whale *Globicephala melas*	Rare	Mainly distributed in the deeper colder waters of the North Atlantic but sometimes recorded in east of the Irish Sea, sometimes close to the coast.
Pygmy sperm whale *Kogia breviceps*	Rare	Species is rare in UK waters, but some historical strandings in South West Ireland.
Sperm whale *Physeter macrocephlus*	Rare	Occurs mainly in deep waters to the north west of the UK and only rarely found in the Irish Sea.
Striped dolphin *Stenella coeruleoalba*	Rare	Species is rare in UK waters, preferring warmer waters south of the UK.
Beaked Whales		
Sowerby's beaked whale *Mesoplodon bidens*	Rare	Associated with deep water off the shelf edge to the north and west of Scotland.
Northern bottlenose whale *Hyperoodon ampullatus*	Rare	Occurs in North Atlantic, favouring cold deep water and very rarely seen in the Irish Sea.
Cuvier's beaked whale *Ziphius cavirostris*	Rare	Wide geographical distribution, with very few sightings in UK waters, mostly off west seaboard of Britain and Ireland.
True's beaked whale *Mesoplodon mirus*	Rare	Inhabits warm-temperate seas, mainly in the North Atlantic, with very few strandings on west coast of Ireland.
Gervais' beaked whale *Mesoplodon europaeus*	Rare	Inhabits warm temperate and tropical Atlantic waters, but only known via strandings.
Baleen Whales		
Humpback whale *Megaptera novaeangliae*	Rare	Favours deeper waters over and along edges of continental shelfs and around oceanic islands, but sightings have occurred in the north of the Irish Sea, south Irish Sea, Celtic Sea and Western Channel. Most sightings have been made between May and September, which is when small numbers have also been seen off the continental shelf west and north of Scotland.

Species	Occurrence in the Irish Sea	Description of species distribution
Minke whale *Balaenoptera acutorostrata*	Common	Ranges widely and can be observed throughout the north of the North Sea but is more localised in the Irish Sea.
Northern right whale *Eubalaena glacialis*	Rare	Confined to the north of the Atlantic, largely in the west along the east coast of the US and Canada, with very few individuals observed in UK waters. Some historical whaling records in Blacksod Bay in Co. Mayo on the west coast of Ireland, and a few reports of individuals in European waters, including two sightings from north west of Donegal in the past decade.
Fin whale *Balaenoptera physalus*	Rare	More typical of the deep waters to the north and west of Scotland rather but occasionally sighted off the south coast of Ireland and in the St George's Channel.
Sei whale *Balaenoptera borealis*	Rare	Concentrated in deep waters in the North Atlantic towards Iceland, but some sightings between South Ireland and South West England.
Blue whale *Balaenoptera musculus*	Rare	Sightings and acoustic detections in recent years have shown they occur during the summer and autumn months offshore along the continental shelf edge, to the south west of Ireland.
Pinnipeds		
Grey seal *Halichoerus grypus*	Abundant	Restricted to North Atlantic but found all around the UK, with breeding populations around the coast of the Irish Sea. High counts along east of Northern Ireland, south west of Isle of man, and north coast of Wales and River Dee. At-sea seal distribution maps show high density areas in the south east of the Irish Sea to the south of the Transmission Assets, and along the east coast of Ireland and west Isle of Man (Carter *et al*., 2022).
Harbour seal *Phoca vitulina*	Abundant	Hauls out on coasts of Scotland and Northern Ireland, with high haul-out counts on the east of Northern Ireland. At-sea seal distribution maps show high density areas on the east coast of Northern Ireland (Carter *et al*., 2022).

1.3.3 Harbour porpoise

Ecology

1.3.3.1 Porpoises comprise a group of relatively small-bodied Odontoceti (toothed) cetaceans within the family Phocoenidae. The harbour porpoise is one of the smallest cetacean species, reaching a maximum length of 1.9 m. On average females grow to a length of 1.6 m whilst males reach 1.45 m in length (Lockyer, 1995). Porpoises in the CIS MU (**Figure 1.19**:) have been shown to be significantly larger in their maximum length, asymptotic length and average length at 50% maturity compared to porpoises in the North Sea MU, in a study by Murphy *et al*. (2020). Although the recorded longevity is 24 years, most individuals do not live past 12 years of age (Lockyer, 2003).

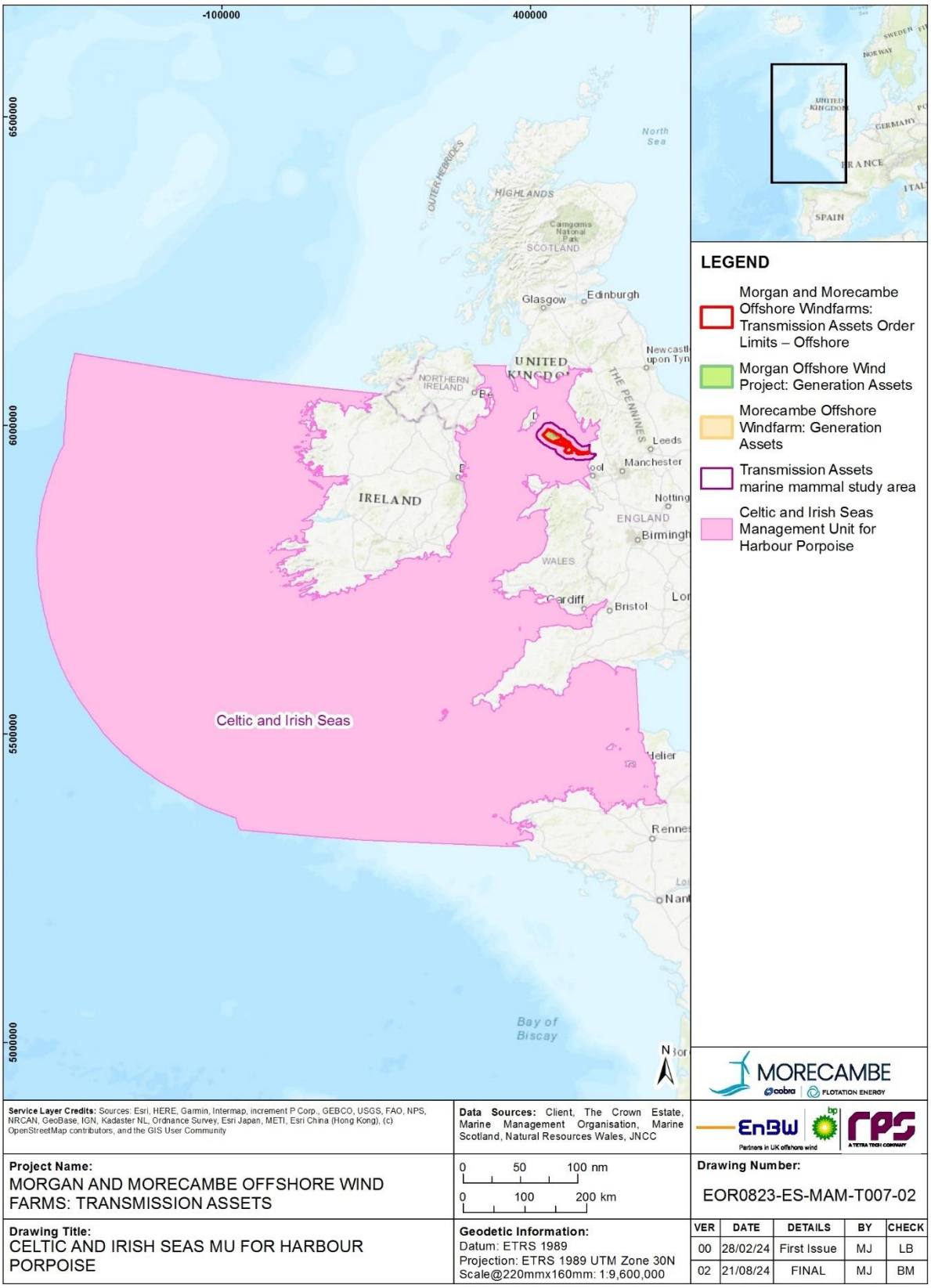

Figure 1.19: Celtic and Irish Seas MU for harbour porpoise

1.3.3.2 Often living in cool, high latitude waters, harbour porpoise have a higher metabolic rate than dolphins and therefore need to feed more frequently and consume more prey per unit body weight, in order to maintain their body temperature and other energy needs (Rojano-Doñate *et al*., 2018). For this reason, porpoise may be highly susceptible to changes in the abundance of prey species or disturbance from foraging areas. A harbour porpoise's field metabolic rate, however, remains stable over seasonally changing water temperatures. Heat loss is deemed to be managed via cyclical fluctuations in energy intake to build up a blubber layer that offsets the extra cost of thermoregulation during winter (Rojano-Doñate *et al*., 2018).

1.3.3.3 Harbour porpoise feeds on a wide range of fish species, but mainly small shoaling species from demersal or pelagic habitats (Santos and Pierce, 2003; Aarfjord, 1995). There are regional and seasonal differences in diet; interannual variation depending on the availability of prey species; and ontogenetic variation (adult and juveniles), with juveniles targeting smaller species such as gobies Gobiidae or smaller individuals of the same prey species targeted by adults (Santos and Pierce, 2003). Analysis of 73 stomachs of harbour porpoise from strandings in Irish waters show that they primarily forage on fish (78%) with the remainder comprising cephalopods and crustaceans (Rogan, 2009). Species such as whiting, Trispoterus spp, unidentified gadoids and herring are important. This diet is similar to analyses elsewhere in European waters; whiting and sandeels were found to be important in Scotland (Santos *et al*., 2004) and in the North Sea during summer (Ransijn *et al*., 2019) whilst during the winter season European sprat *Sprattus sprattus* and Atlantic herring *Clupea harengus* also contributed to overall energy density.

1.3.3.4 Harbour porpoise regularly forage around tidal races, overfalls, and upwelling zones during the ebb phase of the tide (Pierpoint, 2008). Waggitt *et al*. (2018) explored regional scale patterns in occupancy of tidal stream environments in Anglesey and found that encounters with animals were concentrated in small areas (<200 m^2) and increased during certain tidal states (ebb vs. flood). In sites showing relatively high maximum current speeds (2.67 to 2.87 ms^{-1}) encounters were strongly associated with the emergence of shearlines but in sites with relatively low maximum current speeds (1.70–2.08 ms^{-1}), encounters were more associated with areas of shallow water during peak current speeds. The overall probability of encounters was higher in low current sites. Waggitt *et al*. (2017) suggested likelihood of interactions with porpoise could be reduced by restricting developments to sites with high maximum current speeds (>2.5 ms^{-1}) and placing turbines in areas of laminar currents therein. These results are consistent with Embling *et al*. (2010), who analysed results of the dedicated surveys conducted in the south Inner Hebrides and found that maximum tidal current is the best environmental explanation of persistent harbour porpoise abundance.

1.3.3.5 Although harbour porpoise generally hunts alone or in small groups, this species is often seen in larger aggregations of 50 or more individuals, either associated with food concentrations or seasonal migrations. Within these loose aggregations, segregation may occur, with females

travelling with their calves and yearlings, and immature animals of each sex being segregated into groups.

1.3.3.6 The age at sexual maturation for the harbour porpoise is approximately three to four years and reproduction is strongly seasonal with mating occurring between June and August (Lockyer, 1995). Gestation is ten to 11 months and there is a peak in birth rate around the British Isles during the months of June to July (Boyd *et al*., 1999).

1.3.3.7 A range of threats to harbour porpoise around the UK have been identified, with bycatch in fishing gears considered the greatest (Calderan and Leaper, 2019). Harbour porpoise is particularly vulnerable to getting caught in bottom-set gill nets as a result of their feeding behaviour. Other threats include prey depletion, pollution that may affect the health of individuals, as well as acoustic and physical disturbance (Evans and Prior, 2012). These threats are considered likely to continue or increase in future. They are also susceptible to bottlenose dolphin attack and some studies have shown distributions of the two species show relatively little overlap (Pesante *et al*., 2008; Simon *et al*., 2010). Where overlap does exist there is likely to be aggression between the two species (Norrman *et al*., 2015). Nuuttila *et al*. (2017) showed fine-scale temporal partitioning between the species occurring at three levels: seasonal variation (porpoise detections peaking in winter, bottlenose dolphin in summer), diel variation (porpoise detections higher at night, dolphins highest shortly after sunrise) and tidal variation (peak dolphin detections occurring during ebb at the middle of the tidal cycle and before low tide, harbour porpoise detections were highest at slack water, during and after high water with a secondary peak recorded during and after low water).

Distribution and occurrence

1.3.3.8 Harbour porpoise is widely distributed throughout the Irish Sea and through the regional study area and is the most common cetacean in the region (Reid *et al*., 2003; Hammond *et al*., 2005; Baines and Evans, 2012; Wall *et al.,* 2013). Wide-scale historical data collating heterogenous datasets from 1990 to 2009 in the Atlas of the Marine Mammals of Wales (Baines and Evans 2012) confirms regular widespread sightings of harbour porpoise across the Irish Sea (**Figure 1.20**). Species distribution was not even throughout the Irish Sea. Hotspots occurred off North and West Anglesey (particularly around Point Lynas and South Stack, Holyhead), the south west coast of the Llŷn Peninsula, south Cardigan Bay, in the vicinity of Strumble Head and the west Pembrokeshire islands (Skomer and Ramsey), and in the Bristol Channel off the south coast of Wales (around the Gower Peninsula and in Swansea Bay). Whilst the data has broad scale information, limitations include the age of the data and inadequate survey coverage. Most recent SCANS-IV data showed widespread sightings across the Irish Sea in summer 2022 (Gilles *et al.,* 2023), and the observed distribution of harbour porpoise from SCANS-III and the ObSERVE survey around Ireland at the same time (Rogan *et al*. 2018), was similar to that observed in SCANS-II in 2005 (Hammond *et al.*,

2013). Sighting data from MWDW (**Figure 1.11**), shows harbour porpoise are widespread in Manx waters around the Isle of Man, extending out into the Offshore Order Limits south towards the south east of Ireland and up towards the coast of Northern Ireland.

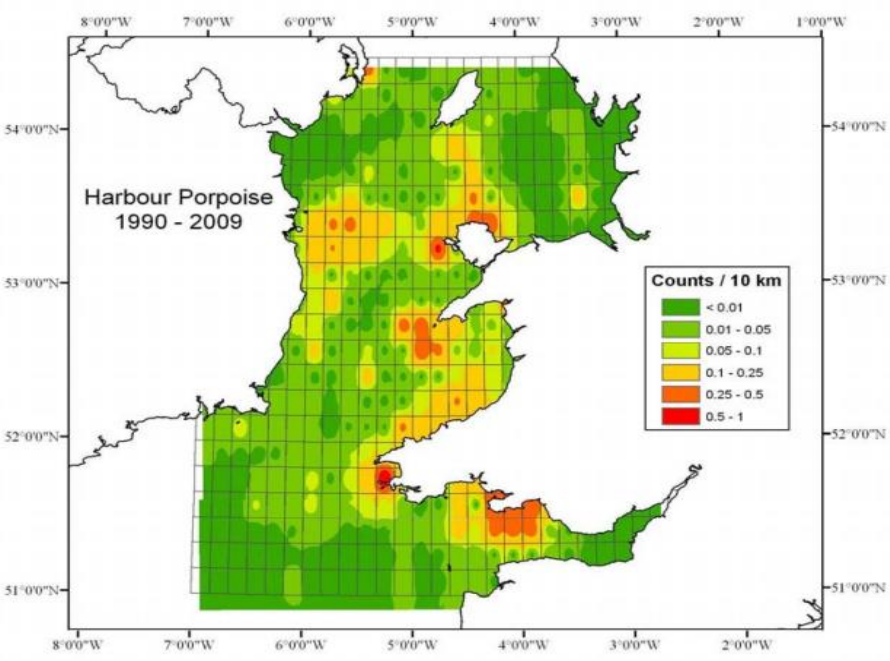

Figure 1.20: Inverse Distance Weighted (IDW) interpolated map of harbour porpoise distribution from Welsh Marine Atlas (from Baines and Evans, 2012)

1.3.3.9 Heinänen and Skov (2015) found that in the CIS MU water depth, surface sediments, current speed and eddy potential all play a major role as determinants of the distribution of harbour porpoise in this MU. In the winter season, water depth and current speed are the major determinants of distribution with some influence from surface salinity. An increased probability of occurrence has been associated with increasing current speed, yet a tendency for lower probability of occurrence has been observed at very high current speeds of greater than 0.7 m/s (Heinänen and Skov, 2015). In summer, current speed and eddy potential are important, with similar increasing probabilities with increasing current speed up to 0.4 m/s and increasing eddy activity.

1.3.3.10 Based on spatio-temporal modelling using species and environmental data, Heinänen and Skov (2015) also concluded that high densities of harbour porpoise are associated with depth and season: the shallowest areas (areas shallower than 40 m) and winter months supporting high densities. During summer, harbour porpoise are associated with areas of high eddy activity and degree of coarseness of sediments also plays an important role. Peak densities were associated with sandy gravelly sediments, with lower densities in muddy areas. Harbour porpoise are often found in areas of high shipping traffic, however, notably the number of ships also has a significant effect on their occurrence (Heinänen and Skov, 2015). This study found that densities of porpoise decreased with increasing levels of traffic. Density of ships was a static predictor variable, given as the mean number of ships per year in each

cell (Heinänen and Skov, 2015). A threshold level in terms of impact seems to be a traffic density of approximately 15,000 ships/year (approximately 50 ships per day).

1.3.3.11 Data from the Morgan Offshore Wind Project: Generation Assets aerial survey data (**Appendix A**) for the two years of survey found that harbour porpoise were recorded in all months of the year and there were higher concentrations in the north part of the Morgan Offshore Wind Project: Generation Assets Aerial Survey Area.

Density/abundance

1.3.3.12 Density and abundance estimates were available across a broad area within the regional study area and provides an overview of harbour porpoise densities over different spatial scales.

Density

1.3.3.13 Broadscale data highlights the variance in density estimates from different sources. Data from SCANS-III that covered European Atlantic waters reported densities of 0.086 animals per km^2 (CV = 0.383) in SCANS-III block F (in which the Transmission Assets are sited) and 0.239 animals per km^2 (CV = 0.282) in SCANS-III block E (Hammond *et al.,* 2021). Surveys were carried out between 27 June and 31 July 2016, therefore focused on a limited summer period and thus densities may vary in other months of the year. Recent DSM estimates using the SCANS-III data (see **paragraph 1.2.4.43 *et seq.***) (Lacey *et al.*, 2022) gave mean densities of 0.434 animals per km^2 for the study area (**Figure 1.21**). Density maps showed higher areas of density in the east Irish Sea[1] (**Figure 1.21**).

[1] Data from SCANS-III estimates are given as point densities, and have been transformed to grid using Voronoi triangle/polygon method to create a grid surface for clearer illustration.

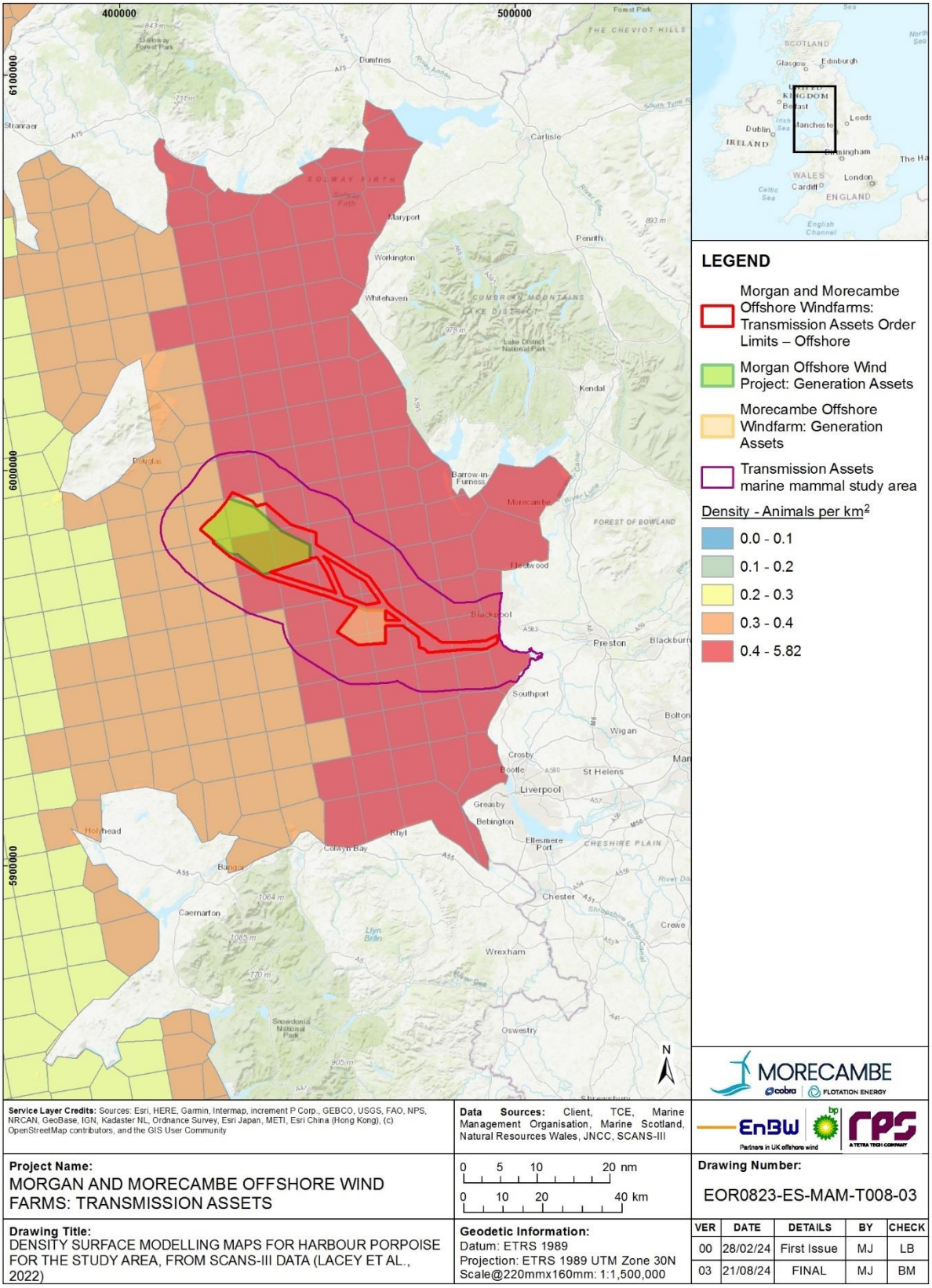

Figure 1.21: Density surface modelling maps for harbour porpoise for the study area, from SCANS-III data (Lacey *et al.,* 2022)

1.3.3.14 In the ObSERVE program, aerial surveys were conducted in the offshore waters of Ireland (west Irish Sea) between 2015 and 2017 (Rogan *et al*., 2018) with the aim to investigate the occurrence, distribution and abundance of key marine species. Stratum 5 (the only strata located in the Irish Sea) is relevant to the regional study area and covers an area of 11,110 km^2. Corrected design-based estimates and model-based estimates were given for each season (summer 2015, winter 2015, summer 2016, winter 2016). Densities were high in comparison to other broadscale studies (ranging from 0.696 animals per km^2 in summer 2015 to 1.046 animals per km^2 in summer 2016 for design-based estimates). Predicted summer distributions for harbour porpoise in 2015 and 2016 was high in Stratum 5, thus highlighting the importance of the west Irish Sea compared to other Irish waters.

1.3.3.15 Density surface modelling in JCP Phase III, aimed at providing estimates of both abundance and changes in abundance for common cetacean species in UK water, gave a mean density of 0.8738 harbour porpoise per km^2 across the entire JCP Phase III study region, with areas of relative higher density in the Irish and Celtic Sea (Paxton *et al.* 2016). This mean density falls within the range predicted for the west Irish Sea using the ObSERVE data (see previous paragraph). Harbour porpoise densities fluctuated throughout the year in the JCP Phase III data, and in the entire Irish Sea predicted mean summer densities ranged from approximately 0.8 animals per km^2 in the 1994 to 2000 time period, to five animals per km^2 in 2001 to 2006 and 2007 to 2010 periods[2]. These high values are driven by the persistent high densities around Cardigan Bay and Anglesey (where the North Anglesey Marine SAC and the West Wales Marine SAC are designated for harbour porpoise), whereas lower densities of approximately 0.4 to 0.8 are seen around the study area. The JCP Phase III data are heavily caveated: authors stated the JCP data comprises poor spatial and temporal coverage, and results should be considered indicative rather than an accurate representation of species density or abundances. The study also combines 38 data sources from 542 distinct survey platforms and therefore deriving robust density estimates from such heterogenous data is difficult and should be interpreted with caution.

1.3.3.16 Using JCP data, Heinänen and Skov (2015) were able to develop a spatial map showing those areas around the UK that supported persistent and high (=>3.0 animals per km^2) densities of harbour porpoise, which were subsequently used to inform designation of SACs for harbour porpoise. For the Irish Sea, three such areas were identified. The closest area of persistent high densities was North Anglesey SAC (16 km to the south of the study area), along with the North Channel SAC (50.61 km to the north west of the study area) and West Wales Marine SAC (97.5 km south of the study area).

1.3.3.17 A study by Waggitt *et al*. (2020) (North East Atlantic Distribution Maps) collated diverse survey data to generate predicted distribution maps at

2 JCP Phase III densities are approximations read off density surface maps in the report (Paxton *et al*., 2016), rather than derived from database. JDCP data was requested but not available currently.

10 km resolution for twelve cetacean species (and twelve seabird species) using SDMs.

1.3.3.18 The study confirmed harbour porpoise to be abundant year-round in the Irish Sea with higher densities towards the east of the Irish Sea (**Figure 1.22**), which correlates with those in the SCANS-III density surfaces (see **1.3.3.13**). Predicted densities for harbour porpoise for the study area based on Waggitt *et al.* (2020) show higher density areas are present further inshore in the east of the Irish Sea, towards Liverpool Bay, from January to June (**Figure 1.23**) but appears to show increased densities in offshore areas from July to October (**Figure 1.24**). Highest densities were predicted in March with 0.76 animals per km^2 in high density areas in the east Irish Sea. Estimates of densities in the study area are lower, with highest densities in August of 0.560 animals per km^2 (**Figure 1.23**). It must be noted however, that such large-scale modelling will not pick up small and isolated sub-populations of cetaceans.

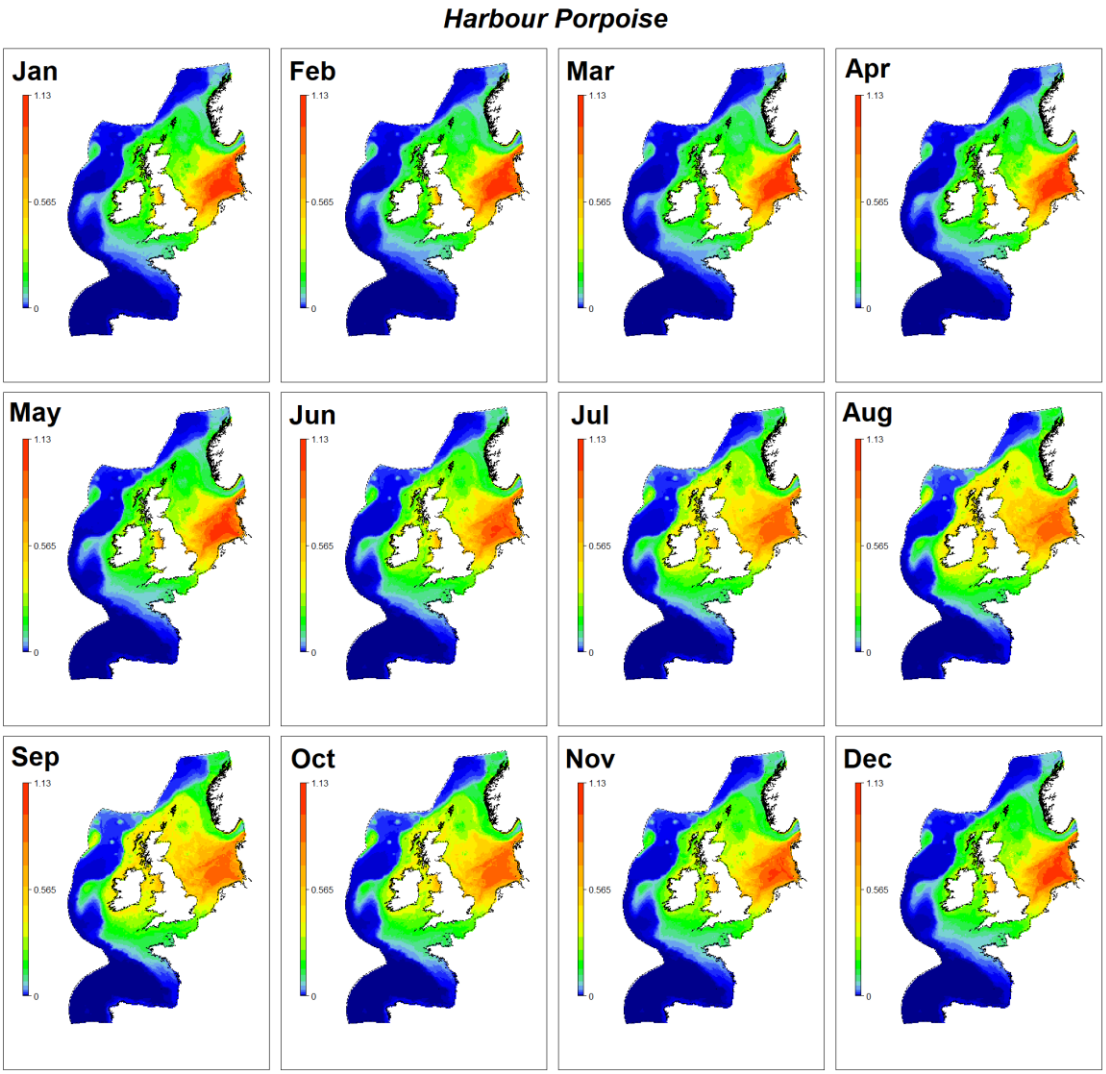

Figure 1.22: Predicted distributions for harbour porpoise per month, from Waggitt *et al.* (2020)

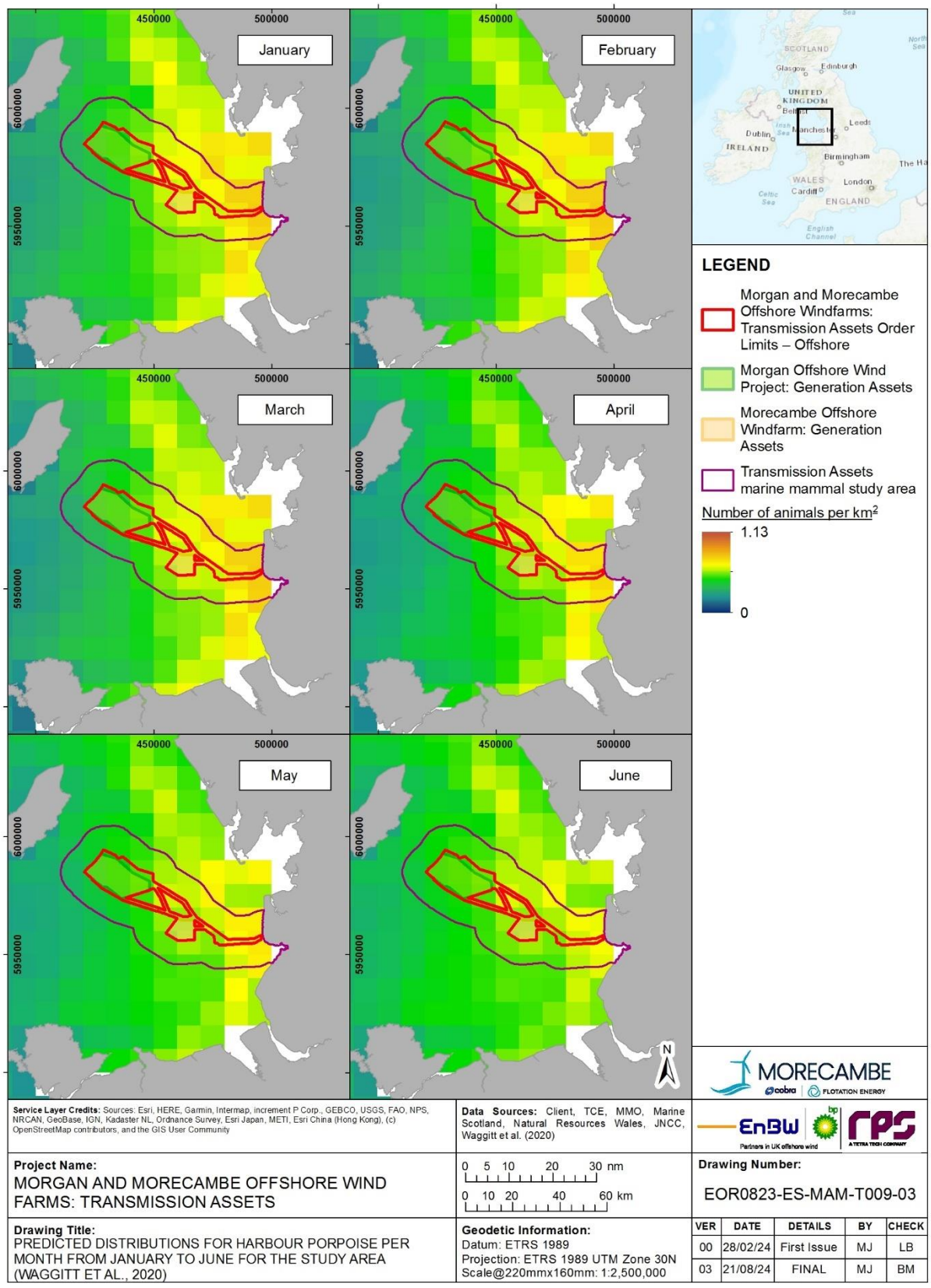

Figure 1.23: Predicted distributions for harbour porpoise per month from January to June for the study area (Waggitt *et al.,* 2020)

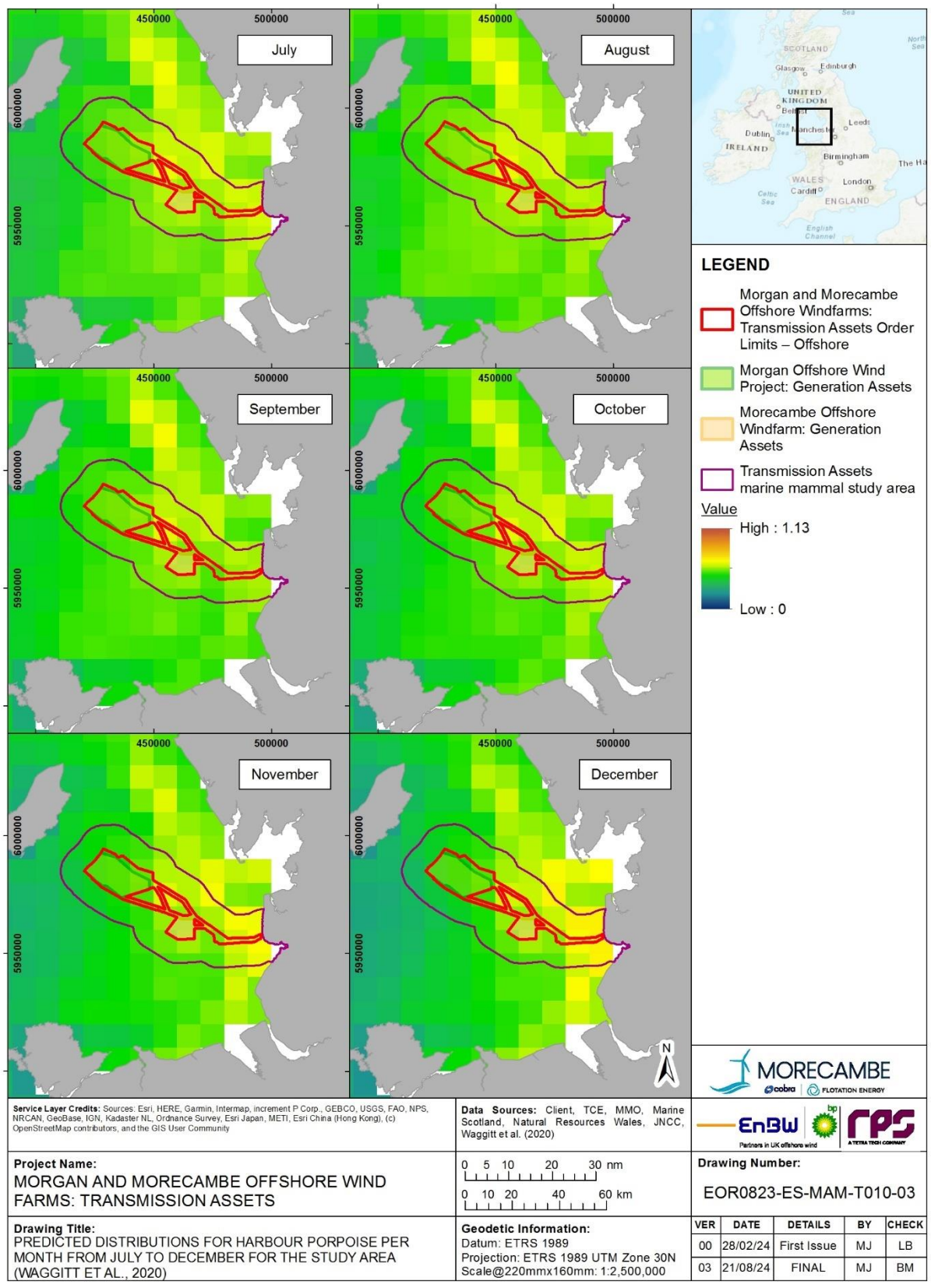

Figure 1.24: Predicted distributions for harbour porpoise per month from July to December for the study area (Waggitt *et al.*, 2020)

1.3.3.19 Modelled outputs at 2.5 km^2 resolution from the Welsh Marine Mammal Atlas (Evans and Waggitt, 2023) indicated areas of high density between north Anglesey and the Isle of Man, as well as the outer part of Cardigan Bay, west Pembrokeshire, and along east Ireland (the coastal area particularly from County Dublin south to County Waterford). Lower densities were reported for the Celtic Deep and north coast of Cornwall. When densities are modelled by quarter (measured as the mean density per cell across months within a season), highest densities were observed in July to September; however, significant seasonality differences were not observed.

1.3.3.20 The average density from the annual composite map for the Offshore Order Limits was 0.227 animals per km^2 (95% CI = 0.209 to 0.245). The average density for the study area from the annual composite maps was 0.226 animals per km^2. As set out in **paragraph 1.2.4.66** this density estimate takes a precautionary approach to the data, as this is the highest value observed for each cell (2.5 km^2 resolution) at any one point in time.

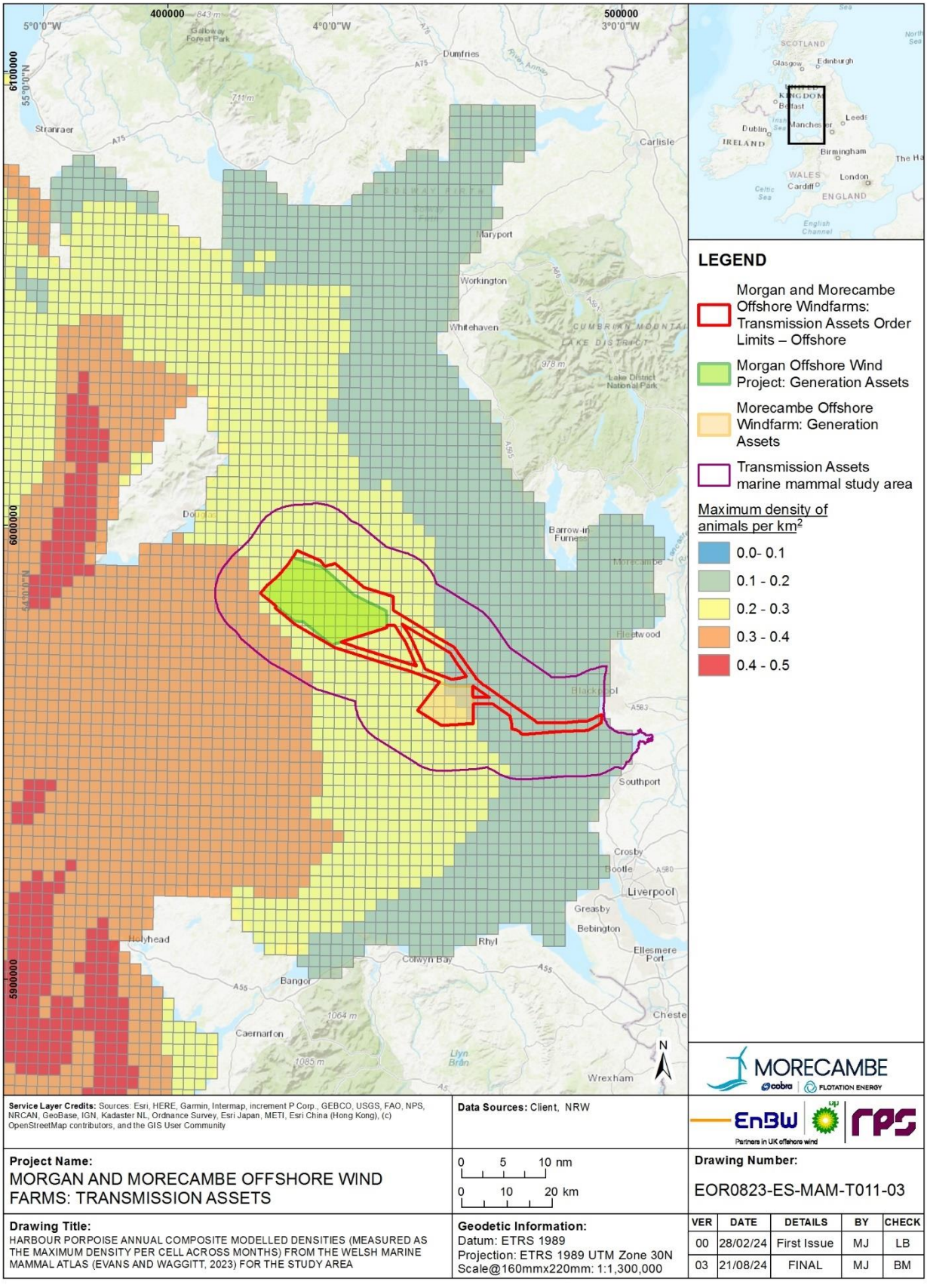

Figure 1.25: Harbour porpoise annual composite modelled densities (measured as the maximum density per cell across months) from the Welsh Marine Mammal Atlas (Evans and Waggitt, 2023) for the study area

1.3.3.21 Aside from boat and aerial surveys, other methods of data collection have been utilised to give density estimates. Evans *et al*. (2015) analysed long term effort-related land-based observations, to identify occurrence and abundance in coastal areas around the UK, using data from 678 sites all around the UK coastline. Effort was concentrated during summer months from May to September, therefore is not reflective of year-round distributions. Count rate was provided alongside Generalised Additive Model based predictions of density for each MU, and found porpoises were widely distributed throughout the CIS MU, with hotspots in west and north Pembrokeshire coast, and north west and north coasts of Anglesey – confirming studies by Shucksmith *et al*. (2009), Gordon *et al*. (2011) and Heinänen and Skov (2015) that suggested high densities in these areas.

