MONA OFFSHORE WIND PROJECT

Environmental Statement

Volume 6, Annex 4.1: Marine Mammal Technical Report

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Image of an offshore wind farm

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RPS	**Mona Offshore Wind Limited.**

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Glossary

Term	Meaning
Benthic	Species that live on or near the sea bottom, irrespective of the depth of the sea.
Bentho-pelagic	Benthopelagic species usually float in the water column just above the sea floor and can occupy either shallow coastal waters or deep waters offshore.
Demersal	Species that live close to the sea floor.
Ecotype	A distinct subdivision of a species occupying a particular habitat.
Ground Sampling Distance	Ground sampling distance (GSD) is the distance between two consecutive pixel centres measured on the ground. The bigger the GSD, the lower the spatial resolution of the image and details are less visible.
Marine Mammal Management Unit	Management units (MUs) for marine mammals in UK waters, which provide an indication of the spatial scales at which impacts of plans and projects alone, cumulatively and in combination, need to be assessed for the key cetacean species in UK waters, with consistency across the UK. For cetaceans, these management units are defined by the Inter-Agency Marine Mammal Working Group. For seal species (harbour and grey seal), the Special Committee on Seals (SCOS) provided advice on seal MUs.
Mona Aerial Survey Area	Mona Array Area plus 7 to 16.5 km buffer.
Ontogenetic variation	Changes due to changes in gene expression through development.
Pelagic	Species which live and feed within the water column.
Sea state	Sea states are categorical values used to give an approximate but concise description of sea condition, as this will affect the probability of a sighting. Sea state conditions used in the aerial surveys were 0 = Calm (Glassy), 1 = Calm (Rippled), 2 = Smooth, 3 = Slightly Moderate and 4 = Moderate.
Teuthophagic	Species primarily preys on cephalopods.

Acronyms

Acronym	Description
CCW	Countryside Council for Wales
CGNS	Celtic and Greater North Seas
CIS	Celtic and Irish Seas
CI	Confidence Interval
CMACS	Centre for Marine And Coastal Studies
CMR	Capture mark recapture
cSAC	candidate Special Area of Conservation
CV	Coefficient of variation
DAS	Digital Aerial Survey
EA	Environment Agency
EIA	Environmental Impact Assessment

Acronym	Description
EIRPHOT	Irish and Celtic Sea Database for grey seal
ESAS	European Seabirds at Sea
EWG	Expert Working Group
GAM	Generalised Additive Model
GPS	Global Positioning System
GSRP	Grey Seal Reference Population
GSD	Ground Sampling Distance
GSM	Global System for Mobile
HRA	Habitats Regulations Assessment
HSRP	Harbour Seal Reference Population
IAMMWG	Inter-Agency Marine Mammal Working Group
ISZ	Irish Sea Zone
ISAA	Information to Support Appropriate Assessment
JCDP	Joint Cetacean Data Programme
JCP	Joint Cetacean Protocol
JNCC	Joint Nature Conservation Committee
KDE	Kernel Density Estimation
MCZ	Marine Conservation Zone
MDZ	Morlais Demonstration Zone
MMEA	Manx Marine Environmental Assessment
MMO	Marine Management Organisation
MMOb	Marine Mammal Observers
MMMU	Marine Mammal Management Unit
MNR	Marine Nature Reserve
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
QA	Quality Assurance
SAC	Special Area of Conservation

Acronym	Description
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
SWF	Sea Watch Foundation
TPOD	Timing Porpoise Detector
TWT	The Wildlife Trust
WDC	Whale and Dolphin Conservation

Units

Unit	Description
cm	Centimetre
ft	Foot
km	Kilometre
kg	Kilogram
km^2	Square kilometres
kn	Knot
m	Metre
m^2	Metre squared
ms^{-1}	Metres per second
nm	Nautical miles
°	Degrees
°C	Degrees centigrade
%	Percentage

1 Marine mammal technical report

1.1 Introduction

1.1.1.1 This marine mammal technical report provides a detailed baseline characterisation of the marine mammal ecology for the Mona Offshore Wind Project and the surrounding area. Data was collated through a detailed desktop study of the existing resources available for marine mammals within the region, incorporating data from third party organisations, to gain a historical perspective.

1.1.1.2 Recent site-specific survey data from aerial digital surveys were available to inform the baseline characterisation. Aerial digital surveys for the Mona Offshore Wind Project were carried out monthly from March 2020 to February 2022, and as such the full 24 months of surveys were available for baseline characterisation.

1.1.1.3 Moreover, the Sea Mammal Research Unit (SMRU) provided telemetry maps and haul-out counts for harbour seal *Phoca vitulina* and grey seal *Halichoerus grypus* for the four seal Management Units (MUs) that cover the Irish Sea (see 1.2), and these have been used as an additional data source to aid baseline characterisation (Wright and Sinclair, 2022).

1.1.1.4 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 area and against which the potential impacts of the Mona Offshore Wind Project can be assessed.

1.2 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:

- **Mona marine mammal study area**: this area broadly encompasses the Mona Array Area including a 7 km to 16.5 km buffer (which is based upon the Mona Aerial Survey Area, see section 1.4.3) plus the Mona Offshore Cable Corridor and Access Areas with a 10 km buffer. Following the Preliminary Environmental Information Report (PEIR), the size of the array project boundary has been reduced, so whilst the buffer extent remains the same as for PEIR, the area of the buffer has increased around the redefined Mona Array Area (previously a 4 to 10 km buffer) (see Figure 1.1).
- **Regional marine mammal 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.

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 MUs as defined by the Inter-Agency Marine Mammal Working Group (IAMMWG) (IAMMWG, 2021) and the Special Committee on Seals (SCOS) (SCOS, 2020) (illustrated in Figure 1.2 and Figure 1.3). Further details of the relevant species MUs are provided in the species accounts (section 1.7 and summarised in section 1.8).

1.2.1.3 For the purpose of the cumulative assessment (as agreed with consultees during the Marine Mammals Expert Working Group (EWG) meeting number 2, see section 1.3) screening of projects was undertaken within the relevant species MUs with the maximum extent delineated by the Celtic and Irish Seas (CIS) MU. This was to ensure a proportionate approach was taken, such that the screening focussed on the region within which receptor-impact pathways are considered likely to occur. Cumulative effects from the Mona Offshore Wind Project are considered unlikely to occur with projects over the extent of the Celtic and Greater North Seas (CGNS) MU (in the North Sea, for example). With respect to grey seal, however, an extended screening area was applied following specific feedback from NRW and included projects within the Oslo and Paris Conventions (OSPAR) Region III.

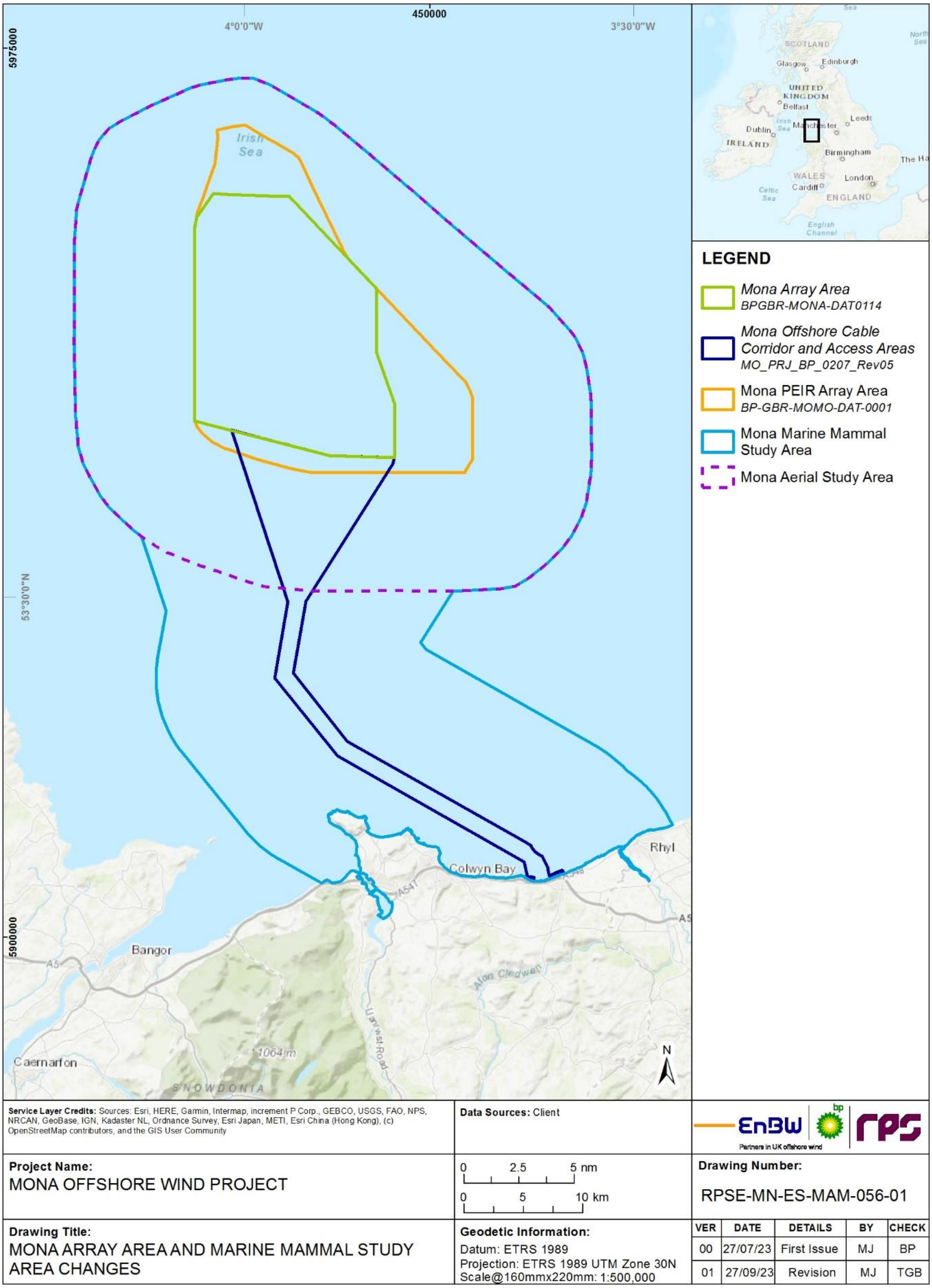
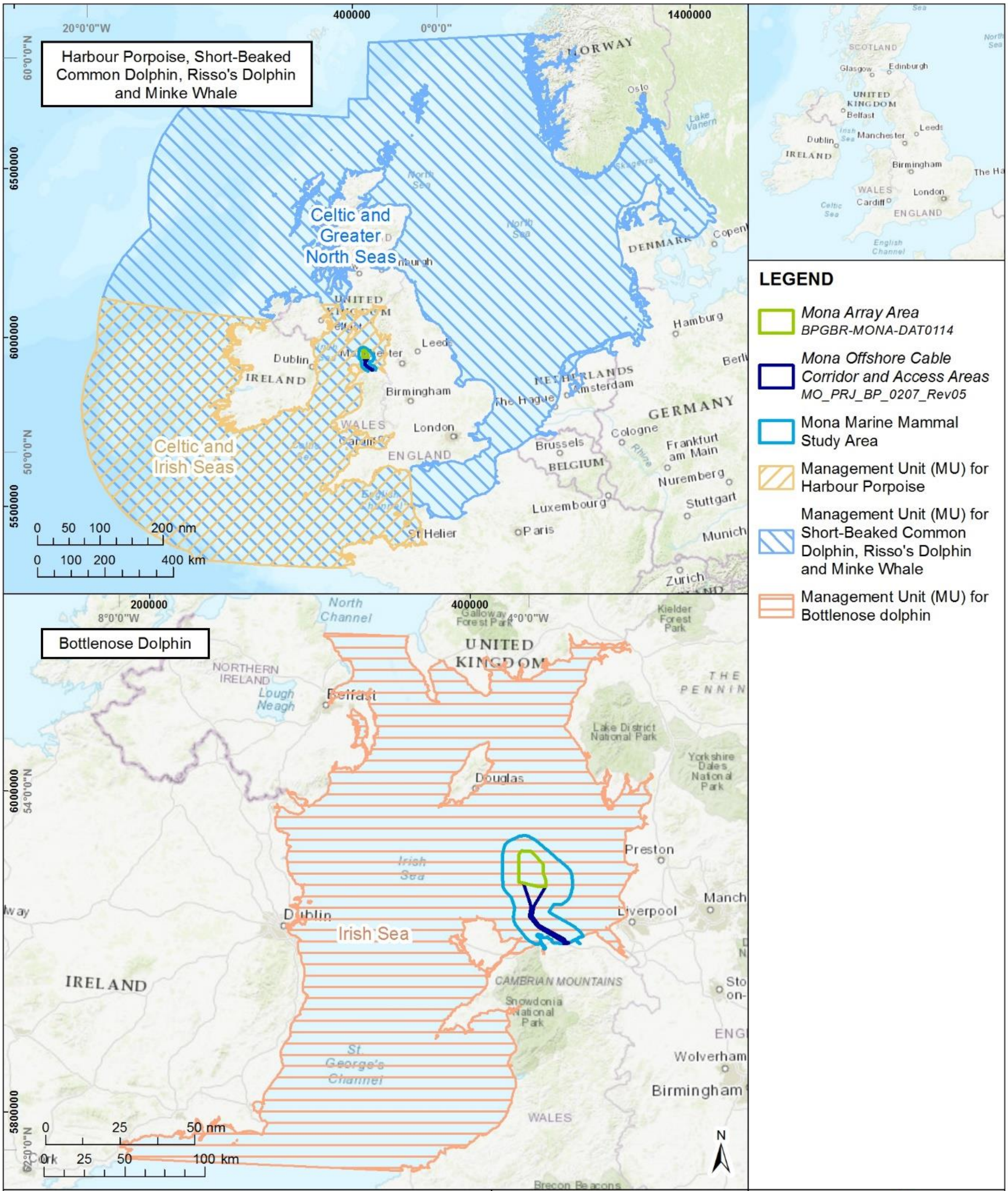


Figure 1.1: Relevant Mona Offshore Wind Project boundaries and the marine mammal study area.



Service Layer Credits: Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

Data Sources: Client, JNCC

Project Name:
MONA OFFSHORE WIND PROJECT

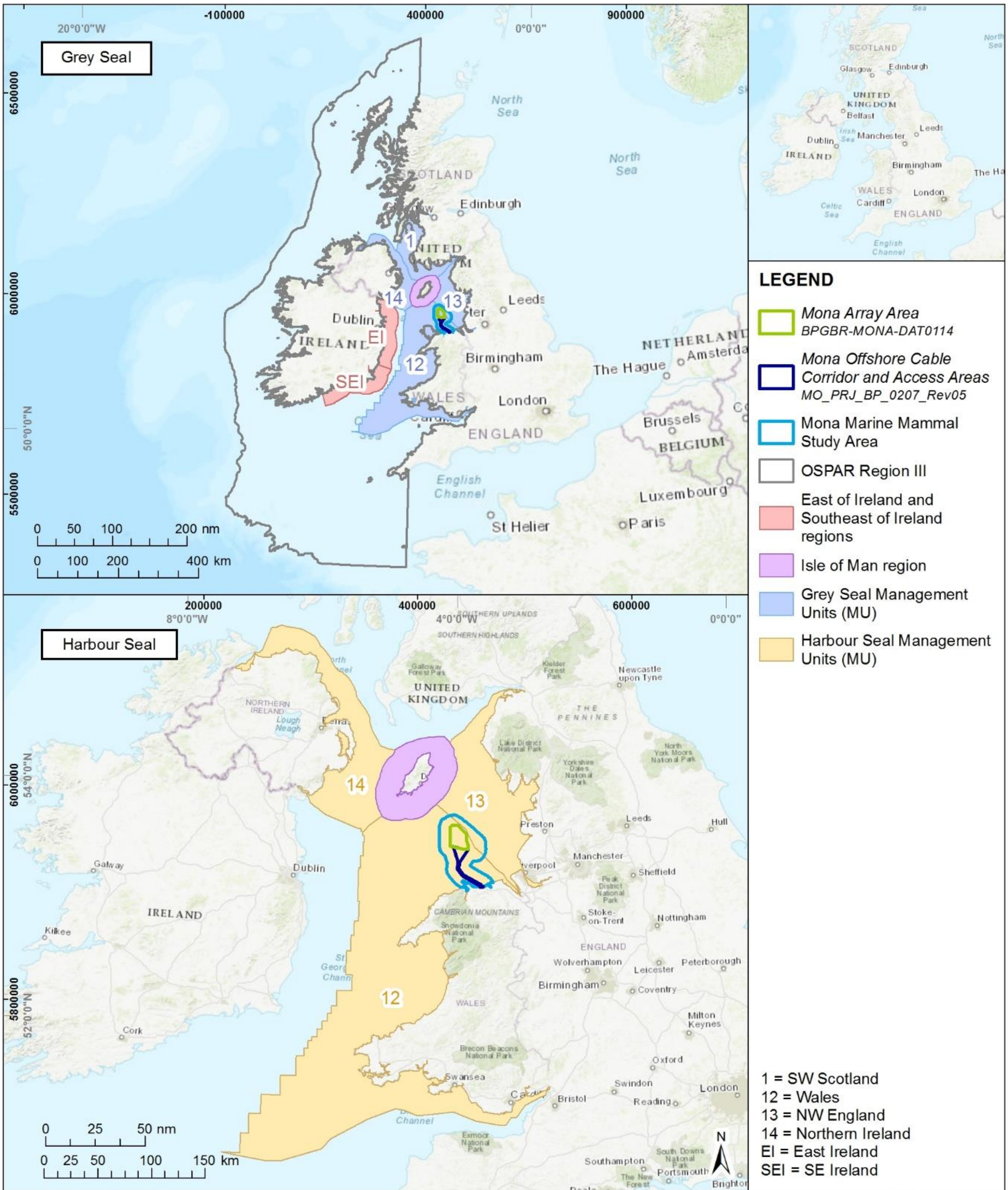
Drawing Number:
RPSE-MN-ES-MAM-001-01

Drawing Title:
MARINE MAMMAL STUDY AREAS AND RELEVANT SPECIES MANAGEMENT UNITS (MUS)

Geodetic Information:
Datum: ETRS 1989
Projection: ETRS 1989 UTM Zone 30N
Scale@160mmx220mm: 1:19,000,000

VER	DATE	DETAILS	BY	CHECK
00	13/07/23	First Issue	NA	BP
01	27/09/23	Revision	MJ	TGB

Figure 1.2: Marine mammal study areas and relevant species MUs for cetacean species.



Service Layer Credits: Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community	**Data Sources:** Client, JNCC, SCOS, NPWS	EnBW bp Partners in UK offshore wind; rps
Project Name: MONA OFFSHORE WIND PROJECT		**Drawing Number:** RPSE-MN-ES-MAM-002-01
Drawing Title: MARINE MAMMAL STUDY AREAS AND RELEVANT SPECIES MANAGEMENT UNITS (MUS)	**Geodetic Information:** Datum: ETRS 1989 Projection: ETRS 1989 UTM Zone 30N Scale@160mmx220mm: 1:16,000,000	

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00	13/07/23	First Issue	NA	BP
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Figure 1.3: Marine mammal study areas and relevant species MUs for pinniped species.

1.3 Consultation

1.3.1.1 A summary of the key issues raised during consultation activities undertaken to date specific to marine mammals is presented in Table 1.1 below.

Table 1.1: Summary of key consultation topics raised during consultation activities undertaken to date for the Mona Offshore Wind Project.

Date	Consultee and type of response	Topics	How/ where addressed in technical report
Apr-21	**Introduction to the project meeting –** Natural England, Marine Management Organisation (MMO), Joint Nature Conservation Committee (JNCC), Natural Resources Wales (NRW), The Wildlife Trust (TWT)	Inception meeting. Initial information on the marine mammal surveys for the Mona Array Area was provided.	N/A
Nov-21	**Evidence Plan Steering group meeting –** Natural England, MMO, JNCC, NRW	Focus on analysis assuming baseline is appropriate. Mitigation hierarchy and stakeholder discussions held early on. Natural England agreed limited data on project areas.	Evidence-based approach has been used in the report, based on extensive baseline characterisation.
Feb-22	**Marine Mammals Expert Working Group (EWG) 1 –** Natural England, MMO, JNCC, NRW, TWT, Environment Agency (EA)	Use of digital aerial survey data requires an assessment of the suitability of analysing data covering 12% of the survey area, such as a power analysis to support approach.	Coverage for Mona aerial surveys are detailed in Appendix A, exceeding previously consented projects and 10% minimum coverage suggested by literature (BSH, 2013). Coefficients of Variation (CVs) also provided in this technical report to give measure of precision to support approach, but noted CVs will be higher for marine mammals, due to very low sighting numbers given their life history, so the difference between raw counts would be proportionally greater.
		EWG suggested evidence of sufficient levels of quality assurance should be provided to resolve any concerns regarding the detection probability or species identification confidence associated with the chosen method (e.g. sample images in range of confidence scenarios and visibility conditions).	APEM only gives definite sightings and then puts uncertain species in their own categories (e.g. 'seal species', 'dolphin/porpoise', 'marine mammal'). If a species is uncertain, it will appear in a non-species-specific category, and this will be considered in further analyses.
		Survey feedback - EWG advised caution in applying feedback on the survey design with respect to birds to marine mammals.	The report has tailored any feedback to marine mammals only.

Date	Consultee and type of response	Topics	How/ where addressed in technical report
		Regional marine mammal study area – NRW queried study area extent.	The Marine Mammal Management Units (MMMUs) have been used to provide regional context in baseline data as highlighted in section 1.2.
		Key species – included minke whale *Balaenoptera acutorostrata*.	Included in technical report, Environmental Impact Assessment (EIA) and Habitats Regulations Assessment (HRA).
		Desktop data sources – additional sources considered for applicability.	Additional data sources or informative documents have been included where applicable.
Jun-22	**Scoping Opinion** The Planning Inspectorate	Harbour seal have been observed in the site-specific digital aerial surveys. The Mona EIA Scoping Report states that low numbers of harbour seals are encountered along the coasts of Wales but that they do not occur in high densities within the regional marine mammal study area. The Planning Inspectorate does not agree that harbour seal can be scoped out of the assessment.	Harbour seal have been included in the baseline environment of the technical report, though noting was not included in Awel y Môr.
		The Planning Inspectorate notes advice from NRW, Natural England, JNCC and the Isle of Man Government that the MMMU is the appropriate scale for consideration of the regional impacts for marine mammals, as opposed to the Irish Sea geographical area presented, and advises the Applicant to apply this study area within the Environmental Statement.	The MMMUs were used to provide regional context in baseline data as highlighted in section 1.2.
		The Scoping Report explains that aerial digital marine mammal surveys collected 30% of the sea surface and 12% was analysed. The Environmental Statement should explain the rationale behind the 12% value and demonstrate that the survey coverage is appropriate to provide adequate baseline characterisation. The Environmental Statement should include reference to any agreements reached through the EWG, including relevant consultation bodies such as NRW and NE.	Coverage for Mona aerial surveys have been detailed in Appendix A, standing at least 14%, exceeding previously consented projects and 10% minimum coverage suggested by literature (BSH, 2013). Coefficient of variation (CVs) have also been provided in this technical report to give measure of precision to support approach, but noted CVs will be higher for marine mammals, due to very low sighting numbers given their life history, so the difference between raw counts would be proportionally greater.

Date	Consultee and type of response	Topics	How/ where addressed in technical report
		A number of datasets proposed to be used to inform the regional marine mammal study area (i.e. out with the site-specific survey area) are more than 10 years old. Whilst it is acknowledged site-specific surveys have been undertaken, the Applicant should ensure that the baseline data used in the Environmental Statement assessments are sufficiently up to date to provide a robust baseline.	Comprehensive desktop review undertaken has included recent data where available (Table 1.2).
	IOM Department of Infrastructure	Refer to the Manx Marine Environmental Assessment (MMEA) which provides a useful overview of the Island's marine environment and should be taken into account as part of both the transboundary and possibly also the cumulative impacts assessment as part of this application.	MMEA has been included in the baseline desktop review.
		The Committee notes that the MUs for these cetaceans include Isle of Man territorial waters and, as such, consider it appropriate that this area is included within the assessment for these species.	MMMUs have been used to provide regional context in baseline data as highlighted in section 1.2.
		Key species – include minke whale.	Included in technical report, EIA and HRA.
		Recommends engagement with the Manx Whale and Dolphin Watch (MWDW) and Manx Wildlife Trust (MWT).	MWDW and MWT contacted as part of desk study and data obtained presented in this report.
		Several Manx Marine Nature Reserves (MNRs) specifically include cetaceans in their designation features, including presumed feeding grounds for Cardigan Bay bottlenose dolphins *Tursiops truncatus*, regionally important populations of Risso's dolphins *Grampus griseus* and wide-ranging populations of grey seals.	These have been included in this report (section 1.6.1).
		Inclusion of Isle of Man Wildlife Act 1990	Legislation included in this section of the report (section 1.6.1).
	JNCC	Mona regional marine mammal study area – JNCC query study area extent.	MMMUs have been used to provide regional context in baseline data as highlighted in section 1.2.

Date	Consultee and type of response	Topics	How/ where addressed in technical report
		Agree that harbour porpoise *Phocoena phocoena*, minke whale, bottlenose dolphin, common dolphin, Risso's dolphin, and grey seal are scoped into the EIA; and white-beaked dolphin and harbour seal are scoped out.	White-beaked dolphin have been scoped out, but harbour seal scoped in as result of EWG discussions.
	Natural England	MMMUs should be used as the regional study area for the purposes of calculating the reference populations, the screening extent as regards Special Areas of Conservation (SACs), and for cumulative impacts spatial screening extent.	MMMUs have been used to provide regional context in baseline data as highlighted in section 1.2.
		Suggest harbour seals cannot yet be excluded from the high-level assessment until there is suitable evidence (i.e. from the results of the complete digital aerial survey campaign) for their exclusion.	Harbour seal scoped in as result of EWG discussions.
		Advise data derived from the site-specific aerial surveys is considered alongside existing data for the area when selecting the best/most precautionary estimate of marine mammal density to use for the quantitative assessment.	MMMUs and other existing baseline data have been used to provide regional context when selecting estimates for quantitative assessment.
		Advises that the regional study area for each marine mammal receptor should be based on the relevant MU for that receptor, insofar as the study area or MUs should be used to determine the appropriate reference population, SACs that should be screened	MMMUs and other existing baseline data have been used to provide regional context when selecting estimates for quantitative assessment.
		Data source suggestions for inclusion.	Included in baseline.
		Note that a number of individuals could not be identified to species level. We welcome clarification on how these observations are going to be included in the assessment to ensure that species' density estimates are not underestimated.	Combining densities to give the most precautionary estimate of density for use in the impact assessment. Detailed methods are given in Appendix A.
	NRW	NRW (A) advise that the MMMU is the appropriate scale for consideration of offsite impacts for marine mammals as per NRW's Position Statement.	The MMMUs have been used to provide regional context in baseline data as highlighted in section 1.2.

Date	Consultee and type of response	Topics	How/ where addressed in technical report
		If Digital Aerial Survey (DAS) data is to be used in environmental assessments, an assessment of the suitability of analysing data covering 12% of the survey area, such as a power analysis, should be provided to support the approach taken.	Coverage for Mona aerial surveys have been detailed in Appendix A, standing at least 14%. Coefficient of variation (CVs) have also been provided in this technical report to give measure of precision to support approach, but noted CVs will be higher for marine mammals, due to very low sighting numbers given their life history, so the difference between raw counts would be proportionally greater.
		Additional data sources or informative documents to those outlined	All have been included in baseline except for Marine Mammal Atlas which is yet to be published. Sea Watch Foundation (SWF) data is incorporated through other studies including Awel y Môr Environmental Statement.
		Where there is no density estimate in Small Cetaceans in the European Atlantic and North Sea (SCANS) Surveys III, SCANS II may be recommended for use in its place. NRW advise that a short, proportionate assessment on species of very low densities is preferable to scoping them out.	For short-beaked common dolphin *Delphinus delphis*, SCANS-II estimates are included as baseline densities for reference (paragraph 1.7.4.6).
Jul-22	**Marine Mammals EWG 2 –** Natural England, MMO, JNCC, NRW, TWT, Cefas.	Agreement sought on approach to the baseline characterisation with regards to regional marine mammal study area. NRW in agreement that Celtic and Irish Sea (harbour porpoise) MU is an appropriate study area for dolphin and minke whale.	Species-specific MUs have been used for reference context to populations. Agreement that the Celtic and Irish Sea (harbour porpoise MU) is an appropriate marine mammal study area.
		Discussion of species to scope in/out of the EIA and HRA. Agreement that white-beaked dolphin can be scoped out.	Harbour seal have been included in the baseline environment of the technical report. White-beaked dolphin have been scoped out.
Nov-22	**Marine Mammals EWG 3** – MMO, Natural England, NRW, TWT, DEFA, Isle of Man Government, Cefas.	NRW have used OSPAR region III as a reference population for grey seals and acknowledge that the use of OSPAR region III could dilute the impact, but the size of the OSPAR region III is likely appropriate to the level of connectivity between grey seal colonies. NRW confirmed OSPAR Region III includes the Isle of Man population.	OSPAR Region III reference population has been discussed in paragraph 1.7.7.44.
		Natural England suggested a high-level qualitative assessment on haul out sites (i.e. a qualitative assessment of movements from key haul out sites to the project area).	Information on haul out sites and telemetry data on seal movements has been provided in relevant species accounts for grey seal (section 1.7.7) and harbour seal (section 1.7.8).

Date	Consultee and type of response	Topics	How/ where addressed in technical report
		The Wildlife Trust offered grey seal count data for the haul out site on Walney Island.	Data is included in section 1.5.23 and discussed in grey seal species account (section 1.7.7), provided by Cumbria Wildlife Trust.
		NRW advised the use of the Welsh Marine Mammal Atlas as it comprises 30 years of survey data and highlighted the higher densities around the Isle of Anglesey and avoids issue of snapshot data.	Densities from the Welsh Marine Mammal Atlas (Evans and Waggitt, 2023) have been given in relevant species accounts sections (1.7.2 to 1.7.6). Densities taken forward to assessment for harbour porpoise and bottlenose dolphin are derived from the Welsh Marine Mammal Atlas.
Jun-23	**Statutory consultation Responses -** MMO, NRW, Natural England, JNCC, DEFA, Isle of Man Government, Wildlife Trust Wales	Use of Welsh Marine Mammal Atlas (Evans and Waggitt, 2023). NRW considers the proposal to use a peak seasonal density of 0.097 harbour porpoise per km^2 to be substantially lower than the more up to date densities supplied from the latest edition of the Marine Mammal Atlas (Evans and Waggitt, 2023) ensuring that the most precautionary (or the most scientifically robust) values are taken forward to the assessment. Also NRW recommend using density from Evans and Waggitt (2023) for bottlenose dolphin to avoid complexity of using two densities in the assessment, and do not recommend distance from coastline approach to predict density distributions.	Densities from the Welsh Marine Mammal Atlas (Evans and Waggitt, 2023) have been given (alongside other desktop and site-specific densities) in relevant species accounts sections (1.7.2 to 1.7.6). Densities taken forward to assessment for harbour porpoise and bottlenose dolphin have been derived from the Welsh Marine Mammal Atlas, noting that one single density has been used for bottlenose dolphin to avoid complexity of using two densities in the assessment.
		NRW recommend adding clarification regarding Mammal Units (MUs) used for grey seal, given that the CIS MU was used as the regional marine mammal study area for cetaceans, but not grey seal.	Study areas used have been described in 1.2, with further detail on the grey seal reference population given in paragraph 1.7.7.43.
		JNCC requested clarification on the Mona marine mammal study area and why it does not extend evenly around the Mona Array Area.	Further detail on study areas has been given in section 1.2, with detail on buffer distances.

Date	Consultee and type of response	Topics	How/ where addressed in technical report
		Isle of Man Government queried the inclusion of Isle of Man data in the haul out and telemetry report from SMRU and sought confirmation that Manx populations have been adequately and equally included. They also wanted clarification that the Manx grey seal population has been appropriately considered within the baseline.	The seal telemetry and haul out report (Appendix B) has presented available data that SMRU hold for the seal MUs, and confirmed they do not hold any additional data for the Isle of Man. However, data has been obtained from Manx Wildlife Trust and has been presented in section 1.5.22, and relevant grey seal (1.7.7) and harbour seal (1.7.8) species accounts. Specific grey seal sections dedicated to the Isle of Man have been given in 1.7.7.19, 1.7.7.38 and the 'Grey Seal Reference population' (GSRP) detailed in paragraph 5.7.7.38 has included an estimate for the Isle of Man from Howe (2018b), which was confirmed in a meeting in August 2023. Furthermore, the Carter *et al*. (2022) maps used to derive densities (paragraph 1.7.7.22 for grey seal and 1.7.8.14 for harbour seal) cover the waters around the Isle of Man and therefore the Isle of Man has been included in densities taken forward to the impact assessment (Table 1.15).
		The Isle of Man Government stated that the Cardigan Bay and Manx winter population of bottlenose dolphins on the east coast are believed to be the same group, based on data, including from photographic recognition of individuals. They suggested this should be acknowledged, and a specific assessment of the Manx population.	Detailed discussion of connectivity of bottlenose dolphin with Manx waters has been presented in 1.7.3.7 and clarifies animals are likely to go between Cardigan Bay and the Isle of Man. However, a specific assessment of the Manx population (as opposed to the Cardigan Bay population) would not support this suggestion of one single moving population. Isle of Man confirmed content with approach in later meeting (Aug 23).
		Isle of Man Government requested clarification on the nature of the seasonal data provided by MWDW.	A personal communication was provided from the MWDW on seasonality for cetaceans around the Isle of Man, and has been included in relevant paragraphs 1.7.2.45, 1.7.3.37, 1.7.5.25, and 1.7.6.21.
Jun-23	**Marine Mammals EWG 05** – MMO, Natural England, NRW, JNCC. TWT, Cefas.	NRW recommend the use of densities from the Welsh Marine Mammal Atlas. As previously mentioned, the Atlas links 30 years of sightings and effort data with a number of other environmental parameters. NRW confirmed agreement with the remaining species densities and reference populations provided in note appended to the draft Meeting Minutes.	Densities from the Welsh Marine Mammal Atlas (Evans and Waggitt, 2023) have been given (alongside other desktop and site-specific densities) in relevant species accounts sections (1.7.2 to 1.7.6). Densities taken forward to assessment for harbour porpoise, bottlenose dolphin and short-beaked common dolphin have been derived from the Welsh Marine Mammal Atlas.

Date	Consultee and type of response	Topics	How/ where addressed in technical report
		NRW agree to using both approaches to grey seal reference populations in parallel. NRW mentioned that when screening in projects if a smaller area is proposed (other than OSPAR III) for grey seal and justified, NRW (A) would not anticipate ruling it out. While we would still advise the use of OSPAR III for screening, we are conscious that a large MU could be somewhat un-pragmatic. Alternatives such as (1) the maximum foraging range of 448 km (Carter et al., 2022); (2) ICES divisions 7a, e,f,g,h; or (3) ICES divisions 7a,b,e,f,g,h,j would still be acceptable as screening distances.	Both approaches have been used in parallel, with the GSRP discussed in paragraph 1.7.7.43 and OSPAR Region III in 1.7.7.44. Cumulative screening approach has been discussed in paragraph 1.2.1.3. For grey seal this comprises the GSRP discussed in paragraph 1.7.7.43, and for harbour seal this comprises the Harbour Seal Reference Population (HSRP) as discussed in paragraph 1.7.8.21.
		Natural England agrees with the use of the one density across the whole study area for bottlenose dolphin referencing the Welsh Marine Mammal Atlas. Natural England did not agree with the proposed short-beaked common dolphin density from Waggitt *et al.* (2020) in EWG 05 note. Natural England is content with the proposed approach to consider the Irish Sea MU for bottlenose dolphin cumulative assessment. Natural England did not have objections on presenting OSPAR region III alongside MUs for comparison. Advise that the more precautionary one should be taken further to the assessment.	One single density has been used for bottlenose dolphin (presented in Table 1.15). The density taken forward for short-beaked common dolphin was taken from the Welsh Marine Mammal Atlas (Evans and Waggitt, 2023) presented in Table 1.15. Cumulative screening approach has been discussed in paragraph 1.2.1.3, and used relevant MUs (for bottlenose dolphin the Irish sea MU) for species. The reference population taken forward to assessment, the 'Grey Seal Reference Population' (GSRP) has been discussed in paragraph 1.7.7.43. The OSPAR Region III population number has been applied to the assessment for additional context and is discussed in paragraph 1.7.7.44. Relevant MUs are taken forward to assessment (presented in Table 1.15).
Aug-23	**Marine mammals meeting with the IoM**	IoM Government wanted clarification that the Manx grey seal population has been appropriately considered within the baseline and offered additional pers. comms surrounding connectivity in IoM waters. RPS requested confirmation that the Isle of Man population estimate is suitable.	MWT provided a pers. comms to explain connectivity of grey seals around the IoM. These have been included in relevant species accounts sections (1.7.2 to 1.7.8). MWT and MWDW confirmed content with list of data sources presented in Table 1.2. MWT confirmed the estimate of 400 is suitable, and provided additional context to this in pers. comm.

1.4 Methodology

1.4.1 Overview

1.4.1.1 Information on marine mammals within the regional marine mammal study area was collected through a detailed desktop review of existing studies and datasets and site-specific surveys.

1.4.2 Desktop study

1.4.2.1 Information on marine mammals within the regional marine mammal study area was collected through a detailed desktop review of existing studies and datasets. These are summarised in Table 1.2 below, with more detailed summaries of each data source below. These data sources are used in detailed species accounts, given in later sections 1.7.2 to 1.7.8.

Table 1.2: Summary of key desktop sources.

Title	Source	Year	Author
Awel y Môr Wind farm surveys	APEM Ltd.	2019 to 2021	Sinclair *et al*. (2021)
Gwynt y Môr baseline	Centre for Marine and Coastal Studies (CMACS)	2003 to 2005	CMACS Ltd. (2011; 2013); Goddard *et al*. (2017); Goddard *et al*. (2018); Goulding *et al*. (2019)
Rhiannon Wind Farm aerial and boat-based surveys	Celtic Array Ltd.	2010 to 2013	Celtic Array Ltd. (2014)
Morecambe Offshore Windfarm Generation Assets Marine Mammal Information and Survey data (this includes HiDef aerial digital site surveys)	Morecambe Offshore Windfarm, Ltd.	Aerial surveys from March 2021 to February 2022	Morecambe Offshore Windfarm, Ltd (2023)
Morgan Offshore Wind Project: Generation Assets interim aerial survey data	Morgan Offshore Wind Project Ltd.	Aerial surveys from April 2021 to April 2022.	Morgan Offshore Wind Project Ltd (2023.
Estimates of cetacean abundance in European Atlantic waters from the SCANS aerial and shipboard surveys	SCANS	1994; 2005; 2016; 2022	Hammond *et al*. (2002); Hammond *et al*. (2017); Hammond *et al*. (2021); Gilles *et al.* (2023)
Density surface modelling from SCANS-III surveys	SCANS	2016	Lacey *et al*. (2022)
Joint Cetacean Protocol (JCP) Phase I, III Analysis	JCP	1994 to 2010	Paxton and Thomas, (2010); Paxton *et al*. (2016)
JNCC Report 544: Harbour Porpoise Density	JNCC	1994 2011	Heinänen and Skov (2015)
Atlas of the Marine Mammals of Wales (2012)	Countryside Council for Wales (CCW)	1990 to 2009	Baines and Evans (2012)

Title	Source	Year	Author
Modelled Distribution and Abundance of Cetaceans and Seabirds in Wales and Surrounding Waters (2023) (Welsh Marine Mammal Atlas)	NRW	1990 to 2020	Evans and Waggitt (2023)
Distribution maps of cetacean and seabird populations in the North-East Atlantic (2020)	Bangor University	1980 to 2018	Waggitt *et al.* (2020)
ObSERVE surveys	National Parks and Wildlife Service (NPWS)	2015 to 2017	Rogan *et al.*, 2018
Strategic Environmental Assessment (SEA) 6	SMRU	2005	Hammond *et al*., 2005
SCOS Reports	SMRU	1990 to 2021	SMRU
Seal Telemetry Data	SMRU	2004 to 2018	Wright and Sinclair (2022)
Habitat-based predictions of at-sea distribution for grey and harbour seals in the British Isles	Report to BEIS	1996 to 2015	Carter *et al*. (2020; 2022)
MWDW surveys: • Opportunistic and effort-based sighting data	MWDW	2006 to 2022	Data from MWDW Manley (2021, 2020, 2019); Clark *et al.* (2019, 2017); Felce and Adams (2016); Felce, (2015); Adams (2017)
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	MWT
Manx Marine Environmental Assessment	Isle of Man Government	2018	Howe (2018a); Howe (2018b)
Walney Nature Reserve survey data	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)
Updated abundance estimates for cetacean MUs in UK waters	JNCC	2021	IAMMWG (2021)

1.4.3 Site-specific surveys

1.4.3.1 A summary of the site-specific surveys undertaken to inform the marine mammal assessment is outlined in Table 1.3 below.

1.4.3.2 The Mona Aerial Survey Area was based upon a pre-scoping original array area layout plus a buffer of 10 km. The array area was subsequently refined to the Mona PEIR Array Area for the PEIR, which led to a 4 to 10 km buffer (as presented in PEIR) following commencement of the marine mammal surveys. The Mona Aerial Survey Area remains unchanged from PEIR to Environmental Statement, and forms part of the boundary of the Mona marine mammal study area (see section 1.2). The Mona Array Area itself has reduced in spatial extent from PEIR to Environmental Statement, but it remains within the boundaries of the Mona Aerial Survey Area and results in an increased buffer region (7 km to 16.5 km).

Table 1.3: Summary of surveys undertaken to inform marine mammals.

Title	Extent of survey	Overview of survey	Survey contractor	Date	Reference to further information
Aerial Digital Surveys - Mona	Mona Array Area plus 7 to 16.5 km buffer.	Aerial digital survey	APEM Ltd.	March 2020 to February 2022	Aerial survey data interim analysis- Appendix A

APEM survey approach

1.4.3.1 The aerial digital surveys surveyed the Mona Array area with a buffer of between 7 and 16.5 km; known hereafter as the Mona Aerial Survey Area.

1.4.3.2 The total area surveyed for the Mona Offshore Wind Project was 1,447 km^2. Surveys started in March 2020 and ended in February 2022 and have been carried out monthly to give two years of baseline data.

1.4.3.3 The Mona aerial surveys were undertaken by APEM and full details of the method are given in Appendix A. Utilising a bespoke camera system on twin-craft engine aircraft, they use a grid-based collection method to collect 30% of the sea surface area and analysed at least 14% of the Mona Aerial Survey Area. Still images along 18 survey lines with approximately 2 km between-track were collected to give 1.5 cm Ground Sampling Distance (GSD) digital still images.

1.4.3.4 All surveys were undertaken in weather conditions that did not compromise the ability to provide data on the identification, distribution and abundance of marine megafauna and were also safe to fly in. Favourable conditions for surveying are defined as a cloud base of >396 m, visibility of >5 km, wind speed of <30 kn and a sea state of no more than four (moderate). Measures were taken to minimise glint and glare which may affect the discovery and identification of marine mammals. Some surveys were undertaken over more than one day or over two flights in one day due to weather constraints or to avoid non-optimal sun angles. Further detailed description of these conditions, measures and survey approaches are given in Appendix A.

1.4.3.5 In processing of aerial data, marine mammals identified in the images were categorised to the lowest taxonomic level possible. Size of individuals can be measured to aid in species-level identification. APEM uses the precautionary principle and only identifies to species level when there is 100% confidence. Comprehensive internal Quality Assurance (QA) processes were undertaken, which included checking for missed targets and review of each image ‘snag’ (i.e. a marine mammal located within the image) for correct species identification by a minimum of two members of staff. APEM included their Senior Marine Mammal Consultant and Principal Marine

Mammal Consultant in the QA process of all marine mammal images, who hold a minimum of five years' experience in identifying marine mammals to species level, nationally and internationally. Full details of the survey methodology, data processing, data analyses, and assumptions and limitations are provided in Appendix A, along with further detail on the APEM marine mammal consultancy team.

1.4.3.6 Summary statistics were produced to describe the data for each of the key species or species groups within the Mona Aerial Survey dataset. For the Mona Offshore Wind Project, the full 24 months are analysed for the Environmental Statement. Data from these surveys have been used to provide current information on species presence, distribution and abundance/densities within the survey area.

1.5 Other studies and data sources

1.5.1 Awel y Môr wind farm

1.5.1.1 Monthly digital still aerial surveys were conducted by APEM, to collect data on the abundance and distribution of marine mammals to characterise the baseline to inform an EIA for the Awel y Môr wind farm (Sinclair *et al.*, 2021). One survey per month was carried out for two years, from March 2020 to February 2022. 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 kn 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). The surveys covered the Awel y Môr wind farm array area (Figure 1.4), 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). 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 GSD imagery captured at 1,700 ft. High altitudes were chosen to allow for clearance of the 500 ft proposed 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. The survey also aimed to get species specific density estimates for the site, but identification rates were low and thus not suitable for providing density estimates.

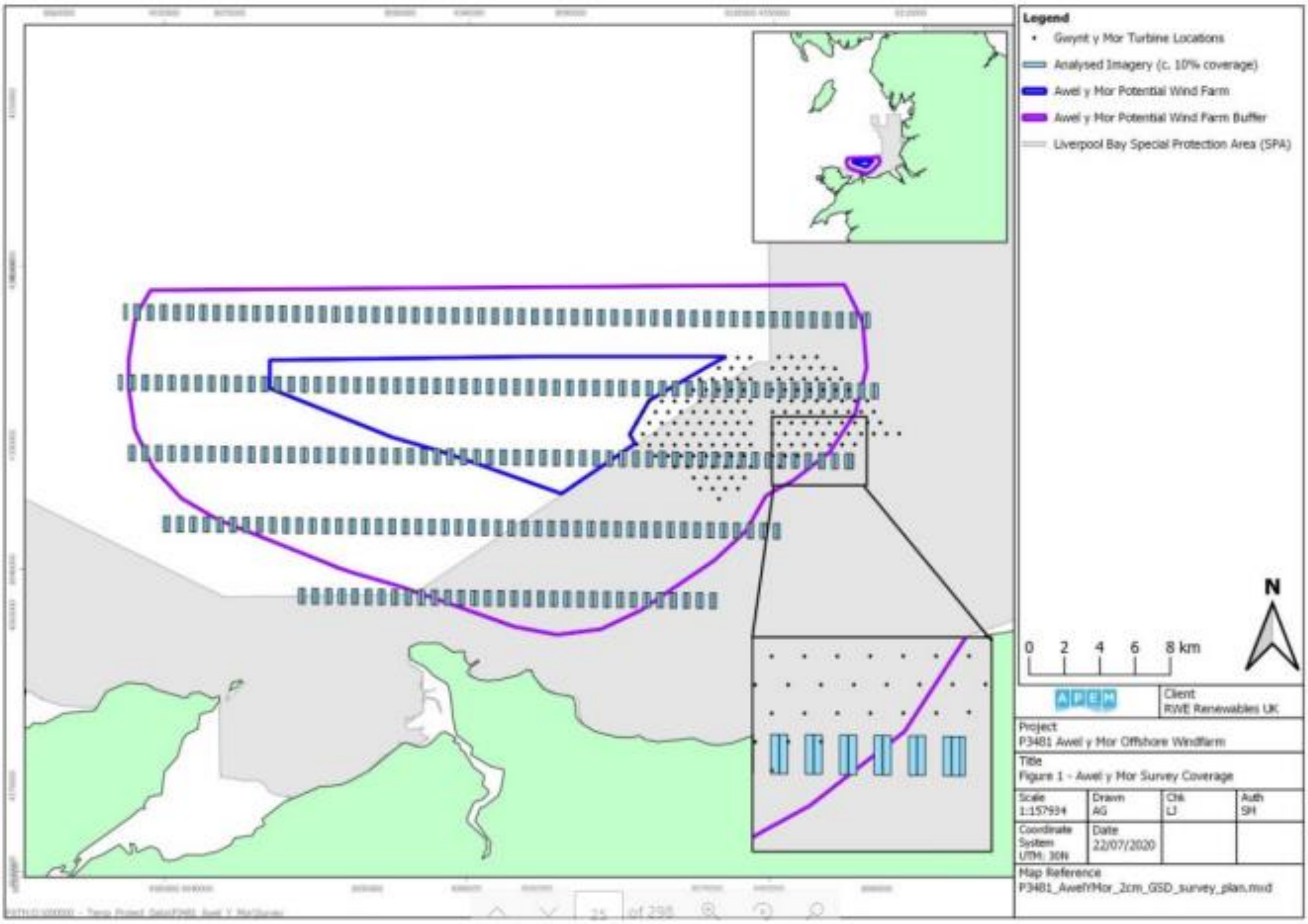


Figure 1.4: Marine mammal survey area for Awel y Môr offshore wind farm. From Sinclair *et al.* (2021).

1.5.2 Gwynt y Môr baseline, mitigation and post-construction surveys

1.5.2.1 Boat and land-based visual surveys were carried out for the initial Gwynt y Môr 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 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. 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 implemented marine mammal mitigation and associated monitoring between 8 May 2012 and 5 April 2013 (CMACS Ltd, 2013).

1.5.2.2 Post construction, 17 digital aerial surveys were conducted between July 2016 and March 2019. The area covered the offshore wind farm, 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).

1.5.3 Rhiannon Wind Farm

1.5.3.1 Rhiannon Wind Farm was the first of the three Potential Development Areas to be taken forward within the Irish Sea Zone (ISZ), and data was collected for a technical assessment, which included marine mammal surveys (Celtic Array Ltd., 2014). Whilst the project was halted in 2014 due to complex ground conditions, the final report on aerial and boat based surveys to collect data to establish baseline use of the ISZ is available and was submitted to the TCE Marine Data Exchange.

1.5.3.2 Twelve digital video aerial surveys were flown by HiDef between 25 April 2012 and 1 March 2013 (Celtic Array Ltd., 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 (see Figure 1.5). 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. Only harbour porpoise was present in the ISZ on a consistent basis, though a pod of short-beaked common dolphins was recorded during July and grey seal was observed.

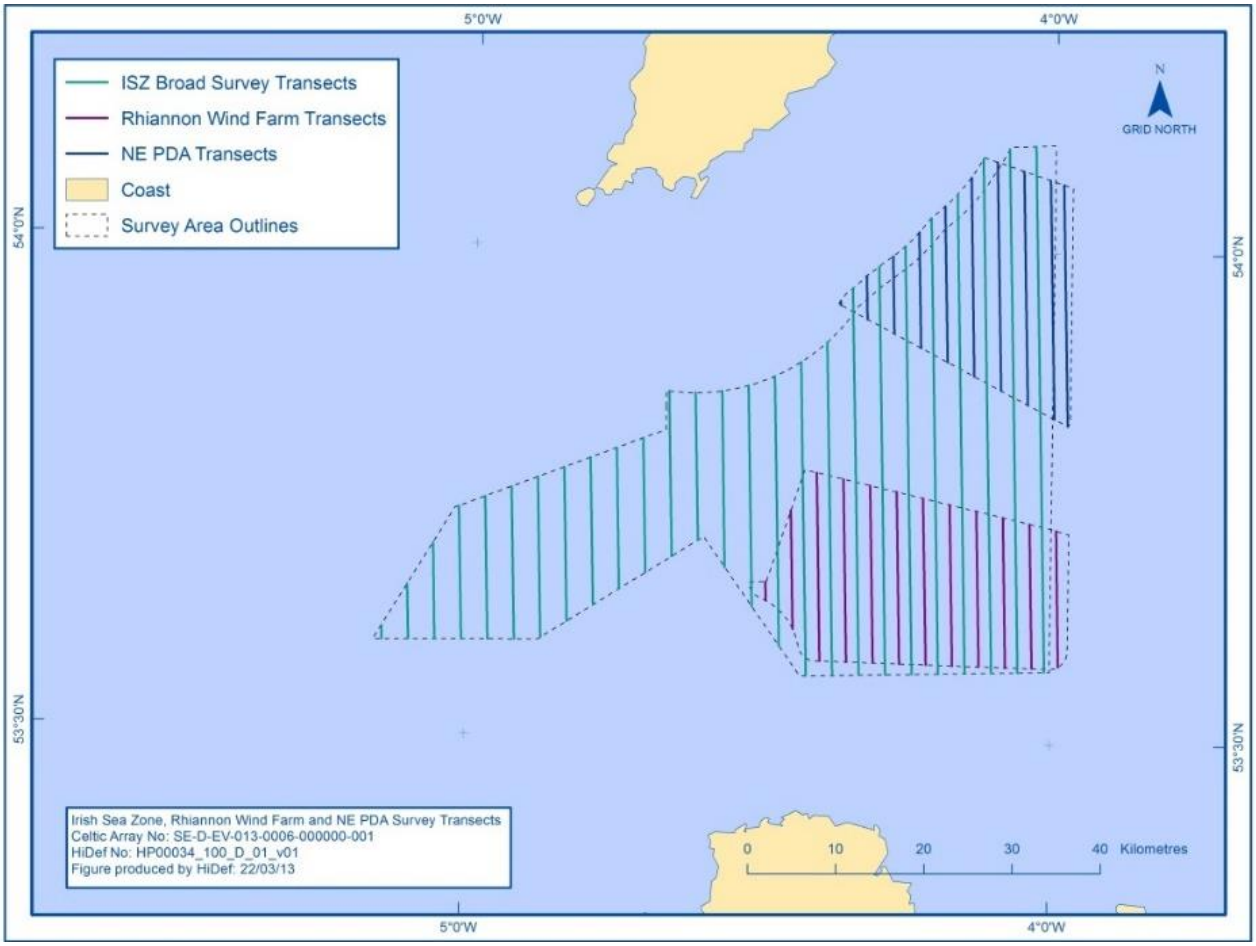


Figure 1.5: Location of aerial survey transects within the Irish Sea Zone (ISZ), proposed Rhiannon Wind Farm and NE Potential Development Area.

1.5.3.3 Boat surveys comprised a series of 17 transects at a 3.7 km spacing, from 21 March 2010 to 13 April 2012 (Figure 1.6). 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 calves/juveniles), 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.

1.5.3.4 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.

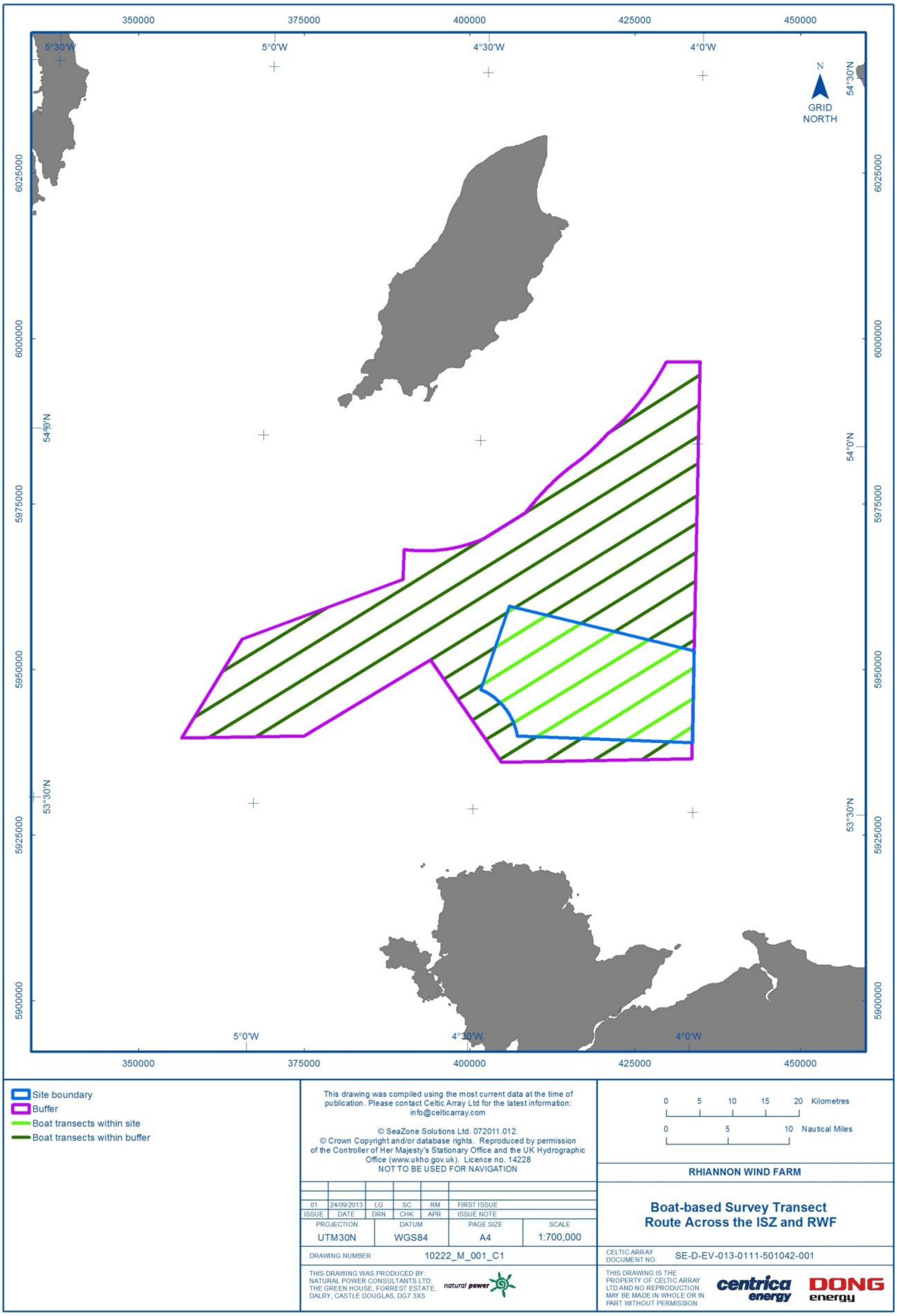


Figure 1.6: Location of transects traversed during boat-based surveys of the Irish Sea Zone (ISZ) (from Celtic Array Ltd., 2013).

1.5.4 Morgan Offshore Wind Project: Generation Assets

1.5.4.1 For Morgan Offshore Wind Project: Generation Assets (Morgan Offshore Wind Ltd, 2023), APEM Ltd collected high resolution aerial digital still imagery for the Morgan Array Area plus a buffer of 10 km (totalling an area of 1,387 km^2). Only the first 12 months of data were available to be included in the PEIR with a full 24 months of data expected to be available for the Morgan Offshore Wind Project: Generation Assets Environmental Statement. The aerial surveys used a grid-based collection method to collect 30% of the sea surface area and analysed at least 12% of the Morgan Aerial Survey Area (Morgan Offshore Wind Ltd, 2023).

1.5.4.2 Estimates of abundance and density were presented in the Morgan Offshore Wind Project: Generation Assets PEIR, noting that estimates were based upon 12 months of data collection. Harbour porpoise was the most frequently recorded species and was sighted every month (April 2021 to March 2022). Grey seal had the second highest number of sightings but were not recorded in every month over the survey period. The only other sightings identified to species level were bottlenose dolphin. Risso's dolphin and harbour seal were not encountered during the 12 months of surveying (Morgan Offshore Wind Ltd, 2023).

1.5.4.3 Modelling of the Morgan aerial survey data allowed absolute estimates of mean abundance, densities and confidence limits to be given for grey seal and for harbour porpoise for the Morgan Aerial Survey Area. Low sighting occurrences for other species meant modelling of densities was not possible (Morgan Offshore Wind Ltd, 2023).

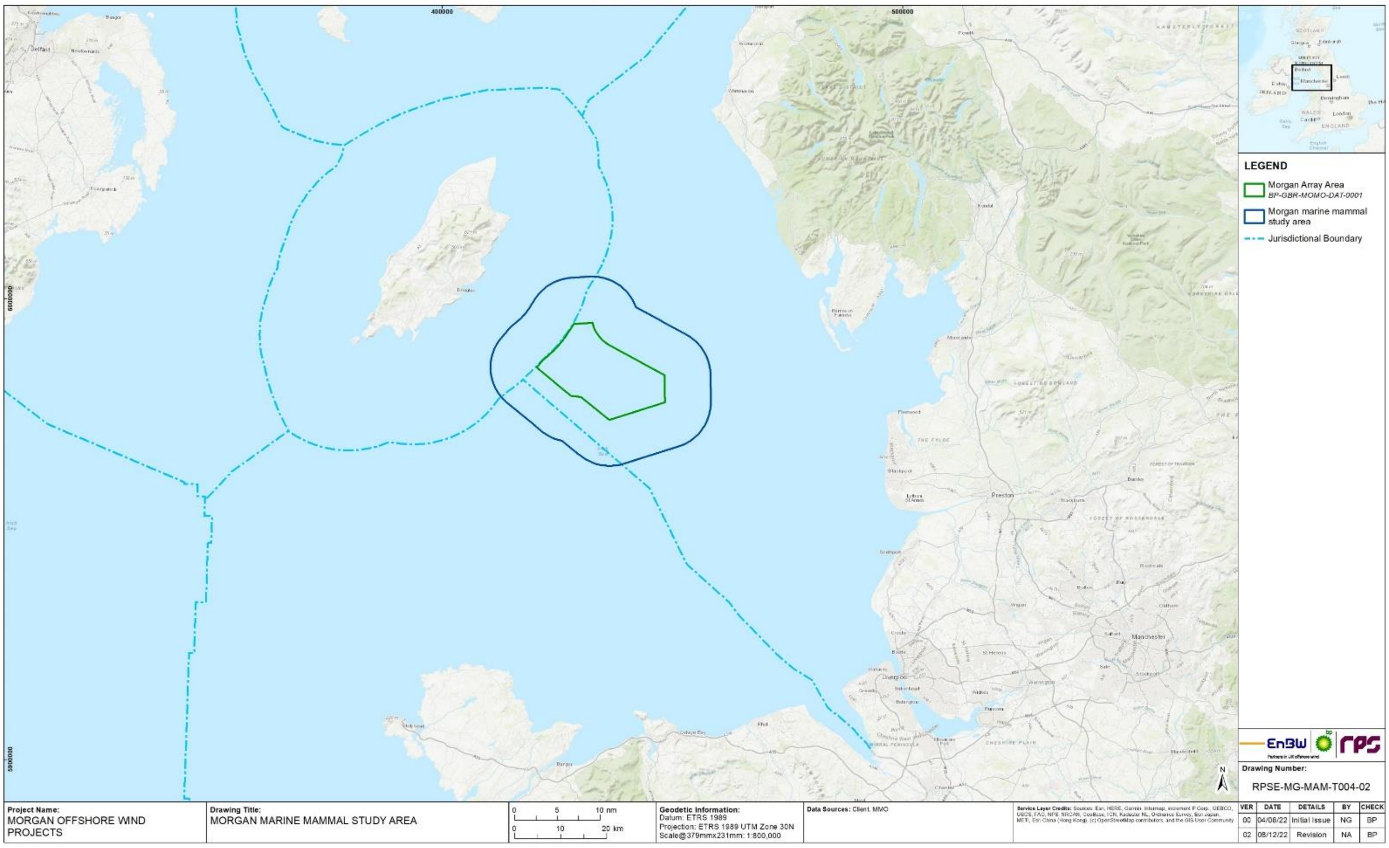


Figure 1.7 Morgan marine mammal Aerial Survey Area from Morgan Offshore Wind Ltd, 2023.