Isle of Man

1.3.3.22 Several studies have focused on more localised areas, including the waters around the Isle of Man, thus giving more detailed densities for a smaller spatial area. Detailed in the cetacean chapter of the MMEA (Howe, 2018a), boat-based surveys undertaken around the Isle of Man between 2006 and 2010 recorded sightings of porpoise year-round, with an estimated average density of 0.207 animals per km^2 (CV = 0.211) (Howe, 2018). There were slightly higher sightings per km^2 in summer (0.038 sightings per km^2) than in winter (0.030 sightings per km^2) and a level of seasonal onshore movement in Manx waters suggested by Howe (2018a), but these sighting rates do not reflect actual porpoise densities. These studies are limited to Manx waters, but aid in providing detailed estimates for these areas.

1.3.3.23 Other small-scale surveys report higher densities of harbour porpoise in areas such as Anglesey and Cardigan Bay. For example, Gordon *et al.* (2011) estimated there to be 0.38 animals per km^2 around The Skerries (58 km to the west from the study area) and Carmel Head (58.2 km to the west of the study area) whilst Shucksmith *et al*. (2009) provided a density estimate of 0.630 animals per km^2 (CV = 0.20) for the waters around Anglesey (~45 km to the south of the study area). As described previously (**paragraph 1.3.3.16**) Heinänen and Skov (2015) reported areas of 'high' summer densities in 2000 to 2005 and 2006 to 2011 around Anglesey. Predicted summer densities for 2003 demonstrated high densities between the Isle of Man and Anglesey, similar to Baines and Evans (2012), but these predicted densities were lower during summer 1997 and 2009. Persistent high density areas[3] during summer are identified to the south and east of the study area (**Figure 1.26**) but not during winter (**Figure 1.27**) and do not overlap with the study area.

[3] In (**Figure 1.26**) red colours mark areas with where persistent high densities as defined by the upper 90th percentile have been identified. In the map B the red colours mark persistent high-density areas with survey effort from three or more years.

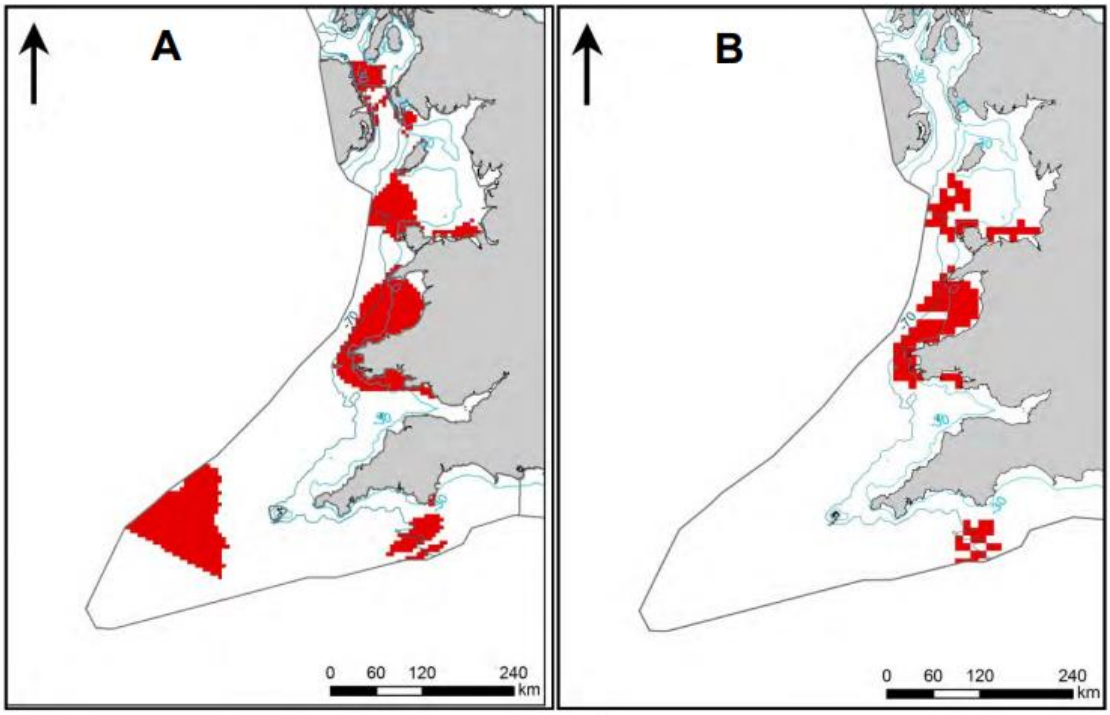

Figure 1.26: Persistent high-density areas identified and selected in Management Unit 0 during summer, from Heinänen and Skov (2015)

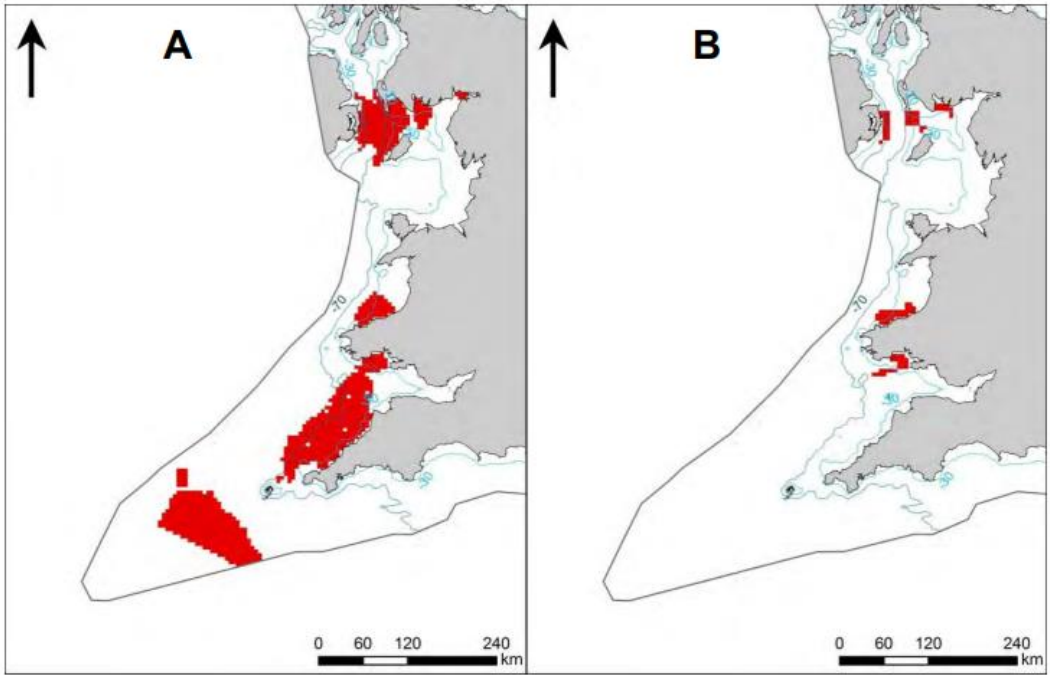

Figure 1.27: Persistent high-density areas identified and selected in Management Unit 0 during winter, from Heinänen and Skov (2015)

1.3.3.24 More recently, several baseline characterisation surveys have provided further fine-scale local density data for harbour porpoise. As discussed in **paragraph 1.2.4.4**, both design-based and model-based relative and absolute densities from the aerial digital survey data was presented in the Morgan Offshore Wind Project: Generation Assets Marine Mammal Technical Report (**Appendix A**), comprising 24 months of surveys (April 2021 to March 2023). For the Morgan Offshore Wind Project:

Generation Assets Aerial survey area, a mean absolute density of 0.189 animals per km^2 per month was estimated from a design-based approach, with highest densities in August (0.307 animals per km^2) and lowest densities in November (0.053 animals per km^2). Model-based densities averaged as 0.056 animals per km^2 per month, with highest densities in October (0.118 animals per km^2, 95% CI = 0.055 to 0.181) and lowest densities in September (0.012 animals per km^2, 95% CI = 0.000 to 0.029).

1.3.3.25 Data was combined by bio-season specific to harbour porpoise to develop the most robust and biologically relevant model. As discussed in more detail in **Appendix A**, dividing the year into bio-seasons is an approach to aid with designating SACs (Heinänen and Skov, 2015). Design-based approaches gave absolute densities of 0.159 and 0.219 animals per km^2 for 'Winter' and 'Summer' respectively. Mean absolute density estimates from the model-based approach was 0.050 for Winter (95% CI = 0.034 to 0.067, CV = 0.860) and 0.062 for Summer (95% CI = 0.043 to 0.082, CV = 0.647). Spatial modelling using linear models showed harbour porpoise density appears to have concentrations of occurrence in the north west and south east parts of the aerial survey area (density maps are presented in Appendix A of the Morgan Offshore Wind Project: Generation Assets Marine Mammal Technical Report) particularly in the summer bio-season.

1.3.3.26 In the aerial survey data for the Morecambe Offshore Windfarm: Generation Assets (**Appendix B**), harbour porpoise density estimates are presented from March 2021 to February 2023. The average annual density estimate was determined based on the 24 months of site-specific surveys. **Appendix B** states it is important to note that the density for the summer average has been skewed by a single month of particularly high numbers (May 2022; n= 179; 6.25 animals per km^2). The resulting mean summer density (1.621 animals per km^2) is significantly higher than the average summer density calculated by Evans and Waggitt (2023) (0.2 animals per km^2) for the area in which the Morecambe Offshore Windfarm: Generation Assets is located.

1.3.3.27 The maximum absolute (corrected) density estimates for the whole survey area ranged between 0.26 animals per km^2 in July 2022 to 6.25 animals per km^2 in May 2022. The average density estimate for the summer period (April to September) was 1.621 animals per km^2 and the average density estimate for the winter period (October to March) was 1.528 animals per km^2. The annual average density estimate for the 24 months of site-specific surveys was 1.574 animals per km^2.

1.3.3.28 From two years of aerial surveys at Mona Offshore Wind Project (Mona Offshore Wind Ltd, 2024), a mean absolute density of 0.079 animals per km^2 per month was estimated from design-based approach for the Mona Aerial Survey Area, with highest densities in July (0.175 animals per km^2) and lowest densities in April (0.012 animals per km^2). Model-based densities averaged as 0.014 animals per km^2 per month, with highest densities in January (0.066 animals per km^2, 95% CI = 0.040 to 0.096) and lowest densities in April (0.002 animals per km^2, 95% CI = 0.001 to 0.003). Design-based approaches gave densities of 0.097 and

0.061 animals per km^2 for 'Winter' and 'Summer' respectively. Mean absolute density from the model-based approach was 0.022 for Winter (95% CI = 0.005 to 0.041, CV = 0.5) and 0.013 for Summer (95% CI = 0.005 to 0.023, CV = 0.478).

1.3.3.29 In summary, densities derived from site-specific surveys within the immediate vicinity of the Transmission Assets, and taken forward to assessment in respective ESs at the Mona Offshore Wind Project (Mona Offshore Wind Ltd, 2024), Morgan Offshore Wind Project: Generation Assets (**Appendix A**), and Morecambe Offshore Windfarm: Generation Assets (**Appendix B**) are wide ranging (0.061, 0.219, and 1.621 animals per km^2, respectively). Densities were derived from sightings of harbour porpoise across each of the site-specific surveys and are reflective of harbour porpoise presence within each survey location, respectively.

1.3.3.30 Wylfa Newydd nuclear power station is located approximately 54 km to the south west of the study area, west of Cemaes Bay on the island of Anglesey, off the north west coast of Wales. The Wylfa Newydd nuclear power station surveys (Jacobs, 2018) gave estimates of harbour porpoise relative density of 0.323 porpoise per km^2. This assumes that the probability of detection of an animal on the trackline (g(0)), or perception bias, is = 1, (i.e. assumes every animal on the trackline is detected). This is unlikely to be the case for marine mammals who spend much of their time below the surface. Therefore when using probability of detection as g(0) = 0.5 (50% of the number of animals on the track line are detectable) densities were 0.646 porpoise per km^2 (Jacobs, 2018).

1.3.3.31 Site-specific boat surveys were used to inform the baseline characterisation for the MDZ (Menter Môn Morlais Ltd., 2019) which is located in West Anglesey, off the coast of Holy Island, approximately 68.71 km south west of the study area. The density estimate range from the site surveys were 0.5 to 1 animal per km^2. Densities were highest in January 2017 (1 porpoise per km^2, 95% CI = 0.02 to 1.11), similar to the Wylfa Newydd surveys which also had highest rates in January. The average estimated relative density within the MDZ site was 0.213 porpoise per km^2, and 0.218 porpoise per km^2 in the 2 km buffer area. Dedicated harbour porpoise boat-based surveys have also been conducted off West Anglesey by SEACAMS (SEACAMS, 2019), which included the MDZ. Eighteen surveys were conducted between January 2015 and December 2016. The SEACAMS gave relative densities of individuals as 0.43 animals per km^2 (CV = 0.18), but correcting for incomplete detection (g(0) = 0.61) density ranged from 0.714 (CV = 0.33) to 0.852 (CV = 0.33) individuals per km^2.

1.3.3.32 In surveys for Rhiannon Wind Farm (Celtic Array Ltd., 2014), estimated density abundance of harbour porpoise within the ISZ based on encounters recorded during visual and acoustic boat-based surveys was given at 0.02 animals per km^2 from visual sightings, 0.12 animals per km^2 for acoustic detection (good and moderate combined) and 0.09 animals per km^2 for acoustic detection (good) (see **section 1.2.4** for further explanation of categories). Aerial surveys of the Irish Sea

Zone produced an overall density of 0.09 per km^2 for the Zone over the entire year.

1.3.3.33 Recent site-specific survey data from April 2019 to February 2021 for the baseline characterisation for Awel Y Môr Offshore Wind Farm, which is located approximately 19 km south of the study area, confirmed a total of 27 harbour porpoise in monthly digital still aerial surveys by APEM over the survey period, but data was not sufficient for estimating densities within the area (Sinclair *et al.*, 2021).

Summary of densities

1.3.3.34 Overall, harbour porpoise are abundant throughout the Irish sea with areas of high density located in the east Irish Sea where the study area is located. A comparison of harbour porpoise densities from key data sources which overlap the study area is shown in **Table 1.5**.

1.3.3.35 The predicted estimate of mean densities for the study area and the Offshore Order Limits from the Welsh Marine Mammal Atlas (Evans and Waggitt, 2023) are comparable to the SCANS-III block E estimate (Hammond *et al.,* 2021) in the west Irish Sea, but provide densities derived from higher resolution data than SCANS-III surveys (2.5 km^2 resolution, compared to a single estimate over 34,870 km^2). Densities from the North East Atlantic Distribution Maps (Waggitt *et al.,* 2020) and SCANS-III DSM data (Lacey *et al.,* 2022) are derived from slightly lower resolution data (10 km resolution for both datasets) compared to the Welsh Marine Mammal Atlas data. In addition, the Welsh Marine Mammal Atlas data is specific to the Irish Sea, in which the Transmission Assets are located, whereas data from SCANS-IV, SCANS-III, the North East Atlantic Distribution Maps and SCANS-III DSM data cover far larger geographic areas. Furthermore, densities from the Welsh Marine Mammal Atlas (Evans and Waggitt, 2023) are higher than absolute densities from Morgan Offshore Wind Project: Generation Assets aerial surveys, but lower than absolute densities for the Morecambe Offshore Windfarm: Generation Assets aerial surveys.

1.3.3.36 The density taken forward to assessment is the density for the Offshore Order Limits from the Welsh Marine Mammal Atlas (Evans and Waggitt, 2023) (as recommended by Natural England) (highlighted in bold in **Table 1.5**) as a precautionary but proportionate density for the area.

Table 1.5: Comparison of main data sources densities and estimates of variation for harbour porpoise

Source	Density (animals per km^2)	Estimate of variation
APEM aerial survey bio-season design based for the Morgan Offshore Wind Project: Generation Assets – absolute densities (**Appendix A**)	Winter = 0.159 Summer = 0.219	Winter (95% CIs = 0.130 to 0.194) Summer (95% CIs = 0.179 to 0.268)
HiDef aerial surveys (24 months) for Morecambe Offshore Windfarm: Generation Assets – absolute densities (**Appendix B**)	Winter = 1.528 Summer = 1.621	*Not given*
SCANS-IV block CS-E (Gilles *et al.*, 2023)	0.515	0.250 (CV)
SCANS-IV block CS-D (Gilles *et al.*, 2023)	0.280	0.316 (CV)
SCANS-III DSM for the study area (Lacey *et al.* 2022)	0.434	0.302 to 0.611 (95% CIs)
SCANS-III block F (Hammond *et al.*, 2021)	0.086	0.383 (CV)
SCANS-III block E (Hammond *et al.*, 2021)	0.239	0.282 (CV)
North East Atlantic Distribution Maps (Waggitt *et al.*, 2020) for the study area for August (peak month)	0.560	0.543 to 0.579 (95% CIs)
Welsh Marine Mammal Atlas (Evans and Waggitt, 2023)[a] for the Transmission Assets Order Limits: Offshore from annual composite maps	**0.227**	**0.210 to 0.245 (95% CIs)**
Welsh Marine Mammal Atlas (Evans and Waggitt, 2023) for the study area from annual composite maps	0.226	0.209 to 0.245 (95% CIs)

Density set out in **bold** = density identified to be taken forward to the assessment in Volume 2, Chapter 4: Marine mammals of the ES.

a. Welsh Marine Mammal Atlas data (Evans and Waggitt, 2023) are presented for both the Offshore Order Limits and the study area (Offshore Order Limits plus 10 to 14 km buffer).

Abundance

1.3.3.37 Abundance estimates for harbour porpoise vary considerably depending on the dataset and spatial scale. For the relevant MU for harbour porpoise (CIS MU) the abundance is estimated as 62,517 (CV = 0.13, 95% CI = 48,324 to 80,877) individuals (IAMMWG, 2023; 2022). These abundance estimates are based on the results of the SCANS-III surveys (Hammond *et al.*, 2017) and ObSERVE Programme (Rogan *et*

al., 2018). Abundance estimates from SCANS-III gave 1,056 animals (95% CI = 342 to 2,010) for block F (in which the Transmission Assets lies) and 8,320 animals for adjacent block E (95% CI = 4,643 to 14,354). Recent SCANS-IV estimates gave 6,325 animals (95% CI = 3,663 to 10,162) for block CS-E (in which the Transmission Assets lies) and 9,773 animals (95% CI = 4,764 to 18,125) for adjacent block CS-D. JCP Phase III gave predicted abundances for the Irish sea by season; winter abundance for harbour porpoise was 4,600 animals; spring was 2,300 animals; summer was 3,200 animals; and autumn had 2,000 animals (Paxton *et al.,* 2016).

1.3.3.38 ObSERVE surveys were conducted in the offshore waters of Ireland between 2015 and 2017 (Rogan *et al.*, 2018), with Stratum 5 (the only strata located in the Irish Sea) of relevance to the regional area. Whilst a total of 256 porpoises were recorded across the entire survey area, corrected design-based estimates and model-based estimates were given for each season (summer 2015, winter 2015, summer 2016, winter 2016). Corrected abundance estimates ranged from 7,494.6 animals (CV = 35.7, 95% CI = 4,789.0 to 11,728) in summer 2015 to 11,624.5 animals (CV = 28.2, 95% CI = 87,25.8 to 15,486.0) in summer 2016. Estimates for the winter season were lower compared to summer.

1.3.3.39 The Mona aerial digital surveys presented in Mona Offshore Wind Ltd (2024) gave both relative and absolute abundance estimates per month. The average means absolute abundance (i.e. corrected for availability bias) for the area was 114 animals in the Mona Aerial Survey Area per month. Mean absolute abundance across the months ranged from 17 animals (in April) to 252 animals (in January). When combined by meteorological season, winter had the highest absolute abundance estimates with 207 animals in the survey area, whilst spring had the lowest with 56 animals. When using bio-season, winter had an abundance of 140 animals in the area and 88 animals during the summer.

1.3.3.40 In site-specific surveys within the study area, the Morgan aerial digital surveys gave both relative and absolute abundance estimates per month for the Morgan Offshore Wind Project: Generation Assets (**Appendix A**). The average mean absolute abundance for the area was 261 animals per month. Mean absolute abundance across the months ranged from 74 animals (in November) to 423 animals (in August). When applying bio-seasons, abundance was calculated for Winter as 220 animals and Summer as 303 animals.

1.3.3.41 The Marine Mammal Observer (MMob) and Passive Acoustic Monitoring (PAM) Report (part of the Morgan Offshore Wind Project: Generation Assets ES) also provided sightings data for visual and acoustic monitoring during targeted integrated surveys in the Irish Sea. During these surveys there were three visual sightings of harbour porpoise from April 2022 to May 2022 across the combined Morgan Offshore Wind Project: Generation Assets and Mona Offshore Wind Project (Mona Offshore Wind Ltd., 2023) surveys (as presented in **Appendix A**).

1.3.3.42 In the aerial survey data for the Morecambe Offshore Windfarm: Generation Assets (**Appendix B**), harbour porpoise abundance estimates were derived in the same way as density estimates and are presented from March 2021 to February 2023. The absolute (corrected) abundance estimates ranged from 180 animals (95% CI = 51 to 309) in the survey area in July 2022 to 4,060 animals (95% CI = 2,196 to 6,481) in May 2022. The average abundance estimate was calculated as 1,029 animals (95% CI = 594 to 1,543). Unlike the approach to density estimates, abundance was not split into seasons (see **paragraph 1.3.3.25**).

1.3.3.43 In surveys for Rhiannon Wind Farm (**see section 1.2.4**~~Error! Reference source not found.~~) (Celtic Array Ltd., 2014), boat-based visual surveys of the Irish Sea Zone between 2011 and 2013 recorded 292 sightings comprising 516 individual animals, of which 44 were identified as calves or juvenile animals. Animals were recorded in all months, but the peak number of sightings occurred during June. Acoustic detections showed a total of 310 harbour porpoise detections and estimated 259 animals in the Irish Sea Zone.

1.3.3.44 Several historical studies had more localised abundance values targeting known high-use areas by cetaceans (Anglesey and Cardigan Bay) (Shucksmith *et al*. 2009; Veneruso and Evans, 2012; Feingold and Evans, 2013), meaning higher survey coverage and effort. Dedicated visual surveys in Anglesey comprising of 31 transect line surveys between 2002 and 2004 gave abundances of 309 individuals (CV = 0.20) for the 489 km^2 study site (Shucksmith *et al.* 2009).

1.3.3.45 SWF carried out line transect surveys in Cardigan Bay SAC during April to October in 2005, 2006 and 2007 and although an increase in abundance was seen over this period (from 107 to 214 animals) this was still slighter lower than recorded in previous years (e.g. 236 in 2003 and 215 in 2004). Later, in July 2011, line-transect surveys carried out in Cardigan Bay SAC, Pen Llŷn a'r Sarnau SAC and outer Cardigan Bay generated an abundance estimate of 990 individuals for the combined area (95% CI = 585 to 1673) albeit with a high CV (27.1) (Veneruso and Evans, 2012). For Cardigan Bay SAC only, abundance estimates were 302 individuals (95% CI = 129 to 711) which was deemed low compared to other studies but again a high CV (44.61) suggests this estimate may be highly variable. Further to this, line transect surveys and *ab libitum* boat surveys were continued in summer months from July 2011 to October 2013 by SWF within Cardigan Bay and Pen Llŷn a'r Sarnau SAC (Feingold and Evans, 2013). Abundance estimates ranged from 1074 (CV 28.73, 95% CI = 634 to 1821) in 2011 to 410 (CV 20.42, 95% CI = 298 to 564) in 2013. Total encounter rates from ad libitum surveys ranged between 0.003 animals per km to 0.052 animals per km.

1.3.3.46 The abundance estimate taken forward to assessment of effects is the CIS MU abundance of 62,517 animals (IAMMWG, 2023; 2022) presented in **paragraph 1.3.3.37** (and presented in **Table 1.15**).

Seasonality

1.3.3.47 The Atlas of the Marine Mammals of Wales considers porpoise to be present year-round in the Irish Sea (Baines and Evans, 2012). Predicted density maps from Waggitt *et al.* (2020) (**Figure 1.23** and **Figure 1.24**) showed moderate densities year-round towards the east of the Irish Sea, overlapping the study area, with increased densities further inshore towards Liverpool Bay. However, during the Wylfa Newydd surveys around the north of Anglesey there were higher sighting rates in January compared to summer months (Jacobs, 2018) and was similar to seasonality found during the MDZ surveys (Royal Haskoning DHV, 2019) which also had highest densities in January 2017. These findings corroborated the JCP Phase III results, where highest densities of harbour porpoise were recorded during winter months (Paxton *et al.,* 2016).

1.3.3.48 MWDW data shows there are sightings of harbour porpoise year-round in Manx waters. This data is a combination of boat-based surveys and opportunistic sightings. However, data has not been analysed in the context of effort and therefore it is not possible to draw direct conclusions on seasonality. However, MWDW have provided the information that “the 16 years of sightings data showing consistency in the temporal observation of each species would seem to reflect a true seasonality of these cetaceans in Manx waters. This is further supported by noting public records of cetaceans are received year-round indicating that lower winter survey effort has not created a false seasonality” (MWDW, personal communication, June 2023).

1.3.3.49 Model results from Heinänen and Skov (2015) indicated that water depth, surface sediments, current speed and eddy potential all play a major role as determinants of the distribution of harbour porpoise in this MU, during the summer season. Porpoise calves occur throughout the regional study area (Baines and Evans, 2012). The calving period for harbour porpoise is primarily between May and July, when sea temperatures are increasing (Sørensen and Kinze 1994; Lockyer, 1995; Börjesson and Read 2003; Learmonth et al., 2014).

1.3.3.50 In the aerial data presented in the Morgan Offshore Wind Project: Generation Assets Marine Mammal Technical Report (**Appendix A**), there was very little evidence of seasonality when modelled by bio-season, with similar densities in winter (mean absolute density = 0.050, CV = 0.860) and summer (0.062, CV = 0.647). The low confidence in the model and high CVs mean that interpretation of the results with respect to seasonal distinctions is difficult. The absolute density from design-based estimates also reflected similar density in winter (mean density = 0.159, CV = 0.740) compared to summer (mean density = 0.219, CV = 0.518).

1.3.4 Bottlenose dolphin

Ecology

1.3.4.1 Bottlenose dolphin are members of the family Delphinidae, which are oceanic dolphin found in temperate and tropical waters worldwide. The largest of the beaked dolphin, this species ranges in size from 1.9 to 3.8 m and can live, on average, between 20 to 30 years. On average, males reach sexual maturity at ten to 12 years and females at five to ten years. Mating occurs during the summer months, with gestation taking 12 months and calves suckling for 18 to 24 months. Females generally reproduce every three to six years (Mitcheson, 2008).

1.3.4.2 There is variation in the patterns of habitat use of bottlenose dolphin, even within a population, and generally the distribution of this species is influenced by factors such as tidal state, weather conditions, resource availability, life cycle stage, or season (Hastie *et al*., 2004). A study of the stomach contents of 12 bottlenose dolphin in Irish waters gave a total of 37 prey taxa, suggesting that they have a broad diet, but the main prey items were species of gadoid fish (pollack, saithe, haddock, blue whiting and whiting) (Hernandez-Milan *et al*., 2015). This is similar to those typical prey items for bottlenose dolphin in Scottish waters which included cod, saithe, salmon and haddock (Santos *et al*., 2001). Differences in diet were also found among these populations, where their stomach contents suggest that these animals might be foraging in different habitats. Significant differences were also found between male and female dolphin diet, with males having eaten a wider variety of prey items than females.

1.3.4.3 Bottlenose dolphin are frequently seen in groups rather than individually, although group size in coastal populations may be smaller than offshore populations; however, very little is known about offshore populations (Rogan *et al*., 2018). Studies on bottlenose dolphin in Cardigan Bay suggests distance from coast had a significant effect on encounter rates, with the dolphins favouring habitat as close as five kilometres from the coast; they also showed a preference for shallow waters (5 to 10 metres deep) and gentle slopes (Pesante *et al*., 2008).

Distribution and occurrence

1.3.4.4 Bottlenose dolphin are found in warm and temperate waters globally and are widely distributed in the North Atlantic. In the Irish Sea, they appear to have a predominantly coastal distribution (Baines and Evans, 2012), although low densities have been recorded offshore, particularly in St George's Channel and the south west area of the Irish Sea (Baines and Evans, 2012). Surveys have indicated bottlenose dolphin have a strong preference for coastal waters (Feingold and Evans, 2014; Pesante *et al.*, 2008). In the Atlas of the Marine Mammals of Wales regular sightings of bottlenose dolphin were confirmed across the Irish Sea, with areas of high counts per kilometre seen in Cardigan Bay and Anglesey (Baines and Evans, 2012). JCP Phase III data also demonstrated bottlenose dolphins were essentially coastal, with

particular consistent regions of high density in Cardigan Bay, the Moray Firth and the west coast of Ireland (Paxton *et al*., 2016*).* Data from MWDW (**Figure 1.11**) shows bottlenose dolphin are widespread in Manx waters around the Isle of Man, extending out towards the Morgan Offshore Wind Project: Generation Assets.

1.3.4.5 There is evidence of large home ranges for bottlenose dolphin, but in the Irish sea their distribution is largely coastal (Quick *et al.*, 2014) and using lower uniform densities for this area (such as those in SCANS-III that use blocks) is unsuitable for this species as it does not take consideration of their specific habitat preferences. In Anglesey for example, the majority (83%) of sightings by SWF were located within 6 km from the coastline (Feingold and Evans, 2014). Therefore, it can be reasonably assumed that most bottlenose dolphin will be located within that 6 km region from the coastline, and those coastal areas may be comparable to other high use areas in the regional study area (such as in outer Cardigan Bay which has higher densities, as described in Lohrengel *et al.,* 2018), though densities are unlikely to be as high as those in Cardigan Bay (which is in a SAC designated for bottlenose dolphin with a resident population, see **paragraph 1.3.4.6**). Further out from the coast, towards the study area, lower densities may be more reflective of the offshore bottlenose dolphin distribution or dolphins moving between areas in the Irish Sea (see **paragraph 1.3.4.7**).

1.3.4.6 In UK territorial waters there are two semi-resident groups of bottlenose dolphin, in Cardigan Bay and the Moray Firth (Wilson *et al.*, 1997). These two areas have been designated due to the Annex II species presence, with the Moray Firth in north east Scotland supporting the only known resident population of bottlenose dolphin in the North Sea (JNCC, 2022f) where dolphins are present all year round. There is also a resident population in the Shannon Estuary, Ireland (Ingram and Rogan, 2002; 2003).

Connectivity with Manx waters

1.3.4.7 Bottlenose dolphin from Cardigan Bay are likely interact with animals in waters of south west UK and South Ireland and are likely to be moving and exchanging with more distant populations (Pesante *et al.,* 2008), with population having a wide habitat range up to the Isle of Man (Duckett, 2018). Howe (2018a) confirmed movement of individuals between Manx waters and Cardigan Bay using comparison of photo ID catalogues in the two areas.

1.3.4.8 Howe (2018a) suggested bottlenose dolphins in Manx waters are highly temporal and sighted only in winter months (between late August and March) where the waters provide vital habitat during these months. There was no observed spatial pattern in terms of the distribution of sightings in Manx waters (Howe, 2018a), and this is also reflected in MWDW sighting data which shows sightings around the entire coastline of the Isle of Man. In contrast to the winter seasonal distribution around Manx waters, bottlenose dolphins occupy the waters around Cardigan Bay during summer months, reflecting the use of this area as a key calving area for the species. The majority of pregnant females are

thought to give birth in the inshore waters around Cardigan Bay (Duckett, 2018). However, after giving birth many individuals moved out of Cardigan bay and travelled north of the Llŷn Peninsula, into the waters of the south Irish Sea with calves within two years of giving birth (Duckett, 2018).

1.3.4.9 Although there is evidence of site fidelity in coastal bottlenose dolphin populations Robinson *et al.* (2012) showed that there were long distance movements by individuals between UK and Irish Waters. Eight individuals, monitored over a 10-year period (2001 to 2010), were resighted within coastal areas in the Moray Firth, Inner Hebrides and Shannon Estuary with minimum dispersal distances of up to 1,277 km (Robinson *et al.,* 2012).

Density/abundance

Density

1.3.4.10 The study area lies within block F of the SCANS-III surveys but no bottlenose dolphin were sighted within the block (Hammond *et al.,* 2021). Bottlenose dolphin were recorded in the adjacent block E, in which the regional study area lies, and the estimated density was 0.008 animals per km^2 (CV = 0.573). As previously mentioned, surveys were carried out between 27 June and 31 July 2016, thus focused on a limited summer period and therefore densities may vary in other months of the year.

1.3.4.11 Recent DSM estimates using the SCANS-III data (Lacey *et al.* 2022) (see **paragraph 1.2.4.43**) gave mean densities of 0.016 animals per km^2 for the study area (**Figure 1.28**) with density maps showing higher areas of density in the east Irish Sea[4]. Recent SCANS-IV data reported similar densities, of 0.0104 animals per km^2 (CV = 0.700) in block CS-E (in which the Transmission Assets lies). In adjacent block CS-D higher densities were given, of 0.235 animals per km^2 (CV = 0.353) (Gilles *et al.*, 2023).

[4] Data from SCANS-III estimates are given as point densities and have been transformed to grid using Voronoi triangle/polygon method to create a grid surface for clearer illustration.

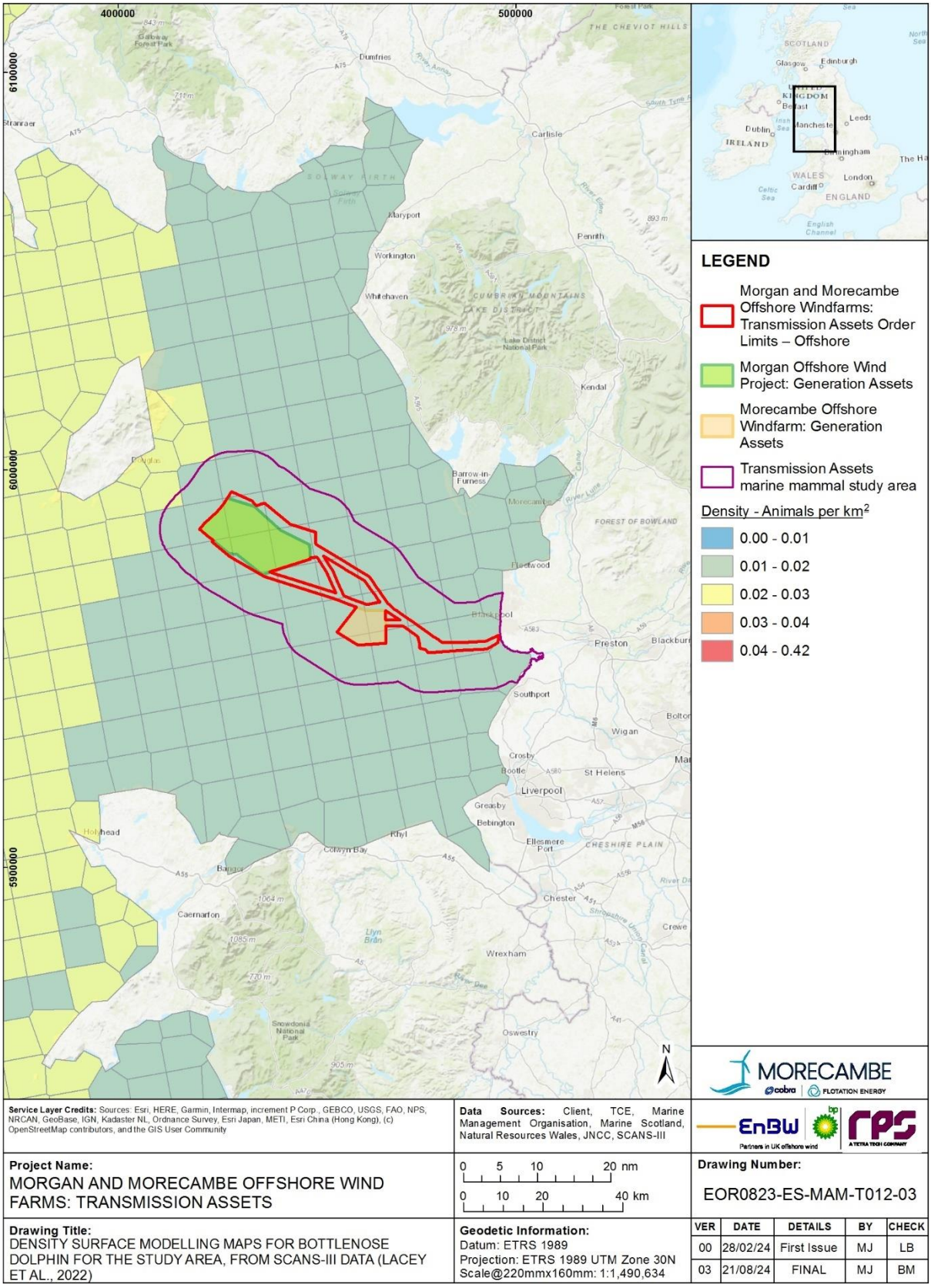

Figure 1.28: Density surface modelling maps for bottlenose dolphin for the study area, from SCANS-III data (Lacey *et al.*, 2022)

1.3.4.12 Modelled outputs from the Welsh Marine Mammal Atlas (Evans and Waggitt, 2023) indicated the importance of Cardigan Bay for bottlenose dolphin, with higher densities along the coast reaching 0.36 animals per km^2. Lower densities were presented for other areas, where groups rarely remain for extended periods in any one locality, instead ranging around and often occurring more offshore along the north coast of the Llŷn Peninsula, around Anglesey, the coast of mainland north Wales east to Liverpool Bay, around the Isle of Man and probably elsewhere in the Irish Sea (Evans and Waggitt, 2023). The authors suggested that modelled distributions reflects a true picture of bottlenose in the Irish Sea with high densities year round in Cardigan Bay, but may under-represent their wider distribution between November and May as bottlenose dolphin do not remain for extended periods of time in these areas (around the Llŷn Peninsula, Anglesey, the coast of mainland North Wales east to Liverpool Bay and around the Isle of Man) and are often moving offshore, which may not be captured in the modelled distributions.

1.3.4.13 The average density for the study area from the annual composite maps was 0.0011 animals per km^2 and the average density for the Offshore Order Limits was 0.0012 animals per km^2 (see **Figure 1.29**). As set out in **paragraph 1.2.4.66** these density estimates are precautionary as this is the highest value observed for each cell (2.5 km^2 resolution) at any one point in time.

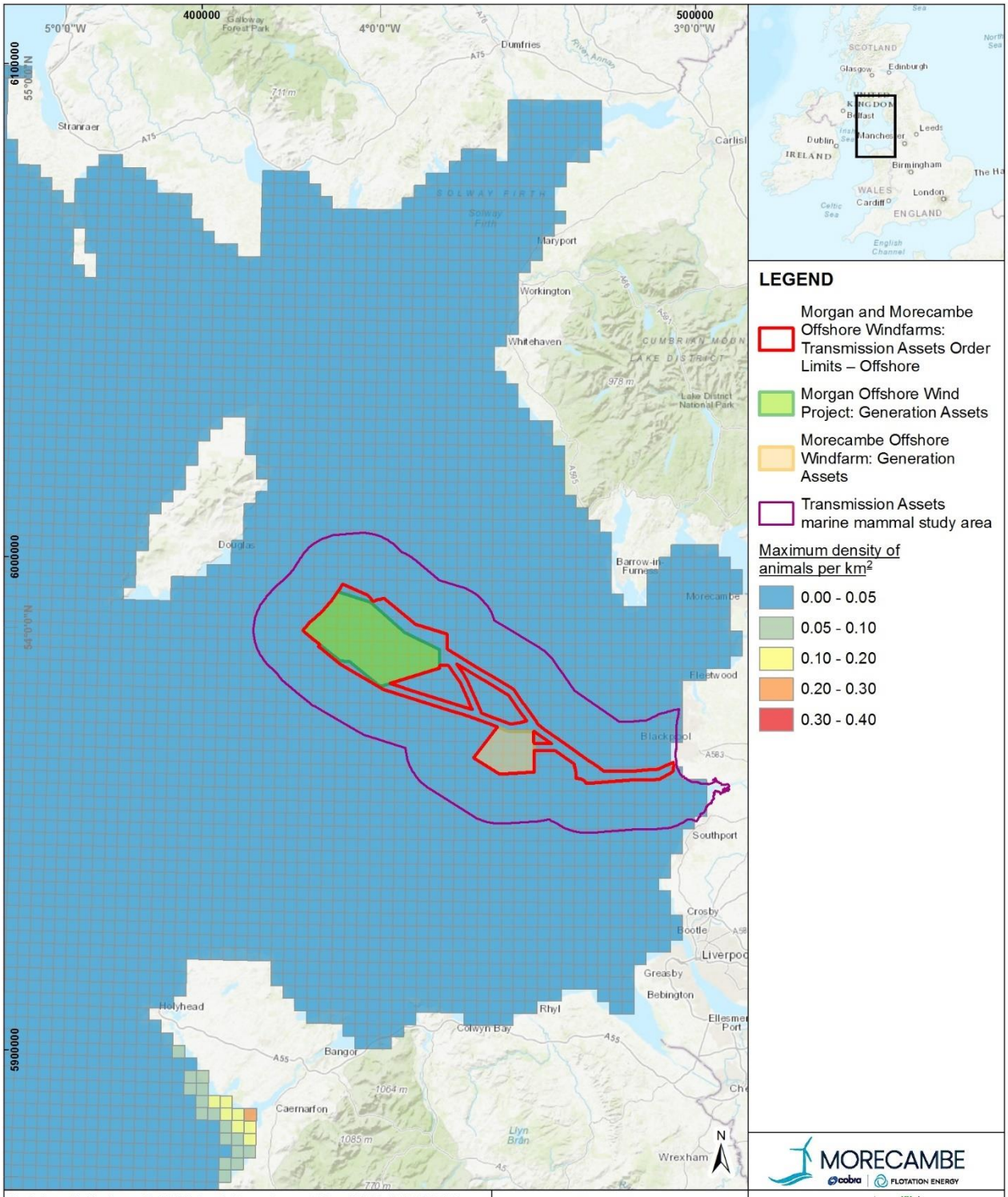

Figure 1.29: Bottlenose dolphin annual composite modelled densities (measured as the maximum density per cell across months) from the Welsh Marine Mammal Atlas (Evans and Waggitt, 2023) for the study area

1.3.4.14 During ObSERVE surveys bottlenose dolphin was more frequently seen in the winter than in the summer in both years. It was the most frequently sighted cetacean species in the surveys (Rogan *et al.*, 2018) and bottlenose dolphin calves were seen in most of the surveyed regions (71 sightings). However, Stratum 5 (West Irish Sea) had much fewer sightings than other strata and of the four survey periods, this species was only observed in Summer 2016 and winter 2016/17. Peak estimates of density for these surveys were given as 0.0106 animals per km^2 and 0.0366 animals per km^2 for summer and winter respectively.