1.5.5 Morecambe Offshore Windfarm Generation Assets

1.5.5.1 For Morecambe Offshore Windfarm Generation Assets, HiDef Aerial Surveying Limited ('HiDef') collected high resolution aerial digital still imagery for marine megafauna (combined with ornithology surveys) over the survey area which includes the windfarm site and a 4 to 10 km buffer (Morecambe Offshore Windfarm Ltd, 2023) (Figure 1.8). The buffer extends 10 km to the north and east due to proximity to Liverpool Bay Special Protection Area for birds. The total survey area is 651 km^2.

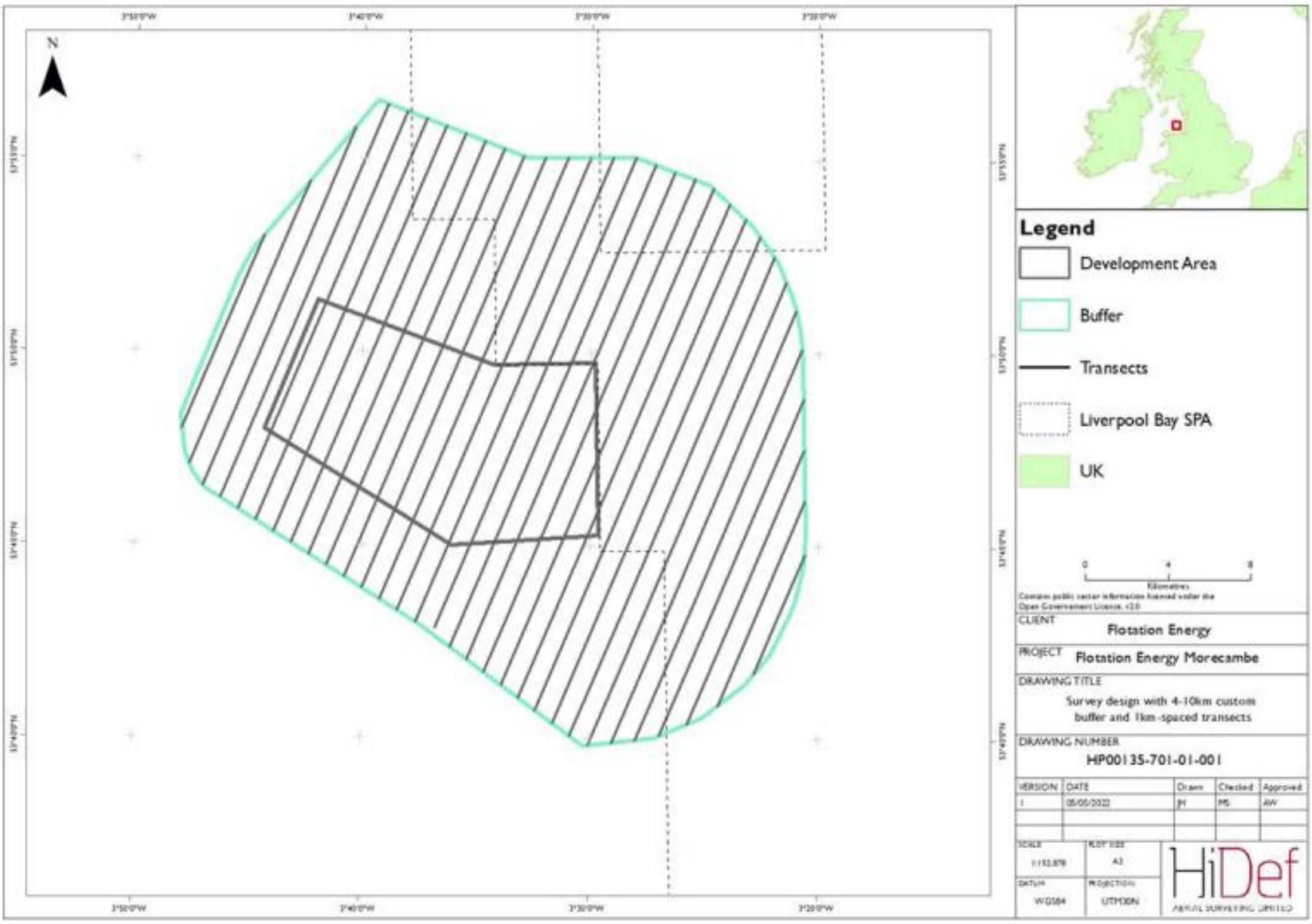


Figure 1.8 Morecambe survey design with 4 to 10 km buffer, with 1 km spaced transects flown between March 2021 and February 2022.

1.5.5.2 The monthly area surveys commenced in March 2021, extending over 24 months. The aerial 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. The results indicate harbour porpoise were the most abundant marine mammal species present within the survey area and were recorded in all 12 months and across the entire survey area.

1.5.5.3 Abundance and density estimates were calculated based upon confirmed sightings for harbour porpoise only. Estimates were calculated using strip transect analysis and a statistical technique called kernel density estimation (KDE) to create density surface maps. The density estimate is expressed as the average number of animals per km^2

in the whole survey area. The population estimate is expressed as the estimated number of animals within the whole survey area, with a measure of CV.

1.5.6 SCANS surveys

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

1.5.6.1 The main objective of SCANS surveys was to estimate small cetacean abundance and density in the North Sea and European Atlantic continental shelf waters. SCANS-I surveys were completed in 1994 (Hammond *et al.*, 2002), SCANS-II in July 2005 (Hammond *et al.*, 2013), SCANS-III in July 2016 (Hammond *et al.*, 2017; Hammond *et al.*, 2021) and SCANS-VI in September 2022 (Gilles *et al.,* 2023), and all comprised a combination of vessel and aerial surveys. Both methodologies were designed to correct for availability and detection bias and allowed the estimation of absolute abundance for each of the Blocks covered by the surveys.

1.5.6.2 SCANS-I surveys did not cover the Mona Array Area but did cover the Celtic Sea to the south of the Mona Offshore Wind Project (Block A) (Hammond *et al.* (2002) (Figure 1.9). The Mona Array Area is in the SCANS-II survey block O (Hammond *et al.* (2013) (Figure 1.10), SCANS-III survey block F (Hammond *et al.*, 2021) (with survey block E adjacent) (Figure 1.11) and SCANS-IV block CS-E (Figure 1.12), all surveyed by aircraft.

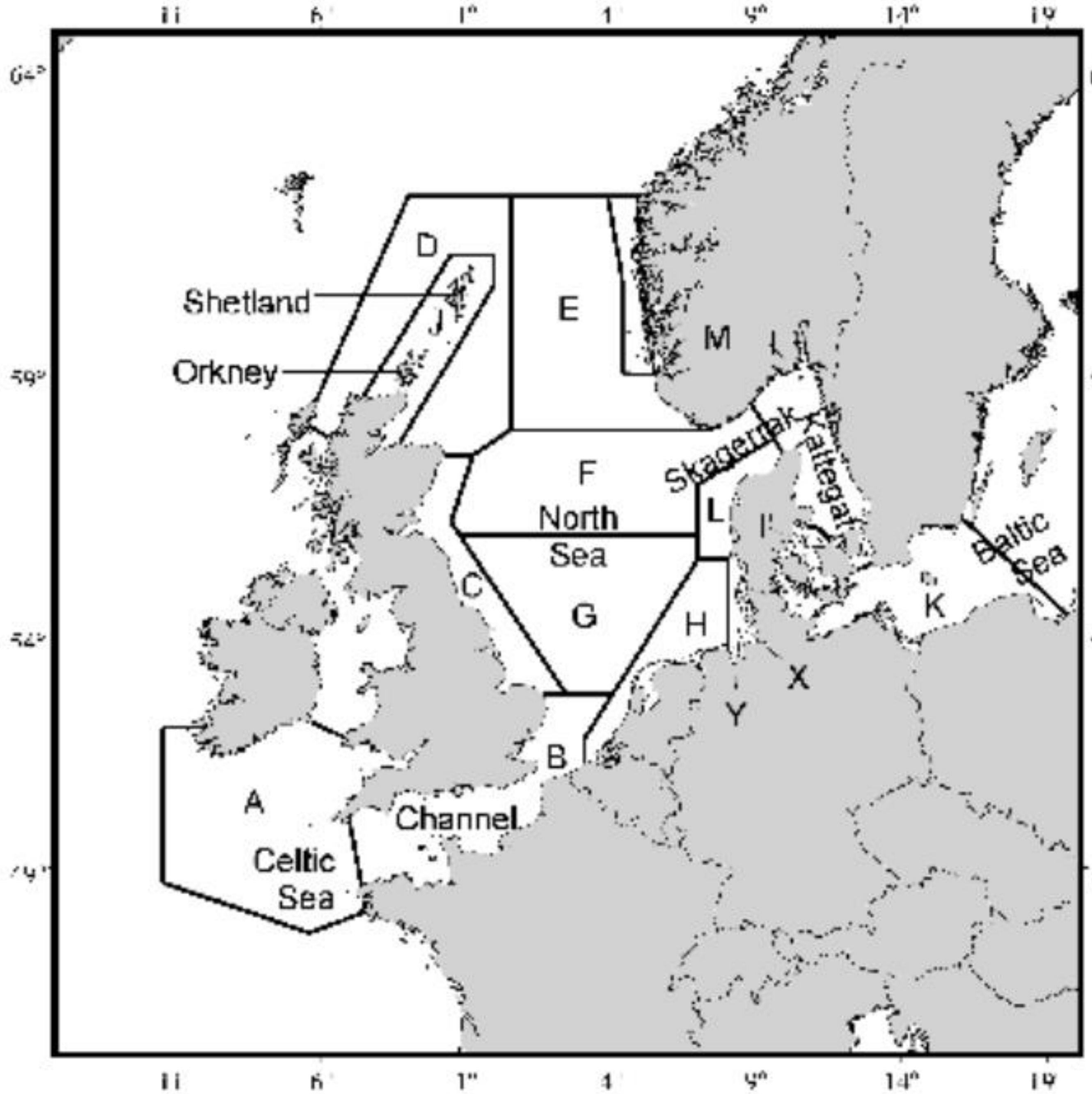


Figure 1.9: Area covered during the SCANS-I survey in 1994 (from Hammond *et al.,* 2002). The aerial transects in SCANS-II covered 15,802 km in good or moderate conditions in an area of 364,371 km^2 (Hammond et al., 2013). For block O, the survey area was 45,417 km^2 with a total survey effort of 2,264 km.

1.5.6.3 In 2016, the SCANS-III aerial survey total search effort was 51,286.7 km and covered the surface area of 1,208,744 km^2 (Hammond *et al.*, 2021). Block F has a surface area of 12,322 km^2 with 619.8 km surveyed under primary effort whilst adjacent 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 for the purpose of this study.

1.5.6.4 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 Mona Offshore Wind Project lies within block

CS-E which has a surface area of 12,274 km^2, with 740.8 km surveyed under primary effort. 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 and 15 August 2022.

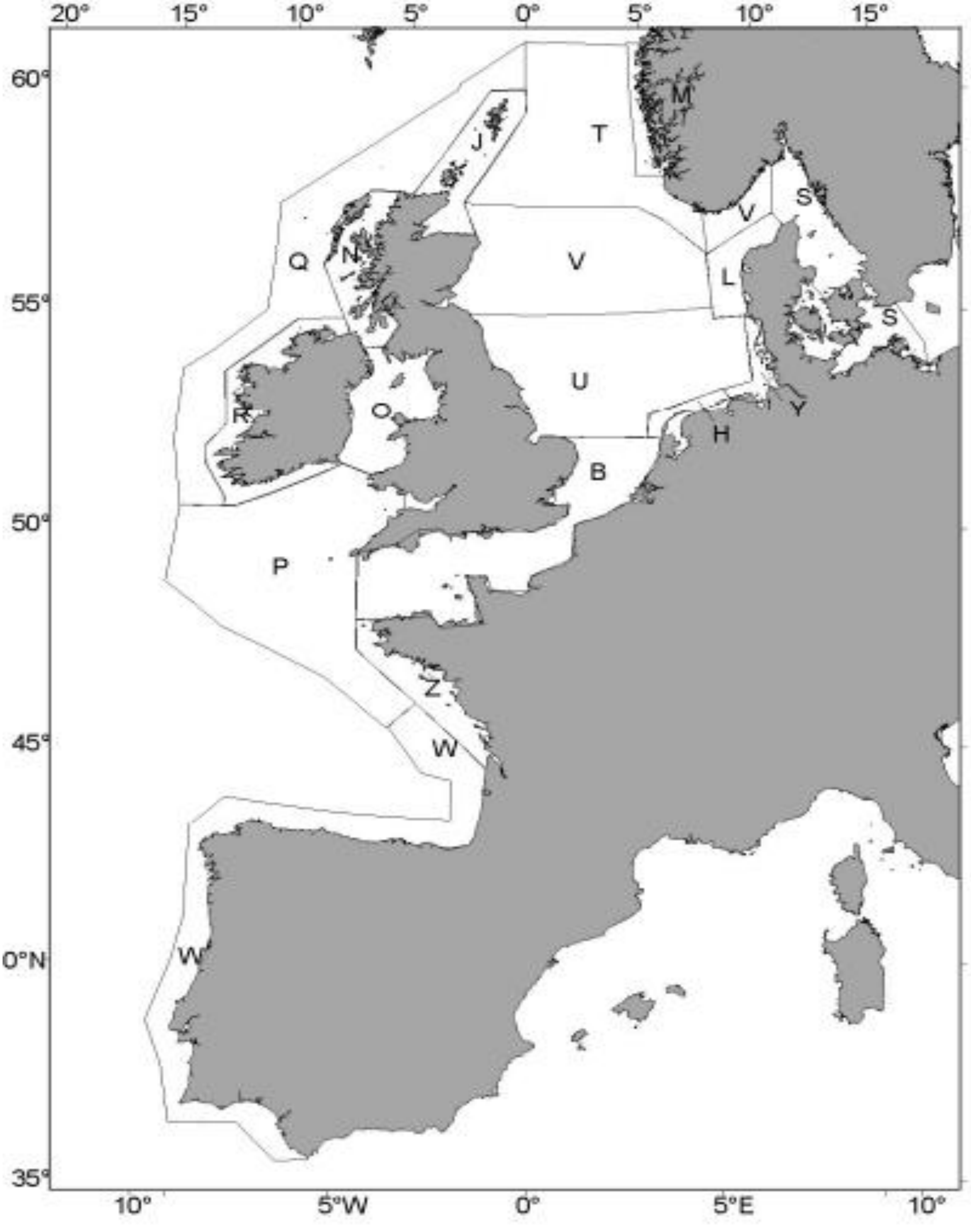


Figure 1.10: Survey blocks for SCANS-II surveys in 2005 (from Hammond *et al.,* 2013).

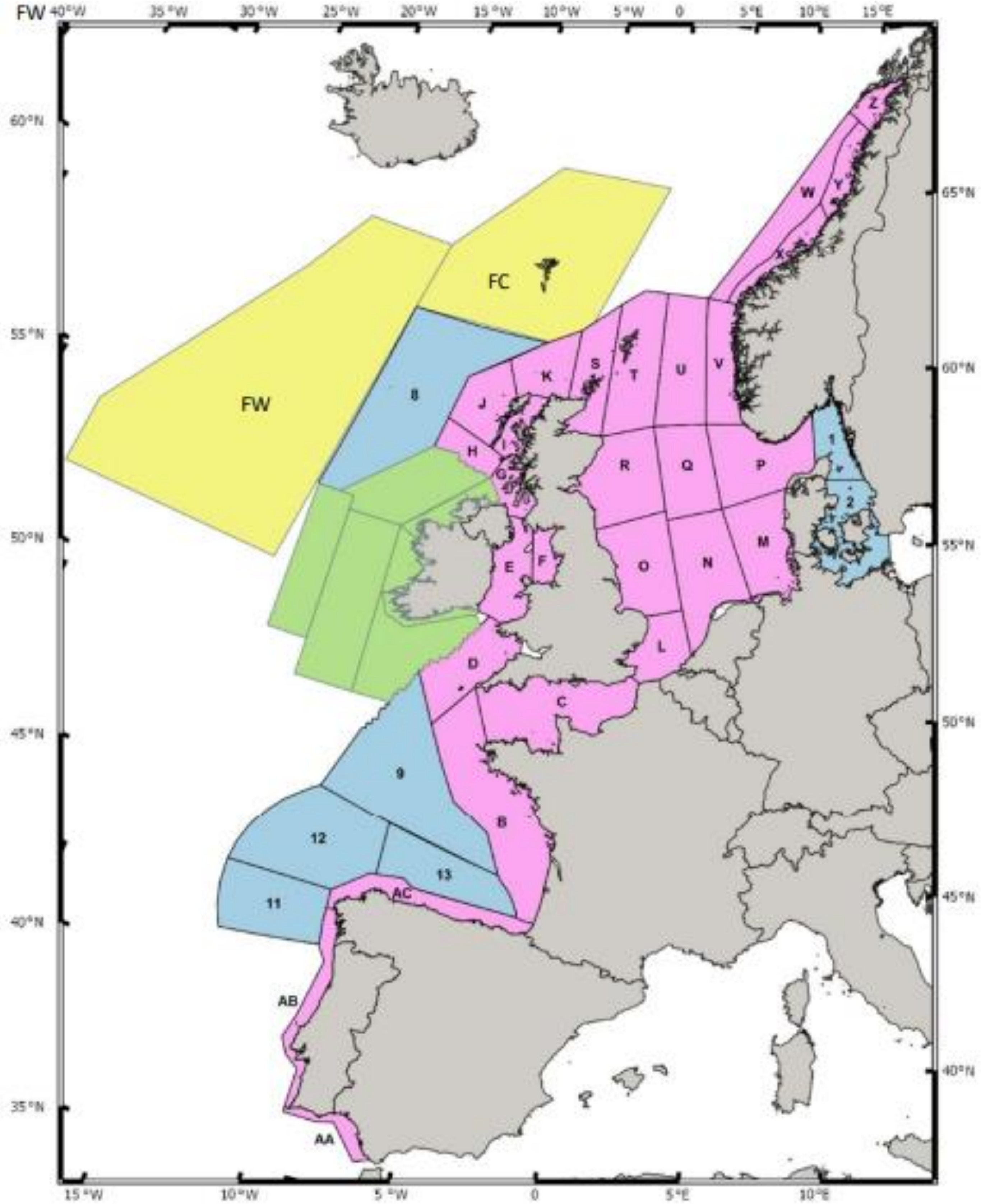


Figure 1.11: SCANS-III blocks surveyed in 2016. Pink blocks surveyed by aerial surveys (from Hammond *et al.,* 2021).

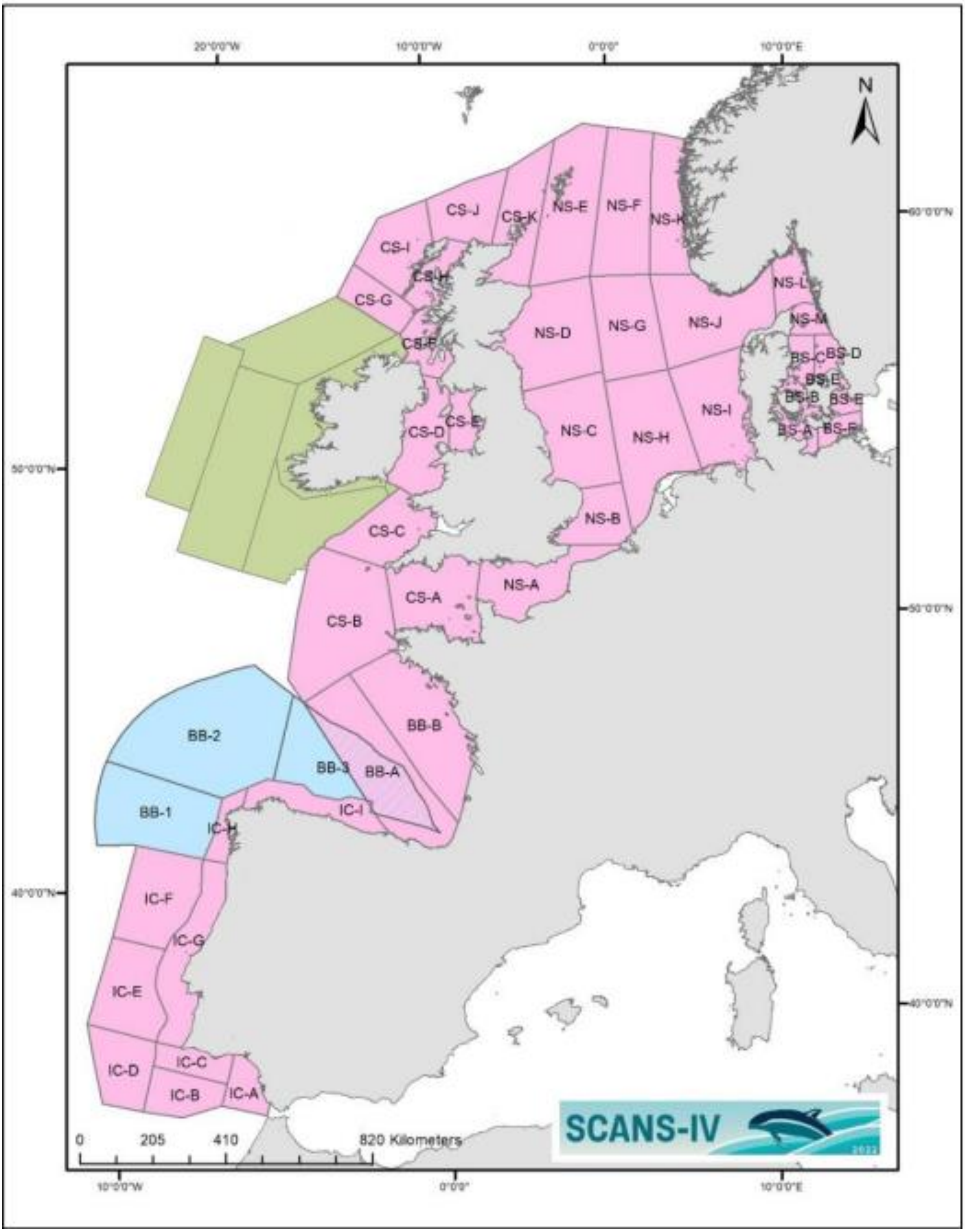


Figure 1.12: SCANS-IV blocks surveyed in 2022. Pink blocks surveyed by aerial surveys (from Gilles *et al.,* 2023).

SCANS-III density surfaces

1.5.6.5 Although a primary aim of SCANS-III was to provide robust large-scale estimates of cetacean abundance (*Hammond et al*., 2021), SCANS-III data 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 density surface modelling for those cetacean species for which sufficient data were obtained during SCANS-III, which includes harbour porpoise, bottlenose dolphin, short-beaked common dolphin *Delphinus delphis* and minke whale. 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).

1.5.6.6 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.

1.5.6.7 Maps showing surfaces of predicted density and estimated 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 Mona marine mammal study area for mean density outputs and are discussed within relevant species sections (harbour porpoise section 1.7.2, bottlenose dolphin section 1.7.3, short-beaked common dolphin section 1.7.4 and minke whale section 1.7.6).

1.5.7 ObSERVE surveys

1.5.7.1 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. Nineteen species of cetaceans were sighted over two years, with 1,844 sightings.

1.5.7.2 The Mona marine mammal study area is located closest to Stratum 5 (Figure 1.13) the only strata in the Irish Sea, which covers only the west Irish coastal waters of the Irish Sea (the ‘western Irish Sea’ stratum). 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.

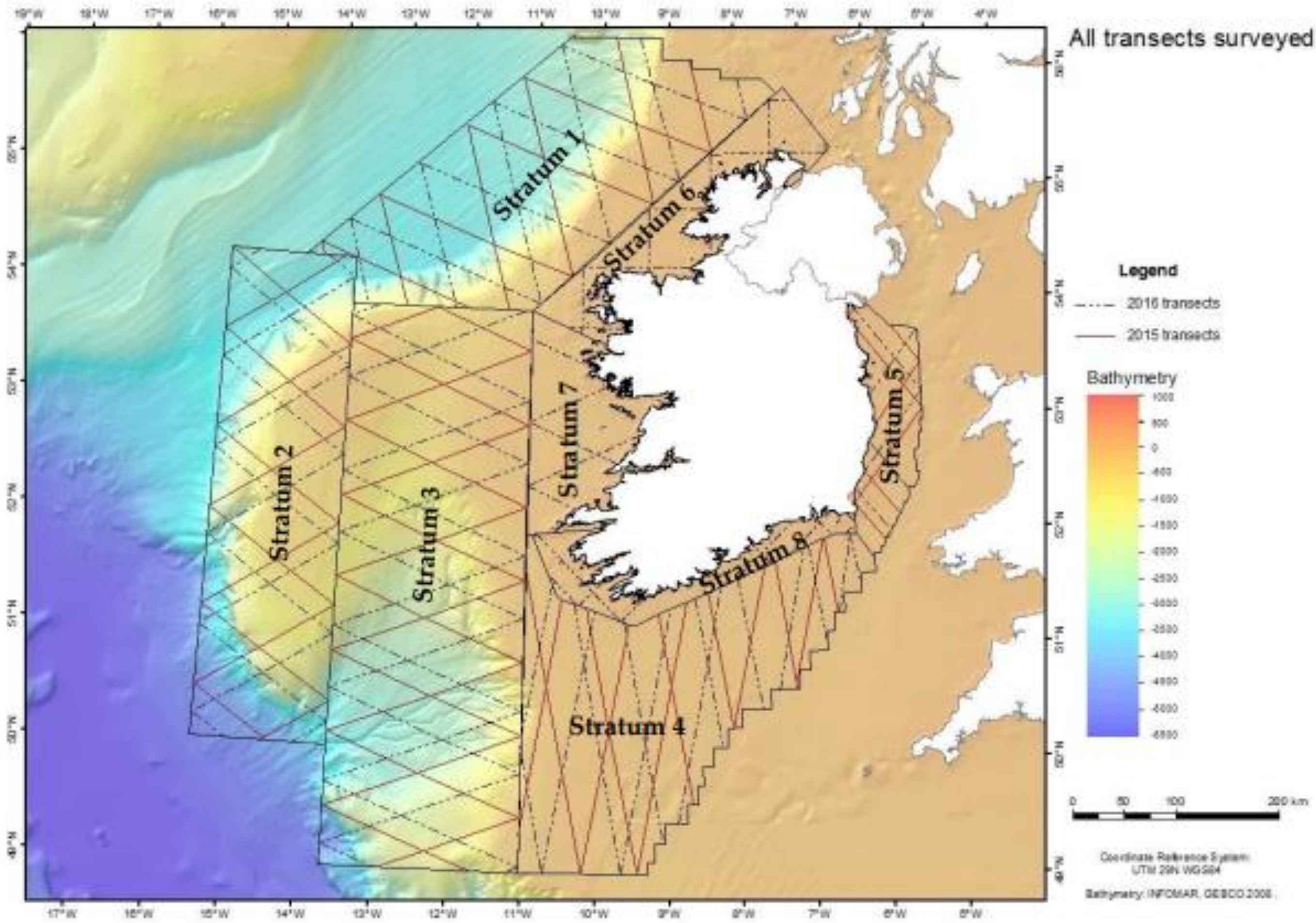


Figure 1.13: ObSERVE Aerial transect lines flown in summer and winter 2015 and 2016 (from Rogan *et al.,* 2018).

1.5.8 Inter-Agency Marine Mammal Working Group MUs

1.5.8.1 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 *Delphinus delphis*, white-beaked dolphin *Lagenorhynchus albirostris*, Atlantic white-sided dolphin *Lagenorhynchus acutus*, Risso's dolphin *Grampus griseus* and minke whale *Balaenoptera acutorostrata*. 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.

1.5.8.2 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 for bottlenose dolphin remains unchanged.

1.5.9 JCP Phase III analysis

1.5.9.1 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 17year 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 cetaceans 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. 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).

1.5.9.2 The Mona Offshore Wind Project is situated within the "Irish Sea" area of special commercial interest (which is different to the geographic region of the Irish Sea), covering the area of 8,227 km^2.

1.5.10 Phase One data analysis of JCP data

1.5.10.1 The JCP data resource (see paragraph 1.5.9.1) 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, short-beaked common dolphin and Risso's dolphin.

1.5.11 Joint Cetacean Data Programme (JCDP)

1.5.11.1 The JCDP launched in 2022, aiming to collate existing cetacean monitoring datasets in the UK and wider northeast 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 the Environmental Statement at the time of writing only contained SCANS-II data, which is previously discussed in section 1.5.6.

1.5.12 JNCC Report 544: Harbour Porpoise Density

1.5.12.1 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 goal of this analysis was to try to identify "discrete and persistent areas of high density" that might be considered important for harbour porpoise, with the ultimate goal of determining 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 patchy survey effort and analysed summer (April to September) and winter (October to March) data separately to explore whether distribution patterns were different between seasons.

1.5.12.2 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.

1.5.13 JNCC Report: 543 Persistent high occurrence and abundance of harbour porpoise and bottlenose dolphin

1.5.13.1 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 to identify 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 was much more evenly distributed. There was very little overlap between species.

1.5.14 Waggitt *et al*. (2020)

1.5.14.1 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 (SDMs) were used to predict comprehensive distribution maps of these taxa in the North-East Atlantic at 10 km resolution.

1.5.14.2 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, whilst the bottlenose dolphin found in the Irish Sea MU are the inshore ecotype.

1.5.15 Atlas of Marine Mammals of Wales (2012)

1.5.15.1 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 and greater part of the Bristol Channel) (Baines and Evans, 2012). The database comprised of 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 11 species (harbour porpoise, bottlenose dolphin, short-beaked common dolphin, Risso's dolphin, minke whale, fin whale, 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 has several limitations. The data is between 11 and 30 years old, and the authors state survey coverage was inadequate all but a few areas.

1.5.16 Welsh Marine Mammal Atlas (2023)

1.5.16.1 A new version of the Atlas of the Marine Mammals of Wales (hereafter known as the Welsh Marine Mammal Atlas) 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.

1.5.16.2 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.

1.5.16.3 Sighting rates were also determined for the more common species (given in paragraph 1.5.16.1) as well as the less common cetaceans and birds. These included striped dolphin, white-beaked dolphin, Atlantic white-sided dolphin, killer whale, long-finned pilot whale, fin whale and humpback whale.

1.5.16.4 Evans and Waggitt (2023) recommended that distribution patterns are taken from the full 30-year data set, and the report subsequently provided an annual composite map for each species showing the maximum density whenever it occurred over the 30 years of data for each cell. Alongside these maximum densities, the report also provided monthly and seasonal (by quarter) density maps for each species. To adopt a precautionary approach, and further to the advice from NRW during the EWG consultation for the Mona Offshore Wind Project, the average density estimates for the Mona marine mammal study area were taken from the maximum densities maps. Therefore, estimates are highly precautionary as this is the highest value observed for each cell at any one point in time.

1.5.17 SCOS

1.5.17.1 Under the Conservation of Seals Act 1970 and the Marine (Scotland) Act 2010, the Natural Environment Research Council (NERC) provides scientific advice to government on matters related to the management of seal populations through the advice provided by the SCOS. SMRU provides this advice to SCOS on an annual basis through meetings and an annual report. The report includes advice on matters related to the management of seal populations, including general information on British seals, information on their current status, and addresses specific questions raised by regulators and stakeholders. The most recent publicly available SCOS report is SCOS (2021) which presents the data collected up to 2020.

1.5.18 SMRU seal surveys

1.5.18.1 SMRU carries out surveys of harbour and grey seal in Scotland and on the east coast of England to contribute to NERC's 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, the National Trust and the Lincolnshire Wildlife Trust) form the routine monitoring of seal populations around the UK.

1.5.18.2 Seals are widely distributed around the UK coast and most surveys are carried out from the air by either light aircraft or helicopter. All surveys are of seals that are hauled-out onshore and it is possible to differentiate between the two species using their thermal profiles and their group structure on shore. On account of 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.

1.5.18.3 A SMRU report was commissioned to support the baseline assessment for the Mona Offshore Wind Project (Wright and Sinclair, 2022). The report presents information and telemetry data that SMRU holds for the four seal MUs that span the Irish Sea (12 Wales, 13 NW England, 14 Northern Ireland and 1 SW Scotland) (to note they do not have any available data for the Isle of Man region). The following sections provide a brief account of the surveys carried out for seals and the data is presented in Appendix B.

Haul-out surveys and grey seal pup counts

Harbour seal

1.5.18.4 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 (further details of survey methods are given in Appendix A). The moult counts obtained represent the number of harbour seal that were on shore (not those in the sea at time of survey) 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.

1.5.18.5 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 regional marine mammal study area.

Grey seal

1.5.18.6 Grey seal counts are obtained from the same August harbour seal moult surveys, but 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. This data does, however, provide useful information on the summer and non-breeding season distribution of grey seal.

1.5.18.7 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).

1.5.18.8 There are no regularly monitored grey seal breeding colonies within the Southwest Scotland MU. In Wales, 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 database for grey seal, named EIRPHOT. In Northwest 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.

1.5.19 Seal telemetry data

1.5.19.1 SMRU has deployed 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.

1.5.19.2 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 (GSM) phone network. These methods are described in more detail in Appendix B.

1.5.19.3 Telemetry data presented in this report draws on the SMRU commissioned study (Wright and Sinclair, 2022), which presents an analysis of existing satellite data to describe the movements of harbour and grey seal within the four MUs (Northwest England, Wales, Southwest Scotland and Northern Ireland) that cover the regional marine mammal study area (Appendix B). SMRU does not hold any telemetry data for the Isle of Man. A 100 km buffer region for grey seals and 50 km buffer region for harbour seal is used to determine connectivity with the Mona Offshore Wind Project, based upon average foraging ranges for the two species (SCOS, 2018; Russell and McConnell, 2014).

1.5.20 Seal usage maps

1.5.20.1 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.

1.5.20.2 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.

1.5.20.3 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 km 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 previous 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.

1.5.20.4 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.

1.5.21 MWDW surveys

1.5.21.1 The MWDW have conducted vessel-based marine mammal surveys throughout the 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. 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 (81.7 %) (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 were the most observed cetacean species as in previous years, representing 36 (75 individuals) of the 47 cetacean sightings.

1.5.21.2 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 requested 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.

1.5.21.3 Public sighting data is also made 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.

1.5.21.4 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 and is presented in Figure 1.14. Harbour porpoises were sighted as recently as 2022 (14 January 2022), and 409 were sighted in 2021. For other species 7,164 of bottlenose dolphin, 703 short-beaked common dolphin, 338 Risso's dolphin and 45 minke whale were sighted in 2021 (MWDW, 2022). Other cetaceans such as fin whale and humpback whale have been recorded in MWDW datasets.

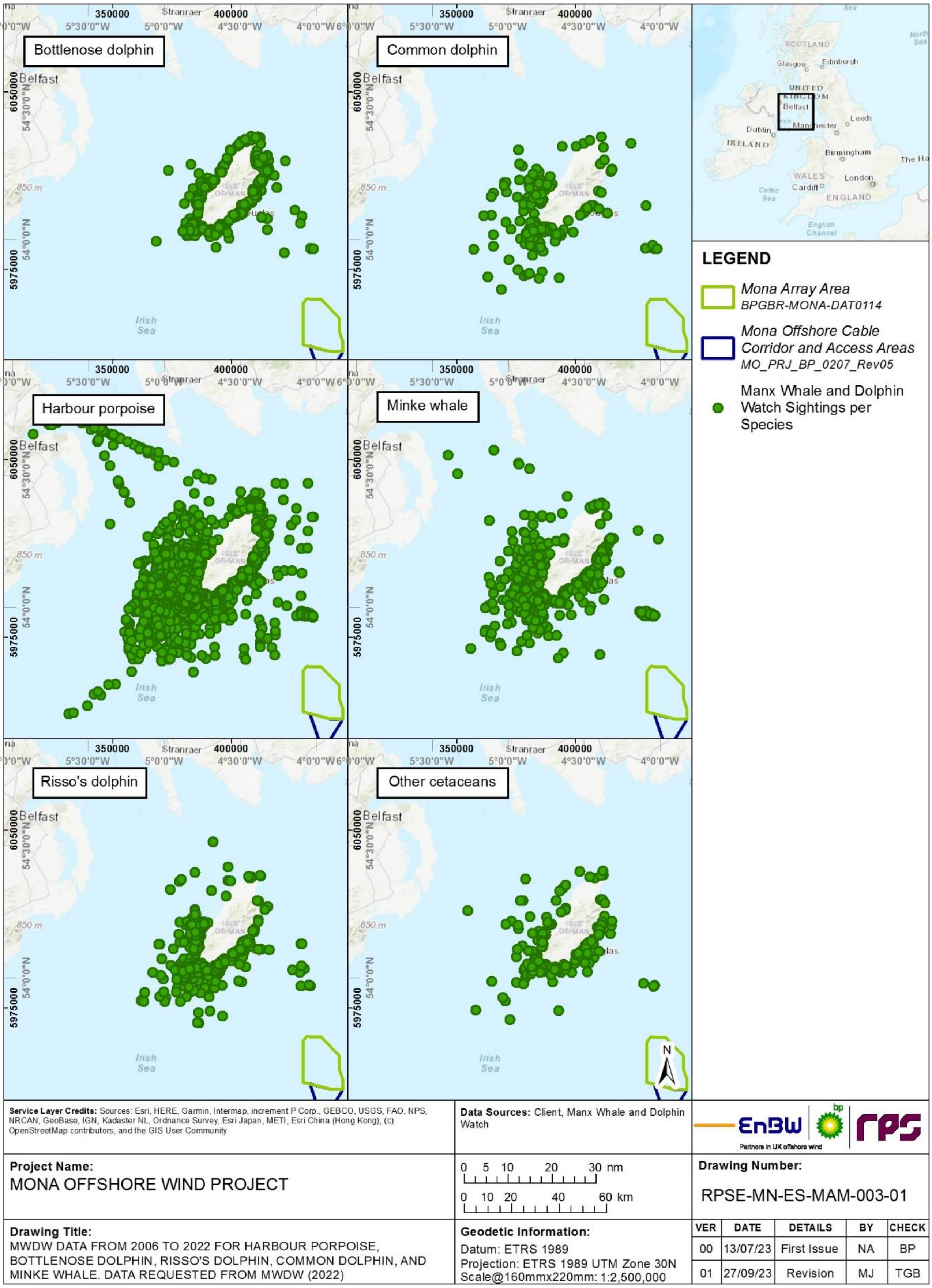


Figure 1.14: MWDW data from 2006 to 2022 for harbour porpoise, bottlenose dolphin, Risso's dolphin, short-beaked common dolphin, and minke whale. Data requested from MWDW (2022).

1.5.22 MWT surveys

1.5.22.1 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 1.15). They also provided opportunistic land sightings from 2017 to 2022 (Figure 1.16) and a dedicated seal haul out survey in 2017 (Figure 1.17) for the Isle of Man.

1.5.22.2 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.

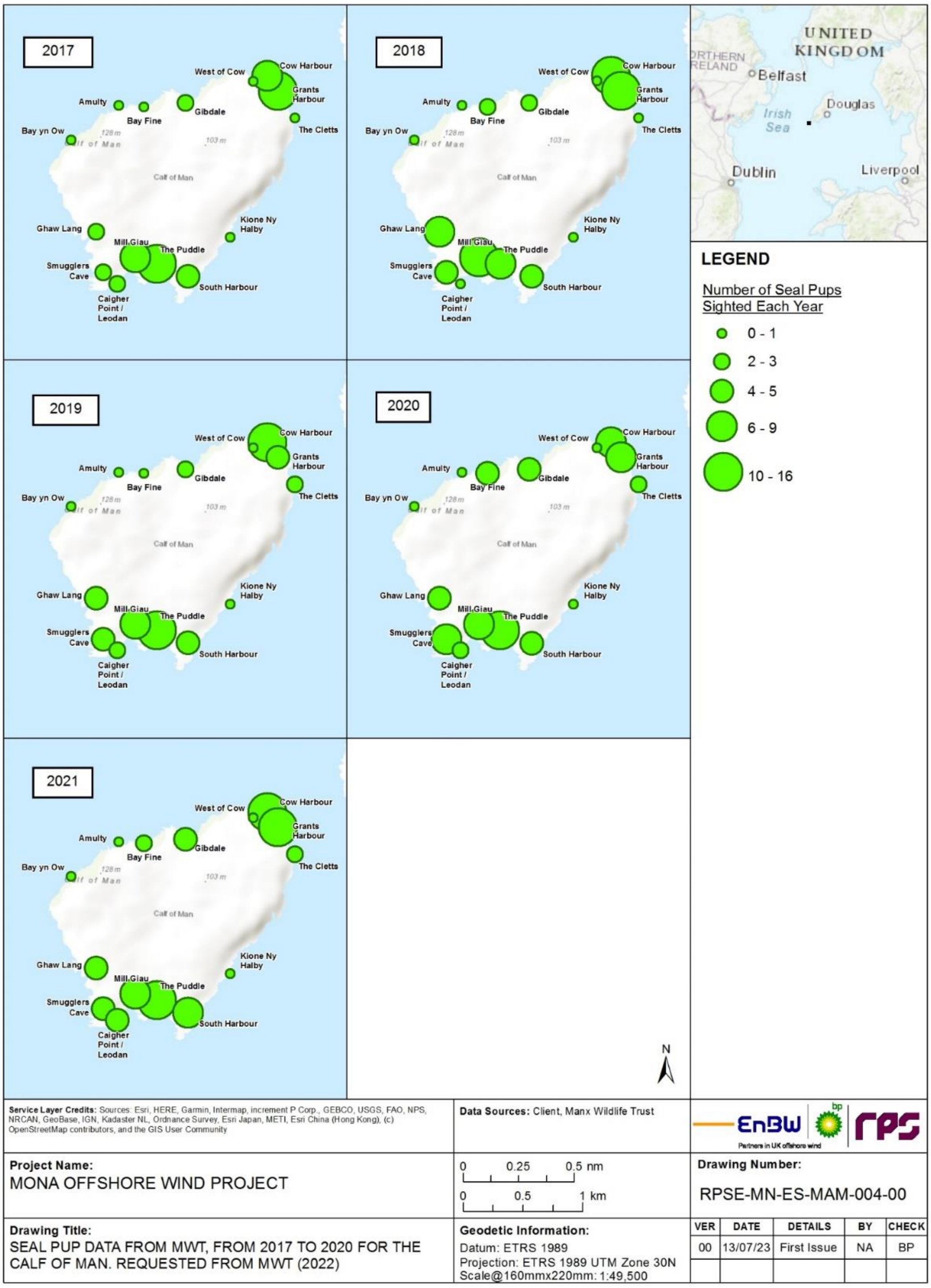


Figure 1.15: Seal pup data from MWT, from 2017 to 2020 for the Calf of Man. Requested from MWT (2022).

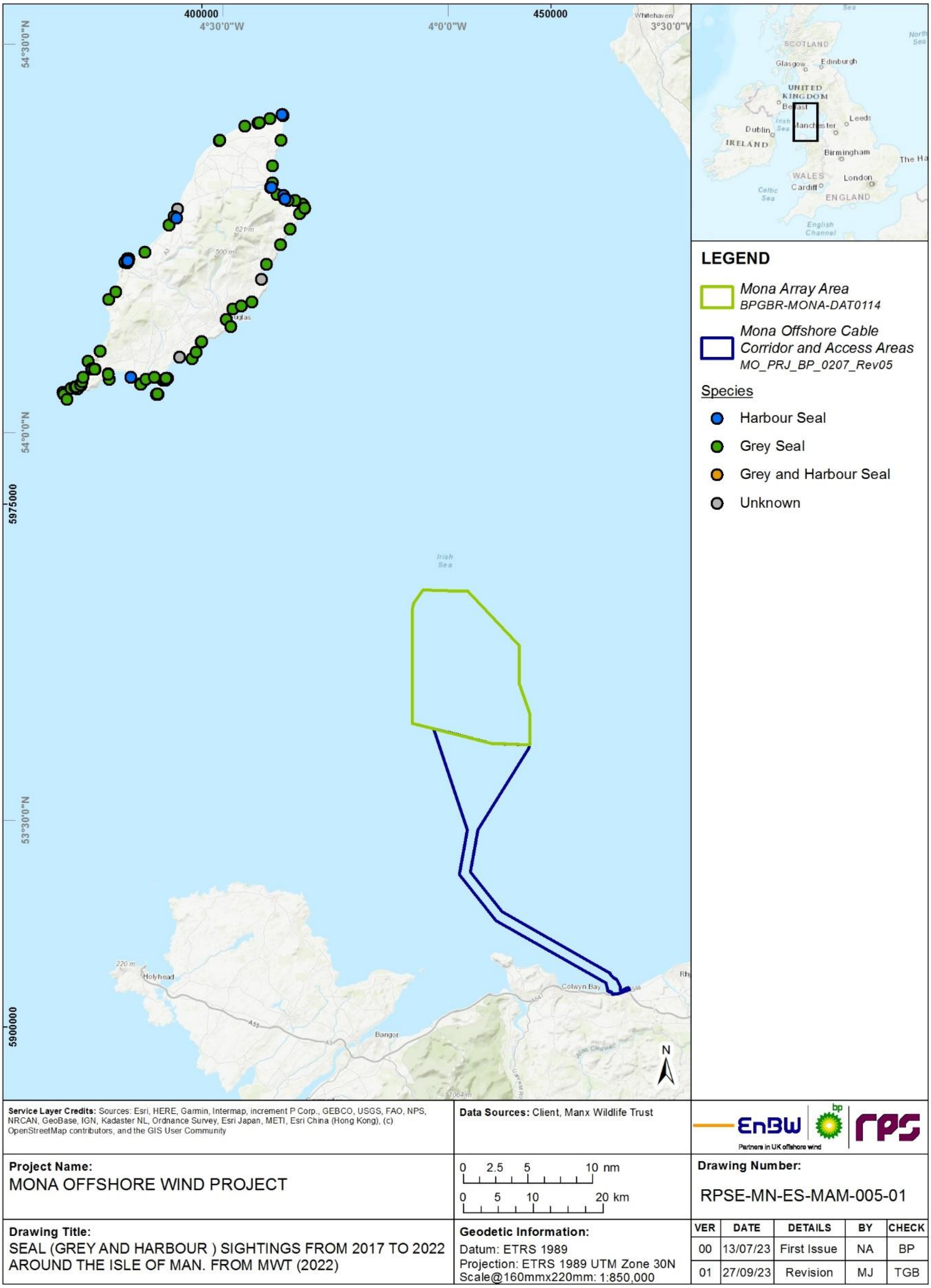


Figure 1.16: Seal (grey and harbour) sightings from 2017 to 2022 around the Isle of Man. From MWT (2022).

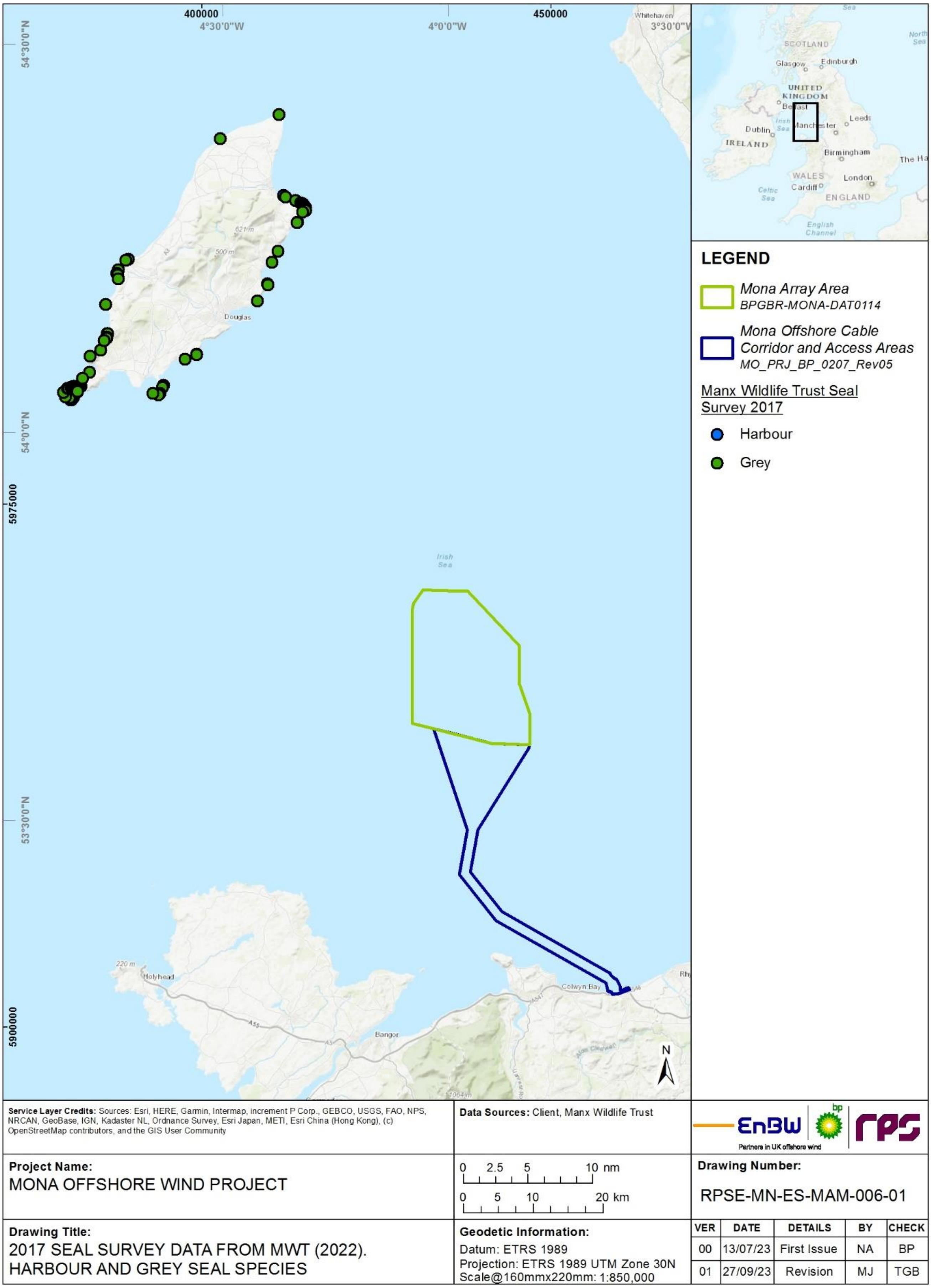


Figure 1.17: 2017 seal survey data from MWT (2022). Common and grey seal species.

1.5.23 Walney Nature Reserve

1.5.23.1 Cumbria Wildlife Trust provided data on grey seal counts at South Walney Nature Reserve from 1981 to 2023. South Walney is the only known grey seal breeding site in the Northwest Seal Management Unit (SMU) (SCOS, 2021). Surveys are undertaken every two weeks from September to March, with highest numbers usually seen in late January and February. Pups are usually born on the reserve from mid-September to mid-October. An increase in seals has been observed at Walney (Figure 1.18).

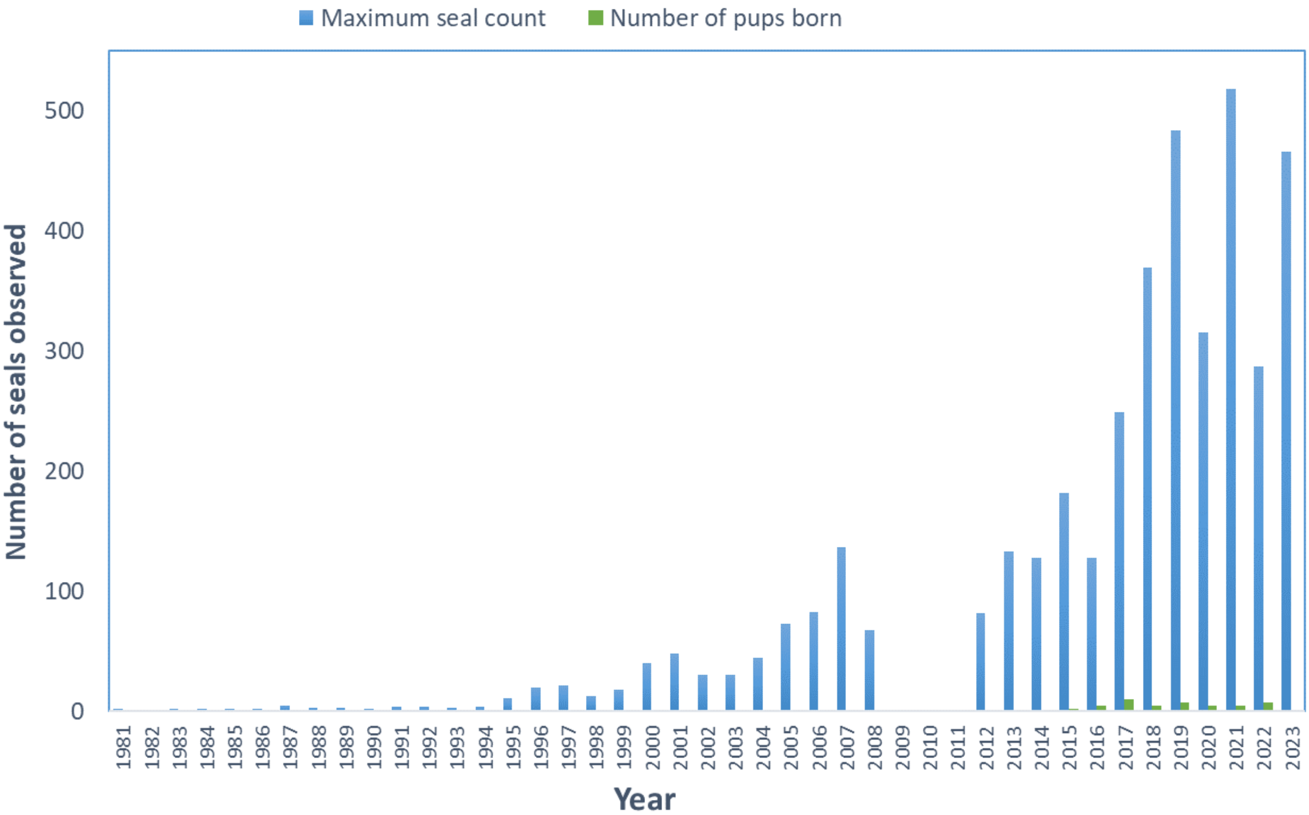


Figure 1.18: Historical maximum count data from South Walney Nature Reserve for maximum seal count observed during annual surveys between September to March (blue) and number of pups born per year (green).

1.5.24 Anglesey based surveys

1.5.24.1 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 1.19). Abundance and densities were estimated using distance-based sampling techniques but were limited to summer only estimates for coastal waters. Porpoise densities were highest at Point Lynas and South Stack.

1.5.24.2 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 northwest 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 was harbour porpoise, with a few bottlenose dolphin and short-beaked common dolphin encounters, and grey seal sighted. Towed acoustic surveys showed that 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.

1.5.24.3 Several surveys are available for informing baselines for projects Horizon Nuclear Power Wyldfa Newydd Project and Morlais Demonstration Zone (MDZ). 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 (ESAS) surveyors, however after this the methodology was altered to include dedicated MMObs providing continuous survey effort and recording bearings and distances to sightings.

1.5.24.4 For the baseline for the 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 1.20). Harbour porpoise, bottlenose dolphin, Risso's dolphin and grey seal were observed during the surveys.

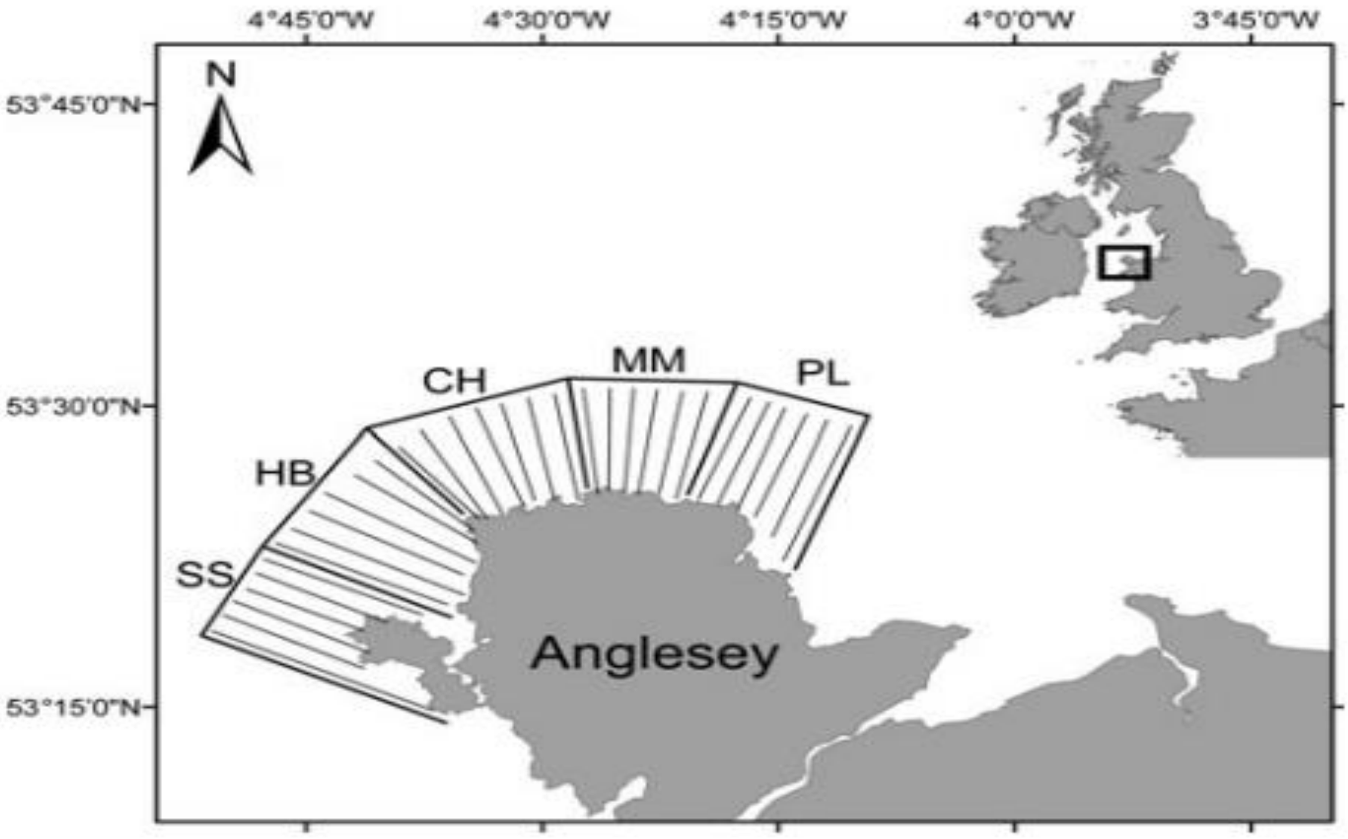


Figure 1.19: The study area of the north coast of Anglesey split in to the five sectors, with transect lines (from Shucksmith *et al.,* 2009).

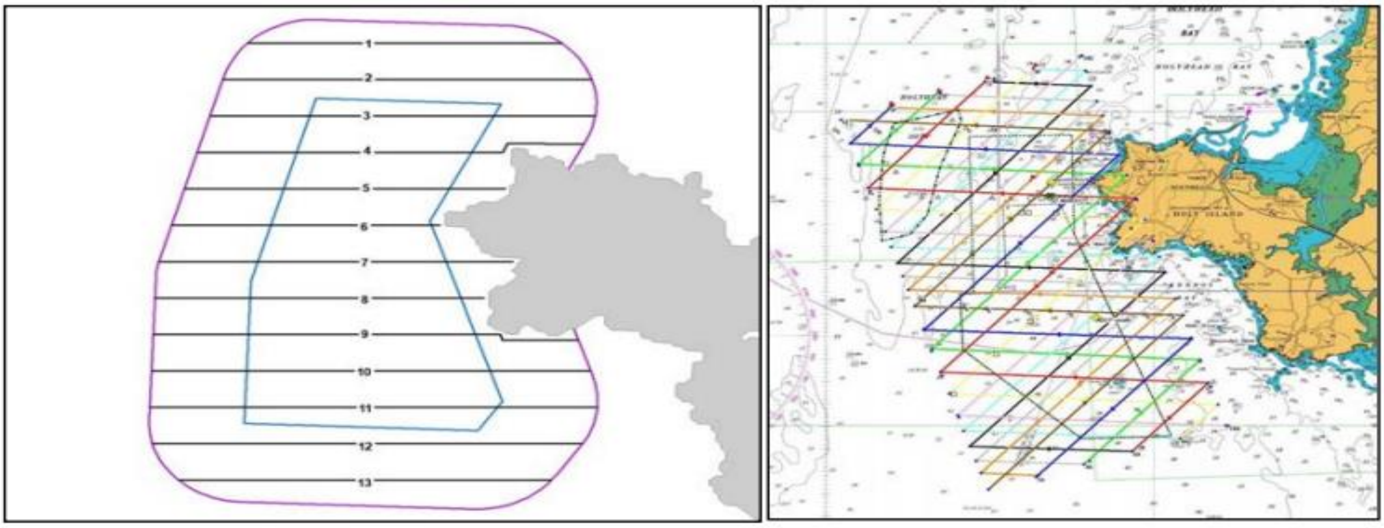


Figure 1.20: Survey transects for the MDZ (from Royal Haskoning DHV, 2019).

1.5.25 Cardigan Bay surveys

1.5.25.1 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 southwest of the Irish Sea, to the south of the Mona Array Area. SWF carried out research work on behalf of the CCW to investigate abundance and life history of bottlenose dolphin in Cardigan Bay. Seventy-six 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 calculated abundance estimates for bottlenose dolphin and harbour porpoise (Pesante *et al.,* 2008), but grey seal were recorded in surveys also.

1.5.25.2 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. Fifteen 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.

1.5.25.3 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.

1.5.25.4 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.

1.6 Baseline environment

1.6.1 Legislation and conservation designations

Legal framework

1.6.1.1 The Applicant entered into agreement for lease for The Mona Offshore Wind Project in early 2023 through the Offshore Wind Leasing Round 4 process.

1.6.1.2 The regional marine mammal study area includes SACs designated for marine mammals. SACs are protected areas in the UK, designated under the Conservation of Habitats and Species Regulations 2017 in England and Wales (including the adjacent territorial sea). 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 Mona Array Area is over 12 nm from land.

1.6.1.3 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).

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

1.6.1.5 For the Isle of Man, the 1990 Wildlife Act 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, National Nature Reserves (NNRs) and MNRs. This list of species was revised in 2004, and the Act itself received some amendment under the Agriculture (Miscellaneous Provisions) Act in 2008.

1.6.1.6 Designation features for MNRs includes harbour porpoise, Risso's dolphin, bottlenose dolphin, grey seal and harbour seal.

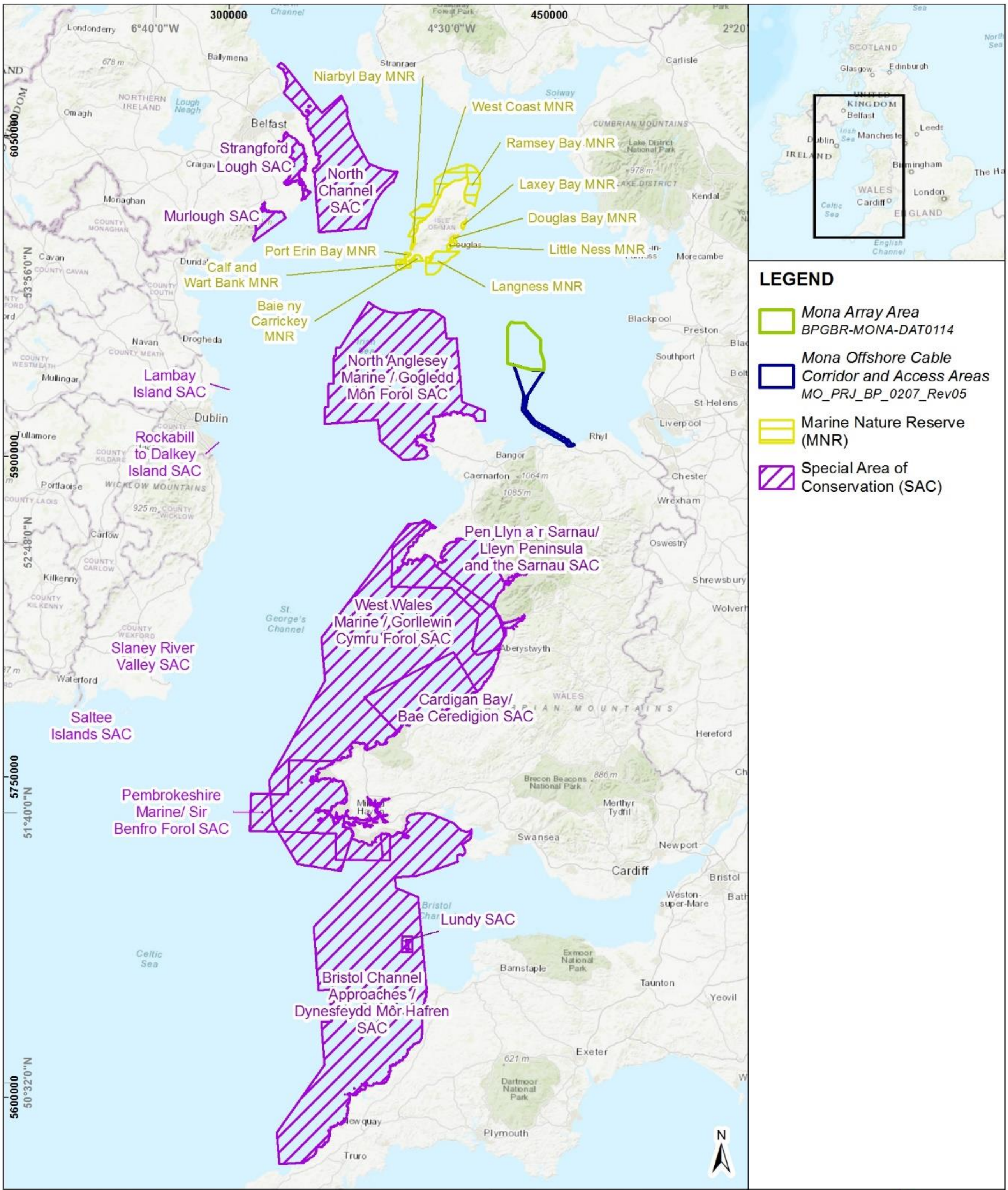
Conservation designations

1.6.1.7 A number of designated areas within the Irish Sea, extending into the Celtic Sea (i.e. the regional marine mammal study area) have marine mammals as notified interest features (Table 1.4). A HRA screening has been undertaken across the whole of the regional marine mammal study area to determine the sites that should be screened into the Information to Support Appropriate Assessment (ISAA. Document Reference E.1). This technical report presents an overview of European sites that fall within the regional marine mammal study area. A summary of the relevant marine mammal qualifying interest and/or protected features for each site is provided in Table 1.4 and Figure 1.21.

Table 1.4: SACs and MNRs designated for the protection of marine mammals within the regional marine mammal study area.

Designated Site	Distance to the Mona Array Area (km) (marine route)	Features
North Anglesey Marine/Gogledd Môn Forol SAC	23.67	Harbour porpoise *Phocena phocoena*
Langness MNR	40.97	Harbour seal *Phoca vitulina*
		Grey seal *Halichoerus grypus*
		Harbour porpoise *Phocena phocoena*
		Risso's dolphin *Grampus griseus*
Little Ness MNR	44.6	Harbour porpoise *Phocena phocoena*
		Bottlenose dolphin *Tursiops truncatus*
		Minke whale *Balaenoptera acutorostrata*
		Risso's dolphin *Grampus griseus*
Douglas Bay MNR	46.68	Bottlenose dolphin *Tursiops truncatus*
		Risso's dolphin *Grampus griseus*
Laxey Bay MNR	48.91	Harbour porpoise *Phocena phocoena*
		Minke whale *Balaenoptera acutorostrata*
		Bottlenose dolphin *Tursiops truncatus*
Baie Ny Carrickey MNR	49.98	Risso's dolphin *Grampus griseus*
		Harbour porpoise *Phocena phocoena*
		Bottlenose dolphin *Tursiops truncatus*
Calf and Wart Bank MNR	53.25	Risso's dolphin *Grampus griseus*
		Harbour porpoise *Phocena phocoena*
Ramsey Bay MNR	56.98	Harbour seal *Phoca vitulina*
		Grey seal *Halichoerus grypus*
Port Erin Bay MNR	58.79	Harbour porpoise *Phocena phocoena*
Niarbyl MNR	63.93	Harbour porpoise *Phocena phocoena*
		Grey seal *Halichoerus grypus*
West Coast MNR	68.74	Harbour porpoise *Phocena phocoena*
		Harbour seal *Phoca vitulina*
		Grey seal *Halichoerus grypus*
North Channel SAC	80.97	Harbour porpoise *Phocena phocoena*
West Wales Marine/Gorllewin Cymru Forol SAC	90.2	Harbour porpoise *Phocena phocoena*
	95.68	Bottlenose dolphin *Tursiops truncatus*

Designated Site	Distance to the Mona Array Area (km) (marine route)	Features
Pen Llŷn a`r Sarnau/Llŷn Peninsula and the Sarnau SAC		Grey seal *Halichoerus grypus*
Strangford Lough SAC	112.01	Harbour seal *Phoca vitulina*
Murlough SAC	115.62	Harbour seal *Phoca vitulina*
Rockabill to Dalkey Island SAC	126.13	Harbour porpoise *Phocena phocoena*
Lambay Island SAC	129.18	Harbour seal *Phoca vitulina*
		Grey seal *Halichoerus grypus*
Cardigan Bay/Bae Ceredigion SAC	164.83	Bottlenose dolphin *Tursiops truncatus*
		Grey seal *Halichoerus grypus*
Slaney River Valley SAC	211.53	Harbour seal *Phoca vitulina*
Pembrokeshire Marine/Sir Benfro Forol SAC	215.24	Grey seal *Halichoerus grypus*
Saltee Islands SAC	237.94	Grey seal *Halichoerus grypus*
Bristol Channel Approaches/Dynesfeydd Môr Hafren SAC	281.11	Harbour porpoise *Phocena phocoena*
Lundy SAC	320.28	Grey seal *Halichoerus grypus*



Service Layer Credits: Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community	**Data Sources:** Client, JNCC, NPWS.	
Project Name: MONA OFFSHORE WIND PROJECT	0 10 20 40 nm 0 20 40 80 km	**Drawing Number:** RPSE-MN-ES-MAM-007-02
Drawing Title: SITES DESIGNATED FOR THE PROTECTION OF MARINE MAMMALS WITHIN THE REGIONAL MARINE MAMMAL STUDY AREA	**Geodetic Information:** Datum: ETRS 1989 Projection: ETRS 1989 UTM Zone 30N Scale@160mmx220mm: 1:3,000,000	

VER	DATE	DETAILS	BY	CHECK
00	13/07/23	First Issue	NA	BP
02	27/09/23	Revision	MJ	TGB

Figure 1.21: Sites designated for the protection of marine mammals within the regional marine mammal study area.

Special Areas of Conservation

North Anglesey Marine/Gogledd Môn Forol SAC

1.6.1.8 The North Anglesey Marine SAC extends north and west from the coast of Anglesey (JNCC, 2022a). 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

1.6.1.9 North Channel SAC is located along the east coast of Northern Ireland and has been identified as an important winter area for harbour porpoise, supporting an estimated 1.2% of the UK CIS MU population. This SAC has an area of 1,604 km^2 and supports areas where large groups of up to 100 harbour porpoises have been sighted and is thus designated for harbour porpoise. Eighteen years of survey data collated through the JCP (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.

West Wales Marine/Gorllewin Cymru Forol SAC

1.6.1.10 West Wales Marine SAC is located off the coast of Wales, from the Llŷn peninsula in the north, to Pembrokeshire in the south-west, 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 for 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.

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

1.6.1.11 Llŷn Peninsula and the Sarnau SAC is situated in northwest Wales. 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 are considered of significant importance within Pen Llŷn a’r 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 northwest of the SAC including Bardsey Island. Persistent breeding seals in the SAC are part of a wider population that extends to southwest Wales and to the southeast and eastern 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.

Strangford Lough SAC

1.6.1.12 Strangford Lough is a large (150 km^2) marine inlet on the east coast of County Down in the northwest Irish Sea. 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 presence, with the minimum population declared at the time of designation as 210 animals.

Murlough SAC

1.6.1.13 Murlough SAC covers an area of 119.02 km^2 and adjoins Dundrum Bay including the shallow waters of the Bay. 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.

Rockabill to Dalkey Island SAC

1.6.1.14 Rockabill to Dalkey Island SAC is situated in the western 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, 2022a). 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 short-beaked common dolphin have all been recorded in the area.

Lambay Island SAC

1.6.1.15 Lambay Island, in the western Irish Sea, is a large (2.5 km^2) inhabited island lying 4 km off Portrane on the north County Dublin coast (NPWS, 2022b). 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

1.6.1.16 Cardigan Bay SAC extends from Ceibwr Bay in Pembrokeshire to Aberarth in Ceredigion and seaward almost 20 km, 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 have 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 bottlenose dolphins 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.

1.6.1.17 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 SW England and Wales MU. Tracking data show that individuals transit to France, the west coast of Scotland and Ireland (NRW, 2018a).

Slaney River Valley SAC

1.6.1.18 Slaney River Valley in the western Irish Sea comprises the freshwater stretches of the River Slaney as far as the Wicklow Mountains, 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

1.6.1.19 Pembrokeshire Marine SAC, in the southeast Irish Sea, extends from just north of Abereiddy on the north Pembrokeshire coast to just east of Manorbier in the south. 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).

1.6.1.20 Pembrokeshire in south-west Wales is representative of grey seal colonies in the south-western 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

1.6.1.21 Saltee Islands SAC comprises the Saltees Islands and surrounding waters, with the islands located between 4 and 5 km off the south Wexford coast, 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

1.6.1.22 Bristol Channel Approaches SAC spans the Bristol Channel between the northern Cornwall coast into Carmarthen Bay in Wales, covering an area of 5,850 km^2, and is designated for harbour porpoise (JNCC, 2022e). The site is estimated to support 4.7% of the CIS MU. Harbour porpoises are 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

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

Marine Nature Reserves

Langness MNR

1.6.1.24 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. The MNR was designated in 2018 for harbour seal, grey seal, harbour porpoise and Risso's dolphin (DEFA, 2018).

Little Ness MNR

1.6.1.25 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 (IOM Government, 2022a), it is an important cetacean area and corresponds to a permanent site for MWDW land-based surveys (see Figure 1.14) and given all cetacean species are protected in Manx waters, Little Ness has been included.

Douglas Bay MNR

1.6.1.26 Douglas Bay MNR is 4.54 km^2 and extends inshore from Onchan Head to Douglas Head, 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 (IOM Government, 2022a).

Laxey Bay MNR

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

Baie Ny Carrickey MNR

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

Calf and Wart Bank MNR

1.6.1.29 Calf and Wart Bank MNR is located off the southwest coast of the Isle of Man, 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.

Ramsey Bay MNR

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

Port Erin MNR

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

Niarbyl MNR

1.6.1.32 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, with an area of 5.66 km^2. It was designated in 2018 for harbour porpoise and grey seal.

West Coast MNR

1.6.1.33 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, is important for harbour porpoise, grey seal and harbour seal.

1.6.2 Overview of marine mammals

Regional marine mammal study area summary

1.6.2.1 The Irish Sea is an important area for marine mammals, with 24 species of cetacean to date sighted in Irish waters (O'Brien *et al.*, 2009) and two species of pinniped. Seven species are known to occur regularly in this region (and thus form the key species taken forward to assessment); harbour porpoise, short-beaked common dolphin, bottlenose dolphin, Risso's dolphin, minke whale, grey seal and harbour seal. Other species are occasional or rare visitors to the area and include fin whale *Balaenoptera physalus*, 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 1.5).

1.6.2.2 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 short-beaked 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 southern irish sea, the north of St George's Channel, and Liverpool Bay (Hammond *et al*., 2005). Wales, southeast Ireland and Liverpool Bay 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 western Scotland and to the south off Cornwall and France. Harbour seal haul out along the northeast coast of Ireland.

Table 1.5: Summary of Cetacean and Pinniped Species Found in the regional marine mammal study area. Sources: Reid *et al.* (2003); O'Brien *et al.* (2009); Baines and Evans (2012); Waggitt *et al.* (2020); 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 northwest 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 western 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).

Species	Occurrence in the Irish Sea	Description of Species Distribution
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 northwest Europe appears to be continental shelf species. Clusters regularly seen in the Irish Sea, with a relatively localised distribution, forming a wide band running SW-NE that encompasses west Pembrokeshire, the western end of the Llŷn Peninsula and Anglesey in Wales, the southeast 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 northeast Atlantic. Widespread and abundant, centred upon the Celtic Deep at the southern end of the Irish Sea, where water depths range from 50 to 150m. 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 northwest 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.
Beluga whale *Delphinapterus leuca*	Rare	Arctic and sub-arctic species but few sightings off northwest 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 southwest Ireland.
Sperm whale *Physeter macrocephlus*	Rare	Occurs mainly in deep waters to the northwest of the UK and only rarely found in the Irish Sea.

Species	Occurrence in the Irish Sea	Description of Species Distribution
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 the western 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 the 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, southern 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.
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 northwest 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 southern Ireland and southwest 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 southwest of Ireland.

Species	Occurrence in the Irish Sea	Description of Species Distribution
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, 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).

Mona aerial digital survey data

1.6.2.3 Data from site-specific surveys conducted within the Mona Aerial Survey Area demonstrate that several marine mammal species occurred regularly within the Mona marine mammal study area. Bottlenose dolphin, harbour seal, grey seal, harbour porpoise and Risso's dolphin were all observed within the Mona Aerial Survey Area. Monthly raw sightings (number of animals) across the Mona Aerial Survey Area are given in Appendix A.

1.6.2.4 Of cetaceans, harbour porpoise was the most frequently recorded species and was sighted in every month of the year when combining the 24 months of Mona Offshore Wind Project surveys. Highest encounters were in January 2022 for the Mona Aerial Survey Area (n = 25). Grey seal had the second highest number of sightings but was not recorded in every month over the survey period.

1.6.2.5 For other sightings identified to species level (bottlenose dolphin, Risso's dolphin and harbour seal) both the number and frequency of sightings was small. Bottlenose dolphin was encountered for two months of the year (June 2021 and January 2022) whilst Risso's dolphin was encountered in just one month of the year (November 2020). Harbour seal was only encountered once, with one animal in March 2020.

1.6.2.6 There were also a number of cetacean sightings ('dolphin species', 'dolphin/porpoise') that could not be assigned to species level which had high sightings and frequency. Similarly, there were a large number of sightings classified as 'seal species' or 'phocid species' due to the issue of identifying to species level from aerial survey data. For the purposes of further analyses these were assigned to grey seal as this was the most commonly occurring seal species across the aerial survey area. There were a number of sightings that were classified as 'marine mammal species' which could not be identified down to species level.

1.6.2.7 Densities are discussed in each relevant section within each species account (Section 1.7), and detailed descriptions given in Appendix A.

1.6.2.8 Modelling of the Mona Offshore Wind Project aerial survey data allowed absolute estimates of mean abundance, densities and confidence intervals (CI) to be given for grey seal and for harbour porpoise within the Mona Aerial Survey Area. Peaks in harbour porpoise density were observed in winter 2021 to 2022, and July 2021. Grey seal densities peaked in March 2020 and April 2021. Low sighting occurrences for other species meant modelling of densities was not possible

Table 1.6: Summary table of estimated absolute (corrected for availability bias) mean abundance and density, per species/grouping, for 'bio-seasons' within the Mona Aerial Survey Area including Lower and Upper 95% confidence intervals (CI), and CV.

Species	Mean absolute abundance	Mean absolute density [design] (animals/km^2)	Mean absolute density [model] (animals/km^2)	Lower CI	Upper CI	Coefficient of Variation
Harbour porpoise						
Winter	140	0.097	0.022	0.005	0.041	0.500
Summer	88	0.061	0.013	0.005	0.023	0.478
Year	114	0.079	0.014	0.008	0.028	0.491
'Porpoise species'						
Winter	195	0.135	0.034	0.015	0.054	0.469
Summer	178	0.123	0.030	0.019	0.042	0.442
Year	186	0.129	0.027	0.021	0.043	0.403
Grey seal						
Pupping	71	0.049	0.016	0.005	0.026	0.264
Non-pupping	201	0.139	0.023	0.015	0.036	0.274
Year	158	0.109	0.020	0.012	0.029	0.268

1.7 Species accounts

1.7.1.1 The following section provides more detailed baseline information for each of the key species identified as likely to occur within the regional marine mammal study area (see Table 1.5). These are:

- Harbour porpoise
- Bottlenose dolphin
- Short-beaked common dolphin
- Risso's dolphin
- Minke whale
- Grey seal
- Harbour seal.

1.7.2 Harbour porpoise

Ecology

1.7.2.1 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 1.22) 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).

1.7.2.2 Often living in cool, high latitude waters, harbour porpoise has a higher metabolic rate than dolphins and therefore need to feed more frequently and consume more prey per unit body weight, 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).

1.7.2.3 Harbour porpoise feed 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 also contributed to overall energy density.

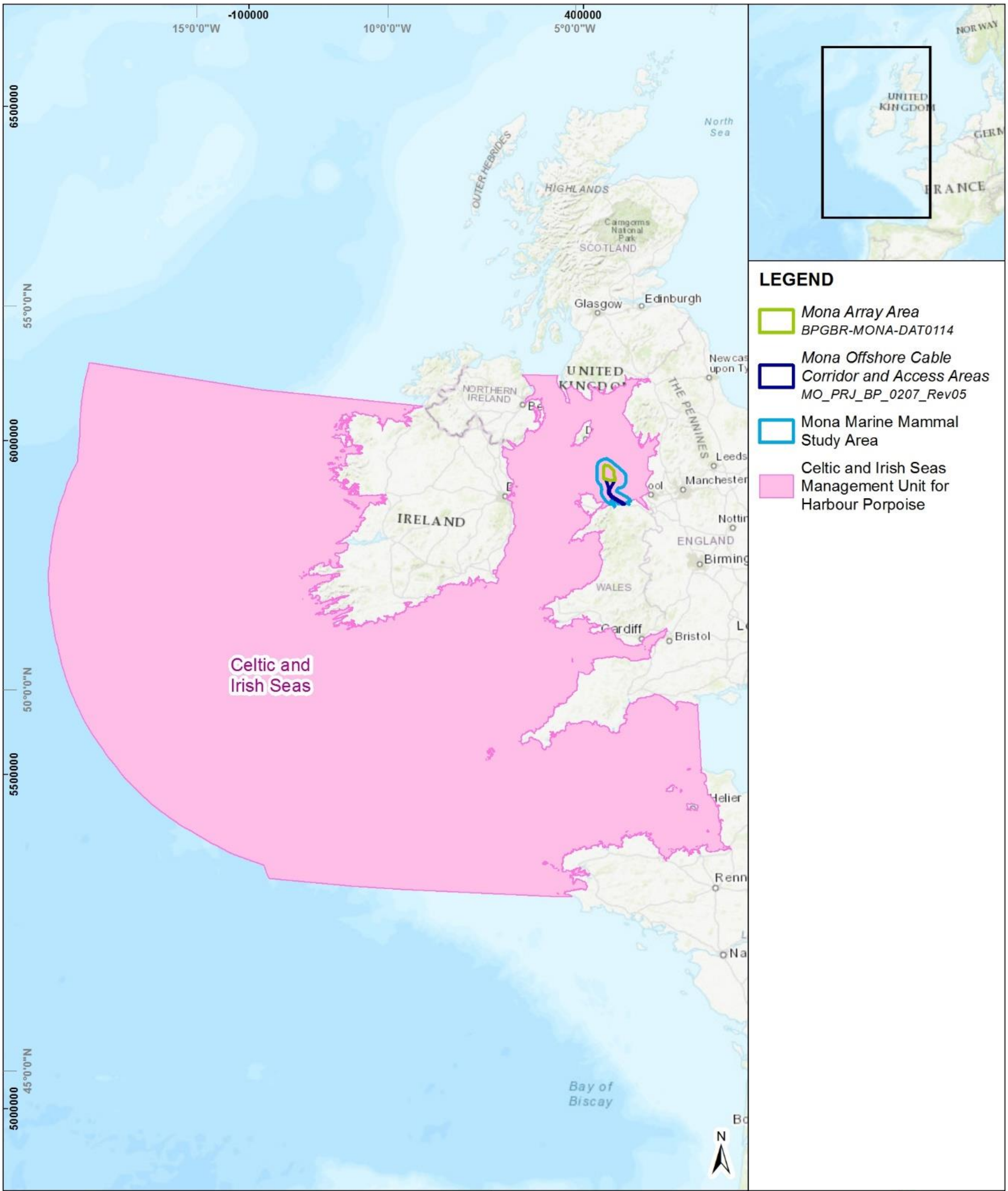
1.7.2.4 Harbour porpoise regularly forage around tidal races, overfalls, and upwelling zones during the ebb phase of the tide (Pierpoint, 2008). Waggitt *et al*. (2018) explored regional scale patterns in occupancy of tidal stream environments in Anglesey and found that encounters with animals were concentrated 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 to 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.* (2018) 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 wind turbines in areas of laminar currents therein.

1.7.2.5 These results are consistent with Embling *et al.* (2010), who analysed results of the dedicated surveys conducted in the southern Inner Hebrides and found that maximum tidal current is the best environmental explanation of persistent harbour porpoise abundance.

1.7.2.6 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.

1.7.2.7 The age at sexual maturation for harbour porpoise is approximately three to four years and reproduction is strongly seasonal with mating occurring between June and August (Lockyer, 1995). Gestation is 10 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).

1.7.2.8 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 porpoises are 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).



Service Layer Credits: Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

Data Sources: Client, JNCC

Project Name: MONA OFFSHORE WIND PROJECT

0 25 50 100 nm
0 50 100 200 km

Drawing Number: RPSE-MN-ES-MAM-008-02

Drawing Title: CELTIC AND IRISH SEAS MU FOR HARBOUR PORPOISE WITH THE MONA MARINE MAMMAL STUDY AREA

Geodetic Information:
Datum: ETRS 1989
Projection: ETRS 1989 UTM Zone 30N
Scale@160mmx220mm: 1:9,600,000

VER	DATE	DETAILS	BY	CHECK
00	13/07/23	First Issue	NA	BP
02	27/09/23	Revision	MJ	TGB

Figure 1.22: Celtic and Irish Seas MU for harbour porpoise with the Mona marine mammal study area.

Distribution and occurrence

1.7.2.9 Harbour porpoises are widely distributed throughout the Irish Sea and through the regional marine mammal study area and are 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 1.23). 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 southwest coast of the Llŷn Peninsula, southern 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.,* 2021), 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 shows harbour porpoise are widespread in Manx waters around the Isle of Man, extending out towards the Mona Array Area (Figure 1.14) and up towards the coast of Northern Ireland.

1.7.2.10 Heinänen and Skov (2015) found that in the Celtic and Irish Sea MUs 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 ms^{-1} (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 ms^{-1} and increasing eddy activity.

1.7.2.11 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).

1.7.2.12 The Mona Offshore Wind Project aerial digital survey data showed that harbour porpoise were recorded in all months of the year and throughout the Mona Aerial Survey Area with the majority of sightings to the east or south of the Mona Aerial Survey Area. Further detail is available in Appendix A.

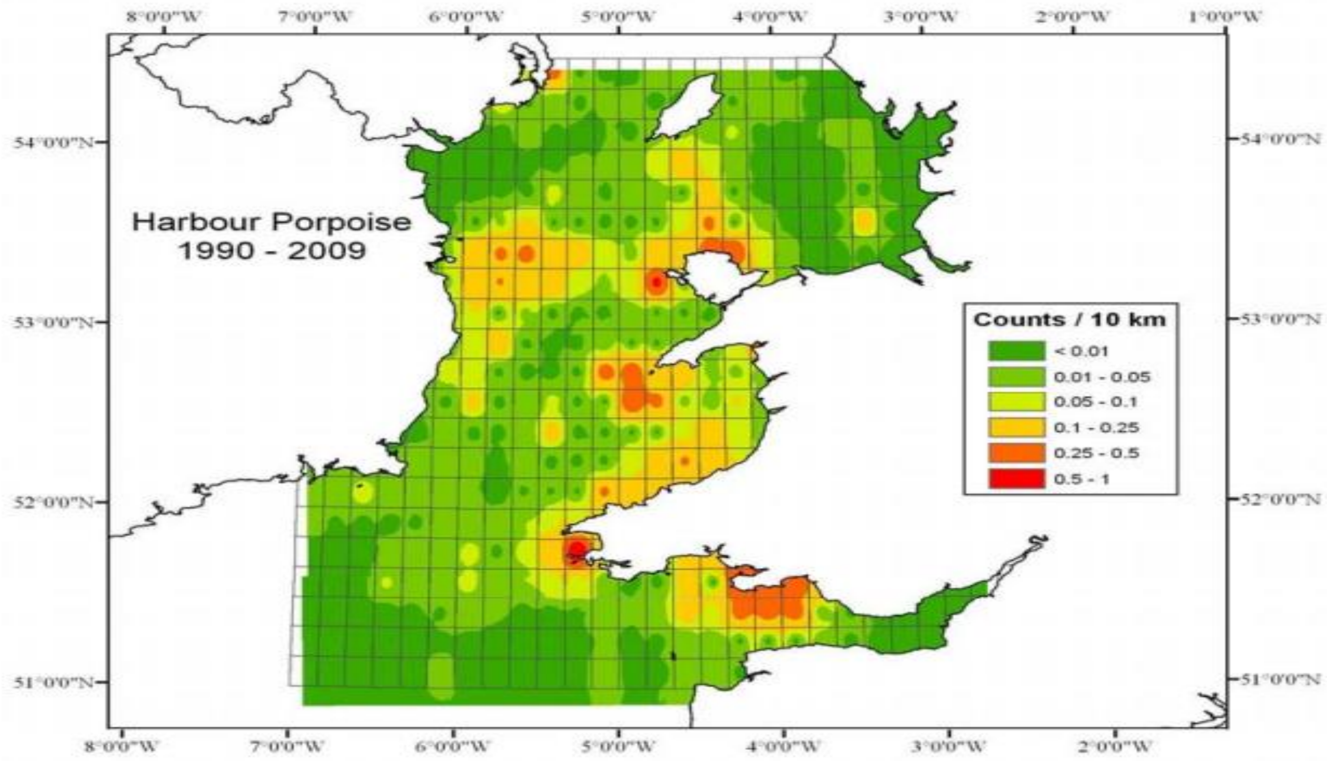


Figure 1.23: IDW interpolated map of harbour porpoise distribution from the 2012 Atlas of Marine Mammals of Wales (from Baines and Evans, 2012).

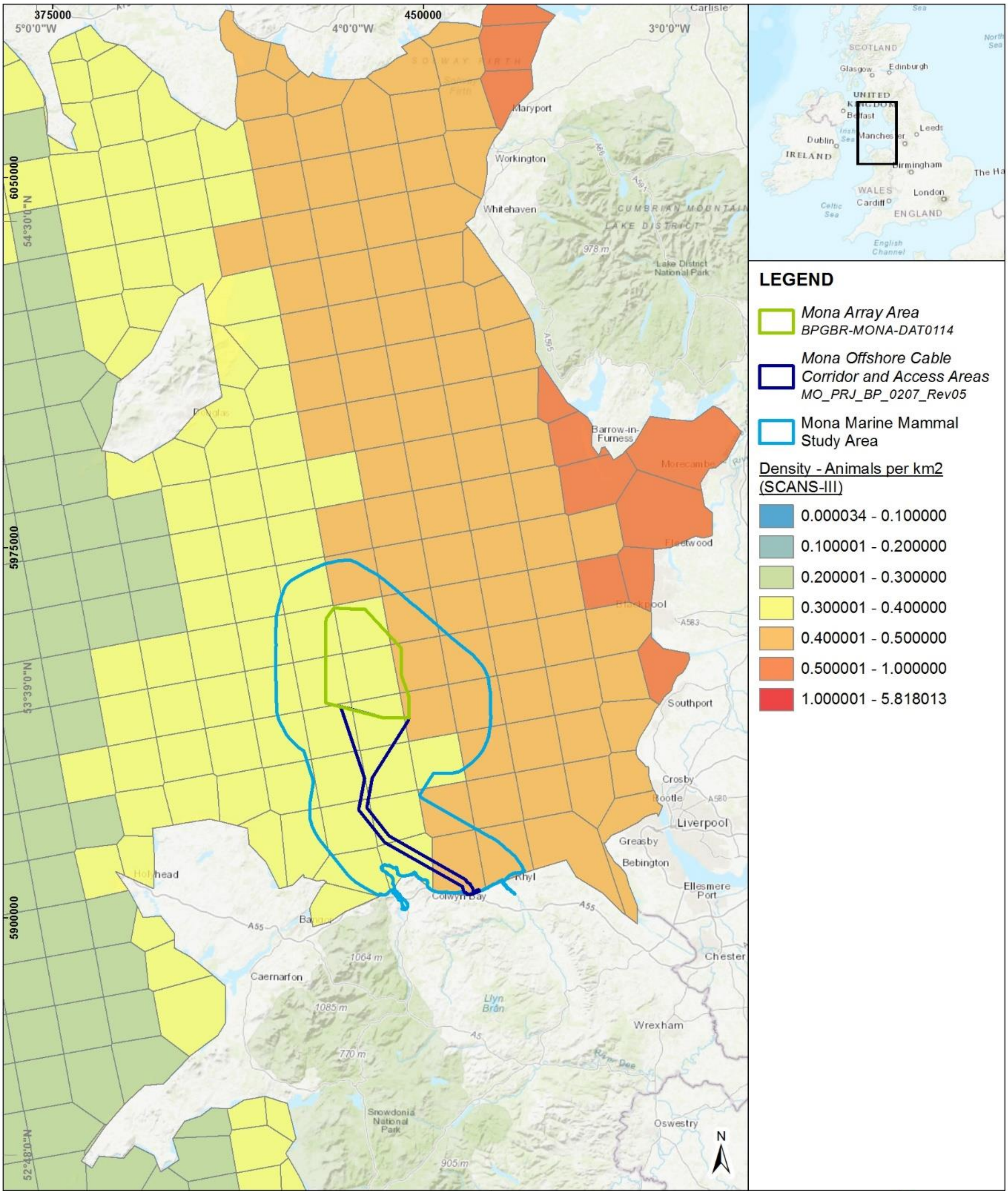
Density/abundance

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

Density

1.7.2.14 Broadscale data highlights the variance in density estimates from different sources. Data from SCANS-III that covered European Atlantic waters reported densities of 0.239 animals per km^2 (CV = 0.282) in block E and 0.086 animals per km^2 (CV = 0.383) in block F (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. Recently modelled density surfaces using the SCANS-III data (see paragraph 1.5.6.5) (Lacey *et al.*, 2022) gave a mean density of 0.397 animals per km^2 and a maximum of 0.434 animals per km^2 for the Mona marine mammal study area (Figure 1.24), with density maps showing higher areas of density in the east Irish Sea[1]. Recent SCANS-IV data reported densities of 0.5153 animals per km^2 (CV = 0.250) in block CS-E and 0.2803 animals per km^2 (CV = 0.316) in block CS-D (Gilles *et al.*, 2023), noting again that 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] 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.



Service Layer Credits: Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community	**Data Sources:** Client, JNCC, SCANS-III	EnBW bp Partners in UK offshore wind rps
Project Name: MONA OFFSHORE WIND PROJECT	0 5 10 nm 0 10 20 km	**Drawing Number:** RPSE-MN-ES-MAM-009-01
Drawing Title: DENSITY SURFACE MAPS FROM SCANS III DATA FOR HARBOUR PORPOISE FROM LACEY ET AL. (2022)	**Geodetic Information:** Datum: ETRS 1989 Projection: ETRS 1989 UTM Zone 30N Scale@160mmx220mm: 1:1,300,000	

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00	13/07/23	First Issue	NA	BP
01	27/09/23	Revision	MJ	TGB

Figure 1.24: Density surface maps from SCANS-III data for harbour porpoise from Lacey *et al.* (2022).

1.7.2.15 In the ObSERVE program, aerial surveys were conducted in the offshore waters of Ireland (western 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 (western Irish Sea) is relevant to the regional marine mammal 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 western Irish Sea compared to other Irish waters.

1.7.2.16 Density surface modelling in JCP 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 animals per km^2 across the entire JCP Phase III study region, with areas of relative higher density for harbour porpoise in the Irish and Celtic Sea (Paxton *et al.* 2016). This mean density falls within the range predicted for the western Irish sea using the ObSERVE data (see paragraph 1.7.2.15). Harbour porpoise densities fluctuated throughout the year in the JCP III data, and in the entire Irish Sea predicted mean summer densities ranged from approximately 0.8 animals per km^2 in years 1994 to 2000, to 5 animals per km^2 in 2001 to 2006 and 2007 to 2010 periods[2]. In winter, spring and autumn 2010, predicted mean densities reached approximately 2, 0.8 and 0.6 animals per km^2 respectively for the entire Irish Sea region. 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 Mona marine mammal study areas (0.4 in 1994 to 2000 and 2007 to 2010 periods and in summer 2010, 0.6 in winter 2010, and 0.8 in 2001 to 2006). The high densities observed in the Irish Sea are not located close to the Mona marine mammal study area. The JCP III data is 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.

1.7.2.17 This study builds upon the Phase One Data Analysis (Paxton and Thomas, 2010), which predicted density surfaces for harbour porpoise from data from 1980 to 2009. Densities for the Mona marine mammal study area ranged from 0.25 to 0.1 animals per km^2 in 1983, 1990 and 1997, but higher densities in the regional marine mammal study area[3]. For example, 2004 showed much higher densities up to 1.25 animals per km^2 around Anglesey and the east coast of Ireland emphasising that densities can be driven by localised persistent densities.

1.7.2.18 Using JCP data, Heinanan 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) of harbour porpoise, and subsequently used to inform designation of SACs for harbour porpoise. For the Irish Sea, three such areas were identified: the

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.

3 JCP Phase I densities are approximations read off the density surface prediction maps in the JCP report (Paxton and Thomas, 2010).

closest area of persistent 'high' densities was North Anglesey SAC (23.67 km to the south of the Mona Array Area) whilst 80.97 km to the northwest of the Mona Array Area, the North Channel SAC was identified as supporting high densities and again 9 km south of the Mona Array Area lies the West Wales Marine SAC.

1.7.2.19 A study by Waggitt *et al*. (2020) collated diverse survey data to generate predicted distribution maps at 10 km resolution for 12 cetacean species (and 12 seabird species) using SDMs. 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 1.25). The predicted densities for harbour porpoise for the Mona Offshore Wind Project are given in Figure 1.26 (January to June) and Figure 1.27 (July to December) and shows higher density areas are present further inshore in the east of the Irish Sea, towards Liverpool Bay, from January to June but appears to show increased densities in offshore areas from June to October. Highest densities were predicted at 0.76 animals per km^2 in high density areas in the east Irish Sea. Estimates of densities for the Mona marine mammal study area are lower, with average density for August (the month with the peak density) as 0.516 animals per km^2. It must be noted such large-scale modelling will not pick up small and isolated sub-populations of cetaceans.

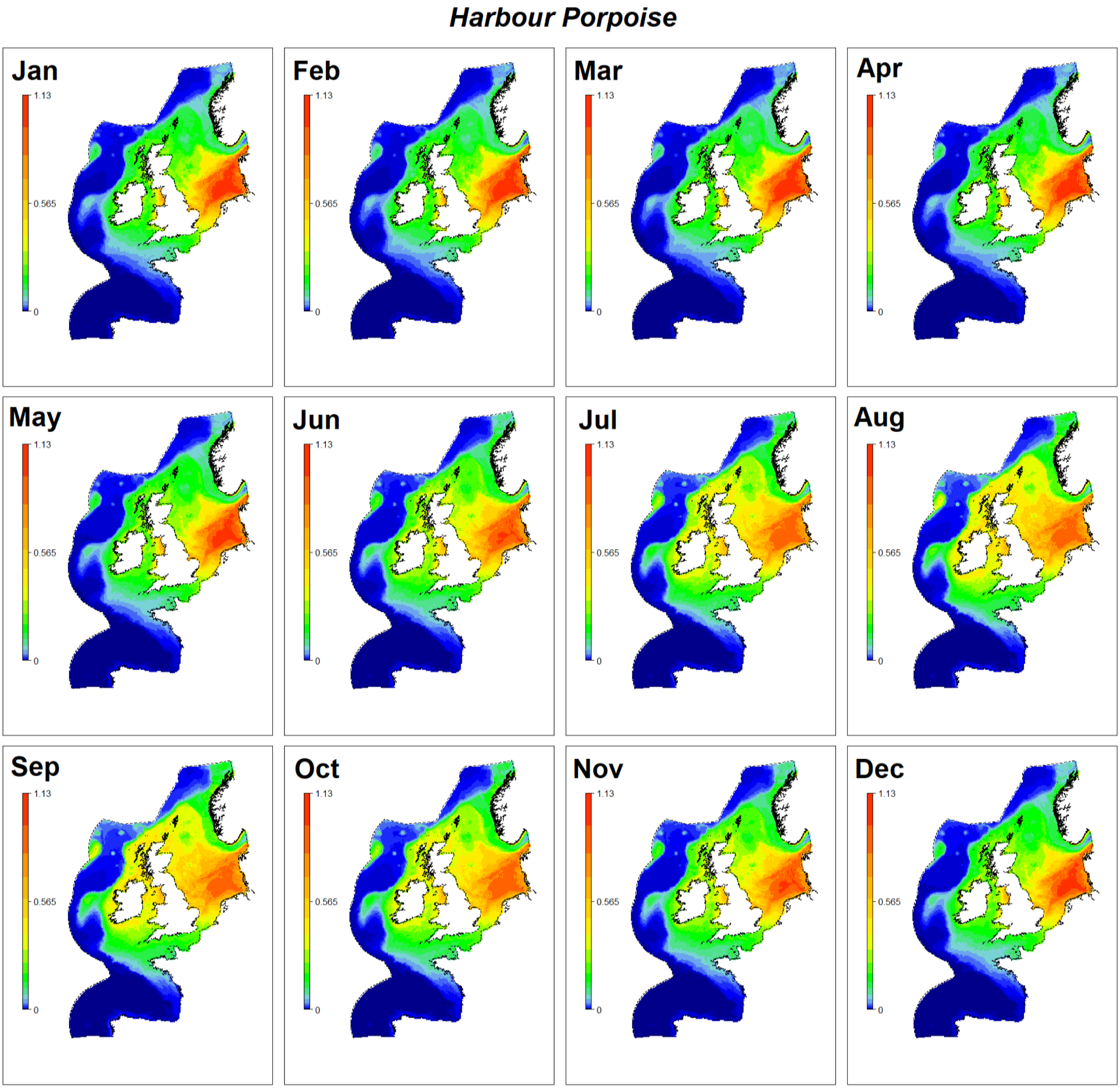
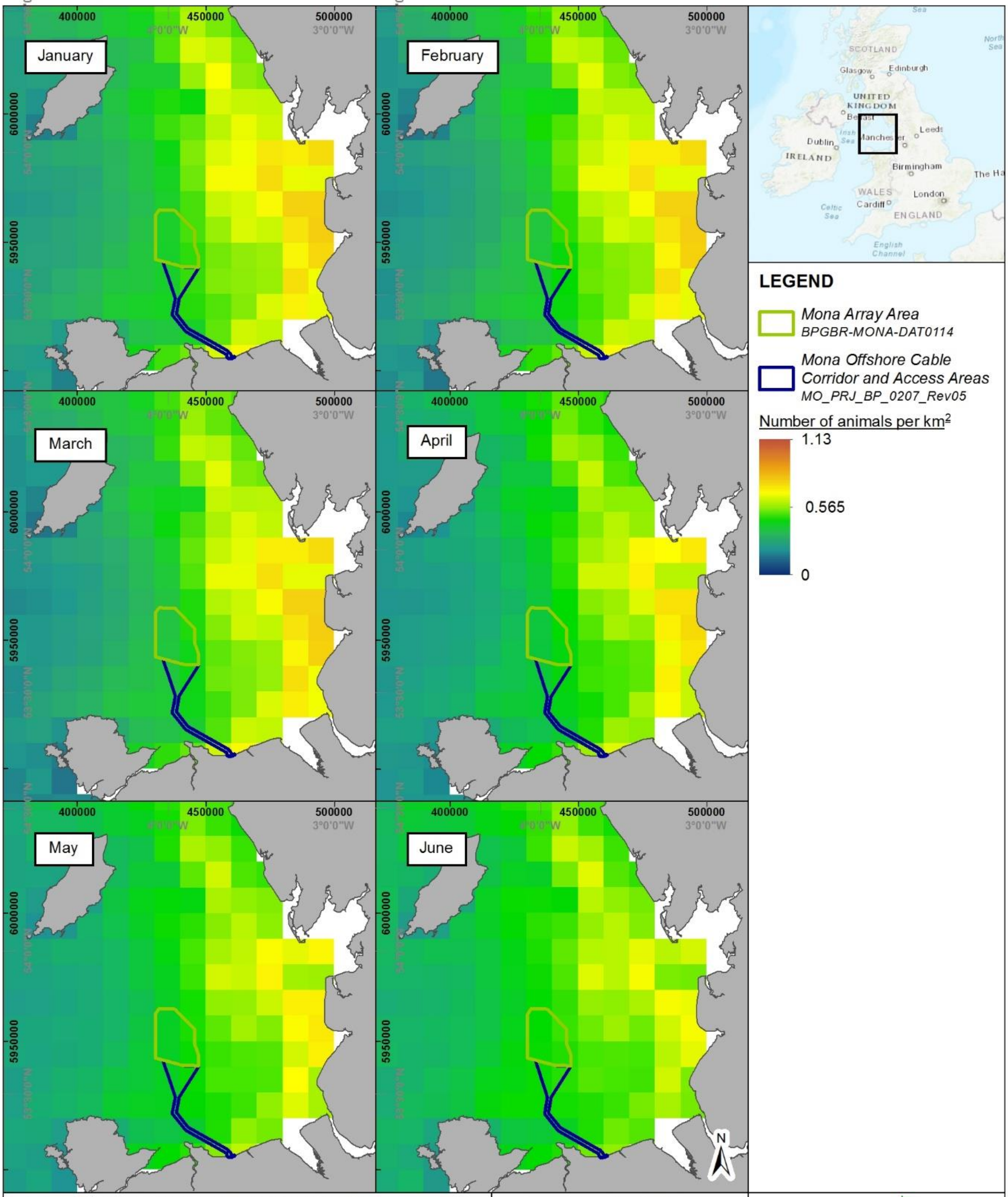


Figure 1.25: Predicted distributions for harbour porpoise per month for the entire study area, from Waggitt *et al.* (2020).



Service Layer Credits: Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

Data Sources: Client, Waggitt (2020).

Project Name:
MONA OFFSHORE WIND PROJECT

0 5 10 20 30 nm
0 10 20 40 60 km

Drawing Number:
RPSE-MN-ES-MAM-010-02

Drawing Title:
PREDICTED DISTRIBUTIONS FOR HARBOUR PORPOISE PER MONTH FROM JANUARY TO JUNE, DATA FROM WAGGITT ET AL. (2020)

Geodetic Information:
Datum: ETRS 1989
Projection: ETRS 1989 UTM Zone 30N
Scale@160mmx220mm: 1:2,500,000

VER	DATE	DETAILS	BY	CHECK
00	13/07/23	First Issue	NA	BP
02	27/09/23	Revision	MJ	TGB

Figure 1.26: Predicted distributions for harbour porpoise per month from January to June for the Mona Array Area, data from Waggitt *et al.* (2020).

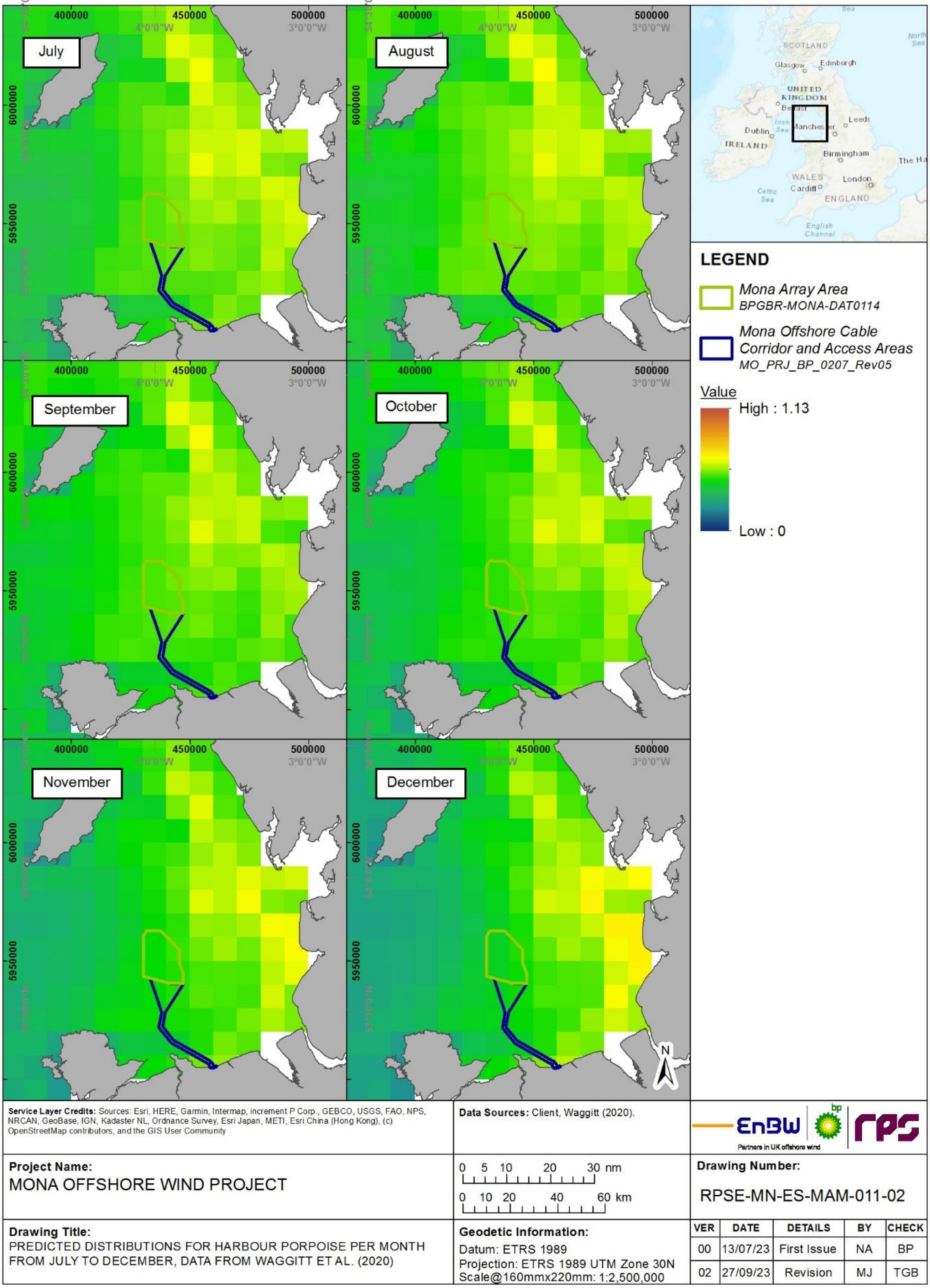
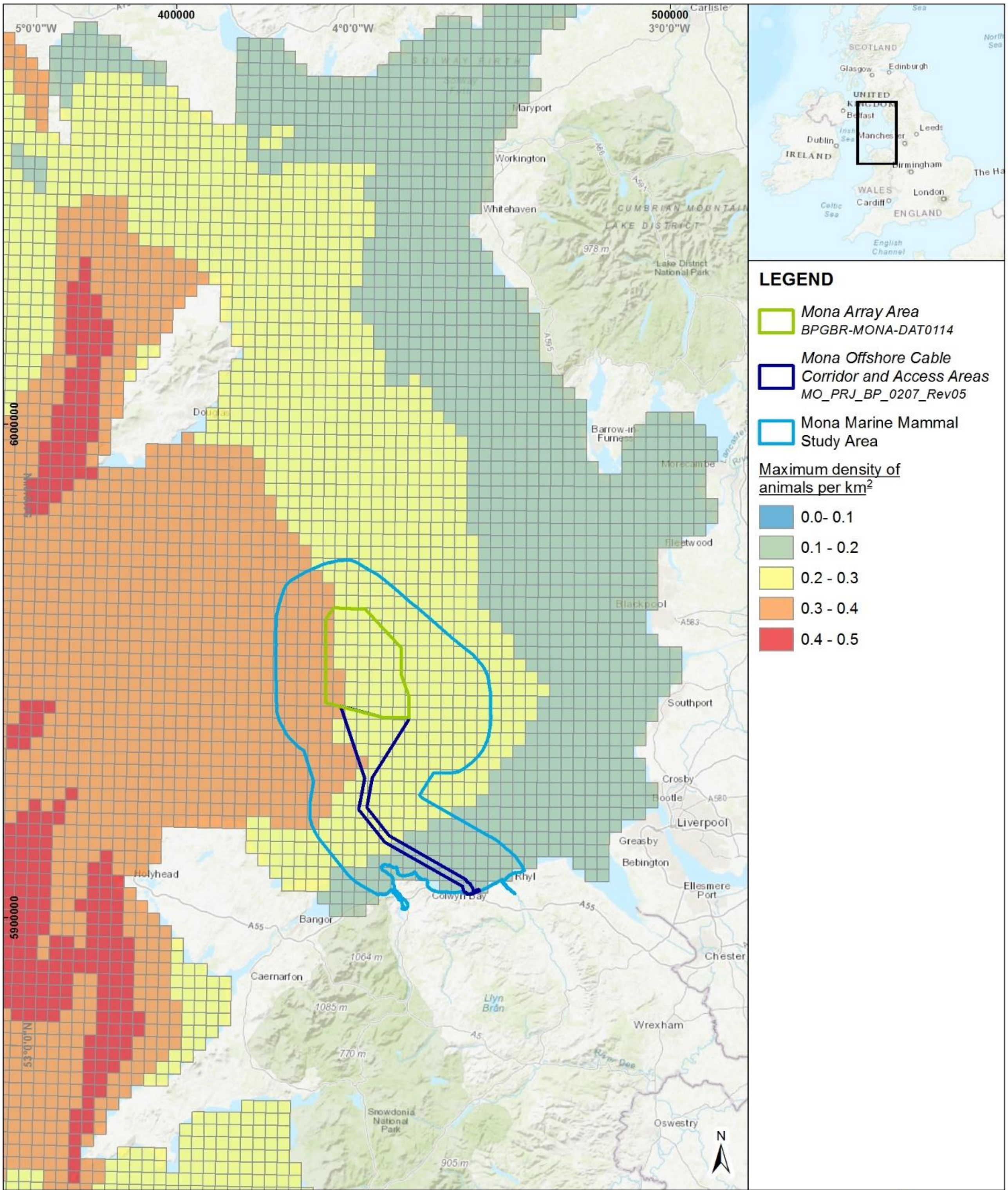


Figure 1.27: Predicted distributions for harbour porpoise per month from July to December for the Mona Array Area, data from Waggitt *et al.* (2020).

1.7.2.20 Modelled outputs at 2.5 km scale 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 in Wales, 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. Highest densities were observed in July to September, when densities are modelled by quarter (measured as the mean density per cell across months within a season).

1.7.2.21 The average density for the Mona marine mammal study area from the annual composite maps (as recommended by NRW and authors of the Marine Mammal Atlas, see paragraph 1.5.16.4) was 0.2577 animals per km^2. A slightly higher average density was estimated for the Mona Array Area (i.e. not including the Mona Offshore Cable Corridor and Access Areas) and this was calculated as 0.2773 animals per km^2 (Figure 1.28).



Service Layer Credits: Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

Data Sources: Client, NRW

Project Name: MONA OFFSHORE WIND PROJECT

Scale bar: 0 5 10 nm; 0 10 20 km

Drawing Number: RPSE-MN-ES-MAM-012-02

Drawing Title: 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)

Geodetic Information:
Datum: ETRS 1989
Projection: ETRS 1989 UTM Zone 30N
Scale@160mmx220mm: 1:1,300,000

VER	DATE	DETAILS	BY	CHECK
00	13/07/23	First Issue	NA	BP
02	27/09/23	Revision	MJ	TGB

Figure 1.28: Harbour Porpoise annual composite modelled densities (measured as the maximum density per cell across months) for the Mona marine mammal study area from the Welsh Marine Mammal Atlas (Evans and Waggitt, 2023).

1.7.2.22 Aside from boat and aerial surveys, other methods of data collection have been utilised to give density estimates for context in the marine mammal study area. 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 (GAM) based predictions of density for each MU. Evans *et al*. (2015) found porpoises were widely distributed throughout the Celtic and Irish Sea MU, with hotspots along the west and north Pembrokeshire coast, and the northwest and north coasts of Anglesey. This confirms 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

1.7.2.23 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 Manx Marine Environmental Assessment (Howe *et al*., 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, 2018a). There were slightly higher sightings per km^2 in summer (0.038 sightings per km^2) than in winter (0.038 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. The MWDW opportunistic and effort based sighting data from 2006 to 2022 showed that harbour porpoise were sighted as recently as 2022 (14/01/2022), and 409 were sighted in 2021 (MWDW, 2022). During MWDW vessel-based marine mammal surveys across Manx waters between 2007 and 2021, harbour porpoise were sighted 769 times (representing 80% of sightings). In 2021, harbour porpoise sightings represented 36 (75 individuals) of the 47 cetacean sightings (Manley, 2021). These studies are limited to Manx waters, but aid in providing detailed estimates for more localised areas.

Anglesey and Cardigan Bay

1.7.2.24 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 (43.13 km to the west from the Mona Array Area) and Carmel Head (43.06 km to the west of the Mona Array 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 (28.2 km to the south of the Mona Array Area). As described previously (paragraph 1.7.2.18) 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 during summer are identified to the south and east of the Mona marine mammal study area (Figure 1.29) but not during winter (Figure 1.30) and do not overlap with the Mona Offshore Wind Project.

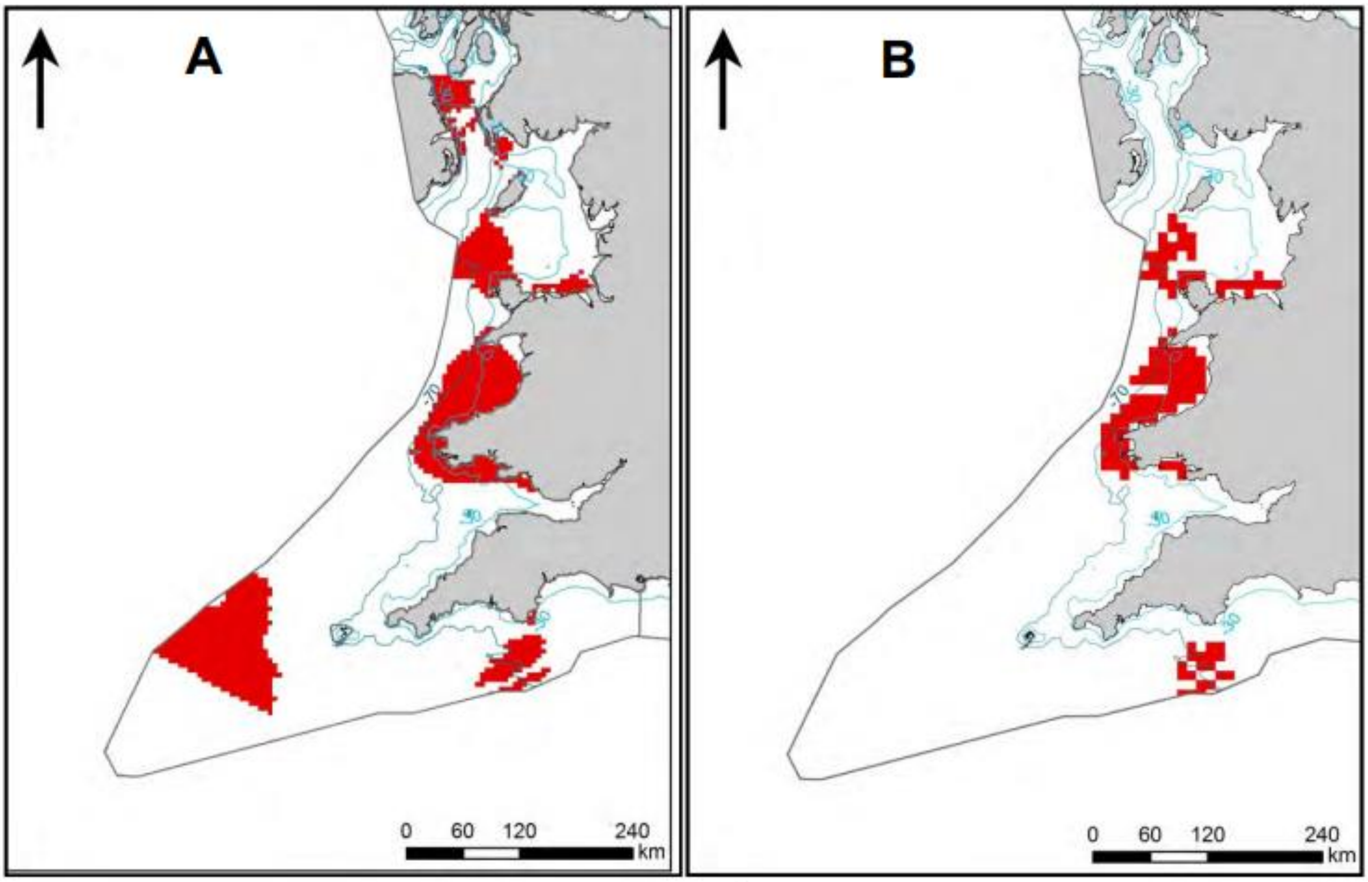


Figure 1.29: Persistent high-density areas identified and selected in MU 0 during summer, from Heinänen and Skov (2015). In map A the red colours mark areas with where persistent high densities as defined by the upper 90th percentile have been identified. In map B the red colours mark persistent high-density areas with survey effort from three or more years.

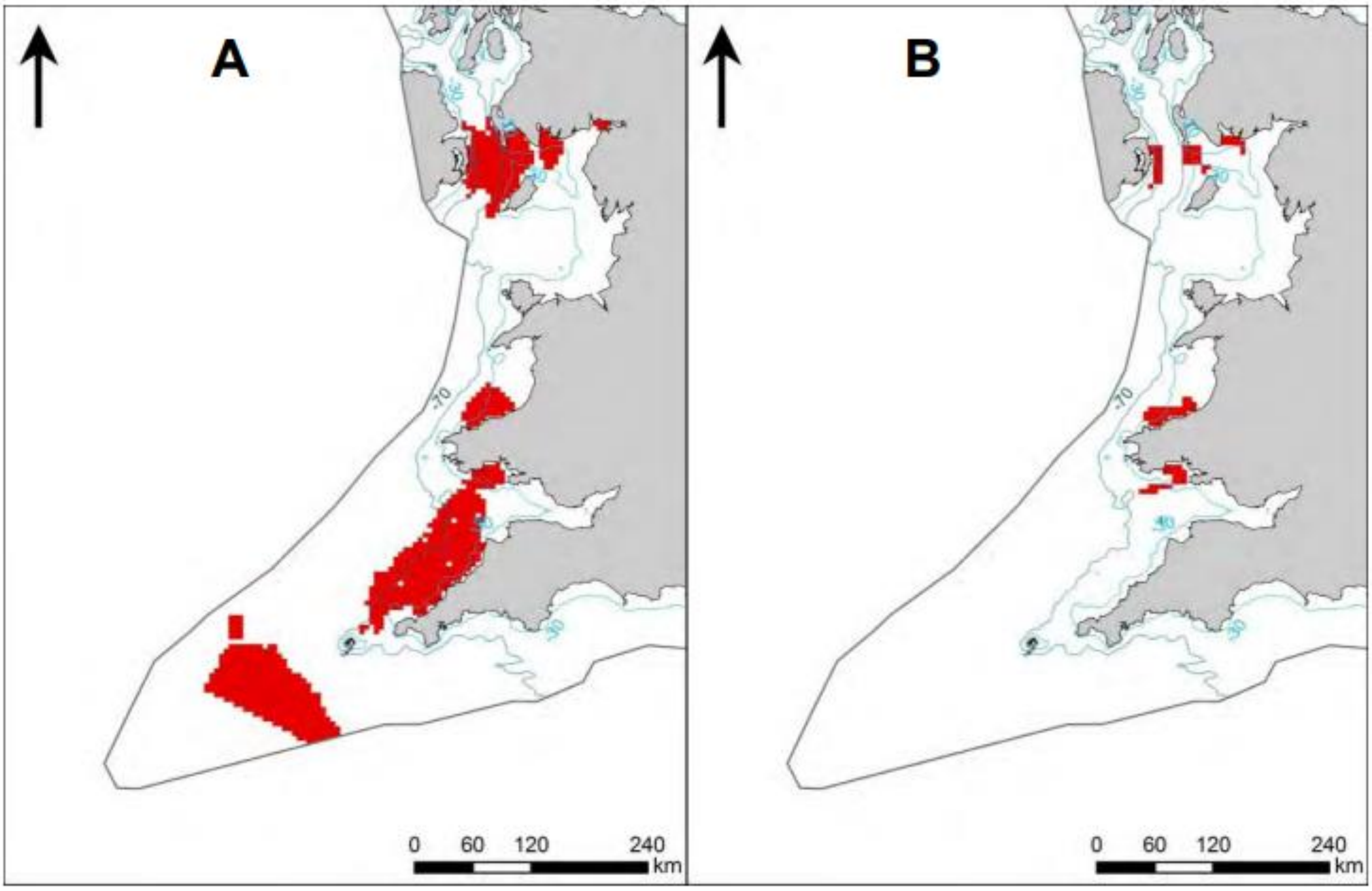


Figure 1.30: Persistent high-density areas identified and selected in MU 0 during winter, from Heinänen and Skov (2015). In map A the red colours mark areas with where persistent high densities as defined by the upper 90 percentile have been identified. In map B the red colours mark persistent high-density areas with survey effort from three or more years.