1.3.4.15 In surveys for Rhiannon Wind Farm (Celtic Array Ltd., 2014), four sightings of bottlenose dolphins recorded 13 animals during the boat-based visual surveys with animals observed in March, June, July and September. Insufficient sightings of bottlenose dolphins were made during the boat-based surveys to generate a site-specific abundance estimate.

1.3.4.16 JCP Phase III density surface modelling gave mean densities of 0.067 animals per km^2 across the entire region of interest, with some areas of high density around Cardigan Bay (Paxton *et al*., 2016)[5]. Mean predicted summer densities in the Irish Sea showed densities reaching 2 animals per km^2 for summer data combined for the periods 1994 to 2000, 2001 to 2006 and 2007 to 2010, all of which exist in the Cardigan Bay area. This study builds upon the JCP Phase One Data Analysis (Paxton and Thomas, 2010), which predicted density surfaces for bottlenose dolphin from data from 1980 to 2009 and showed densities in the region of the study area were 0.01 to 1 animal per km^2 (Paxton and Thomas, 2010).

1.3.4.17 Most recently, North East Atlantic Distribution Maps for bottlenose dolphin at monthly scales, demonstrated bottlenose dolphin densities to be fairly consistent all year round (**Figure 1.30**), with some higher densities in winter (January) than in summer (July) off the west coast of Ireland and Bay of Biscay (Waggitt *et al.,* 2020). Low density areas of bottlenose dolphin were predicted in the Irish Sea year-round but does not appear to reflect the known localised higher densities around Cardigan Bay (Evans and Waggitt, 2023; Lohrengel *et al.,* 2018). The North East Atlantic Distribution Maps (Waggitt *et al.*, 2020) show that small and isolated sub-populations would have little influence on these broad scale models, and despite seasonal movements being detected, seasonal increases and decreases in densities without notable changes in distribution were more commonplace. Predicted distributions for bottlenose dolphin per month for the study area show low relative densities year-round (**Figure 1.31, Figure 1.32**). Highest densities in the east Irish sea were predicted in August with 0.025 animals per km^2 in high density areas. Within the study area, bottlenose dolphin

[5] JCP Phase III densities are approximations read off density surface maps in the report (Paxton *et al*., 2016), rather than derived from database. JDCP data was requested but not available currently.

densities were comparatively low, given for August as 0.0011 animals per km^2 (**Figure 1.32**).

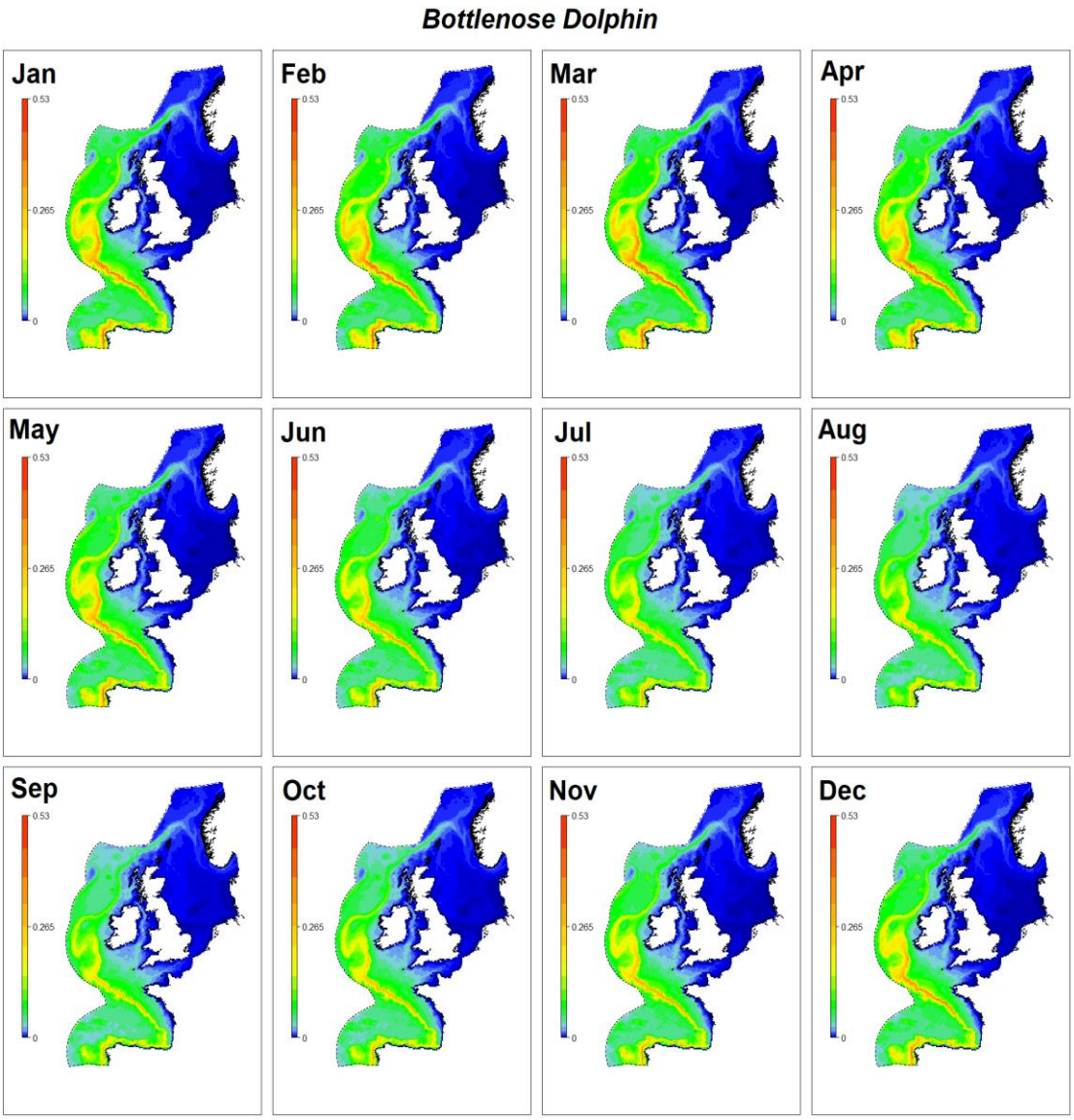

Figure 1.30: Predicted distributions for bottlenose dolphin per month (Waggitt *et al.*, 2020)

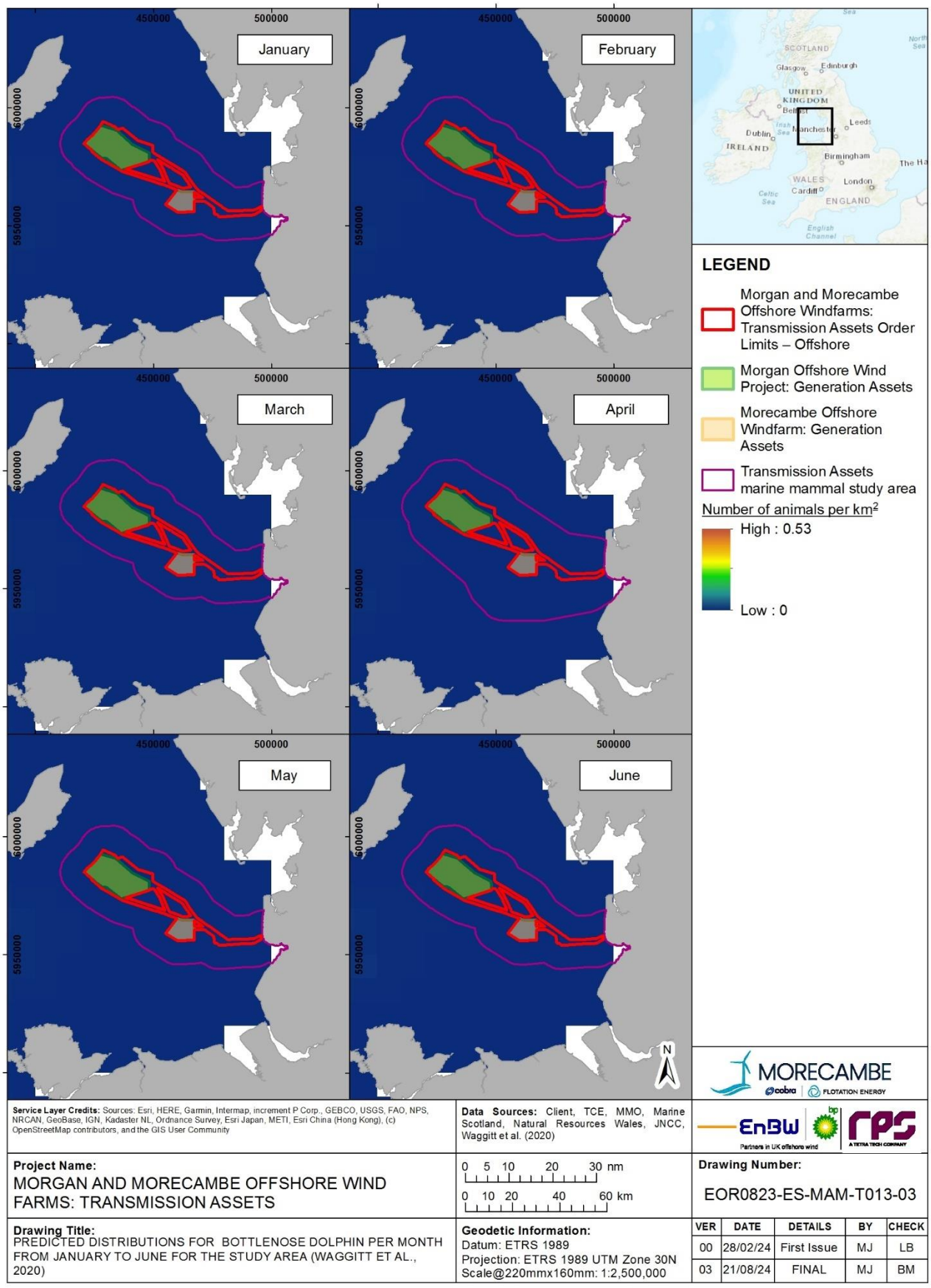

Figure 1.31: Predicted distributions for bottlenose dolphin per month from January to June for the study area (Waggitt *et al.,* 2020)

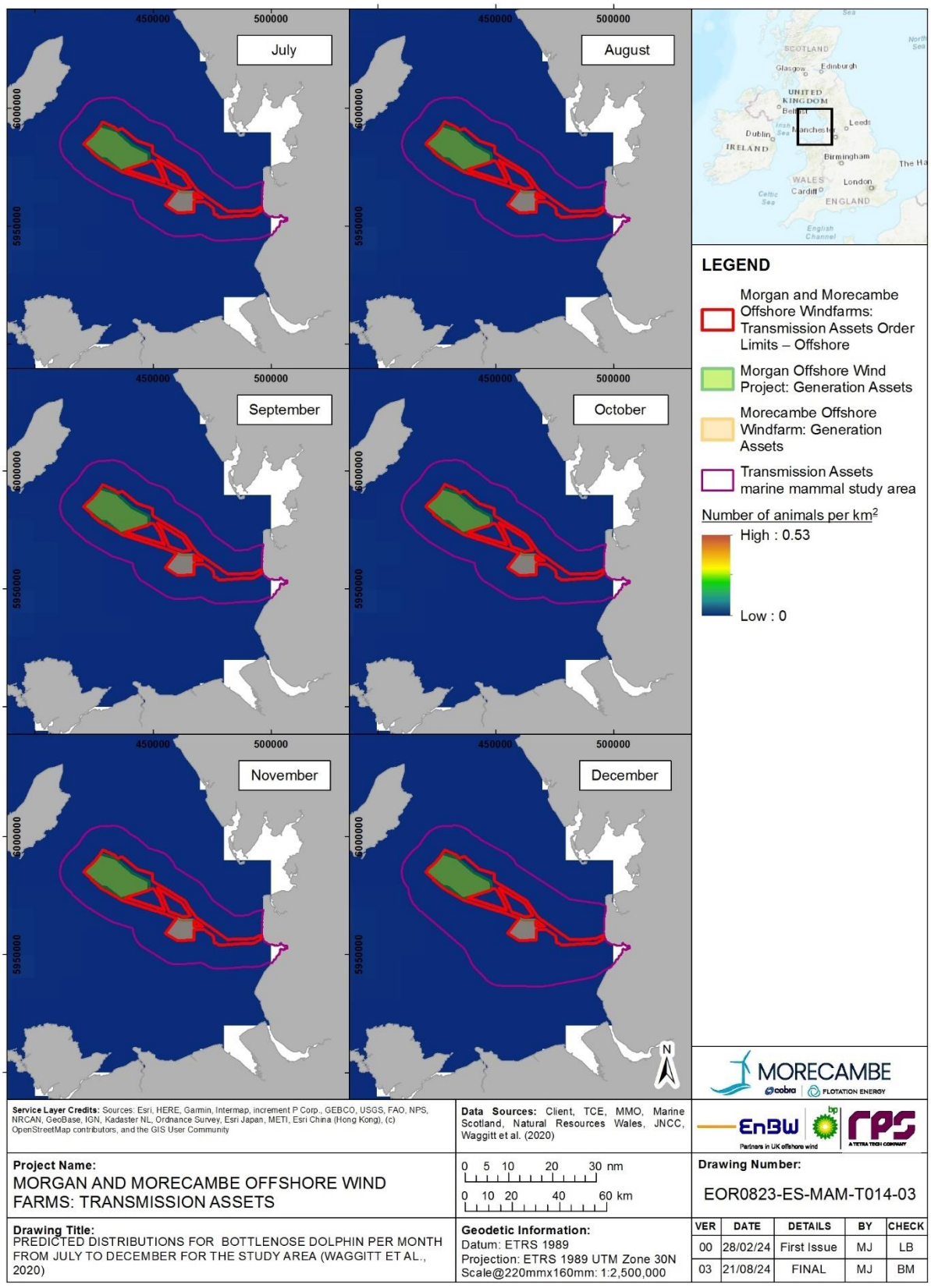

Figure 1.32: Predicted distributions for bottlenose dolphin per month from July to December for the study area (Waggitt *et al.*, 2020)

1.3.4.18 Several studies have targeted areas of high use, particularly in Cardigan Bay given a resident population exists in this area, but most give abundance estimates rather than densities. Baines *et al.* (2002) carried out boat line transect surveys across Cardigan Bay SAC from April to September 2001. The study gave estimates of 0.2607 animals per km^2 (CV = 0.237) for the inshore zone of the candidate SAC (now designated Cardigan Bay SAC), with density of animals per km^2 as 0.2483 (CV = 0.335) for May to July and 0.2932 (CV = 0.329) for August to September. Density from coastal and extra transects were also used and gave estimates of 0.2128 (CV = 0.3201) and 0.1120 (CV = 0.3582) respectively. It is noted only data from inshore transects have been used to calculate abundance, as no sightings were obtained from the offshore half of Cardigan Bay SAC.

1.3.4.19 More recently, Lohrengel *et al.* (2018) summarised distance sampling surveys carried out by SWF (between 2014 and 2016) in the Cardigan Bay SAC and the wider Cardigan Bay, to provide estimates of abundance for bottlenose dolphin. Densities for these areas have been calculated using this abundance data (Sinclair *et al.*, 2021). Within Cardigan Bay SAC, density estimates for the SAC have been given as 0.088 dolphins per km^2 (based upon abundance estimates of 85 dolphins in 2016, 95% CI = 44 to 160), and SAC area of 958.58 km^2. For the wider Cardigan Bay area (reported as 4,986.86 km^2), a density of 0.035 dolphins per km^2 has been given (based upon abundance estimates of 174 dolphins in 2016, 95% CI = 150 to 246 in closed population Capture, Mark and Recapture (CMR) model). This does, however, assume uniform density of animals throughout the areas and the study did not extend into North Wales, thus not covering the study area.

1.3.4.20 Though abundance estimates vary by sampling method (e.g. line transects, distance sampling, CMRs, closed/open population modelling), there remains a large inter-annual variance in abundance. Duckett (2018) reported that females recorded from North Wales were significantly more likely to move into Cardigan Bay in the year and year +1 of breeding, suggesting it is a favoured breeding/nursing area for bottlenose dolphin. This is corroborated by a higher peak of sightings in winter in Manx waters (Howe, 2018a) suggesting this is important winter habitat for the species, where animals move further offshore. Overall, whilst there has been a suggested decline over the last 10 years in Cardigan Bay (with design models indicating some permanent emigration from this area) (Lohrengel *et al*. 2018), abundance appears to be relatively stable in the IS MU (IAMMWG, 2022; Evans and Waggitt 2023). However much of this region has not been well surveyed for population trends and it may be difficult to determine an overall trend for the IS MU.

1.3.4.21 The regional study area includes the waters of the Isle of Man territorial sea and bottlenose dolphin have been reported in Manx Waters, particularly off the south west coast, mainly between August and March (Felce, 2014; 2015; Adams, 2017; Howe, 2018a). These studies in Manx waters have given count-rates or cetacean positive intervals but not abundances or densities.

1.3.4.22 Site-specific digital aerial surveys for the Morgan Offshore Wind Project: Generation Assets (**Appendix A**) did not record enough bottlenose dolphin in the area to carry out model-based density analyses.

1.3.4.23 Site-specific aerial surveys for Morecambe Offshore Windfarm: Generation Assets recorded two bottlenose dolphin within one month February 2023, although more animals were observed during separate geotechnical surveys during July, August and September 2023 (**Appendix B**). Therefore, there were not sufficient bottlenose dolphin sightings to establish site-specific densities.

Summary of densities

1.3.4.24 Overall, bottlenose dolphin are abundant in the Irish sea but there are known areas of high density in Cardigan Bay, to the south of the study area which may increase mean density estimates for the Irish Sea as a whole However, densities around the study area remain low. A comparison of bottlenose dolphin densities from key data sources which overlap the study area is shown in **Table 1.6**).

1.3.4.25 Predicted estimates of mean density for the study area from North East Atlantic Distribution Maps (Waggitt *et al.*, 2020) are very similar to those from the Welsh Marine Mammal Atlas (Evans and Waggitt, 2023), although Waggitt *et al.* (2020) represents the offshore ecotype of bottlenose dolphin. Estimates are lower than the SCANS-III block E estimate, however the SCANS-III density is for a large-scale block that includes the Cardigan Bay population. The Transmission Assets lies in SCANS-III block F, within which no bottlenose dolphins were recorded. SCANS-IV block CS-E in which the Transmission Assets lies, also demonstrated a higher density value, but (as highlighted in Lacey *et al.,* 2022) large scale line transect surveys (such as SCANS) are not designed to collect data at a sufficiently small spatial scale necessary to generate estimates of abundance for small coastal populations, such as the bottlenose dolphin population in the Irish Sea. The SCANS-III DSM density (Lacey *et al.,* 2022) for the Transmission Assets is higher than the Welsh Marine Mammal Atlas (Evans and Waggitt, 2023) but is a dataset based on UK-wide modelling of SCANS-III data, unlike the Welsh Marine Mammal Atlas which specifically accounts for the inshore ecotype of bottlenose dolphin in the Irish Sea MU.

1.3.4.26 Therefore, the density taken forward to the assessment is derived from the Welsh Marine Mammal Atlas (Evans and Waggitt, 2023, highlighted in bold in **Table 1.6**) (as recommended by Natural England) for the Offshore Order Limits, providing the most robust density estimate for the area.

Table 1.6: Comparison of main data sources densities and estimates of variation for bottlenose dolphin

Source	Density (animals per km^2)	Estimate of variation
SCANS-IV block CS-E (Gilles *et al.,* 2023)	0.011	0.700 (CV)
SCANS-IV block CS-D (Gilles *et al.,* 2023)	0.235	0.353 (CV)
SCANS-III DSM for the study area (Lacey *et al.* 2022)	0.016	0.005 to 0.050 (95% CIs)
SCANS-III block F (Hammond *et al.,* 2021)	N/A[b]	N/A[b]
SCANS-III block E (Hammond *et al.,* 2021)	0.008	0.573 (CV)
North East Atlantic Distribution Maps (Waggitt *et al.*, 2020) for the study area for August (peak month)	0.0011	0.0007 to 0.0016 (95% CIs)
Welsh Marine Mammal Atlas (Evans and Waggitt, 2023)[a] for the Offshore Order Limits from annual composite maps	**0.0012**	**0.0005 to 0.0026 (95% CIs)**
Welsh Marine Mammal Atlas (Evans and Waggitt, 2023) [a] for the study area from annual composite maps	0.0011	0.0005 to 0.0025 (95% CIs)

Density set out in **bold** = density identified to be taken forward to the assessment in Volume 2, Chapter 4: Marine mammals of the ES.

a. Welsh Marine Mammal Atlas data (Evans and Waggitt, 2023) are presented for both the Offshore Order Limits and the study area (Offshore Order Limits plus 10 to 14 km buffer).

b. No bottlenose dolphin were recorded within this SCANS block.

Abundance

1.3.4.27 On a widescale, IAMMWG (2022; 2023) estimated abundance for the Irish Sea MU (**Figure 1.33**) as 293 bottlenose dolphin (CV = 0.54, 95% CI = 108 to 793). SCANS-III gave abundance estimates of 288 animals (95% CI = 0 to 664) and mean group size of 1.50 (CV = 0.192) for block E, and no bottlenose dolphin were sighted within block F, in which the Transmission Assets lies. Abundance within the Irish Sea MU (IAMMWG, 2021), overall, appears stable, although much of the region has not been well surveyed for population trends.

1.3.4.28 Recent SCANS-IV surveys gave abundance estimates of 127 animals (95% CI = 3 to 353) and mean group size of 1.50 (CV = 0.333) for block CS-E in which the Transmission Assets lies. Adjacent block CS-D had a much higher abundance (than block CS-E and the equivalent SCANS-III block) of 8,199 animals (95% CI = 3,595 to 15,158) but this block extends towards the Celtic Sea, and therefore may include the more abundant offshore ecotype of bottlenose dolphin found in the Offshore Channel, Celtic Sea and South west England MU.

1.3.4.29 From the 3,065 sightings over all surveys included in the JCP Phase III dataset estimated predicted abundances in 2010 were given per season for the Irish Sea. Winter abundance for bottlenose dolphin was

10 animals, spring was 30 animals, summer was 30 animals and autumn had 10 animals (Paxton and Thomas, 2010).

1.3.4.30 During ObSERVE surveys, bottlenose dolphin were not observed in Strata 5 in summer 2015 or winter 2015/16, but in summer 2016 model-based estimates abundance was 118 animals (CV = 117.94, 95% CI = 0 to 1,129). No designed-based estimates were given for summer 2016 for Strata 5. For winter 2016/2017 designed based estimate abundance for Strata 5 is 401 animals (CV = 93.55, 95% CI = 76 to 2,105) whilst model-based estimates of abundance were 223 animals (CV = 82.55, 95% CI = 0 to 828).

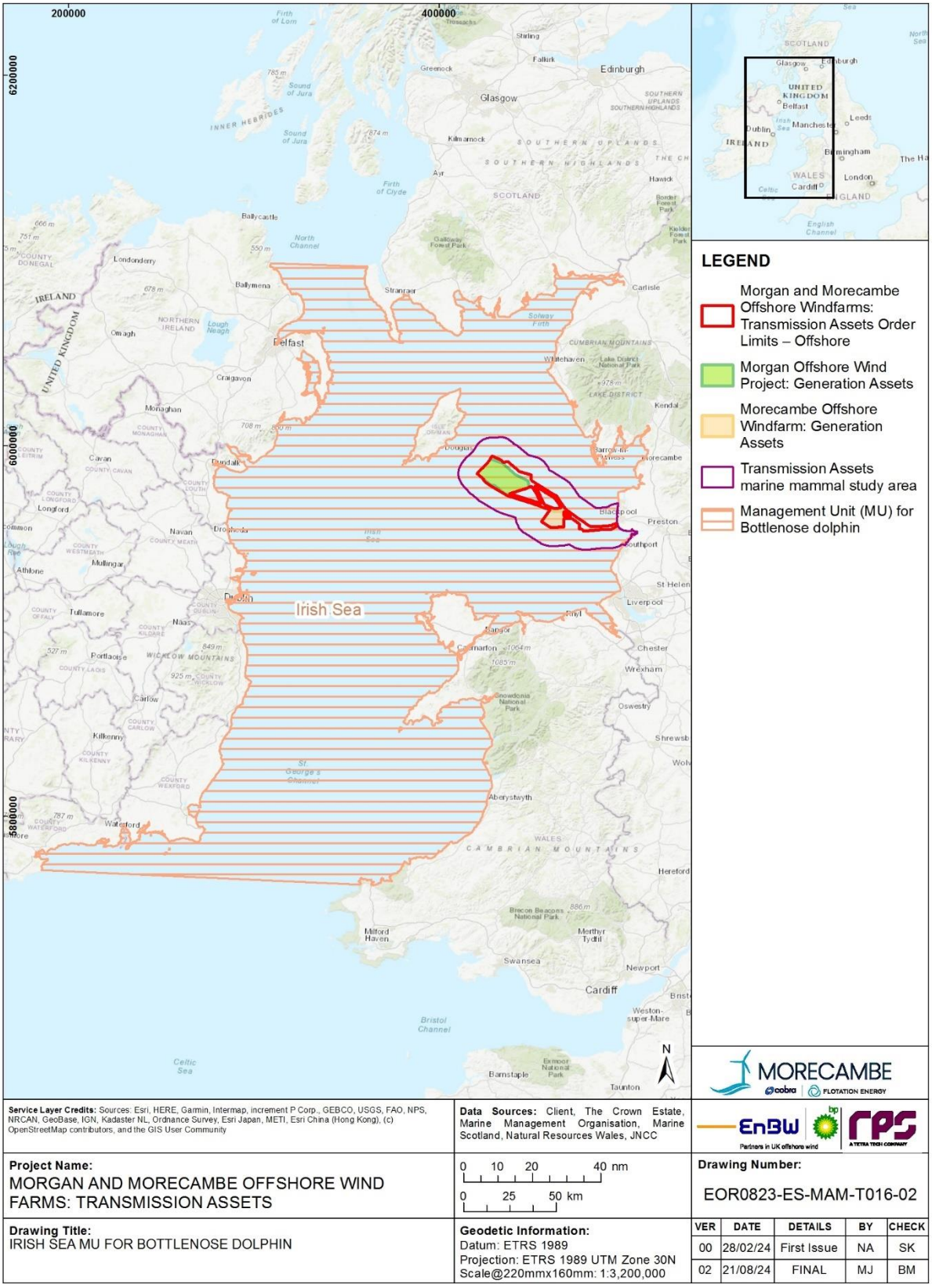

Figure 1.33: Irish Sea MU for bottlenose dolphin

Localised abundances

1.3.4.31 Several studies have targeted areas of high use, particularly in Cardigan Bay given a resident population exists in this area. There is variability in abundance estimates over the years.

1.3.4.32 Boat transects in Cardigan Bay SAC by Baines *et al.* (2002) gave estimates of 135 animals in Cardigan Bay SAC (CV = 0.237, 95% CI = 85 to 214), with 128 animals for May to July (CV = 0.3352, 95% CI = 67 to 245) and 152 from August to September (CV = 0.329, 95% CI = 80 to 287).

1.3.4.33 Subsequently, SWF carried out boat line transect surveys in Cardigan Bay SAC during April to October from 2005 to 2007 (Pesante *et al.* 2008). Abundance analyses provided estimates of 154 bottlenose dolphin for 2005, 206 dolphins for 2006 and 109 dolphins for 2007 for Cardigan Bay SAC and demonstrated an increase in the population size for the bottlenose dolphin compared to previous estimates for the period 2003 to 2004 (140 dolphins). The study also carried out photoidentification wherever possible, with an average of 58% of the population marked and as such the overall estimate for Cardigan Bay in any one year was therefore 133 animals in 2005, 179 in 2006, and 198 in 2007, but 328 when considering the entire 2001 to 2007 period. Two other models were also used. The closed population model using the period from 2001 to 2007 gave abundance estimates of between 121 and 210 bottlenose dolphins using the Cardigan Bay SAC in any one year, and 379 over the whole period, whilst the open population model (which considered the entire Cardigan Bay) estimated between 154 and 248 animals in each year. All three approaches indicate that it is the largest coastal bottlenose dolphin population in the British Isles (Pesante *et al.,* 2008).

1.3.4.34 Later in 2011, research was carried out by SWF to provide preliminary information on the condition of bottlenose dolphin and harbour porpoise in both the Cardigan Bay and Pen Llŷn a'r Sarnau SACs (Veneruso and Evans, 2012). The abundance estimate for the whole of Cardigan Bay was 296 animals (95% CI = 170 to 518, CV = 28.82) from line transect surveys.

1.3.4.35 Further studies by Feingold and Evans (2014) in Cardigan Bay between 2011 and 2013 recorded a total of 295 bottlenose dolphin, with 128 bottlenose dolphin recorded in line-transect mode. Abundance estimates varied between years, with 309 in 2011 (95% CI = 179 to 353, CV 28.34), 330 in 2012 (95% CI = 203 to 534, CV = 24.87) and 254 individuals in 2013 (95% CI = 151 to 427, CV = 26.83).

1.3.4.36 More recently, Lohrengel *et al.* (2018) summarised distance sampling surveys between 2014 and 2016 in Cardigan Bay and gave an estimate of 64 individuals (95% CI = 19 to 220; CV = 0.65) in 2015 and 84 (95% CI = 44 to 160; CV = 0.33) in 2016 for Cardigan Bay SAC; and for the wider Cardigan Bay, 277 (95% CI = 138 to 555; CV = 0.36) in 2015 and 289 (95% CI = 184 to 453; CV = 0.23) in 2016 based on distance sampling. CMR analysis using a closed population gave higher estimates up to 147 (95% CI = 127 to194; CV = 0.29) in 2016 for

Cardigan Bay SAC, but lower estimates for the wider Cardigan Bay, with the highest estimate of 206 (95% CI = 171 to 278; CV = 0.28) occurring in 2015.

1.3.4.37 The Mona Offshore Wind Project (Mona Offshore Wind Ltd, 2024) reported aerial surveys recorded maximum raw counts of six bottlenose dolphin in the Mona Aerial Survey Area (June 2021), which gave maximum abundance estimates of 29 bottlenose dolphins for the Mona Aerial Survey Area in June 2021.

1.3.4.38 Aerial surveys presented in the Morgan Offshore Wind Project: Generation Assets Marine Mammal Technical Report (**Appendix A**) recorded maximum raw counts of nine bottlenose dolphin in the Morgan Aerial Survey Area (June 2021), which gave maximum abundance estimates of 71 bottlenose dolphin for the Morgan Aerial Survey Area in June 2021.

1.3.4.39 As reported in the Morgan Offshore Wind Project: Generation Assets Marine Mammal Technical Report (**Appendix A**), during integrated surveys detailed in the MMOb and PAM Report, there were eight visual sightings of bottlenose dolphin from April 2022 to May 2022 across the combined Morgan Offshore Wind Project: Generation Assets and Mona Offshore Wind Project (Mona Offshore Wind Ltd., 2023) surveys.

1.3.4.40 Site-specific aerial surveys for Morecambe Offshore Windfarm: Generation Assets recorded two bottlenose dolphin within a single month (February 2023) of the 24 months of survey but there were not sufficient sightings numbers to determine abundance estimates (**Appendix B**).

1.3.4.41 The abundance estimate taken forward to assessment of effects is the IS MU estimate of 293 animals (IAMMWG, 2023; 2022) presented in **paragraph 1.3.4.27** (and presented in summary **Table 1.15**).

Seasonality

1.3.4.42 Marked seasonal trends are evident in bottlenose dolphin distribution in Cardigan Bay, with high coastal sighting rates in the summer and autumn and low rates in late winter and early spring (Baines and Evans, 2012). Winter aerial surveys and Timing Porpoise Detector (T-POD) acoustic data from coastal sites around Cardigan Bay showed a strong seasonal peak in summer, and there was a significant increase in the overall number of individuals that were encountered and identified in the summer months when compared to the winter (Duckett *et al.*, 2018). There is some suggestion of dispersal into the Irish Sea during winter, with a northward shift in distribution (Pesante *et al.*, 2008). It has been proposed at least a third of the Cardigan Bay population move into north Wales and Manx waters (Pesante and Evans, 2008).

1.3.4.43 In Manx waters, bottlenose dolphin show a very clear temporal pattern, with 73% of sightings being reported between October and March (Howe, 2018a), with a winter peak unusual for cetacean species in temperate waters in Europe. This opposite temporal regime of sightings of bottlenose dolphin in Manx waters compared to Cardigan Bay may suggest that Manx waters may provide vital winter habitat whilst

Cardigan Bay is important for calving during summer months. MWDW data (**Figure 1.11**) shows a general pattern of higher bottlenose dolphin sightings in winter months than summer months. As detailed in **paragraph 1.3.3.48**, MWDW confirmed that sightings data reflects a true seasonality of these cetaceans in Manx waters and that lower winter survey effort has not created a false seasonality (MWDW, personal communication, June 2023).

1.3.4.44 This seasonal pattern was also detected in the ObSERVE surveys (Rogan *et al.*, 2018) where sightings of bottlenose dolphin were higher during winter in Stratum 5 (the west Irish sea). SWF also suggested that there may also be some range shift towards the north in response to increased pressure from boat traffic in Cardigan Bay (Howe, 2018). Calves have been observed most months of the year, but particularly between April and October (Berrow *et al.*, 2010). Cardigan Bay has been suggested as a preferable calving area, and between 13 and 20 bottlenose calves have been recorded annually between 2005 and 2007 within the SAC (Pesante *et al.*, 2008).

1.3.5 Short-beaked common dolphin

Ecology

1.3.5.1 The short-beaked common dolphin is a member of the Delphinidae family, which are oceanic dolphin found in temperate and tropical waters worldwide. It is widely distributed throughout Europe, and in particular around the UK it is common in the west approaches to the Channel and the south Irish Sea (particularly around the Celtic Deep) and around the Inner Hebrides north to Skye (SWF, 2012a). It is one of the smallest true dolphins, measuring between 2.1 to 2.4 metres in length and weighing between 75 and 85 kg, with a long slender body with tall pointed dorsal fin. Short-beaked common dolphins can live to between 30 to 35 years. It has a distinctive pattern on its flanks, with tan or yellowish patch before the dorsal fin, and pale grey behind. It is a very agile active dolphin capable of great speeds and is often found in large active schools. Common dolphin are found in a wide range of group sizes from small schools to large concentrations of 1,000 to 5,000 individuals but the average group size reported in Reid *et al.* (2003) was 14 individuals. In offshore waters south west of the UK, they occasionally form mixed schools with striped dolphin. School size increases in mid-summer and mid-winter, possibly linked to the dolphins following prey moving inshore.

1.3.5.2 Common dolphin appears to have two calving peaks (spring and autumn) with a gestation period of 10 to 11 months. Calves are 80 to 90 cm long at birth (SWF, 2012a). They are weaned at 19 months, and the mother has a resting period of about four months before her next pregnancy so that calving intervals are generally two or three years or more. Males become sexually mature between five to seven years of age, and females at around six years (SWF, 2012a).

1.3.5.3 They are mainly opportunistic feeders and have a varied diet which often consists of small schooling fish (e.g. cod, hake, mackerel, sardine,

pilchard, horse mackerel, scad, sprat, sand eel, herring, whiting and blue whiting, as well as squid). However, the type of food taken depends on local availability, with small pelagic schooling fishes and squids likely to be the main food items in the Irish Sea (Hammond *et al.,* 2005a). The species often uses co-operative feeding techniques to herd schools of fish, panicking the fish through frenzied activity and taking them in the confusion, which is known as 'bait-balling'.

Distribution and occurrence

1.3.5.4 The common dolphin has a worldwide distribution and inhabits both oceanic and shelf-edge waters of tropical, subtropical and temperate seas of the Atlantic and Indo-Pacific. The majority of sightings having been reported in waters south of 60 °N (Murphy *et al.,* 2013), but analysis of summer sightings on shelf waters around the UK and adjacent waters showed the vast majority of common dolphin to occur in waters above 14 °C in temperature (MacLeod *et al.,* 2008, Cañadas *et al.*,2009). Strong seasonal shifts in their distribution have been observed, including winter inshore movements onto the Celtic Shelf (Northridge *et al.,* 2004). During Celtic Sea herring surveys off the south coast of Ireland in October they were the most frequently incidentally sighted cetacean (O'Donnell *et al.* 2017, 2018). The ObSERVE aerial surveys of Irish waters showed common dolphin to be widely distributed in shelf waters off the south and west coasts of Ireland, with higher numbers observed in winter (Rogan *et al.,* 2018). The species has been observed further north and east in shelf seas in recent years, reflecting changes in the strength of the Gulf Stream. Sighting data from MWDW (**Figure 1.11**) shows short-beaked common dolphin are widespread in Manx waters around the Isle of Man, extending out towards the study area.

1.3.5.5 During the summer (May to September), the majority of sightings are more widely dispersed along and off the continental shelf slope and in deep waters to the south west of the UK (Murphy *et al.,* 2005; Murphy *et al*.,2008), off the west coast of Ireland and to the west and north west of Scotland. This likely coincides with the mating and calving period.

Density/abundance

Density

1.3.5.6 SCANS-III is a key baseline dataset, and the study area lies within block F for the SCANS-III surveys, but no common dolphin were sighted within the entire Irish Sea (Hammond *et al.,* 2021). Predicted density values using SCANS-III data was presented in the Offshore Energy Strategic Environmental Assessment (SEA) 4: Appendix 1 Environmental Baseline (BEIS, 2022) and showed common dolphin densities were low (0 to 0.07 animals per km^2) in the Irish sea but increased towards the Celtic Sea **(Figure 1.34)**. In the absence of SCANS-III sightings in the Irish Sea, the SCANS-II density for block O was 0.018 animals per km^2 (CV = 0.78).

1.3.5.7 More recently, SCANS-III DSM (Lacey *et al.* 2022) (see **paragraph 1.2.4.43**) gave mean densities of 0.004 animals per km^2 for the study area (**Figure 1.35**) with low densities across the east Irish Sea.

1.3.5.8 Prior to the SCANS-surveys, wide-scale historical data collating heterogenous data from 1990 to 2009 in the Atlas of the Marine Mammals of Wales (Baines and Evans, 2012) confirms regular sightings of short-beaked common dolphin across the Irish Sea study area. The Atlas of the Distribution and Relative Abundance of Marine Mammals in Irish Offshore Waters also confirmed common dolphin were recorded in all months of the year (Wall, 2013), with high densities in the south approaches to the Irish Sea in the spring and summer.

1.3.5.9 Recent SCANS-IV data did not report any short-beaked common dolphin in block CS-E (in which the Transmission Assets lies) but reported a density of 0.027 animals per km^2 (CV = 0.814) in adjacent block CS-D (Gilles *et al.*, 2023).