1.7.2.25 More recently, several consenting surveys have provided further fine-scale local density data for harbour porpoise. Wylfa Newydd nuclear power station is located approximately 37 km to the southwest of the Mona Offshore Wind Project, west of Cemaes Bay on the island of Anglesey, off the northwest 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 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).

1.7.2.26 Site-specific boat surveys were used to inform the baseline characterisation for the MDZ (Royal Haskoning DHV, 2019) which is located in West Anglesey, off the coast of Holy Island, approximately 54 km southwest of the Mona Offshore Wind Project. 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 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.

1.7.2.27 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 1.5.3 for further explanation of categories). Aerial surveys of the ISZ produced an overall density of 0.09 per km^2 for the Zone over the entire year.

1.7.2.28 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 23 km to the south of the Mona Offshore Wind Project, confirmed 27 harbour porpoises in monthly digital still aerial surveys by APEM but data was not sufficient for estimating densities within the area.

1.7.2.29 The Morgan Offshore Wind Project: Generation Assets PEIR (Morgan Offshore Wind Ltd, 2023) estimated a mean absolute density of 0.196 animals per km^2 per month for the Morgan Aerial survey area (from a design-based approach, with highest densities in August (0.482 animals per km^2) and lowest densities in December (0.04 animals per km^2). Model-based densities averaged as 0.076 animals per km^2 per month, with highest densities in August (0.260 animals per km2, 95% CL = 0.176 to 0.349) and lowest densities in December (0.009 animals per km2, 95% CL = 0.006 to 0.012). Models were also given by bio-season, with design-based approaches gave densities of 0.145 and 0.247 animals per km^2 for winter and summer respectively. Mean absolute density from the model-based approach was 0.083 for Winter (95% CL = 0.032 to 0.149, CV = 0.493) and 0.112 for Summer (95% CL = 0.051 to 0.177, CV = 0.333).

1.7.2.30 Both design-based and model-based relative and absolute densities from the aerial digital survey data for the Mona Aerial Survey Area are given in full in Appendix A. For the Mona Offshore Wind Project, a mean absolute density of 0.079 animals per km^2 per month was estimated from design-based approach, 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% CL = 0.040 to 0.096) and lowest densities in April (0.002 animals per km^2, 95% CL = 0.001 to 0.003).

1.7.2.31 The most robust method was developed by combining the data by bio-season specific to harbour porpoise (winter and summer seasons), as the most biologically relevant approach. As discussed in more detail in Appendix A, dividing the year into bio-seasons is an approach to aid with designating SACs (Heinänen & Skov, 2015). 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% CL = 0.005 to 0.041, CV = 0.5) and 0.013 for Summer (95% CL = 0.005 to 0.023, CV = 0.478).

1.7.2.32 Spatial modelling using linear models showed harbour porpoise density appears uniformly low in the Mona Aerial Survey Area (Figure 1.29), with a concentration of occurrence in the east part of the Mona Aerial Survey Area, particularly in the winter bio-season (October to March). Full detail of the modelling approach is given in Appendix A.

Summary of densities

1.7.2.33 Overall, harbour porpoise is abundant throughout the Irish sea with areas of high density located in the east Irish Sea where the Mona marine mammal study area is located, which may drive up mean density estimates. Comparison of key data sources within the Mona marine mammal study area for harbour porpoise is shown in Table 1.7.

1.7.2.34 Predicted estimates of mean density for the Mona marine mammal study area and Mona Array Area from Evans and Waggitt (2023) are comparable to the SCANS-III block E estimate (Hammond *et al.,* 2021), but provides densities at a higher 2.5 km resolution from a study which targets the Irish Sea (utilising 30 years of sighting and effort data), rather than a single estimate over a wide area (as is the case with SCANS surveys which use blocks). Densities from Waggitt *et al.* (2020) and Lacey *et al.* (2022) are derived from lower resolution data (10 km resolution for both) compared to the Welsh Marine Mammal Atlas data (Evans and Waggitt, 2023). In addition, the Welsh Marine Mammal Atlas data is specific to the Irish Sea, in which the Mona Offshore Wind Project is located, whereas SCANS-IV, SCANS-III, Waggitt *et al*. (2020) and Lacey *et al.* (2022) cover larger geographic areas. Furthermore, the densities from the Welsh Marine Mammal Atlas are significantly higher than absolute densities from Mona aerial surveys.

1.7.2.35 The density taken forward to assessment is the density for the Mona Array Area from the Welsh Marine Mammal Atlas (Evans and Waggitt, 2023) (highlighted in bold in Table 1.7) providing the most robust density for the area. This choice of density was consulted upon, and densities agreed via the Marine Mammal EWG for the Mona Offshore Wind Project.

Table 1.7: Comparison of main data sources densities and variation for harbour porpoise.

Source	Density (animals per km^2)	Estimate of variation
SCANS-IV – block CS-E (Gilles *et al.*, 2023)	0.5153	0.250 (CV)
SCANS-III – block E (Hammond *et al.*, 2021)	0.239	0.282 (CV)
SCANS-III – block F (Hammond *et al.*, 2021)	0.086	0.383 (CV)
Lacey *et al.* (2022) derived from SCANS-III for the Mona marine mammal study area	0.397	0.174 (CV)
APEM aerial survey bio-season design based for the Mona Offshore Wind Project – absolute densities	Winter = 0.097 Summer = 0.061	N/A
Waggitt *et al.* (2020) for the Mona marine mammal study area for August (peak month)	0.516	0.5 to 0.53 (95% CIs)
Welsh Marine Mammal Atlas (Evans and Waggitt, 2023) for the Mona Array area from the annual composite maps	**0.2773**	**0.258 to 0.299** (95% CIs)
Welsh Marine Mammal Atlas (Evans and Waggitt, 2023) for the Mona marine mammal study area from the annual composite maps	0.2577	0.239 to 0.278 (95% CIs)

Abundance

1.7.2.36 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, 2021). 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 8,320 animals for block E (95% CI = 4,643 to 14,354) and 1,056 animals (95% CI = 342 to 2,010) for block F. Recent SCANS-IV estimates for block CS-E gave 6,325 animals (95% CI = 3,663 to 10,162). 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).

1.7.2.37 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 marine mammal study area (Figure 1.31). 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 = 4789.0 to 11,728) in summer 2015 to 11,624.5 animals (CV = 28.2, 95% CI = 8725.8 to 15486.0) in summer 2016. Estimates for the winter season were lower compared to summer.

1.7.2.38 In surveys for Rhiannon Wind Farm (Celtic Array Ltd., 2014), boat-based visual surveys of the ISZ 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 ISZ.

1.7.2.39 The Morgan aerial digital surveys presented in the Morgan Offshore Wind Project: Generation Assets PEIR (Morgan Offshore Wind Ltd., 2023) gave both relative and absolute abundance estimates per month for the interim analysis. For Morgan Generation Assets, the average mean absolute abundance for the area was 270 animals in the Morgan Aerial Survey Area per month. Mean absolute abundance across the months ranged from 56 animals (in December) to 665 animals (in June). Again, the Morgan Offshore Wind Project: Generation Assets PEIR noted that this is based on 12 months of survey data and estimates are high and likely to change when the full 24 months are included. When using bio-season, winter had an abundance of 199 animals in the area and 341 animals during the summer.

1.7.2.40 Several historical studies had more localised abundance values targeting known high-use areas by cetaceans (Anglesey and Cardigan Bay), 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.

1.7.2.41 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% Cl = 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, 2014). Abundance estimates ranged from 1074 (CV 28.73, 95% Cl 634 to 1821) in 2011 to 410 (CV 20.42, 95% Cl = 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.

1.7.2.42 The Mona aerial digital surveys gave both relative and absolute abundance estimates per month (full detail in Appendix A). 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.

1.7.2.43 The MMOb and Passive Acoustic Monitoring (PAM) Report also provides sightings data for visual and acoustic monitoring during the Applicant's 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 Mona Array Area and Morgan Array Area.

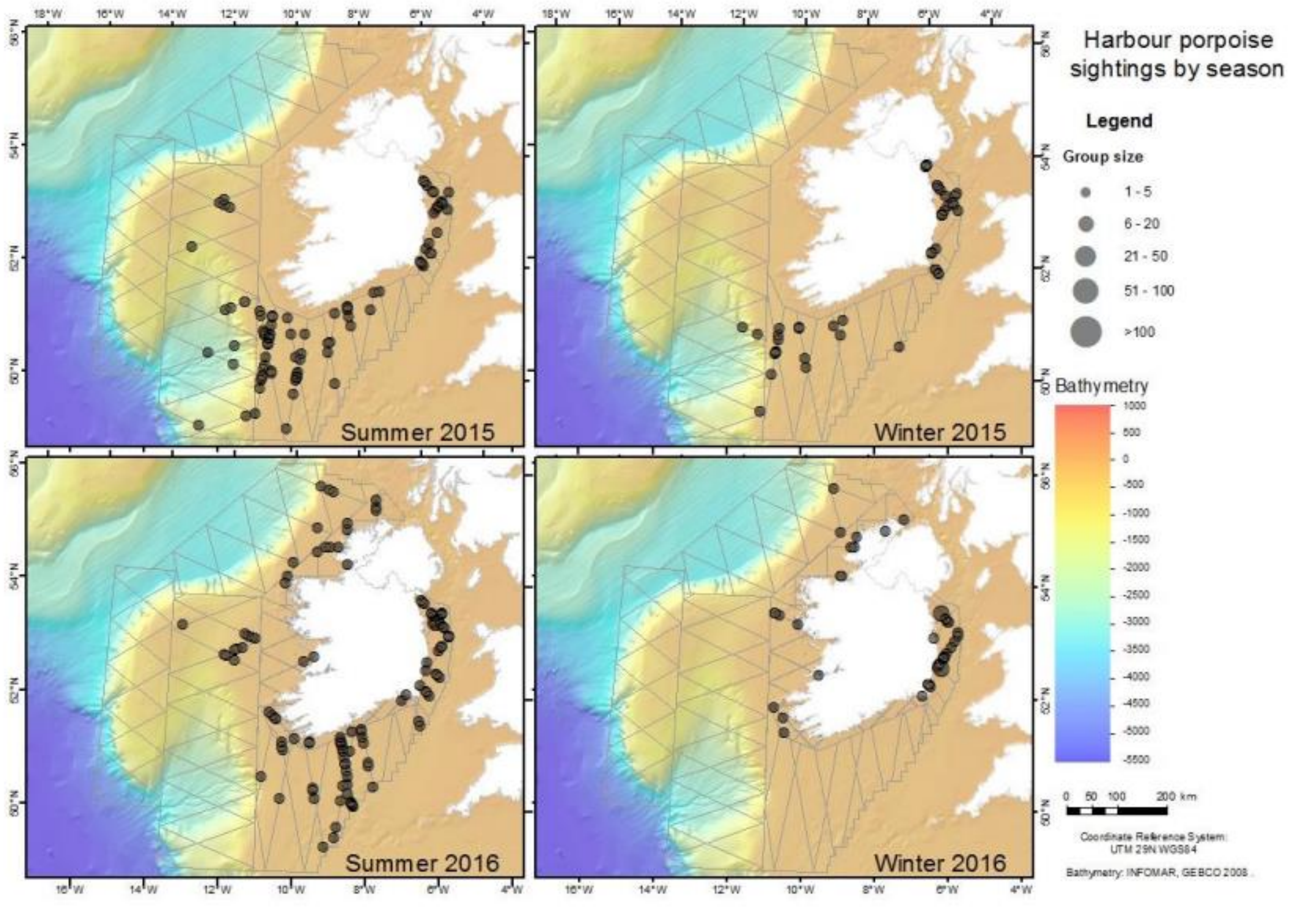


Figure 1.31: Sightings of harbour porpoise in each survey period (bottom). Grey lines indicate the survey tracklines along which sightings were made. Circles are proportional to the estimated number of porpoises seen in each sighting. From Rogan *et al.* (2018).

Seasonality

1.7.2.44 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 1.25) showed moderate densities year-round towards the east of the Irish Sea, overlapping the Mona marine mammal 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).

1.7.2.45 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).

1.7.2.46 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 marine mammal 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).

1.7.2.47 In the aerial data, there was some evidence of seasonality when modelled by bio-season, with higher densities in winter (mean absolute density = 0.022, CV = 0.5) than summer (0.013, CV = 0.478) for the Mona Aerial Survey Area, however these are difficult to determine due to low confidence in the model and high CVs. The absolute density from design-based estimates also reflects a higher density in winter (mean density = 0.097) than summer (mean density = 0.061).

1.7.3 Bottlenose dolphin

Ecology

1.7.3.1 Bottlenose dolphin are members of the family Delphinidae, which are oceanic dolphins found in temperate and tropical waters worldwide. The largest of the beaked dolphins, this species ranges in size from 1.9 to 3.8m 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).

1.7.3.2 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 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.

1.7.3.3 Bottlenose dolphin is 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 5 km from the coast; they also showed a preference for shallow waters (5 to 10 m deep) and gentle slopes (Pesante *et al.*, 2008).

Distribution and occurrence

1.7.3.4 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 southwest 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 (Baines and Evans, 2012) regular sightings of bottlenose dolphin were confirmed across the Irish Sea study area, with areas of high counts per kilometre seen in Cardigan Bay and Anglesey (Figure 1.32) (Baines and Evans, 2012; Evans *et al*., 2015). JCP Phase III data also demonstrated bottlenose dolphin 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 shows bottlenose dolphin are widespread in Manx waters around the Isle of Man, extending out towards the Mona Array Area but no sightings are located within the Mona Array Area and Mona Offshore Cable Corridor and Access Areas (Figure 1.14).

1.7.3.5 There is evidence of large home ranges for bottlenose dolphin, but in the Irish sea their distribution is largely coastal (Oudejans *et al.*, 2015; Paxton *et al.,* 2016). 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 marine mammal study area (such as in outer Cardigan Bay which has higher densities, as described in Lohrengel *et al.,* 2018). Further out from the coast, towards the Mona Array Area, lower densities may be more reflective of the offshore bottlenose dolphin distributions. The Welsh Marine Mammal Atlas demonstrates a high density along the coastal region of Cardigan Bay (Evans and Waggitt, 2023; Figure 1.38).

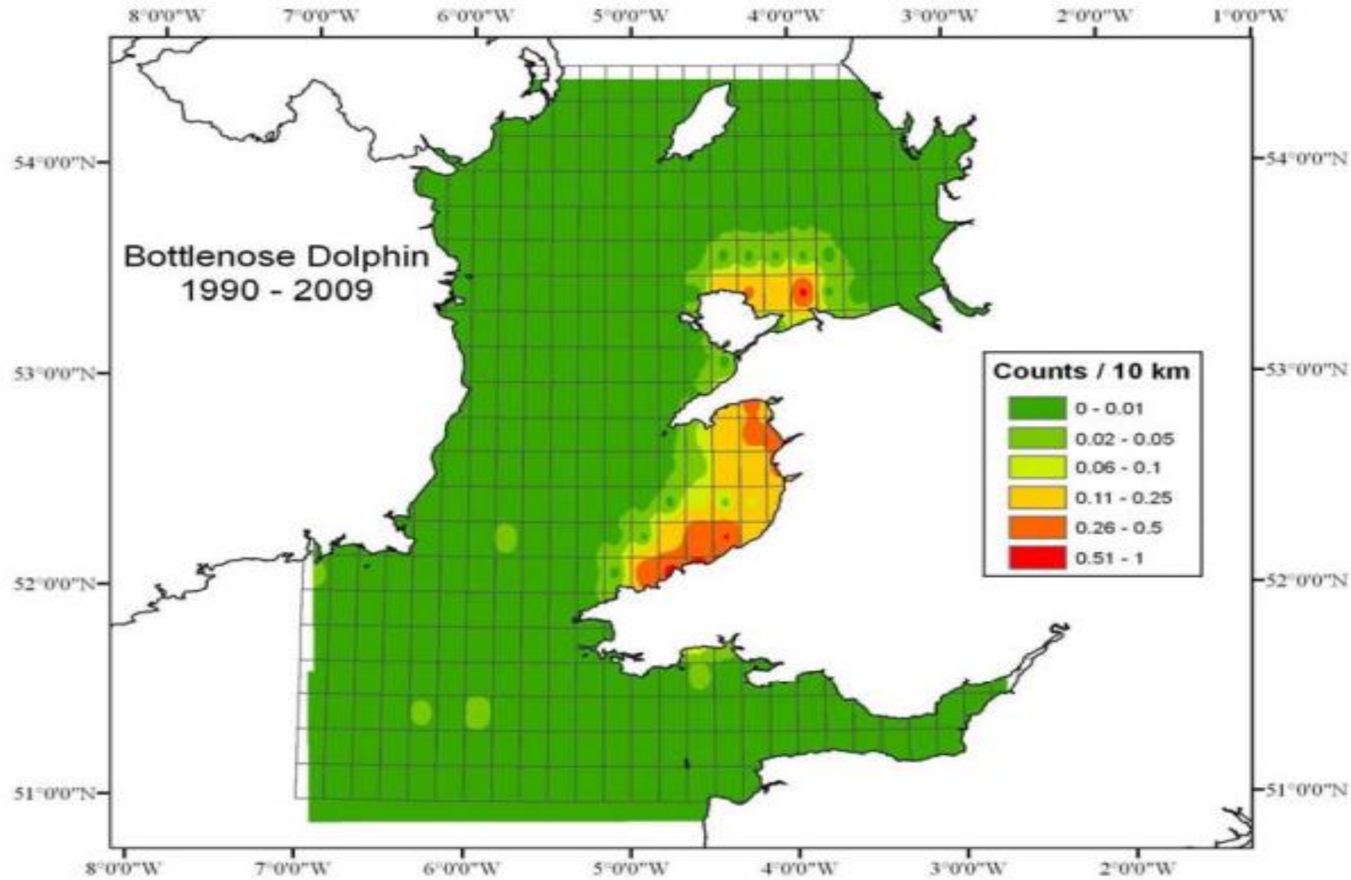


Figure 1.32: IDW interpolated map of bottlenose dolphin distribution, from Baines and Evans (2012).

1.7.3.6 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 northeast Scotland supports 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

1.7.3.7 Bottlenose dolphin from Cardigan Bay are likely to interact with animals in waters of southwest UK and southern Ireland, and are likely to be moving and exchanging with more distant populations (Pesante *et al.,* 2008), with the 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. 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 a 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 (Figure 1.14) which shows sightings around 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 Llyn Peninsula, into the waters of south of the Irish Sea with their calf within two years of giving birth (Duckett, 2018).

1.7.3.8 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 ten-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 determined (Robinson *et al.* 2012).

Density/abundance

1.7.3.9 Density and abundance estimates are available across a broader area within the regional marine mammal study area for bottlenose dolphin.

Density

1.7.3.10 The Mona Offshore Wind Project lies within block F for the SCANS-III surveys in 2016 (Figure 1.11) but no bottlenose dolphin were sighted within the block. Bottlenose dolphin were recorded in the adjacent block E, which spans the regional marine mammal study area, and the estimated density was 0.0082 animals per km^2 (CV = 0.573). As 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. Recently modelled density surfaces using the SCANS-III data (see paragraph 1.5.6.5) (Lacey *et al.*, 2022) gave mean densities of 0.017 animals per km^2 and a maximum of 0.018 animals per km^2 for the Mona marine mammal study area (Figure 1.33), with density maps showing higher areas of density in the east Irish Sea[4]. Recent SCANS-IV data reported densities of 0.0104 animals per km^2 (CV = 0.700) in block CS-E and 0.2352 animals per km^2 (CV = 0.353) in block CS-D (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.

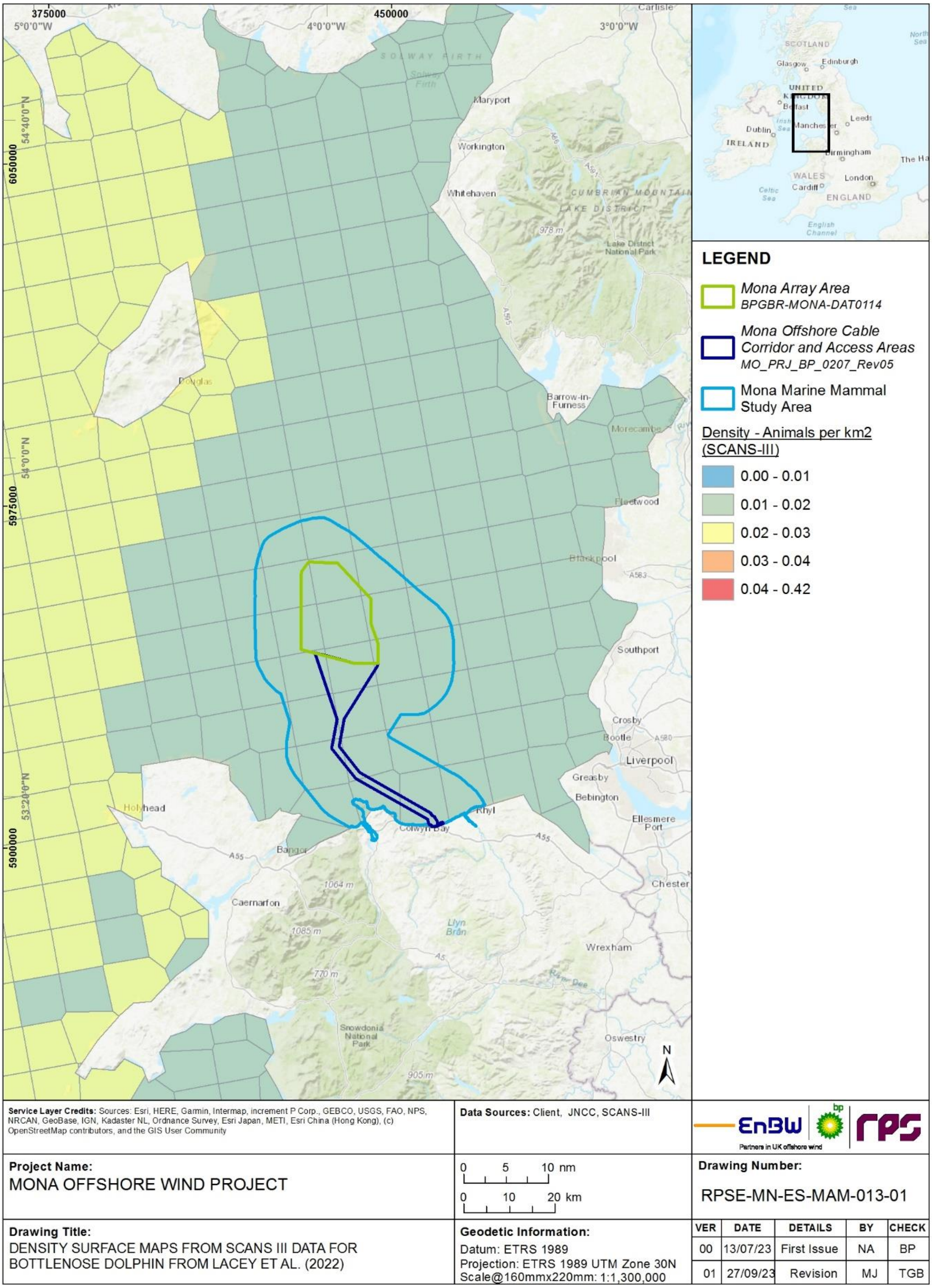


Figure 1.33: Density surface maps from SCANS-III data for bottlenose dolphin from Lacey *et al.* (2022).

1.7.3.11 During ObSERVE surveys bottlenose dolphin was more frequently seen in the winter than in the summer in both years and was the most frequently sighted cetacean species in the surveys (Rogan *et al.*, 2018) (Figure 1.34) and bottlenose dolphin calves were seen in most of the surveyed regions (71 sightings). However, stratum 5 (Western 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.

1.7.3.12 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. Winter densities for 2010 in the Irish Sea area peaked at 1 animal per km^2, again along the Cardigan Bay coast. This study builds upon the Phase One Data Analysis (Paxton and Thomas, 2010), which predicted density surfaces for bottlenose dolphin from data from 1980 to 2009. Densities for the Irish Sea ranged from 0.01 to 1 animal per km^2 in 1983, 1990, 1997 and 2004, with areas of higher densities in Cardigan Bay, around Anglesey and close to the coast in Liverpool Bay (5 animals per km^2) (which partly overlaps the Mona Offshore Cable Corridor); densities in the region of the Mona Array Area were 0.01 to 1 animal per km^2 (Paxton and Thomas, 2010).

[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.

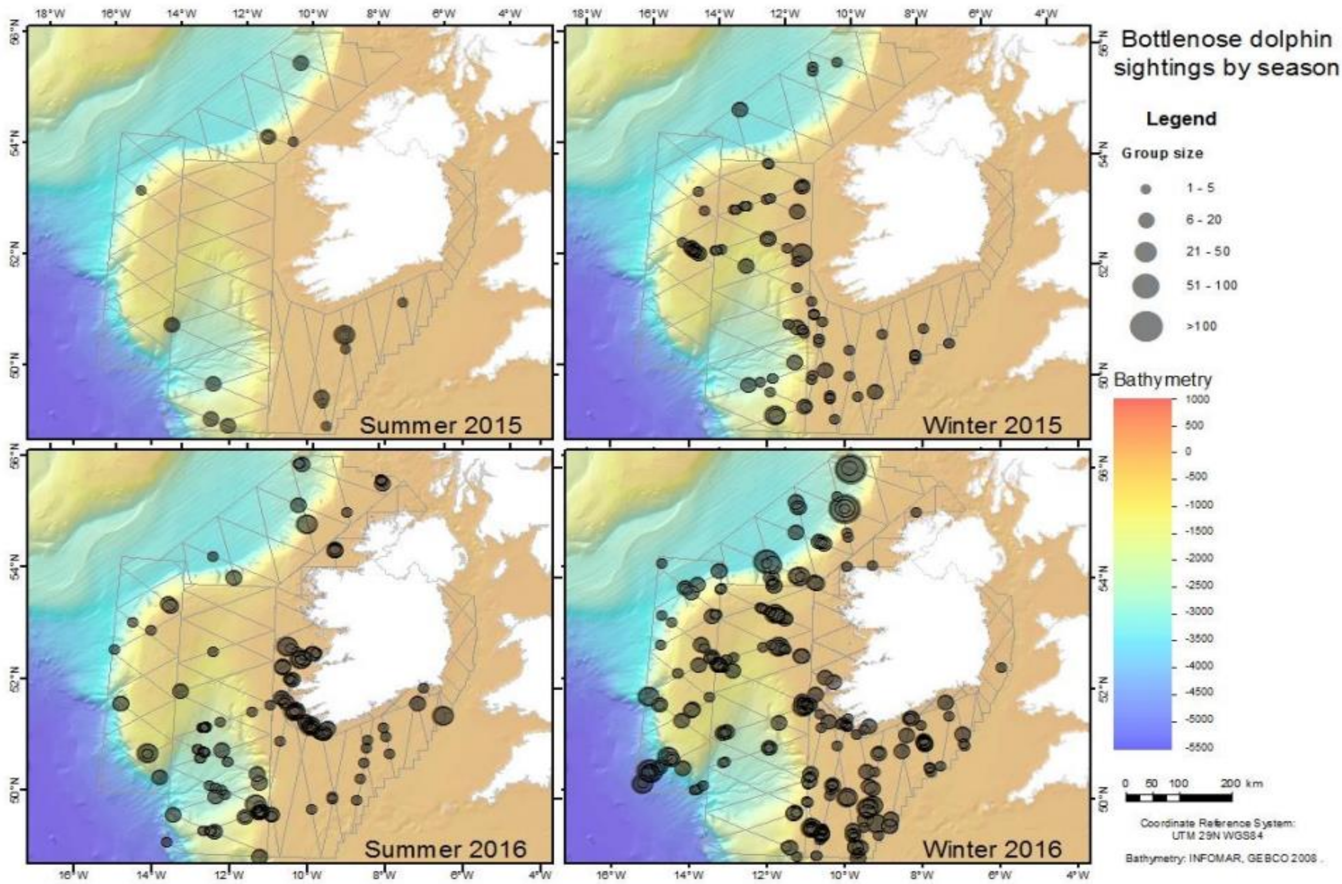


Figure 1.34: Sightings of bottlenose dolphin in each survey period (bottom). Grey lines indicate the survey tracklines along which sightings were made. Circles are proportional to the number of dolphins in each sighting. From Rogan *et al.* (2018).

1.7.3.13 Most recently, predicted distribution maps of bottlenose dolphin at monthly scales by Waggitt *et al.* (2020) demonstrated bottlenose dolphin densities to be fairly consistent all year round (Figure 1.35) with some higher densities in winter (January) than in summer (July) off the western coast of Ireland and Bay of Biscay. Low density areas of bottlenose 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). Waggitt *et al.* (2020) states 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 Mona marine mammal study area show low relative densities year-round (Figure 1.36 and Figure 1.37). Highest densities in the east Irish sea were predicted in August with 0.025 animals per km^2 in high density areas. However, within the Mona marine mammal study area bottlenose dolphin densities were highest in August and reached a maximum of 0.002 animals per km^2 , thus very low densities.

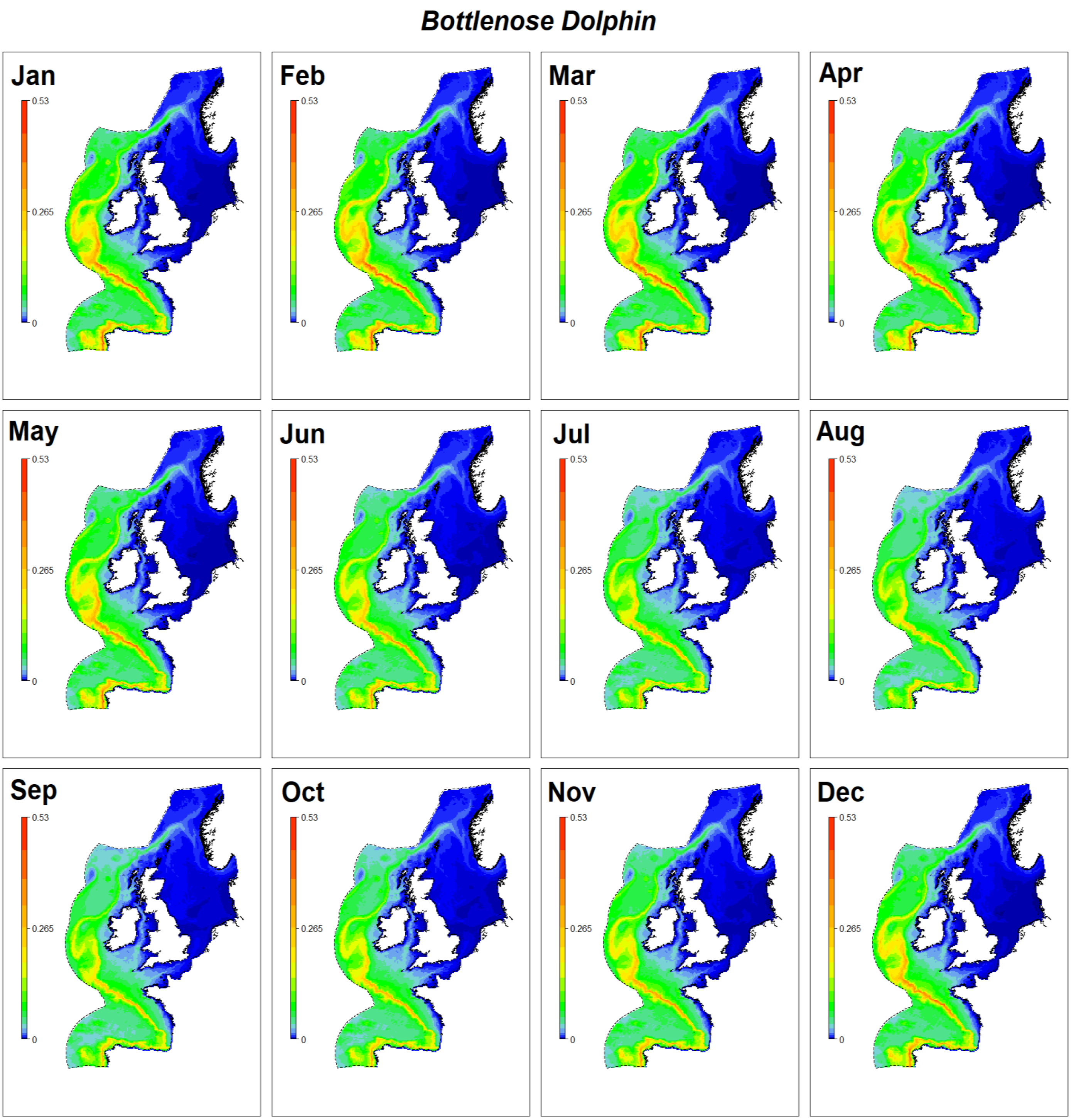
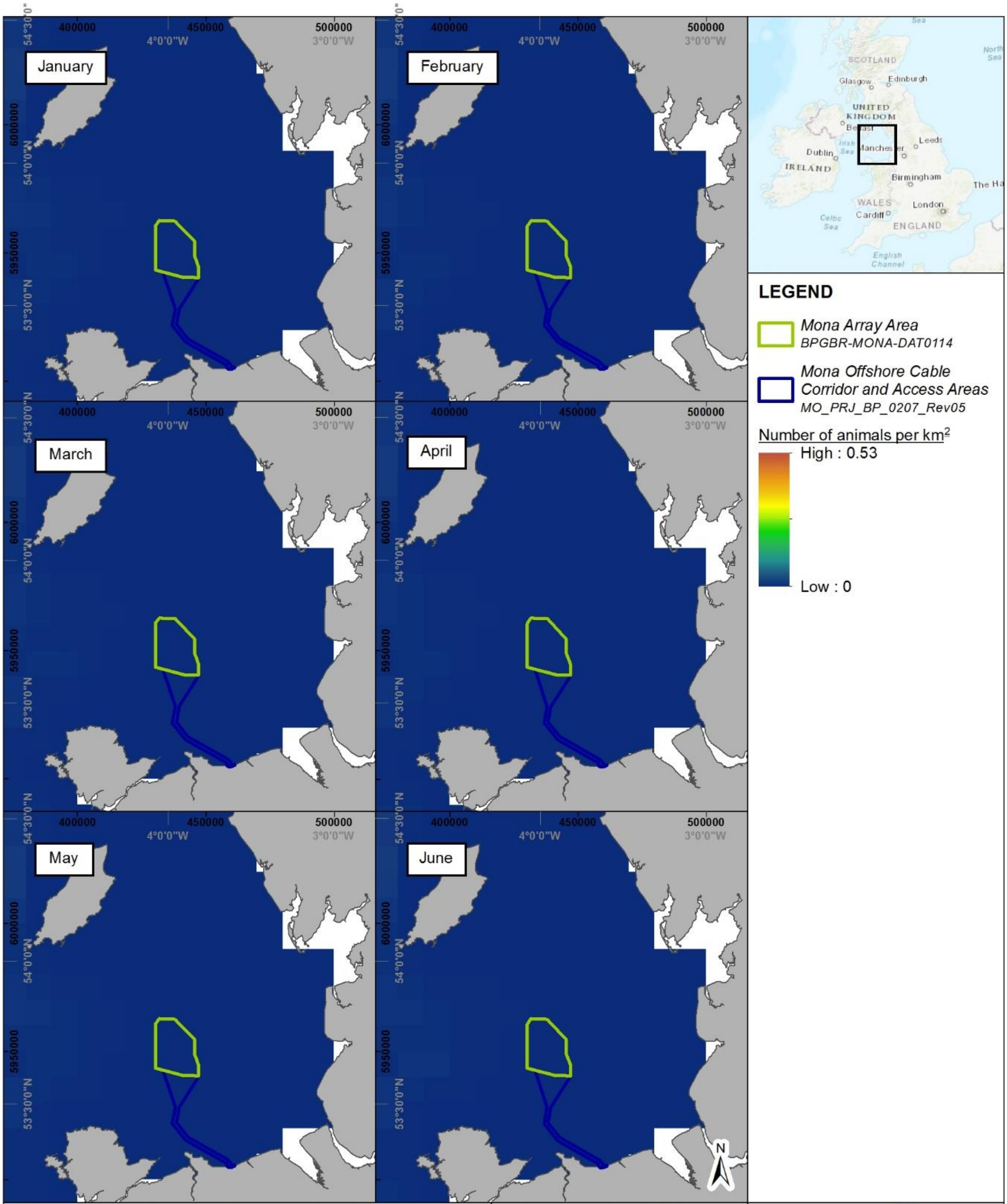


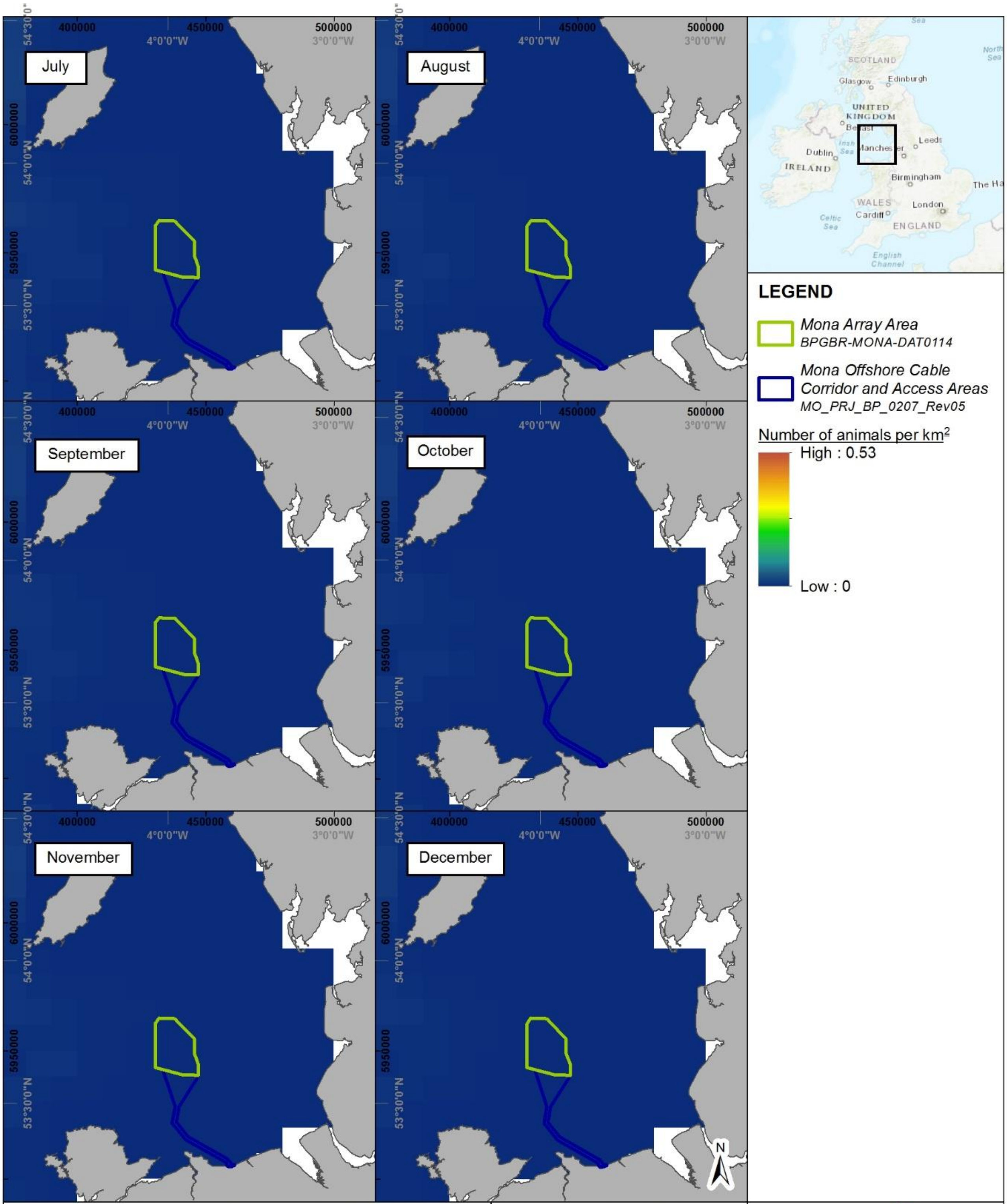
Figure 1.35: Predicted distributions for bottlenose dolphin per month for the entire study area, from Waggitt *et al.* (2020).



Service Layer Credits: Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community	Data Sources: Client, Waggitt (2020).	EnBW bp Partners in UK offshore wind; RPS
Project Name: MONA OFFSHORE WIND PROJECT	0 5 10 20 30 nm 0 10 20 40 60 km	Drawing Number: RPSE-MN-ES-MAM-014-02
Drawing Title: PREDICTED DISTRIBUTIONS FOR BOTTLENOSE DOLPHIN PER MONTH FROM JANUARY TO JUNE, DATA FROM WAGGITT ET AL. (2020)	Geodetic Information: Datum: ETRS 1989 Projection: ETRS 1989 UTM Zone 30N Scale@160mmx220mm: 1:2,500,000	

VER	DATE	DETAILS	BY	CHECK
00	13/07/23	First Issue	NA	BP
02	28/09/23	Revision	MJ	TGB

Figure 1.36: Predicted distributions for bottlenose dolphin per month from January to June for the Mona Array Area, data from Waggitt *et al.* (2020).



Service Layer Credits: Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

Data Sources: Client, Waggitt (2020).

Project Name:
MONA OFFSHORE WIND PROJECT

0 5 10 20 30 nm
0 10 20 40 60 km

Drawing Number:
RPSE-MN-ES-MAM-015-02

Drawing Title:
PREDICTED DISTRIBUTIONS FOR BOTTLENOSE DOLPHIN PER MONTH FROM JULY TO DECEMBER, DATA FROM WAGGITT ET AL. (2020)

Geodetic Information:
Datum: ETRS 1989
Projection: ETRS 1989 UTM Zone 30N
Scale@160mmx220mm: 1:2,500,000

VER	DATE	DETAILS	BY	CHECK
00	13/07/23	First Issue	NA	BP
02	28/09/23	Revision	MJ	TGB

Figure 1.37: Predicted distributions for bottlenose dolphin per month from July to December for the Mona Array Area, data from Waggitt *et al*. (2020).

1.7.3.14 Modelled outputs from the Welsh Marine Mammal Atlas (Evans and Waggitt, 2023) indicated the importance of Cardigan Bay, 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.

1.7.3.15 The average density for the Mona marine mammal study area from the annual composite maps (as recommended by NRW and authors of the Marine Mammal Atlas, see paragraph 1.5.16.4) was 0.00171 animals per km^2, and the average density for the Mona Array area was 0.00098 animals per km^2 (Figure 1.38).

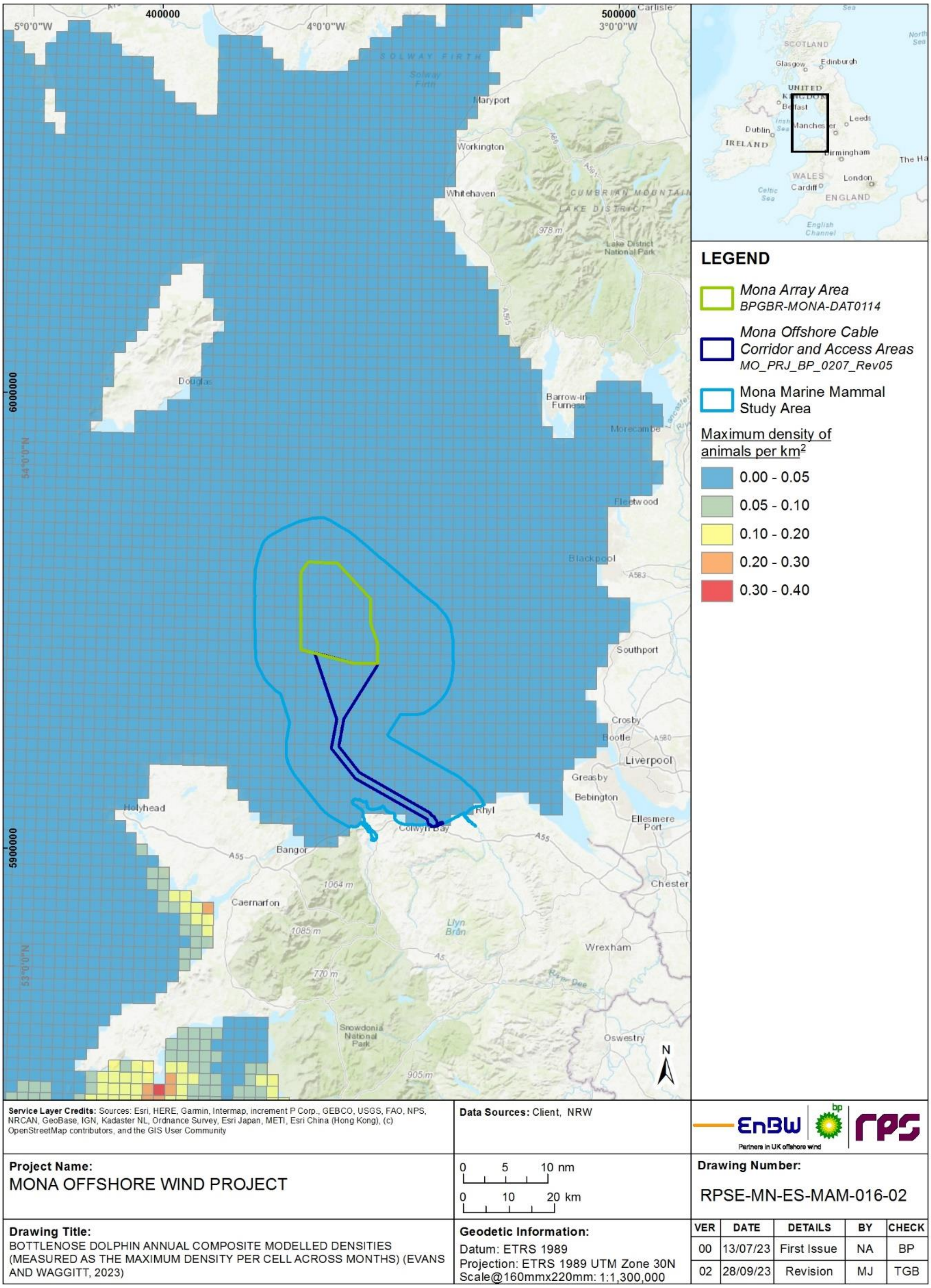


Figure 1.38: Bottlenose dolphin annual composite modelled densities (measured as the maximum density per cell across months) for the Mona marine mammal study area (Evans and Waggitt, 2023).

1.7.3.16 Several studies have targeted particular 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 Special Area of Conservation (cSAC) (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 the cSAC.

1.7.3.17 More recently, Lohrengel *et al.* (2018) summarised distance sampling surveys between Cardigan Bay and the wider Cardigan Bay to provide estimates of abundance for bottlenose dolphin (described in detail in section 1.7.3.31). 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 Mona marine mammal study area.

1.7.3.18 The regional marine mammal study area includes the waters of the Isle of Man territorial sea and, as discussed in paragraph 1.7.3.7, bottlenose dolphin have been commonly reported in Manx Waters, particularly off the southwest 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.

1.7.3.19 Site-specific digital aerial surveys did not record enough bottlenose dolphin in the area to carry out model-based density analyses. Bottlenose dolphin were observed in June 2021 and January 2022, with a maximum density (design-based relative) estimate of 0.020 animals per km^2 in the Mona Aerial Survey Area (in June 2021).

Summary of densities

1.7.3.20 Overall, bottlenose dolphins are abundant in the Irish sea but there are known areas of high density in Cardigan Bay, to the south of the Mona marine mammal study area, and this may drive up mean density estimates for the Irish Sea (Table 1.8). However, densities around the Mona marine mammal study area remain low.

1.7.3.21 Predicted estimates of mean density for the Mona marine mammal study area from Waggitt *et al.* (2020) are very similar to those from Welsh Marine Mammal Atlas (2023), but Waggitt *et al.* (2020) represents the offshore ecotype of bottlenose dolphin. Estimates are lower than the SCANS-III block E estimate (Hammond *et al.,* 2021) but this is the entire large-scale block that includes the Cardigan Bay population, and the Mona Offshore Wind Project lies in SCANS-III block F which recorded no bottlenose dolphin. SCANS-IV block CS-E 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 density from Lacey *et al.* (2022) is higher than the Welsh Marine Mammal Atlas, but it is UK-wide modelling, unlike the Welsh Marine Mammal Atlas which specifically accounts for the inshore ecotype of bottlenose dolphin in the Irish Sea MU.

1.7.3.22 Therefore (and as requested during the EWG process) the density taken forward to assessment is a single density from the Welsh Marine Mammal Atlas (Evans and Waggitt, 2023) for the Mona marine mammal study area, providing the most robust density for the area.

Table 1.8: Comparison of main data sources densities and variation estimates for bottlenose dolphin.

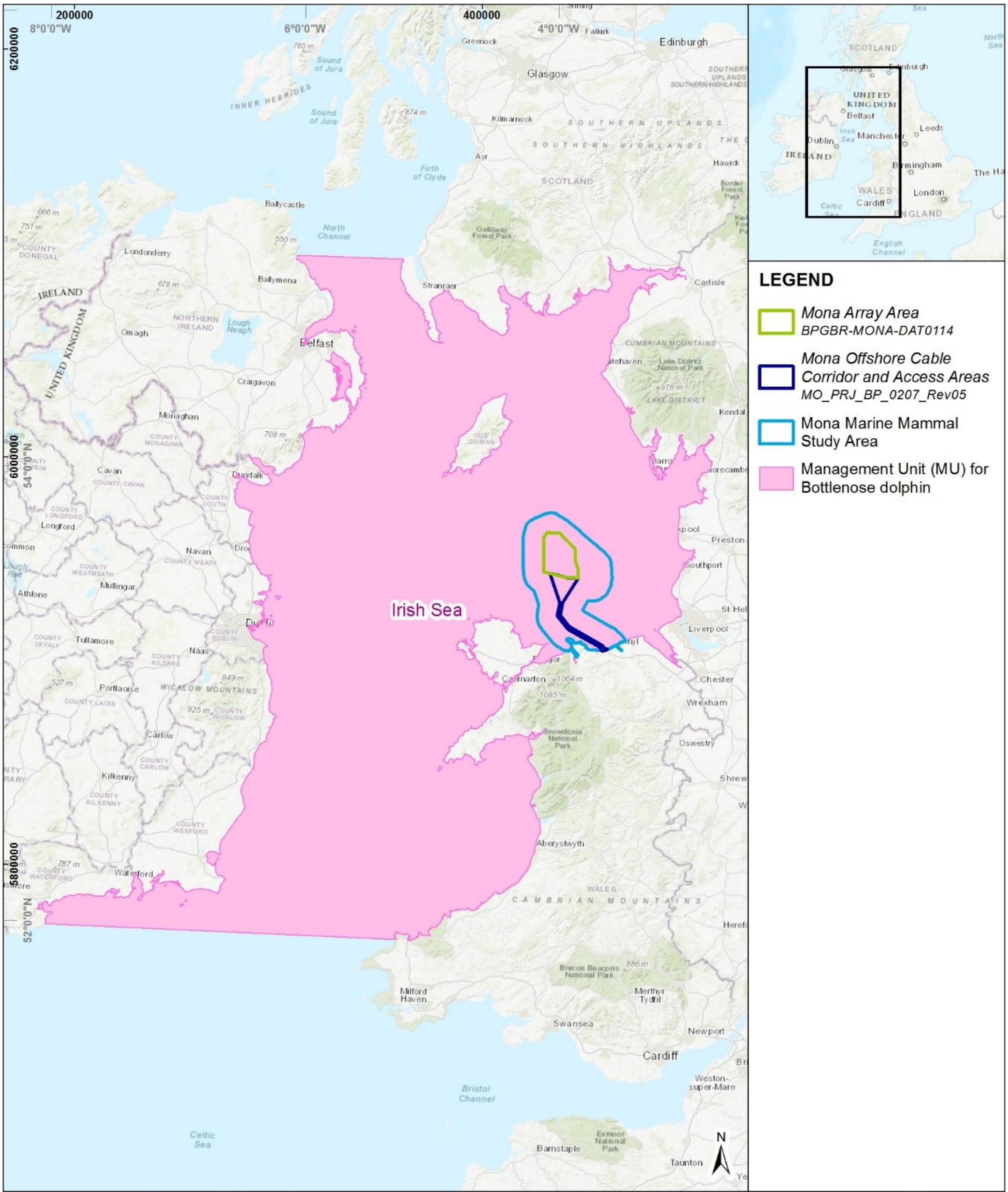
Source	Density (animals per km^2)	Estimate of variation
SCANS-IV – block CS-E (Gilles *et al.*, 2023)	0.0104	0.700 (CV)
SCANS-III – block E (Hammond *et al.*, 2021)	0.0082	0.573 (CV)
SCANS-III – block F (Hammond *et al.*, 2021)	N/A	N/A
Lacey *et al.* (2022) derived from SCANS-III for the Mona marine mammal study area	0.017	0.610 (CV)
Waggitt *et al.* (2020) for the Mona marine mammal study area	0.002	0.001 to 0.002 (95% CI)
Welsh Marine Mammal Atlas (Evans and Waggitt, 2023) for the Mona marine mammal study area from the annual composite maps	**0.00171**	**0.0007 to 0.0035 (95% CI)**
Welsh Marine Mammal Atlas (Evans and Waggitt, 2023) for the Mona Array area from the annual composite maps	0.00098	0.0004 to 0.002 (95% CI)

Abundance

Broadscale abundances

1.7.3.23 On a widescale, IAMMWG (2022; 2023) estimated abundance for the Irish Sea MU (see Figure 1.29) as 293 bottlenose dolphins (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. Abundance within the Irish Sea MU (Evans, 2012; IAMMWG, 2021), overall, appears stable, although much of the region has not been well surveyed for population trends. 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. Block CS-D had a much higher abundance (than 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 Southwest England (OCSW) MU.

1.7.3.24 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 *et al.* 2016).



Service Layer Credits: Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

Data Sources: Client, JNCC

Project Name:
MONA OFFSHORE WIND PROJECT

0 10 20 40 nm
0 25 50 km

Drawing Number:
RPSE-MN-ES-MAM-017-01

Drawing Title:
IRISH SEA MU FOR BOTTLENOSE DOLPHIN WITH THE MONA MARINE MAMMAL STUDY AREA

Geodetic Information:
Datum: ETRS 1989
Projection: ETRS 1989 UTM Zone 30N
Scale@160mmx220mm: 1:3,150,000

VER	DATE	DETAILS	BY	CHECK
00	13/07/23	First Issue	NA	BP
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Figure 1.39: Irish Sea MU for bottlenose dolphin with the Mona marine mammal study area.

1.7.3.25 During ObSERVE surveys (details given in section 1.5.7), 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% confident interval = 0 to 828).

1.7.3.26 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.

Localised abundances

1.7.3.27 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.

Cardigan Bay

1.7.3.28 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 – 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).

1.7.3.29 Later, 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).

1.7.3.30 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 Special Areas of Conservation (SACs) (Veneruso and Evans, 2012). The abundance estimate for the whole of Cardigan Bay was 296 animals (95% CL = 170 to 518, CV = 28.82) from line transect surveys.

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

1.7.3.32 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, 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 estimates of 206 (95% CI = 171 to 278; CV = 0.28) occurring in 2015. The latest estimate (2019) for the Cardigan Bay SAC is 138 individuals (95% confidence interval (CI): 68–303 animals) representing a decline of approximately 30% over the last ten-year period, but no significant change since the start of the time series (Evans and Waggitt, 2023).

1.7.3.33 As presented in the Morgan Offshore Wind Project PEIR (Morgan Offshore Wind Ltd, 2023) aerial digital surveys recorded maximum raw counts of nine bottlenose dolphin in the Morgan Aerial Survey Area (June 2021), which gave interim maximum abundance estimates of 71 bottlenose dolphins for the Morgan Aerial Survey Area in June 2021.

1.7.3.34 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.

1.7.3.35 During integrated surveys detailed in the PAM and MMO Report, there were eight visual sightings of bottlenose dolphin from April 2022 to May 2022.

Seasonality

1.7.3.36 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 (TPOD) 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 least a third of the Cardigan Bay population move into north Wales and Manx waters (Pesante *et al.*, 2008).

1.7.3.37 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 in Cardigan Bay compared to Manx waters may suggest that Manx waters may provide vital winter habitat, whilst Cardigan Bay is important for calving during summer months. MWDW data (Figure 1.14) shows a general pattern of higher bottlenose dolphin sightings in winter months than summer months. As detailed in paragraph 1.7.2.45, 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, 2023, personal communication, June 2023).

1.7.3.38 This seasonal pattern was also detected in the ObSERVE surveys (Rogan *et al.*, 2018) where sightings of bottlenose 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, 2018a).

1.7.3.39 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).

1.7.4 Short-beaked common dolphin

Ecology

1.7.4.1 The short-beaked common dolphin is a member of the Delphinidae family, which are oceanic dolphins found in temperate and tropical waters worldwide. It is widely distributed throughout Europe, and around the UK, is common in the western approaches to the Channel and the southern 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 m in length and weighing between 75 and 85 kg, with a long slender body with tall pointed dorsal fin. Short-beaked common dolphin 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. Short-beaked 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 dolphins. School size increases in mid-summer and mid-winter, possibly linked to the dolphins following prey moving inshore.

1.7.4.2 Short-beaked common dolphin appear 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. 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.

1.7.4.3 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.,* 2005). 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

1.7.4.4 The short-beaked 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 short-beaked 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). They are also the most frequently sighted and abundant cetacean recorded during Celtic Sea herring surveys off the south coast of Ireland in October (O'Donnell *et al.* 2017, 2018). The ObSERVE aerial surveys of Irish waters showed short-beaked 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 shows short-beaked common dolphin are widespread in Manx waters around the Isle of Man, extending out towards the Mona Array Area (Figure 1.14).

1.7.4.5 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 southwest of the UK (Murphy *et al.,* 2005; Murphy *et al*.,2008), off the west coast of Ireland and to the west and northwest of Scotland. This likely coincides with the mating and calving period.

Density/abundance

Density

1.7.4.6 Density and abundance estimates were available across a broader area within the regional marine mammal study area. SCANS-III is a key baseline dataset, and the Mona Offshore Wind Project lies within block F for the SCANS-III surveys in 2016 (Figure 1.11), but no common dolphin were sighted within that block or the adjacent block E (Hammond *et al.,* 2021). Predicted density values using SCANS-III data was presented in the Offshore Energy SEA 4: Appendix 1 Environmental Baseline (BEIS, 2022) and showed common dolphin densities were low (0 – 0.07 animals per km^2) in the Irish sea but increased towards the Celtic Sea (Figure 1.40). The SCANS-II density for block O was 0.018 animals per km^2 (CV = 0.78). Recently modelled density surfaces using the SCANS-III data (see paragraph 1.5.6.5) (Lacey *et al.*, 2022) gave mean densities of 0.005 animals per km^2 and a maximum of 0.125 animals per km^2 for the Mona marine mammal study area (Figure 1.42), with density maps showing lower areas of density in the east Irish Sea[6]. Recent SCANS-IV data did not report any short-beaked common dolphin in block CS-E (in which the Mona Offshore Wind Project lies) but reported a density of 0.0272 animals per km^2 (CV = 0.814) in adjacent block CS-D (Gilles *et al.*, 2023).

1.7.4.7 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 Irish Atlas of Marine Mammals also confirmed short-beaked common dolphin were recorded in all months of the year (Wall, 2013), with high densities in the southern approaches to the Irish Sea in the spring and summer.

[6] 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.

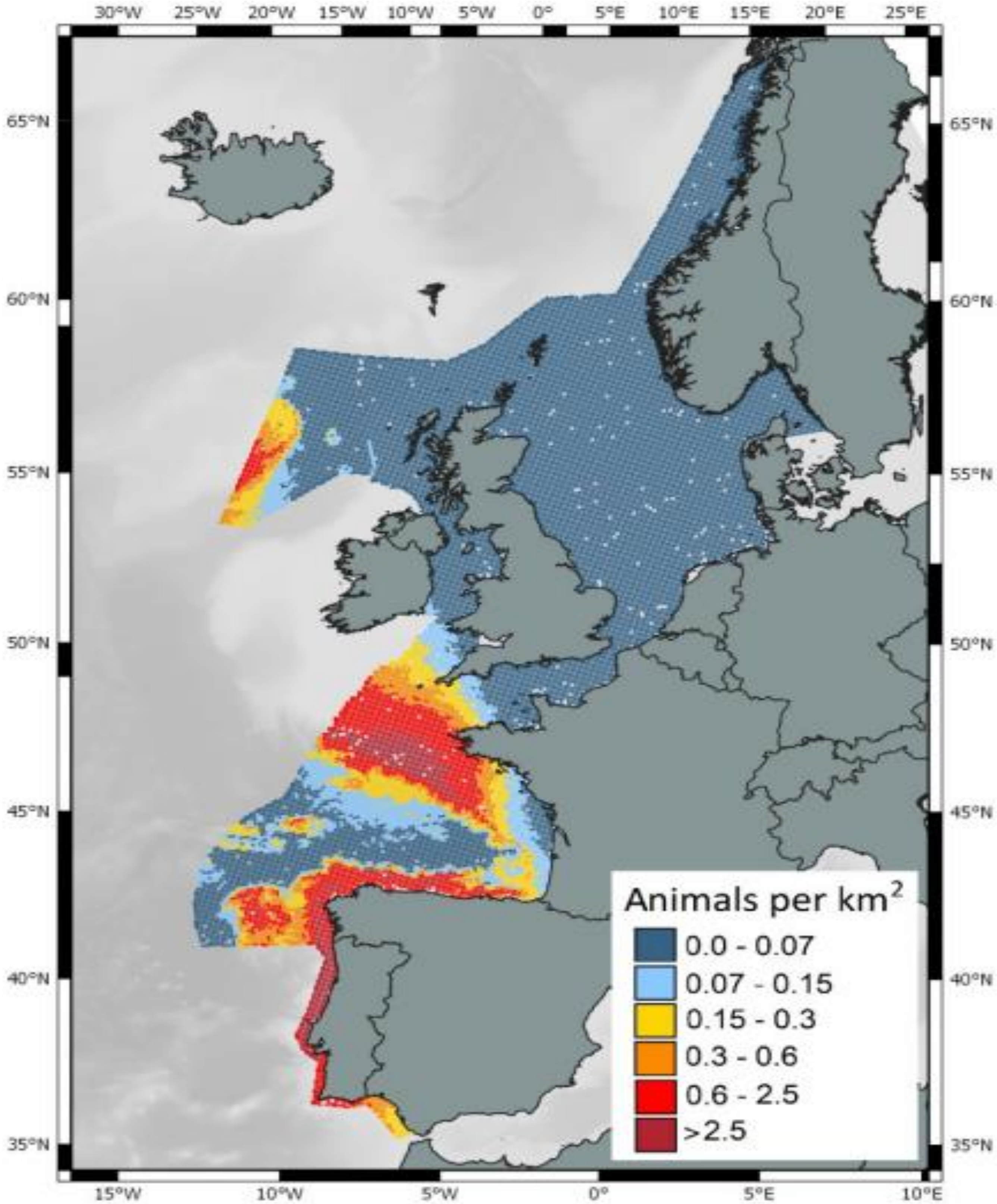


Figure 1.40: Density predictions for short-beaked common dolphin based on the observed distributions and their relationships with habitat variables (longitude and latitude, plus distance from coast, depth or aspect of seabed slope if selected). From BEIS (2022).

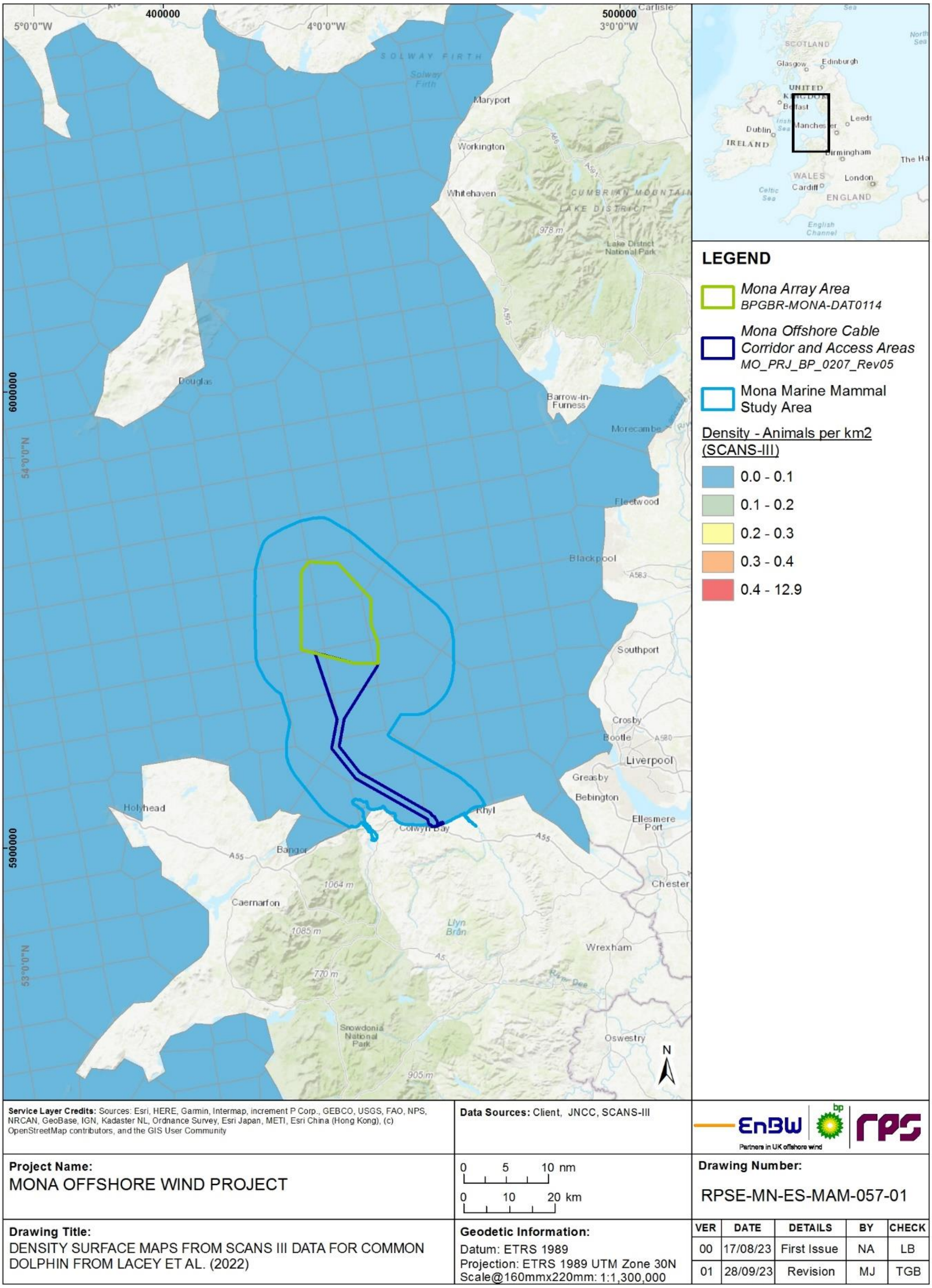


Figure 1.41: Density surface maps from SCANS-III data for short-beaked common dolphin from Lacey *et al.* (2022).

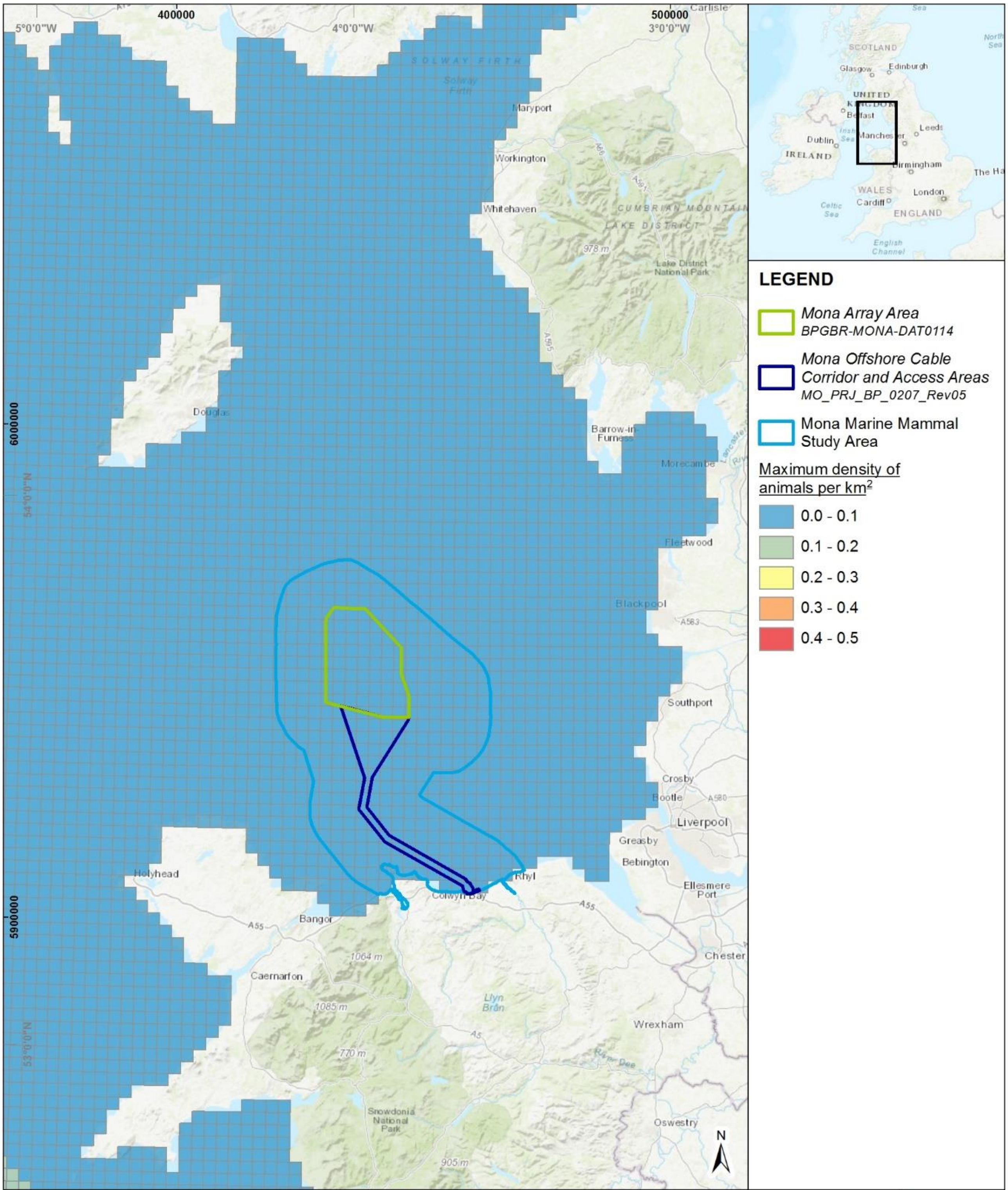
1.7.4.8 JCP III density surface modelling gave mean densities of 0.117 (SE = 0.009) animals per km^2 across the entire region of interest (UK waters and North Sea), but highest densities in the southwest of the prediction area, to the west of Ireland and the Hebrides (Paxton *et al*., 2016). In the Irish Sea, mean predicted densities were 0.5 animals per km^2 for summer 2001 to 2006 and 2017 to 2010, spring, autumn and winter 2010 (Paxton *et al.*, 2016). Areas of higher density were predicted for the Celtic Deep, to the south of the regional marine mammal 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 Phase One Data Analysis (Paxton and Thomas, 2010), which predicted density surfaces for short-beaked common dolphin from data from 1980 to 2009. The density for the Mona marine mammal study area was 0.5 animals per km^2 in 1983, 1990, 1997 and 2004. Some areas of higher density were predicted off the southwest of Pembrokeshire in 1997 and 2004 (up to 5 animals per km^2) towards the Celtic Deep. These higher density areas off west Pembrokeshire are also confirmed in acoustic and visual surveys by Gordon *et al.*, (2011) which confirmed substantial numbers of short-beaked common dolphin off the Bishops and Clerks. However, there were insufficient independent encounters to model patterns of density and distribution in this study by Gordon *et al.* (2011).

1.7.4.9 Wide scale predicted density 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 1.43). Figure 1.44 and Figure 1.45 demonstrate the predicted monthly densities for short-beaked common dolphin for the Mona marine mammal study area and demonstrates how areas of higher densities during summer months from July to September exist to the west of the Mona Offshore Wind Project. 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. However, within the Mona Array area plus buffer, short-beaked dolphin densities were highest in August and reached a maximum of 0.074 animals per km^2, thus still a low density compared to other areas of the Irish Sea (Waggitt *et al.,* 2020).

1.7.4.10 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. Largest 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 southern 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).

1.7.4.11 The average density for the Mona marine mammal study area from the annual composite maps (as recommended by NRW and authors of the Marine Mammal Atlas, see paragraph 1.5.16.4) was 0.00046 animals per km^2. The density for the Mona Array area was 0.0006 animals per km^2 (Evans and Waggitt, 2023; Figure 1.42).

1.7.4.12 Site-specific survey data from Mona digital aerial surveys did not record any short-beaked common dolphin.



Service Layer Credits: Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community	**Data Sources:** Client, NRW	
Project Name: MONA OFFSHORE WIND PROJECT	0 5 10 nm 0 10 20 km	**Drawing Number:** RPSE-MN-ES-MAM-018-02
Drawing Title: SHORT-BEAKED COMMON DOLPHIN ANNUAL COMPOSITE MODELLED DENSITIES (MEASURED AS THE MAXIMUM DENSITY PER CELL ACROSS MONTHS) (EVANS AND WAGGITT, 2023)	**Geodetic Information:** Datum: ETRS 1989 Projection: ETRS 1989 UTM Zone 30N Scale@160mmx220mm: 1:1,300,000	

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Figure 1.42: Short-beaked common dolphin annual composite modelled densities (measured as the maximum density per cell across months) for the Mona marine mammal study area (Evans and Waggitt, 2023).

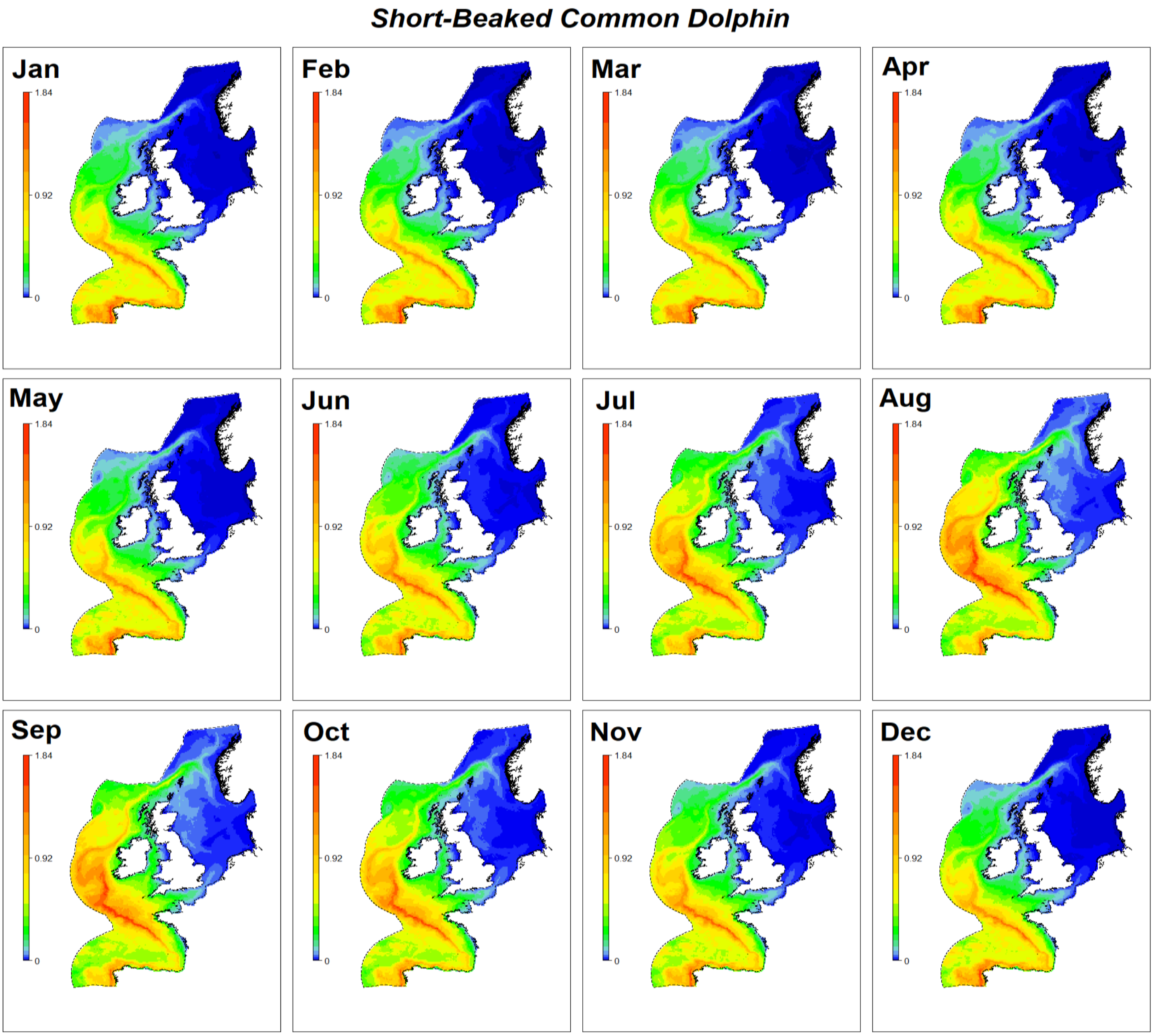


Figure 1.43: Predicted distributions for short-beaked common dolphin per month for the entire study area, from Waggitt *et al.* (2020).

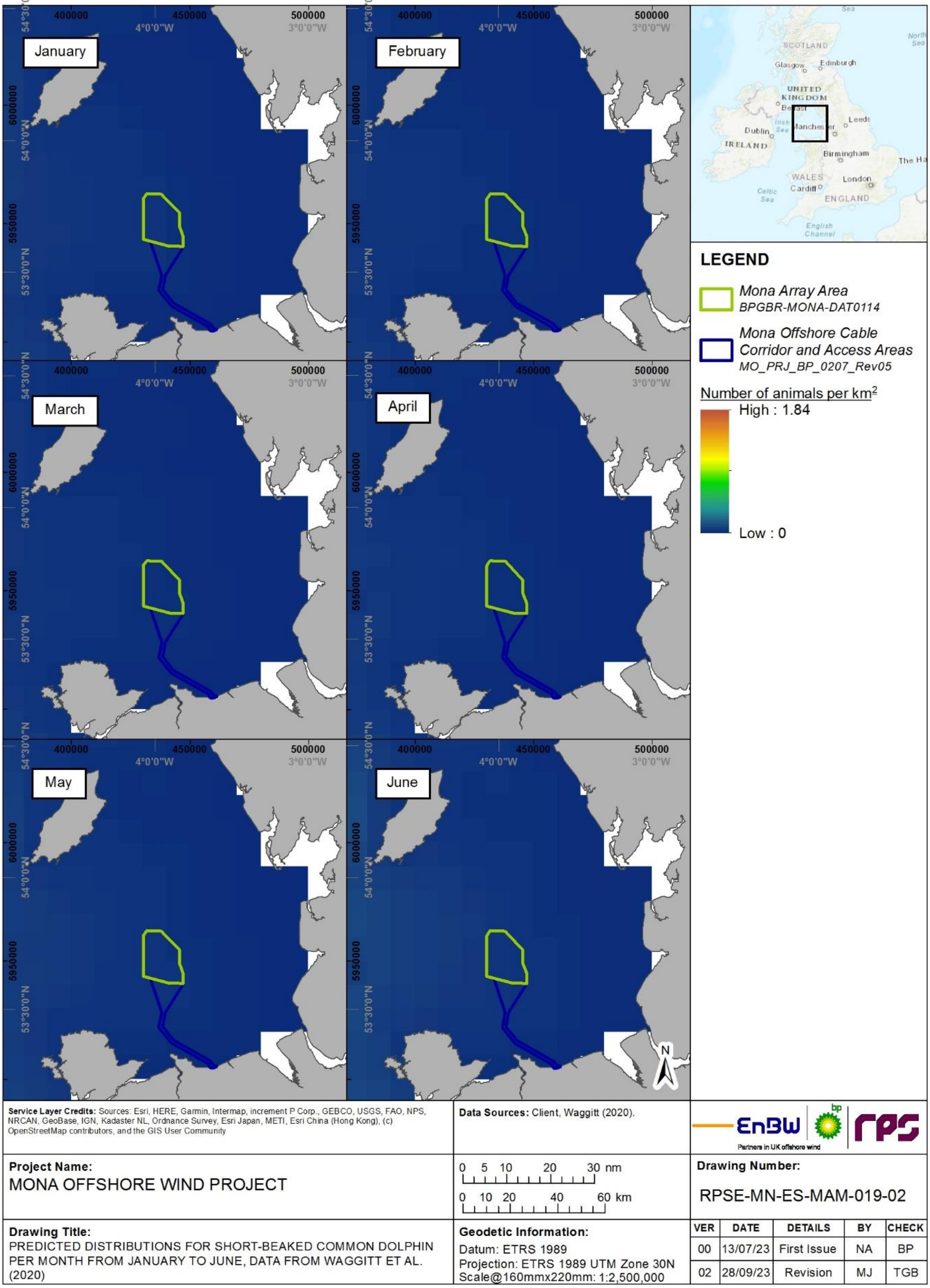
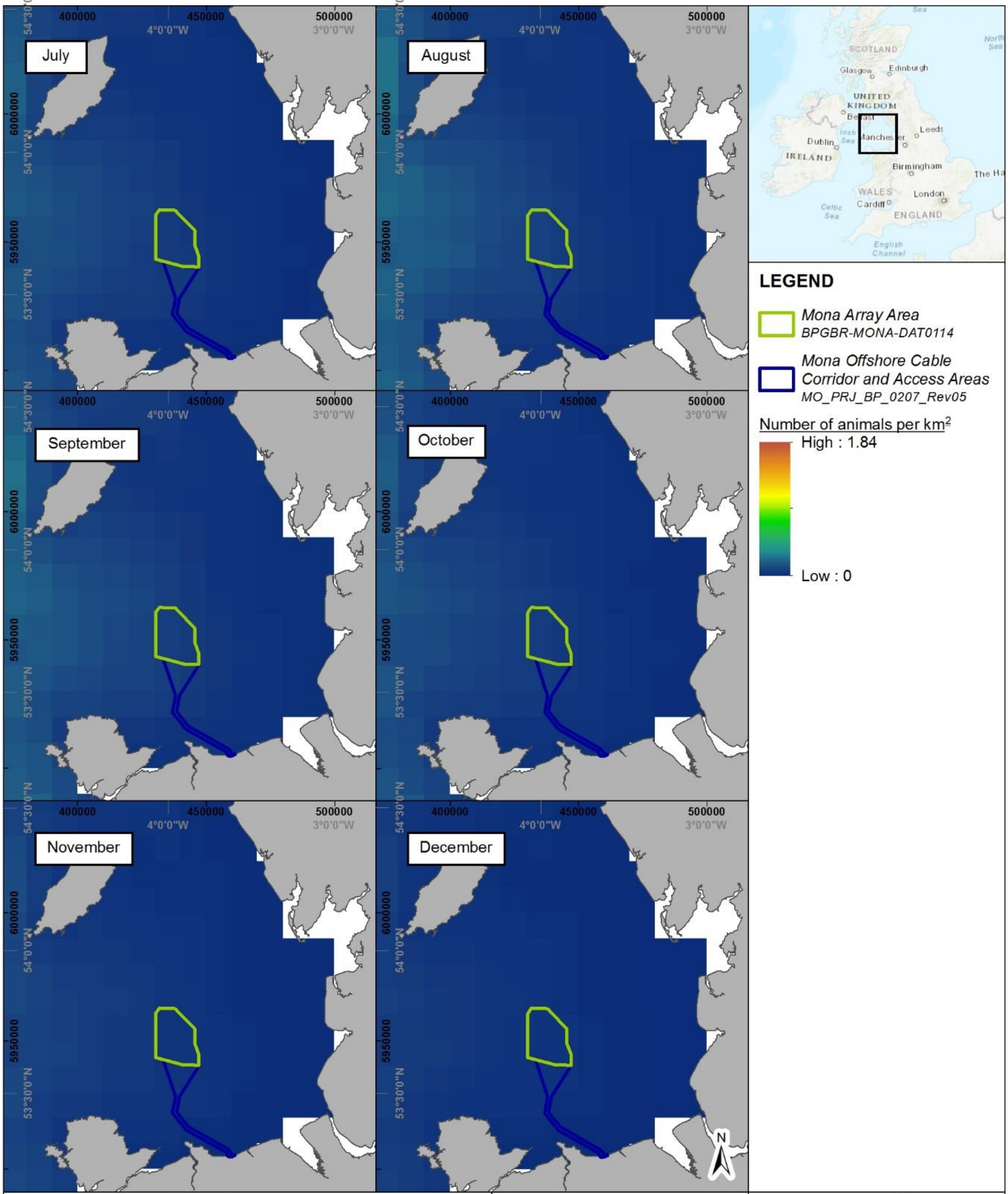


Figure 1.44: Predicted distributions for short-beaked common dolphin per month from January to June for the Mona Array Area, data from Waggitt *et al.* (2020).



Service Layer Credits: Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community	**Data Sources:** Client, Waggitt (2020).	EnBW bp Partners in UK offshore wind rps
Project Name: MONA OFFSHORE WIND PROJECT	0 5 10 20 30 nm 0 10 20 40 60 km	**Drawing Number:** RPSE-MN-ES-MAM-020-02
Drawing Title: PREDICTED DISTRIBUTIONS FOR SHORT-BEAKED COMMON DOLPHIN PER MONTH FROM JULY TO DECEMBER, DATA FROM WAGGITT ET AL. (2020)	**Geodetic Information:** Datum: ETRS 1989 Projection: ETRS 1989 UTM Zone 30N Scale@160mmx220mm: 1:2,500,000	

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Figure 1.45: Predicted distributions for short-beaked common dolphin per month from July to December for the Mona Array Area, data from Waggitt *et al.* (2020).

Summary of densities

1.7.4.13 Overall, short-beaked common dolphin are abundant in the Irish sea but areas of high density appear to be found in the southern Irish Sea, around the Celtic Deep These higher densities can therefore increase mean density for the entire Irish Sea region. However, in the east Irish Sea, where the Mona marine mammal study area is located, the densities have been consistently lower. A summary of key densities is presented in Table 1.9.

1.7.4.14 The density taken forward to assessment is from the Welsh Marine Mammal Atlas (2023) (Evans and Waggitt, 2023) for the Mona Array area, to provide a precautionary but proportionate density for the area from recent robust data modelling rather than older SCANS II data from 2006, or broad-scale block estimates from an adjacent SCANS-IV block (CS-D) (Gilles *et al.,* 2023)

Table 1.9: Comparison of main data sources densities and variance estimates for short-beaked common dolphin.

Source	Density (animals per km^2)	Estimate of variation
SCANS-IV – block CS-D (Gilles *et al.,* 2023)	0.0272	0.814 (CV)
SCANS-IV – block CS-E (Gilles *et al.,* 2023)	-	
SCANS-III - block E (Hammond *et al.,* 2021)	-	
SCANS-III - block F (Hammond *et al.,* 2021)	-	
SCANS-II - block O (Hammond *et al.,* 2013)	0.018	0.78 (CV)
Lacey *et al*. (2022) derived from SCANS-III for the Mona marine mammal study area	0.005	1.15 (CV)
Waggitt *et al*. (2020) for the Mona Array Area plus buffer	0.074	0.067 to 0.082 (95% CIs)
Welsh Marine Mammal Atlas (Evans and Waggitt, 2023) for the Mona Array Area from the annual composite maps	**0.0006**	**0.0003 to 0.011 (95% CIs)**

Abundance

1.7.4.15 Broad scale estimates of abundance for short-beaked common dolphin exist, with IAMMWG (2023; 2022) estimating abundance for the CGNS MU (Figure 1.46) as 102,656 (CV = 0.29, 95% CI = 58,932 to 178,822) short-beaked common dolphin.

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

1.7.4.17 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 western Irish Sea stratum (Stratum 5).

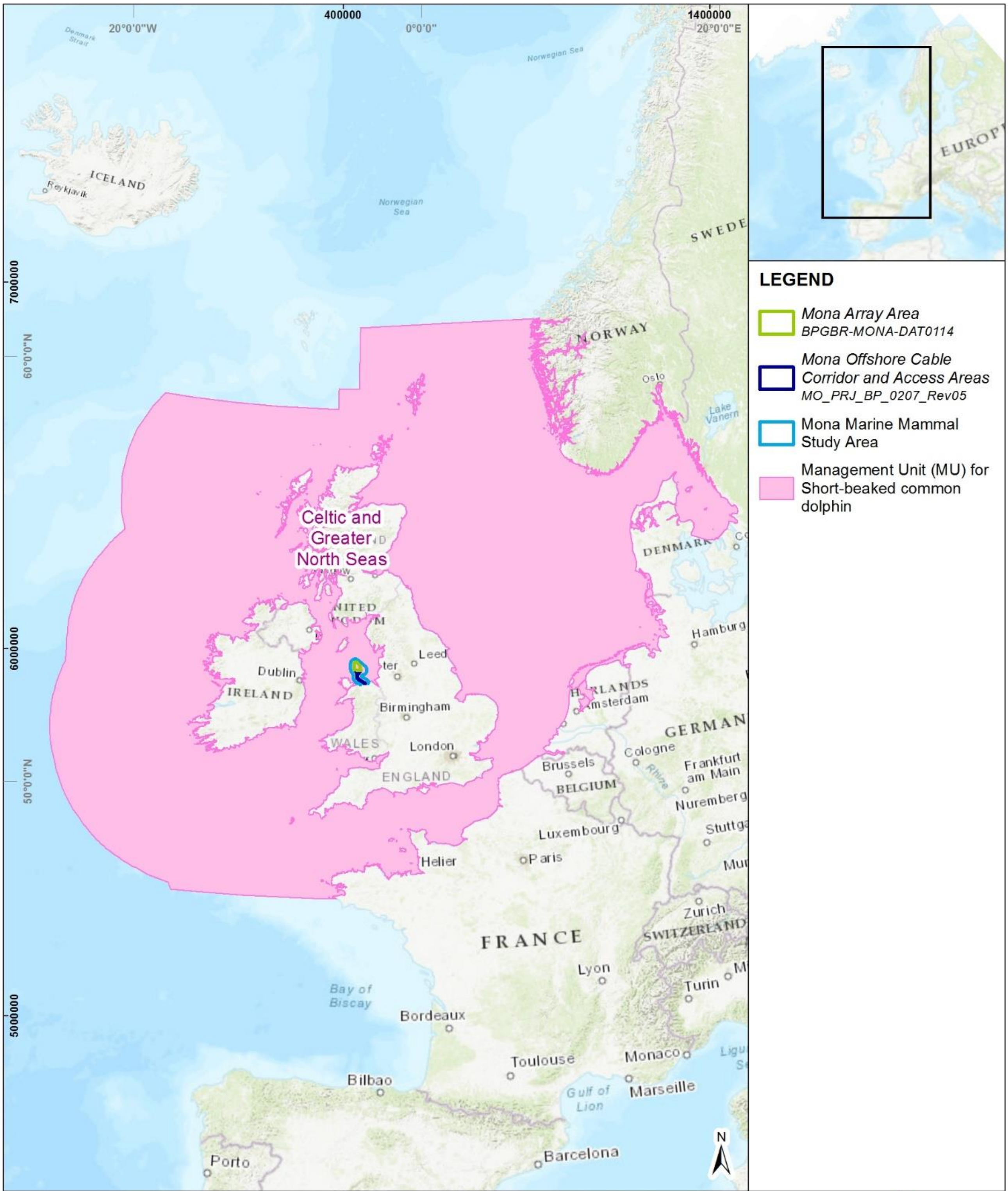
1.7.4.18 In surveys for Rhiannon Wind Farm (Celtic Array Ltd., 2014), a single sighting of eight short-beaked common dolphin was recorded during the boat-based visual surveys.

Insufficient sightings of short-beaked common dolphins were made during the boat-based surveys to generate a site-specific abundance estimate.

1.7.4.19 Data from the MWDW confirms short-beaked common dolphin have been regularly observed in Manx waters (Howe, 2018a) with data on sightings and observation counts, but abundance and density estimates are not given. Sighting data requested from MWDW is presented in Figure 1.14.

Seasonality

1.7.4.20 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 northwest 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 western 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. 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.



Service Layer Credits: Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community	**Data Sources:** Client, JNCC	
Project Name: MONA OFFSHORE WIND PROJECT	0 50 100 200 nm 0 100 200 400 km	**Drawing Number:** RPSE-MN-ES-MAM-021-02
Drawing Title: CELTIC AND GREATER NORTH SEAS MU FOR SHORT-BEAKED COMMON DOLPHIN WITH THE MONA MARINE MAMMAL STUDY	**Geodetic Information:** Datum: ETRS 1989 Projection: ETRS 1989 UTM Zone 30N Scale@160mmx220mm: 1:17,500,000	

VER	DATE	DETAILS	BY	CHECK
00	13/07/23	First Issue	NA	BP
02	28/09/23	Revision	MJ	TGB

Figure 1.46: Celtic and Greater North Seas MU for short-beaked common dolphin with the Mona marine mammal study area.

1.7.5 Risso's dolphin

Ecology

1.7.5.1 Risso's dolphin are oceanic dolphins 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 100m (Evans *et al.*, 2003). The majority of Risso's dolphin sightings in UK waters have been reported around the Hebrides, the Celtic Sea, western English Channel and the Irish Sea. The species is uncommon but regularly sighted in the southern Irish Sea, particularly off the northwest and southwest coast of Wales and around the Isle of Man (Evans *et al.*, 2003).

1.7.5.2 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 m in length, and the average lifespan is between 20 to 30 years. Sexual maturity occurs between 8 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.

1.7.5.3 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 western Scotland (Hodgins *et al.,* 2014). particularly adult males, show very strong associations, whereas others have pair only or no associations, particularly juveniles (Hartman *et al.,* 2008).

1.7.5.4 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. 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* (Clarke and Pascoe, 1985; Santos *et al.*, 1994). There does appear to be regional variations in dietary preferences (Evans and Bjørge, 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

1.7.5.5 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. The species is uncommon but regularly sighted in the southern Irish Sea, particularly off the northwest and southwest 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 1000m) waters.

1.7.5.6 Risso's dolphin appear to have a localised distribution in the Irish Sea, in a wide band running from southwest to northeast which encompasses west Pembrokeshire, the western end of the Llŷn Peninsula and Anglesey, the southeast coast of Ireland, and around the north of the Isle of Man (Baines and Evans, 2012) (Figure 1.47). 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).

1.7.5.7 Sighting data from MWDW shows Risso's are widespread in Manx waters around the Isle of Man, with high sightings to the southwest of the Island, with some sightings extending out towards the Mona Array Area (Figure 1.14).

1.7.5.8 Studies conducted by SWF, Whale and Dolphin Conservation (WDC) 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.*, 2015). 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).

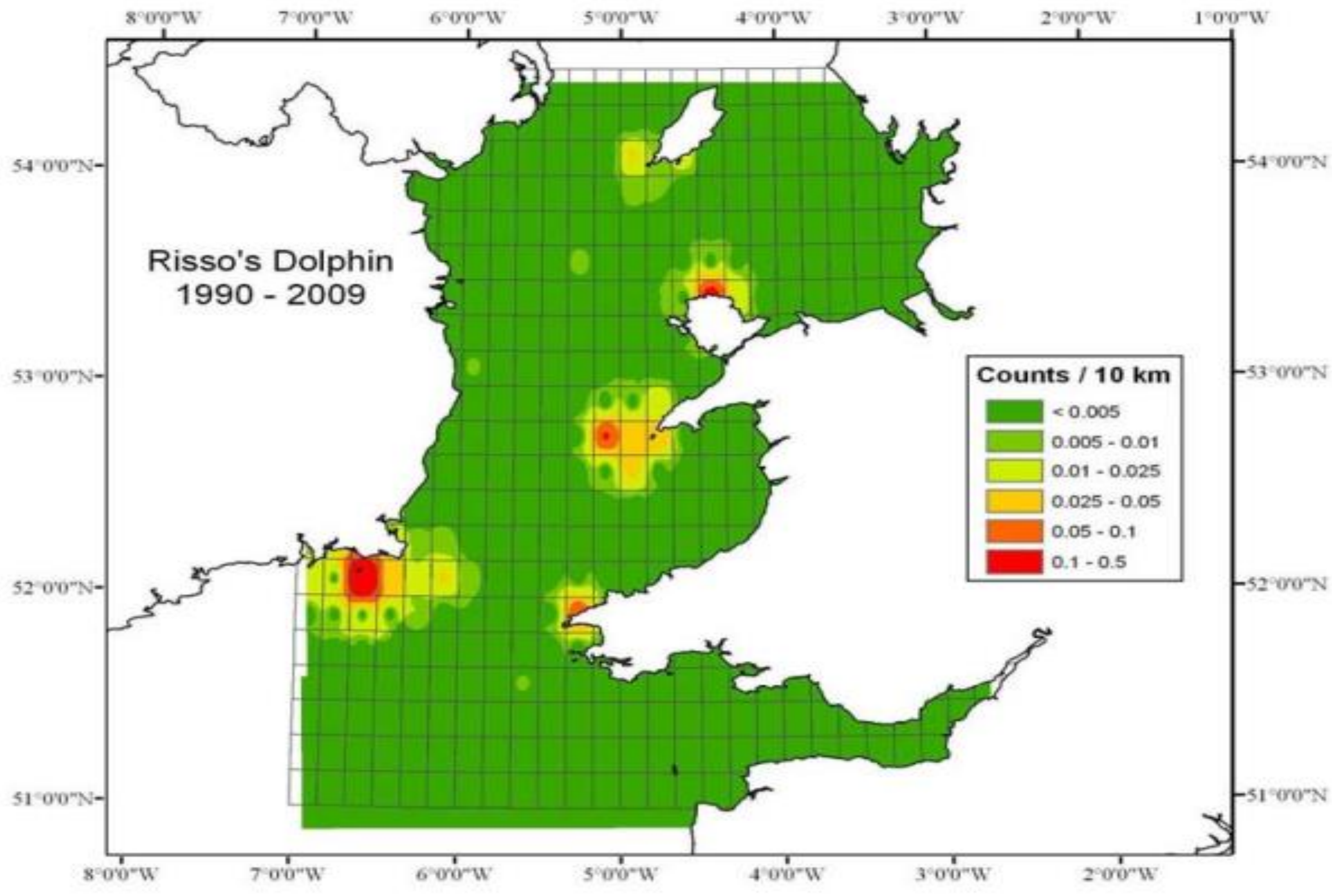


Figure 1.47: IDW interpolated map of Risso's dolphin distribution, from Baines and Evans (2012).

Density/abundance

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

Density

1.7.5.10 The Mona Offshore Wind Project lies within block F for the SCANS-III surveys in 2016 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). Recent SCANS-IV data did not report any Risso's dolphin in block CS-E but reported a density of 0.0022 animals per km^2 (CV = 1.012) in adjacent block CS-D (Gilles *et al.*, 2023). 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, but 0.09 animals per km^2 in 2001 to 2006. Predicted mean winter and autumn densities in 2010 were low across the Irish Sea (0.01 animals per km^2), whilst spring densities reached 0.03 animals per km^2. For the Mona marine mammal study area densities were 0.01 animals per km^2 in summers from 2001 to 2006 combined, summers 2007 to 2010 combined and winter 2010[7] and therefore lower than the rest of the Irish Sea. In the previous JCP Phase I study (Paxton and Thomas, 2010) densities for the marine mammal study area was 0.01 animals per km^2 in 1983 and 1990, but in 1997 and 2004 densities ranged between 0.01 and 0.04 animals per km^2, with the areas of higher densities in a band through the Irish Sea passing the west of the Isle of Man[8].

1.7.5.11 During ObSERVE surveys (Rogan *et al.*, 2018), Risso's dolphin were seen in all seasons in both years in a variety of habitats (Figure 1.48), 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% confidence limits. Risso's dolphin were only observed in Stratum 5 (Western Irish Sea) during Season 1 (Summer 2015). For Season 1 design-based estimate of density was 0.0032 animals per km^2.

1.7.5.12 In recent years, predicted distribution maps of Risso's dolphin at monthly scales by 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 1.49). Figure 1.50 and Figure 1.51 demonstrates the predicted monthly densities for Risso's dolphin for the extent of the Mona marine mammal study area and demonstrates areas of low-density overlap. There are areas of higher density around the southwest of the Isle of Man from July to November, and towards Anglesey between July and October but these are further from the Mona marine mammal study area. Highest densities in the east Irish Sea were predicted in August with 0.0095 animals per km^2 in high density areas around the Isle of Man. The maximum density estimate within the Mona marine mammal study area is lower, at 0.0013 animals per km^2 (August) and the density estimate for the Mona Array area was 0.0012 animals per km^2. This matches previous studies (Stevens, 2014; de Boer *et al.*, 2002, 2013)

[7] 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.

[8] JCP Phase I densities are approximations read off the density surface prediction maps in the JCP report (Paxton and Thomas, 2010).

which found areas of high sightings densities and predicted habitat suitability around the coast of the Isle of Man, Anglesey, Bardsey Island and west Pembrokeshire.

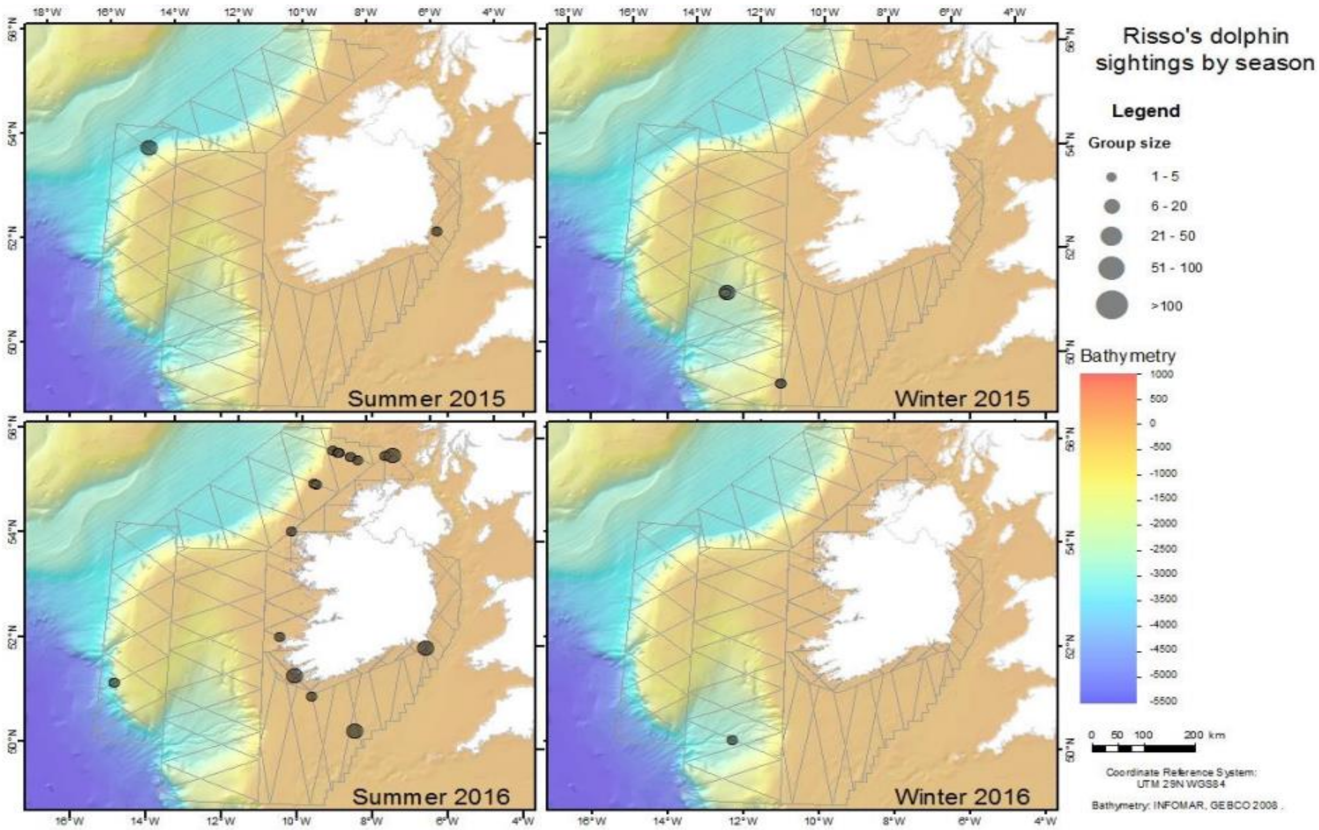


Figure 1.48: Sightings of Risso's dolphin in each survey period (bottom). Grey lines indicate the survey tracklines along which sightings were made. Circles are proportional to the number of dolphins in each sighting. From Rogan *et al.*, (2018).

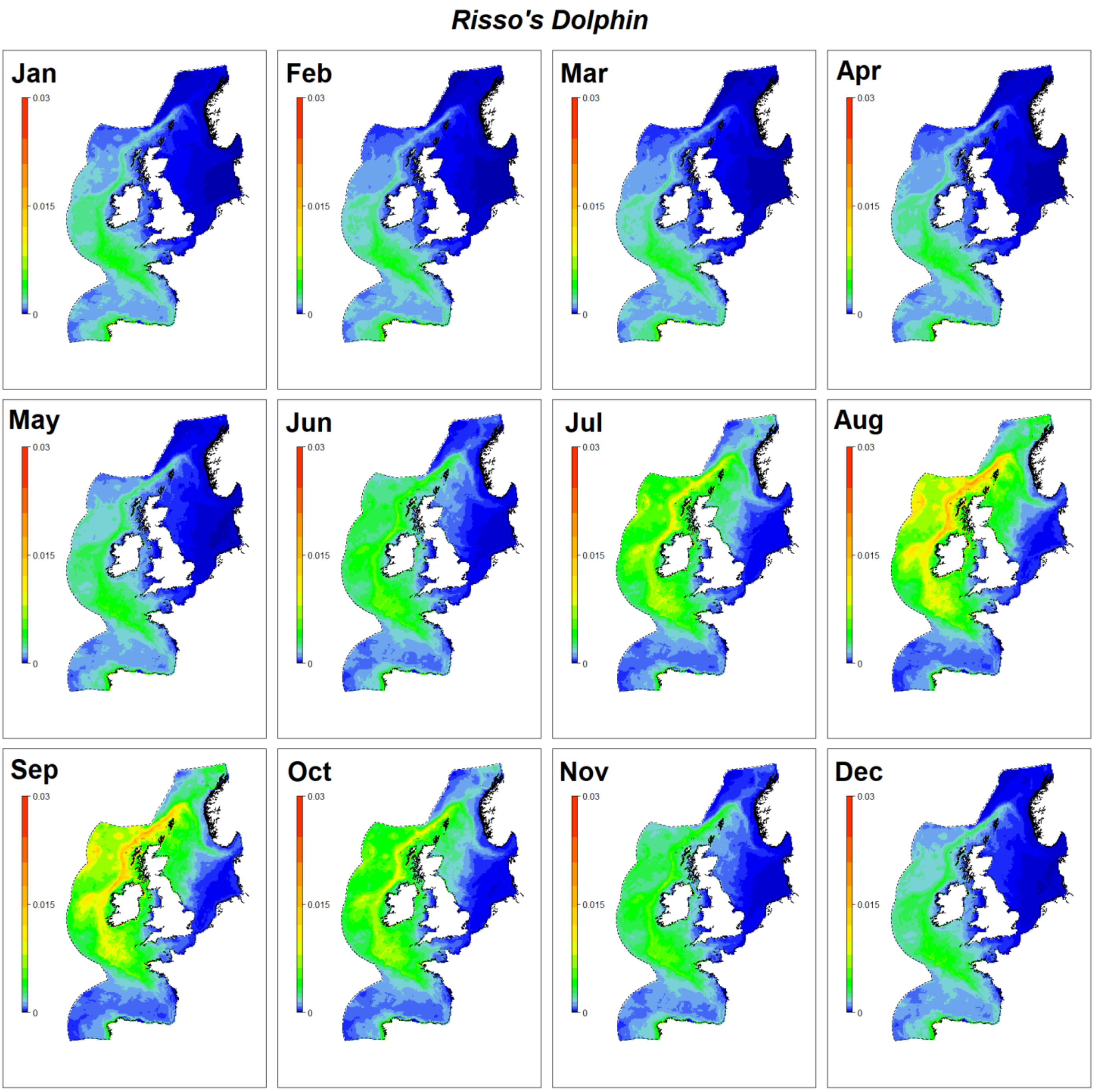
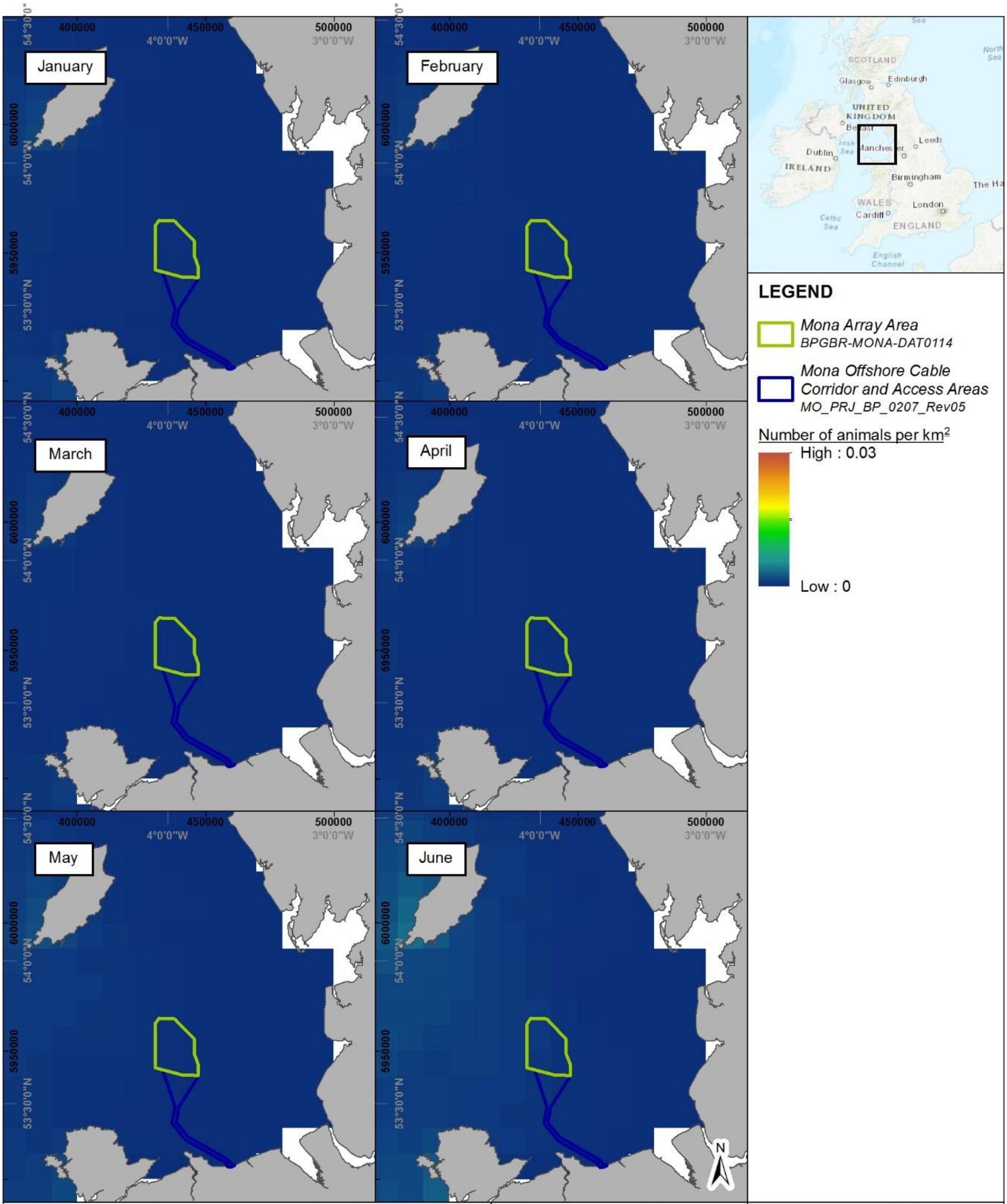


Figure 1.49: Predicted distributions for Risso's dolphin per month for the entire study area, from Waggitt *et al.* (2020).



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Data Sources: Client, Waggitt (2020).

Project Name:
MONA OFFSHORE WIND PROJECT

0 5 10 20 30 nm
0 10 20 40 60 km

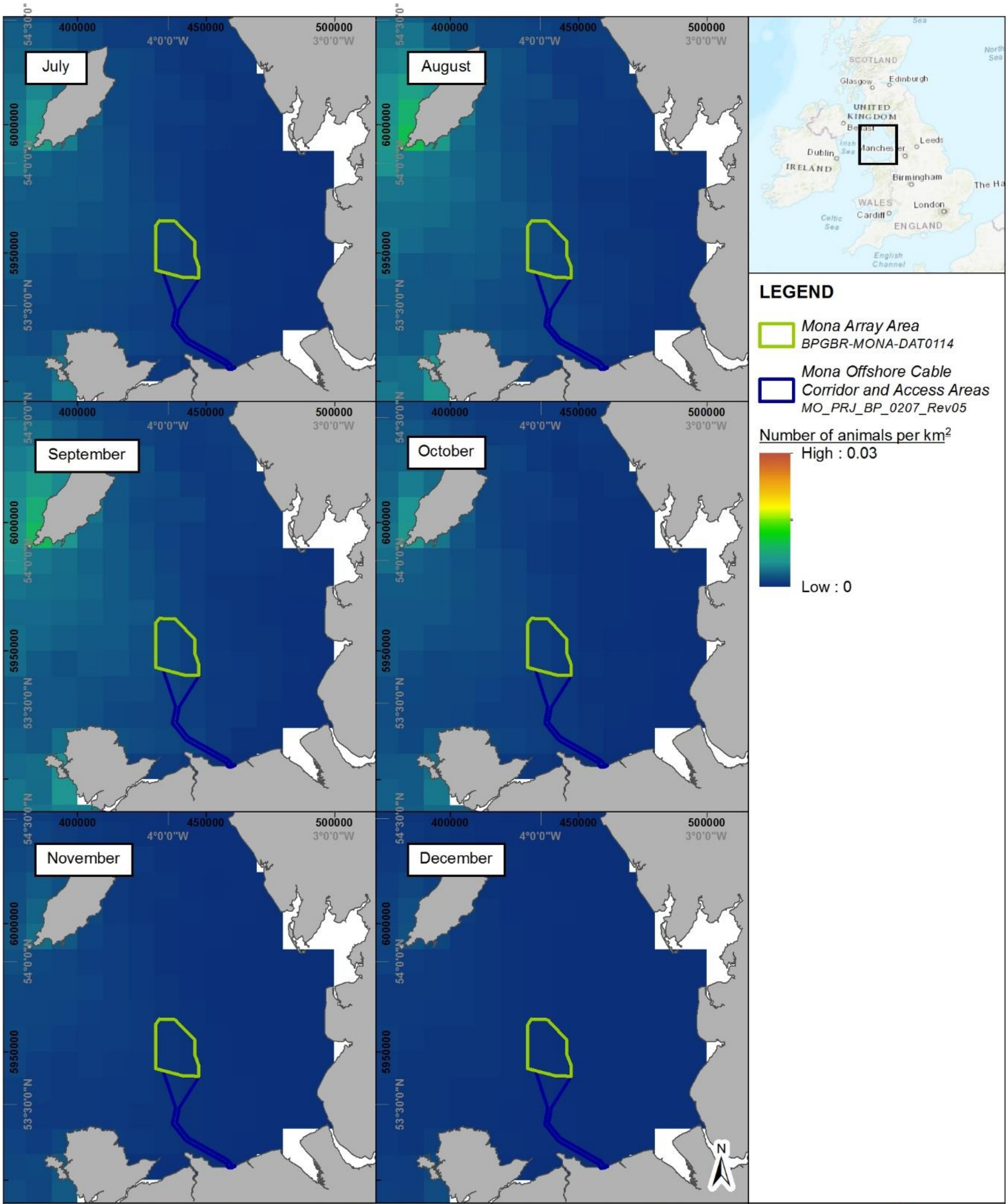
Drawing Number:
RPSE-MN-ES-MAM-022-02

Drawing Title:
PREDICTED DISTRIBUTIONS FOR RISSO'S DOLPHIN PER MONTH FROM JANUARY TO JUNE (WAGGITT ET AL., 2020)

Geodetic Information:
Datum: ETRS 1989
Projection: ETRS 1989 UTM Zone 30N
Scale@160mmx220mm: 1:2,500,000

VER	DATE	DETAILS	BY	CHECK
00	13/07/23	First Issue	NA	BP
02	28/09/23	Revision	MJ	TGB

Figure 1.50: Predicted distributions for Risso's dolphin per month from January to June for the Mona Array Area, data from Waggitt *et al.* (2020).



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Data Sources: Client, Waggitt (2020).

Project Name:
MONA OFFSHORE WIND PROJECT

Scale bar: 0 5 10 20 30 nm; 0 10 20 40 60 km

Drawing Number:
RPSE-MN-ES-MAM-023-02

Drawing Title:
PREDICTED DISTRIBUTIONS FOR RISSO'S DOLPHIN PER MONTH FROM JULY TO DECEMBER (WAGGITT ET AL., 2020)

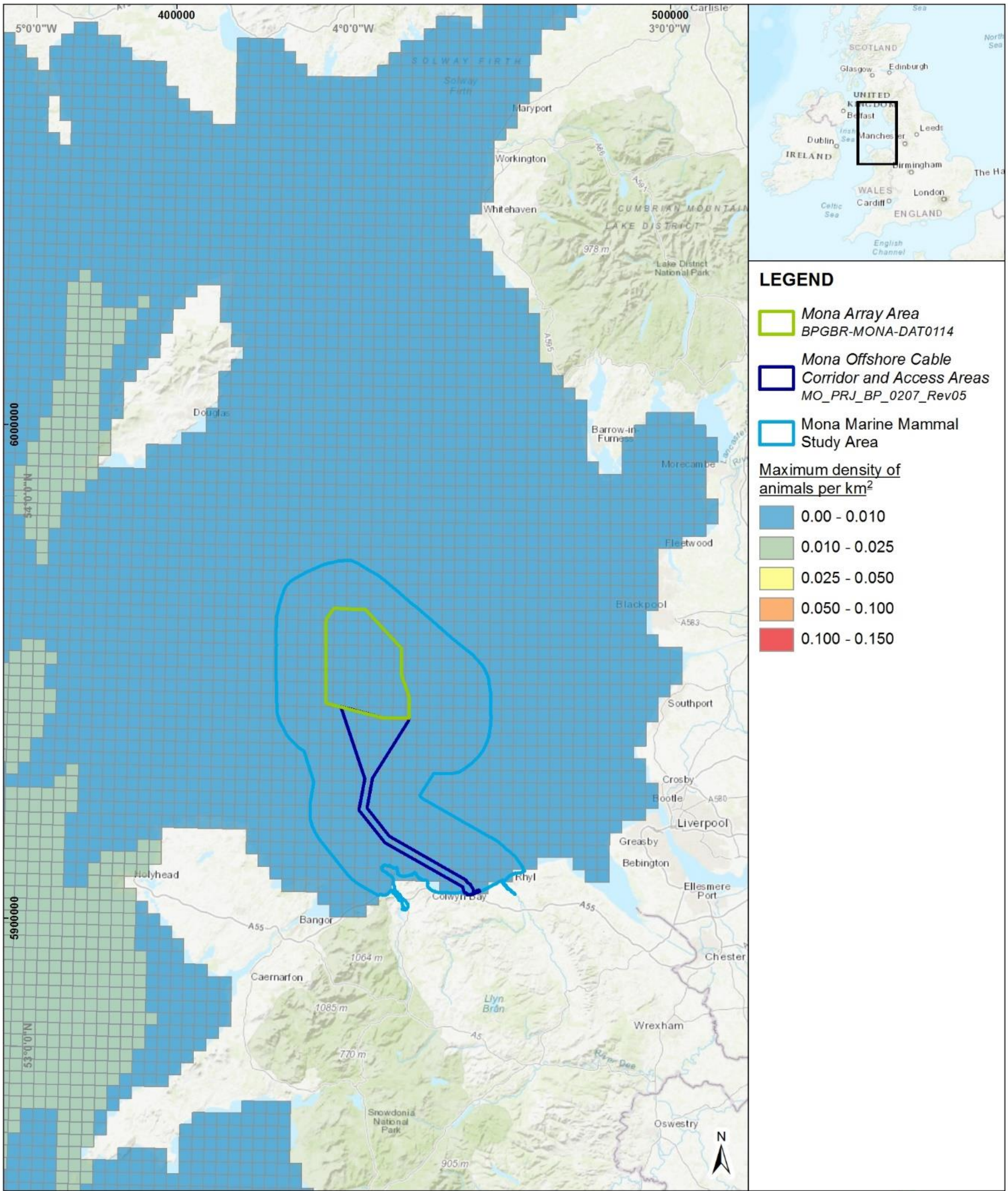
Geodetic Information:
Datum: ETRS 1989
Projection: ETRS 1989 UTM Zone 30N
Scale@160mmx220mm: 1:2,500,000

VER	DATE	DETAILS	BY	CHECK
00	13/07/23	First Issue	NA	BP
02	28/09/23	Revision	MJ	TGB

Figure 1.51: Predicted distributions for Risso's dolphin per month from July to December for the Mona Array Area, data from Waggitt *et al.* (2020).

1.7.5.13 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 Co. Wexford coast 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, and around the Isle of Man. Modelled distributions suggested that the major part of the population occurs in the southern Irish Sea. Sightings occured 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 Waggit, 2023).

1.7.5.14 The average density for the Mona marine mammal study area from the annual composite maps (as recommended by NRW and authors of the Marine Mammal Atlas, see paragraph 1.5.16.4) was 0.001 animals per km^2, with the density for the Mona Array area as 0.00098 animals per km^2 (Figure 1.52).



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Data Sources: Client, NRW

Project Name: MONA OFFSHORE WIND PROJECT

Scale bar: 0 5 10 nm; 0 10 20 km

Drawing Number: RPSE-MN-ES-MAM-024-02

Drawing Title: RISSO'S DOLPHIN ANNUAL COMPOSITE MODELLED DENSITIES (MEASURED AS THE MAXIMUM DENSITY PER CELL ACROSS MONTHS) (EVANS AND WAGGITT, 2023)

Geodetic Information:
Datum: ETRS 1989
Projection: ETRS 1989 UTM Zone 30N
Scale@160mmx220mm: 1:1,300,000

VER	DATE	DETAILS	BY	CHECK
00	13/07/23	First Issue	NA	BP
02	28/09/23	Revision	MJ	TGB

Figure 1.52: Risso's dolphin annual composite modelled densities (measured as the maximum density per cell across months) for the Mona marine mammal study area (Evans and Waggitt, 2023).

1.7.5.15 More locally, MWDW confirms this presence of Risso's dolphin in the waters around the Isle of Man (Figure 1.14), 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, 2018a; Stevens, 2014). Sightings are abundant around the east and southwest of the Island (Figure 1.14).

1.7.5.16 Whilst Risso's dolphin were observed in aerial surveys for the Mona Offshore Wind Project (November 2020), sightings were not high enough to calculate model-based densities. Maximum design-based relative densities of 0.01 animals per km^2 were given for the Mona Aerial Survey Area.

Summary of densities

1.7.5.17 Risso's dolphin are common in the Irish sea, particularly in the south of the regional marine mammal study area, but areas of high density appear to be also located towards the Isle of Man and northwest and southwest coast of Wales.