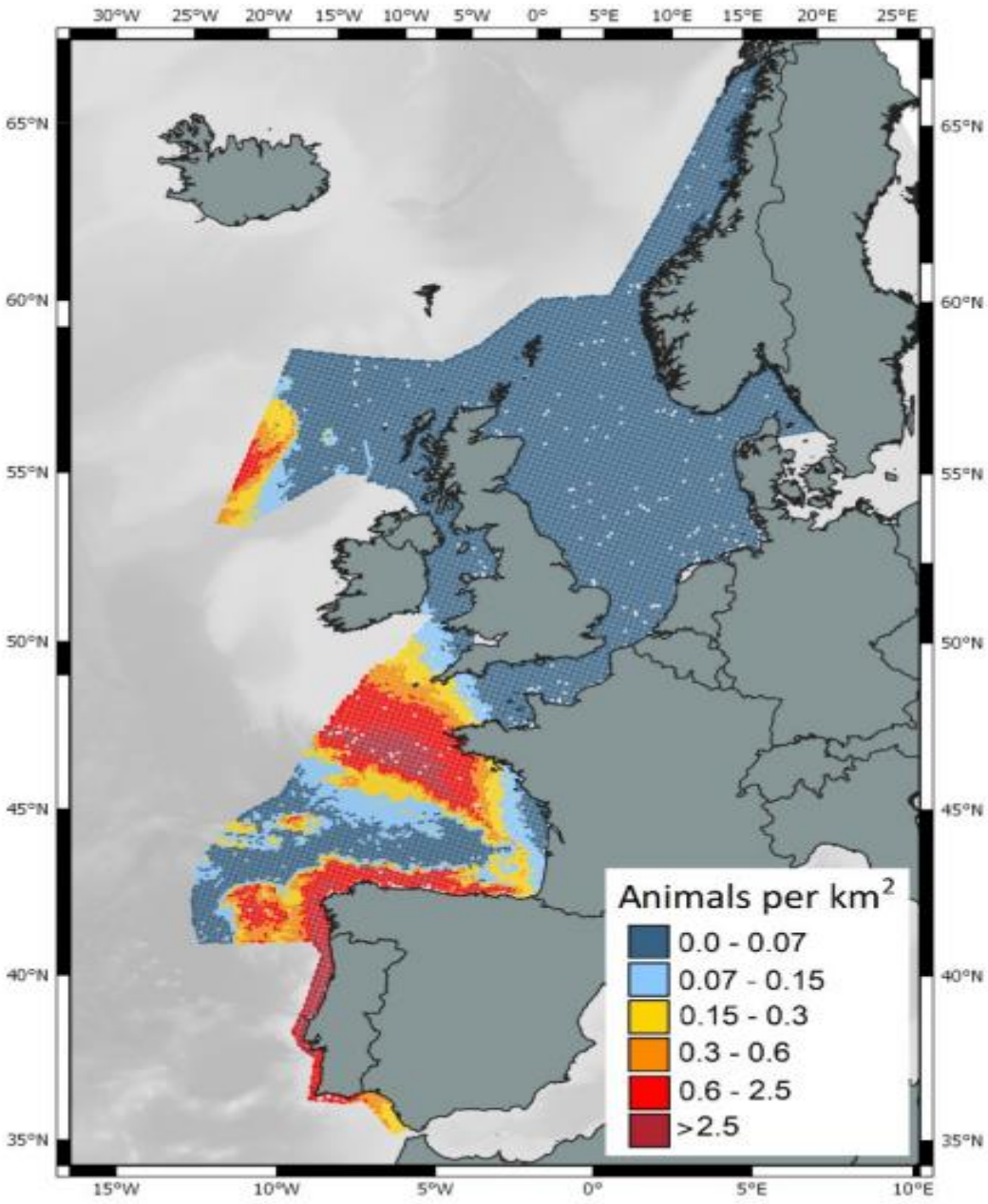

Figure 1.34: Density predictions for short-beaked common dolphin based on the observed distributions and their relationships with habitat variables (longitude and latitude, plus distance from coast, depth or aspect of seabed slope if selected) (BEIS, 2022)

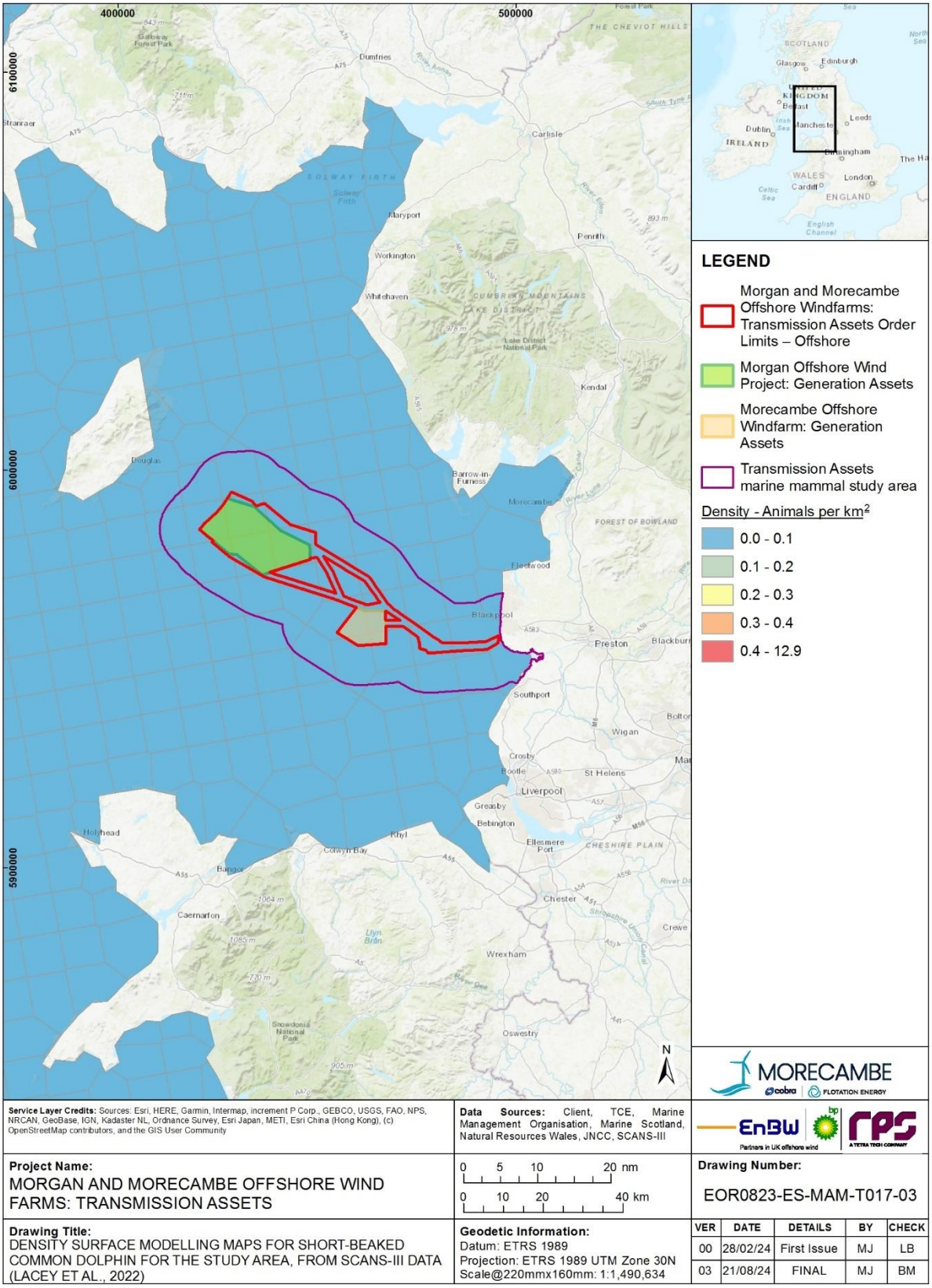

Figure 1.35: Density surface modelling maps for short-beaked common dolphin for the study area, from SCANS-III data (Lacey *et al.,* 2022)

1.3.5.10 JCP Phase III data from surveys collected between 1994 to 2010 were used to model surface densities of common dolphin. JCP Phase III density surface modelling gave mean densities of 0.117 (Standard Errors = 0.009) animals per km^2 across the entire region of interest (UK waters and North Sea), but highest densities in the south west of the prediction area, to the west of Ireland and the Hebrides (Paxton *et al*., 2016). In the Irish Sea, mean predicted densities were 0.5 animals per km^2 for all three time periods (Paxton *et al.*, 2016). Areas of higher density were predicted for the Celtic Deep, to the south of the regional study area. Much lower densities of approximately 0.05 animals per km^2 were estimated for the east Irish Sea (Paxton *et al.*¸ 2016). This study builds upon the original JCP Phase One Data Analysis (Paxton and Thomas, 2010), which predicted density surfaces for short-beaked common dolphin from data from 1980 to 2009.

1.3.5.11 The North East Atlantic Distribution Maps from Waggitt *et al.* (2020) showed low densities all year round in the Irish Sea, particularly the east Irish Sea, but densities were higher from May to October (**Figure 1.36**). **Figure 1.38** and **Figure 1.38** demonstrate the predicted monthly densities for common dolphin for the study area and demonstrates how areas of higher densities during summer months from July to September exist to the west of the study area. This is similar to patterns observed in Wall (2013) and Baines and Evans (2012). Highest densities in the east Irish Sea are predicted in August with 0.339 animals per km^2 in high density areas. Within the study area, short-beaked common dolphin densities were comparatively lower (**Figure 1.38**) at 0.047 animals per km^2, or August.

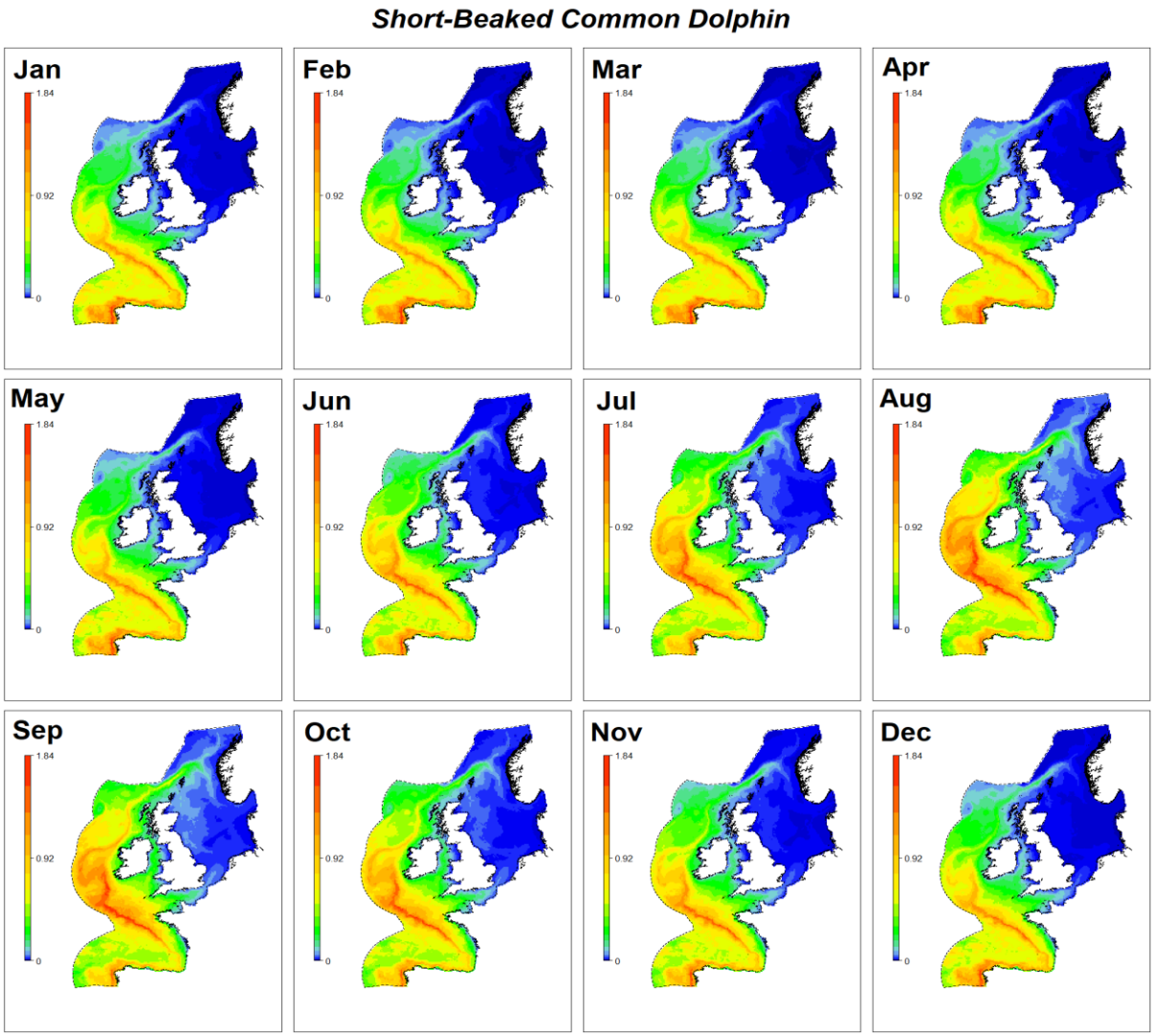

Figure 1.36: Predicted distributions for short-beaked common dolphin per month (Waggitt *et al.,* 2020)

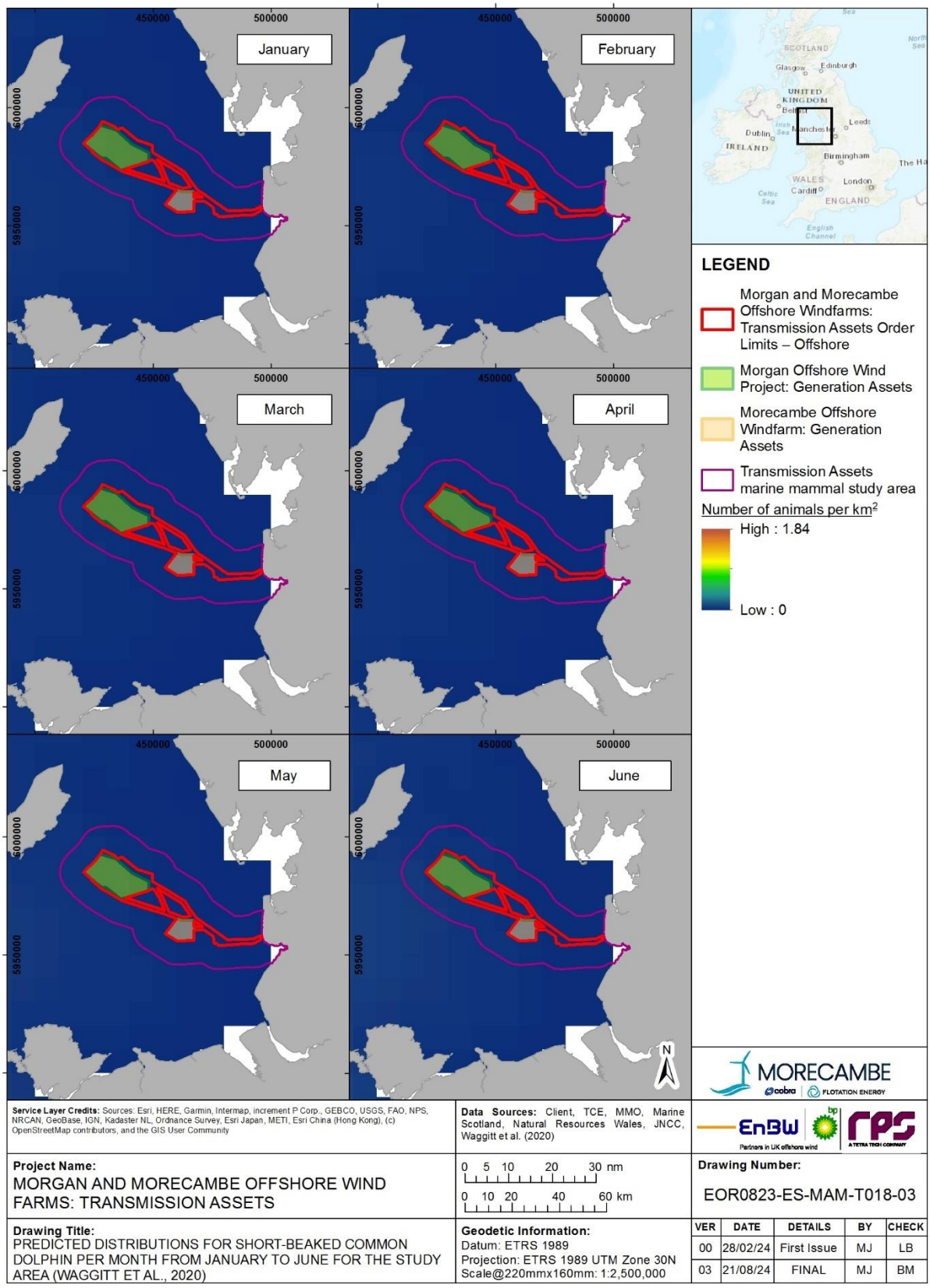

Figure 1.37: Predicted distributions for short-beaked common dolphin per month from January to June for the study area (Waggitt *et al.*, 2020)

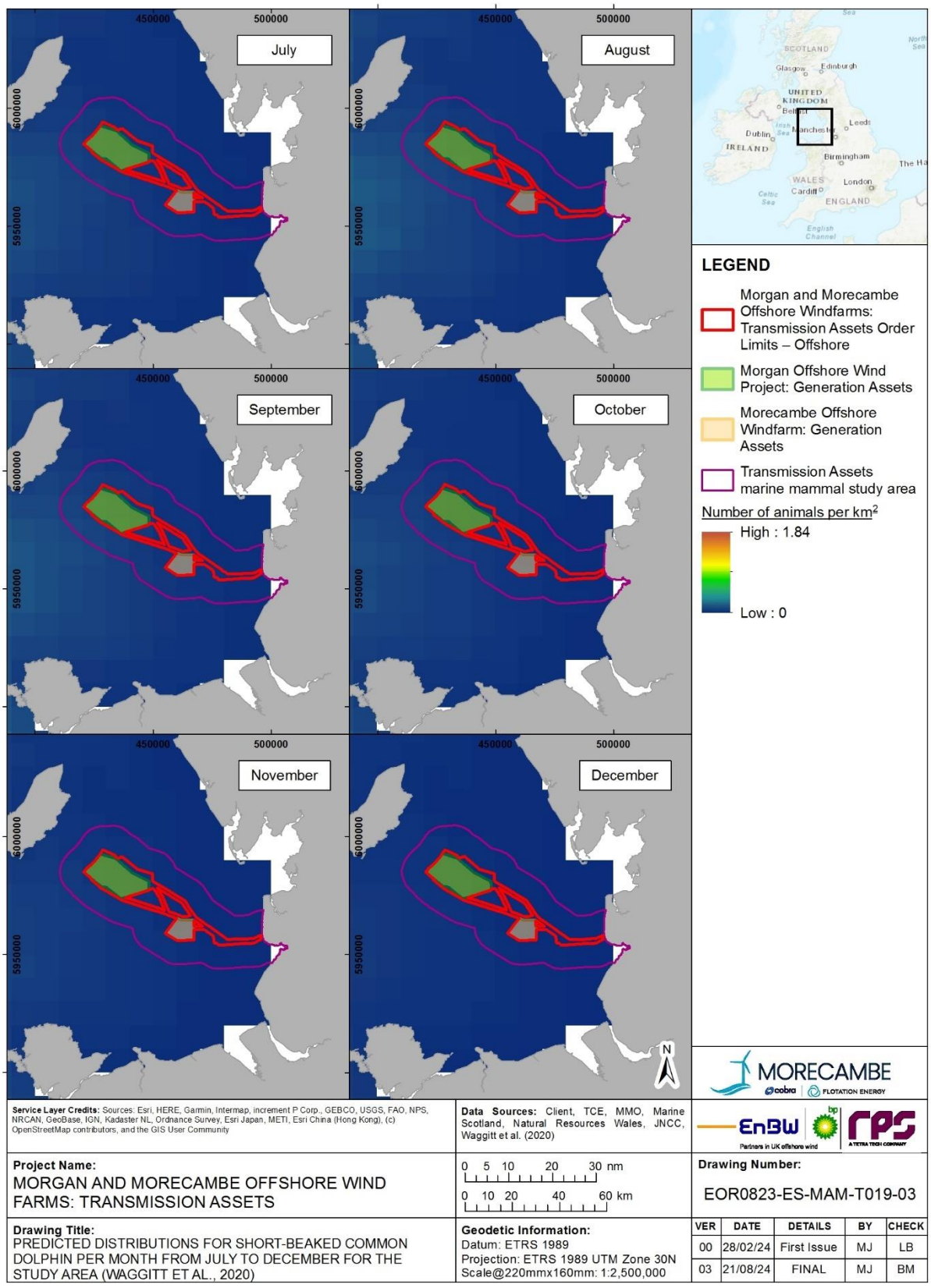

Figure 1.38: Predicted distributions for short-beaked common dolphin per month from July to December for the study area (Waggitt *et al.,* 2020)

1.3.5.12 Modelled outputs from the Welsh Marine Mammal Atlas (Evans and Waggitt, 2023) indicated short-beaked common dolphin are most abundant in the Celtic Deep within St. George's Channel but their distribution does extend northwards in deeper waters through the middle of the Irish Sea. Large groups have only been recorded in areas deeper than 50 m in the Irish Sea, though smaller group or individual sightings have occurred in the Bristol Channel, off the North Wales Coast and around the Isle of Man. The study does caveat that density maps for short-beaked common dolphin need careful interpretation because survey effort is patchy and greater in the south Irish Sea than elsewhere and, although modelled density maps aim to overcome this bias, there may be greater uncertainty. Numbers are greatest in summer although the species is recorded in all months of the year and may be under-recorded in winter when offshore survey effort is much lower. Animals in this area move up and down the shelf edge and are believed to be part of the same wide north east Atlantic population (Murphy *et al.*, 2021).

1.3.5.13 The average density for both the study area, and the Offshore Order Limits, from the annual composite maps was 0.00025 animals per km^2 (**Figure 1.39**). As set out in **paragraph 1.2.4.66** these density estimates are precautionary as this is the highest value observed for each cell (2.5 km^2 resolution) at any one point in time.

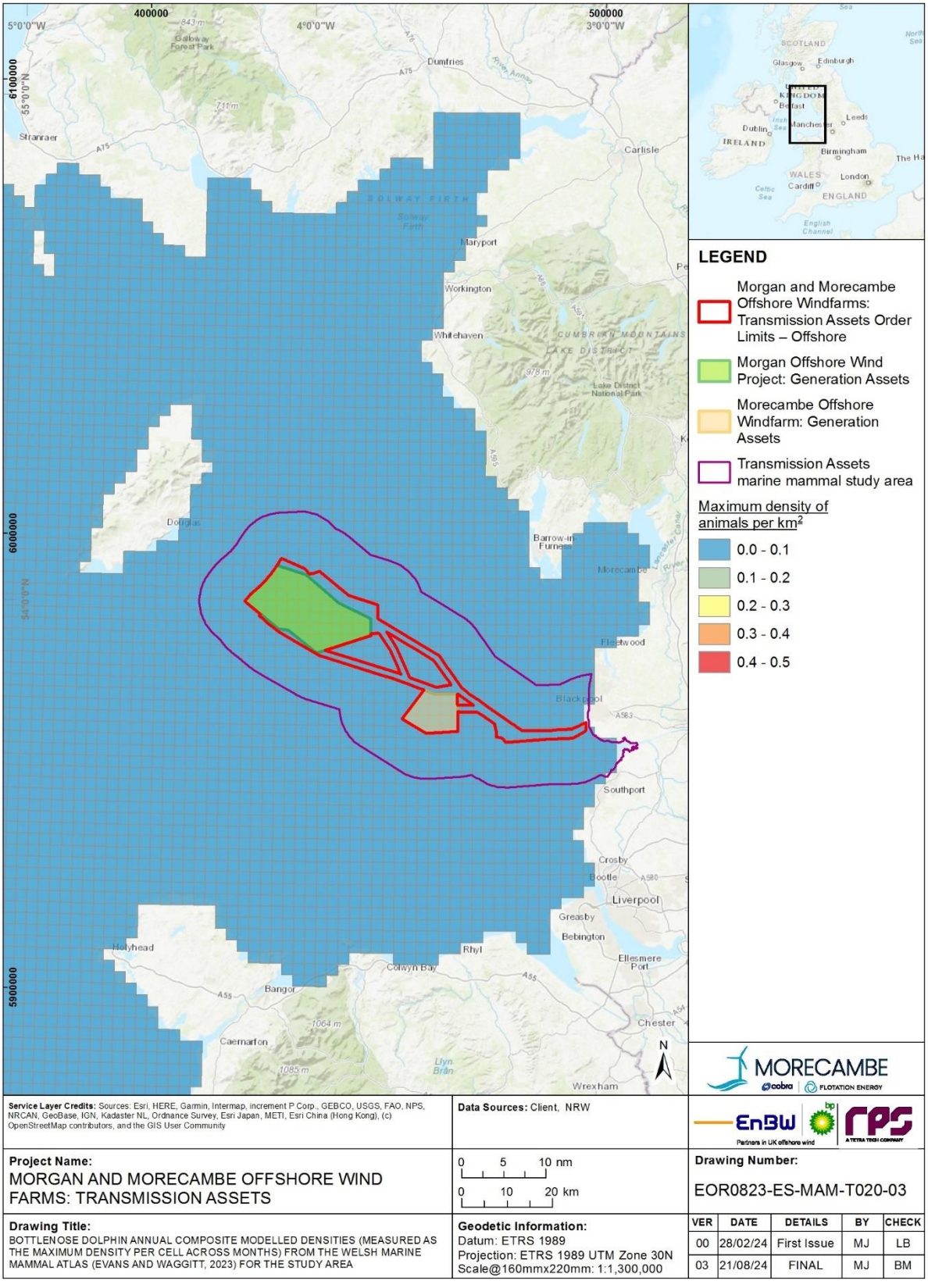

Figure 1.39: Short-beaked common dolphin annual composite modelled densities (measured as the maximum density per cell across months) from the Welsh Marine Mammal Atlas (Evans and Waggitt, 2023) for the study area

1.3.5.14 No short-beaked common dolphins were recorded in 24 months of survey for the Morgan Offshore Wind Project: Generation Assets (April 2021 to March 2023) (**Appendix A**).

1.3.5.15 Site-specific aerial surveys for the Morecambe Offshore Windfarm: Generation Assets (**Appendix B**) recorded 32 short-beaked common dolphin within a single month of 24 months of survey (August 2022) but there were not sufficient sightings numbers to determine density estimates.

Summary of densities

1.3.5.16 Overall, short-beaked common dolphin are abundant in the Irish sea but areas of high density appear to be found in the south Irish Sea, around the Celtic deep and these high values can thus drive up mean density for the Irish Sea region. However, in the east Irish Sea, where the study area is located, the densities have been consistently lower. A summary of key densities is presented in **Table 1.7**.

1.3.5.17 The density taken forward to assessment is from the most recent Welsh Marine Mammal Atlas data specific to the Irish Sea region (Evans and Waggitt, 2023) (as recommended by Natural England) for the study area. This was considered to be the most representative density for the region, when compared to the older SCANS II data (Hammond *et al.,* 2006) and broad scale block estimates from an adjacent SCANS-IV block (CS-D) (Gilles *et al.,* 2023).

Table 1.7: Comparison of main data sources densities and estimates of variation for short-beaked common dolphin

Source	Density (animals per km^2)	Estimate of variation
SCANS-IV block CS-E (Gilles *et al.,* 2023)	N/A[b]	N/A[b]
SCANS-IV block CS-D (Gilles *et al.,* 2023)	0.027	0.814 (CV)
SCANS-III DSM for the study area (Lacey *et al.* 2022)	0.004	0.001 to 0.026 (95% CIs)
SCANS-III block F (Hammond *et al.,* 2021)	N/A[b]	N/A[b]
SCANS-III block E (Hammond *et al.,* 2021)	N/A[b]	N/A[b]
SCANS-II block O (Hammond *et al.*, 2013)	0.018	0.78
North East Atlantic Distribution Maps (Waggitt *et al.*, 2020) for the study area for August (peak month)	0.047	0.042 to 0.052 (95% CIs)
Welsh Marine Mammal Atlas (Evans and Waggitt, 2023)[a] for the Offshore Order Limits from annual composite maps	**0.00025**	**0.0001 to 0.0005 (95% CIs)**
Welsh Marine Mammal Atlas (Evans and Waggitt, 2023) for the study area from annual composite maps	0.00025	0.0001 to 0.0005 (95% CIs)

Density set out in **bold** = density identified to be taken forward to the assessment in Volume 2, Chapter 4: Marine mammals of the ES.

a. Welsh Marine Mammal Atlas data (Evans and Waggitt, 2023) are presented for both the Offshore Order Limits and the study area (Offshore Order Limits plus 10 to 14 km buffer).

b. No short-beaked common dolphin were recorded within this SCANS block.

Abundance

1.3.5.18 Broad scale estimates of abundance for short-beaked common dolphin exist, with IAMMWG (2023; 2022) estimating abundance for the CGNS MU as 102,656 (CV = 0.29, 95% CI = 58,932 to 178,822) common dolphin.

1.3.5.19 There was no abundance available for block CS-E of recent SCANS-IV surveys, in which the Transmission Assets lies. For the adjacent block, block CS-D, an abundance estimate of 949 animals (95% CI = 32 to 2,990) was given.

1.3.5.20 For the Irish Sea in particular, JCP Phase III analysis (Paxton *et al.* 2016) gave estimated predicted abundances in 2010 per season, with winter abundance for short-beaked common dolphin was 10 animals (95% CI = 0 to 50), spring was 50 animals (95% CI = 20 to 160), summer was 80 animals (95% CI = 30 to 260), and autumn had 310 animals (95% CI = 110 to 860). Summer and autumn therefore had the highest abundances.

1.3.5.21 During ObSERVE surveys (Rogan *et al.*, 2018), short-beaked common dolphin were seen in neritic waters, predominantly to the south and west of Ireland, but no sightings were recorded in the Strata 5 (West Irish Sea) area.

1.3.5.22 In surveys for Rhiannon Wind Farm (Celtic Array Ltd., 2014), a single sighting of eight short-beaked common dolphin was recorded during the boat-based visual surveys. Insufficient sightings of common dolphins were made during the boat-based surveys to generate a site-specific abundance estimate.

1.3.5.23 Data from the MWDW (**Figure 1.11**) confirms short-beaked common dolphin have been regularly observed in Manx waters (Howe, 2018) with data on sightings and observation counts, but abundance and density estimates are not given.

1.3.5.24 Site-specific aerial surveys for Morecambe Offshore Windfarm: Generation Assets recorded 32 short-beaked common dolphin within a single month of the surveys (in February (1) 2023) but it was not possible to determine the species abundance estimate (**Appendix B**).

1.3.5.25 The abundance estimate taken forward to assessment of effects is the CGNS (IAMMWG, 2023; 2022) estimate given in **paragraph 1.3.5.18** (and presented in **Table 1.15**).

Seasonality

1.3.5.26 Analysis of summer sightings on shelf waters around the UK and adjacent waters showed the vast majority of short-beaked common dolphin to occur in waters above 14°C in temperature (MacLeod *et al.,* 2008, Cañadas *et al.,* 2009), and therefore there may be seasonal

patterns depending on water temperature. The species moves onto continental shelf waters in the summer and then back offshore in the winter (Evans *et al.,* 2003). During the summer, coinciding with the mating/calving period (May to September), the majority of sightings are more widely dispersed along and off the continental shelf slope and in deep waters to the south west of the UK (BEIS, 2022), off the west coast of Ireland and to the west and north west of Scotland. There is evidence of strong seasonal shifts in short-beaked common dolphin around the UK, with winter inshore movements onto the Celtic Shelf and into the west English Channel and St. George's Channel resulting in pronounced concentrations (Northridge *et al.,* 2004). Waggitt *et al.* (2020) predicted low short-beaked common dolphin densities present all year round, but densities were higher in summer. MWDW data also shows higher sighting rates in July and August than other times of the year, but sightings were observed year-round in Manx waters (**Figure 1.11**). Howe (2018a) states the temporal distribution of short-beaked common dolphin in Manx waters matches that of short-beaked common dolphin throughout the UK, being seen mainly between May and September.

1.3.6 Risso's dolphin

Ecology

1.3.6.1 Risso's dolphin are oceanic dolphin widely distributed in tropical and temperate seas, and the only member of their genus. They tend to inhabit deeper water, which is home to their preferred prey of squid, octopus and cuttlefish but can occasionally be seen in coastal areas, and in the UK, they appear to prefer shallower waters of 50 to 100 m (Evans *et al.*, 2003). The majority of Risso's dolphin sightings in UK waters have been reported around the Hebrides, the Celtic Sea, west English Channel and the Irish Sea. The species is uncommon but regularly sighted in the south Irish Sea, particularly off the north west and south west coast of Wales and around the Isle of Man (Evans *et al.*, 2003).

1.3.6.2 They have robust, stocky bodies with a tall sickle-shaped dorsal fin, no prominent beak and a distinctive blunt melon with a v-shaped crease running from the upper lip to the blowhole. They have narrow tail stocks with median notch and concave trailing edge (Evans, 2008a). Calves are born grey but turn darker grey to dark brown as they become juveniles. As they age, they become more silvery-grey, and the body is often covered in scars by other Risso's or prey species (squid). Adult Risso's dolphin measure between 2.6 to 3.7 metres in length, and the average lifespan is between 20 to 30 years. Sexual maturity occurs between eight to 10 years for females and 10 to 12 years for males, with a gestation lasting 13 to 14 months and calving interval at 2.4 years (Baird, 2009). Adults can weigh up to 500 kg.

1.3.6.3 They are typically encountered in groups of up to 20 individuals, but may form larger aggregations, including mixed schools with bottlenose dolphin (Reid *et al.* 2003). In the North Atlantic, Risso's dolphin have

occasionally been observed in association with other cetaceans, including long-finned pilot whale, white-beaked dolphin, white-sided dolphin and bottlenose dolphin (Reid *et al.* 2003), and several suspected Risso's-bottlenose dolphin hybrid individuals have been sighted off west Scotland (Hodgins *et al.,* 2014). Association patterns and social units vary between age classes (Hartman *et al.,* 2008). Adult males in particular show very strong associations and cooperation, whereas females may adapt patterns of association towards defending calves. Risso's may also have pair only or no associations, particularly juveniles (Hartman *et al.,* 2008).

1.3.6.4 Risso's dolphin are known to be almost exclusively teuthophagic, meaning they feed primarily on squid (both neritic and oceanic species) and octopus within the UK, although they also eat cuttlefish and various fish species. Limited behavioural research suggests that they feed primarily at night (Soldevilla *et al.*, 2010). Stomach contents analysis of five Risso's dolphin from UK waters found that the primary prey species was the curled octopus *Eledone cirrhosa*, followed by the cuttlefish *Sepia officinalis*, the veined squid *Loligo forbesi* and the flying squid *Todarodes sagittatus* (Clark and Pascoe, 1985; Santos *et al.*, 1994). There does appear to be regional variations in dietary preferences (Evans, 2013), and there have also been large seasonal variations in prey type observed (Bloch *et al.*, 2012) and resource partitioning between subgroups (Würtz *et al.*, 1992). SWF have observed them travelling in a line formation which is thought to improve effectiveness of hunting (SWF, 2012b).

Distribution and occurrence

1.3.6.5 Risso's dolphin are distributed worldwide in temperate and tropical oceans and appear to have a preference for steep shelf-edge habitats (Baird, 2009). The range of Risso's dolphin seems to be limited by water temperature, with animals most common in waters between 15°C and 20°C and rarely found in waters below 10°C (Baird, 2009). The species is regularly sighted in the south Irish Sea, particularly off the north west and south west coast of Wales and around the Isle of Man (Evans *et al*., 2003). The Irish Sea group is unusual because of the shallow waters that the population inhabits, Risso's dolphin elsewhere tending to favour deep (over 1000 m) waters.

1.3.6.6 Risso's dolphin appear to have a localised distribution in the Irish Sea, in a wide band running from south west to north east which encompasses west Pembrokeshire, the west end of the Llŷn Peninsula and Anglesey, the south east coast of Ireland, and around the north of the Isle of Man (Baines and Evans, 2012) (**Figure 1.40**). This general distribution appears to have persisted over the long-term although numbers visiting the coasts of Wales have varied greatly between years. They have mainly been observed in the region in summer (Hammond *et al*., 2005). Young animals have been reported off the north coasts of Pembrokeshire and Anglesey and in Manx waters (Baines and Evans, 2012).

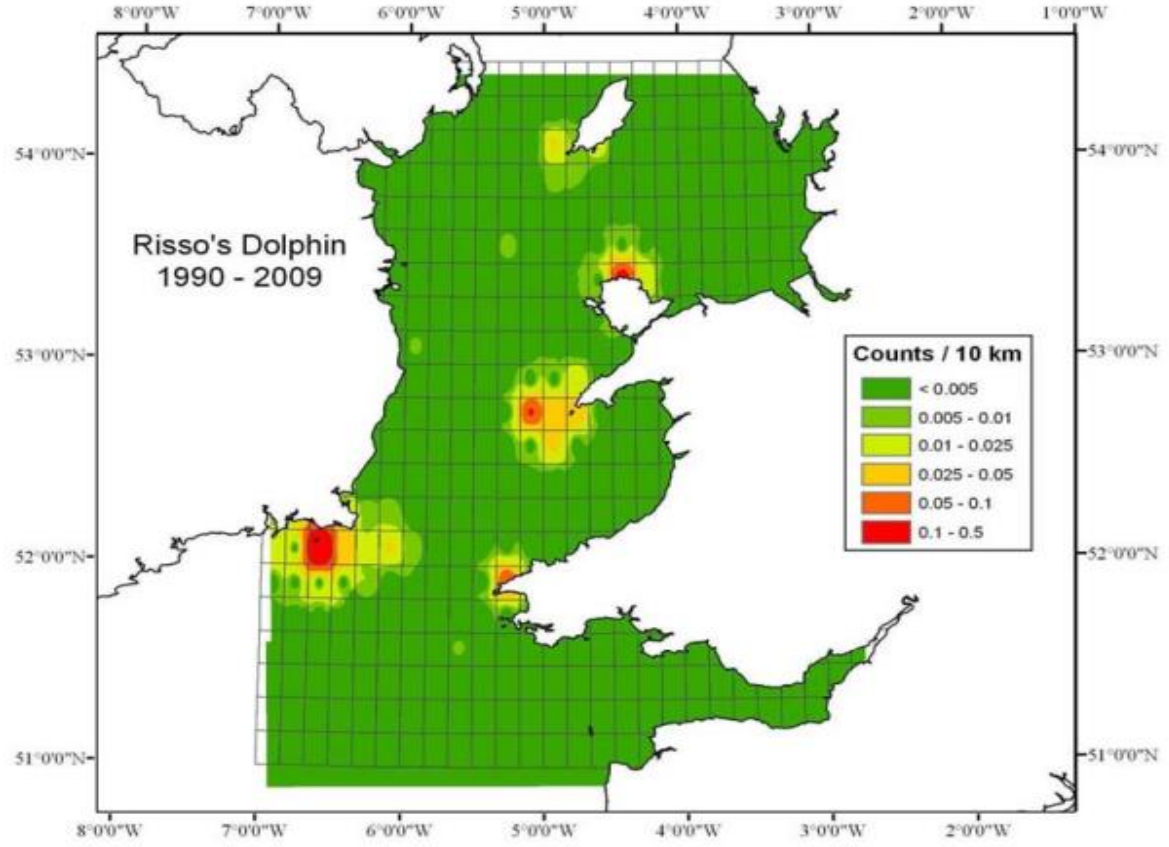

Figure 1.40: IDW interpolated map of Risso's dolphin distribution (Baines and Evans, 2012)

1.3.6.7 Sightings data from MWDW (**Figure 1.11**) shows Risso's are widespread in Manx waters around the Isle of Man, extending out into the study area.

1.3.6.8 Studies conducted by SWF, Whale and Dolphin Conservation and MWDW indicate movements of recognisable individuals of Risso's dolphin between Cornwall, Pembrokeshire, the Llŷn Peninsula, Anglesey, the Isle of Man and West Scotland (Evans *et al*., 2015a). Similarly, through photo-identification both seasonal and long-term site-fidelity has been revealed for some Risso's dolphin in the waters off Bardsey Island in Cardigan Bay (de Boer *et al*., 2013; Eisfeld-Pierantonio and James, 2018).

Density/abundance

1.3.6.9 Density and abundance estimates were available across a broader area within the regional study area for Risso's dolphin.

1.3.6.10 The study area lies within block F for the SCANS-III surveys and although no Risso's dolphin were sighted within this block they were recorded in the adjacent block E and estimated density was given at 0.0313 animals per km^2 (CV = 0.686) (Hammond *et al,* 2021). No DSM was undertaken for Risso's dolphin in Lacey *et al*. (2022). Recent SCANS-IV data did not report any Risso's dolphin in block CS-E (in which the Transmission Assets lies) but reported a density of 0.0022 animals per km^2 (CV = 1.012) in adjacent block CS-D (Gilles *et al.*, 2023).

1.3.6.11 JCP Phase III density surface modelling gave mean densities of 0.004 animals per km^2 across the entire JCP Phase III region (UK and North Sea waters), with some areas of high density around the Isle of Man and west of Anglesey. Predicted mean summer densities in the 1994 to 2010 period and 2007 to 2010 period reached 0.5 animals per km^2 to the west of the Isle of Man. For the study area, densities were 0.02 animals per km^2 in all three time periods[6] and therefore lower than the rest of the Irish Sea.

1.3.6.12 During ObSERVE surveys (Rogan *et al.*, 2018), Risso's dolphin were seen in all seasons in both years in a variety of habitats (**Figure 1.41**), some sightings were close to shore, whilst others were over deeper waters. Density was low across years and CVs per stratum were high resulting in wide 95% CIs. Risso's dolphin were only observed in Stratum 5 (West Irish Sea) during Season 1 (Summer 2015). For Season 1 design-based estimate of density was 0.0032 animals per km^2.

[6] JCP Phase III densities are approximations read off density surface maps in the report (Paxton *et al*., 2016), rather than derived from database. JDCP data was requested but not available currently.

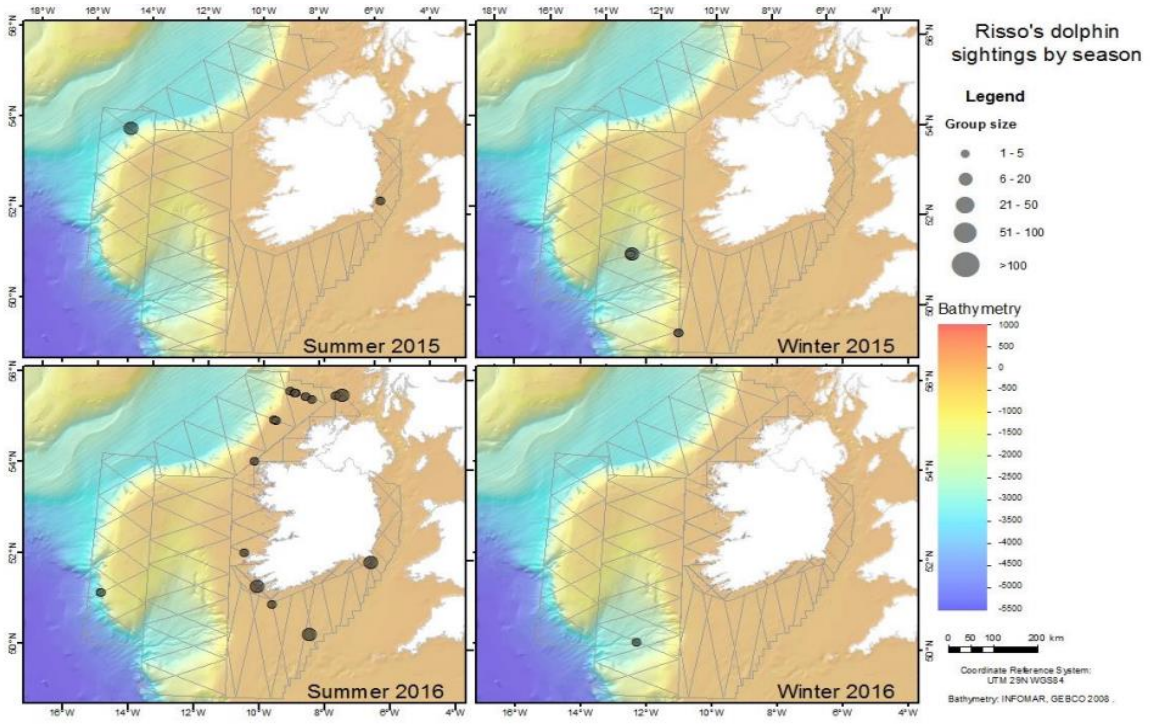

Figure 1.41: Sightings of Risso's dolphin in each survey period (bottom). Grey lines indicate the survey tracklines along which sightings were made. Circles are proportional to the number of dolphins in each sighting (Rogan *et al.*, 2018)

1.3.6.13 The North East Atlantic Distribution Maps at monthly scales (Waggitt *et al.,* 2020) demonstrated Risso's dolphin densities to be lower in the Irish Sea from November to May, with increased densities in summer months between June to September. **Figure 1.42**. **Figure 1.43** and **Figure 1.44** demonstrate the predicted monthly densities for Risso's dolphin for the extent of the study area showing areas of comparatively lower density. There are areas of higher density around the south west of the Isle of Man from July to November, and towards Anglesey between July and October but these lie outside of the study area. Highest densities in the east Irish Sea were predicted in August with 0.0095 animals per km^2 in those high density areas around the Isle of Man. Density estimates within the study area were comparatively lower, at 0.0009 animals per km^2 for August. This aligns with previous studies (Stevens, 2014; de Boer *et al.*, 2002, 2004) which found areas of high densities and predicted habitat suitability around the coast of the Isle of Man, Anglesey, Bardsey Island and west Pembrokeshire.