1.7.5.18 The density taken forward to assessment is the SCANS-III (Hammond *et al*., 2021) estimate for adjacent block E, as agreed with the EWG. This density is the most precautionary estimate compared to the Welsh Marine Mammal Atlas estimate (Evans and Waggitt, 2023), Waggitt *et al.* (2020) and SCANS-IV block CS-D (Gilles *et al.*, 2023) density estimates. Risso's dolphin were not included in maps by Lacey *et al* (2022).

Table 1.10: Comparison of main data sources densities and variance estimates for Risso's dolphin.

Source	Density (animals per km^2)	Estimate of variation
SCANS-IV – block CS-D (Gilles *et al.*, 2023)	0.0022	1.012 (CV)
SCANS-IV – block CS-E (Gilles *et al.*, 2023)	-	
SCANS-III – block E (Hammond *et al.*, 2021)	**0.0313**	**0.686 (CV)**
SCANS-III – block F (Hammond *et al.*, 2021)	-	-
Waggitt *et al.* (2020) for the Mona marine mammal study area	0.0013	0.0009 to 0.0016 (95% CI)
Welsh Marine Mammal Atlas (Evans and Waggitt, 2023) for the Mona marine mammal study area	0.001	0.0005 to 0.002 (95% CI)

Abundance

1.7.5.19 IAMMWG (2023; 2022) estimated abundance for the CGNS MU (12,262 (CV = 0.46, 95% CI = 5,227 to 28,764) Risso's dolphin (Figure 1.53). The Mona Offshore Wind Project lies within block F for the SCANS-III surveys in 2016 but no Risso's dolphin were sighted within the block. They were recorded in the adjacent block E and abundance estimated at 1,090 animals (95% CI = 0 to 2,843) and 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 Mona Offshore Wind Project lies) but 75 animals (95% = 2 to 259) were estimated in the adjacent block CS-D.

1.7.5.20 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% CL: 0 to 10), spring was 70 animals (95% CL: 0 to 280), summer was 30 animals (95% CL: 30 to 160) and autumn had zero animals (95% CL: 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% Cl = 7 to 188).

1.7.5.21 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, 2018a; Stevens, 2014). MWDW sightings from 2006 to 2021 are presented in Figure 1.14, and show in particular the south edge of the Island is important for Risso's dolphin.

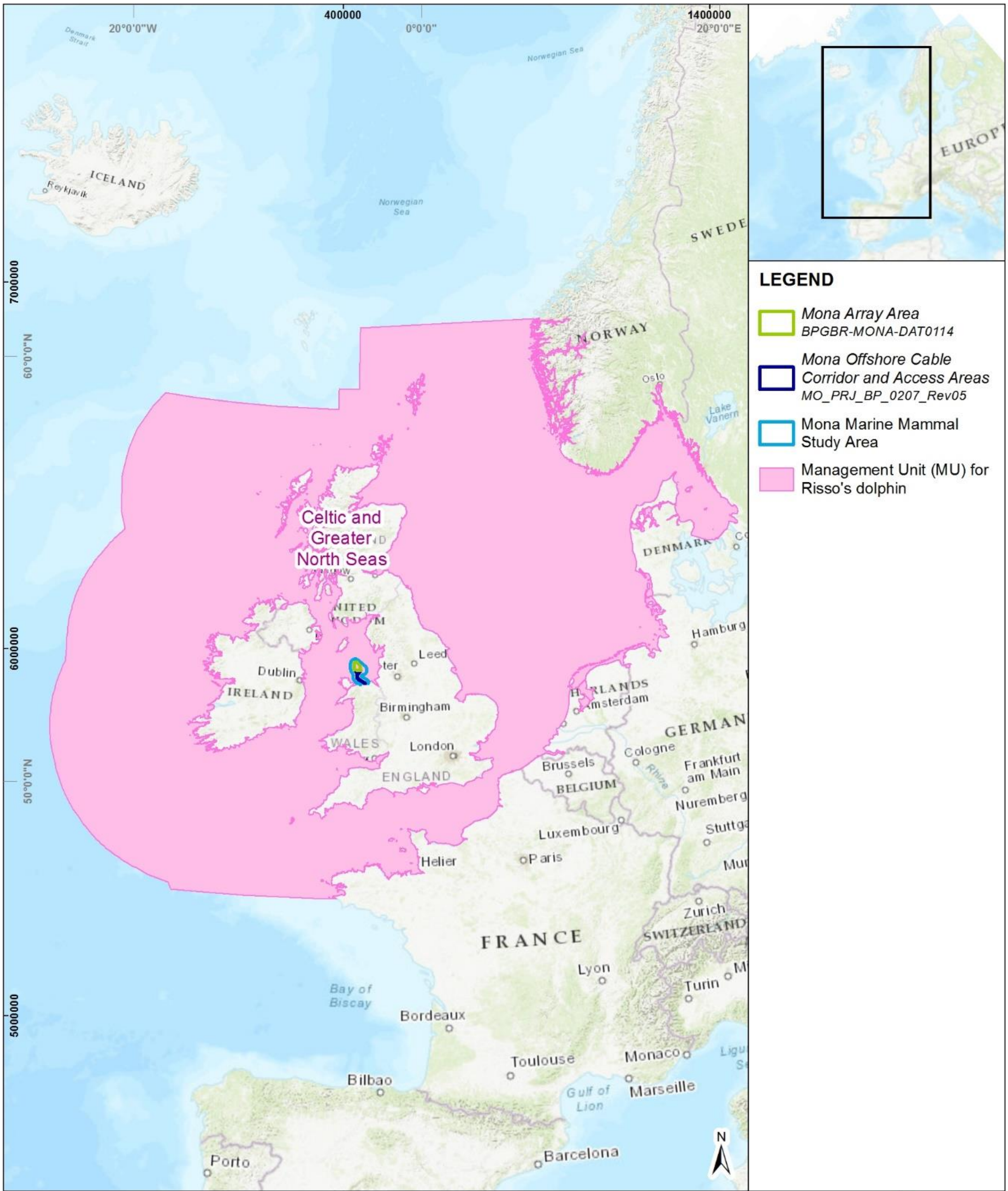
1.7.5.22 In surveys for Rhiannon Wind Farm (Celtic Array Ltd., 2014), three observations were recorded during the boat-based visual surveys, comprising 18 animals. All sightings were between June and September with group size ranging between two and ten animals. Insufficient sightings of Risso's dolphins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

1.7.5.23 Aerial surveys for the Mona Offshore Wind Project demonstrated two Risso's dolphin were recorded in November 2020, with relative design-based abundance estimate of 14 Risso's dolphin for the Mona Aerial Survey Area.

Seasonality

1.7.5.24 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.

1.7.5.25 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 Island around the Calf of Man or to the south west of the Calf of Man. Data obtained from MWDW (2022) also shows higher sightings of Risso's dolphin in summer months, with peaks in June and July. As described in paragraph 1.7.2.45 MWDW confirmed that sightings data seems to reflect a true seasonality of these cetaceans in Manx waters, with public records of cetaceans received year round indicating that lower winter survey effort has not created a false seasonality" (Bryony Manley (Manx Whale and Dolphin Watch), personal communication, June 2023).



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Project Name: MONA OFFSHORE WIND PROJECT	0 50 100 200 nm; 0 100 200 400 km	**Drawing Number:** RPSE-MN-ES-MAM-025-02
Drawing Title: CELTIC AND GREATER NORTH SEAS MU FOR RISSO'S DOLPHIN WITH THE MONA MARINE MAMMAL STUDY AREA	**Geodetic Information:** Datum: ETRS 1989; Projection: ETRS 1989 UTM Zone 30N; Scale@160mmx220mm: 1:17,500,000	

VER	DATE	DETAILS	BY	CHECK
00	13/07/23	First Issue	NA	BP
02	28/09/23	Revision	MJ	TGB

Figure 1.53: Celtic and Greater North Seas MU for Risso's dolphin with the Mona marine mammal study area.

1.7.6 Minke whale

Ecology

1.7.6.1 Minke whale is 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 whales typically live up to 60 years, with male minke whales reaching sexual 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.

1.7.6.2 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 *et al.*, 2007). Mostly inhabiting continental shelf waters, this species occurs in depths of less than 200m 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 whale 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 the Irish Sea, two known herring stocks exist and minke whales seem to mirror these stocks in Manx Waters. The Manx herring stock are known to spawn on the east coast of the island, in September to October (Bowers, 1969), hence the presence of Minke whale on the east coast during these months whilst during the summer months, the Manx stock and Mourne stock are found together off the west coast of the island (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 northeast 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

1.7.6.3 Minke whale inhabit 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, they are widely distributed throughout the region, including coastal and offshore shelf waters, and deeper waters on and beyond the shelf slope.

1.7.6.4 In the 2012 Atlas of Marine Mammals of Wales, highest densities 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). In the Irish Sea, they mainly occur in the south and west of the area (Hammond *et al.*, 2005), 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 Environmental Statement, with presence between June and November (Howe, 2018a). Howe (2018a) also 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 mentioned, two herring stocks in the Irish Sea (the Mourne Stock and the Manx Stock) may drive this pattern, with the Manx herring stock spawning east coast of the island in September to October (Bowers, 1969), and Mourne stock are found together off the west coast of the island (Bowers, 1980). 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 northwest of the Mona Array Area (Figure 1.14) and up towards the coast of Northern Ireland.

Density/abundance

Density

1.7.6.5 The Mona Offshore Wind Project lies within block F for the SCANS-III surveys in 2016, but no minke whale were recorded in this block. However, the regional marine mammal study area also spans block E, and estimated densities were 0.0173 animals per km^2 (CV = 0.618). 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 – 0.036 animals per km^2) and moderate densities across the entire Irish Sea (0.012 – 0.02 animals per km^2). 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 1.54).

1.7.6.6 Recently modelled density surfaces using the SCANS-III data (see paragraph 1.5.6.5) (Lacey *et al.*, 2022) gave mean densities of 0.018 animals per km^2 and a maximum of 0.024 animals per km^2 for the Mona marine mammal study area (Figure 1.55), with density maps showing higher areas of density in the east Irish Sea[9]. Recent SCANS-IV data reported densities of 0.0088 animals per km^2 (CV = 1.145) in block CS-E 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.

[9] 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.

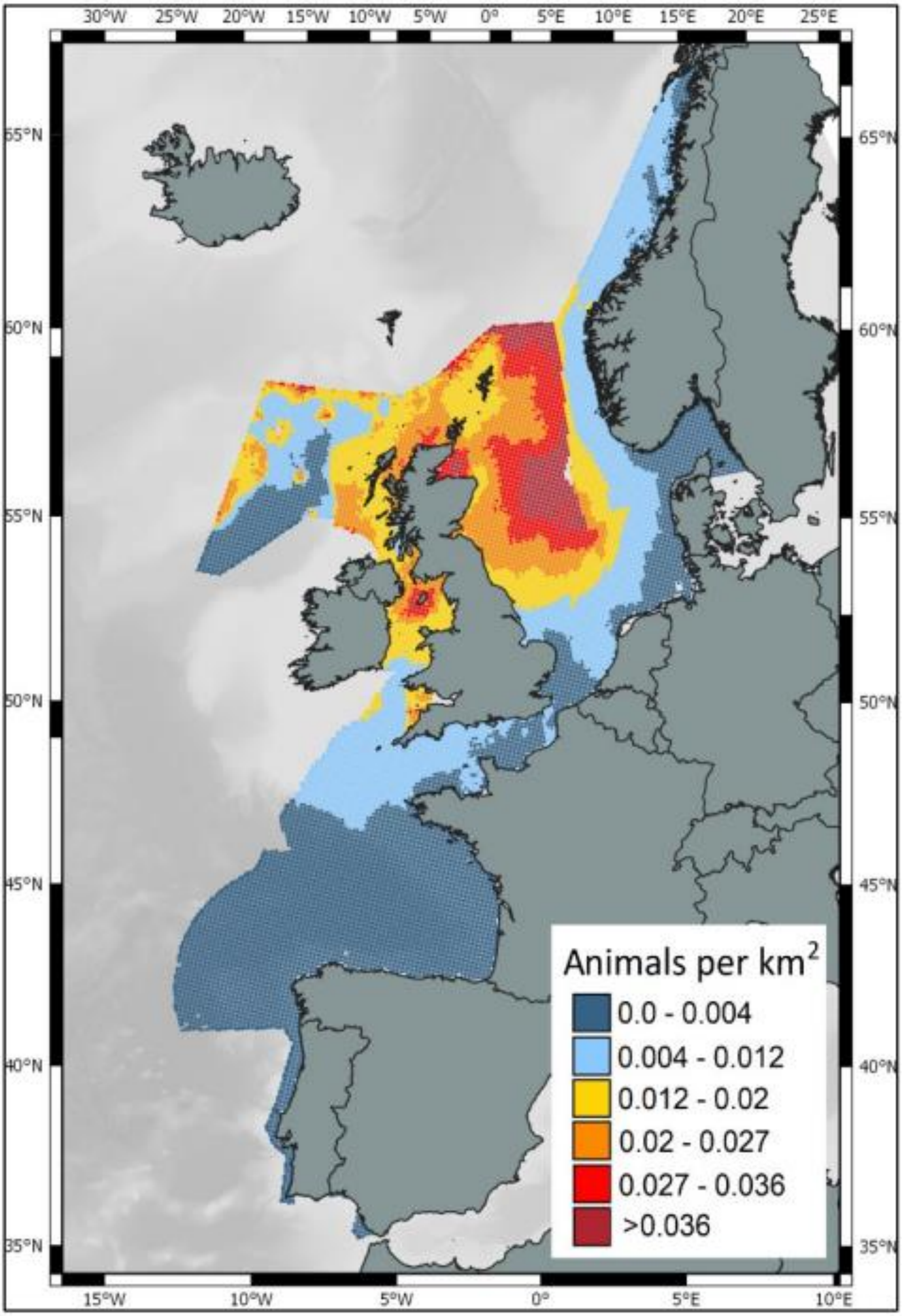


Figure 1.54: Predicted density surface for minke whale in 2016, using SCANS-III data, from Offshore Energy SEA 4: Appendix 1 Environmental Baseline (BEIS, 2022.).

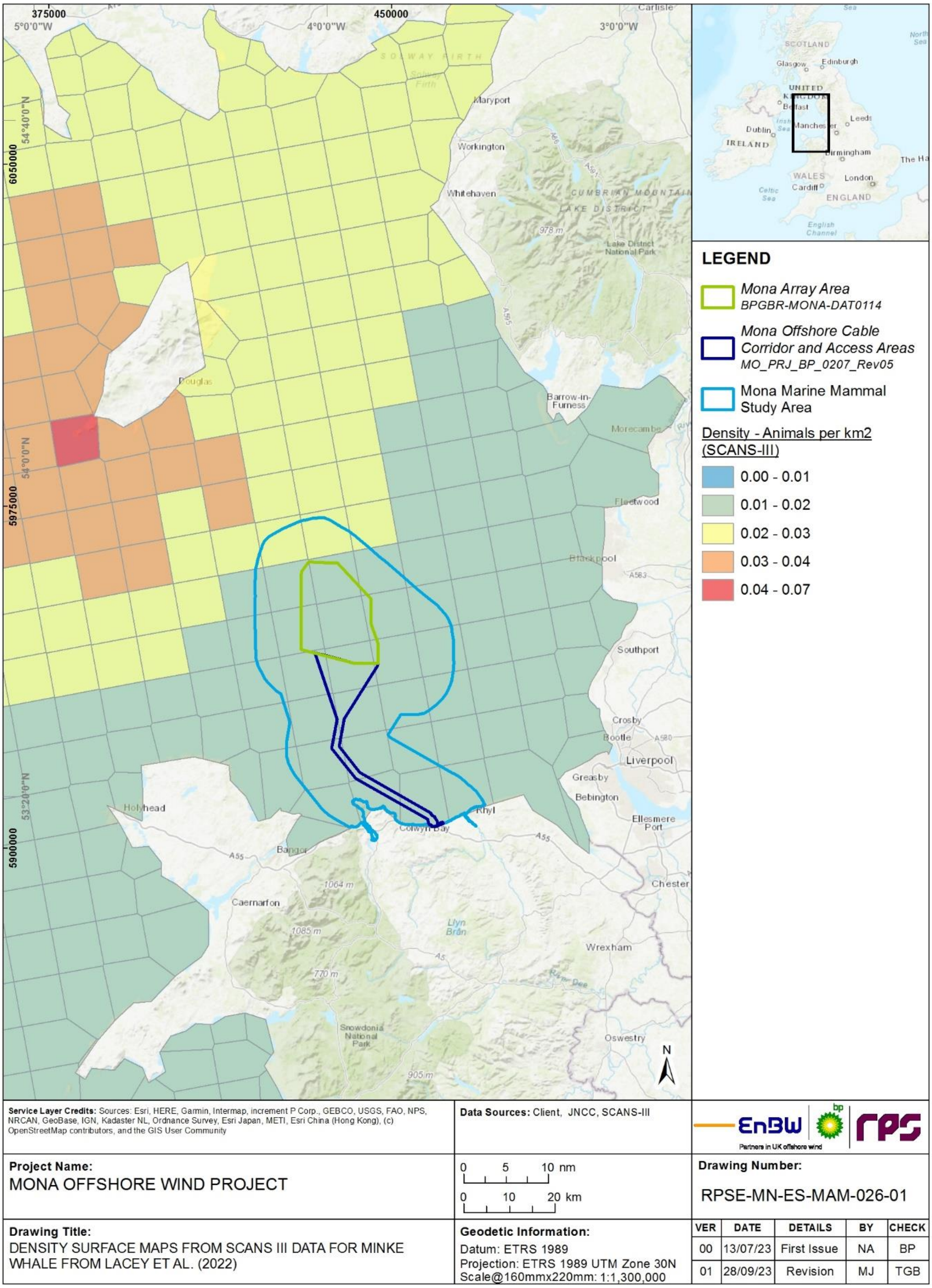


Figure 1.55: Density surface maps from SCANS-III data for minke whale from Lacey *et al.* (2022).

1.7.6.7 JCP 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. Minke whale densities for spring, autumn and winter 2010 were lower, at 0.02 animals per km^2 across the Irish Sea region. For the Mona marine mammal 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.

1.7.6.8 This study builds upon the 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 the density for the Mona marine mammal study area was 0.005 animals per km^2 in 1983, 1990, 1997 and 2004.

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

1.7.6.10 Most recently, UK-wide predicted 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 northwest Scotland, with higher densities from June to October (Figure 1.56). Figure 1.57 and Figure 1.58 demonstrates the predicted monthly densities for minke whale for the region around the Mona marine mammal study area. Densities were found to be low in the east Irish Sea region as a whole, with the highest predicted densities in August with 0.0409 animals per km^2. Densities were estimated to be 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. Considering just the Mona marine mammal study area, highest densities were 0.0071 animals per km^2 in August, thus very low in comparison to other areas of the Irish Sea.

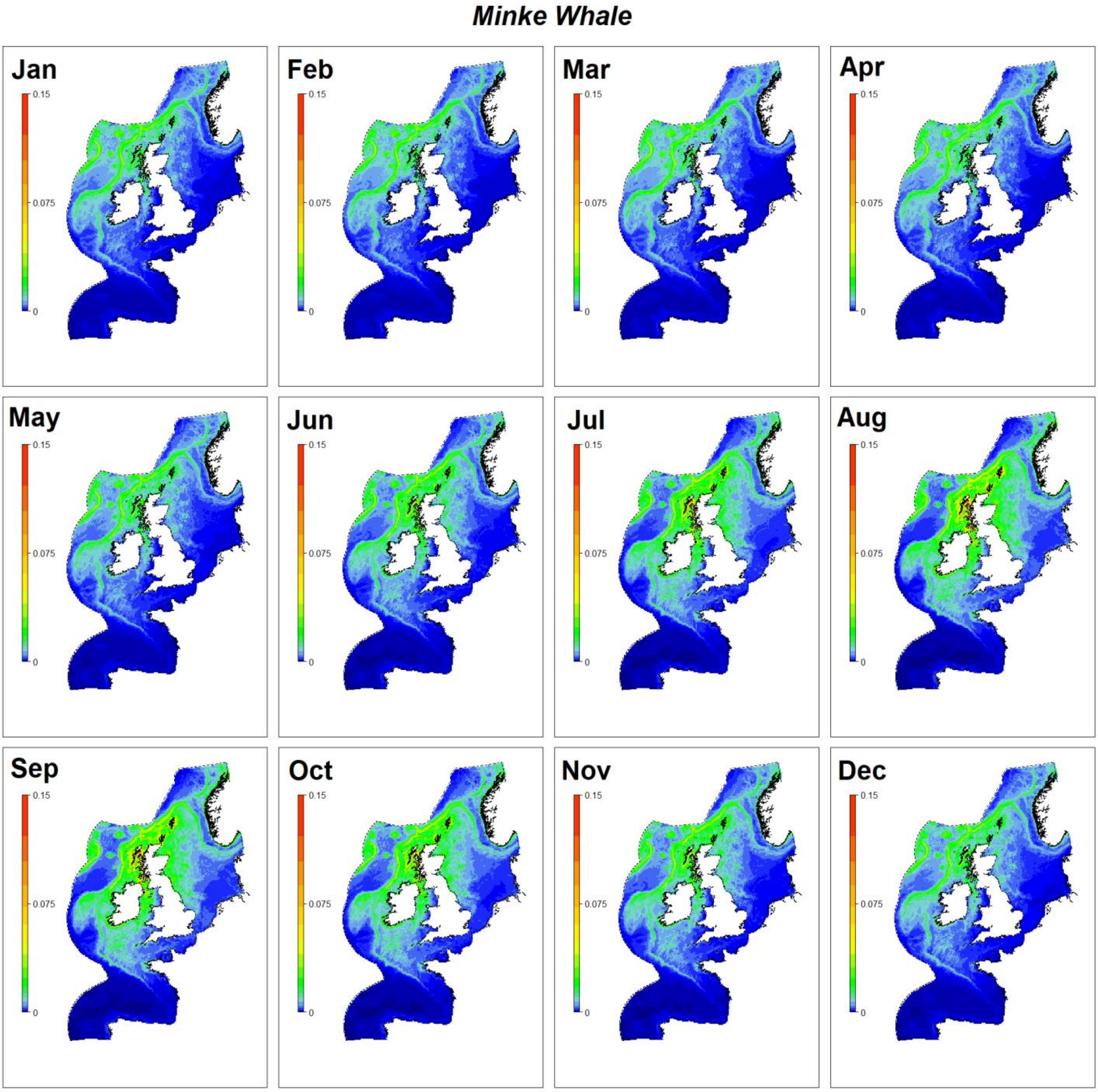


Figure 1.56: Predicted distributions for minke whale per month for the entire study area, from Waggitt *et al.,* (2020).

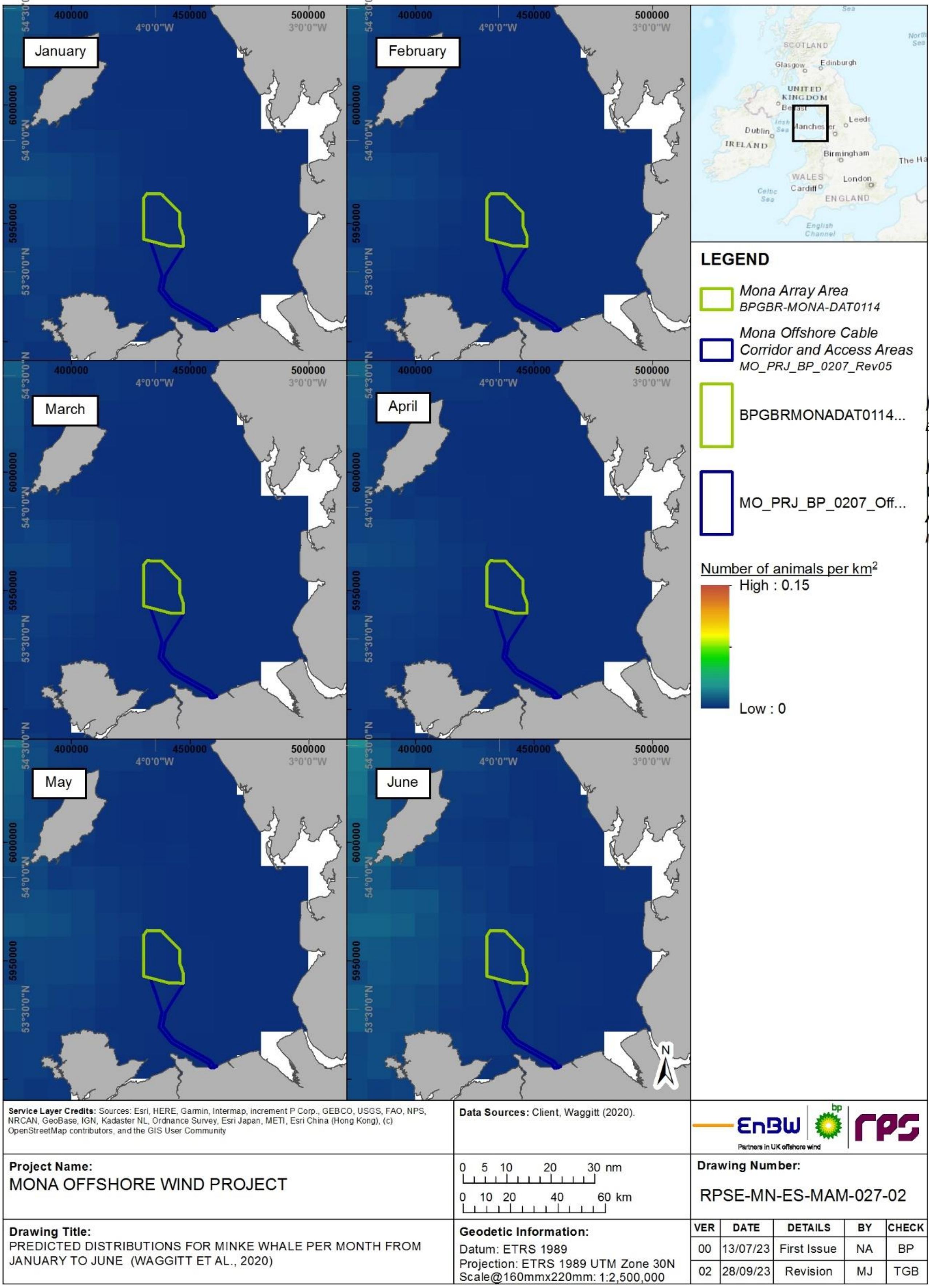


Figure 1.57: Predicted distributions for minke whale per month from January to June for the Mona Array Area, data from Waggitt *et al.* (2020).

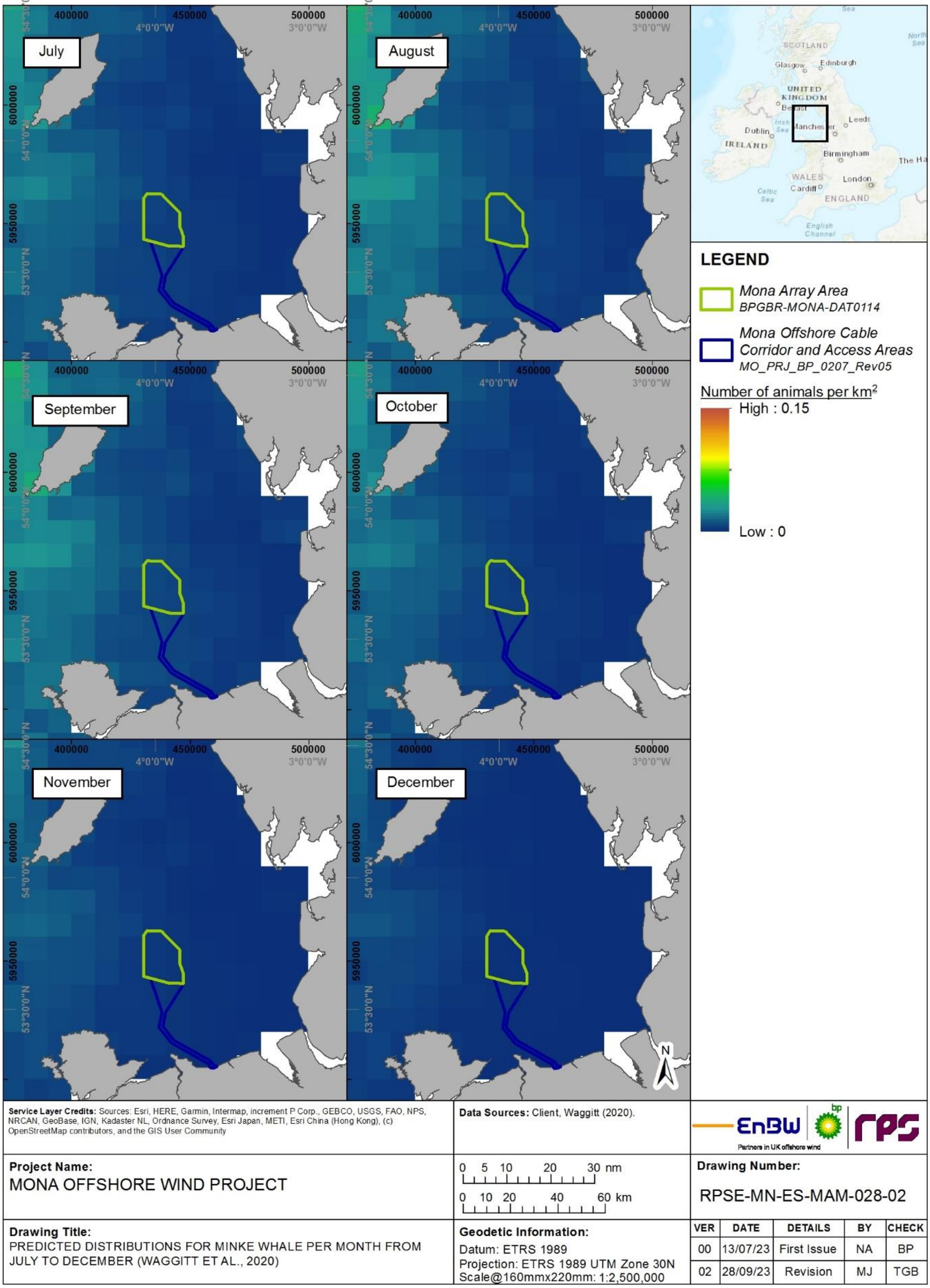


Figure 1.58: Predicted distributions for minke whale per month for July to December for the Mona Array area, data from Waggitt *et al.* (2020).

1.7.6.11 Modelled outputs from the Welsh Marine Mammal Atlas (Evans and Waggitt, 2023) indicated minke whale density was high 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.

1.7.6.12 The average density for the Mona marine mammal study area from the annual composite maps (as recommended by NRW and authors of the Marine Mammal Atlas, see paragraph 1.5.16.4) was 0.004 animals per km^2, and the average density for the Mona Array Area was 0.005 animals per km^2 (Figure 1.59).

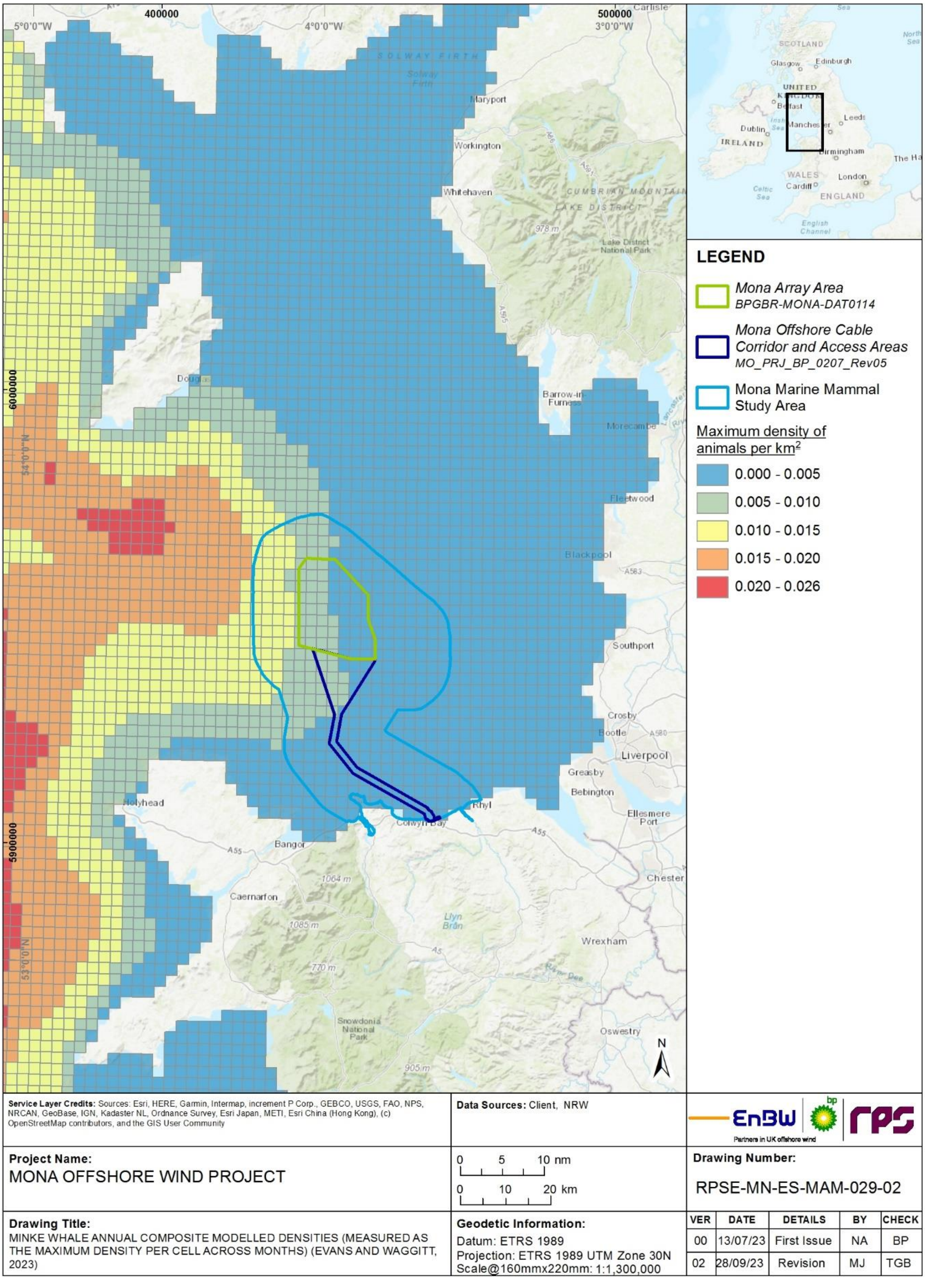


Figure 1.59: Minke whale annual composite modelled densities (measured as the maximum density per cell across months) for the Mona marine mammal study area (Evans and Waggitt, 2023).

1.7.6.13 No individuals of minke whale were recorded in the Mona digital aerial surveys.

Summary of densities

1.7.6.14 Minke whale is distributed across the Irish sea, with high densities seen in the west Irish Sea and around the Isle of Man. No minke whale were observed in SCANS-III block F but animals were observed in block E (Hammond *et al.,* 2021), and this value is higher than densities from Waggitt *et al.* (2020), the Welsh Marine Mammal Atlas (Evans and Waggitt, 2023) and SCANS-IV (Gilles *et al.,* 2023) (which are all similar in value). The Lacey *et al*. (2022) maps also provided a similar estimate to the SCANS-III estimate, which is expected, due to use of the same sighting data source.

1.7.6.15 Therefore, the density taken forward to assessment is SCANS-III block E estimate (Hammond *et al.,* 2021), as agreed through the Marine Mammal EWG process for the Mona Offshore Wind Project.

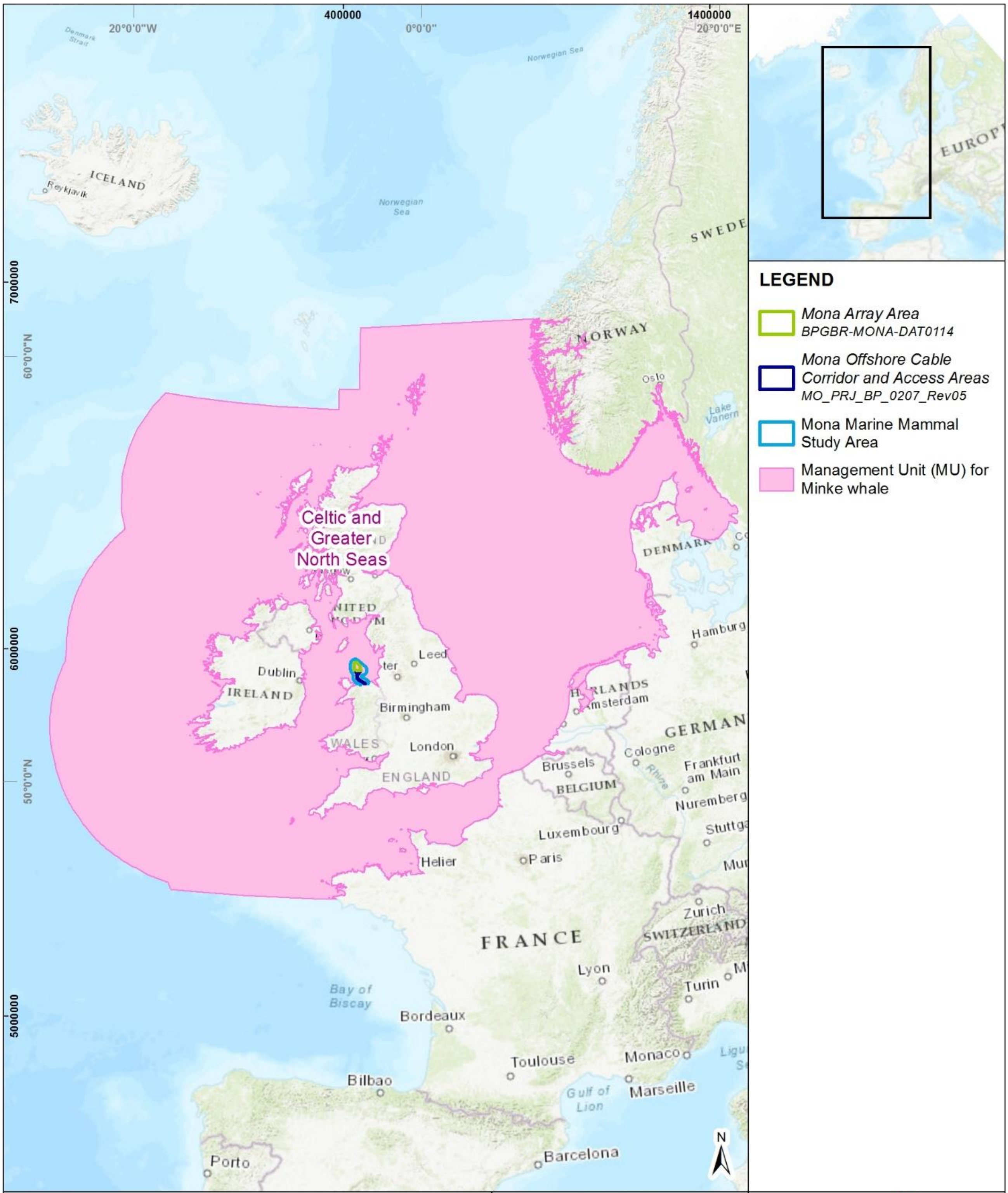
Table 1.11: Comparison of main data sources densities and estimates of variance for minke whale.

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 – block E (Hammond *et al.,* 2021)	**0.0173**	**0.618 (CV)**
SCANS-III – block F (Hammond *et al.,* 2021)	-	-
Lacey *et al.* (2022) derived from SCANS-III for the Mona marine mammal study area - average density	0.018	0.35 (CV)
Waggitt *et al.* (2020) for the Mona marine mammal study area - average density	0.0071	0.006 to 0.008 (95% CIs)
Welsh Marine Mammal Atlas (Evans and Waggitt, 2023) for the Mona marine mammal study area - average density	0.004	0.0028 to 0.007 (95% CIs)
Welsh Marine Mammal Atlas (Evans and Waggitt, 2023) for the Mona Array Area	0.005	0.0036 to 0.0085 (95% CIs)

Abundance

1.7.6.16 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 1.60). 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). The Mona Offshore Wind Project lies within block F for the SCANS-III surveys in 2016, but no minke whale were recorded in this block. However, the regional marine mammal study area also spans block E, and a mean group size of 1.00 and abundance of 603 animals was estimated for this block (95% CI = 134 to 1,753). 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 block CS-D (Gilles *et al.,* 2023).

1.7.6.17 JCP Phase III analysis gave total sightings of 1,860 minke whales for the JCP 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.



Service Layer Credits: Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

Data Sources: Client, JNCC

Project Name: MONA OFFSHORE WIND PROJECT

Scale: 0 50 100 200 nm; 0 100 200 400 km

Drawing Number: RPSE-MN-ES-MAM-030-02

Drawing Title: CELTIC AND GREATER NORTH SEAS MU FOR MINKE WHALE WITH THE MONA MARINE MAMMAL STUDY AREA

Geodetic Information:
Datum: ETRS 1989
Projection: ETRS 1989 UTM Zone 30N
Scale@160mmx220mm: 1:17,500,000

VER	DATE	DETAILS	BY	CHECK
00	13/07/23	First Issue	NA	BP
02	28/09/23	Revision	MJ	TGB

Figure 1.60: Celtic and Greater North Seas MU for minke whale with the Mona marine mammal study area.

1.7.6.18 The ObSERVE surveys recorded minke whale in all strata (Figure 1.61), 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 whales observed in S5 during winter 2015/2016 or winter 2016 / 2017). For summer 2016, the corrected design-based estimate of abundance for Stratum 5 was 180.1 animals (CV = 106.13, 95% CI = 58.6 to 552.9).

1.7.6.19 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.

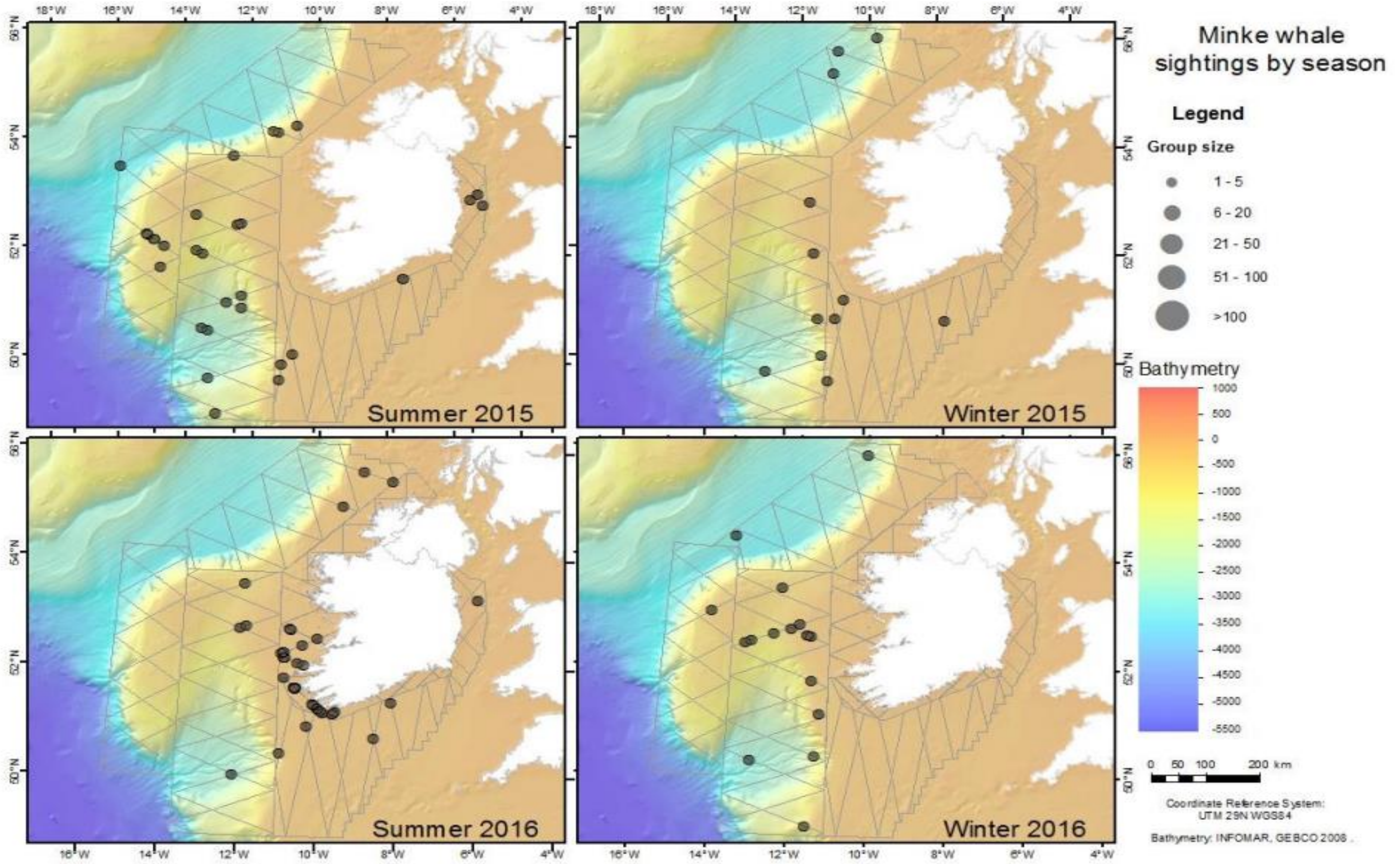


Figure 1.61: Sightings of minke whales in each survey period (bottom). Grey lines indicate the survey track lines along which sightings were made. Circles are proportional to the number of individuals in each sighting. From Rogan *et al.* (2018).

Seasonality

1.7.6.20 Minke whale show high seasonality to the area, as a summer visitor, similar to recent studies in the North Sea where minke whale were 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).

1.7.6.21 In Manx waters, they 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 (MWDW, 2022), and as detailed in paragraph 1.7.2.45, 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).

1.7.6.22 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. The driving factor behind both temporal and spatial patterns appears to be the distribution of herring, a recognised food source of minke whale in Manx waters. There are two known herring stocks in the Irish Sea, known as the Mourne stock, near the east coast of Northern Ireland and the Manx stock. The Manx herring stock are known to spawn on the east coast of the island, 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 island (Bowers 1980), hence the presence of minke whale in this area between these months. Both temporally and spatially, the distribution of minke whale seems to mirror the distribution of the Irish Sea herring in Manx waters. Sightings in Irish waters also appear to reflect this seasonal pattern (Howe, 2018a).

1.7.6.23 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, with estimated abundances of 494.7 animals and 180.1 animals for the Strata 5 (West Irish Sea) area. Wall (2013) suggested highest relative abundances of minke whale were in the western Irish Sea in spring. Both peaks in relative abundance were thought to be due to whales foraging on concentrations of pelagic schooling fish (Wall *et al.,* 2013). JCP Phase III data also showed higher estimated abundances of minke whale (190 animals) in summer in the Irish Sea than winter, spring and autumn.

1.7.6.24 Density maps from Waggitt *et al*. (2020) show higher densities of minke whale in July than January, and this is reflected in Figure 1.57 and Figure 1.58, with higher densities for the Mona marine mammal study area from June to November.

1.7.6.25 The Welsh Marine Mammal Atlas (Evans and Waggitt, 2023) suggested strong seasonality in sightings with most during April to September, a few in and around the Celtic Deep in October to December, and virtually none between January and March. Survey effort is much lower in winter than in summer, so that although this likely reflects a general seasonal movement out into the Atlantic, some individuals probably remain in the region during winter, as revealed from casual sightings elsewhere in UK waters (Anderwald *et al.,* 2007).

1.7.6.26 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).

1.7.7 Grey seal

Ecology

1.7.7.1 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.

1.7.7.2 Grey seal gathers 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 seal 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.

1.7.7.3 The SMRU Report commissioned as an additional baseline source (Wright and Sinclair, 2022) states there are seven designated seal haul-out sites located in the Southwest Scotland MU, one of which overlaps into the Northwest England MU but these haul-outs are over ~74 km swimming distance away from the Mona Offshore Wind Project (Table 1.12) and therefore there is expected to be no direct impacts to seals on land while hauled-out at these designated sites. There are no designated grey seal breeding colonies in the Mona marine mammal study area.

Table 1.12: Designated seal haul-out sites in the Southwest Scotland MU based on August survey counts (both grey seal and harbour seal). From SMRU report (Wright and Sinclair, 2022).

[a] Distances presented in the SMRU Report have been revised to align with the latest Mona Array Area.

Site ID	Site Name	Location	Distance from the Mona Area (km) by sea[a]	Description
SW-001	Sanda and Sheep Island	Mull of Kintyre	203.9 km	Intertidal sandbanks and rocky coastline of Sanda and Sheep Island and associated rocky outcrops.
SW-002	Sound of Pladda Skerries	South Arran	213.7 km	Intertidal sandbanks and rocky coastline between Port a Ghillie Ghlais and Port Dearg and associated rocky outcrops.
SW-003	Rubha nan Sgarbh	Kilbrannan Sound, East Kintyre	228.1 km	Intertidal sandbanks and rocky coastline between Pluck Point and Sgorshuil and associated rocky outcrops.
SW-004	Yellow Rock	Ardnacross Bay, East Kintyre	219.1 km	Intertidal sandbanks and rocky coastline between Macringan's Point and the north end of Yellow Rock and associated rocky outcrops.
SW-005	Lady Isle	Firth of Clyde, West of Troon	235.7 km	Entire island of Lady Isle and associated rocky outcrops
SW-006	Little Scares	Luce Bay, between Mull of Galloway and Burrow Head	107.1 km	Entire islands of the Big Scares and the Little Scares.
SW-007	Solway Firth Outer Sandbank	Solway Firth, between Southerness Point and Dubmill Point	115.9 km	Intertidal mud banks southeast of Southerness Point in the Solway Estuary.

1.7.7.4 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.

1.7.7.5 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 seals 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 western 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 western Irish Sea (Kiely *et al.*, 2000).

1.7.7.6 Grey seal tend to forage in the open sea, returning to land regularly to haul out. Foraging trips can be wide-ranging, 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 northwest 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. The distribution and size of the main grey seal breeding colonies in the UK are shown in Figure 1.62 from SCOS, 2020.

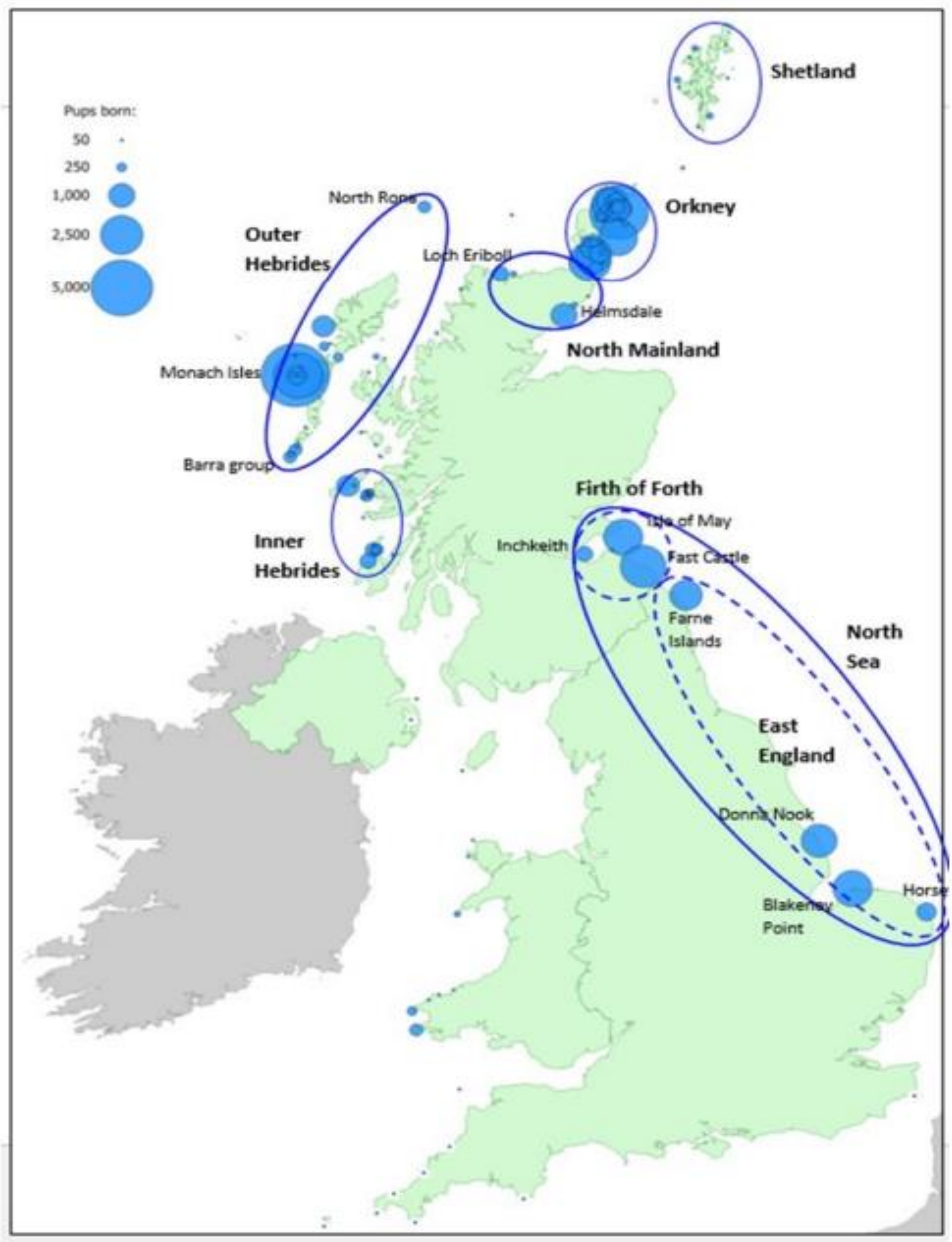


Figure 1.62: Distribution and size of the main grey seal breeding colonies in the UK. Blue ovals indicate groups of regularly monitored colonies within each region and blue circles represent number of pups born. From SCOS (2020)[10].

Distribution

1.7.7.7 Globally there are three centres of grey seal abundance: one in the east of Canada and the northeast 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 and 82% of the European population (SCOS, 2021). 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).

1.7.7.8 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 – 169,400) (SCOS, 2021). The grey seal pup production and 2020 population estimates for Wales, England, Scotland and Northern Ireland are given in Table 1.13.

Table 1.13: Grey seal pup production by country (based on 2019 pup production estimates), and total population estimates at the start of the 2020 breeding season. From SCOS (2021).

[1]The Isle of Man grey seal count included with England.

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

1.7.7.9 Grey seal pup production in 2019 of 2,250 pups presented in SCOS (2021) resulted in a population estimate of 5,200 seals in Wales in 2020. The largest breeding population in the Irish Sea and southwest 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 northwest England is comparatively low compared to that of Wales, whilst in Northern Ireland, 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 Southwest Scotland MU.

1.7.7.10 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 higher numbers of seals seen to move between the southeast coast of Ireland and the southwest 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).

1.7.7.11 Haul-out counts are presented in the SMRU data report for each MU (Figure 1.2). In the Southwest Scotland MU (Figure 1.2), the main haul-outs sites where grey seal have been counted are located in the north region of the MU, with comparatively higher counts than harbour seal along the southern 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.

1.7.7.12 In the Northwest England MU (Figure 1.2) 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 (2-10 pups produced per year), however data suggests grey seal abundance is steadily increasing (SCOS, 2020). This is reflected in historical count data provided by Cumbria Wildlife Trust from Walney Island (Figure 1.18), with maximum seal count increasing particularly from 2012 onwards. 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)

1.7.7.13 SACs designated for grey seal in the regional marine mammal 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-western 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).

1.7.7.14 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 a photo ID database known as EIRPHOT to look at spatial connectivity of haul-out sites and fidelity of adult females to breeding sites. It contains images from 280 sites around the UK, collected between 1992 and 2016, with a specific focus on the Celtic and Irish Seas from 1996 onwards and had a minimum of 2688 female grey seal in the database. 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 sites reported on In Langley *et al.*, (2020), located closest to the Mona Offshore Wind Project. 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.

Wright and Sinclair (2022) also concluded that there is a high level of connectivity between the Mona marine mammal 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 Mona Offshore Wind Project.

1.7.7.15 Telemetry data were available for harbour and grey seal from tags deployed by SMRU (Wright and Sinclair, 2022), referencing the seal MUs in Figure 1.2. In total, 43 adult grey seal recorded telemetry data within the Mona marine mammal study area (Figure 1.63). Thirty-nine adult grey seal (and one juvenile) were tagged in the Wales MU between 2004 and 2018, and therefore recorded tracks throughout the regional marine mammal study area (Figure 1.63). MWT highlighted in a pers. comms that a seal (tagged by SMRU) in the Dee Estuary travelled to the Calf of Man during breeding season (included in Figure 1.63). No adult grey seal were tagged in the northwest England, Southwest Scotland or Northern Ireland MUs. An additional four grey seal were tagged in the adjacent West Scotland MU, to the north of the Southwest Scotland MU, with tracks seen across the north part of the Irish Sea and down the east coast of Ireland and are therefore included (Figure 1.63). There was connectivity with several UK and Irish grey seal SACs. Of the adult grey seal that were recorded within the regional marine mammal study area, there was (non-exclusive) connectivity with several UK and Irish grey seal SACs: 17 with Pen Llŷn a'r Sarnau/Llyen Peninsula and the Sarnau SAC (39.5%), 14 with Pembrokeshire Marine/Sir Benfro Forol 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 (Southwest England MU) (2.3%). Some individuals visited multiple SACs. Of these adult grey seal, 36 recorded tracks within a 100 km buffer (based upon general typical ranging distances) (Wright and Sinclair, 2022) of the Mona Offshore Wind Project (Figure 1.64. Nineteen of those showed connectivity to the surrounding SACs (Pen Llŷn a'r Sarnau/Llyen Peninsula and the Sarnau SAC, Pembrokeshire Marine/Sir Benfro Forol SAC, Saltee Islands SAC and The Maidens SAC) suggesting a high level of connectivity between SACs and the Mona marine mammal study area.

1.7.7.16 For pups and juvenile grey seal, 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 northwest England, Southwest Scotland or Northern Ireland mUs). Juvenile/pups showed non-exclusive connectivity to multiple SACs: 11 juveniles/pups with Pembrokeshire Marine/Sir Benfro Forol SAC (61.1%), 10 with Pen Llŷn a'r Sarnau/Llyen Peninsula and the Sarnau SAC (55.6%), four with Cardigan Bay SAC (22.2%), four with Saltee Islands SAC (Ireland) (22.2%), two with Isle of Scilly Complex SAC (11.1%) (Figure 1.65). Of these 18 juvenile/pups, 13 recorded telemetry tracks within a 100 km buffer of the Mona Offshore Wind Project described by SMRU (Figure 1.66), 11 of which showed connectivity to surrounding SACs.

1.7.7.17 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 northwest 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) who highlighted some higher densities observed around Liverpool Bay close to the Mona marine mammal study area than in the west Irish Sea.

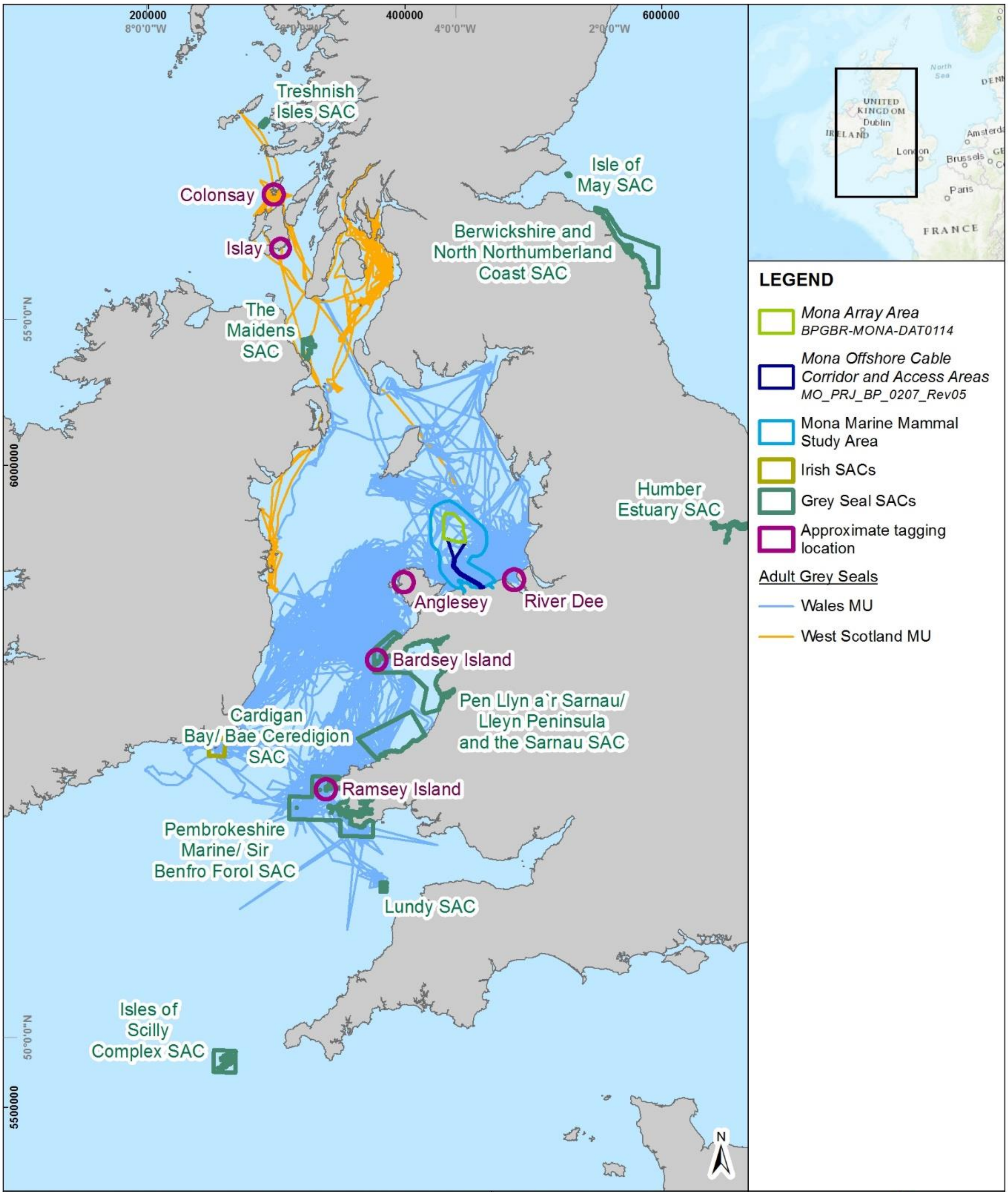
1.7.7.18 Duck and Morris (2019) conducted thermal-imaging surveys of grey seal around Ireland in August 2017 and 2018, with the Irish coast divided into five regions, East, South-east, South-west, West and North. In all surveys the greatest proportion of grey seal were counted in the west of Ireland. In the east and southeast, closest to the Mona Offshore Wind Project the grey seal count was substantially higher in 2017/2018 than in 2011/2012, thus demonstrating it is an increasingly important area for grey seal populations. 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

1.7.7.19 The Isle of Man is an important area for grey seal, using 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 from the Isle of Man from 2017 to 2022 showed grey seal around the entire coastline of the Island (Figure 1.16), whilst specific seal surveys carried out in 2017 showed counts of grey seal along the coast, particularly on the Calf of Man and around Maughold (Figure 1.17).