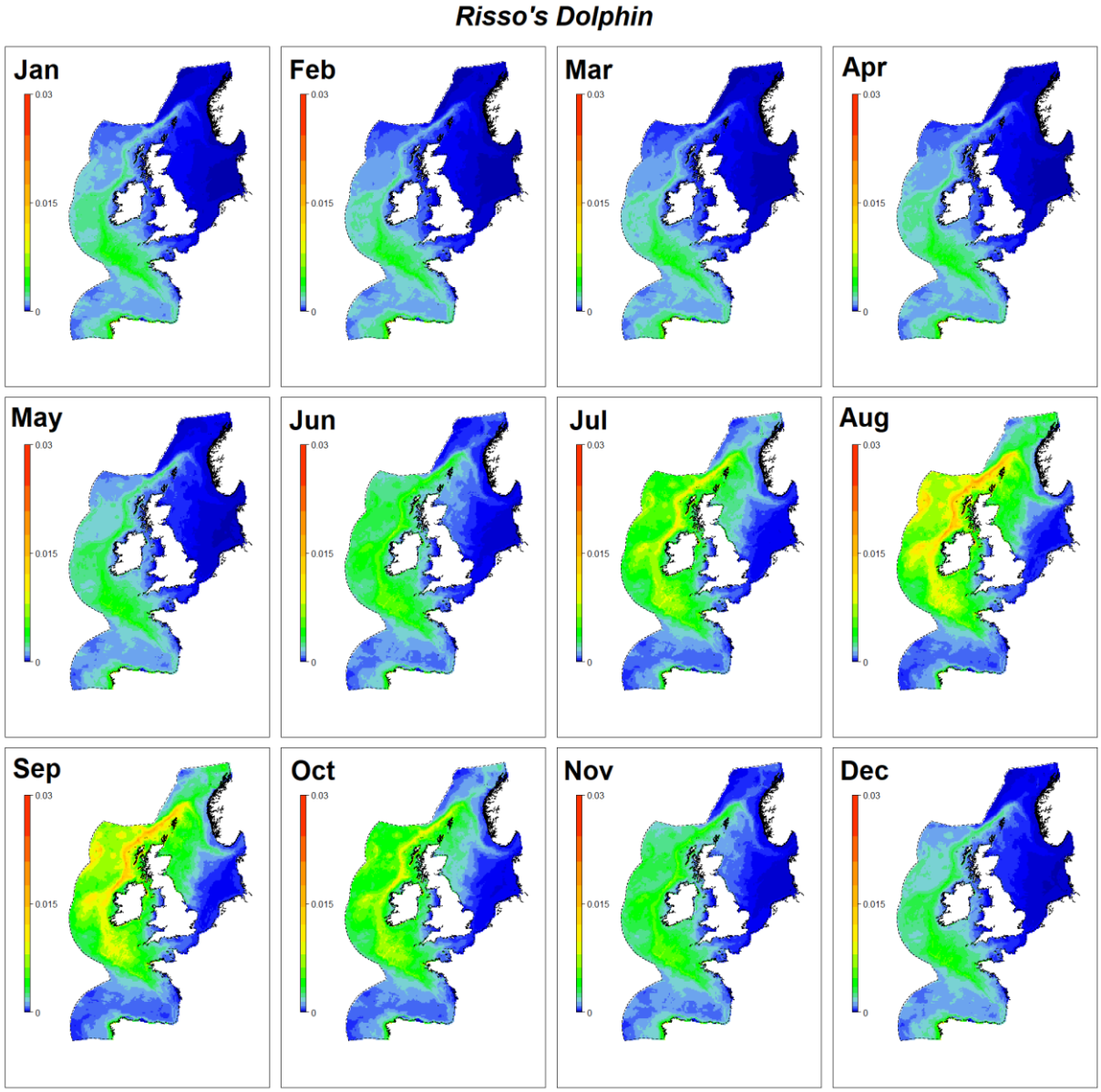

Figure 1.42: Predicted distributions for Risso's dolphin per month (Waggitt *et al.,* 2020)

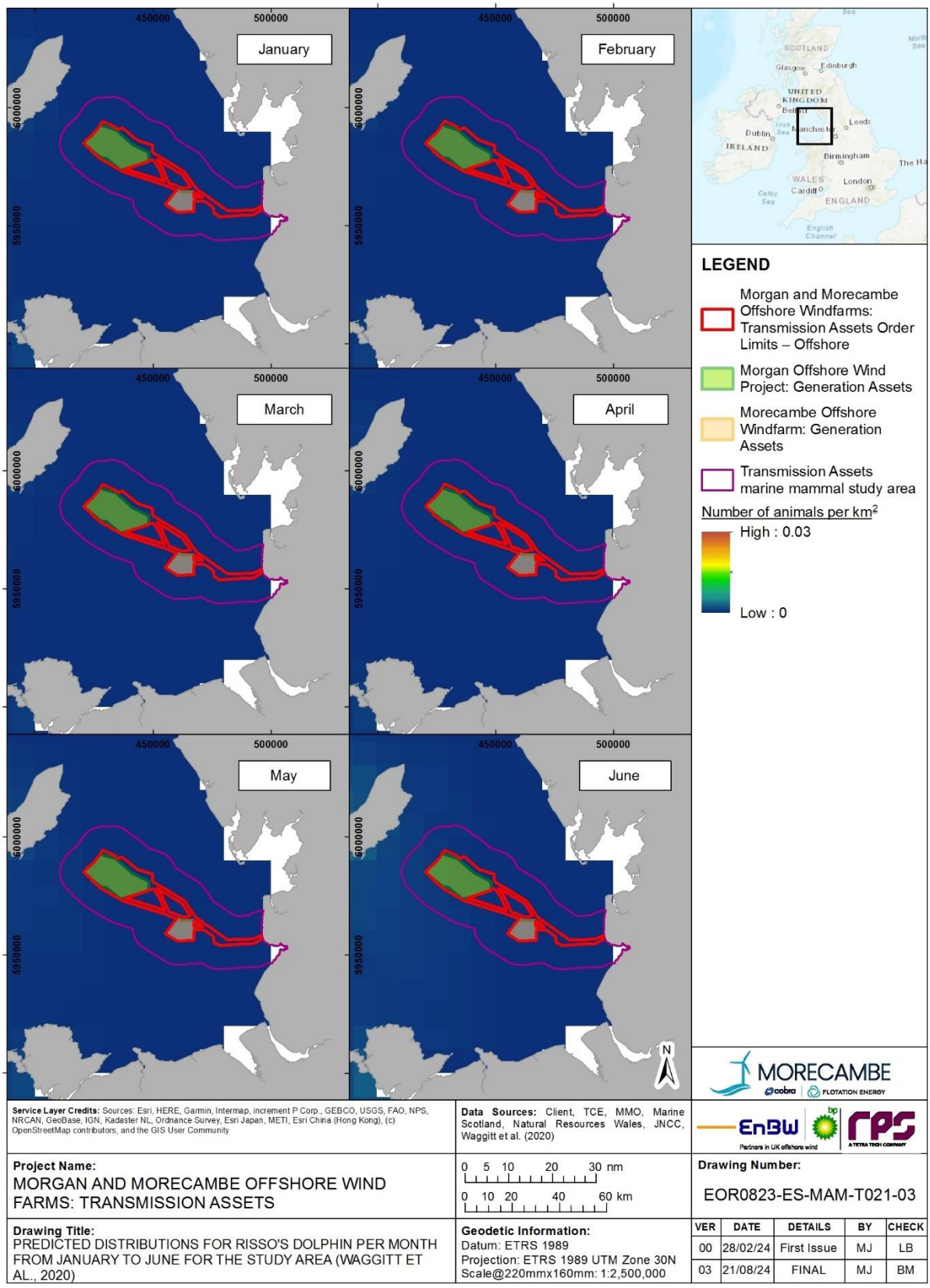

Figure 1.43: Predicted distributions for Risso's dolphin per month from January to June for the study area (Waggitt *et al.,* 2020)

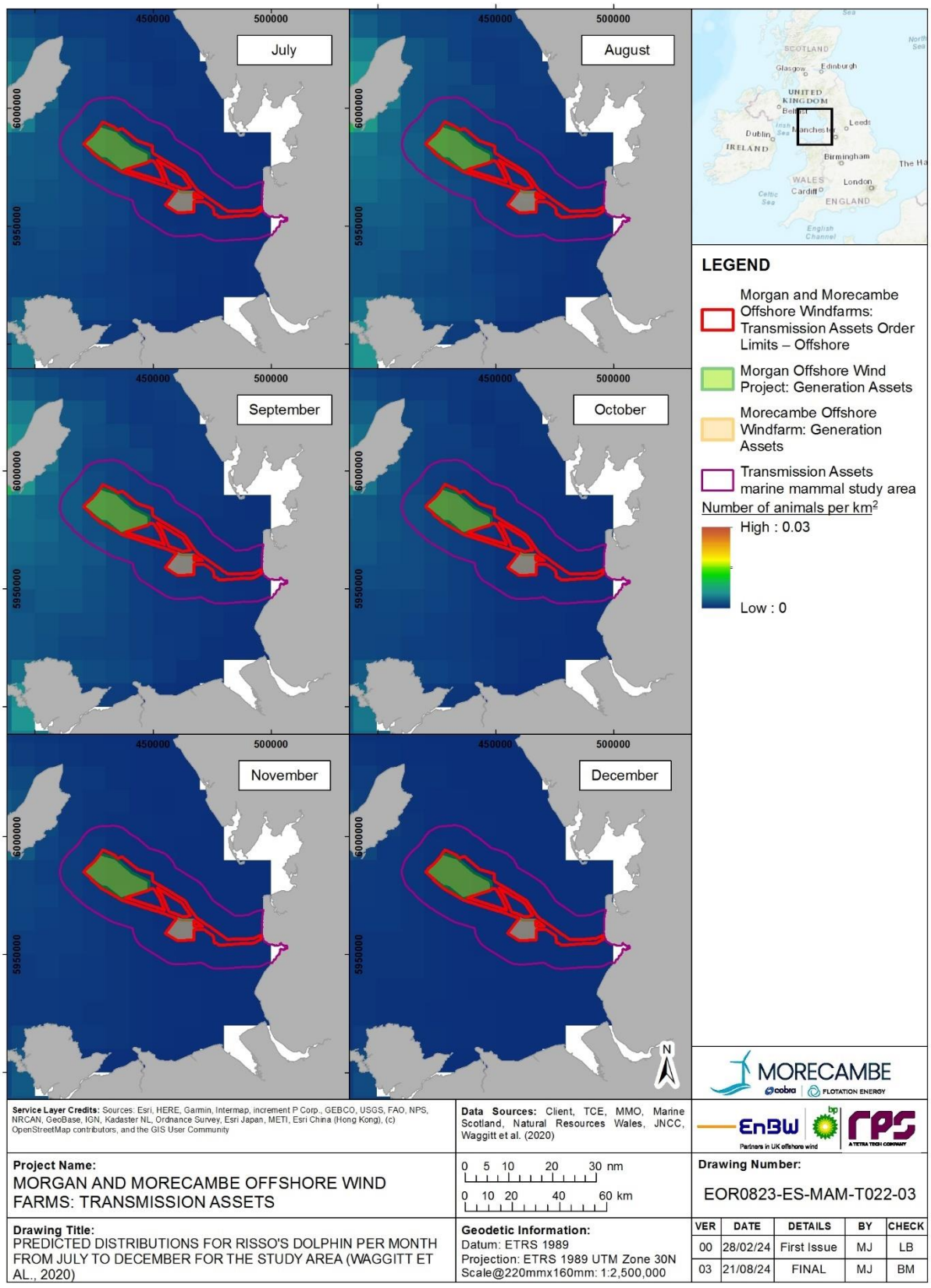

Figure 1.44: Predicted distributions for Risso's dolphin per month from July to December for the study area (Waggitt *et al.*, 2020)

1.3.6.14 Modelled outputs from the Welsh Marine Mammal Atlas (Evans and Waggitt, 2023) indicated Risso's dolphin occur at various locations across the Irish Sea with decadal maps showing the same principal areas for the species. Principal areas included the waters off the coast of County Wexford in south east Ireland, to the west of Pembrokeshire, off the western end of the Llŷn Peninsula around Bardsey Island and beyond, off north west and north Anglesey, as well as around the Isle of Man. Modelled distributions suggested that the core population distribution occurs in the south Irish Sea. Sightings occurred mainly between June and October, and although the species has been recorded in every month of the year, there were few sightings between December and March, suggesting that the species may move offshore or even entirely out of the region (Evans and Waggitt, 2023).

1.3.6.15 The average density for the study area from the annual composite maps was 0.0005 animals per km^2 and the density for the Offshore Order Limits was 0.0003 animals per km^2 (**Figure 1.45**). As set out in **paragraph 1.2.4.66** these density estimates are precautionary as this is the highest value observed for each cell (2.5 km^2 resolution) at any one point in time.

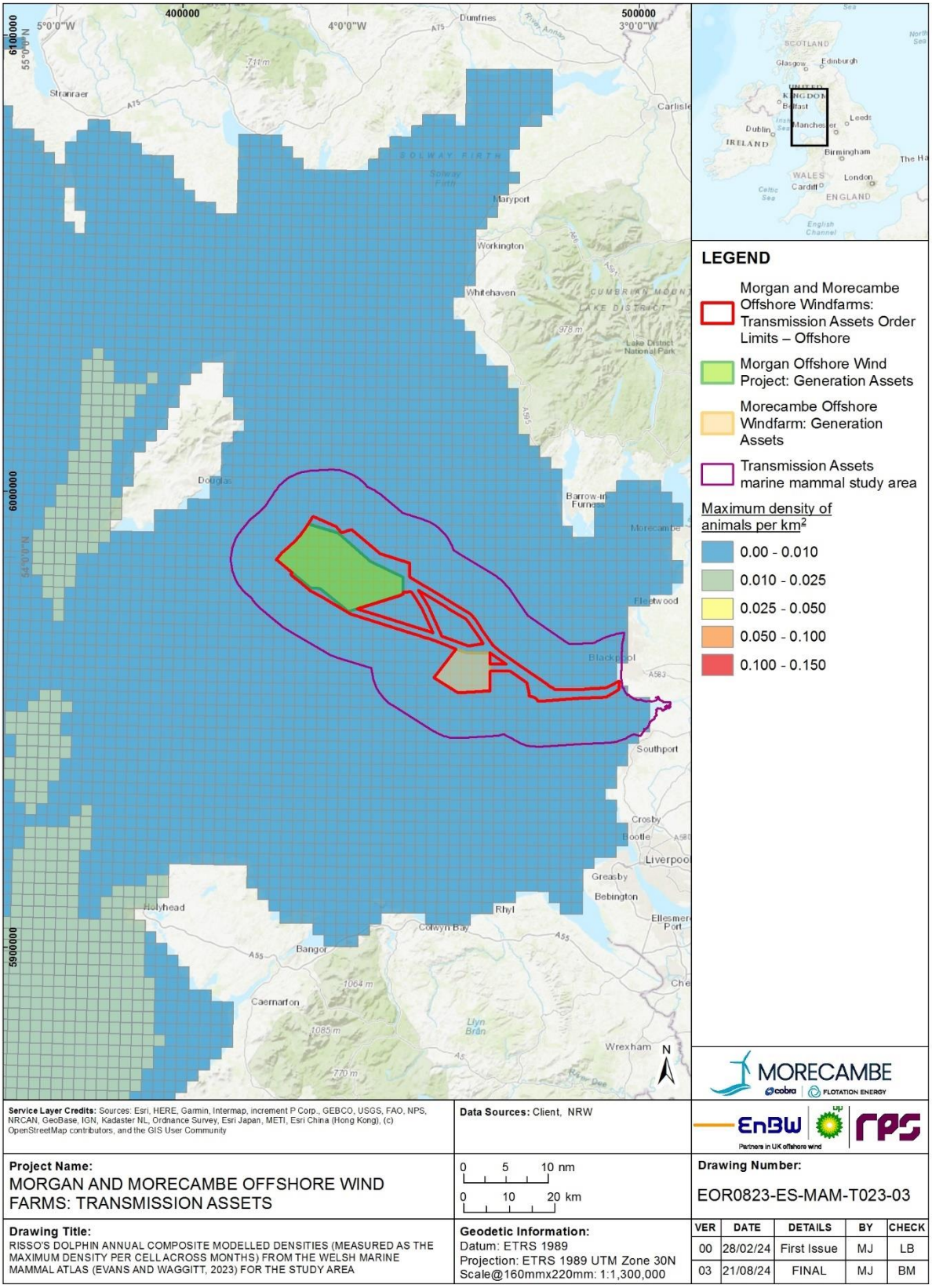

Figure 1.45: Risso's dolphin annual composite modelled densities (measured as the maximum density per cell across months) from the Welsh Marine Mammal Atlas (Evans and Waggitt, 2023) for the study area

1.3.6.16 More locally, the MWDW confirms this presence of Risso's dolphin in the study area (**Figure 1.11**), with Risso's dolphin as the most commonly seen dolphin species in Manx territorial waters (Felce, 2014). Sightings are common in the area but are often given as counts of sightings rather than abundances or densities (Howe, 2018; Stevens, 2014).

1.3.6.17 In surveys for Rhiannon Wind Farm (Celtic Array Ltd., 2014), three observations were recorded during the boat-based visual surveys, comprising 18 animals. All sightings were between June and September with group size ranging between two and ten animals. Insufficient sightings of Risso's dolphins were made during the boat-based surveys to generate a site-specific abundance estimate.

1.3.6.18 No Risso's dolphin sightings were recorded in 24 months of survey for Morgan Offshore Wind Project: Generation Assets (April 2021 to March 2023) (**Appendix A**).

1.3.6.19 No Risso's dolphin sightings were recorded in 24 months of the site-specific aerial surveys for the Morecambe Offshore Windfarm: Generation Assets (February 2021 to March 2023) (**Appendix B**).

Summary of densities

1.3.6.20 Risso's dolphin are common in the regional study area, particularly to the south of the Irish and Celtic Seas, but areas of high density appear to be also located towards the Isle of Man and north west and south west coasts of Wales. A comparison of Risso's dolphin densities from key data sources which overlap the study area is shown in **Table 1.8.**

The density taken forward to assessment is the SCANS-III (Hammond *et al*., 2021) estimate for block E. This is the most precautionary estimate when compared to estimated from the Welsh Marine Mammal Atlas (Evans and Waggitt, 2023), Waggitt *et al.* (2020) and SCANS-IV block CS-D (Gilles *et al.,* 2023).

Table 1.8: Comparison of main data sources densities and estimates of variation for Risso's dolphin

Source	Density (animals per km^2)	Estimate of variation
SCANS-IV block CS-E (Gilles *et al.,* 2023)	N/A[b]	N/A[b]
SCANS-IV block CS-D (Gilles *et al.,* 2023)	0.0022	1.012 (CV)
SCANS-III block F (Hammond *et al.,* 2021)	N/A[b]	N/A[b]
SCANS-III block E (Hammond *et al.,* 2021)	**0.0313**	**0.686 (CV)**
SCANS-III DSM for the study area (Lacey *et al.* 2022)	N/A[c]	N/A[c]
North East Atlantic Distribution Maps (Waggitt *et al.*, 2020) for the study area for August (peak month)	0.0009	0.0007 to 0.0344 (95% CIs)

Source	Density (animals per km^2)	Estimate of variation
Welsh Marine Mammal Atlas (Evans and Waggitt, 2023)[a] for the Transmission Assets Order Limits: Offshore from annual composite maps	0.0003	0.0001 to 0.0007 (95% CIs)
Welsh Marine Mammal Atlas (Evans and Waggitt, 2023)[a] for the study area from annual composite maps	0.0005	0.0002 to 0.0011 (95% CIs)

Density set out in **bold** = density identified to be taken forward to the assessment in Volume 2, Chapter 4: Marine mammals of the ES.

a. Welsh Marine Mammal Atlas data (Evans and Waggitt, 2023) are presented for both the Offshore Order Limits and the study area (Offshore Order Limits plus 10 to 14 km buffer).

b. No Risso's dolphin were recorded within this SCANS block.

c. No density estimate available for Density Surface Modelling for Risso's dolphin (Lacey *et al.,* 2022)

Abundance

1.3.6.21 IAMMWG (2023; 2022) estimated abundance for the CGNS MU (12,262 (CV = 0.46, 95% CI = 5,227 to 28,764) Risso's dolphin. The Transmission Assets lie within block F of the SCANS-III surveys but no Risso's dolphin were sighted within the block (Hammond *et al.,* 2021). Risso's dolphin were recorded in adjacent block E and abundance estimated at 1,090 animals (95% CI = 0 to 2,843) with a mean group size of 7.50 (CV = 0.200). In recent SCANS-IV data, no Risso's dolphin were sighted within block CS-E (in which the Transmission Assets lies) but 75 animals (95% CI = 2 to 259) were estimated in the adjacent block CS-D.

1.3.6.22 JCP Phase III analysis gave sightings of 284 Risso's dolphin within the truncation distance. In the Irish Sea, estimated predicted abundances in 2010 were given per season, with winter abundance for Risso's dolphin was zero animals (95% CI: 0 to 10), spring was 70 animals (95% CI: 0 to 280), summer was 30 animals (95% CI = 30 to 160) and autumn had zero animals (95% CI: 0 to 10). ObSERVE surveys (Rogan *et al.*, 2018), gave Season 1 design-based estimate of abundance for S5 (West Irish Sea) was 35.1 animals (CV = 96.16, 95% CI = 7 to 188).

1.3.6.23 More locally, MWDW confirms this presence of Risso's dolphin in the area, with Risso's dolphin as the most commonly seen dolphin species in Manx territorial waters (Felce, 2014). Sightings are common in the area but are often given as counts of sightings rather than abundances or densities (Howe, 2018; Stevens, 2014).

1.3.6.24 In surveys for Rhiannon Wind Farm (Celtic Array Ltd., 2014), three observations were recorded during the boat-based visual surveys, comprising 18 animals. All sightings were between June and September with group size ranging between two and 10 animals. Insufficient sightings of Risso's dolphins were made during the boat-based surveys to generate a site-specific abundance estimate.

1.3.6.25 Aerial surveys for the Mona Offshore Wind Project demonstrated two Risso's dolphin were recorded in November 2020 (Mona Offshore Wind

Ltd, 2024) with relative design-based abundance estimate of 14 Risso's dolphin for the Mona Aerial Survey Area.

1.3.6.26 The abundance estimate taken forward to assessment of effects is the CGNS MU estimate of 12,262 animals (IAMMWG, 2023; 2022) presented in **paragraph 1.3.6.21** (and presented in summary **Table 1.15**).

Seasonality

1.3.6.27 Risso's dolphin are observed year-round in the UK but are mainly a summer and autumn visitor with highest sighting rates in summer months (Evans *et al*., 2003, Reid *et al*., 2003, Baines and Evans, 2012, Wall, 2013). They are regularly seen in Welsh waters between July to September (Baines and Evans, 2012). Risso's dolphin are known to breed in the Celtic and Irish Sea and young have been observed when groups have been sighted (Baines and Evans, 2012). Waggitt *et al*. (2020) shows increased relative densities off the south west coast of the Isle of Man from June to October.

1.3.6.28 Howe (2018a) suggested Risso's dolphin show high seasonality to Manx waters, with marked spatial and temporal distribution, being present only between March and September and with 90% of sightings on the east coast of the Isle of Man, around the Calf of Man or to the south west of the Calf. Data presented in Morgan Offshore Wind Project: Generation Assets Marine Mammal Technical Report (**Appendix A**) obtained from MWDW (2022) also shows higher sightings of Risso's dolphin in summer months, with peaks in June and July however there is no control for survey effort.

1.3.7 Minke whale

Ecology

1.3.7.1 Minke whale are the most frequently sighted mysticete (baleen whale) species in UK waters and is particularly common around the Northern Isles and in regions of the North Sea (Weir, 2001). Minke whale typically live up to 60 years, with male minke whale reaching sexually maturity at the age of five to eight years and females at the age of six to eight years. In the northern hemisphere, mating occurs between October to March and the gestation period lasts approximately ten months, with the peak birth period between December and January (Seawatch Foundation, 2012c). Calves usually nurse for a period of four to six months.

1.3.7.2 This species tends to be observed either solitarily or in pairs or threes. However, in higher latitudes larger groups of ten to 15 individuals can be observed, particularly in areas of high prey density (Anderwald and Evans, 2007). Mostly inhabiting continental shelf waters, this species occurs in depths of less than 200 m and can often be seen close to land. This species is often known to exploit prey resources through other species that herd prey, enabling a low energy foraging strategy. Some regional differences exist with respect to diet (Robinson *et al.*,

2007). Minke whales follow prey distribution and sandeel are the key food resource throughout the North Sea, with sprat, shad and herring also preferred prey items (Robinson and Tetley, 2007). Samples taken from the stomach contents of specimens within the North Sea determined that in UK waters the dominant prey items were sandeels, followed by clupeids *Clupeidae* and to a lesser extent mackerel *Scomber scombrus* (Robinson *et al.*, 2007). In Manx waters, two known herring stocks exist (the Manx and Mourne stocks) and the distribution and occurrence of minke whale seems to mirror these. The Manx herring stock are known to spawn on the east coast of the island during Autumn (in September to October) (Bowers 1969), hence the presence of minke whale on the east coast during these months. During the summer months, the Manx stock and Mourne stock are found together off the west coast of the Isle of Man and minke whales are present in this area during this period (Bowers 1980). However, Hammond *et al.* (2005a) states there is no specific information on feeding in the SEA6 area. Some genetic differentiation among individuals has been reported (Andersen *et al.,* 2003) but since this does not appear to be caused by geographic structuring within the North East Atlantic (Anderwald *et al.,* 2011). They are usually observed singly or in pairs although may form larger feeding aggregations of ten to 15 individuals (Reid *et al.,* 2003).

Distribution and occurrence

1.3.7.3 Minke whale inhabits all major oceans of the world and are most abundant in relatively cool waters, and on the continental shelf in waters. In UK waters, minke whale are widely distributed and present year-round but by far the most sightings within continental shelf waters occur between May and September, with peak numbers from July to September, depending on the region (Evans *et al.*, 2003). During these summer months, the species is widely distributed throughout the region, including coastal and offshore shelf waters, and deeper waters on and beyond the shelf slope.

1.3.7.4 In the 2008 Welsh Marine Atlas, highest number of sightings occurred in the area of the Celtic Deep, although the species is found also in deeper areas (generally >50 m) northwards particularly between the coast of Co. Dublin and Anglesey, and around the Isle of Man (Baines and Evans, 2008). They mainly occur in the south and west of the Irish Sea (Hammond *et al.*, 2005a), and are present from late April to early August (Wall, 2013). This is confirmed by a high degree of seasonality to Manx waters, as detailed in the Manx Marine ES, with presence between June and November (Howe, 2018). Howe (2018a) noted a clear spatial aspect to the distribution of minke whale sightings in Manx waters, with the majority of summer sightings on the west coast of the island, whereas in the autumn most sightings are on the east coast. As discussed in **paragraph 1.3.7.2,** this mirrors the two herring stocks in the Irish Sea (the Mourne Stock and the Manx Stock) and may drive distribution of minke whale in Manx waters. Sighting data 2006 to 2022 obtained from MWDW (MWDW, 2022) confirms minke whale are widespread in Manx waters around the Isle of Man, with some sightings

to the north and north west of the study area and up towards the coast of Northern Ireland.

Density/abundance

Density

1.3.7.5 The Transmission Assets lies within block F of SCANS-III, but no minke whale were recorded in this block. However, the regional study area also spans block E, and the estimated density was 0.0173 animals per km^2 (CV = 0.618) (Hammond *et al.,* 2021).

1.3.7.6 More recently, SCANS-III DSM data (Lacey *et al.* 2022) (see **paragraph 1.2.4.43**) gave mean densities of 0.0211 animals per km^2 for the study area.

1.3.7.7 Recent SCANS-IV data reported densities of 0.0088 animals per km^2 (CV = 1.145) in block CS-E (in which the Transmission Assets lies) and 0.0137 animals per km^2 (CV = 0.632) in block CS-D (Gilles *et al.*, 2023), noting surveys for these blocks were carried out over a limited summer period (between 28 June and 15 August 2022) and thus densities may vary in other months of the year.

1.3.7.8 The Offshore Energy SEA 4: Appendix 1 Environmental Baseline (BEIS, 2022) used SCANS-III data to give predicted density surfaces for Minke whale in 2016 and demonstrated high areas of minke whale density around the Isle of Man (0.027 to 0.036 animals per km^2) and moderate densities across the entire Irish Sea (0.012 to 0.02 animals per km^2) (**Figure 1.46**). These densities are predictions based upon based on the observed distributions and their relationships with habitat variables (longitude and latitude, plus distance from coast, depth or aspect of seabed slope).

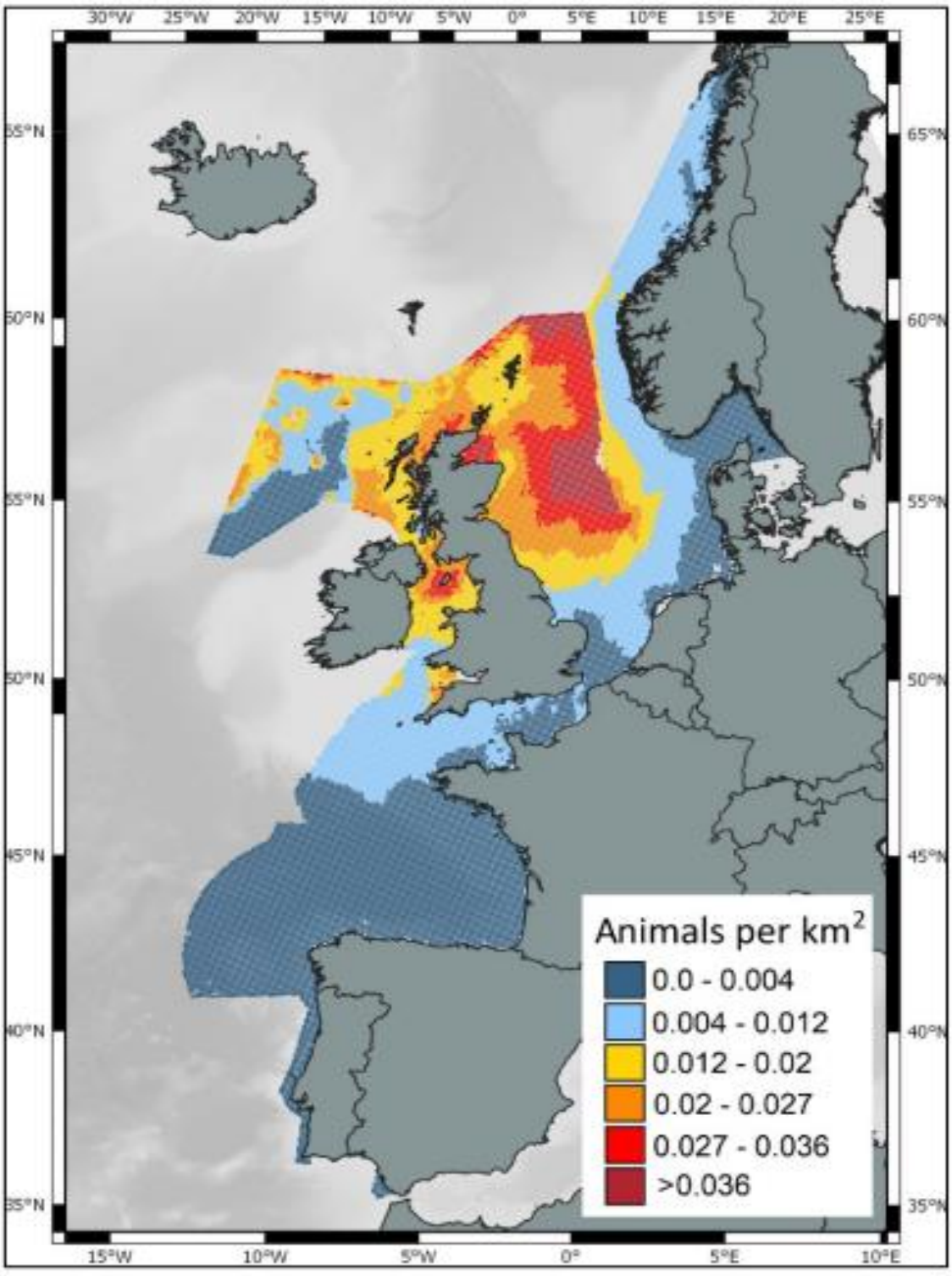

Figure 1.46: Predicted density surface for minke whale in 2016, using SCANS-III data, from Offshore Energy SEA 4: Appendix 1 Environmental Baseline (BEIS, 2022)

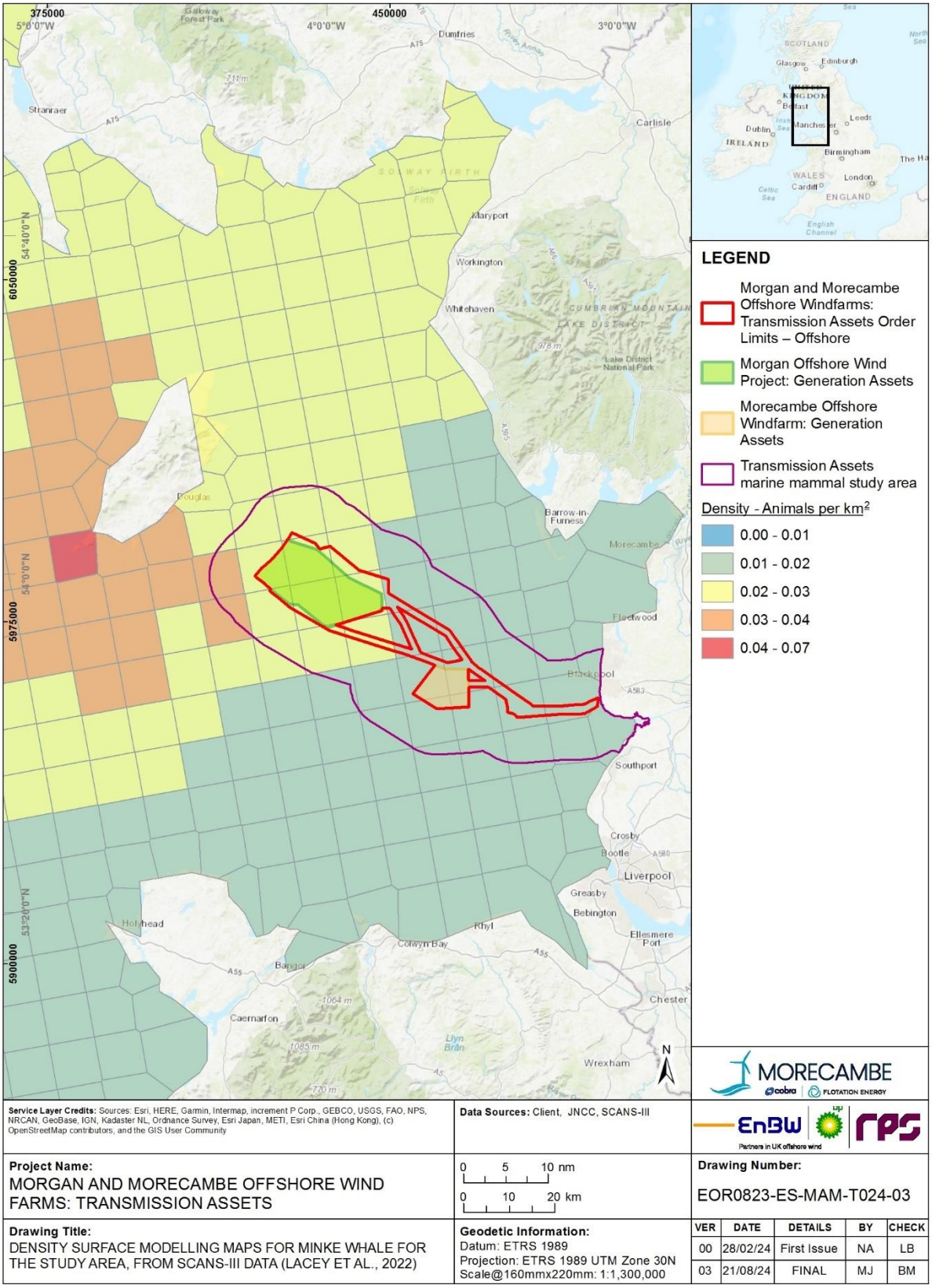

Figure 1.47: Density surface modelling maps for minke whale for the study area, from SCANS-III data (Lacey *et al.,* 2022)

1.3.7.9 JCP Phase III (Paxton *et al.,* 2016) density surface modelling gave mean densities of 0.022 animals per km^2 across the entire region of interest (UK wide), with some areas of persistent high relative density around the Isle of Man (in summer 2010 densities of 0.1 animals per km^2). Mean minke whale densities in the entire Irish Sea for summers from the periods 1994 to 2000, 2001 to 2006 reached 0.5 animals per km^2, whilst summers in 2007 to 2010 reached 0.2 animals per km^2. For the study area, densities were lower than in the Irish Sea, with 0.02 animals per km^2 for spring, summer and winter 2010, and 0.04 animals per km^2 in summer periods 2001 to 2006 and 2007 to 2010.

1.3.7.10 This study builds upon the JCP Phase One Data Analysis (Paxton and Thomas, 2010), which predicted density surfaces for minke from data from 1980 to 2009. In the Irish Sea there were some areas of higher densities in 2004 along the east coast of Ireland (0.05 animals per km^2) and around the Isle of Man (0.02 animals per km^2), but densities around the study area were 0.005 animals per km^2 in 1983, 1990, 1997 and 2004.

1.3.7.11 Minke whale was the most frequently observed mysticete species in ObSERVE surveys in Irish Waters in 2015 and 2016 which included one sighting of a mother and calf pair (Rogan *et al.*, 2018). High use of coastal waters in the summer months was observed, including in the Irish Sea, but sightings were lower during winter months. For summer 2015, the corrected design-based estimate of density was 0.045 animals per km^2. There were no minke whale observed in Stratum 5 (in the west Irish Sea) during winter 2015/2016 or winter 2016/2017. For summer 2016, corrected design-based density was estimated as 0.016 animals per km^2.

1.3.7.12 The North East Atlantic Distribution Maps of minke whale at monthly scales by Waggitt *et al.* (2020) showed areas of low minke whale density in the Irish Sea compared to areas in north west Scotland, with higher densities from June to October (**Figure 1.48**). **Figure 1.49** and **Figure 1.50** demonstrate the predicted monthly densities for minke whale for the region around the study area. Densities are seen to be low in the east Irish Sea, with the highest predicted densities in August at 0.0409 animals per km^2. Densities are higher in the mid channel and west side of the Irish Sea, particularly around the Isle of Man from July to November, and towards the west of the Irish Sea. Density estimates within the study area were comparatively lower, at 0.0054 animals per km^2 for August (**Figure 1.50**).