1.7.7.20 Key haul-out sites include the Calf of Man, The Sound, Langness and Maughold (Stokes and Young, 2021). The Calf of Man is an important pupping site for grey seal around the Isle of Man (Stokes and Young, 2021) with high counts of pups in all years from 2017 to 2021 (MWT, 2022) (Figure 1.15) 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 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 Manx coast, for example around the southwest coast and at Maughold (Figure 1.17). Recently, the Point of Ayre has become an important haul out site for grey seals, with over 100 animals seen fairly regularly (with the highest count at 160) (MWT, pers. comms., 2023). Gob Garvain, Santon head, Maughold Head, Clay head and Contrary head and Calf of Man have also been highlighted as important sites for grey seals, though are not designated sites (MWT, pers. comms., 2023).

1.7.7.21 MWT also highlighted, through Photo ID work, mobile connectivity of seals on the Isle of Man with other areas in the regional marine mammal study area. One grey seal (Tulip Belle) has been matched with the Cornwall Seal Group Research Trust and demonstrates movement between the Calf and Cornwall for several years, breeding on the Calf of Man (MWT, pers. comms., 2023). Recently (August 2023) a grey seal from Cornwall was observed in Manx waters (near Fleshwick, north of Port Erin), it confirmed by the flipper tag and obvious scar on its side (MWT, pers. comms., 2023).



Service Layer Credits: Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

Data Sources: Client, SMRU

Project Name: MONA OFFSHORE WIND PROJECT

0 25 50 nm; 0 50 100 km

Drawing Number: RPSE-MN-ES-MAM-031-01

Drawing Title: TELEMETRY TRACKS FOR ALL 43 ADULT GREY SEAL (AND ONE JUVENILE) THAT ENTERED THE REGIONAL MARINE MAMMAL STUDY AREA (COLOURED BY THE MU THEY WERE TAGGED IN). WRIGHT AND SINCLAIR (2022)

Geodetic Information:
Datum: ETRS 1989
Projection: ETRS 1989 UTM Zone 30N
Scale@160mmx220mm: 1:5,000,000

VER	DATE	DETAILS	BY	CHECK
00	13/07/23	First Issue	NA	BP
01	28/09/23	Revision	MJ	TGB

Figure 1.63: Telemetry tracks for all 43 adult grey seal (and one juvenile) that entered the regional marine mammal study area (coloured by the MU they were tagged in). Wright and Sinclair (2022).

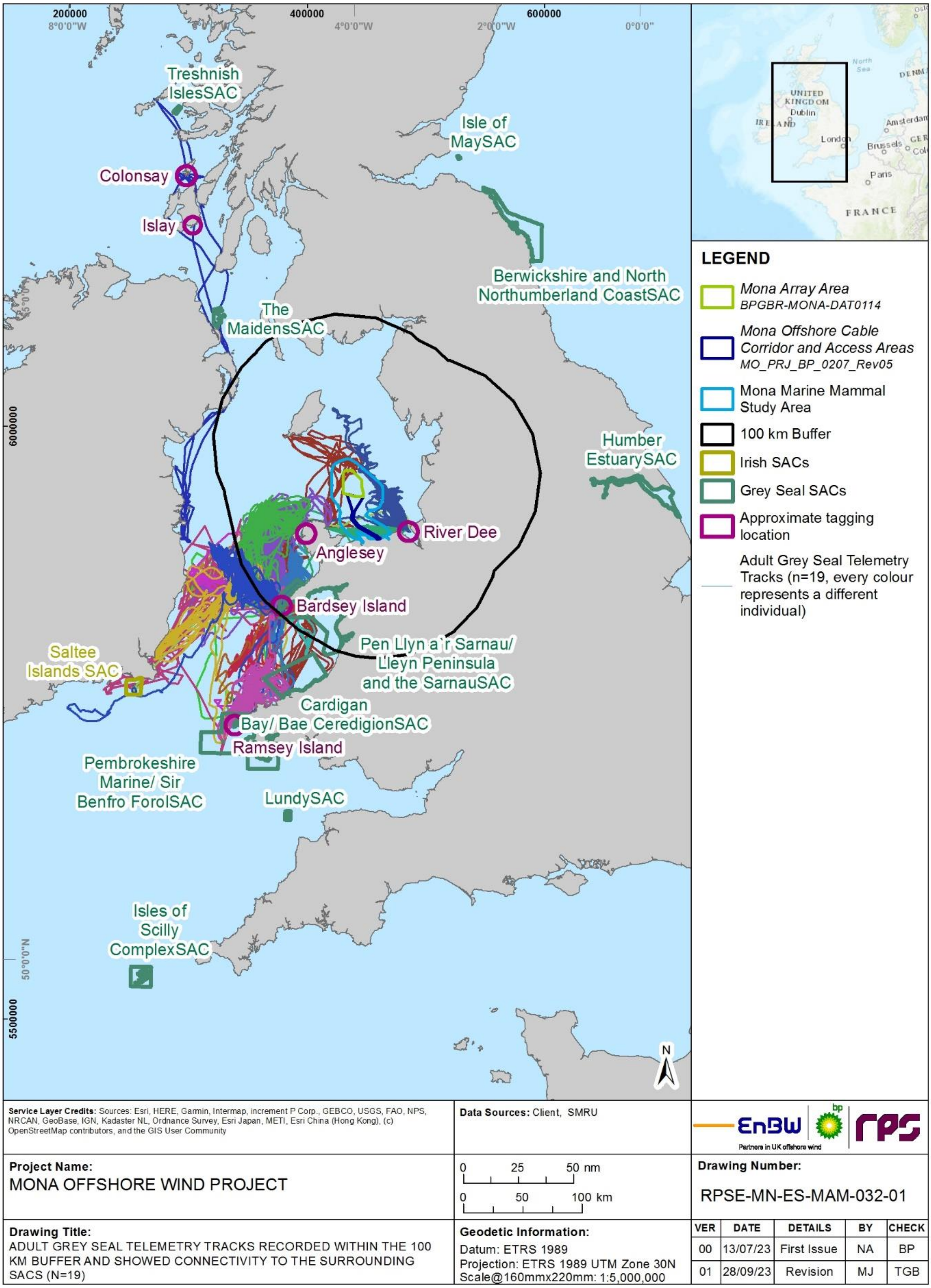


Figure 1.64: Adult grey seal telemetry tracks recorded within the 100 km buffer and showed connectivity to the surrounding SACs (n=19).

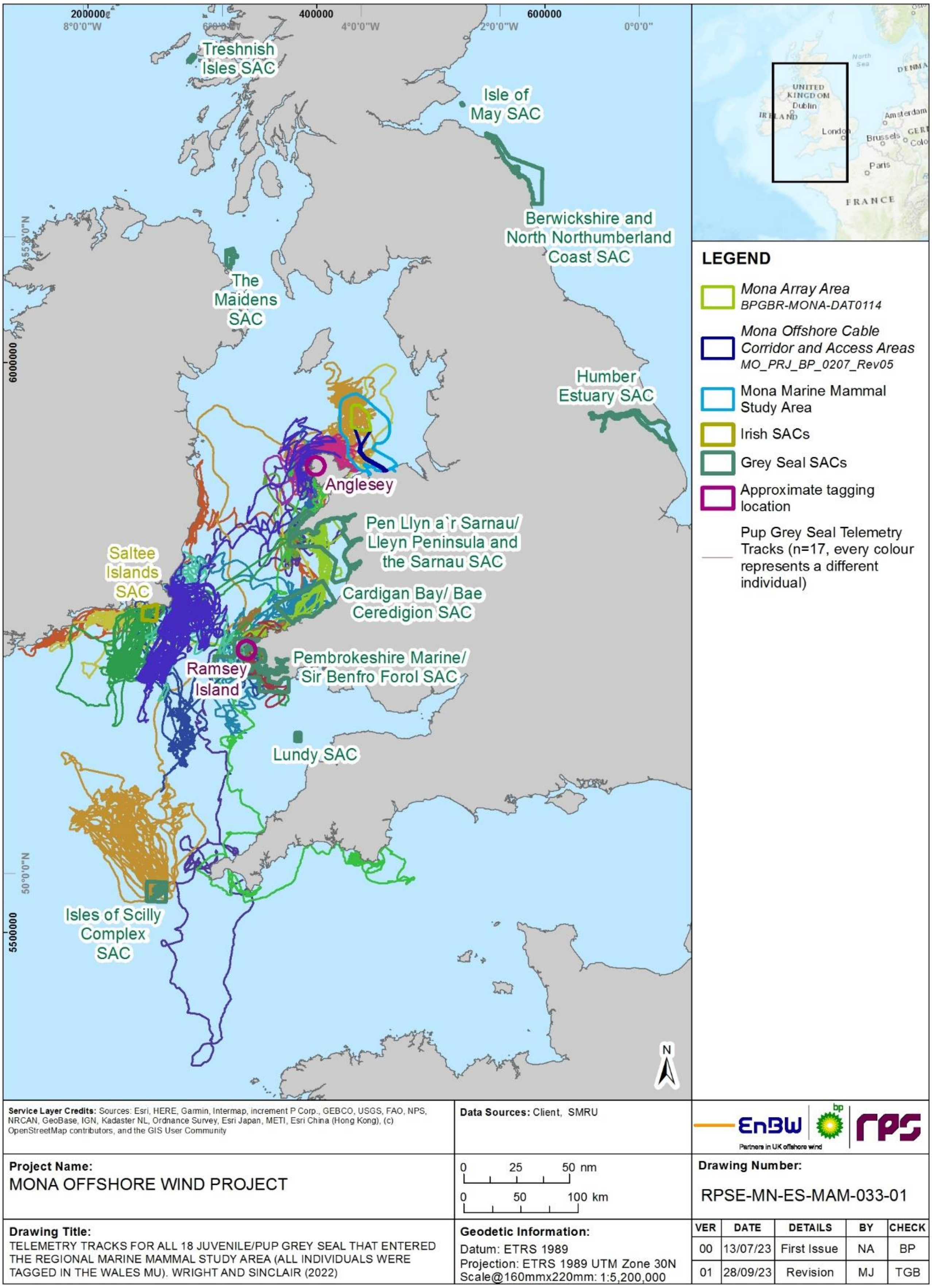
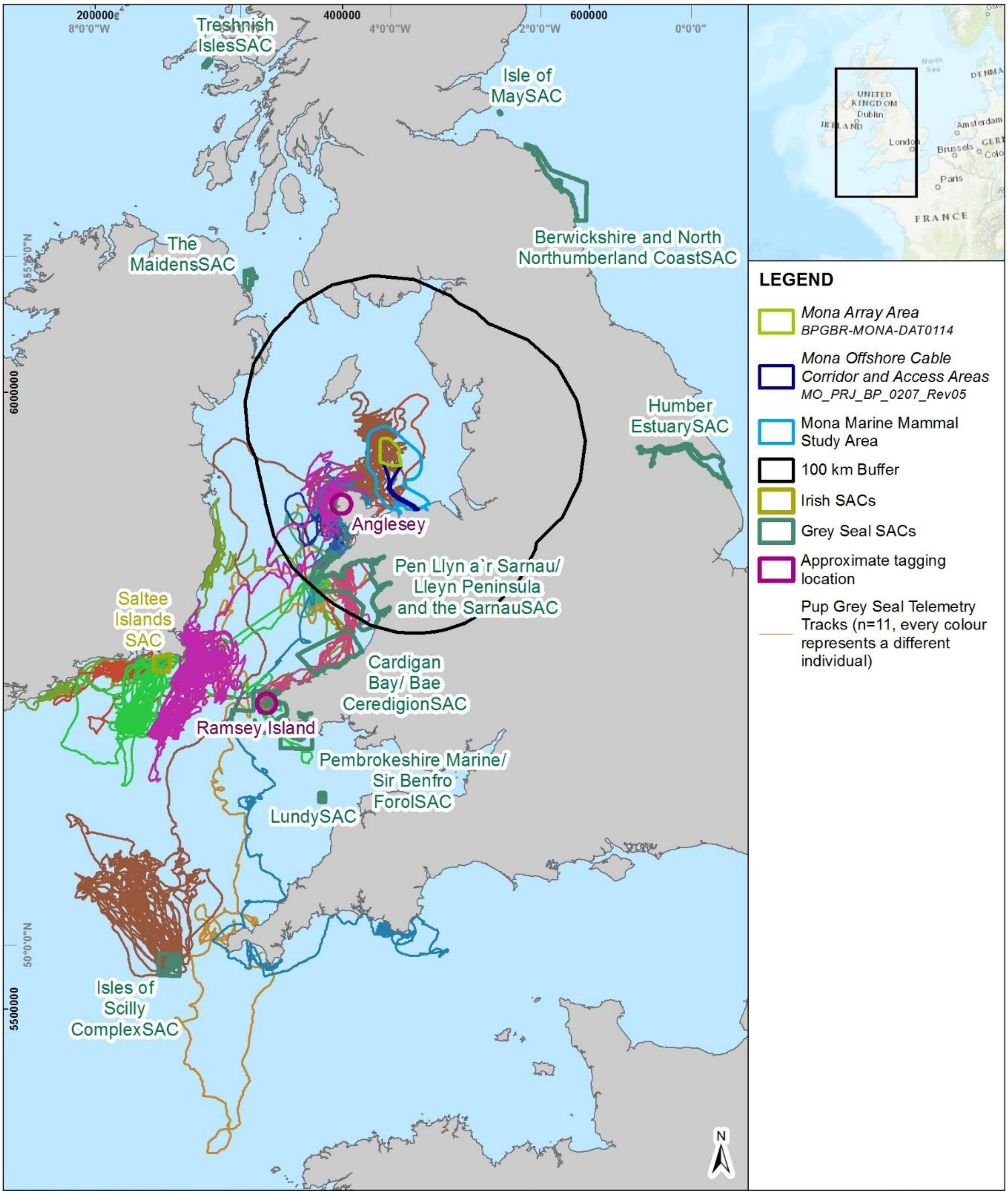


Figure 1.65: Telemetry tracks for all 18 juvenile/pup grey seal that entered the regional marine mammal study area (all individuals were tagged in the Wales MU). Wright and Sinclair (2022).



Service Layer Credits: Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community	**Data Sources:** Client, SMRU	Partners in UK offshore wind
Project Name: MONA OFFSHORE WIND PROJECT	0 25 50 nm 0 50 100 km	**Drawing Number:** RPSE-MN-ES-MAM-034-01
Drawing Title: JUVENILE/PUP GREY SEAL TELEMETRY TRACKS THAT RECORDED DATA IN THE 100 KM BUFFER AND SHOWED CONNECTIVITY TO THE SURROUNDING SACS (N=11, ALL TAGGED IN THE WALES MU). WRIGHT AND SINCLAIR (2022)	**Geodetic Information:** Datum: ETRS 1989 Projection: ETRS 1989 UTM Zone 30N Scale@160mmx220mm: 1:5,200,000	

VER	DATE	DETAILS	BY	CHECK
00	13/07/23	First Issue	NA	BP
01	28/09/23	Revision	MJ	TGB

Figure 1.66: Juvenile/pup grey seal telemetry tracks that recorded data in the 100 km buffer and showed connectivity to the surrounding SACS (n=11, all tagged in the Wales MU). Wright and Sinclair (2022).

Density/abundance

Density

1.7.7.22 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 northwest of the Isle of Man (Figure 1.67). 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. Distribution and predicted number of grey seal from Carter *et al.* (2022) in the vicinity of the Mona Offshore Wind Project is given in Figure 1.67, and shows areas of high density at seal usage in the inshore areas of Liverpool Bay (> 50 to 100 animals per 25 km^2) to the southeast of the developments, and moderate densities (>5 to 10 animals per 25 km^2) further out from Liverpool Bay towards the Mona Offshore Wind Project and to the southwest of the Isle of Man. Average grey seal densities from Carter *et al.* (2022) for the Mona Array Area plus buffer zone was estimated at 0.037 animals per km^2. For the Mona Offshore Cable Corridor plus a 10 km buffer, average densities were 0.180 animals per km^2, with maximum estimated densities of 45.3 animals per 25 km^2 (= 1.812 animals per km^2) along the coast.

1.7.7.23 SMRU tagged seals also showed grey seal tracks have been recorded throughout the regional marine mammal study area, with a higher density of tracks in the southern region of the regional marine mammal study area in the northwest England and Wales MUs and a lower density in the northern region of the regional marine mammal study area. A higher density of grey seal tracks was shown within the extent of the Mona Offshore Cable Corridor compared to the Mona Array Area.

1.7.7.24 Both design-based and model-based densities are available from the aerial digital survey data for the Mona Array Area for grey seal (Appendix A). Design-based approach gave a mean absolute density of 0.109 animals per km^2 for the Mona Offshore Wind Project 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.

1.7.7.25 The 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% CL = 0.028 to 0.057) and lowest for May (0.003 animals per km^2, CL = 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.

1.7.7.26 Spatial density mapping using linear models showed relative higher densities in the northwest and south-east of the Mona Aerial Survey Area (density maps are presented in Appendix A).

1.7.7.27 The Morgan Offshore Wind Project: Generation Assets PEIR (Morgan Offshore Wind Ltd, 2023) presented interim design-based and model-based densities grey seal. The design-based approach gave a mean absolute density of 0.075 animals per km^2 across the months, with highest densities for March (0.143 animals per km^2) and lowest in January, February and May (0.036 animals per km^2). Model-based approach gave an average absolute density estimate of 0.018 animals per km^2 per month with the highest densities for March (0.047 animals per km^2, 95% CL = 0.033 to 0.062) and lowest for January (0.007 animals per km2, 95% CL = 0.005 to 0.009). The "bio-season" model predicted a mean absolute density of 0.015 animals per km^2 (95% CI: 0.003 to 0.029) during the pupping season, and 0.022 animals per km^2 (95% CI: 0.012 to 0.026) during the non-pupping season. Morgan Offshore Wind Ltd (2023) highlights these are based upon 12 months of data and will differ following the full 24 months of surveys.

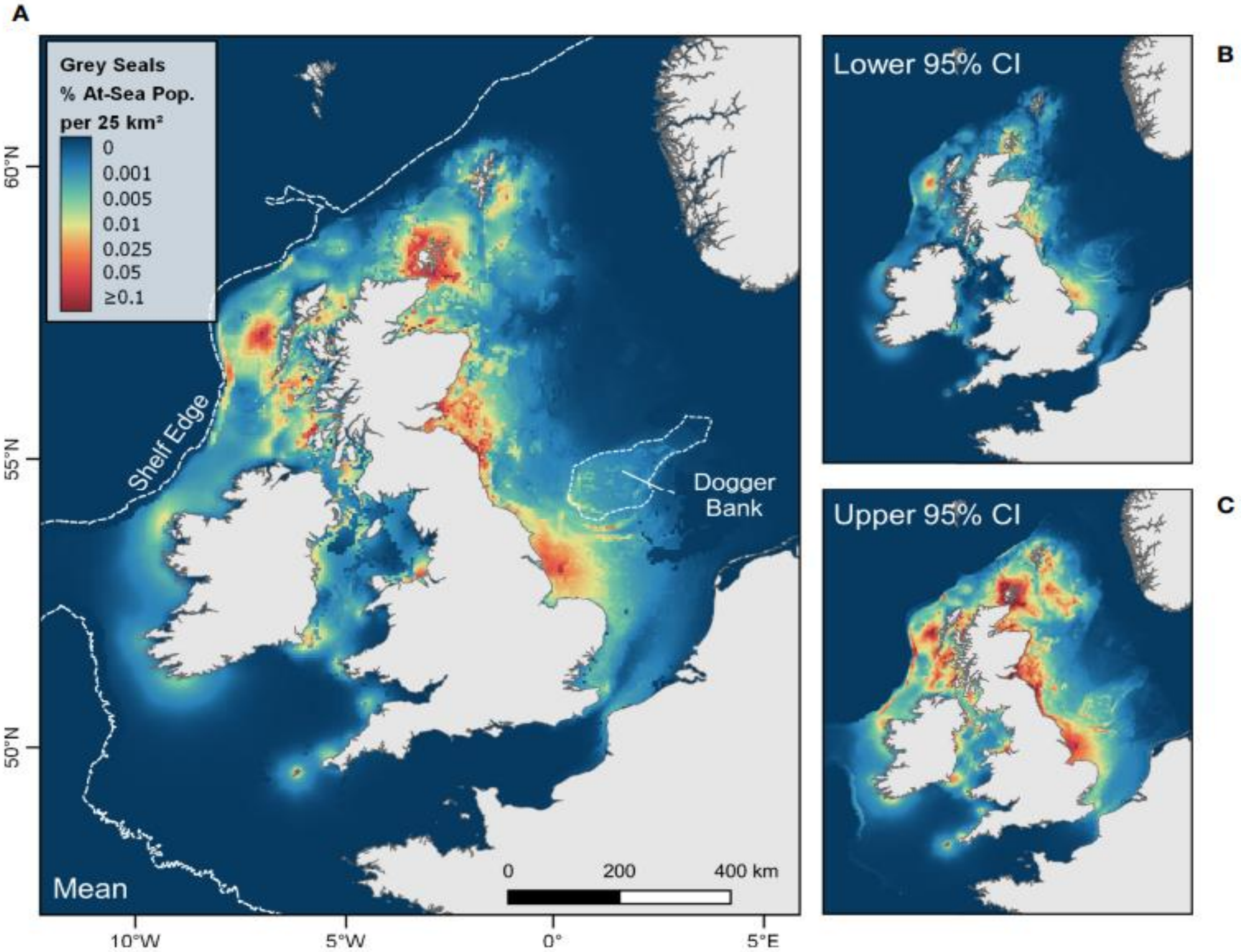
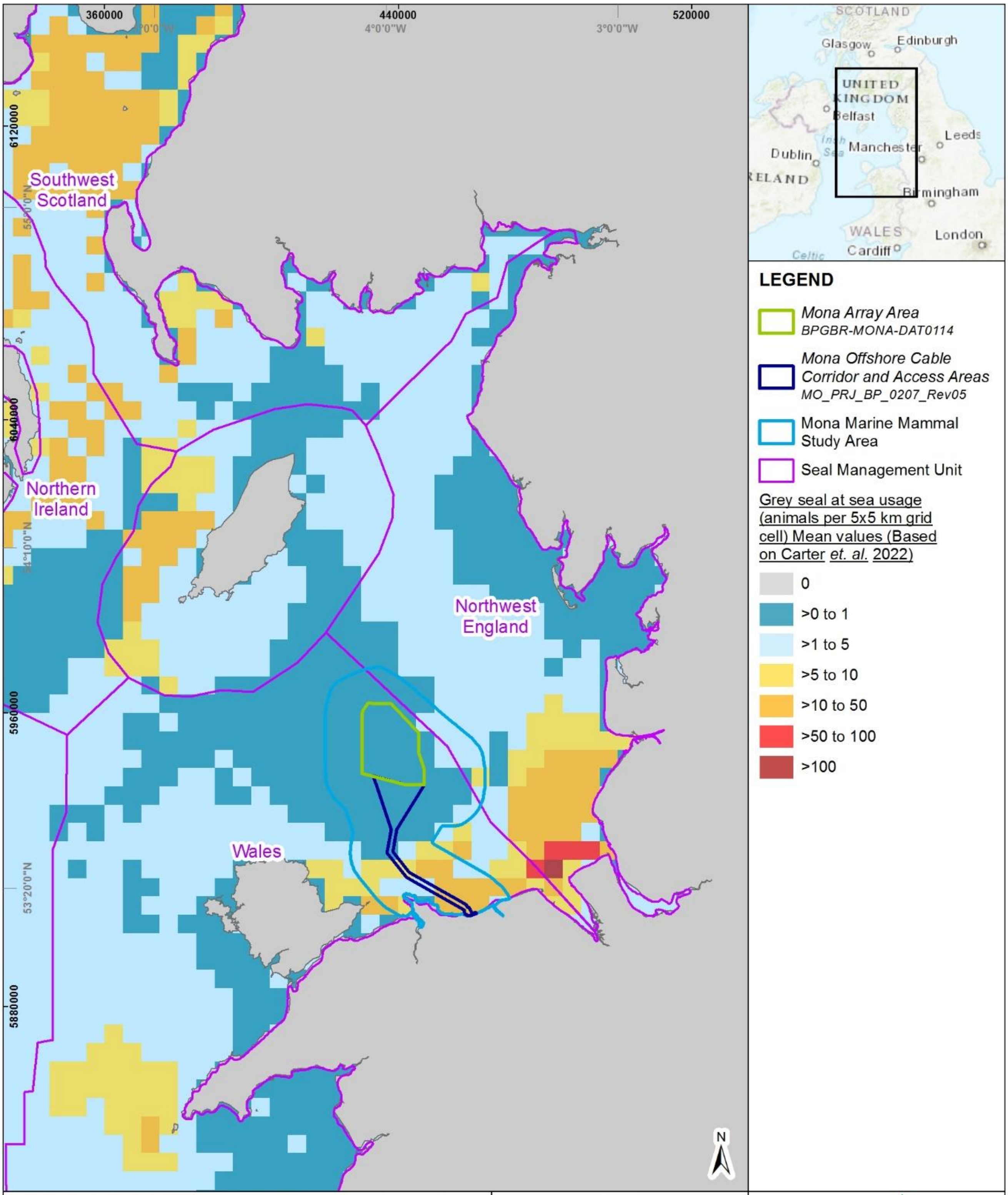


Figure 1.67: Grey seal at-sea distribution maps. From Carter *et al.* (2022).



Service Layer Credits: Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

Data Sources: Client, JNCC, St Andrews University

Project Name: MONA OFFSHORE WIND PROJECT

0 5 10 20 nm
0 10 20 40 km

Drawing Number: RPSE-MN-ES-MAM-035-01

Drawing Title: THE DISTRIBUTION AND PREDICTED NUMBER OF GREY SEAL IN 5 KM X 5 KM GRID CELLS (MEAN) IN THE VICINITY OF THE MONA OFFSHORE WIND PROJECTS. SOURCE: CARTER ET AL. (2022)

Geodetic Information:
Datum: ETRS 1989
Projection: ETRS 1989 UTM Zone 30N
Scale@160mmx220mm: 1:1,750,000

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00	13/07/23	First Issue	NA	BP
01	28/09/23	Revision	MJ	TGB

Figure 1.68: The distribution and predicted number of grey seal in 5 km x 5 km grid cells (mean) in the vicinity of the Mona Offshore Wind Projects. Source: Carter *et al.* (2022).

Abundance/Counts

1.7.7.28 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 (2020) was the most recent report to present August counts of grey seals at haul out sites in the British Isle specifically by SMUs which can be converted to population estimates using a scalar (see paragraph 1.7.7.30).

1.7.7.29 The latest 2021 SCOS report presented a total population estimate (not by SMU) for the UK (therefore not including the Republic of Ireland) of 157,300 animals (approximate 95% CI 144,600 to 169,400) at the start of the 2020 breeding season. This uses a mathematical model which converts pup production estimates in 2019 to estimates of total population size (1+ aged population at the start of the breeding season) (SCOS, 2021).

1.7.7.30 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). 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%).

1.7.7.31 Broad scale data primarily includes the SCOS SMUs which are currently used as the relevant MUs in the absence of defined seal MUs from the IAMMWG (2021). Relevant SMUs from the SCOS 2020 report are Wales, Northwest England, Northern Ireland and Southwest Scotland (Figure 1.69). SCOS (2020) states there is limited data for SMUS 10 to 13 (which includes Wales, NW England) and values given are rough estimates and advises caution during interpretation. Abundances are estimated from counts per SMU, as it is estimated that grey seal spend 25.15% of their time hauled-out on average (SCOS, 2021). No updated counts are given per SMU in SCOS 2021 so estimates will be based upon counts presented in SCOS (2020) and Appendix B.

1.7.7.32 Estimates of grey seal counted in August 2018 in the Wales MU and Northwest England MU are 900 and 250, respectively. Extrapolating to population size based on the proportion hauled out (based upon scalar in SCOS 2021) grey seal abundance estimates for the Wales and Northwest England mUs of approximately 3,579 and 994 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 the Cumbria Wildlife Trust which started conducting low tide counts of grey seal at South Walney in 2019 (Wright and Sinclair, 2022). Thus far, a total of 248 and 300 grey seal have been counted in 2019 and 2020 respectively for the Cumbria grey seal surveys (counts are not yet available for 2021).

1.7.7.33 In the Southwest Scotland MU, grey seal August haul-out counts have been lower than harbour seal counts. Overall, counts within the MU have seen a steady increase from 75 in the 1997-1997 period to 517 in the 2016-2019 period. The August haul-out count of 517 can be scaled to account for the proportion of the population at sea at the time of the survey, resulting in a population estimate of 2,056 grey seal in the Southwest Scotland MU.

1.7.7.34 In the Northern Ireland MU, the most recent August haul-out survey conducted in 2018 showed an estimated count of 505 grey seal, resulting in a population estimate of 2,008 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).

1.7.7.35 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 southern Irish Sea were investigated in a 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 mark-recapture data which delivered an estimate of 5,613 seals (CV = 0.2%).

1.7.7.36 For Ireland, Ó Cadhla *et al.*, (2007) provided the first grey seal population size in 2005, which gave definitive minimum population estimate of 5,509 to 7,083 grey seal of all ages for the Republic 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.

1.7.7.37 For Wales waters, the West Wales Grey Seal Census (WWGSC) established a core concentration of breeding grey seal, with all-age estimates of 5,000 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 seals, based upon 110 pups and the same correction factor of 3.5. This correction factor is derived from a life table in Hewer (1974) 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).

1.7.7.38 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 seals, 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).

1.7.7.39 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 (2017/2018) in the East region 418 grey seal were counted, and in the South-east 556 grey seal were counted (Figure 1.4). Using population scalars from SCOS (2021) this leads to population estimates of 1,662 grey seal for the East region and 2,211 for the South-east 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).

1.7.7.40 For the Mona Aerial Survey Area, grey seal abundance varied across months and seasons, with greatest abundance observed during the winter (December to February) and spring (March to May) months. 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 here as “bio-seasons”. 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.

1.7.7.41 During integrated surveys detailed in the PAM and MMO Report, there were also 39 visual sightings of grey seal from April 2022 to June 2022.

1.7.7.42 Interim abundances from the Morgan Offshore Wind: Generation Assets PEIR (Morgan Offshore Wind Ltd, 2023) showed grey seal abundance varied across months and seasons with highest abundances in March, with 197 animals from mean absolute abundance (i.e. adjusted by availability bias). When split by bio-season, mean absolute abundance was 116 animals for the Morgan Aerial Survey Area in the pupping season and 99 in the non-pupping season.

1.7.7.43 The reference population taken forward to assessment for grey seals comprises a combined sum of population estimates from populations within the Irish Sea including: four SMUs that cover the Irish sea and show connectivity to each other in telemetry figures (12 Wales = 3,579, 13 NW England = 994, 14 Northern Ireland = 2,008 and 1 SW Scotland = 2,056) plus separate estimates for the East of Ireland (1,662) and Southeast of Ireland (2,211) from Morris and Duck (2019) and the Isle of Man estimate (400) from Howe (2018b) to form one ‘Grey Seal Reference Population’ (GSRP) for the impact assessment, which gives a total of 12,910 grey seal. This is deemed the most relevant reference population for the impact assessment.

1.7.7.44 During the EWG consultations, NRW requested consideration of OSPAR Regional III, particularly with respect to cumulative impacts of other projects. The OSPAR Region III Nmin estimate of 60,780 from OSPAR Quality Status Report[11] for 2023 (Banga, 2022) will be applied for additional context in the assessment. This has been chosen as a conservative estimate for OSPAR Region III, over the N value of 64,854 to facilitate a precautionary approach.

[11] 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).

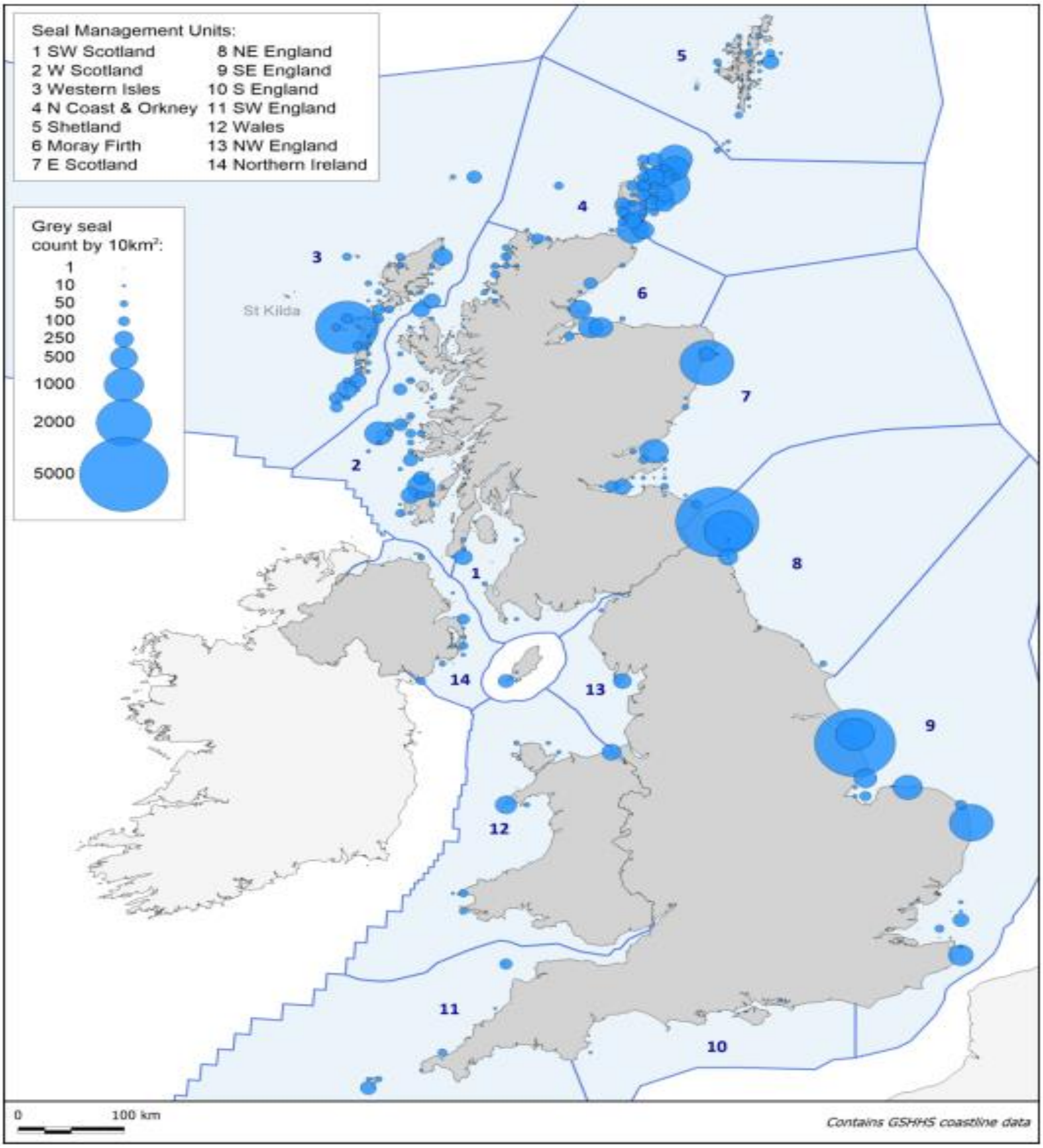


Figure 1.69: August distribution of grey seal around the British Isles by 10 km squares based on the most recent available haul-out count data collected up until 2019. From SCOS (2020).

Seasonality

1.7.7.45 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 southwest 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).

1.7.7.46 Grey seal may redistribute outside of the breeding season so regional differences in population estimates do not necessarily reflect the 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).

1.7.7.47 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 Mona Offshore Wind Project, 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 average age of mothers and a temperature increase of 2°C causing a pupping season to advance of approximately seven days.

1.7.7.48 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).

1.7.8 Harbour seal

Ecology

1.7.8.1 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 seal occurs in late summer (Wilson and Jones, 2018, Thompson *et al.,* 2019).

1.7.8.2 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 *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.

1.7.8.3 Harbour seal, is a central place forager, 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. Because of 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).

1.7.8.4 Harbour seal breeds in small groups scattered along the coastline. They breed between June and August (Carter *et al.*, 2022), and study 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).

1.7.8.5 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, including species from the surface, mid-water and benthic habitats such as sandeels, whitefish, herring, sprat, common octopus, and squid *Loligo* spp. (Hammond and Wilson, 2016). 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 southeast 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

1.7.8.6 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 36% of the pup production for Eastern Atlantic subspecies of harbour seal (SCOS, 2020). Carter *et al.* (2022) suggested large centres of harbour seal abundance in Shetland, The Wash (in southeast 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 (Figure 1.70). 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.

1.7.8.7 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 and, in recent years, in 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 marine mammal study area, these are not considered further.

1.7.8.8 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 (more detail in Appendix B).

1.7.8.9 The main harbour seal haul-outs are located in the northern region of the regional marine mammal study area, in the Southwest Scotland MU, particularly in the north of the MU (Figure 1.70). There is no information on the location of harbour seal hauled-out in the Wales and Northwest England MUs (Wright and Sinclair, 2022) as numbers are so few and there are no dedicated SMRU surveys routinely carried in these MUs, with "estimates compiled from counts shared by other organisations". In Northern Ireland most harbour seal haul-outs are located in the southeast 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.

1.7.8.10 Interregional movements within the foraging season are more limited (Russell *et al*., 2013) particularly for harbour seal (Carroll *et al*., 2020). Telemetry data presented in Wright and Sinclair (2022) showed no harbour seal were tagged in the Northwest England, Wales or Southwest Scotland MUs between 2001 and 2017, but 34 harbour seal were tagged in the Northern Ireland MU between 2006 to 2010 (Figure 1.71). All 34 harbour seal recorded telemetry tracks within the regional marine mammal 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 marine mammal study area (specifically within Southwest Scotland and

Northern Ireland MUs). Therefore, a total of 46 harbour seal telemetry tracks were recorded in the regional marine mammal study area (Figure 1.71). Five harbour seal all tagged in Northern Ireland MU were recorded within 50 km of the Mona Offshore Wind Projects, but no tracks were recorded within or south of the Mona Offshore Wind Projects (Figure 1.72). These seals showed connectivity to the surrounding SACs, and with the south coast of the Isle of Man. The Manx Marine Environmental Assessment details harbour seal are rare in Manx waters but are observed in small numbers throughout the year around the Sound and Maughold head areas, more commonly in summer months (Howe, 2018).

1.7.8.11 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).

1.7.8.12 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 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.

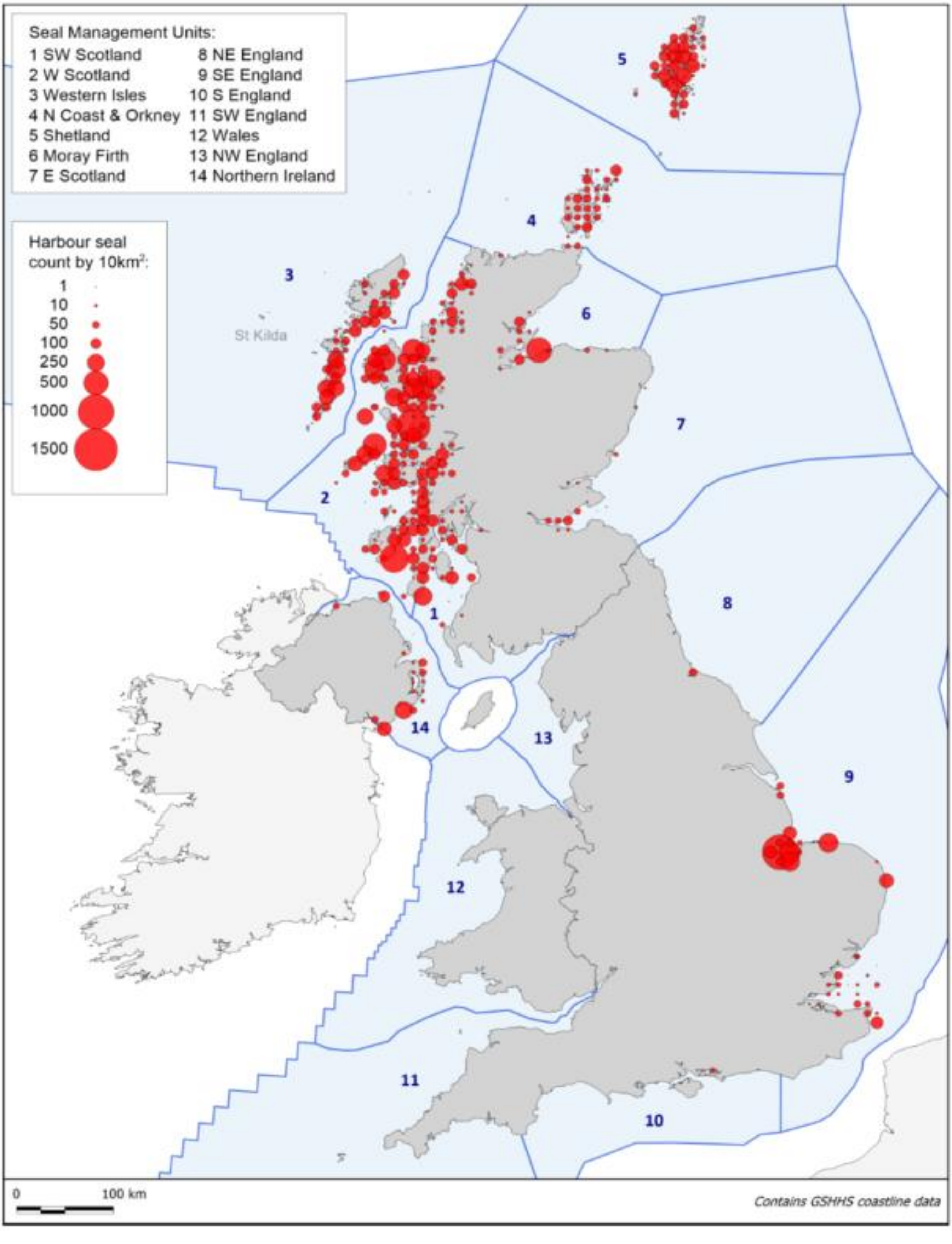
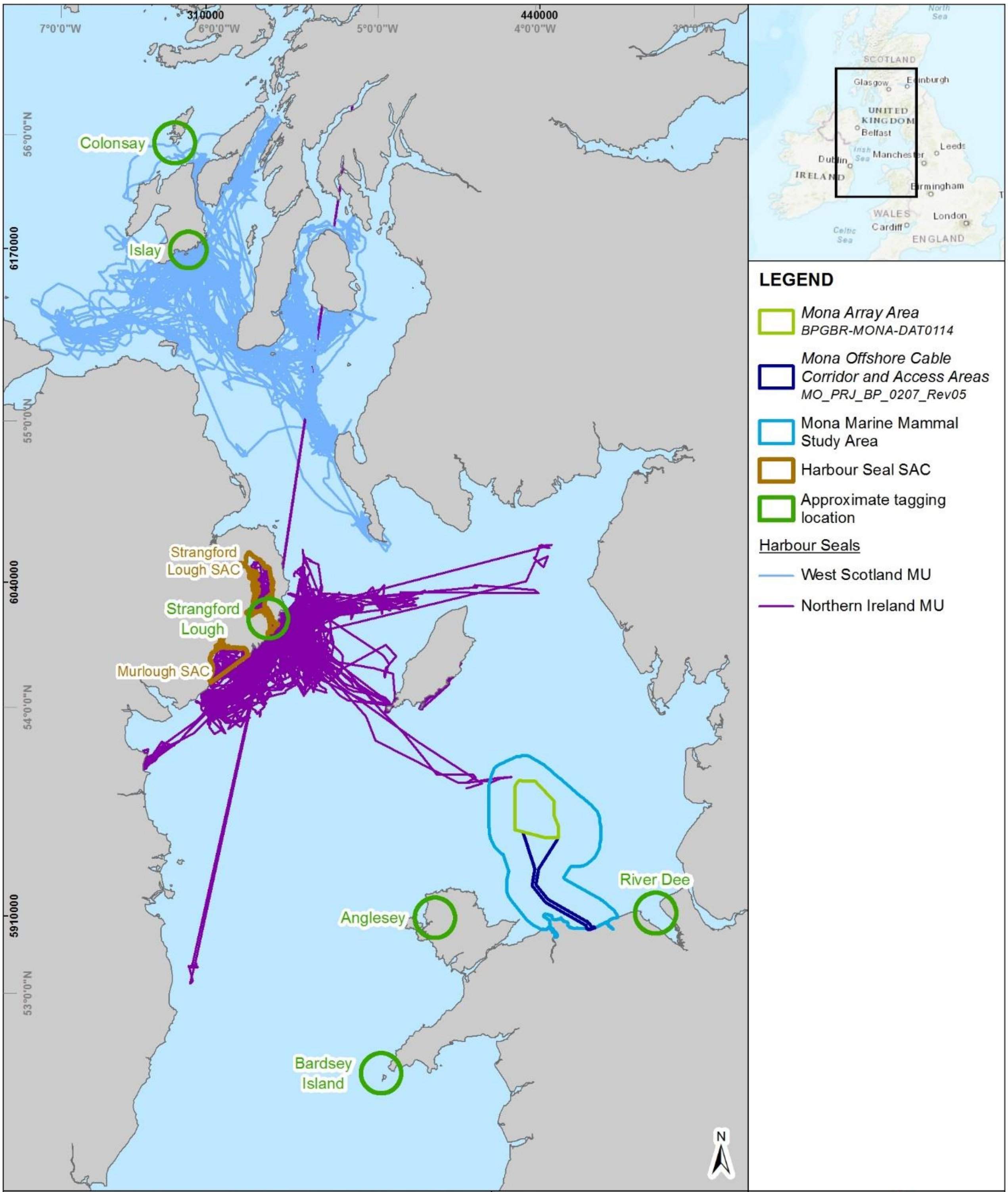


Figure 1.70: August distribution of harbour seal around the British Isles by 10 km squares based on the most recent available haul-out count data collected up until 2019. Limited data available for SMUs 10-13. Figure obtained from SCOS (2020).



Service Layer Credits: Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

Data Sources: Client, SMRU

Project Name:
MONA OFFSHORE WIND PROJECT

0 5 10 20 30 nm
0 10 20 40 60 km

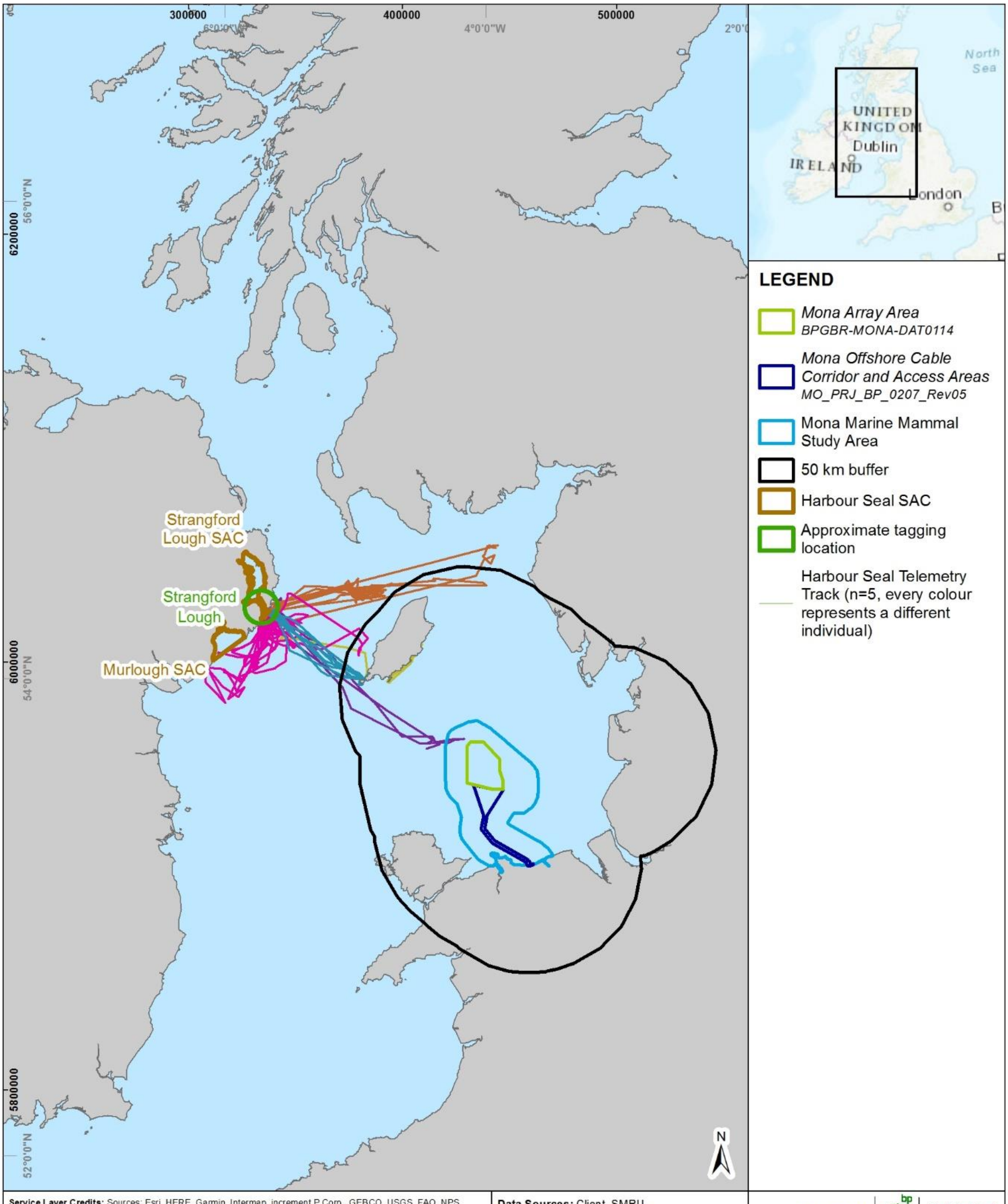
Drawing Number:
RPSE-MN-ES-MAM-036-02

Drawing Title:
TELEMETRY TRACKS FOR ALL 46 HARBOUR SEAL THAT ENTERED THE REGIONAL MARINE MAMMAL STUDY AREA (34 TAGGED IN THE NORTHERN IRELAND MU AND 12 TAGGED IN WEST SCOTLAND MU) (WRIGHT AND SINCLAIR, 2022)

Geodetic Information:
Datum: ETRS 1989
Projection: ETRS 1989 UTM Zone 30N
Scale@160mmx220mm: 1:2,500,000

VER	DATE	DETAILS	BY	CHECK
00	13/07/23	First Issue	NA	BP
02	28/09/23	Revision	MJ	TGB

Figure 1.71: Telemetry tracks for all 46 harbour seal that entered the regional marine mammal study area (34 tagged in the Northern Ireland MU and 12 tagged in West Scotland MU).



Service Layer Credits: Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

Data Sources: Client, SMRU

Project Name: MONA OFFSHORE WIND PROJECT

0 5 10 20 30 40 nm
0 10 20 40 60 80 km

Drawing Number: RPSE-MN-ES-MAM-037-02

Drawing Title: HARBOUR SEAL TELEMETRY TRACKS THAT ENTERED THE 50 KM BUFFER AND SHOWED CONNECTIVITY TO THE SURROUNDING SACS (N=5, ALL TAGGED IN NORTHERN IRELAND MU) (WRIGHT AND SINCLAIR, 2022)

Geodetic Information:
Datum: ETRS 1989
Projection: ETRS 1989 UTM Zone 30N
Scale@160mmx220mm: 1:3,000,000

VER	DATE	DETAILS	BY	CHECK
00	13/07/23	First Issue	NA	BP
02	28/09/23	Revision	MJ	TGB

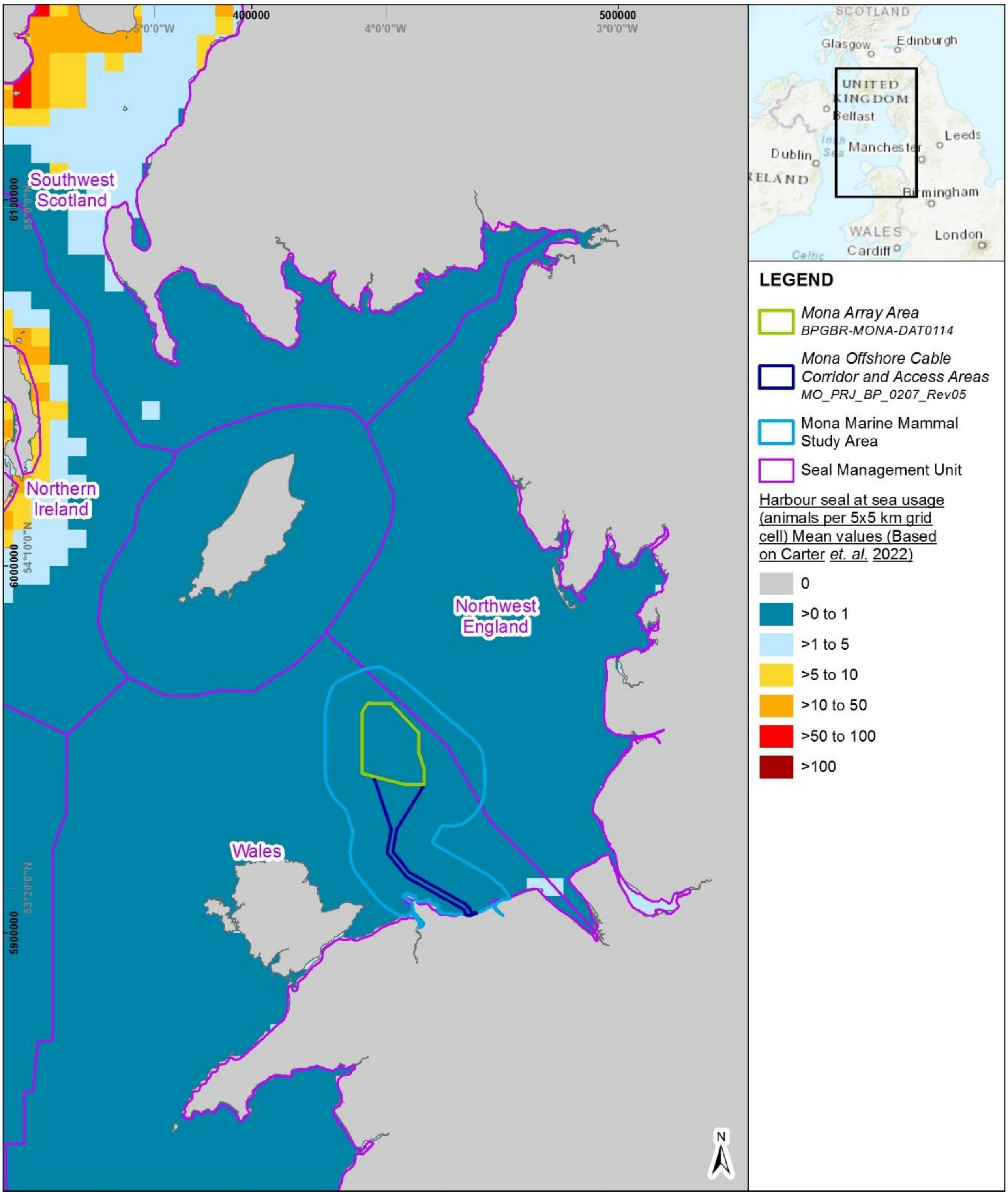
Figure 1.72: Harbour seal telemetry tracks that entered the 50 km buffer and showed connectivity to the surrounding SACs (n=5, all tagged in Northern Ireland MU).

Density/abundance

Density

1.7.8.13 The Mona Offshore Wind Project is located in the Wales and Northwest England SMUs. The nearest designated haul out sites for harbour seal in the MU in the vicinity of the Mona Offshore Wind Projects are Manx MNRs (Calf and Wart Bank, Langness, Ramsey and West Coast), and Murlough SAC, Strangford Lough SAC and The Maidens SAC.

1.7.8.14 Mean harbour seal at-sea usage in the vicinity of the Mona marine mammal study area is low (Carter *et al.*, 2022), with the main area of usage in the regional marine mammal study area along the east coast of Northern Ireland. Within the Mona Array Area plus buffer, the average density (of the mean at-sea usage) was 0.0002 animals per km^2. For the Mona Offshore Cable Corridor plus a 10 km buffer, the average density was estimated at 0.001 animals per km^2 (Figure 1.73).



Service Layer Credits: Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

Data Sources: Client, JNCC, St Andrews University

Project Name: MONA OFFSHORE WIND PROJECT

Scale bars: 0 5 10 20 nm; 0 10 20 40 km

Drawing Number: RPSE-MN-ES-MAM-038-01

Drawing Title: THE DISTRIBUTION AND PREDICTED NUMBER OF HARBOUR SEAL IN 5 KM X 5 KM GRID CELLS (MEAN AT SEA USAGE) IN THE VICINITY OF MONA OFFSHORE WIND PROJECT. SOURCE: CARTER ET AL. (2022)

Geodetic Information:
Datum: ETRS 1989
Projection: ETRS 1989 UTM Zone 30N
Scale@160mmx220mm: 1:1,750,000

VER	DATE	DETAILS	BY	CHECK
00	13/07/23	First Issue	NA	BP
01	28/09/23	Revision	MJ	TGB

Figure 1.73: The distribution and predicted number of harbour seal in 5 km x 5 km grid cells (mean at sea usage) in the vicinity of Mona Offshore Wind Project. Source: Carter *et al*. (2022).

Abundance/Counts

1.7.8.15 The most recent estimate of the UK harbour seal population (2016 to 2021) is 43,750 (approximate 95% CI: 35,800-58,300) (SCOS, 2021). This is derived by scaling the most recent composite count of 31,500 (based on surveys between 2016 and 2021) by the estimated proportion hauled out during the surveys (0.72 (95% CI: 0.54-0.88) 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 seal MUs.

1.7.8.16 In the Republic of Ireland research programmes have 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 2905 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.

1.7.8.17 The relevant seal MUs that surround the Mona Offshore Wind Project are Wales, Southwest Scotland, Wales and Northern Ireland (Figure 1.4). In the Wales and Northwest England MU, there are no dedicated harbour seal surveys routinely carried out due to the very low numbers of seals (Wright and Sinclair, 2022) but harbour seal haul-out counts for those MUs have remained steady over the survey periods. SCOS (2021) provides the latest updated estimates of harbour seal populations in the British Isles per SMU, and these are reported in Table 1.14. 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 from Lonergan *et al.* (2013).

Table 1.14: Harbour seal August haul-out counts for various survey periods. Data from SCOS (2021).

SMU	Parameter	2011 to 2015	2016-2021
Wales	Count	10	10
	Population estimate	13	13
NW England	Count	5	5
	Population estimate	6	6
Northern Ireland	Count	948	1,012
	Population estimate	1,316	1,405
Southwest Scotland	Count	1,200	1,709
	Population estimate	1,666	2,373

1.7.8.18 In the most recent survey period (from 2016 to 2019), the harbour seal haul-out counts for the Wales and Northwest England MUs were 10 and 5, respectively. When scaled by the proportion of seals hauled-out at the time of the counts to give estimated population sizes, Wales MU has an estimated population size of 13 harbour seal and Northwest England MU has an estimated population size of six harbour seal.

1.7.8.19 For the Northern Ireland MU, the haul-out count of 1,012 seals gave a population estimate of 1,405 harbour seal. The population appears to have declined slowly after 2002 in Northern Ireland MU but appears to be stable since 2011. Sites within this MU are not surveyed annually, with the most recent full survey in 2018 showing a 6.8% increase from the previous survey period (2011 to 2015).

1.7.8.20 Similarly, not all sites within Southwest Scotland MU are surveyed annually and the most recent August haul-out count of 1,709 harbour seal for the 2016-2019 count period gave a population estimate of 2,373 harbour seal in the MU. The rate of increase over the past five years was approximately 3.9% per annum (SCOS, 2021).

1.7.8.21 Connectivity presented in Figure 1.71 and Figure 1.72 demonstrates there is little overlap in at-sea space use between the Southwest Scotland MU and the three remaining MUs that cover the Irish Sea (Wales, Northern Ireland and Northwest England MU) and therefore the three seal MUs to be taken forward as the reference population (the 'Harbour Seal Reference Population') to the assessment are the combined total of the Wales, Northern Ireland and Northwest England MU population estimates (a total of 1,424 harbour seal).

1.7.8.22 Other localised estimates of abundance have been given for Strangford Lough, to the northwest of the regional marine mammal study area, as 200 animals (Lonergan, 2013). 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 region 131 harbour seal were counted, and in the Southeast 34 grey seal were counted (Figure 1.3). Using population scalars from Lonergan *et al.* (2013) this leads to population estimates of 182 harbour seal for the East region and 47 for the southeast 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).

1.7.8.23 In the Mona aerial surveys, only one harbour seal has been observed in aerial surveys, in March 2020. This led to an abundance estimate of eight within the whole Mona Aerial Survey Area.

Seasonality

1.7.8.24 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 highlighting that seasonal patterns may vary over time (Cordes *et al*., 2011).

1.8 Summary

1.8.1.1 Data gathered through a desktop review and Mona aerial surveys 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 Mona Offshore Wind Project. Key marine mammals identified within the regional marine mammal study area included: harbour porpoise, bottlenose dolphin, minke whale, short-beaked common dolphin, Risso's dolphin, grey seal and harbour seal.

1.8.1.2 Where possible, mean monthly density estimates were generated for this species using site-specific data (from Mona aerial surveys) gathered during monthly aerial digital surveys across the Mona Array Area plus 7 to 16.5 km buffer (offshore densities). Where it was not possible to estimate densities due to low sightings rates, data were sought from published sources including regional studies of key species. A summary of the mean densities for each species are provided in Table 1.15. Where site specific density estimates are suitable with acceptable CVs, they are used. If density estimates and CVs are not suitable, alternative densities are given (such as SCANS-III block estimates). For some species (i.e. harbour porpoise and bottlenose dolphin) a range of densities are presented reflecting the variability in data sources.

Harbour seal and grey seal densities were calculated using the Carter *et al.* (2022) and are provided as an offshore estimate (reflective of the Mona Array Area) and inshore estimates (reflective of the Mona Offshore Cable Corridor) (Table 1.15).