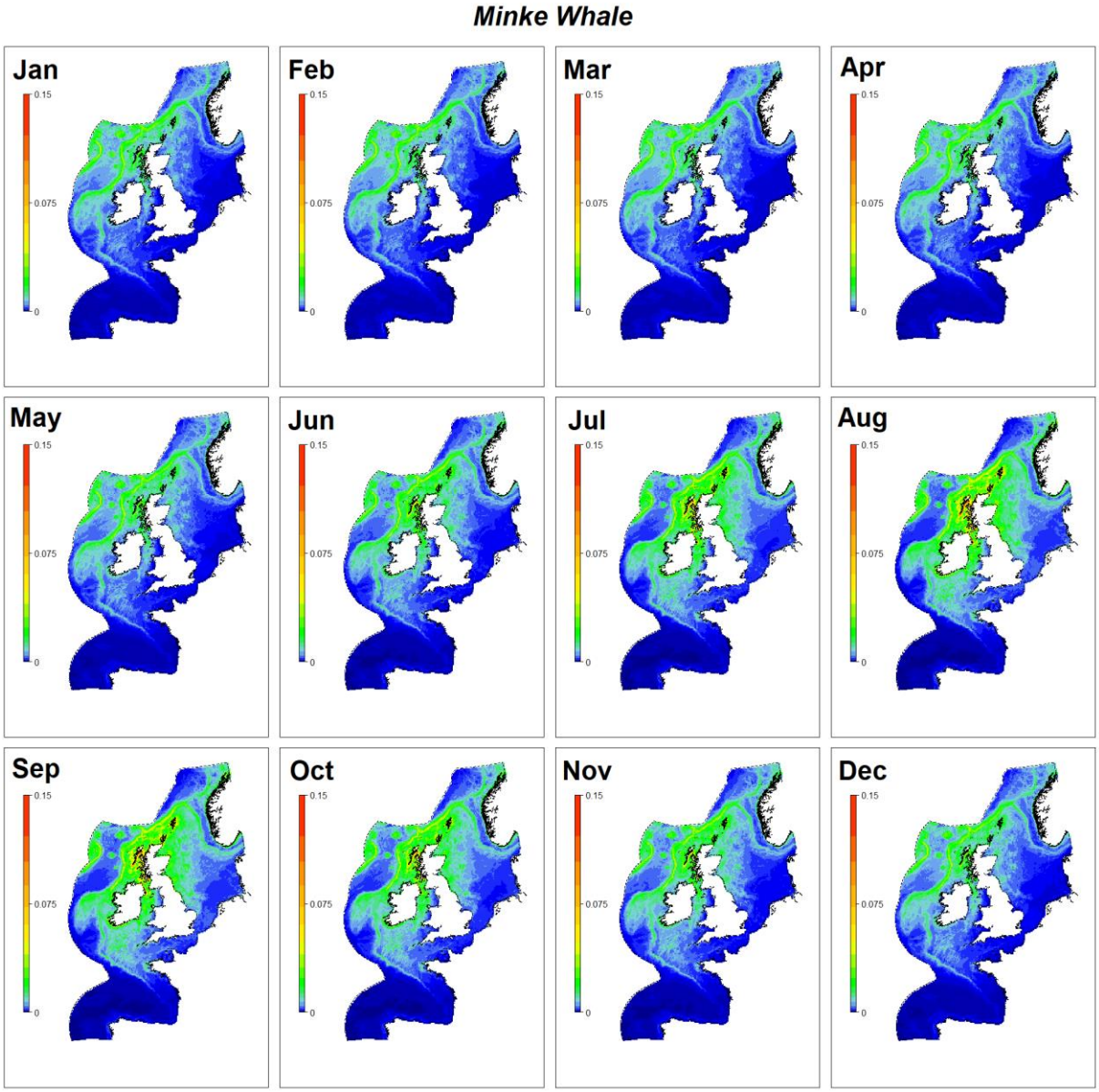

Figure 1.48: Predicted distributions for minke whale per month (Waggitt *et al.*, 2020)

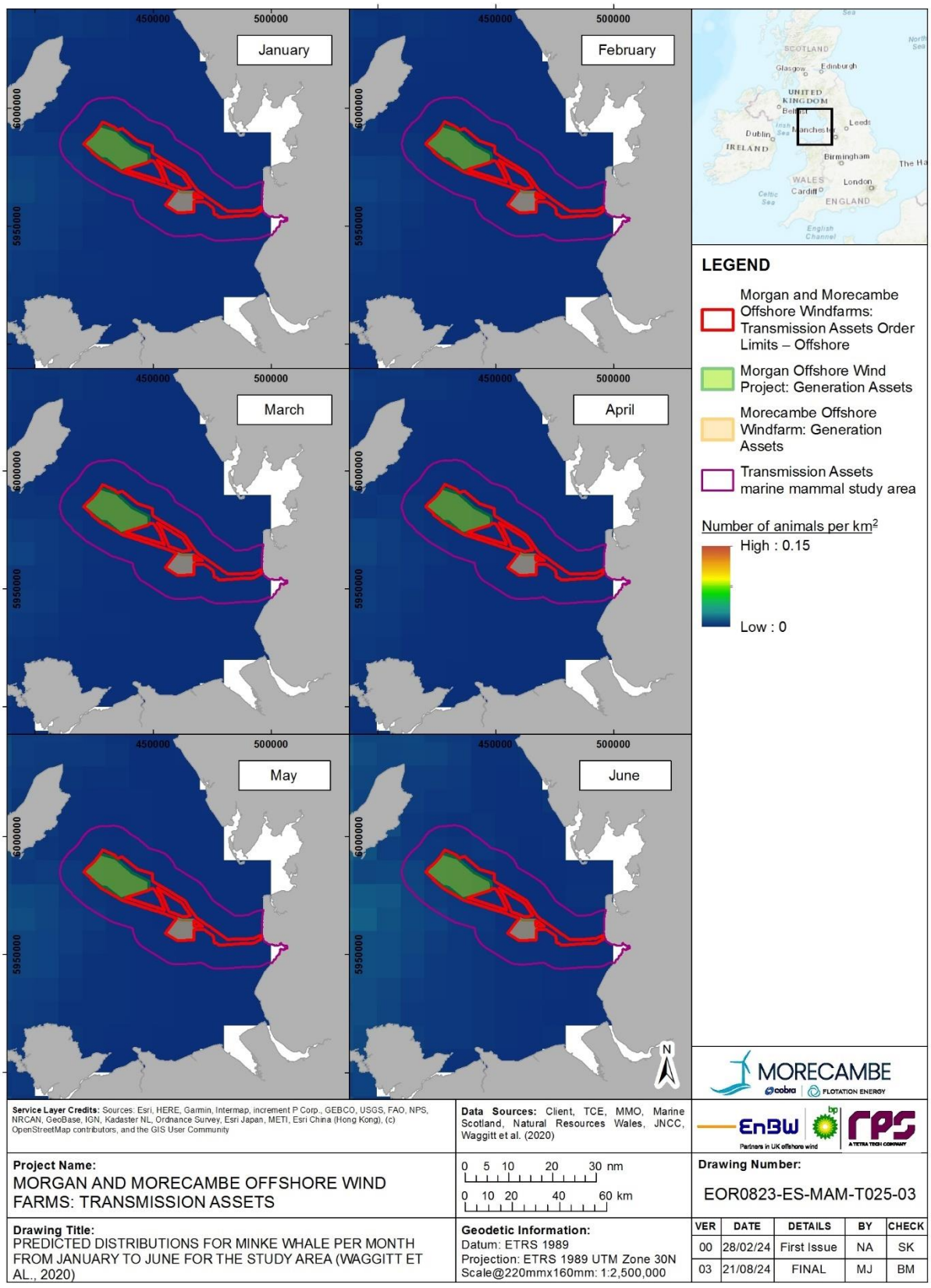

Figure 1.49: Predicted distributions for minke whale per month from January to June for the study area (Waggitt *et al.,* 2020)

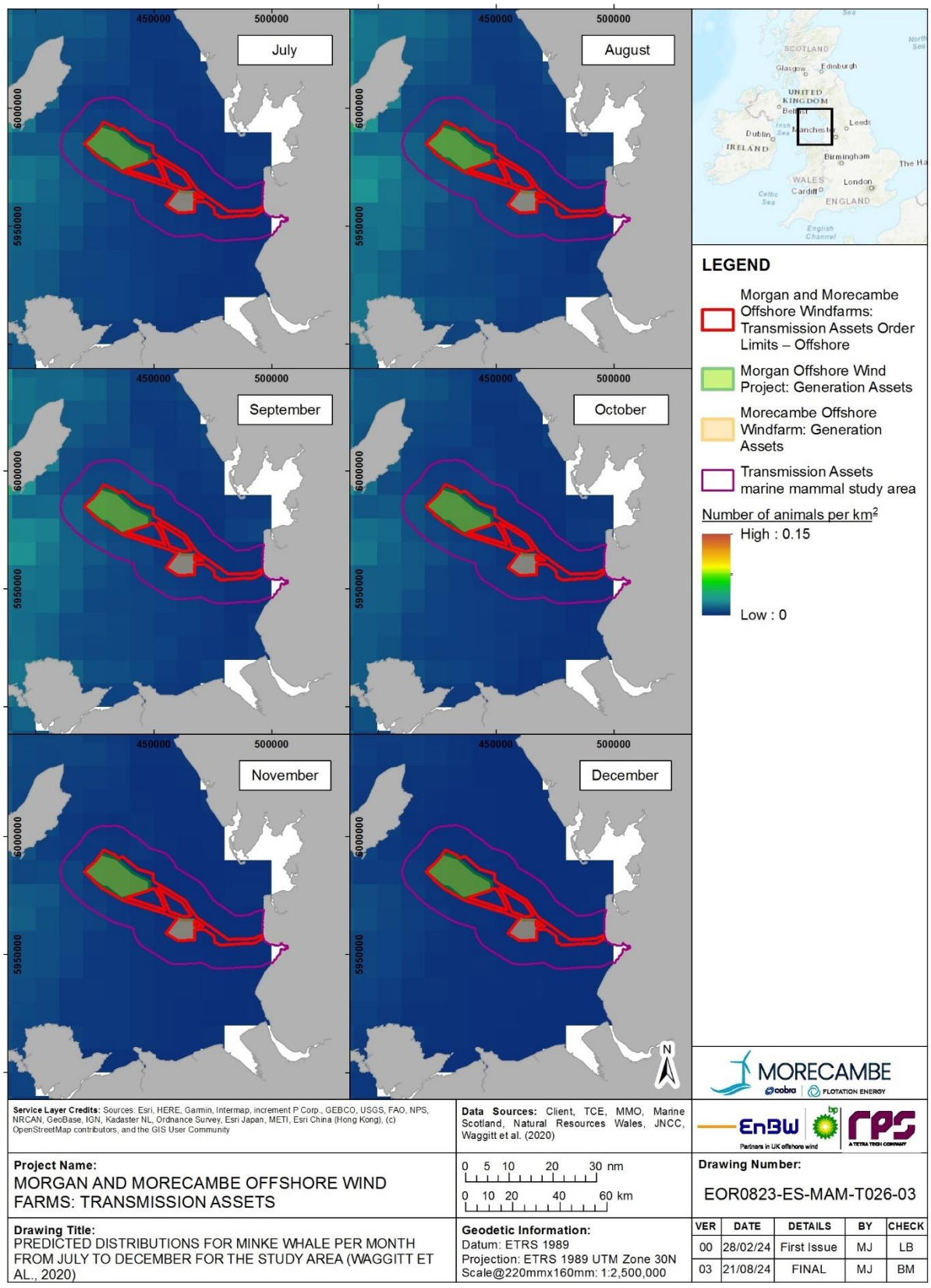

Figure 1.50: Predicted distributions for minke whale per month for July to December for the study area (Waggitt *et al.,* 2020)

1.3.7.13 Modelled outputs from the Welsh Marine Mammal Atlas (Evans and Waggitt, 2023) indicated minke whale density was highest across the west Irish Sea, with lower densities towards the east. Sightings broadly coincided with the two main frontal systems in the Irish Sea (the Celtic Sea Front in the south and the Irish Sea Front in the north) but it should be noted that survey effort between those two regions has been very limited, and modelled distributions indicate similar densities in the deeper waters of the Irish Sea between those two fronts.

1.3.7.14 The average density for the study area from the annual composite maps was 0.0029 animals per km^2 and the average density for the Offshore Order Limits was 0.0027 animals per km^2 (**Figure 1.51**). As set out in **paragraph 1.2.4.66** these density estimates are highly precautionary as this is the highest value observed for each cell (2.5 km^2 resolution) at any one point in time.

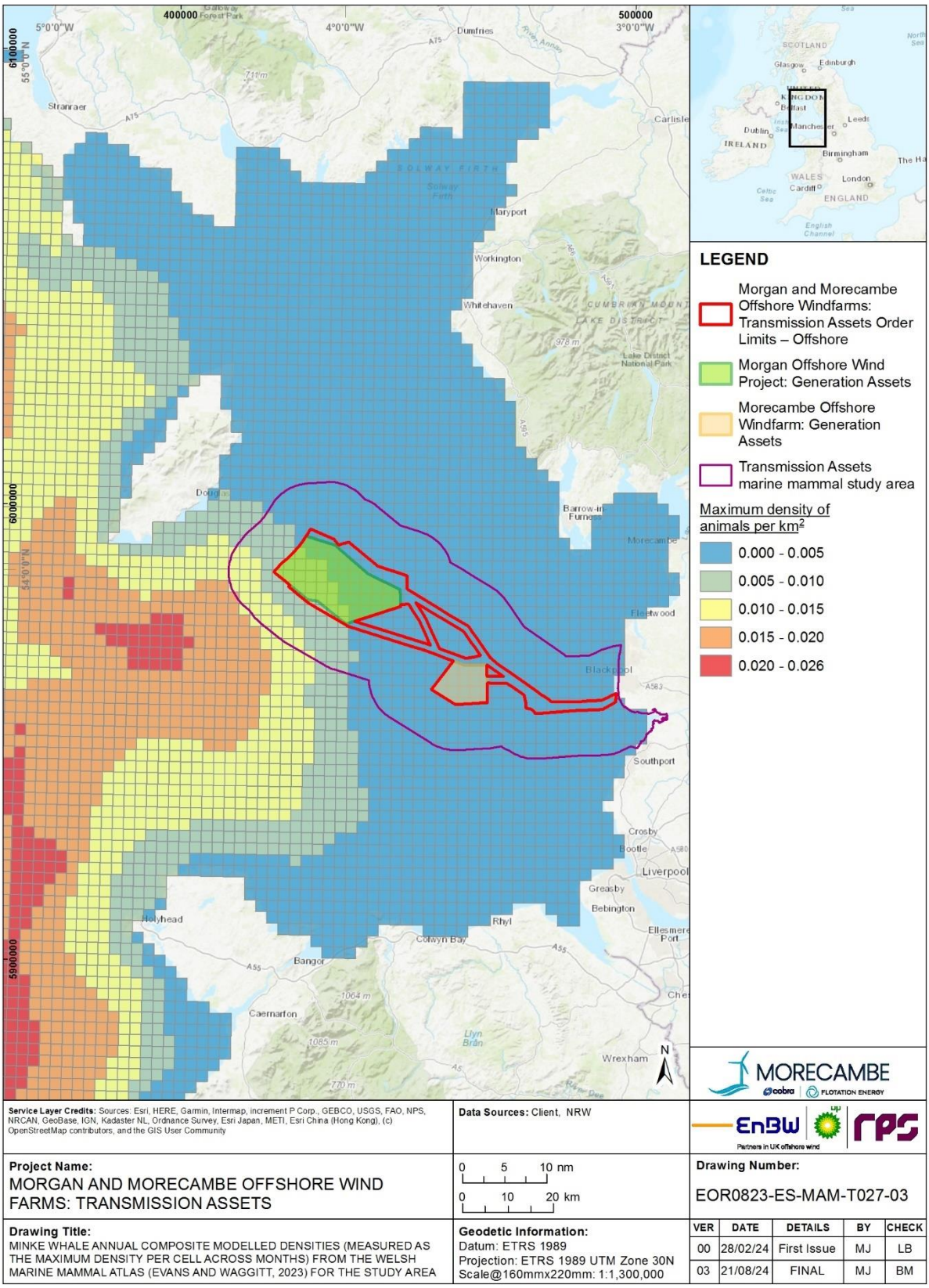

Figure 1.51: Minke whale annual composite modelled densities (measured as the maximum density per cell across months) from the Welsh Marine Mammal Atlas (Evans and Waggitt, 2023) for the study area

1.3.7.15 No minke whale were recorded in 24 months of the site-specific aerial surveys for the Morgan Offshore Wind Project: Generation Assets did (April 2021 to March 2023) (**Appendix A**).

1.3.7.16 No minke whale were recorded in 24 months of the site-specific aerial surveys for the Morecambe Offshore Windfarm: Generation Assets (March 2021 to February 2023) but it was not possible to determine the species (**Appendix B**).

Summary of densities

1.3.7.17 Minke whale are distributed across the Irish sea, with high densities seen in the west Irish Sea and around the Isle of Man. Minke whale were sighted in block CS-E of SCANS-IV (in which the Transmission Assets lies) but the density given was lower in comparison to the density estimate derived for the study area from SCANS-III DSM (Lacey *et al.,* 2022). No minke whale were observed in SCANS-III block F (in which the Transmission Assets lies) but animals were observed in adjacent block E (Hammond *et al.,* 2021), which is similar to, but lower than the SCANS-III DSM density estimate. This SCANS-III DSM density estimate is also more conservative than densities for the study area derived from Waggitt *et al.,* 2020 and the Welsh Marine Mammal Atlas (Evans and Waggitt, 2023). A comparison of minke whale densities from key data sources which overlap the study area is shown in **Table 1.9.**

1.3.7.18 Therefore, the density taken forward to assessment is the SCANS-III DSM estimate for the study area (Lacey *et al.,* 2022), as the most conservative estimate.

Table 1.9: Comparison of main data sources densities and estimates of variation for minke whale

Source	Density (animals per km^2)	Estimate of variation
SCANS-IV block CS-E (Gilles *et al.,* 2023)	0.0088	1.145 (CV)
SCANS-IV block CS-D (Gilles *et al.,* 2023)	0.0137	0.632 (CV)
SCANS-III DSM for the study area (Lacey *et al.* 2022)	**0.0211**	**0.011 to 0.040 (95% CIs)**
SCANS-III block F	N/A[b]	N/A[b]
SCANS-III block E	0.0173	0.618
North East Atlantic Distribution Maps (Waggitt *et al.*, 2020) for the study area for August (peak month)	0.0054	0.0047 to 0.0063 (95% CIs)
Welsh Marine Mammal Atlas (Evans and Waggitt, 2023)[a] for the Transmission Assets Order Limits: Offshore from annual composite maps	0.0027	0.0017 to 0.0043 (95% CIs)

Source	Density (animals per km^2)	Estimate of variation
Welsh Marine Mammal Atlas (Evans and Waggitt, 2023)[a] for the study area from annual composite maps	0.0030	0.0019 to 0.0048 (95% CIs)

Density set out in **bold** = density identified to be taken forward to the assessment in Volume 2, Chapter 4: Marine mammals of the ES.

a. Welsh Marine Mammal Atlas data (Evans and Waggitt, 2023) are presented for both the Offshore Order Limits and the study area (Offshore Order Limits plus 10 to 14 km buffer).

b. No minke whale were recorded within this SCANS block.

Abundance

1.3.7.19 Broad scale abundance estimates are available for minke whale. All minke whale in UK waters are considered to be part of the CGNS MU (**Figure 1.52**). Based on the most up to date estimates, the abundance of minke whale in this MU is 20,118 animals (CV = 0.18, 95% CI = 14,061 to 28,786; IAMMWG, 2023; 2022).

1.3.7.20 The Transmission Assets lie within block F of SCANS-III, but no minke whale were recorded in this block. However, the regional study area also spans block E, and an abundance estimate of 603 animals (95% CI = 134 to 1,753) and a mean group size of 1.00 was estimated for this block (Hammond *et al.,* 2021). Recent SCANS-IV data gave abundance estimates of 108 animals (95% CI = 1 to 491) for block CS-E and 477 animals (95% CI = 85 to 1,425) for adjacent block CS-D (Gilles *et al.,* 2023).

1.3.7.21 JCP Phase III analysis gave total sightings of 1,860 minke whale for the JCP Phase III survey region, and in the Irish Sea, estimated predicted abundances in 2010 were given per season, with winter abundance for minke whale was ten animals, spring was 40 animals, summer was 190 animals and autumn had 20 animals.

1.3.7.22 The ObSERVE surveys recorded minke whale in all strata (**Figure 1.53**), but for Season 1 (summer 2015), corrected design-based estimates abundance for S5 (west Irish Sea) is 494.7 animals (CV = 68.75, 95% CI = 221.5 to 1105.0). There were no minke whale observed in Stratum 5 during winter 2015/2016 or winter 2016/2017). For summer 2016, the corrected design-based estimate of abundance for S5 was 180.1 animals (CV = 106.13, 95% CI = 58.6 to 552.9).

1.3.7.23 In surveys for Rhiannon Wind Farm (Celtic Array Ltd., 2014), 19 minke whale sightings of 21 animals were made during the boat-based visual surveys. All observations were made between May and August and all bar two were of single animals. Insufficient sightings of minke whale were made during the boat-based surveys to generate a site-specific abundance estimate.

1.3.7.24 The abundance estimate taken forward to assessment of effects is the CGNS MU estimate of 20,118 animals (IAMMWG, 2023; 2022) presented in **paragraph 1.3.7.19** (and presented in **Table 1.15**).

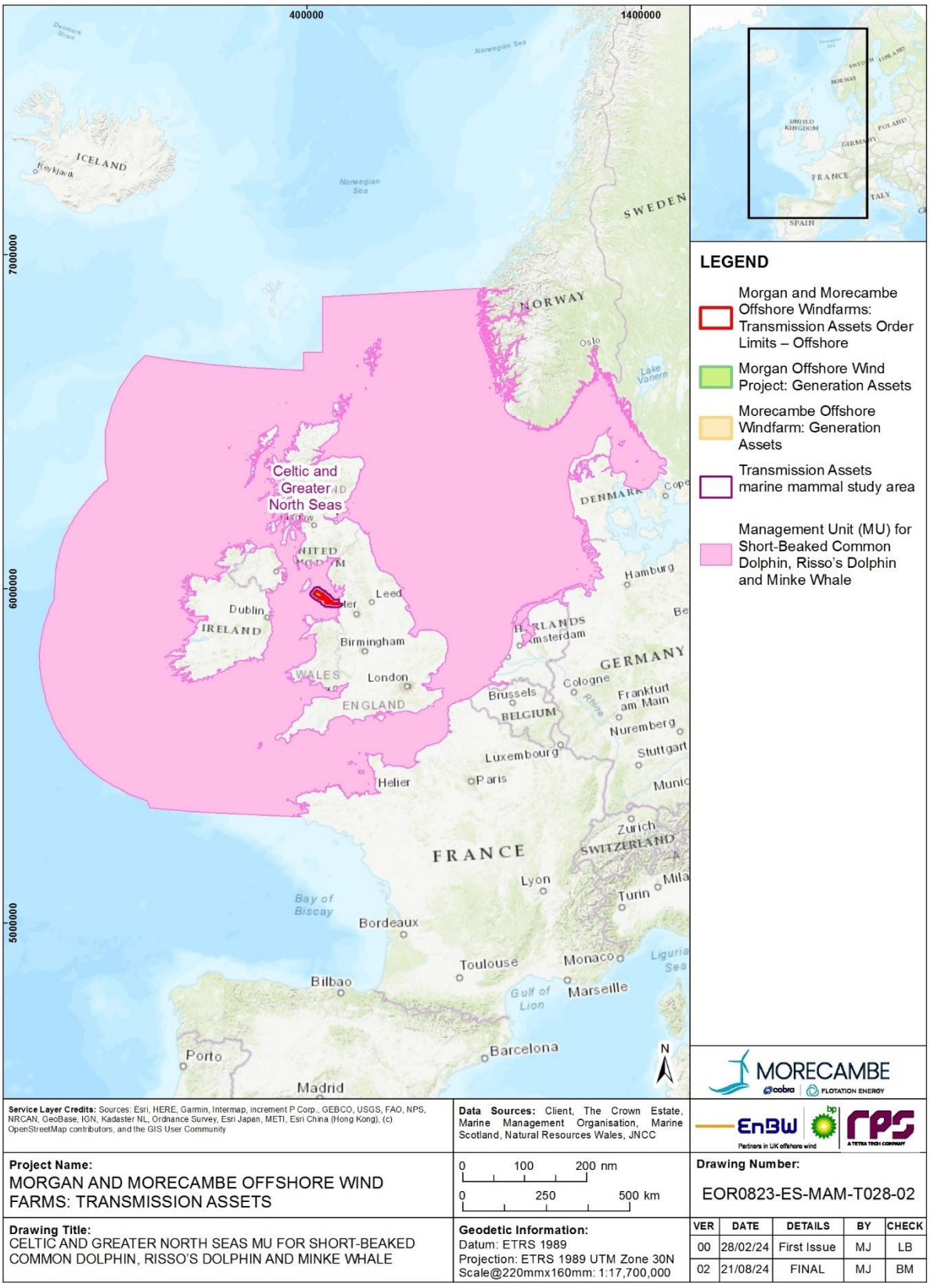

Figure 1.52: Celtic and Greater North Seas MU for short-beaked common dolphin, Risso's dolphin and minke whale

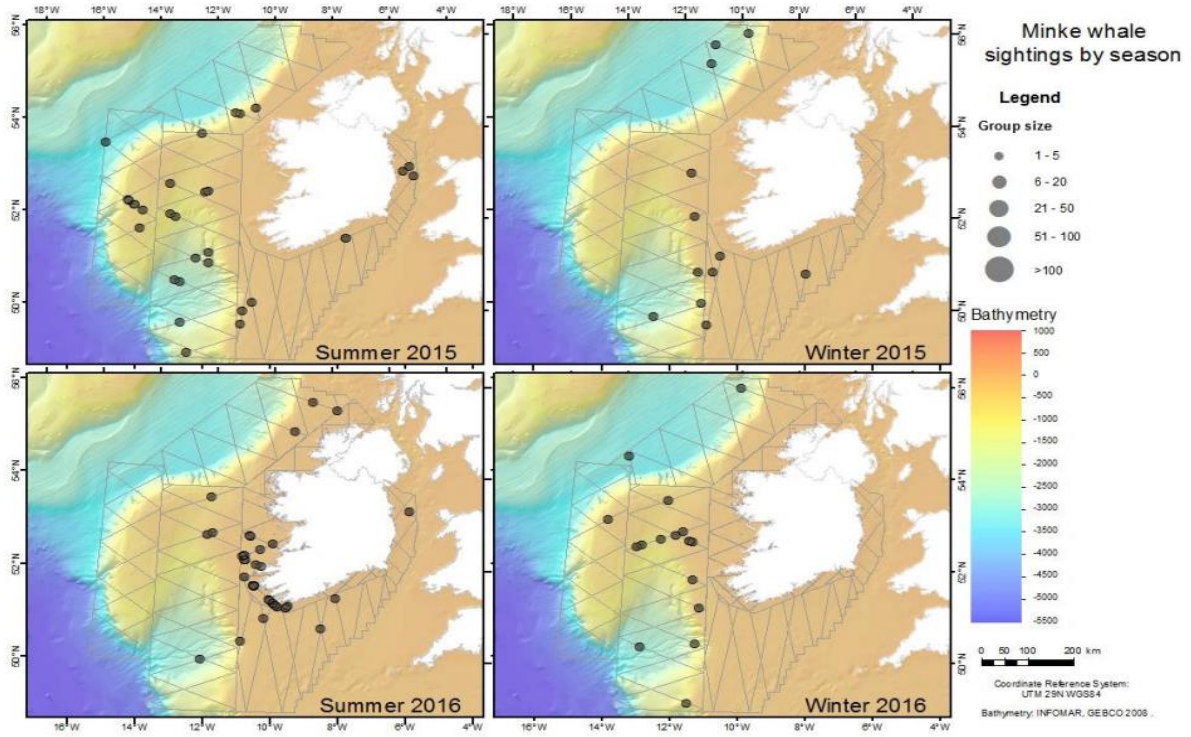

Figure 1.53: Sightings of minke whale in each survey period (bottom). Grey lines indicate the survey track lines along which sightings were made. Circles are proportional to the number of individuals in each sighting (Rogan *et al.,* 2018)

Seasonality

1.3.7.25 Minke whale shows high seasonality to the area, as a summer visitor, and in this respect is similar to the seasonality found in the North Sea where minke whale have been detected from May to November (Risch *et al.*, 2019). There is evidence that minke whale undertake large-scale seasonal migrations between feeding and breeding grounds (Risch *et al.,* 2014, Skaug *et al.,* 2004).

1.3.7.26 In Manx waters, minke whale are present between June and the end of November (Howe, 2018a). MWDW data shows higher numbers of minke whale sightings in months from June to November, and as detailed in **paragraph 1.3.3.48**, MWDW confirmed sightings data reflects a true seasonality of these cetaceans in Manx waters and that lower winter survey effort has not created a false seasonality (MWDW, personal communication, June 2023). **Figure 1.11** shows minke whale sightings from 2006 to 2022.

1.3.7.27 Howe (2018a) suggests a very clear spatial aspect to the distribution of minke whale sightings in Manx waters. In the summer (June to August), virtually all sightings are on the west coast of the island, whereas in the autumn (September to November), most sightings are on the east coast. As discussed in **paragraph 1.3.7.2** minke whale found in different areas in Manx waters appears to be driven by herring stocks,

with the distribution mirroring the distribution of the herring. Sightings in Irish waters also appear to reflect this seasonal pattern (Howe, 2018a).

1.3.7.28 Similarly, Baines and Evans (2012) suggest minke whale is a summer visitor to the region, with few sightings in winter, although this may partly be due to low effort at that period. There is no evidence as yet that the species breeds in Welsh waters. ObSERVE surveys in Irish waters also highlighted minke whale were more commonly sighted in summer, with sightings higher in summer 2015 and 2016, than winter, for Stratum 5 (West Irish Sea) area. Wall (2013) suggested highest relative abundances of minke whale were in the west Irish Sea in spring. Both peaks in relative abundance were thought to be due to whale foraging on concentrations of pelagic schooling fish (Wall, 2013). JCP Phase III data also showed higher estimated abundances of minke whale in summer in the Irish Sea than winter, spring and autumn.

1.3.7.29 The North East Atlantic Distribution Maps from Waggitt et al. (2020) (**Figure 1.48**) show higher densities of minke whale in July than January, and this is reflected in **Figure 1.49** and **Figure 1.50**, with higher densities around the study area from June to November (**Figure 1.50**).

1.3.7.30 The Welsh Marine Mammal Atlas (Evans and Waggitt, 2023) suggested strong seasonality in sightings with most occurring during April to September, some in and around the Celtic Deep in October to December, and very few between January and March. Survey effort was much lower in winter than in summer, so although sightings data likely reflects a general seasonal offshore movement into the Atlantic, some individuals likely remain in the region during winter, as revealed from casual sightings elsewhere in UK waters (Anderwald *et al.*, 2007).

1.3.7.31 Risch *et al.* (2019) also demonstrated strong diel periodicity, whereby during autumn and spring, minke whale pulse train detections showed calling rates were lowest during daylight and highest during the night. Diel variation in baleen whale vocalisations has also been attributed to prey distribution, with reduced vocalisation rates during active feeding and an increase in vocalisations in a social context at hours of lowest prey availability (Risch *et al*., 2019). Minke whale main prey items, such as sandeel species, show a strong diurnal pattern and are generally less available in the water column during the night (Risch *et al*., 2019).

1.3.8 Grey seal

Ecology

1.3.8.1 Grey seal is the larger of the two pinniped species which occur around the British Isles. Males weigh up to 300 kg and female up to 200 kg. Grey seal can live for over 20 to 30 years, with females tending to live longer than males (SCOS, 2015). Sexual maturity is reached at approximately ten years in males and five years in females (SCOS, 2015), and gestation occurs over ten to 11 months.

1.3.8.2 Grey seal gather in colonies on land (known as haul-outs) where they breed, rest, moult and engage in social activity. Russell and Lonergan

(2012) reported that haul-out events occur also at sea on exposed sandbanks, but their frequency is low, and their duration is on average shorter than those events on land. Breeding occurs between September to December and the annual moult between November to April (Harwood and Wylie, 1987). Female grey seals tend to return to the same breeding site at which they were born to give birth. Preferred breeding locations around the UK coast include rocky shores, beaches, caves, sandbanks and small, largely uninhabited islands. Pupping tends to take place between August and November (SCOS, 2018) in the UK, though there is a clockwise cline in mean birth date around the UK. The largest pupping sites are located in the Inner and Outer Hebrides, Orkney, Isle of May, Farne Islands and Donna Nook (JNCC, 2022g), with 84% of the population breeding in Scotland. There are however smaller colonies around Wales, including Lundy and islands off Pembrokeshire and the Llŷn Peninsula, and east Northern Ireland.

1.3.8.3 The distribution and size of the main grey seal breeding colonies is presented in **Figure 1.54** (SCOS, 2020), with blue ovals indicating groups of regularly monitored colonies within each region and blue circles represent number of pups born. Within the east coast region, estimates of the number of pups are based upon a combination of SMRU aerial surveys (north dashed area) and ground surveys (south dashed area) conducted Lincolnshire Wildlife Trust, National Trust and Friends of Horsey Seals.

1.3.8.4 There are seven designated seal haul-out sites in the South West Scotland MU, one of which overlaps into the North West England MU but these haul-outs are over ~67 km swimming distance away from the study area (**Table 1.10**) and therefore there is expected to be no direct impacts to seals on land while hauled-out at these designated sites.

1.3.8.5 In the Wales MU, monitoring focuses on two areas: North Wales (Dee Estuary- Aberystwyth) and West Wales (Aberystwyth – Caldey Island), with intensive monitoring of pup production focused on Bardsey Island, parts of Ramsey Island and Skomer Marine Conservation Area (SCOS, 2020). The largest grey seal breeding sites in Wales are Ramsey Island (designated as an NNR) and on Skomer and the adjacent Marloes Peninsula (which forms the Skomer MCZ) (SCOS, 2021). There is considerable uncertainty around the estimate for Wales MU, but comprehensive datasets from Bardsey Island and Hilbre Island show increasing mean counts (SCOS, 2020).

1.3.8.6 Within the North West England MU, the two main haul-outs are Hilbre Island in the Dee Estuary (which spans the Wales MU) (approximately 39.9 km from the Offshore Order Limits) and South Walney (approximately 28 km from the Offshore Order Limits). At South Walney counts by Cumbria Wildlife Trust and Walney Bird Observatory indicate that grey seal abundance is steadily increasing (SCOS, 2020).

1.3.8.7 There are no designated grey seal breeding colonies in the study area.

Table 1.10: Designated seal haul-out sites in the South West Scotland MU based on August survey counts (both grey seal and harbour seal). Information from SMRU

Site ID	Site Name	Location	Description	Distance from study area (km)
SW-006	Little Scares	Luce Bay, between Mull of Galloway and Burrow Head	Entire islands of the Big Scares and the Little Scares.	~67 km
SW-007	Solway Firth Outer Sandbank	Solway Firth, between Southerness Point and Dubmill Point	Intertidal mud banks south east of Southerness Point in the Solway Estuary.	~82 km
SW-001	Sanda and Sheep Island	Mull of Kintyre	Intertidal sandbanks and rocky coastline of Sanda and Sheep Island and associated rocky outcrops.	~157 km
SW-004	Yellow Rock	Ardnacross Bay, East Kintyre	Intertidal sandbanks and rocky coastline between Macringan's Point and the north end of Yellow Rock and associated rocky outcrops.	~175 km
SW-002	Sound of Pladda Skerries	South Arran	Intertidal sandbanks and rocky coastline between Port a Ghillie Ghlais and Port Dearg and associated rocky outcrops.	~167 km
SW-003	Rubha nan Sgarbh	Kilbrannan Sound, East Kintyre	Intertidal sandbanks and rocky coastline between Pluck Point and Sgorshuil and associated rocky outcrops.	~204 km
SW-005	Lady Isle	Firth of Clyde, West of Troon	Entire island of Lady Isle and associated rocky outcrops.	~183 km

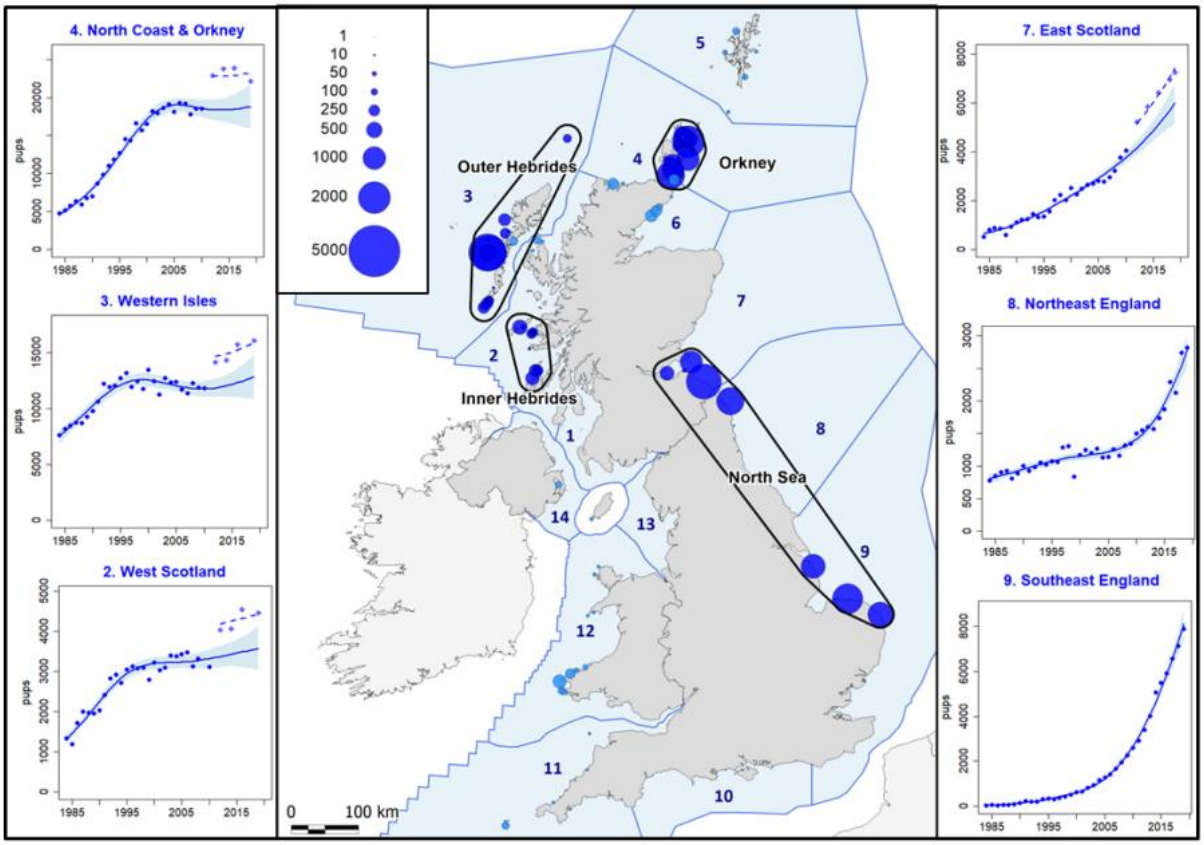

Figure 1.54: Distribution and estimated pup production of the main grey seal breeding colonies around the UK (SCOS, 2022)[7]

[7] Dark blue circles – regularly monitored, and light blue – sporadically monitored. Black polygons indicate regional groups of regularly monitored colonies and SMU boundaries are shown in blue. For regularly monitored colonies, on a SMU-scale, the pup production estimates by year, and predicted trend and associated 95% CIs, are shown. For aerially surveyed SMUs (2 to7), the dashed line shows the same trend as the solid line but at the level of pup production predicted from digital survey

1.3.8.8 Grey seal give birth to a single, white-coated pup which are weaned over a period of 17 to 23 days (SCOS, 2018), with the pups leaving the breeding site for the sea after approximately one month. Following this, the female comes into oestrus and mating occurs, after which adult grey seal return to sea to forage and build up fat reserves. Just before weaning the pups shed their white natal coat (lanugo) and develop their first adult coat. Moult occurs in stages at the colony with juvenile seal moulting first, followed by adults.

1.3.8.9 They are generalist feeders, foraging mainly on the seabed at depths of up to 100 m, although they are probably capable of feeding at all the depths found across the UK continental shelf. They take a wide variety of prey including sandeels, gadoids (cod, whiting, haddock, ling), and flatfish (plaice, sole, flounder, dab). Gosch (2017) reported that there are significant regional and temporal differences in the diet of grey seal. Seals in shallow waters show a preference for demersal and groundfish species such as cephalopods and flatfish, whilst seal foraging in deeper waters, over sandy substrates, will target pelagic and bentho-pelagic species such as blue whiting *Micromesistius poutassou* and sandeels (Gosch, 2017). Food requirements depend on the size of the seal and fat content (oiliness) of the prey, but an average consumption estimate of an adult is 4 to 7 kg of fish per seal per day depending on the prey species. Studies of seal diet in the west Irish Sea found gadoids were the main prey species among the 19 species identified in stomach samples from by-caught seals (n = 17) (Kiely *et al.*, 2000), whilst seal faecal samples collected at haul-out sites between 1997 and 1998 showed 23 species of prey with gadoids and flatfish dominant in the diet. *Trisopterus* species (Bib, Norway Pout and Poor Cod), plaice and whiting appeared to be the most important species in the diet of grey seal in the west Irish Sea (Kiely *et al.*, 2000).

1.3.8.10 Grey seal tend to forage in the open sea, returning to land regularly to haul out. Foraging trips can be wide-ranging; tracking data from Carter *et al.,* 2022 showed a maximum foraging range of 448 km. However, tracking studies have shown that most foraging is likely to occur within 100 km of a haul-out site (SCOS, 2018). Foraging trips can last anywhere between 1 and 30 days. Movements of grey seal between haul-out sites in the North Sea and haul-out sites in the Outer Hebrides have been recorded as well as movements from sites in Wales and north west France, to the Inner Hebrides (SCOS, 2020). Grey seal swim at an average of 1-2 ms^{-1} (Gallon *et al.*, 2007) and dive to depths of up to 100 m (SCOS, 2015), though they have been recorded at much greater depths.

Distribution and occurrence

1.3.8.11 Globally there are three centres of grey seal abundance: one in the east of Canada and the north east USA, a second around the coast of the UK, especially in Scottish coastal waters, and a third, smaller group in the Baltic Sea. All populations are known to be increasing (SCOS, 2020). Approximately 35% of the world population occurs in the UK

(SCOS, 2021), and 82% of the European population. Grey seal numbers around the UK have increased steadily over the past 60 years since survey effort began, but the rate of population growth varies among regions (Thomas *et al.,* 2019).

1.3.8.12 Population size is derived by extrapolation of pup production surveys and demographic parameters, and the total UK grey seal population of at the start of the 2020 breeding season (before pups are born) was estimated at 157,300 individuals (approximate 95% CI = 144,600 to169,400) (SCOS, 2021) (**Table 1.11**), and the overall UK pup production increased by <1.5% per annum between 2016 and 2019 but growth was mainly limited to the North Sea colonies along the east coast of Scotland and England, rather than the Irish Sea.

Table 1.11: Grey seal pup production by country (based on 2019 pup production estimates), and total population estimates at the start of the 2020 breeding season (SCOS, 2021)

Location	Pup production in 2019[1]	2020 Population Estimate[2]
England	11,300	30,700
Wales	2,250	5,200
Scotland	54,050	120,800
Northern Ireland	250	600
Total	**67,850**	**157,300**

1. Rounded to nearest 50.

2. Rounded to nearest 100.

1.3.8.13 Grey seal pup production in 2019 of 2,250 pups presented in SCOS (2021) resulted in a 2020 population estimate of 5,200 individuals in Wales. The largest breeding population in the Irish Sea and south west UK is located in Pembrokeshire, accounting for 4% of the UK grey seal breeding population (Strong and Morris 2010; Stringell *et al*. 2014). The majority of this pup production is located around Yyns Dewi/Ramsey Island and the north Pembrokeshire mainland coast between St Davids Head and the Teifi Estuary (Morgan *et al.,* 2018). In north Wales, smaller breeding populations can be found on the west coast of Anglesey and the Llŷn Peninsula. Grey seal pup production in the North West England MU is comparatively low compared to that of the Wales MU, whilst in the Northern Ireland MU, the majority of grey seal pups are born in Strangford Lough where the National Trust estimated a pup production of 181 in 2019. There are no regularly monitored grey seal breeding sites within the South West Scotland MU.

1.3.8.14 Population studies of the Celtic and Irish Sea have revealed that grey seal are present year-round on both the Irish and Welsh coasts. Seals are known to move between the two areas, with highest numbers of seals seen to move between the south east coast of Ireland and the south west coast of Wales (Kiely *et al*., 2000). Telemetry studies at five SACs across the UK demonstrated adults and pups travel between Pembrokeshire Marine SAC, Llŷn Peninsula and the Sarnau SAC and the Saltee Islands SAC (Ireland) (SCOS, 2014).

1.3.8.15 Haul-out counts were provided by SMRU (**Table 1.12**). In the South West Scotland MU, the main haul-outs sites where grey seal has been counted are located in the north region of the MU, with comparatively higher counts than harbour seal along the south coast of the MU. From 1997 to 2018, the August grey seal haul-out counts have increased, and haul-out locations remain consistent throughout the years.

Table 1.12: Grey seal August haul-out counts for various survey periods. Data from SCOS (2020), provided by SMRU

Location	Measure	1996 to 1997	2000 to 2006	2007 to 2009	2011 to 2015	2016- to 2019
Wales[1]	Count	-	750	750	850	900
	Population estimate	-	3,138	3,138	3,556	3,766
North West England[1]	Count	-	30	30	50	250
	Population estimate	-	126	126	209	1,046
Northern Ireland[2]	Count	-	272	243	468	505
	Population estimate	-	1,138	1,017	1,958	2,113
South West Scotland	Count	75	206	233	374	517
	Population estimate	314	862	975	1,565	2,163

[1] No SMRU surveys, but some data available. Estimates compiled from counts shared by other organisations (Langstone Harbour Board & Chichester Harbour Conservancy, Natural England, Natural Resources Wales, RSPB, Hilbre Bird Observatory) or found in reports & on websites (Boyle, 2012; Büche & Stubbings, 2019; Hilbrebirdobs blogspot; Leeney et al., 2010; Sayer, 2010, 2011, 2012a, 2012b; Sayer et al., 2012; Westcott, 2002, 2009; Westcott & Stringell, 2004; Woodfin Jones, 2019). Apparent increases may partly be due to increased reporting.

[2] Surveys carried out by SMRU and funded by Northern Ireland Environment Agency (NIEA) in 2002, 2011 & 2018 (Morris & Duck, 2019a) and Marine Current Turbines Ltd in 2006-2008 & 2010 (SMRU Ltd, 2010).

1.3.8.16 In the North West England MU there are two main grey seal haul-out sites: one in the Dee Estuary on the Welsh-English border (Hilbre Island), and South Walney. In 2019 and 2020, the August count at Walney Island was 248 and 300 adults, respectively. It has been a pupping site since 2015 and numbers are currently still low (2 to10 pups produced per year), however, data suggests grey seal abundance is steadily increasing (SCOS, 2020). Less extensive monitoring has occurred at the Dee Estuary haul-out site (SCOS, 2020). In north Wales, grey seal mainly haul-out around the coast of Anglesey (including the Skerries), around Llandudno (Angel Bay) and the Dee Estuary (Hilbre North and West Hoyle Sandbank). At the Dee Estuary, there were 236 unique individuals identified by left head extracts from the EIRPHOT database, and photo-ID data showed connectivity between the Dee Estuary and the Skerries, with some connectivity with Cardigan Bay and Skomer (Langley *et al*., 2018). Monitoring of grey seal by the Angel Bay Seal Volunteer Group has been conducted at Angel Bay, Llandudno (Porth Dyniewaid) since 2016 and they are now additionally monitoring at Pigeon's Cave, on Great Orme (Angel Bay Seal Volunteer Group, 2021). In Northern Ireland, grey seal mainly haul

out in Carlingford Lough, Murlough SAC, Strangford Narrows, North and South Rocks (east of the Ards), the Copeland Islands and Rathlin Island (Duck and Morris, 2019).

1.3.8.17 SACs designated for grey seal in the regional study area include Cardigan Bay SAC (qualifying feature), Pembrokeshire Marine SAC (primary feature), Pen Llŷn a'r Sarnau/Llŷn Peninsula and the Sarnau SAC (qualifying feature), and The Maidens SAC (qualifying feature). Pembrokeshire Marine SAC is representative of grey seal colonies in the south west part of the breeding range in the UK and is the largest breeding colony on the west coast south of the Solway Firth, representing over 2% of annual UK pup production (JNCC, 2022d). Telemetry studies from Carter *et al*. (2020) include tagging deployments from Ramsey and Skomer Islands, Bardsey Island and the Dee Estuary and shows that seals hauling out at one SAC during the foraging season may comprise breeding stock from another (Carter *et al*., 2020).

1.3.8.18 Connectivity between breeding stocks was reflected in a research study by Langley *et al*. (2020) who suggested inter-annual breeding is high in the Irish Sea. The study utilised the EIRPHOT database to look at spatial connectivity of haul-out sites and fidelity of adult females to breeding sites. Locations within EIRPHOT were largely along the Welsh coast and islands (n = 246), with other sites in Ireland (n = 23), Isle of Man (n = 3), England (n = 1), Scotland (n = 1) and France (n = 1). The Dee Estuary and Skerries were amongst the sites reported on in Langley *et al*. (2020) and are located closest to the Morgan Offshore Wind Project: Generation Assets. Results showed adjacent locations (such as Llŷn Peninsula and Bardsey) were highly connected (spatial transition probability = 0.7) but that there were still connections across the entire region, up to 230 km apart (e.g. Skomer and Dee Estuary, spatial transition probability = 0.004). Skomer was the most connected, with individuals moving between Skomer and all other broad areas, whilst the Dee Estuary was one of the least connected areas. The study highlighted extensive site use beyond protected areas, and thus grey seal should be expected widely within the Irish Sea.

1.3.8.19 Adult grey seal telemetry data provided by SMRU demonstrated that there is a high level of connectivity between the study area and the Pen Llŷn a'r Sarnau/Llŷn Peninsula, the Sarnau SAC and the Pembrokeshire Marine/Sir Benfro Forol SAC and the Cardigan Bay SAC and lower levels of connectivity with grey seal SACs at further distances from the study area (**Figure 1.55**).

1.3.8.20 The Wright and Sinclair (2022) telemetry data showed a total of 43 adult grey seal occurring within the four SMUs covering the Irish Sea. Thirty-nine adult grey seal (and one juvenile) were tagged in the Wales MU between 2004 and 2018, and recorded tracks throughout the regional study area. No adult grey seal were tagged in the North West England, South West Scotland or Northern Ireland MUs. An additional four grey seal were tagged in the adjacent West Scotland MU, to the north of the South West Scotland MU, with tracks seen across the north part of the Irish Sea and down the east coast of Ireland.

1.3.8.21 Of the 43 adult grey seal that were recorded within the regional study area, there was (non-exclusive) connectivity with several UK and Irish grey seal SACs: 17 with Llŷn Peninsula and the Sarnau SAC (39.5%), 14 with Pembrokeshire Marine SAC (32.6%), 10 with Cardigan Bay SAC (18.6%), four with Saltee Islands SAC (Ireland) (9.3%), one with The Maidens SAC (2.3%) and one with Lundy SAC (South west England MU) (2.3%). Some individuals visited multiple SACs. Of these adult grey seal, 36 recorded tracks within a 100 km buffer of the Transmission Assets. Nineteen of those showed connectivity to the surrounding SACs Llŷn Peninsula and the Sarnau SAC, Pembrokeshire Marine SAC, Saltee Islands SAC and The Maidens SAC) suggesting a high level of connectivity between SACs and the Transmission Assets marine mammals study area.

1.3.8.22 For pups and juvenile grey seal (**Figure 1.56**), movement data obtained from telemetry tags may not be representative of the typical movement patterns of adult grey seal. One juvenile grey seal and 17 grey seal pups were tagged in the Wales MU between 2009 and 2017 (no grey seal juvenile/pups were tagged in the North West England, South West Scotland or Northern Ireland MUs). Juvenile/pups showed non-exclusive connectivity to multiple SACs: 11 juveniles/pups with Pembrokeshire Marine (61.1%), 10 with Llŷn Peninsula and the Sarnau SAC (55.6%), four with Cardigan Bay SAC (22.2%), four with Saltee Islands SAC (22.2%), two with Isle of Scilly Complex SAC (11.1%). Of these 18 juvenile/pups, 13 recorded telemetry tracks within a 100 km buffer of the study area, 11 of which showed connectivity to surrounding SACs (**Figure 1.57**).

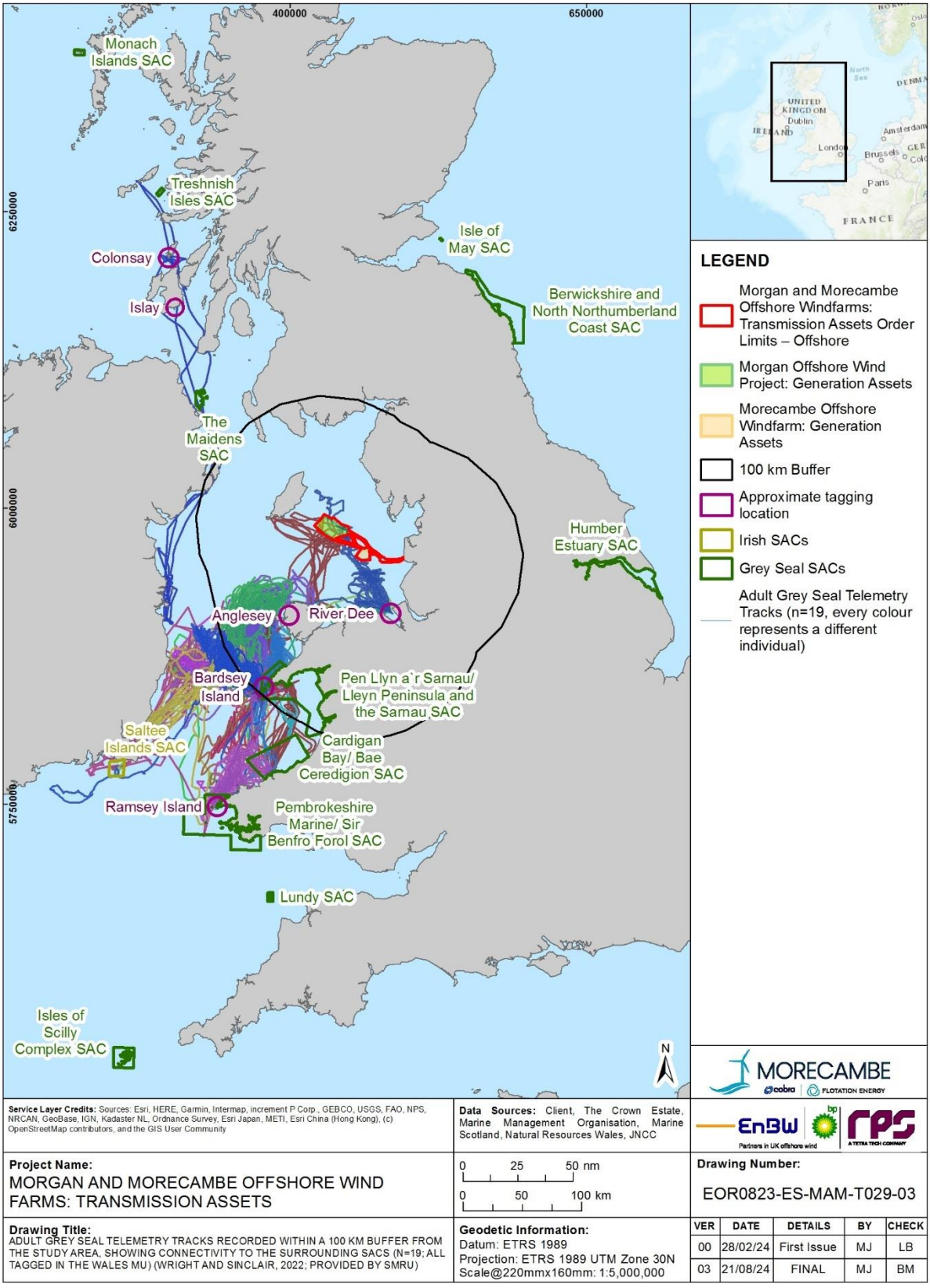

Figure 1.55: Adult grey seal telemetry tracks recorded within a 100 km buffer, showing connectivity to the surrounding SACs (n=19; all tagged in the Wales MU) (Wright and Sinclair, 2022; provided by SMRU)

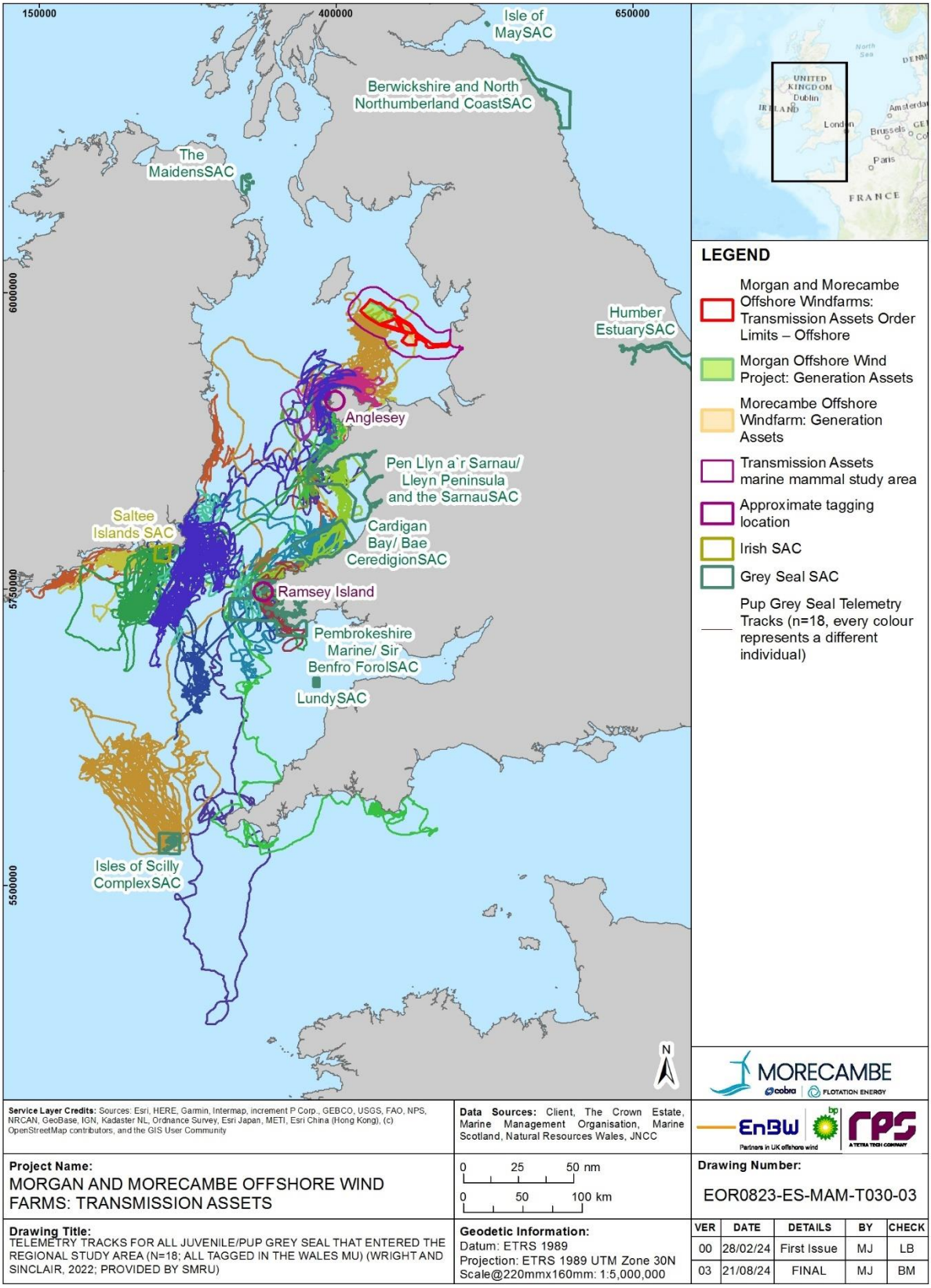

Figure 1.56: Telemetry tracks for all juvenile/pup grey seal that entered the regional study area (n=18; all tagged in the Wales MU) (Wright and Sinclair, 2022; provided by SMRU)

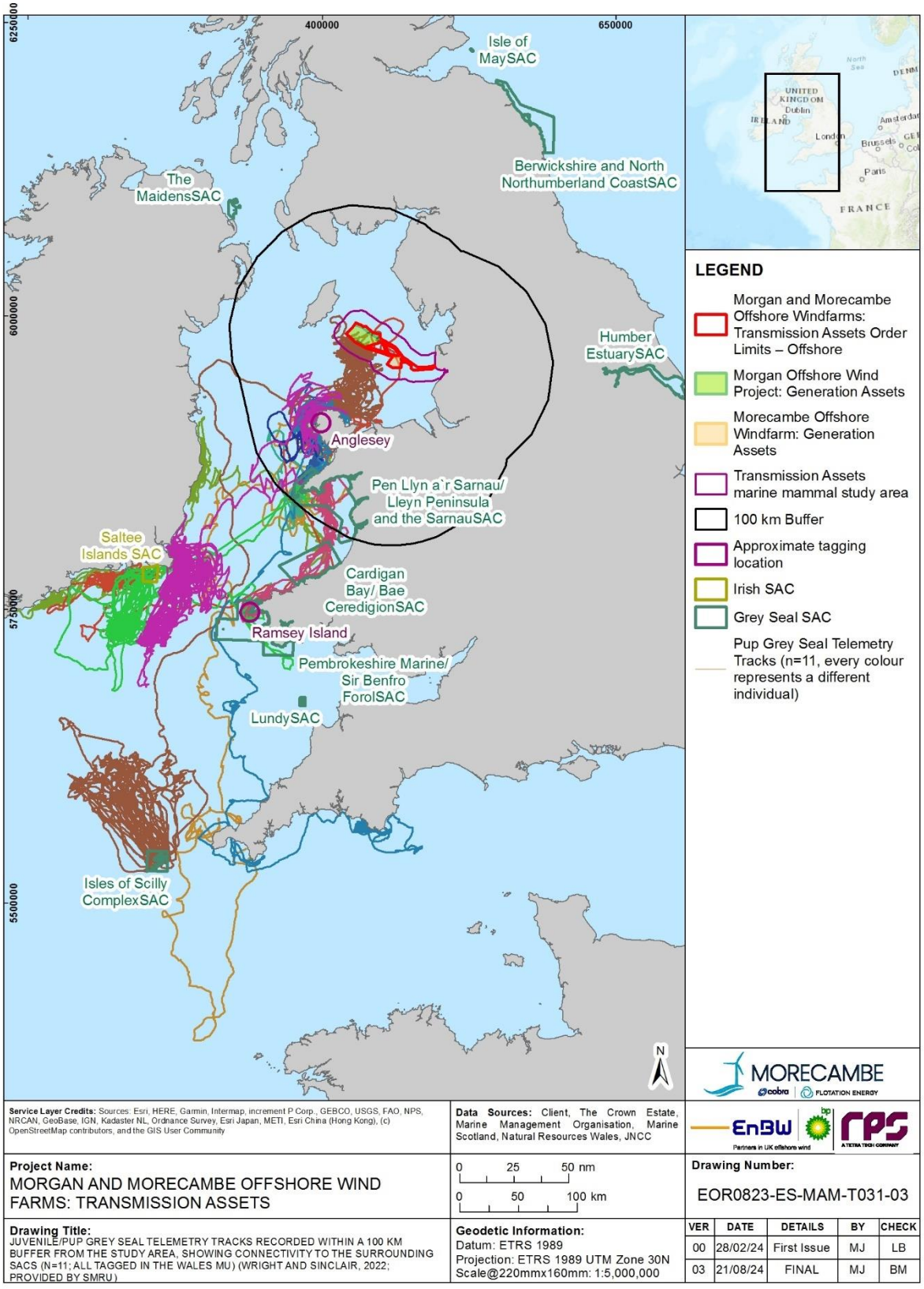

Figure 1.57: Juvenile/pup grey seal telemetry tracks recorded within a 100 km buffer from the study area, showing connectivity to the surrounding SACs (n=11; all tagged in the Wales MU) (Wright and Sinclair, 2022; provided by SMRU)

1.3.8.23 The most recent UK-wide study of at-sea distribution for grey seal by Carter *et al*. (2022) demonstrated areas of high use around Liverpool Bay, the east coast of Ireland and to the north west of the Isle of Man. Finer scale seasonal movements were also identified in the study, with seals transitioning between sites within the Irish Sea, but not leaving Wales. This confirms at-sea usage maps by Carter *et al*. (2020) which highlighted some higher densities observed around Liverpool Bay, which overlaps the study area (see densities in **paragraph 1.3.8.29**).

1.3.8.24 Duck and Morris (2019) conducted thermal-imaging surveys of grey seal around Ireland in August 2017 and 2018, with the Irish coast divided into five regions, east, south east, south west, west and north. In all surveys the greatest proportion of grey seal were counted in the west of Ireland. In the east and south east, closest to the Morgan Offshore Wind Project: Generation Assets, the grey seal count was substantially higher in 2017/2018 than in 2011/2012. The 2017/2018 survey found that there is currently only very little spatial overlap between major haul-out aggregations of harbour seal and grey seal in Ireland.

Isle of Man grey seals

1.3.8.25 The Isle of Man is an important area for grey seal, which use coastal areas all around the Manx coast (Howe, 2018b). Howe (2018b) suggests that a number of animals are fairly resident to the Island, but a much higher number of transient individuals visit the Island. Observational sightings provided by MWT surveys of the Isle of Man from 2017 to 2022 showed grey seal around the entire coastline of the Island (**Figure 1.13**). Targeted seal surveys carried out in 2017 (**Figure 1.14**) showed a reduced distribution of grey seal along the coast, with particularly high densities on the Calf of Man and around Maughold.

1.3.8.26 Key haul-out sites include the Calf of Man, The Sound, Langness and Maughold. The Calf of Man is the main pupping site for grey seal around the Isle of Man with high counts of pups in all years from 2017 to 2021 (**Figure 1.12**) (MWT, 2022), and fidelity to pupping locations apparent on the Calf of Man (Howe, 2018b). The 2021 Calf of Man Seal Survey (Stokes and Young, 2021) recorded 62 pups on the Calf of Man over the survey (the same value as in 2020), with historical data ranging from a minimum of 26 pups counted in 2009 to a maximum of 84 pups in 2016. However, pupping also occurs elsewhere around the Isle of Man coast, for example around the south west coast and at Maughold (**Figure 1.13**). Recently, the Point of Ayre has become an important haul out site for grey seals, with over 100 animals seen regularly (highest count at 160) (MWT, pers. Comms., 2023). Gob Garvain, Santon head, Maughold Head, Clay Head and Contrary Head have also been highlighted as important sites for grey seals, though are not designated sites (MWT, pers. Comms., 2023).

1.3.8.27 MWT also highlighted (through photo identification work) mobile connectivity of seals on the Isle of Man with other areas in the regional study area. One grey seal (“Tulip Belle”) has been identified by the Cornwall Seal Group Research Trust, in Cornwall, over several years,

demonstrating movement between the Calf of Man and Cornwall (MWT, pers. Comms., 2023). In August 2023 a grey seal from Cornwall was observed in Manx waters (near Fleshwick, north of Port Erin); confirmed by the flipper tag and obvious scar on its side (MWT, personal communication, 2023).

Density/abundance

Density

1.3.8.28 A study of UK-wide at-sea distribution for grey seal by Carter *et al.* (2022) demonstrated areas of high use around Liverpool Bay, the east coast of Ireland and to the north west of the Isle of Man (**Figure 1.58**). These maps improve on those in Carter *et al.* (2020) and have increased potential for ecological insights on both regional and population wide scales. Finer scale seasonal movements were also identified Carter *et al*, (2020), with seals transitioning between sites within the Irish Sea, but not leaving Wales.

1.3.8.29 Average grey seal densities from Carter *et al.* (2022) for the study area were estimated at 2.70 animals per 25 km^2 (=0.108 animals per km^2) (**Figure 1.59**), with some areas of high density (>10 to 50 animals per 25 km^2) towards the coast in the study area. The figure shows areas of high density at seal usage in the inshore areas of Liverpool Bay (up to >100 animals per 25 km^2) to the south of the study area, and moderate densities (>5 to 10 animals per 25 km^2) further out from Liverpool Bay towards the Isle of Man. Therefore, the density of 0.108 animals per km^2 will be carried forward to the assessment.

1.3.8.30 SMRU seal tagging data also showed grey seal tracks have been recorded throughout the regional study area, with a higher density of tracks in the south region of the regional study area in the North West England and Wales MUs and a lower density in the north region of the regional study area.

1.3.8.31 The Mona Offshore Wind Project presented both design-based and model-based densities for the Mona Array Area for grey seal (Mona Offshore Wind Ltd, 2024). Design-based approach gave a mean absolute density of 0.109 animals per km^2 for the Mona Aerial Survey Area across the months, with highest densities for March (0.205 animals per km^2) and lowest in May (0.03 animals per km^2). The most biologically relevant design-based estimates by “bio-season” (pupping versus non-pupping season) predicted a mean absolute density (i.e. adjusted for availability bias) of 0.049 in the pupping season and 0.139 in the non-pupping season. A model-based approach gave an average absolute density estimate of 0.020 animals per km^2 per month with the highest densities for March and December (0.042 animals per km^2, 95% CI = 0.028 to 0.057) and lowest for May (0.003 animals per km^2, CI = 0.002 to 0.004). The most biologically relevant model was observed in the “bio-season” model (pupping versus non-pupping season) which predicted a mean absolute density (model based) of 0.016 animals/km^2 (95% CI = 0.005 to 0.026, CV = 0.264) during the pupping season and 0.023 animals/km^2 (95% CI: 0.015 to 0.036, CV =

0.274) during the non-pupping season for the Mona Aerial Survey Area. Spatial density mapping using linear models showed relative higher densities in the north west and south east of the Mona Aerial Survey Area.

1.3.8.32 Both design-based and model-based grey seal densities are presented from aerial digital survey data for the Morgan Offshore Wind Project: Generation Assets (**Appendix A**). The design-based approach gave a mean absolute density of 0.099 animals per km^2 across the 24 survey months, with highest densities for March (0.182 animals per km^2) and lowest in November (0.036 animals per km^2). Model-based approach gave an average absolute density estimate of 0.019 animals per km^2 per month with the highest densities for December (0.035 animals per km^2, 95% CI = 0.041 to 0.067) and lowest for March (0.0104 animals per km^2, 95% CI = 0.000 to 0.221). The 'bio-season' model predicted a mean absolute density of 0.0184 animals per km^2 (95% CI = 0.0028 to 0.0378) during the pupping season, and 0.0196 animals per km^2 (95% CI = 0.0014 to 0.0400) during the non-pupping season.

1.3.8.33 Spatial density mapping for the Morgan Offshore Wind Project: Generation Assets (**Appendix A**), using linear models, showed relative higher densities in the non-pupping season for the Morgan Offshore Wind Project: Generation Assets, but densities were distributed throughout the area, with some higher densities towards the north east and east of the Morgan Aerial Survey Area. Therefore, there may be some higher densities in the non-pupping season for Transmission Assets, and higher densities towards the north east and east of the study area.

1.3.8.34 Aerial survey data for the Morecambe Offshore Windfarm: Generation Assets (**Appendix B**) presented apportioned absolute density estimates for grey seal for the 24 month survey period (March 2021 to February 2023). The maximum absolute density estimates (apportioned) over the 24 months of surveys ranged from 0.01 to 0.06 for the whole survey area. The average for the summer period (April to September) was 0.032 for the whole survey area and for the winter period (October to March) was 0.024 for the whole survey area. The annual average maximum absolute density estimate (apportioned) for the whole survey area is 0.0284. **Appendix B** highlights that site-specific density estimates for the whole survey area were lower than density estimates derived from the data provided by Carter *et al.* (2022) for the Morecambe Offshore Windfarm: Generation Assets.

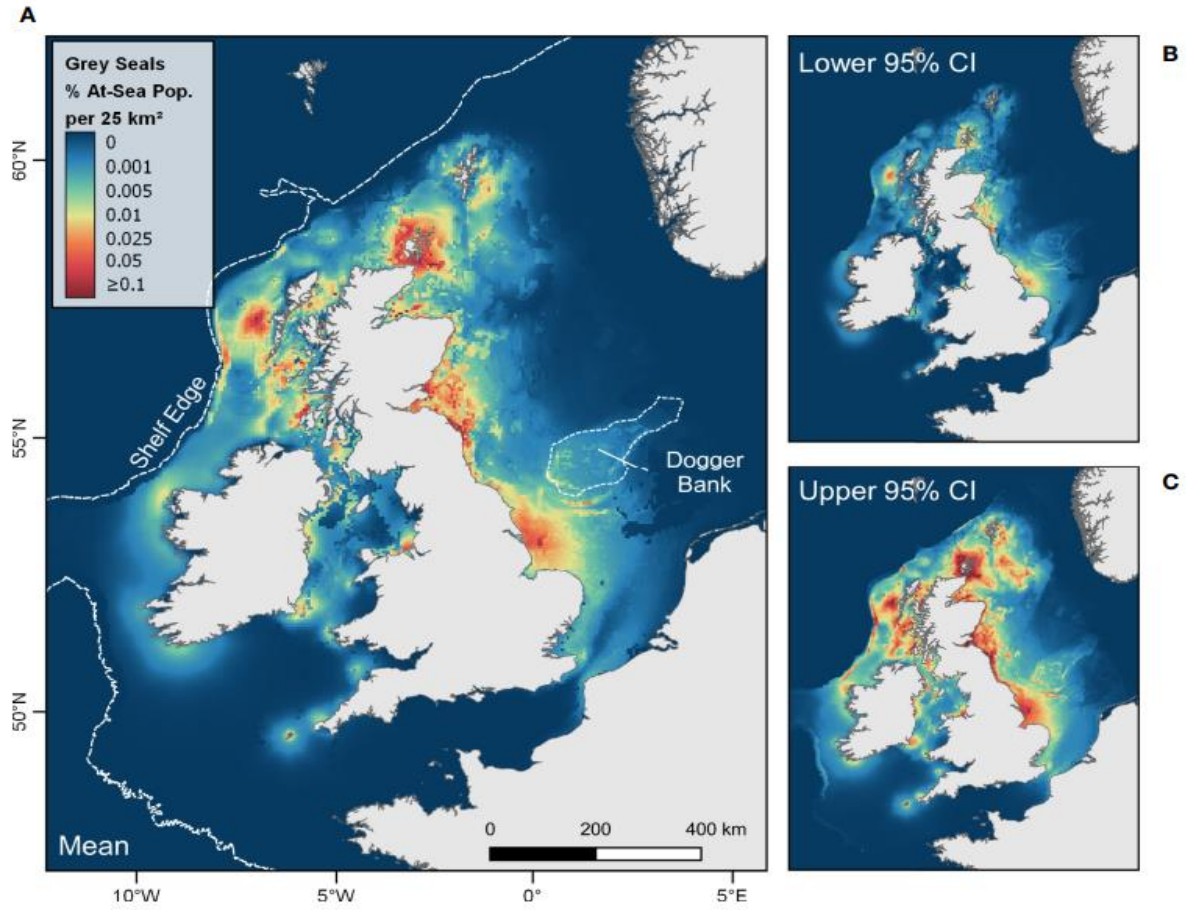

Figure 1.58: Grey seal at-sea distribution maps (Carter *et al.*, 2022)

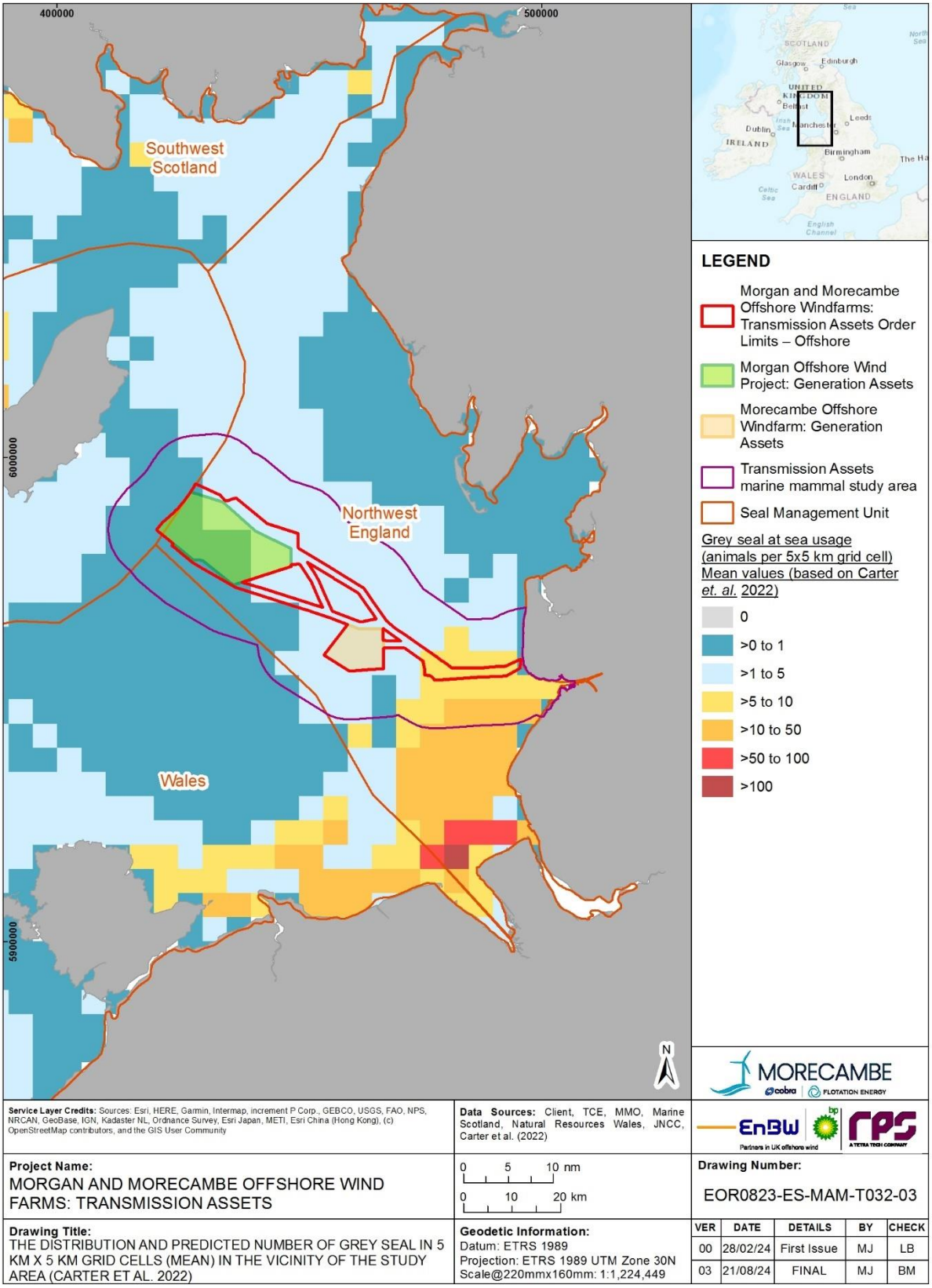

Figure 1.59: The distribution and predicted number of grey seal in 5 km x 5 km grid cells (mean) in the vicinity of the study area (Carter *et al.* 2022)

Summary of densities

1.3.8.35 For grey seal, there are areas of high use around Liverpool Bay, the east coast of Ireland and to the north west of the Isle of Man. Carter *et al.* (2022) represents the most recent revised estimated at-sea distribution usage maps for both grey and harbour seal based on habitat association modelling. The peer-reviewed study uses an extensive high-resolution GPS tracking dataset containing 114 grey and 239 harbour seal to model habitat preference and generate at-sea distribution estimates for the entire UK and Ireland populations of both species. Previous studies predicted seal distribution, but no study has previously used habitat preference to generate distribution estimates for the whole of the UK and Ireland.

1.3.8.36 Therefore, the density taken forward to the assessment is the mean grey seal density for the study area from Carter *et al.* (2022), which is 0.108 animals per km^2. It is the most robust estimate of grey seal density in the absence of any site-specific surveys for the Transmission Assets.

Abundance

1.3.8.37 Grey seal population trends are assessed from the counts of pups born during the autumn breeding season, when females congregate on land to give birth (SCOS, 2020). SCOS (2022) was the most recent report to present August counts of grey seals at haul out sites in the British Isles by SMUs. A total count of 40,586 grey seal was given for Great Britain in 2021 (41,135 grey seal in the UK and 44,833 including the Republic of Ireland). It is estimated that 25.15% of the total grey seal population are hauled-out and available to count during August surveys (Russell *et al.,* 2016 *in* SCOS, 2022) and therefore the total number of grey seal in the population for the count period of 2016 to 2019, accounting for those at-sea at the time of the August count, is estimated to be ~161,400 grey seal in Great Britain (~163,500 in the UK and ~178,250 including Ireland).

1.3.8.38 The latest SCOS (2022) report presented a total population estimate (not by SMU) for the UK (therefore not including the Republic of Ireland) of 162,000 animals (approximate 95% CI = 146,700 to 178,500) at the start of the 2022 breeding season (before pups are born). This represents an increase of approximately 1.6% over the previous year (SCOS, 2022).

1.3.8.39 Russell *et al.* (2016) previously estimated that 23.9% of the total grey seal population are hauled-out and available to count during August surveys based upon 25 GPS tagged seals. However, this was subsequently updated in SCOS (2021) and was also adopted by SCOS (2022). A large grey seal tagging programme increased sample size (n=60) allowing the analysis to be revisited, and provides a new mean estimate of the percentage of the population hauled out of 25.15% (95% CI = 21.45 to 29.07%).

1.3.8.40 Broad scale data primarily includes the SCOS SMUs which are currently used as the relevant MUs in the absence of defined SMUs

from the IAMMWG (2023). Relevant counts from SMUs are presented in SCOS (2022), and include Wales, North West England, Northern Ireland and South West Scotland (**Figure 1.60**). SCOS (2022) states there is limited data for SMUs 10 to 13 (which includes Wales and North West England) and values given are rough estimates, advising caution during interpretation. Abundance is estimated from counts per SMU, scaling counts by the previously mentioned assumption that on average 25.15% of the population are hauled out at any one time (see **paragraph 1.3.8.39**).

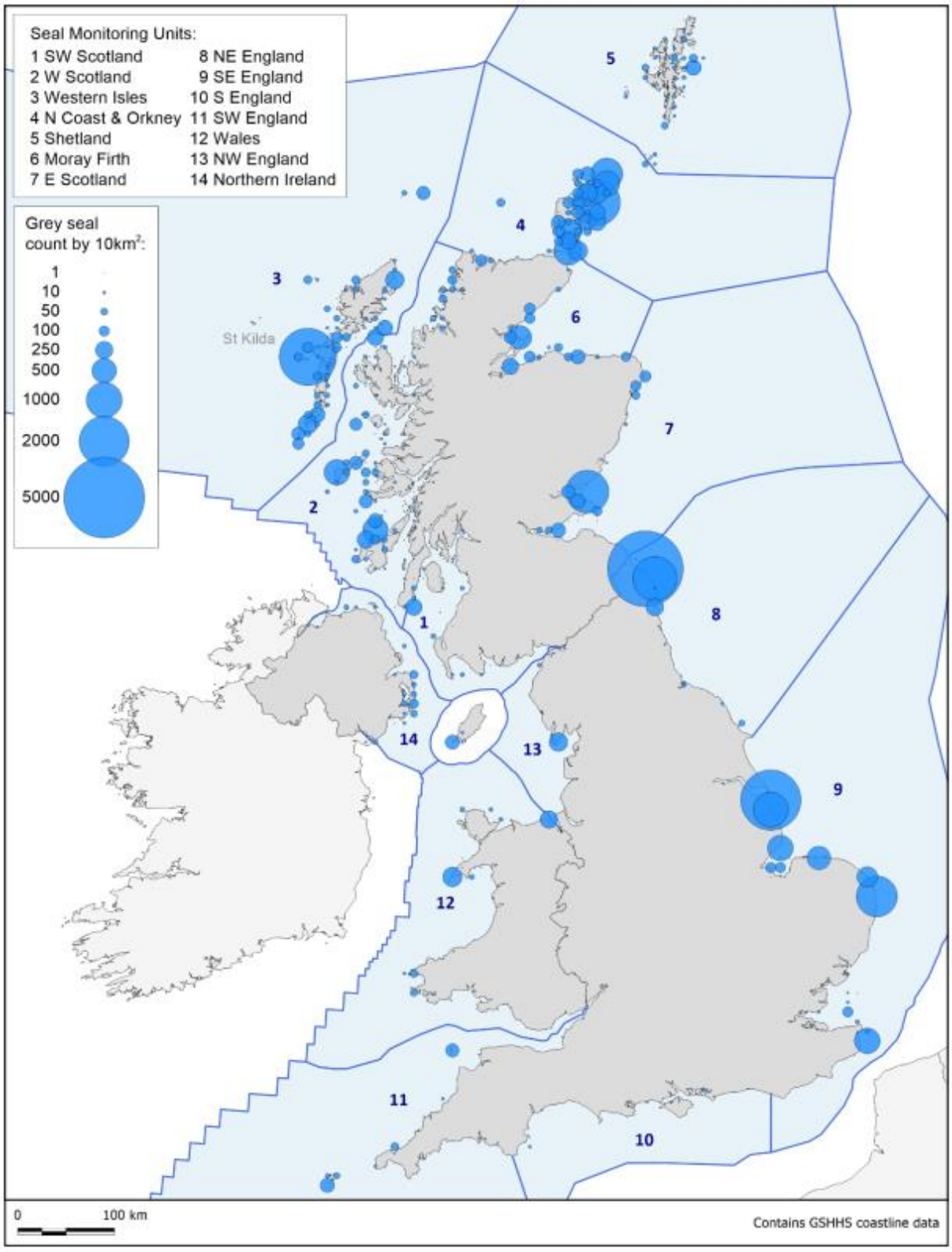

Figure 1.60: August distribution of grey seal around the British Isles by 10 km squares based on the most recent available haul-out count data collected up until 2021 (limited data available for SMUs 10 to 13) (SCOS, 2022)

1.3.8.41 Estimates of grey seal counted in August 2018 in the Wales MU and North West England MU were 900 and 250, respectively, and updated count estimates provided for 2021 were given as 900 and 300, respectively (SCOS, 2022). Extrapolating to population estimates based on the proportion hauled-out (25.15%) gives grey seal population estimates for the Wales and North West England MUs of approximately 3,579 and 1,193 grey seal, respectively. However, given the lack of dedicated SMRU surveys in these areas, this estimate should be considered with caution due to the limited data used to inform the estimate. Additional data was available from other organisations and it is highlighted that increases in population estimates may partly be due to increased reporting and improved species identification.

1.3.8.42 In the South West Scotland MU, counts have seen a steady increase from 75 in the 1997 to 1997 period to 517 in the 2016 to 2019 period (an updated count estimate was not provided in SCOS, 2022). The August haul-out count of 517 can be scaled to account for the proportion of the population hauled-out at the time of the survey, resulting in a population estimate of 2,065 grey seal in the South West Scotland MU.

1.3.8.43 In the Northern Ireland MU, the most recent August haul-out survey conducted in 2018 showed an estimated count of 505 grey seal, which has been updated by the SCOS (2022) report to 549 animals, resulting in a population estimate of 2,183 grey seal in the Northern Ireland MU. There is an indication of an increasing population within these areas however due to the lack of dedicated surveys, a population trend could not be estimated (SCOS, 2021).

1.3.8.44 Several studies focused on smaller areas such as the Irish Sea, or Wales. Population size and seasonal distribution of grey seal at principal haul-out sites in the central and south Irish Sea were investigated in an Interregional cooperation (INTERREG) Programme study conducted between 1996 and 1998 (Kiely, *et al.* 2000). This study included ground counts of annual pup production, which recorded 177 new-born pups at Irish study sites and 744 pups at sites spanning Ceredigion, north Pembrokeshire and Ramsey Island in South West Wales. All-age population estimates for the Irish Sea were 5,198 to 6,976 grey seal and was supported by photo-identification CMR data which delivered an estimate of 5,613 seal (CV = 0.2%).

1.3.8.45 For Ireland, Ó Cadhla *et al.* (2007) provided the first grey seal population size in 2005, which gave a definitive minimum population estimate of 5,509 to 7,083 grey seals of all ages for the Republic of Ireland. Following SMRU methods to assess breeding population size, this was revised to 5,859 to 7,533 grey seal of all ages, and population estimate of 1,574 pups for the Republic of Ireland and approximately 100 pups for Northern Ireland in 2005 (SCOS, 2007). Ground truthing was also included in the 2005 study which suggested a slight under-recording of the true number of pups present due to reliance on aerial imagery.

1.3.8.46 For Welsh waters, the West Wales Grey Seal Census established a core concentration of breeding grey seal, with all-age estimates of 5000 animals for west Wales (Baines *et al.*, 1995). Major haul-out sites were also identified in North Wales (Llŷn Peninsula, Anglesey and West Hoyle Sandbank) in census studies by Westcott (2002) and Westcott and Stringell (2002; 2003; 2004). Westcott (2002) tentatively estimated the total number of grey seal at North Wales sites as 365 for 2001 to 2002, whilst Westcott and Stringell (2003) estimated the 2002-2003 population as 385 seal, based upon 110 pups and the same correction factor of 3.5. This correction factor is derived from a life table in Hewer (1964) to calculate seal population numbers from the number of pups born. In 2006, grey seal monitoring at the Pembrokeshire Marine SAC incorporating Ramsey Island gave estimates of 788 grey seal (adults and juveniles) on Pembrokeshire mainland (Strong *et al.*, 2006).

1.3.8.47 The Manx Marine Environmental Assessment details an estimate of 350 to 400 individuals on the Isle of Man (Howe, 2018b). Monthly counts on the island recorded from snapshot surveys have ranged from 135 to 405 individuals (Sharpe, 2007). MWT (pers. Comm, 2023) reported 365 seals in 2017 during an island-wide survey in 2017, though this was a one-off snapshot during October and November. The Calf of Man seal catalogue has around 450 individuals, but this covers the span of the programme from 2009 to 2022 (pers. Comm, 2023). At the south end of the Isle of Man, there is a resident population estimated at 50 seal which is included in the total population estimate given above. Therefore, the estimate of 400 animals from Howe (2018b) aligns and accounts for monthly mean estimate reported in Sharpe (2007), with Howe (2018b) stating population numbers are stable or possibly elevated compared to Sharpe (2007).

1.3.8.48 Morris and Duck (2019) gave counts of harbour seal and grey seal in Ireland from surveys in 2003, 2011/2012 and 2017/2018. In the most recent survey (2017/2019) in the East Ireland region 418 grey seal were counted, and in the South East Ireland region, 556 grey seal were counted. Using a population scalar of 25.15% (from Russell *et al*., 2016 *in* SCOS, 2022) this leads to population estimates of 1,662 grey seal for the East Ireland region and 2,211 for the South East Ireland region. The study suggests grey seal numbers are increasing at a significantly higher rate than harbour seal (currently in the order of 2.5 to 3.5 times more grey seal than harbour seal in Ireland).

1.3.8.49 Recent aerial surveys for the Mona Offshore Wind Project (Mona Offshore Wind Ltd, 2024) showed grey seal abundance varied across months and seasons, with greatest abundance observed during the winter (December to February) and spring (March to May) months. Mean absolute abundance (i.e. adjusted by availability bias) was 146 animals in the Mona Aerial Survey Area per month, with the lowest abundance of 43 animals per the aerial survey area in May and the highest in March of 296 animals In the survey area. Note these are absolute abundances, adjusted to the size of the aerial survey area and corrected for availability, rather than relative abundances. When split by bio-season, mean absolute abundance was 71 animals per survey area in the pupping season and 201 in the non-pupping season.

1.3.8.50 Grey seal abundance from modelling for the Morgan Offshore Wind Project: Generation Assets varied across months and seasons. Highest abundances were presented for March, with 251 animals from mean absolute abundance (i.e. adjusted by availability bias). Abundance was modelled by month, within meteorological seasons, and within the 'Pupping' (August to November) and 'Non-pupping' (December to July) divisions determined in consultation with Manx Wildlife Trust, for clarity referred to as 'bio-seasons'. Mean absolute abundance was 137 animals in Morgan Offshore Wind Project: Generation Assets per month, with the lowest abundance of 50 animals in November and the highest in March of 251 animals. Note these are absolute abundances, adjusted to the size of the aerial survey area and corrected for availability, rather than relative abundances. When split by bio-season, mean absolute abundance was 98 animals for the Morgan Offshore Wind Project: Generation Assets in the pupping season and 180 in the non-pupping season.

1.3.8.51 As reported in the Morgan Offshore Wind Project: Generation Assets Marine Mammal Technical Report (**Appendix A**), during integrated surveys detailed in the PAM and MMOb Report, there were 39 visual sightings of grey seal from April 2022 to May 2022 across the across the combined Morgan Offshore Wind Project: Generation Assets and Mona Offshore Wind Project (Mona Offshore Wind Ltd., 2023) surveys.

1.3.8.52 In the aerial survey data for the Morecambe Offshore Windfarm: Generation Assets (**Appendix B**), grey seal abundance estimates were derived in the same way as density estimates and are presented from March 2021 to February 2023. The corrected abundance estimates ranged between 4 animals (95% CI = 0 to 12) in the survey area in February 2022 to 41 animals (95% CI = 20 to 66) in August 2022. The annual average for the surveys was 19 animals (95% CI = 4.8 to 36.7) in the survey area. Abundance was not split into season, unlike density (see **paragraph 1.3.8.34**).

1.3.8.53 The reference population taken forward to the assessment for grey seal comprises a combined sum of population estimates from populations within the Irish Sea including: four SMUs that overlap the Irish sea with identified connectivity to the study area, based on telemetry data (**Figure 1.55** to **Figure 1.57**) (12: Wales = 3,579; 13: NW England = 1,193; 14: Northern Ireland = 2,183 and 1: SW Scotland = 2,056) (derived from SCOS, 2022); separate estimates for the East of Ireland region (1,662) and South East of Ireland region (2,211) (derived from Morris and Duck, 2019); and the Isle of Man estimate (400) (Howe, 2018b). The combined populations form one Grey Seal Reference Population (GSRP) to be taken forward to the assessment, with a combined total of 13,284 grey seal. This is deemed the most relevant reference population to apply to the impact assessment.

1.3.8.54 The OSPAR Region III min estimate of 60,780 from the OSPAR Quality Status Report[8] for 2023 will be applied for additional context in the assessment (Banga, 2022). This has been chosen as a conservative estimate for OSPAR Region III, over the N value of 64,854 to facilitate a precautionary approach.

Seasonality

1.3.8.55 UK grey seal breed in the autumn, but there is a clockwise cline in the mean birth date around the UK (SCOS, 2018). In the south west of the UK (including Wales) the pupping season occurs between August and November, with peak births in September and October (Morgan *et al.,* 2018; Langley *et al.,* 2020; SCOS 2020). However, pups have also been recorded outside of this period and have been recorded throughout the year at Ramsey Island (Morgan *et al*., 2018). In Manx waters, the grey seal pupping season usually occurs between September and November with moulting December to March (Howe, 2018b).

1.3.8.56 Grey seal may redistribute outside of the breeding season so regional differences in population estimates do not necessarily reflect the time of the year, grey seal in the UK spend longer hauled out during their annual moult (between December and April) and during their breeding season (between August and December) (SCOS, 2020).

1.3.8.57 Studies in North Wales demonstrated grey seal were found to be present at all surveyed sites throughout the year, albeit in varying numbers (Westcott, 2002; Westcott and Stringell, 2003; 2004). The number of grey seal assembled ashore is generally greater in the summer months than in winter for the North Wales region surveyed. It was suggested seals use the islands off the east coast of Anglesey much more intensively in the winter months than in summer, whilst the West Hoyle Sandbank and Bardsey Island rises to a peak in the summer months. In summer 2003, largest counts were recorded for West Hoyle Sandbank on the Dee Estuary (330 on 11 July 2003) (which is the closest site to the Transmission Assets) and Ynys Enlli/Bardsey Island (228 on 30 July 2003). In winter, most of the largest winter counts were recorded for the east Anglesey islands (Wescott and Stringell, 2004). Ynys Dulas recorded 139 on February 2003, and Puffin Island 127 on December 2003, and 116 for the West Hoyle Sandbank in November 2002. The highest winter counts were lower than the highest summer counts for the region as a whole and were made in the central sector of the range (Westcott and Stringell, 2004). Recent evidence from Wales has shown that pup production at Marloes Peninsula and Skomer is increasing, and the onset of the pupping season is getting earlier (Bull *et al.,* 2017a; 2017b; Morgan *et al.,* 2014; 2018). Bull *et al.* (2021) found that climate causes shifts in grey seal pupping phenology, with warmer years associated with an older

[8] The OSPAR Quality Status Report (QSR) 2023 reflects the work of the Contracting Parties, scientists, experts and their institutions, and the OSPAR Secretariat, to assess the status of various components of the North-East Atlantic and examine how conditions have changed since the last QSR (2010)

average age of mothers and a temperature increase of 2°C causing a pupping season to advance approximately seven days.

1.3.8.58 On the east coast of Ireland, the largest grey seal haul-outs were recorded during the months of July and August, peaking during annual breeding (September to December) and moulting seasons (November to March) (Kiely, *et al.* 2000).

1.3.9 Harbour seal

Ecology

1.3.9.1 Harbour seal is the smaller of the two species of pinniped that breed in the UK, typically weighing between 80 to 100kg (SCOS, 2015). Female harbour seal become sexually mature at three to five years of age and gestation lasts between 10.5 and 11 months (Thompson and Härkönen, 2008). Harbour seal are long-lived animals with individuals estimated to live to between 20 and 30 years (SCOS, 2018). Breeding and moulting seasons take place between June and August (Carter *et al*, 2022). Pups are born in June and July, having moulted their white coats prior to birth, allowing harbour seal pups to swim within a few hours of birth (Burns, 2002). During lactation, females spend much of their time in the water with their pups and, although they will forage during this period, distances travelled at this time are more restricted than during other periods (Thompson *et al*., 1994). Following the spring/summer breeding and nursing season, the annual moult of harbour seals occurs in late summer (Wilson *et al*., 2018, Thompson *et al.,* 2019).

1.3.9.2 Different sex and age classes are thought to haul out at different times during the moult (which may influence the proportion of the total population that are counted during surveys), with juvenile harbour seal moulting earliest and adult males latest (Cronin *et al.*, 2014; Daniel, Jemison *et al.*, 2003; Thompson and Rothery, 1987). Timings of the moult are different between Ireland, Scotland and the Wadden Sea (Cronin *et al.*¸2014) and it has also been suggested the timing of the moult also varies throughout the UK.

1.3.9.3 Harbour seal, are central place foragers, requiring haul-out sites on land for resting, moulting and breeding, and dispersing from these sites to forage at sea. In order to reduce time and energy searching for prey, animals are likely to travel directly to areas of previously or predictably high foraging success (Bailey *et al*., 2014). Harbour seal persist in discrete metapopulations and tend to stay within 50 km of the coast, although most foraging trips are over shorter ranges (Russell and McConnell, 2014). Harbour seal have a smaller maximum foraging range of 273 km, than grey seal (448 km) (Carter *et al.,* 2022). Harbour seal, an income breeder, undertakes foraging trips during lactation, in contrast to grey seal which are capital breeders and tend to stay with the pups until they are weaned (Bonner, 1972). Since harbour seal females need to regularly return to their pups at the haul-out site they may be more limited in foraging distance. Carter *et al.* (2022) found during their study, that distance to haul-out site was the primary driver of distribution for harbour seal in all regions. Due to the constraint on

their foraging range, particularly during the breeding season, harbour seal may be particularly vulnerable to changes in prey abundance or disturbance events from human activities (Bailey *et al*., 2014).

1.3.9.4 Harbour seal breed in small groups scattered along the coastline. They breed between June and August (Carter *et al.*, 2022), and research has shown peak pupping time at two sites at Dundrum Bay, County Down in the Irish Sea to be between 4 to 15 July (Wilson and Jones, 2018). Haul out sites are on two types of intertidal habitat; sandbanks and beaches (such as in the east coast of England and Scotland) or rocky shores (such as West Scotland). There is also evidence for a slight temporal effect on numbers of seals hauled out, with higher numbers associated with low tides occurring in the afternoon (Russell *et al*., 2015; Thompson and Harwood, 1990).

1.3.9.5 Harbour seal are opportunistic, generalist feeders and their diet varies both seasonally and from region to region (Hammond *et al*., 2001; Wilson and Hammond, 2016) as they consume prey in relation to its availability (Kavanagh *et al.*, 2010). Analyses of seal scat in Ireland has demonstrated that a wide variety of prey items are exploited by harbour seal (Hammond and Wilson, 2016). These includes species from the surface, mid-water and benthic habitats including sandeels, whitefish, herring, sprat, common octopus, and squid *Loligo* species (SCOS, 2010). Gadoid fish (whiting, pollack and haddock) are key prey species of harbour seal with pouting *Trisopterus luscus* contributing to the largest proportion of diet by weight (Kavanagh *et al.,* 2010). In the Irish Sea, a study on the seasonal and regional estimates of harbour seal diet demonstrated in South East Scotland (to the north of the marine mammal regional study area) the diet comprised primarily flatfish (mainly plaice) and also sandeel and large gadids (Wilson and Hammond, 2016).

Distribution and occurrence

1.3.9.6 Harbour seal are widely distributed, inhabiting temperate and subpolar seas throughout the Northern Hemisphere. The UK and Ireland represents an important population centre for both species, with approximately 32% of European harbour seal found in the UK (SCOS, 2022). Carter *et al.* (2022) suggested large centres of harbour seal abundance in Shetland, The Wash (in south east England) and west Scotland, with high density at-sea areas adjacent to those hotspots. For management purposes, the UK harbour seal population is subdivided into SMUs that were defined on the basis of the spatial distribution of haul-out sites. The wide geographical spread of haul-out sites and their general inaccessibility means that aerial surveys provide the best practical method for obtaining reliable indices of abundance.

1.3.9.7 Surveys of harbour seal are carried out during the summer and early autumn months in the UK. There are two types of surveys conducted: breeding counts and moult counts. Breeding seals are surveyed in June and July annually in a small number of areas (Moray Firth, Lincolnshire and Norfolk), and a very limited number of breeding season surveys have been carried out on behalf of NatureScot in areas designated as

SACs for harbour seal in Scottish waters. Given that there are no harbour seal breeding surveys conducted in the regional study area, these are not considered further.

1.3.9.8 The main population surveys for harbour seal are carried out during moulting, during the first three weeks of August when the greatest and most consistent numbers of harbour seal are believed to haul-out ashore during their annual moult. To maximise the numbers of seals on shore and to reduce the effects of environmental variables, surveys are restricted to within two hours either side of afternoon low tides on days with no rain. The frequency of surveys differ, with annual moult surveys carried out in Lincolnshire and Norfolk (England), the Moray Firth and the Firth of Tay (Scotland) whilst the remainder of the Scottish coast is surveyed approximately every four to five years, although there is considerable variation between areas.

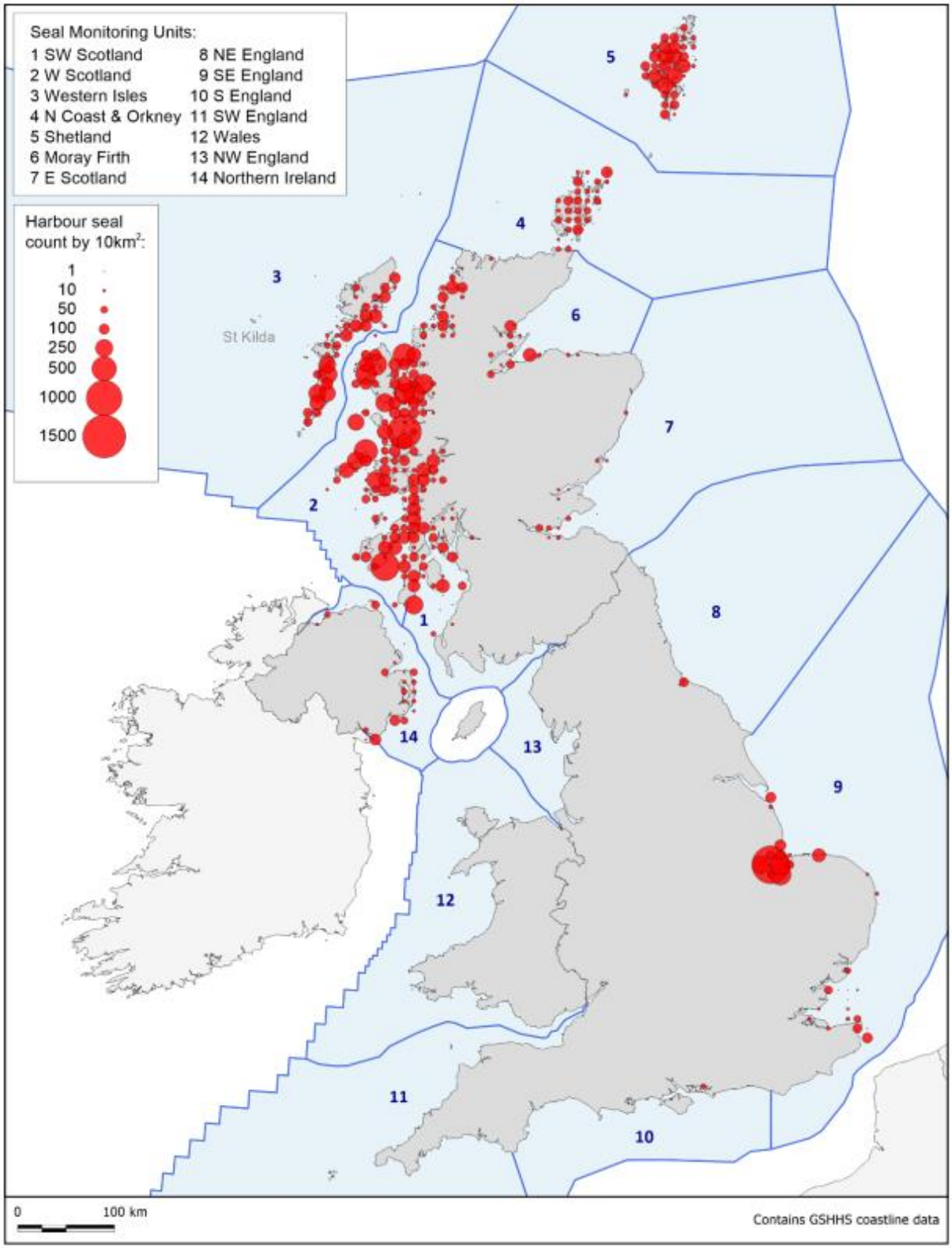

Figure 1.61: August distribution of harbour seal around the British Isles by 10 km squares based on the most recent available haul-out count data collected up until 2021. Limited data available for SMUs 10-13 (SCOS, 2022)

1.3.9.9 The main harbour seal haul-outs are located in the north region of the regional study area, in the South West Scotland MU, particularly in the north of the MU. There is no information on the location of harbour seal hauled-out in the Wales and North West England MUs (stated in **Appendix A**, by SMRU) as numbers are so few and there are no dedicated SMRU surveys routinely carried out in these MUs, with estimates compiled from counts shared by other organisations. In Northern Ireland most harbour seal haul-outs are located in the south east of the country, with most harbour seal being counted at Carlingford Lough, Murlough SAC and Rathlin Island (Duck and Morris, 2019). Harbour seal were counted in aerial surveys (in 2002, 2011 and 2018) in the Maidens SAC, Strangford Lough SAC and Murlough SAC.

1.3.9.10 Interregional movements within the foraging season are more limited (Russell *et al*., 2013) particularly for harbour seal (Carroll *et al*., 2020). Telemetry data from SMRU (2022) (**Figure 1.62**) demonstrates no harbour seal were tagged in the North West England, Wales or South West Scotland MUs between 2001 and 2017, but 34 harbour seal were tagged in the Northern Ireland MU between 2006 to 2010. All 34 harbour seal recorded telemetry tracks within the regional study area, confirming harbour seal usage of the area. Furthermore, telemetry track data from 12 harbour seal tagged in the adjacent West Scotland MU were recorded within the regional study area (specifically within South West Scotland and Northern Ireland MUs). Therefore, a total of 46 harbour seal telemetry tracks were recorded in the regional study area. Five harbour seal, all tagged in Northern Ireland MU, were recorded within 50 km of the Transmission Assets, with one seal track entering the study area to the south of the Transmission Assets (**Figure 1.63**). These five seals showed connectivity to the surrounding SACs, and with the south coast of the Isle of Man.

1.3.9.11 Duck and Morris (2019) carried out thermal-imaging surveys of harbour seal around Ireland in August 2017 and 2018, with the Irish coast divided into five regions: East, South east, South west, West and North. In all surveys the greatest proportion of harbour seal were counted in the west of Ireland, and the smallest proportions were in the East and South east (3% and 1% in 2017/2018; 3% and 2% in 2011/2012; 4% and 1% in 2003 respectively).

1.3.9.12 Past telemetry studies have also confirmed harbour seal movements between Inner Strangford Lough and the Irish Sea (Sparling *et al.,* 2018). In this study, the operational tidal turbine did not prevent transit of the animals through the channel to give a barrier effect, but animal behaviour did change during operation and some degree of local avoidance was evident thus minimising collision risk.

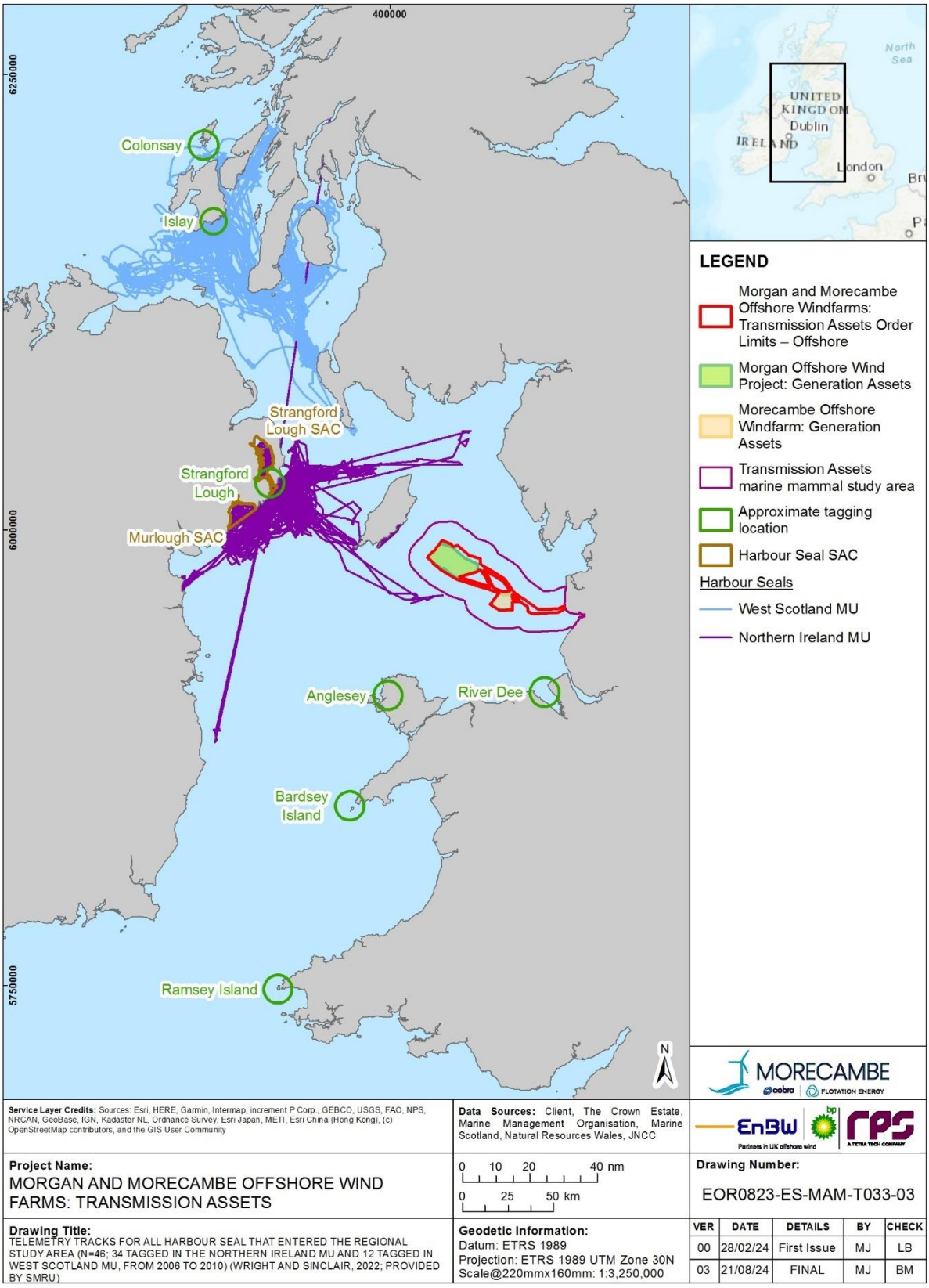

Figure 1.62: Telemetry tracks for all harbour seal that entered the regional study area (n=46; 34 tagged in the Northern Ireland MU and 12 tagged in West Scotland MU, from 2006 to 2010) (Wright and Sinclair, 2022; provided by SMRU)

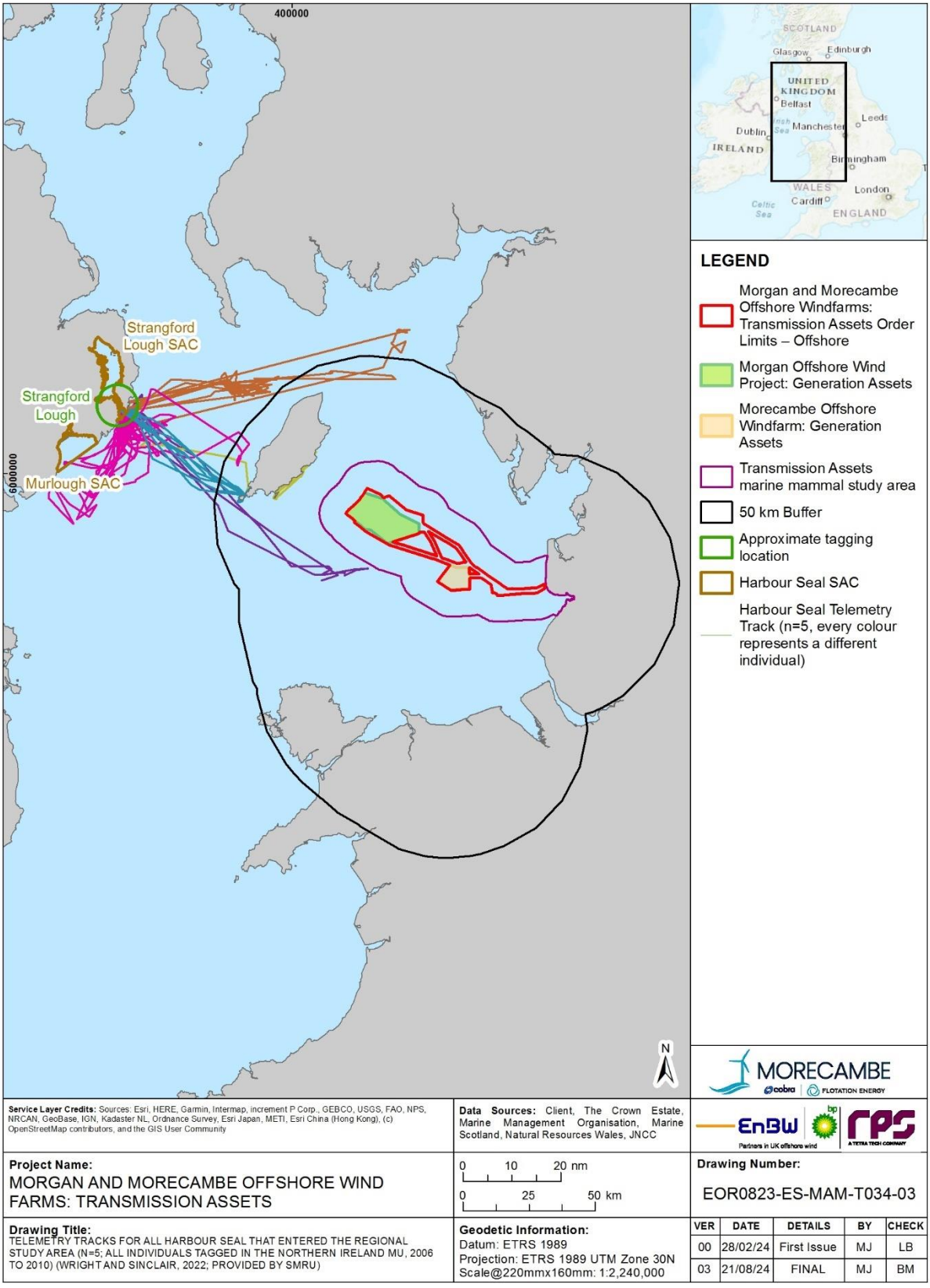

Figure 1.63: Telemetry tracks for all harbour seal that entered the regional study area (n=5; all individuals tagged in the Northern Ireland MU, 2006 to 2010) (Wright and Sinclair, 2022; provided by SMRU)

Density/abundance

1.3.9.13 The Transmission Assets are located in the Wales and North West England MUs. The nearest designated haul out sites for harbour seal in the vicinity of the study area are Manx MNRs (Calf and Wart Bank, Langness, Ramsey and West Coast), and Murlough SAC, Strangford Lough SAC and The Maidens SAC.

1.3.9.14 Mean harbour seal at-sea usage in the vicinity of the study area is very low (Carter *et al*., 2022) (**Figure 1.64**), with the main area of usage in the regional study area along the east coast of Northern Ireland. Within the study area, the average value (of the mean at-sea usage) from Carter *et al*. (2022) was estimated at 0.004157 animals per 5 x 5 km grid cell, equating to a density of 0.0002 animals per km^2.

1.3.9.15 For the Generation Assets surveys, whilst harbour seal were sighted numbers were so low that density estimates could not be calculated (**see Appendix A and Appendix B**).

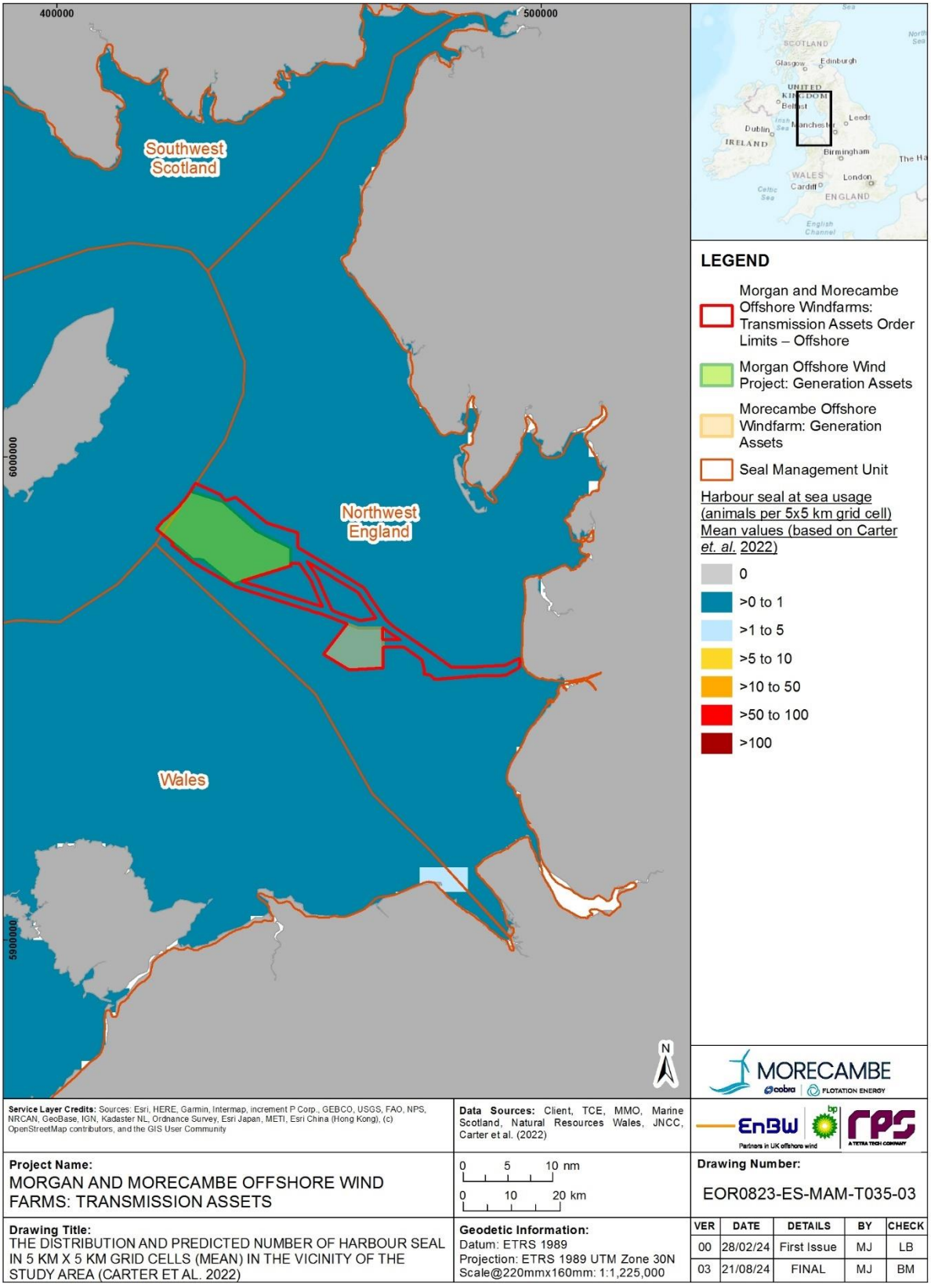

Figure 1.64: The distribution and predicted number of harbour seal in 5 km x 5 km grid cells (mean at sea usage) in the vicinity of the study area (Carter *et al.*, 2022)

Summary of densities

1.3.9.16 For harbour seal, whilst present in the Irish Sea, clear areas of high density are distributed towards Northern Ireland and Scotland with very low densities around the study area. As described in **paragraph 1.3.8.35**, Carter *et al.,* 2022 represents the most robust recent at-sea distribution usage maps available for harbour seal.

1.3.9.17 Therefore, the density taken forward to the impact assessment is the mean harbour seal density for the study area from Carter *et al.* (2022), which is 0.0002 animals per km^2.

Abundance

1.3.9.18 The most recent estimate of the UK harbour seal population (2021) is 42,900 (SCOS, 2022), which represents a decrease of approximately 1% compared to the previous survey round, although numbers have increased since the late 2000s (SCOS, 2022). This is derived by scaling the most recent composite count of 30,800 (based on surveys between 2016 and 2021) for the estimated proportion hauled out during the surveys (0.72 (95% CI = 0.54 to 0.88; from Lonergan *et al.*, 2013). The overall UK population has increased in the last decade, but there are significant differences in the population dynamics between SMUs. Additionally, counts of harbour seal in all areas surveyed in 2021(including Northern Ireland) were all substantially lower than counts in recent years (SCOS, 2022).

1.3.9.19 In the Republic of Ireland, research programmes established national population baselines for harbour seal in 2003 (Cronin *et al.,* 2007), and the harbour seal population assessment, carried out during the moult season determined a minimum population of 2,905 harbour seal. This estimate in 2003 was combined with a comparable survey of Northern Ireland in 2002 (Duck, 2006) and gives an all-Ireland minimum population of 3,988 harbour seal.

1.3.9.20 The relevant SMUs that surround the study area are Wales, North West England and Northern Ireland (**Table 1.13**). In the Wales and North West England MUs, there are no dedicated harbour seal surveys routinely carried out due to the very low numbers of seals but harbour seal haul-out counts for those MUs have remained steady over the survey periods.

1.3.9.21 SCOS (2021) provides the latest updated counts and population estimates of harbour seal in the British Isles per SMU, as shown in and **Table 1.14**. Population estimates are based on the most recent August counts of harbour seals at haul-out sites scaled by the proportion of the population estimated to be hauled out (0.72, from Lonergan *et al.,* 2013 *in* SCOS, 2022).

Table 1.13: Harbour seal August haul-out counts from 2011 to 2021 (SCOS, 2022).

SMU	Parameter	2011 to 2015	2016 to 2019	2021
Wales	August count	10	10	10
NW England	August count	5	5	5
Northern Ireland	August count	948	1,062	818

Table 1.14: Harbour seal population estimates for 2011 to 2021 (SCOS, 2022)

SMU	Parameter	2011 to 2015	2016 to 2021
Wales	Population estimate	13	13
NW England	Population estimate	6	7
Northern Ireland	Population estimate	1,316	1,136

1.3.9.22 For the Wales MU and North West England MU, the most recent harbour seal counts (SCOS, 2022) were 10 and 5, respectively (**Table 1.13**). When scaled by the proportion of seals hauled-out at the time of the counts to give estimated population sizes, the estimated population sizes were 13 and 7 harbour seal for the Wales MU and North West England MU, respectively (**Table 1.14**).

1.3.9.23 For the Northern Ireland MU the most recent harbour seal count (SCOS, 2022) was 818 (**Table 1.13**) giving a population estimate of 1,136 harbour seal (**Table 1.14**). The population appears to have declined slowly after 2002 in the Northern Ireland MU but after a period of stability, appears to have declined since the previous estimates of abundance (n = 1,405; SCOS, 2021). Sites within this MU are not surveyed annually, but were most recently surveyed in 2021.

1.3.9.24 Connectivity presented in **Figure 1.62** and **Figure 1.63** demonstrates there is little overlap in at-sea space use between the South West Scotland MU and the three remaining MUs that cover the Irish Sea (Wales, Northern Ireland and North West England MU) and therefore the three SMUs to be taken forward as the reference population (the 'Harbour Seal Reference Population' (HSRP)) to the assessment are the combined total of the Wales, Northern Ireland and North West England MU population estimates (a total of 1,156 harbour seal).

1.3.9.25 Other localised estimates of abundance have been given for Strangford Lough, to the north west of the regional study area, as 200 animals (Lonergan, 2013). Duck and Morris (2019) gave counts of harbour seal and grey seal in Ireland from surveys in 2003, 2011/2012 and 2017/2018. In the most recent survey (2017/2019) in the East Ireland region 131 harbour seal were counted, and in the South East Ireland regions 34 grey seal were counted. Using population scalars from Lonergan *et al.* (2013) this leads to population estimates of 182 harbour seal for the East Ireland region and 47 for the South East Ireland region. The study suggests grey seal numbers are increasing at a significantly higher rate than harbour seal (currently in the order of 2.5 to 3.5 times more grey seal than harbour seal in Ireland).

1.3.9.26 In the Mona aerial surveys (Mona Offshore Wind, 2024), only one harbour seal was observed in aerial surveys, in March 2020. This led to an abundance estimate of eight within the whole Mona Aerial Survey Area.

1.3.9.27 As reported in the Morgan Offshore Wind Project: Generation Assets Marine Mammal Technical Report (**Appendix A**), only one harbour seal was observed in aerial surveys for Morgan Offshore Wind Project: Generation Assets, in March 2020. This led to an abundance estimate of eight animals within the whole Morgan Aerial Survey Area.

1.3.9.28 Only one harbour seal was recorded within the survey area (July 2021) over the 24 months of survey for the Morecambe Offshore Windfarm: Generation Assets (**Appendix B**). It was therefore deemed not possible to determine an abundance estimate for harbour seal.

Seasonality

1.3.9.29 Measures of abundance and distribution are largely based on summer surveys during either the pupping or moulting seasons but may vary seasonally. For example, in a study in the Moray Firth, harbour seal in the SAC showed changes in their seasonal pattern of site-use over this period and results highlighted that seasonal patterns may vary over time (Cordes *et al*., 2011).

1.4 Site-specific surveys

1.4.1.1 No site-specific surveys have been undertaken for the Transmission Assets. However, two sets of site-specific aerial digital survey results that overlap with the Transmission Assets have informed the baseline characterisation, one across the Morgan Offshore Wind Project: Generation Assets plus 10 to 13.3 km buffer and one across the Morecambe Offshore Windfarm: Generation Assets plus 4 to 10 km buffer. As key data sources, these are presented in **Appendix A** and **Appendix B** respectively.

1.4.1.2 Aerial survey methodology and comprehensive results are detailed within the relevant technical reports:

- Morgan Offshore Wind Project: Generation Assets Marine Mammal Technical Report (**Appendix A**) (Morgan Offshore Wind Ltd., 2023).
- Morecambe Offshore Windfarm: Generation Assets Marine Mammal Information and Survey Data (**Appendix B**) (Morecambe Offshore Windfarm Ltd., 2023).

1.5 Summary

1.5.1.1 Data gathered through a desktop review found that that the Irish Sea supports a number of different marine mammal species with internationally important populations of certain species occurring within the vicinity of the study area.

1.5.1.2 Key marine mammal species identified within the regional study area included: harbour porpoise, bottlenose dolphin, short-beaked common

dolphin, Risso's dolphin, minke whale, grey seal and harbour seal. Other species are occasional or rare visitors to the area and were scoped out during consultation, on the basis that it was considered unlikely that these are key species within the study area (as agreed via the scoping process).

1.5.1.3 No site-specific surveys were carried out for Transmission Assets. Site-specific studies were carried out for the Morgan Offshore Wind Project: Generation Assets (**Appendix A**) and for Morecambe Offshore Windfarm: Generation Assets (**Appendix B**), both of which are located within the Offshore Order Limits.

1.5.1.4 Data were sought from published sources including regional studies of key species and from site-specific surveys within the study area. A summary of the mean densities for each species for the study area are provided in **Table 1.15**. These are the densities per species to be taken forward to the impact assessment.

1.5.1.5 Sites designated for the conservation of internationally important populations closest to the study area include Langness MNR, Little Ness MNR, Douglas Bay MNR, Laxey Bay MNR, Ramsey Bay MNR, North Anglesey Marine/ Gogledd Môn Forol SAC, Baie Ny Carrickey MNR, Calf and Wart Bank MNR, Port Erin Bay MNR, Niarbyl MNR, West Coast MNR, North Channel SAC, Strangford lough and Murlough SAC Strangford Lough SAC and Murlough SAC. These sites lie 16.8 km to 98.5 km distance from the Offshore Order Limits (**Table 1.2**).

1.5.1.6 West Wales Marine/Gorllewin Cymru Forol SAC, Pen Llŷn a`r Sarnau/ Llŷn Peninsula and the Sarnau SAC, Rockabill to Dalkey Island SAC, Lambay Island SAC, Cardigan Bay/Bae Ceredigion SAC, Slaney River Valley SAC, Pembrokeshire Marine/Sir Benfro Forol SAC, Saltee Islands SAC, Bristol Channel Approaches/Dynesfeydd Môr Hafren SAC and Lundy SAC are also designated for the conservation of internationally important populations, lying at distances from 110.9 km to 336.0 km from the Offshore Order Limits (**Table 1.2**).

Table 1.15: Summary of marine mammal receptors to be considered in the Marine Mammal Chapter, together with relevant densities and reference populations (species-specific MUs)

Species	Transmission Assets		
	Density (animals per km^2)	Management Unit (MU)	Population estimate in MU[5]
Harbour porpoise *Phocoena phocoena*	0.227[1]	CIS MU	62,517[6]
Bottlenose dolphin *Tursiops truncatus*	0.0012[1]	IS MU	293[6]
Short-beaked common dolphin *Delphinus delphis*	0.0003[1]	CGNS MU	102,656[6]
Risso's dolphin *Grampus griseus*	0.0313[2]	CGNS MU	12,262[6]
Minke whale *Balaenoptera acutorostrata*	0.0211[3]	CGNS MU	20,118[6]
Grey seal *Halichoerus grypus*	0.108[4]	12 Wales 13 NW England 14 Northern Ireland 1 SW Scotland Isle of Man estimate East of Ireland South east of Ireland **(GSRP)**	3,579[7] 1,193[7] 2,183[7] 2,056[7] 400[8] 1,662[9] 2,211[9] **13,283**
		OSPAR Region III	60,780[10]
Harbour seal *Phoca vitulina*	0.0002[4]	12 Wales 13 NW England 14 Northern Ireland Isle of Man **(HSRP)**	13[11] 7[11] 1,136[11] No estimate available **1,156**

[1] Density derived from Evans and Waggitt (2023) for the Offshore Order Limits

[2] SCANS-III (Hammond *et al.,* 2021) for adjacent block E (none observed for block F)

[3] Density derived from SCANS-III Density Surface Modelling for the study area (Lacey *et al.,* 2022)

[4] Carter *et al.* (2022) values – average densities calculated to per km^2 from 25 km^2 cells for the study area

[5] All population estimates include the Isle of Man unless population estimate given separately

[6] Population estimate from IAMMWG, 2023

[7] Based upon counts presented in SCOS (2022) with scalar of 0.215

[8] Population estimate from Howe (2018b)

[9] Based upon counts in Morris and Duck (2019) with scalar of 0.215 from SCOS (2022)

[10] Estimate derived from the OSPAR Quality Status Report (QSR) 2023 (Banga, 2022) (n*min* applied as a precautionary estimate, rather than n*mean*)

[11] Population estimate from SCOS (2022).

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