1.8.1.3 Sites designated for the conservation of internationally important populations closest to the Mona marine mammal study area include North Anglesey Marine/Gogledd Môn Forol SAC, Langness MNR, Little Ness MNR, Douglas Bay MNR, Laxey Bay MNR, Baie Ny Carrickey MNR, Calf and Wart Bank MNR, Ramsey Bay MNR, Port Erin Bay MNR, Niarbyl MNR, West Coast MNR, and North Channel SAC, West Wales Marine/Gorllewin Cymru Forol SAC and Pen Llŷn a`r Sarnau/ Llŷn Peninsula and the Sarnau SAC. These sites lie 23.67 km to 95.68 km distance from the Mona Array area (Table 1.4).

1.8.1.4 Strangford Lough SAC, Murlough 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 112.01 km to 320.28 km from the Mona Array Area (Table 1.4).

Table 1.15: Summary of marine mammal receptors to be considered in the Marine Mammal Chapter together with relevant densities and reference population sizes.

[1] Density from Evans and Waggitt (2023).

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

[3] Carter *et al* (2022) values – average densities calculated to per km^2 from 25 km^2 cells for the Mona marine mammal study area. Offshore densities are from the array area plus buffer, whilst inshore densities are the average for the Mona Offshore Cable Corridor plus buffer.

[4] All population estimates include the Isle of Man unless population estimate given separately. Based upon species specific MUs.

[5] Based upon counts in SCOS (2020) and Morris and Duck (2019) with updated scalar of 0.215 from SCOS (2021) for grey seal.

[6] From Howe (2018b).

[7] Population estimates per SMU from SCOS (2021).

Species	Density (Animals per km^2)	Management Unit (MU)	Reference population (MU)[4]
Harbour porpoise *Phocoena phocoena*	0.2773[1]	Celtic and Irish Sea	62,517
Bottlenose dolphin *Tursiops truncatus*	0.0017[1]	Irish Sea	293
Short-beaked common dolphin *Delphinus delphis*	0.0006[1]	Celtic and Greater North Seas	102,656
Risso's dolphin *Grampus griseus*	0.0313[2]	Celtic and Greater North Seas	12,262
Minke whale *Balaenoptera acutorostrata*	0.0173[2]	Celtic and Greater North Seas	20,118

Species	Density (Animals per km²)	Management Unit (MU)	Reference population (MU)[4]
Grey seal *Halichoerus grypus*	Mona Array Area plus buffer (offshore) = 0.037[3] Mona Offshore Cable Corridor and Access Areas plus buffer (inshore) = 0.180[3]	12 Wales 13 NW England 14 Northern Ireland 1 SW Scotland Isle of Man estimate East of Ireland Southeast of Ireland ('Grey Seal Reference Population' (GSRP))	3,579[5] 994[5] 2,008[5] 2,056[5] 400[6] 1,662[5] 2,211[5]
		OSPAR Region III	60,780
Harbour seal *Phoca vitulina*	Mona offshore (Array Area) = 0.0002[3] Mona inshore (Offshore Cable Corridor and Access Areas) = 0.001[3]	12 Wales 13 NW England 14 Northern Ireland (No estimate available for the Isle of Man) ('Harbour Seal Reference Population' (HSRP))	13[7] 6[7] 1,405[7]

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Appendix A: Aerial Survey data analysis

MONA OFFSHORE WIND PROJECT

Environmental Statement

Volume 6, Annex 4.1, Appendix A: Marine Mammal Aerial Survey Data Analyses

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F01

Image of an offshore wind farm

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Appendices

Tables

Figures

Glossary

Term	Meaning
Mona Aerial Survey Area	Mona Array Area plus 7 to 16.5 km buffer. The Mona Aerial Survey Area was based upon a pre-scoping original array area layout plus a buffer of 10 km. The array area was subsequently refined to give the 4 to 10 km buffer (presented in PEIR) following commencement of the marine mammal surveys. The Mona Aerial Survey Area remains unchanged from PEIR to Environmental Statement The Mona Array Area itself has reduced in spatial extent from PEIR to Environmental Statement, but it remains within the boundaries of the Mona Aerial Survey Area and results in an increased buffer region (7 km to 16.5 km).
Bio-season	Division of time into 'seasons' according to ecologically driven changes in distribution. For harbour porpoise this is winter (October to March) and summer (April to September). For grey seal this is pupping (August to November) and non-pupping (December to July).
Degrees of freedom	The number of independent pieces of information used in estimating a test statistic (e.g. a sample mean) which are free to vary, often calculated as the number of data points, or the number of categories, minus one. For instance, if the mean of a set of n values is known, n-1 values may vary, but for the given result to be correct, the n^{th} value would be determined by the other values.
Quasi-poisson	When analysing count data, a Poisson regression assumes that the variance of the data is equal to the mean. When a data set contains a lot of zero counts (is 'zero-inflated'), its mean skews towards zero while its variance may increase, and the assumptions of the Poisson regression are no longer valid. A quasi-poisson regression facilitates analysis of zero-inflated data, by accounting for this skew.

Acronyms

Acronym	Description
BEIS	Department for Business, Energy and Industrial Strategy
BHS	Bundesamt für Seeschifffahrt und Hydrographie
CI	Confidence Interval
CL	Confidence Limit
CV	Coefficient of Variation
GSD	Ground Sampling Distance
ICES	International Council for the Exploration of the Seas
MHWS	Mean High Water Springs
PEIR	Preliminary Environmental Information Report
QA	Quality Assurance
SMRU	Sea Mammal Research Unit
SPA	Special Protection Area
ZoI	Zone of Influence

Units

Unit	Description
%	Percentage
cm	Centimetre
m	Metre
km	Kilometre
km^2	Square kilometres
nm	Nautical miles
s	Seconds

A.1. Introduction

A.1.1.1.1 Mona Offshore Wind Limited (the Applicant), a joint venture of bp Alternative Energy investments (hereafter referred to as bp) and Energie Baden-Württemberg AG (hereafter referred to as EnBW) is developing the Mona Offshore Wind Project. The Mona Offshore Wind Project is a proposed offshore wind farm located in the east Irish Sea.

A.1.1.1.2 The Mona Array Area (i.e. the area of the Mona Offshore Wind Project within which the offshore wind turbines will be located) is 300 km^2 in area and is located 28.2 km (15.2 nm) from the Anglesey coastline, 46.9 km (25.3 nm) from the northwest coast of England and 46.6 km (25.2 nm) from the Isle of Man (when measured from Mean High Water Springs (MHWS)). The Mona Array Area is located in Welsh offshore waters (beyond 12 nm from the Welsh coast).

A.1.1.1.3 To inform the baseline for marine mammals and offshore ornithology, the Applicant commissioned aerial surveys, undertaken by APEM Ltd., across the Mona Array Area plus appropriate buffer. For the Mona Array Area, the aerial surveys commenced in March 2020 and were undertaken monthly, with a total of 24 months of data collected up until February 2022. Comparisons with data collected from the Mona Survey Area should be made with care, since estimates here are calculated from 24 months of data.

A.1.1.1.4 The Mona Aerial Survey Area remains unchanged from the Preliminary Environmental Information Report (PEIR) to Environmental Statement. It was based upon a pre-scoping original array area layout plus a buffer of 10 km. The array area was subsequently refined to the Mona PEIR Array Area to give the 4 to 10 km buffer around the Mona PEIR Array Area (as presented in PEIR) following commencement of the marine mammal surveys. However, the Mona Array Area itself has reduced in spatial extent from PEIR to Environmental Statement, but it remains within the boundaries of the Mona Aerial Survey Area and results in an increased buffer region (7 to 16.5 km).

A.1.1.1.5 The extent of the Mona Aerial Survey Area provides an indication of marine mammal activity over the Mona Array Area and beyond, and therefore will be useful to determine where Zones of Influence (ZOIs) for some impacts associated with the Mona Offshore Wind Project extend further than the Mona Array Area (although may not cover the full extent of the ZOI for all impacts (e.g. piling noise)). The Mona Aerial Survey Area also covers the offshore section (area beyond 12 nm from the coast) of the Mona Offshore Cable Corridor and Access Areas.

A.2. Methodology

A.2.1 Study area

A.2.1.1 Mona

A.2.1.1.1 The Mona Aerial Survey Area comprising the Mona Array Area plus 7 to 16.5 km buffer is located off the west coast of the UK, in the Liverpool Bay area of the Irish Sea (Figure A.1). Due to the proximity to the survey area to the Liverpool Bay Special Protection Area (SPA) an original buffer of 4 km to 10 km around the Mona PEIR Array Area was chosen (see paragraph A.1.1.1.4), bringing the total area surveyed to 1,447 km^2. The Mona Array Area was refined following commencement of the digital aerial surveys (see paragraph A.1.1.1.4).

A.2.1.1.2 Surveys started in March 2020 and ended in February 2022.

A.2.2 Survey approach

A.2.2.1.1 The Mona aerial surveys have been undertaken by APEM. APEM used a grid-based collection method in which imagery of 30% of the sea surface was collected, and 15.2% of the Mona Aerial Survey Area was analysed. For context, it has been suggested baseline studies should collect a minimum of 10% coverage (Bundesamt für Seeschifffahrt und Hydrographie (BSH), 2013), noting that the BSH study was based on transect-based surveys and it has been suggested that due to the high number of replicates achieved from grid-based surveys this method requires less coverage compared to transect-based surveys (Coppack *et al.,* 2017; Weidauer *et al.,* 2016). APEM utilised a bespoke camera system fitted into a twin-engine aircraft and custom flight planning software allowed each flight line to be accurately mapped for use before and during the flight.

A.2.2.1.2 The camera system captured abutting still imagery along 18 survey lines spaced approximately 2 km between-track. The aircraft collected the data at an altitude of approximately 396 m, and a speed of approximately 120 kn. The data collected were 1.5 cm Ground Sampling Distance (GSD) digital still images, and coverage was met for each survey. Sea states are categorical values used to give an approximate but concise description of sea condition, as this will affect the probability of a sighting. Sea state conditions used in the aerial survey were 0 = Calm (Glassy), 1 = Calm (Rippled), 2 = Smooth, 3 = Slightly Moderate and 4 = Moderate.

A.2.2.1.3 All surveys were undertaken in weather conditions that did not compromise the ability to provide data on the identification, distribution and abundance of marine megafauna and were also safe to fly in. Favourable conditions for surveying are defined as a cloud base of >396 m, visibility of >5 km, wind speed of <30 km and a sea state of no more than four (moderate).

A.2.2.1.4 Measures were taken to minimise glint and glare (strong reflected light off the sea), that makes finding and identifying marine megafauna more difficult. On days with minimal cloud, surveys were avoided for two hours around midday. This reduced the risk of collecting images that are difficult to analyse. Due to weather constraints some surveys were undertaken over more than one day; where this was the case, the survey was undertaken at the very next opportunity. In other surveys two flights were needed to cover the survey area whilst avoiding non-optimal sun angle.

A.2.3 Processing of aerial data

A.2.3.1.1 The images were analysed to enumerate marine mammals to species level, where possible. Internal Quality Assurance (QA) was undertaken to check for missed targets and to ensure the correct species were identified. Marine mammals identified from the images were ‘snagged’ (i.e. located within the images) and categorised to the lowest taxonomic level possible.

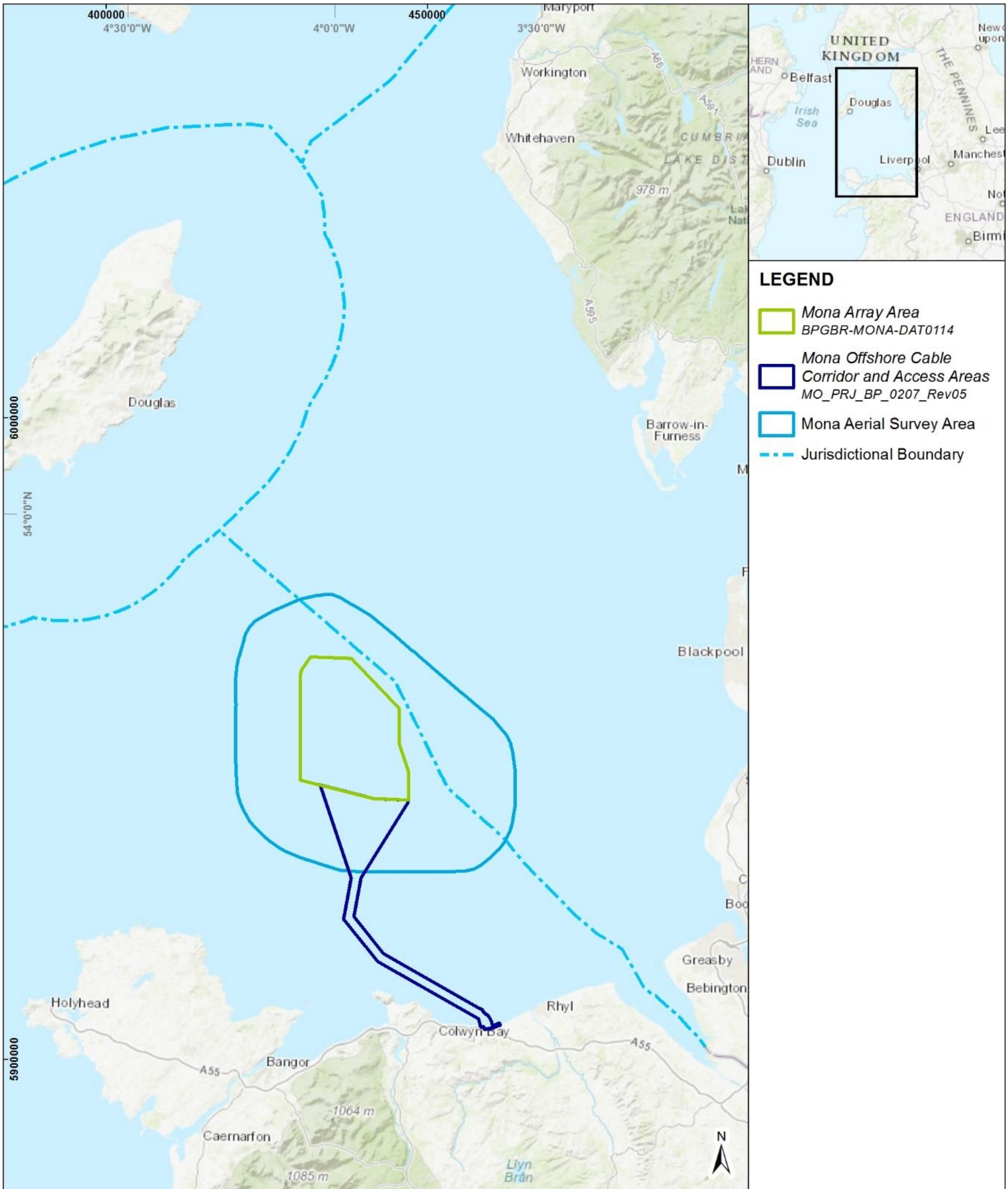
A.2.3.1.2 The analysis was undertaken by senior image analysts with at least two years of full-time experience. Image analysts receive ongoing identification training from APEM’s QA Manager and have access to a regularly updated in-house Image Archive reference library to aid in the identification of marine mammals. As part of the image analysis process the size of individuals can also be measured, which can aid in species-level identification. Images are always reviewed by a minimum of two members of staff as part of a comprehensive internal QA process. APEM have included their Senior Marine Mammal Consultant and Principal Marine Mammal

Consultant in the QA process of all marine mammal images, holding a minimum of five years' experience at identifying marine mammals to species level nationally and internationally.

A.2.3.1.3 APEM's marine mammal consultancy team includes:

- Helen Hedworth: Principal Marine Mammal Consultant, with experience of environmental impact assessment coordination, and marine mammal and noise monitoring and mitigation for offshore and coastal development projects
- Dr Ross Culloch: Technical Specialist, Ross joined APEM at the end of February 2022 from Marine Scotland Science, bringing a wealth of expertise in the field of marine mammal ecology, conservation and management.
- Ashleigh Kitchiner; a Senior Marine Mammal Consultant with a comprehensive knowledge of marine mammal ecology and six years of experience in providing services from survey design and execution to post-processing analysis.

A.2.3.1.4 APEM uses the precautionary principle and only identifies species to a level they are 100% confident with. Accurate identification is based upon species level ID, and if a target cannot be identified to species level it is assigned to the next taxonomic level possible.



Service Layer Credits: Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community	**Data Sources:** Client,	EnBW bp Partners in UK offshore wind / rps
Project Name: MONA OFFSHORE WIND PROJECT	0 5 10 nm 0 10 20 km	**Drawing Number:** RPSE-MN-ES-MAM-040-01
Drawing Title: MONA MARINE MAMMAL AERIAL SURVEY AREA	**Geodetic Information:** Datum: ETRS 1989 Projection: ETRS 1989 UTM Zone 30N Scale@160mmx220mm: 1:1,000,000	

VER	DATE	DETAILS	BY	CHECK
00	27/07/23	First Issue	NA	BP
01	29/09/23	Revision	MJ	TGB

Figure A.1: Mona marine mammal Aerial Survey Area.

A.2.3.1.5 Summary statistics (monthly sightings, monthly mean density, group size) were produced to describe the data for each of the key species or species groups within the aerial survey dataset.

A.2.4 Density estimates with bootstrapping

A.2.4.1.1 Statistically robust, design-based baseline population estimates for marine mammals identified in the Mona Aerial Survey Area were calculated. For each aerial digital survey, species-specific abundances and density estimates for the Mona Aerial Survey Area were produced, with upper and lower confidence limits and precision estimates in the form of a Coefficient of Variation (CV). The input data comprised of geo-referenced locations of marine mammals contained within each individual digital still image, which were used to generate the raw counts for the analysis. Only individuals located within the Mona Aerial Survey Area boundaries (Mona Array Area and buffer shapefiles) were used to calculate the population estimates.

A.2.4.1.2 Non-parametric bootstrap methods were used for variance estimation. A variability statistic was generated by re-sampling 999 times with replacement from the raw count data. The statistic was evaluated from each of these 999 bootstrap samples and upper and lower 95% Confidence Intervals (CI) of these 999 values taken as the variability of the statistic over the population (Tibshirani and Efron, 1993). Measures of precision were calculated using a negative binomial estimator, suitable for a pseudo-Poisson over-dispersed distribution (Elliott 1977). This produced a poisson CV, labelled 'Precision' in APEM reporting, based on the relationship of the standard error to the mean. A target precision of ≤0.16 allows the detection of a population change of a factor as small as two (Bohlin 1990).

A.2.4.1.3 For marine mammals however, it is unlikely that low CVs would be obtainable. It is not always possible to achieve the 0.16 target precision on species with lower abundances, as the calculation uses both the sample number and encounter rate. To get a sufficient sample size for cryptic species, in particular species that spend the majority of their life underwater such as cetaceans, a high level of survey effort would be required. CVs will be higher for marine mammals, due to very low sighting numbers given their life history, so the difference between raw counts would be proportionally greater. Literature has highlighted CVs for marine mammal abundances can be large (Taylor *et al*., 2007), and detecting population trends is difficult due to small sample size and relatively large uncertainty in abundance or density estimates (Authier *et al*., 2020). Expert groups (International Council for the Exploration of the Seas (ICES), 2008; 2014; 2016) have discussed this at length, but statistical power to detect change remained low (ICES, 2016; OSPAR, 2017). Furthermore, there will be big differences between species and months due to abundance and distribution within the Mona Aerial Survey Area. As discussed in 2.5.1.2, for density modelling, where possible species categories were grouped to give higher sample numbers to improve power and CVs and provide more conservative estimates of density.

A.2.4.1.4 All analysis and data manipulation were conducted in the R programming language (R Development Core Team, 2022) and non-parametric 95% confidence intervals were generated using the 'boot' library of functions (Canty & Ripley 2021).

A.2.4.1.5 Raw counts, abundance, confidence limits and precision (Poisson CV) were provided monthly (where animals were present) for each species for the Mona Aerial Survey Area.

A.2.5 Model-based density estimates

A.2.5.1.1 For the Mona Aerial Survey Area data were imported into R statistical software v4.2.0 (R Core Team, 2022), and the MRSea package v1.3.1 (Scott-Hayward *et al*., 2013) was used in the analysis to best predict the density of marine mammals within the Mona Aerial Survey Area.

A.2.5.1.2 When carrying out density estimates, based on the frequency of occurrence of known species across the Mona Aerial Survey Area, unidentified seal species were considered most likely to be grey seal and as such were grouped together. Whilst unidentified seals were assigned to grey seal, it is noted that this does not discount the possibility that unidentified seal species may have been harbour seal.

A.2.5.1.3 Months were initially modelled separately, however this approach was not found to be robust due to data being too sparse to fit MRSea models. Next data were explored by pooling across months within the meteorological seasons (winter: December, January, February; spring: March, April, May; summer: June, July, August; and autumn: September, October, November) to overcome this issue, incorporating the biological assumption that species behave similarly within each season. Again, data pooled by meteorological season also proved too sparse for robust analysis. Finally, data were pooled into two “bio-seasons” according to species, (discussed in detail in the paragraphs 3.6.1.1, and 3.6.1.2, in the relevant species modelling accounts) and this proved to be the most statistically robust approach. For completeness, however, the results of all three modelled approaches have been presented in this report.

A.2.5.1.4 The following covariates were used within all modelling to predict species distribution:

- Bathymetry (depth and ruggedness)
- Distance to coast
- Latitude and longitude
- Season.

A.2.5.1.5 The degree of smoothing for each species and season was determined within the MRSea software using tenfold cross validation and a range of different models were explored to determine the best model to predict species distribution. Within each of the exploratory models, separate maps with associated 95% lower and upper confidence intervals were also produced for each species and season.

A.2.5.1.6 Before any analyses could take place, the data had to be pre-processed to ensure no survey date/time data were missing from image identifiers, which would prevent accurate assignment and cross-referencing of observations. This occurred in just six out of 23,588 cases, which were removed from further analysis.

A.2.5.1.7 In total, for the Mona Aerial Survey Area, 432 survey transects were used in the analysis (18 flight lines, for 24 months) which covered a total aerial survey area of 5,293.82 km^2 and collected 23,588 images (mean 0.22 km^2 (SE = $1.2e^{-4}$) coverage per image).

A.2.6 Data limitations

A.2.6.1 Snap-shot data

A.2.6.1.1 Aerial survey data represents a snapshot of marine mammal distribution and densities within a given survey month and may not fully capture the natural variability of marine mammal distribution or densities over time. Changes in sightings rates may be influenced by environmental conditions; however, due to the short time frames (single day) of data collection, this has not been possible to analyse. Therefore, whilst differences in sightings rates between months may be due to seasonal changes, environmental conditions also have the potential to influence these results.

A.2.6.2 Bias

A.2.6.2.1 Availability bias – an estimator of the probability that an animal is available at any randomly chosen time – is used as multiplier to account for the period of time that each species may be available for detection. In the case of aerial digital surveys, the time when an animal is available for detection is during the period that an animal is on the sea surface or just below the surface.

A.2.6.2.2 Availability bias is likely to be influenced by extrinsic factors that combine to produce a situation that is unique to each survey: factors such as light conditions, water clarity (turbidity), and animal behaviour can influence whether an animal will be detected, particularly those beneath the water surface. In most cases (section A3.2.2), animals were noted and identified from digital images where the animal is under the sea surface. The depth at which reliable interpretation of images is assured will therefore rely considerably on the factors mentioned and for this reason availability bias may differ from month to month.

A.2.6.2.3 Estimates of availability bias during aerial surveys are often based on studies looking at diving behaviour of a species, which provide a correction factor for the proportion of time that animals are under the sea surface and therefore not available for detection. For the purpose of this assessment, correction factors were derived from studies in the Baltic and North Seas. The caveat here is that species correction factors are unlikely to be a true representation of availability bias from one region to another, or from one month to the next, due to the potential spatial and temporal differences in environmental conditions. However, a precautionary approach was taken by reviewing the literature to compare correction factors from different studies and different months and then applying a conservative estimate (see section 3.6.1.5 and 3.6.1.8).

A.2.6.2.4 Perception bias – where an animal is available for detection, but the detection is missed – is less of a limiting factor during digital aerial surveys compared to visual boat-based surveys since the high-definition video utilised during digital aerial surveys captures all animals on the sea surface, or just under the sea surface, and the detection is not influenced by the ability of an observer to detect an animal. In addition, during data processing, a 20% subsample of the data were quality assured to ensure that images were not overlooked and therefore the potential for perception bias is negligible.

A.2.6.2.5 Similarly, response bias, where an animal may respond to the presence of the platform (either moving towards or away from the platform), is considered to be less of a limiting factor for aerial surveys compared to boat-based surveys. Therefore, the potential for response bias is negligible.

A.2.6.3 Species identification

A.2.6.3.1 Animals were identified first to a species group (e.g. seals) and then to species level where possible (for example grey seal or harbour seal). For seals, the identification to species level is more difficult as it is not always possible to distinguish between species where an individual is submerged. A subsample of data was subject to an external QA process by a third-party marine mammal expert to ensure agreement in identification. Where a full species identification could not be made, rather than discarding data, where possible the animal sighting was assigned to a species based on the representation of the key species within the Mona Aerial Survey Area.

A.3. Results

A.3.1 Summary data

A.3.1.1 Survey descriptions

A.3.1.1.1 Coverage was evenly spaced over the survey areas (as discussed in A.2.2.1.2) and is presented in Figure A 2. A summary of monthly survey coverage is presented in Table A.1, presented as area (km^2) and as a percentage of the Mona Aerial Survey Area (1,447 km^2) per month. As per paragraph A.2.2.1.1, baseline studies should collect a minimum of 10% coverage (BSH, 2013). As well as the figures presented, 18 records were unable to be used due to incomplete information, and these were removed from the analyses. The total area corresponding to the removed records was 0.55 km^2 across the whole 24-month survey campaign.

A.3.1.1.2 This provided consistent spatial coverage of the Mona Aerial Survey Area monthly for two years (March 2020 to February 2022), which spanned seasonal breeding seasons for marine mammals (such as harbour porpoise (bio-seasons used described in A.3.6.1.10) and grey seal (bio-seasons used described in A.3.6.1.20)).

A.3.1.1.3 A summary of the survey dates and conditions during surveys of the Mona Array Area is given in Table A.2. The majority of surveys were carried out in sea states of 1 with good visibility (≥10 km in 22 months, 7-10+ and 5-10+ in two months), and no surveys were cancelled or postponed into later months.

Table A.1: Monthly survey effort across the Mona Aerial Survey Area.

Survey no.	Survey month	Survey coverage (km^2)	Survey coverage (% Mona Aerial Survey Area)
1	March 2020	228.75	15.81
2	April 2020	218.03	15.07
3	May 2020	256.97	17.76
4	June 2020	216.62	14.97
5	July 2020	215.57	14.90
6	August 2020	216.06	14.93
7	September 2020	221.72	15.32
8	October 2020	222.68	15.39
9	November 2020	217.21	15.01
10	December 2020	219.98	15.20

Survey no.	Survey month	Survey coverage (km^2)	Survey coverage (% Mona Aerial Survey Area)
11	January 2021	214.95	14.85
12	February 2021	218.10	15.07
13	March 2021	219.37	15.16
14	April 2021	215.49	14.89
15	May 2021	217.60	15.04
16	June 2021	215.82	14.91
17	July 2021	216.11	14.94
18	August 2021	225.03	15.55
19	September 2021	214.75	14.84
20	October 2021	212.83	14.71
21	November 2021	220.57	15.24
22	December 2021	220.96	15.27
23	January 2022	217.83	15.05
24	February 2022	217.22	15.01

Table A.2: Survey dates and conditions during surveys for the Mona Aerial Survey Area.

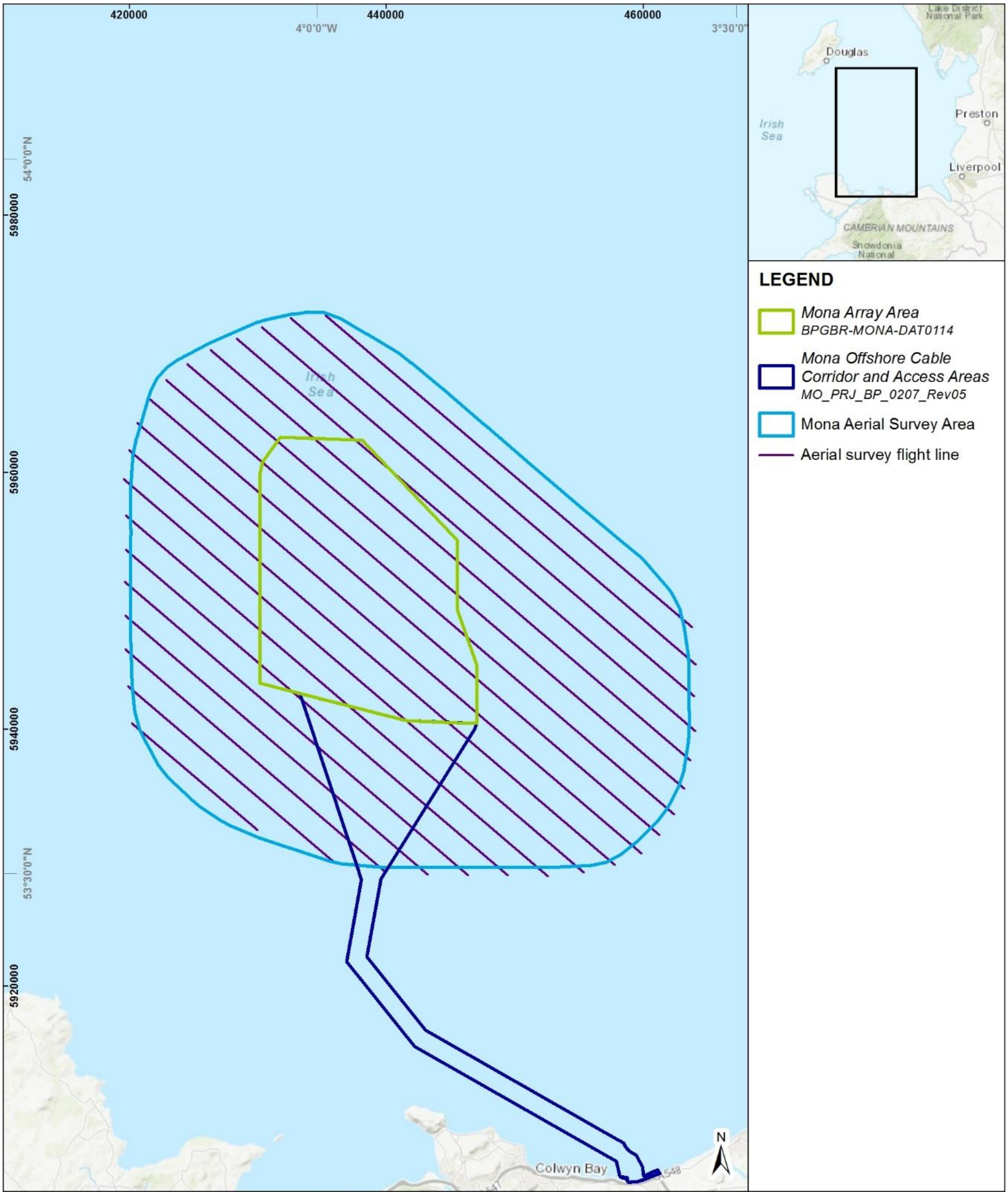
1 Sea state categories: 0 = Calm (Glassy), 1 = Calm (Rippled), 2 = Smooth, 3 = Slightly Moderate, 4 = Moderate

2 Turbidity categories: 0 = Clear, 1 = Slightly Turbid, 2 = Moderately Turbid, 3 = Highly Turbid

3 Cloud cover coverage categories: 0 = Clear, 1 – 10 = Few, 11 – 50 = Scattered, 51 – 95 = Broken, 96 – 100 = Overcast

Survey no.	Month	Date	Visibility	Sea state[1]	Glint / Glare (%)	Turbidity[2]	Cloud cover (%)[3]	Air Temp (°C)	Wind speed (knots) / Direction
1	March 2020	28/03/2020	10+	0	<10	1	60	0-1	10–20 / NE
2	April 2020	17/04/2020	10+	2-4	0-40	1	50-100	4–7	20–25 / E–SE
3	May 2020	05/05/2020	10+	2-4	0-30	1	0-50	8–15	15–20 / SE
4	June 2020	08/06/2020	10+	1-2	0-20	0-1	0-100	9–10	5–10 / SE–W
5	July 2020	06/07/2020	10+	1-3	<10	0.5	10	11	12–25 / NW
6	August 2020	11/08/2020	7-10+	0	0-10	0	100	20	8–20 / SE
7	September 2020	01/09/2020	10+	1	-	1	1-50	13	6 / SE
8	October 2020	14/10/2020	10+	1	0-10	1-2	5-40	10-12	10–20 / NE–E

Survey no.	Month	Date	Visibility	Sea state[1]	Glint / Glare (%)	Turbidity[2]	Cloud cover (%)[3]	Air Temp (°C)	Wind speed (knots) / Direction
9	November 2020	04/11/2020	10+	1	-	1	11-95	8-10	15–25 / NW
10	December 2020	09/12/2020	10+	1-2	0-5	2	90-100	2-4	14–16 / SW
11	January 2021	04/01/2021	10+	2-3	0-5	1	30-100	4	10–18 / N–NNE
12	February 2021	01/02/2021	10+	1	0	1	75-100	1	15–20 / ESE
13	March 2021	12/03/2021	10+	2-3	0	2	50-100	11	35 / W
14	April 2021	01/04/2021	10+	2	5	0	0-100	6-16	17–23 / SE
15	May 2021	06/05/2021	10+	1.5	0	1-2	20	3	22 / NNW
16	June 2021	08/06/2021	10+	1	0-30	2	50-75	16-22	5–10 / SW
17	July 2021	05/07/2021	10+	1-2	0-40	1	20-40	10	10 / SW
18	August 2021	09/08/2021	10+	2-3	0-100	1-2	30-100	8	10 / WNW
19	September 2021	02/09/2021	10+	1	0-30	1	100	11	15–19 / ENE
20	October 2021	06/10/2021	5-10+	1	0	1.5	0	10-12	15 / NW
21	November 2021	03/11/2021	15+	3	0-25	1	45-80	6-7	15–22 / N–NNE
22	December 2021	02/12/2021	10+	2-3	0-10	1-2	10-40	2-3	15–20 / N
23	January 2022	11/01/2022	10+	1	0	2	20-60	2	10 / NNW
24	February 2022	09/02/2022	10+	1	0-20	2	10-50	4	15–26 / SW



Service Layer Credits: Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

Data Sources: Client,

Project Name: MONA OFFSHORE WIND PROJECT

Scale bar: 0 – 2.5 – 5 nm; 0 – 5 – 10 km

Drawing Number: RPSE-MN-ES-MAM-058-01

Drawing Title: MONA MARINE MAMMAL AERIAL SURVEY FLIGHT LINES

Geodetic Information:
Datum: ETRS 1989
Projection: ETRS 1989 UTM Zone 30N
Scale@160mmx220mm: 1:500,000

VER	DATE	DETAILS	BY	CHECK
00	25/08/23	First Issue	NA	AR
01	29/09/23	First Issue	NA	AR

Figure A 2: Aerial survey flight lines for the Mona Aerial Survey Area.

A.3.1.2 Counts by species

A.3.1.2.1 Marine mammal counts are presented in Table A.3. Harbour porpoise accounted for the highest number of individuals identified to species level (based on raw count data) across the Mona Aerial Survey Area, and was recorded in all survey months except for July, November and December 2020 (Table A.3). Highest encounters were in January 2022 with a total of 25 harbour porpoise.

A.3.1.2.2 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 was small (Table A.3). Bottlenose dolphin were encountered in two months of the year (June 2021 and January 2022), with highest in June 2021 where four animals (two groups of two individuals) were counted. Risso's dolphin were encountered in just one month of the year (November 2020), with two animals sighted together. One harbour seal was encountered, in March 2020 only.

A.3.1.2.3 There were also a number of cetacean sightings ('dolphin species', 'dolphin/porpoise') that could not be assigned to species level (n = 163), which had high sightings and frequency. Similarly, there were a large number of sightings classified as 'seal species' or 'phocid species' due to the issue of identifying to species level from aerial survey data. For the purposes of further analyses these were assigned to grey seal as this was the most commonly occurring seal species across the Mona Aerial Survey Area (i.e. there was only one sighting of one individual identified as harbour seal in the whole 24 months of survey). There were a number of animals (n = 22) that were classified as 'marine mammal species' which could not be identified down to species level.

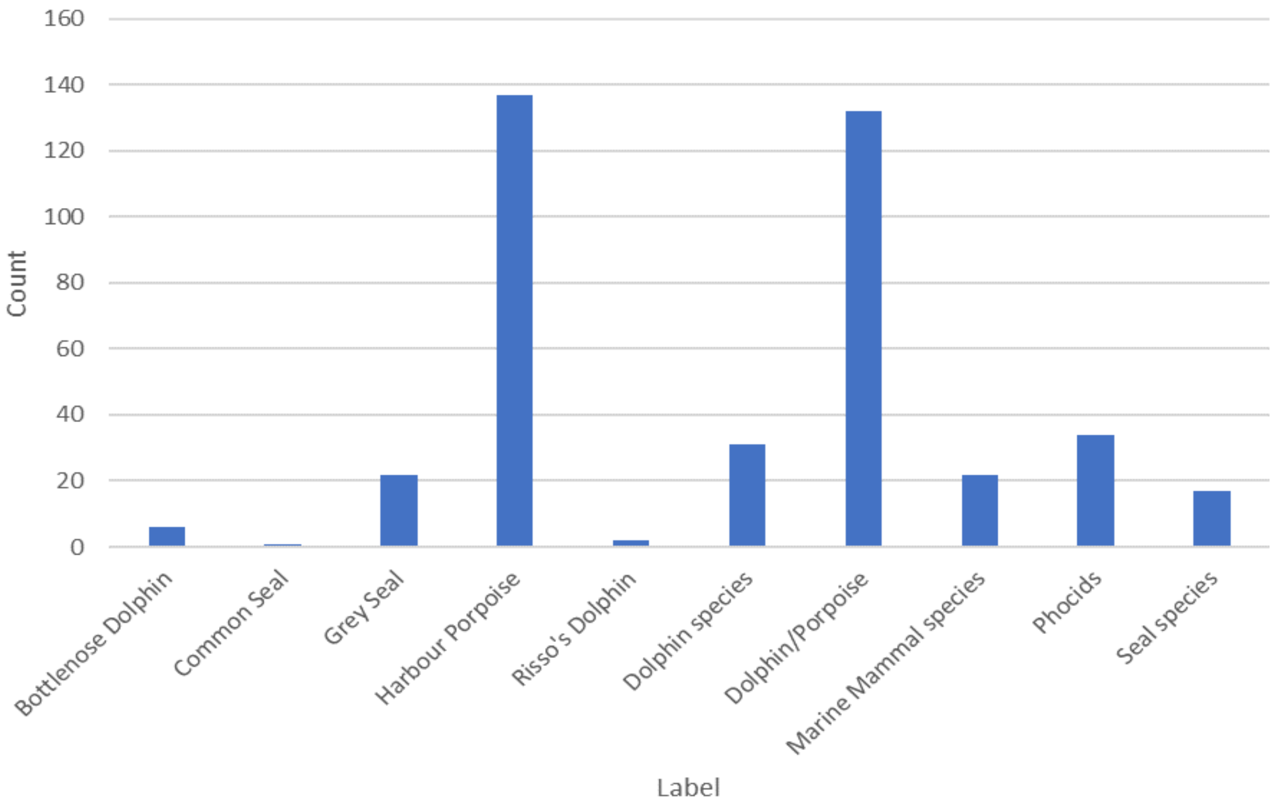


Figure A.3: Marine mammal sightings classified by label, in the Mona Aerial Survey Area. Species names are 'definite' confidence sightings.

Table A.3: Monthly raw sightings data (number of animals) across the Mona Aerial Survey Area.

*For the purposes of analyses the two dates given in the APEM data for October (06/10/2021 and 08/10/2021) have been combined to provide one data entry for the month of October, and grouped under October 2021, as in the APEM Aerial survey report.

			Species level identification				Non-species level identification					
Survey number	**Month survey**	**Date**	**Harbour porpoise**	**Bottlenose dolphin**	**Risso's dolphin**	**Common seal**	**Grey seal**	**Dolphin species**	**Dolphin/ Porpoise**	**Phocids**	**Seal species**	**Marine mammal species**	**Total**
1	March 2020	28/03/2020	7	-	-	1	2	2	28	5	-	-	**48**
2	April 2020	17/04/2020	-	-	-	-	-	-	5	3	-	-	**8**
3	May 2020	05/05/2020	3	-	-	-	1	1	3	-	-	-	**11**
4	June 2020	08/06/2020	7	-	-	-	-	-	10	-	-	-	**27**
5	July 2020	06/07/2020	-	-	-	-	-	-	10	3	-	-	**18**
6	August 2020	11/08/2020	3	-	-	-	-	-	9	1	-	-	**13**
7	September 2020	01/09/2020	6	-	-	-	1	1	20	1	-	-	**44**
8	October 2020	14/10/2020	2	-	-	-	-	-	-	-	-	-	**2**
9	November 2020	04/11/2020	-	-	2	-	1	1	2	1	-	-	**6**
10	December 2020	09/12/2020	-	-	-	-	-	-	2	6	-	-	**8**
11	January 2021	04/01/2021	5	-	-	-	-	-	2	2	-	-	**10**
12	February 2021	01/02/2021	8	-	-	-	5	5	10	1	-	-	**24**

			Species level identification				Non-species level identification						
13	March 2021	12/03/2021	5	-	-	-	2	2	9	4	-	-	**21**
14	April 2021	01/04/2021	1	-	-	-	-	-	5	7	-	-	**17**
15	May 2021	06/05/2021	1	-	-	-	-	-	2	-	-	-	**4**
16	June 2021	08/06/2021	11	4	-	-	1	1	1	-	1	1	**18**
17	July 2021	05/07/2021	15	-	-	-	1	1	1	-	2	2	**19**
18	August 2021	09/08/2021	3	-	-	-	-	-	10	-	1	1	**14**
19	September 2021	02/09/2021	3	-	-	-	1	1	-	-	-	-	**5**
20	October 2021	06/10/202*	6	-	-	-	1	1	-	-	-	-	**7**
21	November 2021	03/11/2021	2	-	-	-	-	-	-	-	3	3	**5**
22	December 2021	02/12/2021	14	-	-	-	-	-	-	-	6	6	**20**
23	January 2022	11/01/2022	25	2	-	-	3	3	-	-	2	2	**32**
24	February 2022	09/02/2022	10	-	-	-	3	3	3	-	2	2	**23**
Total			**137**	**6**	**2**	**1**	**22**	**31**	**132**	**34**	**17**	**22**	**404**

A.3.2 Group size

A.3.2.1.1 Group size was calculated using source image files. Any image that had more than one animal in it was deemed a group, as they occur within a close enough vicinity to each other. Average group size was given per month, calculated across both survey years, alongside minimum and maximum group sizes for species and for those non-species-specific groupings (Table A.4).

A.3.2.1.2 The mean group size for harbour porpoise was 1.24 animals, with the minimum group size of 1.17 and maximum of 2.25 animals. For bottlenose dolphin and Risso's dolphin the mean group size was 2 animals, with a minimum and maximum of 2 animals.

A.3.2.1.3 Whilst grey seal were observed in most of the months, they were only observed as one animal per image (therefore not a group). Only one harbour seal was observed.

Table A.4: Monthly mean, minimum and maximum group sizes for species sightings across the Mona Aerial Survey Area.

	Bottlenose Dolphin			Common Seal			Risso's dolphin			Harbour porpoise			Grey seal		
Month	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max
Jan	2									1.3	1	3	1	1	1
Feb										1.29	1	4	1	1	1
Mar				1	1	1				1.33	2	2	1	1	1
Apr										1	1	1			
May										1	1	1	1	1	1
Jun	2	2	2							1.13	1	2	1	1	1
Jul										1.14	1	4	1	1	1
Aug										1.2	1	2			
Sep										1.13	1	2	1	1	1
Oct										1.33	1	2	1	1	1
Nov							2	2	2	2	2	2	1	1	1
Dec										1.08	1	2			
Mean	2	2	2	1	1	1	2	2	2	1.24	1.17	2.25	1	1	1

Table A.5: Monthly mean, minimum and maximum group sizes for non-species-specific grouping sightings across the Mona Aerial Survey Area.

	Marine mammal species			Phocids			Seal species			Dolphin species			Dolphin/Porpoise		
Month	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**
Jan	1	1	1	1	1	1	1	1	1				1	1	1
Feb	1.3	1	2	1	1	1	1	1	1				1.18	1	2
Mar	1.2	1	2	1	1	1							1.19	1	3

	Marine mammal species			Phocids			Seal species			Dolphin species			Dolphin/Porpoise		
Apr	1	1	1	1	1	1				1	1	1	1.25	1	2
May	1	1	1							1.5	1	2	1	1	1
Jun							1	1	1	1.25	1	2	1	1	1
Jul	1.33	1	2	1	1	1	1	1	1	1	1	1	1.38	1	2
Aug				1	1	1	1	1	1				1.27	1	4
Sep	1	1	1	1	1	1				2	1	7	1.18	1	3
Oct															
Nov				1	1	1	1	1	1				1	1	1
Dec				1	1	1	1	1	1				2	2	2
Mean	1.11	1	1.43	1	1	1	1	1	1	1.35	1	2.60	1.22	1.09	2

A.3.2.2 Surfacing and submerged behaviour

A.3.2.2.1 Some months had no surfacing animals (May 2020, August 2020, December 2020, January 2021, September 2021) but there was not a distinct seasonal pattern to this. In November 2021, the number of sightings based on surfacing animals were higher compared to submerged animals. In October 2020 and November 2021, the number of sightings of surfacing animals and submerged animals were equal. All other months had more submerged animals than surfacing animals. It is considered possible that as water clarity decreases (e.g. during winter months), the depth at which an animal is able to be detected would decrease and therefore the proportion of animals recorded when submerged would also decrease during those months, but there is no evidence of this in the aerial surveys and no distinct seasonal patterns.

A.3.2.2.2 There were also inter-species differences noted in the surfacing categories for species identified to species level (Figure A.4). Bottlenose dolphin, Risso's dolphin, and harbour seal were all identified as submerged, with only grey seal and harbour porpoise having identifications at the surface. However, all species were observed more frequently submerged than at the surface.

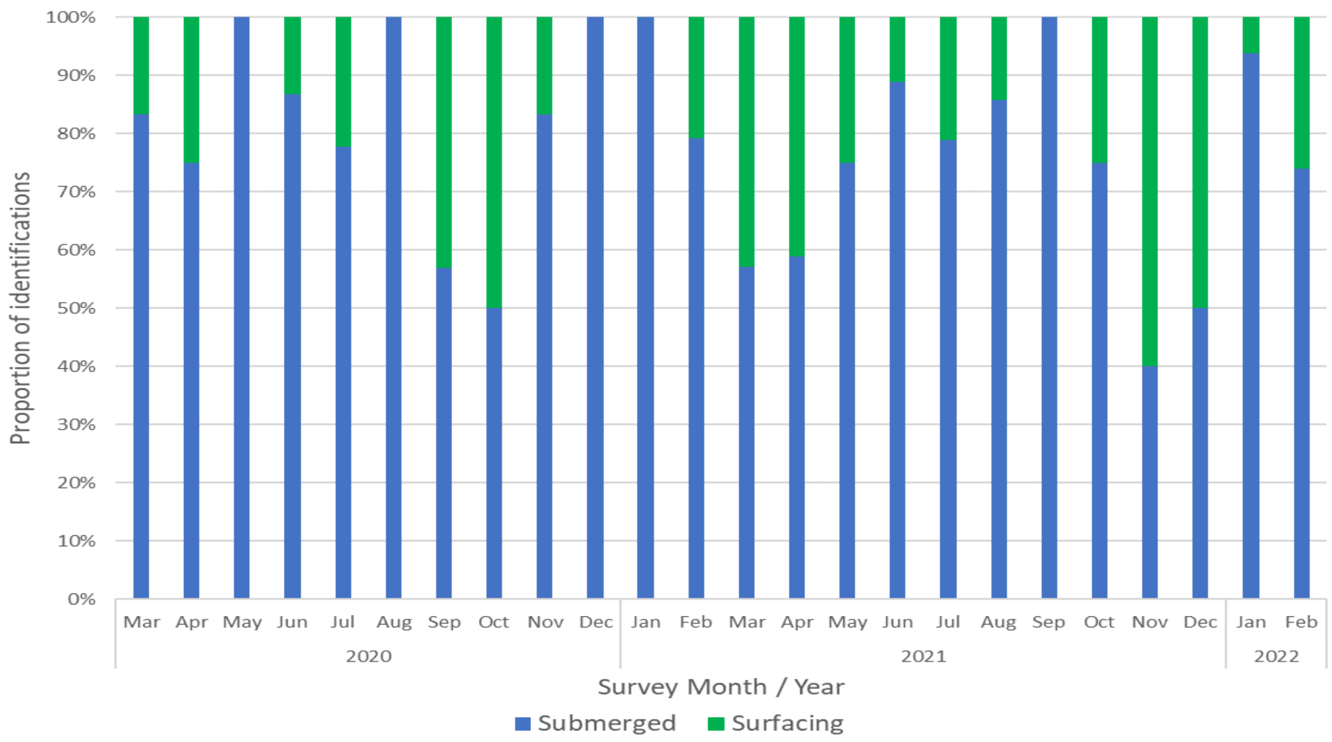


Figure A.4: Summary data showing surfacing categories by month combined across species, for Mona surveys.

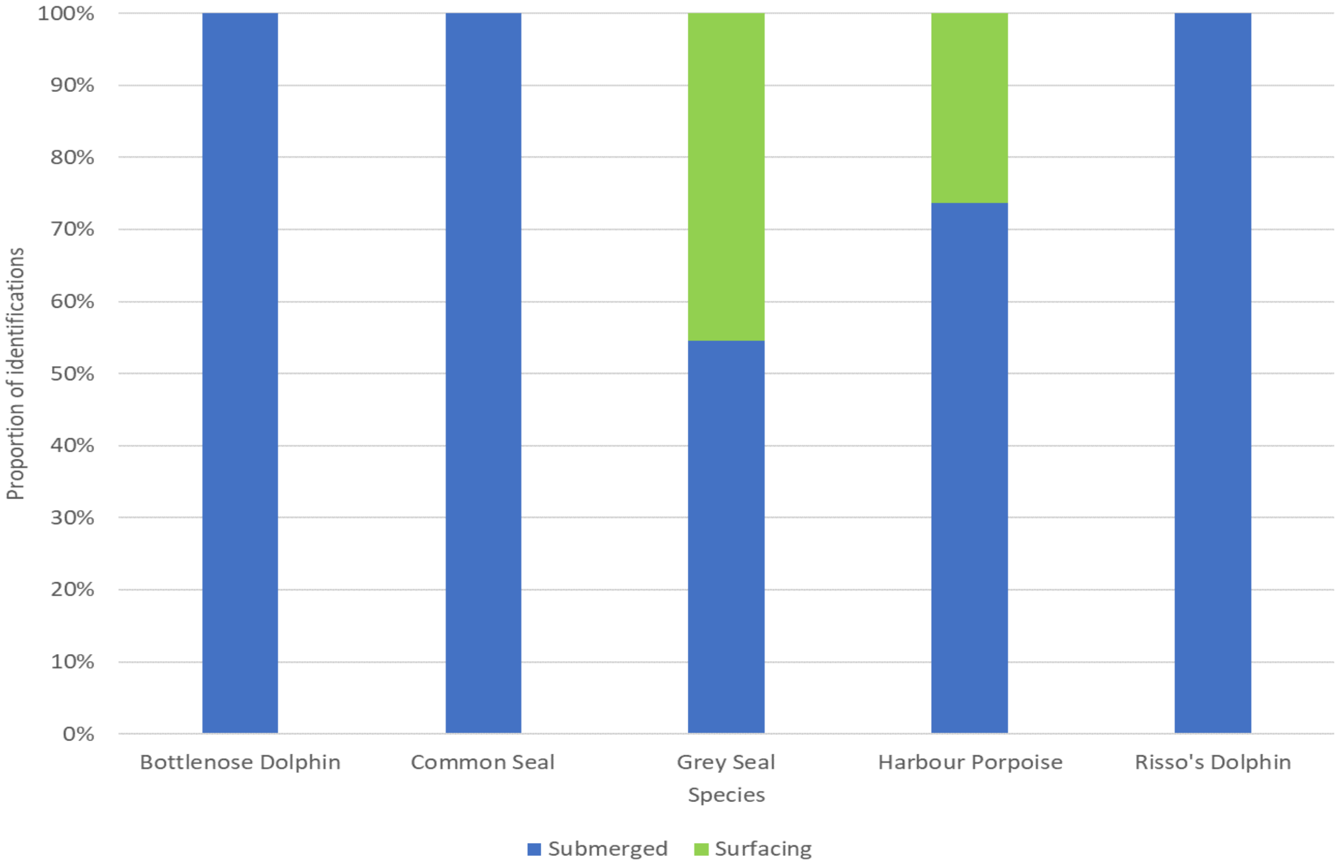


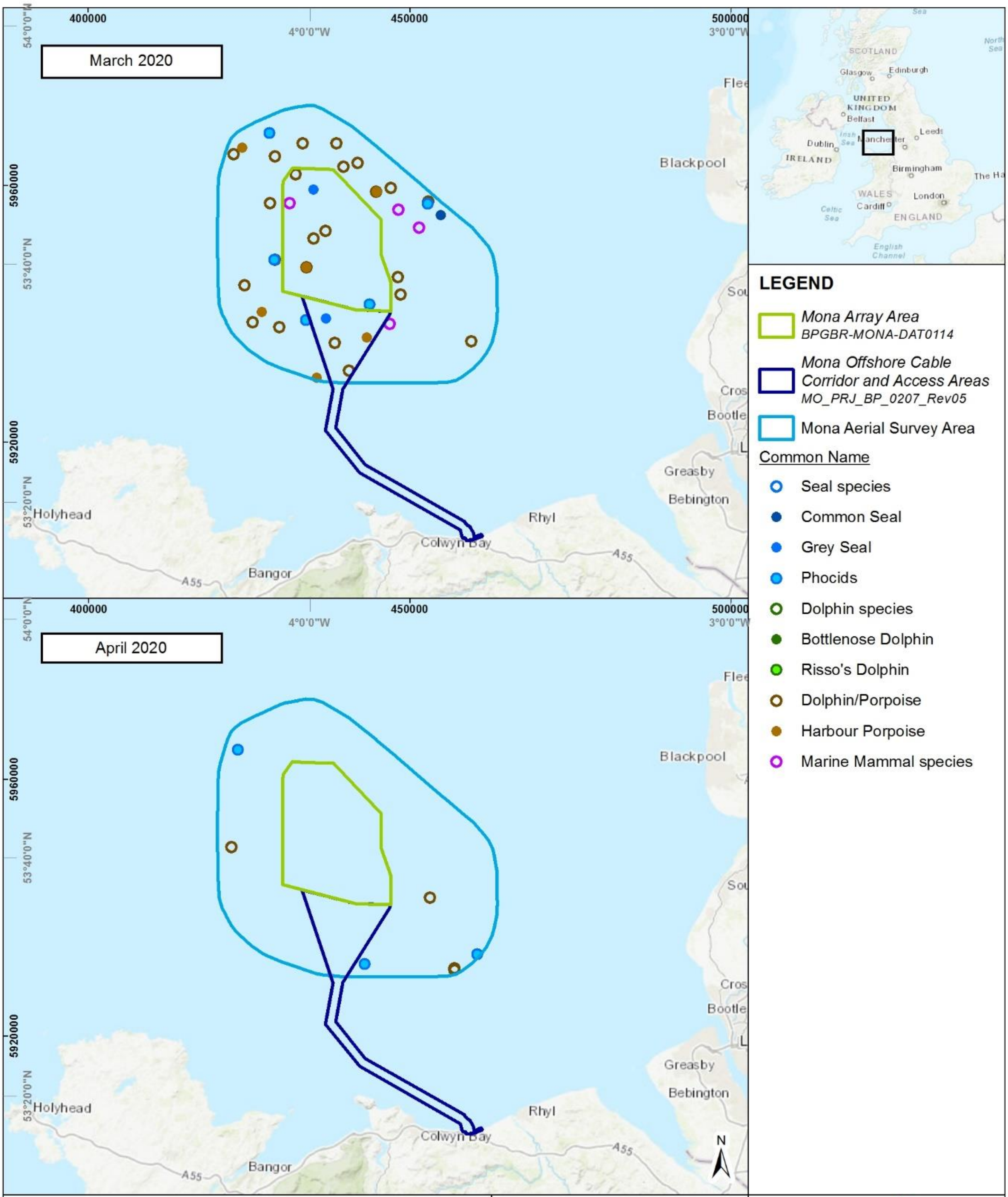
Figure A.5: Summary data showing surfacing categories by species combined across months.

A.3.3 Confidence assessment

A.3.3.1.1 Confidence in identification varied by species/species group for Mona. Where possible, high confidence sightings were identified to species level, but where not possible they were assigned to other descriptive categories (Table A.4 and Table A.5). Figure A.6 to Figure A.17 gives the distribution of sightings of marine mammals in the Mona Aerial Survey Area across the two year survey period. A total of 22 animals were identified as grey seal and one animal in the Mona Aerial Survey Area was assigned to harbour seal (labelled as common seal in APEM data) whilst a further 51 animals were identified as seal species (i.e. could not be assigned to either grey seal or harbour seal and were instead labelled 'phocids' or 'seal species'). For cetaceans, a total of 6 bottlenose dolphin, 137 harbour porpoise and two Risso's dolphin were identified to species level, whilst a further 31 were labelled as 'dolphin species' and 132 identified as 'dolphin/porpoise' (i.e. could not be assigned to a species). Twenty-two sightings could not be assigned to cetacean or phocid and were assigned the label 'marine mammal species'.

A.3.4 Distribution of sightings

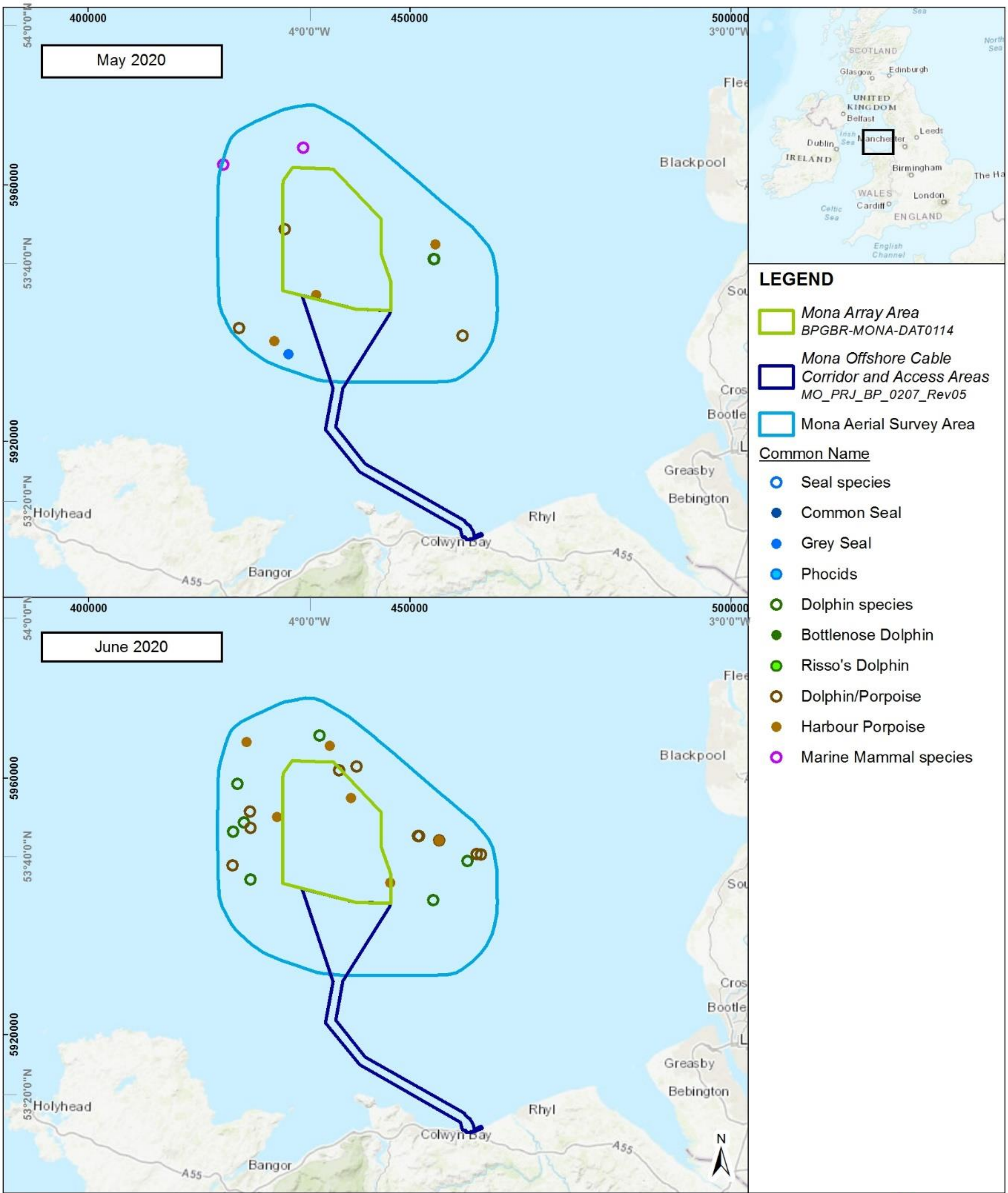
A.3.4.1.1 Sightings of marine mammals were spatially distributed throughout the Mona Aerial Survey Area. Figure A.6 to Figure A.17 show the distribution of the sightings per month of the survey.



Service Layer Credits: Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community	**Data Sources:** Client, APEM	EnBW bp Partners in UK offshore wind; rps
Project Name: MONA OFFSHORE WIND PROJECT	0 5 10 nm; 0 10 20 km	**Drawing Number:** RPSE-MN-ES-MAM-041-01
Drawing Title: DISTRIBUTION OF SIGHTINGS OF MARINE MAMMALS IN THE AERIAL SURVEY AREA (MONA) OVERLAID ON TRANSECTS FLOWN EACH MONTH: MARCH AND APRIL 2020	**Geodetic Information:** Datum: ETRS 1989; Projection: ETRS 1989 UTM Zone 30N; Scale@160mmx220mm: 1:1,000,000	

VER	DATE	DETAILS	BY	CHECK
00	27/07/23	First Issue	NA	BP
01	29/09/23	Revision	MJ	TGB

Figure A.6: Distribution of sightings of marine mammals in the Mona Aerial Survey Area: March and April 2020.



Service Layer Credits: Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

Data Sources: Client, APEM

Project Name:
MONA OFFSHORE WIND PROJECT

0 5 10 nm
0 10 20 km

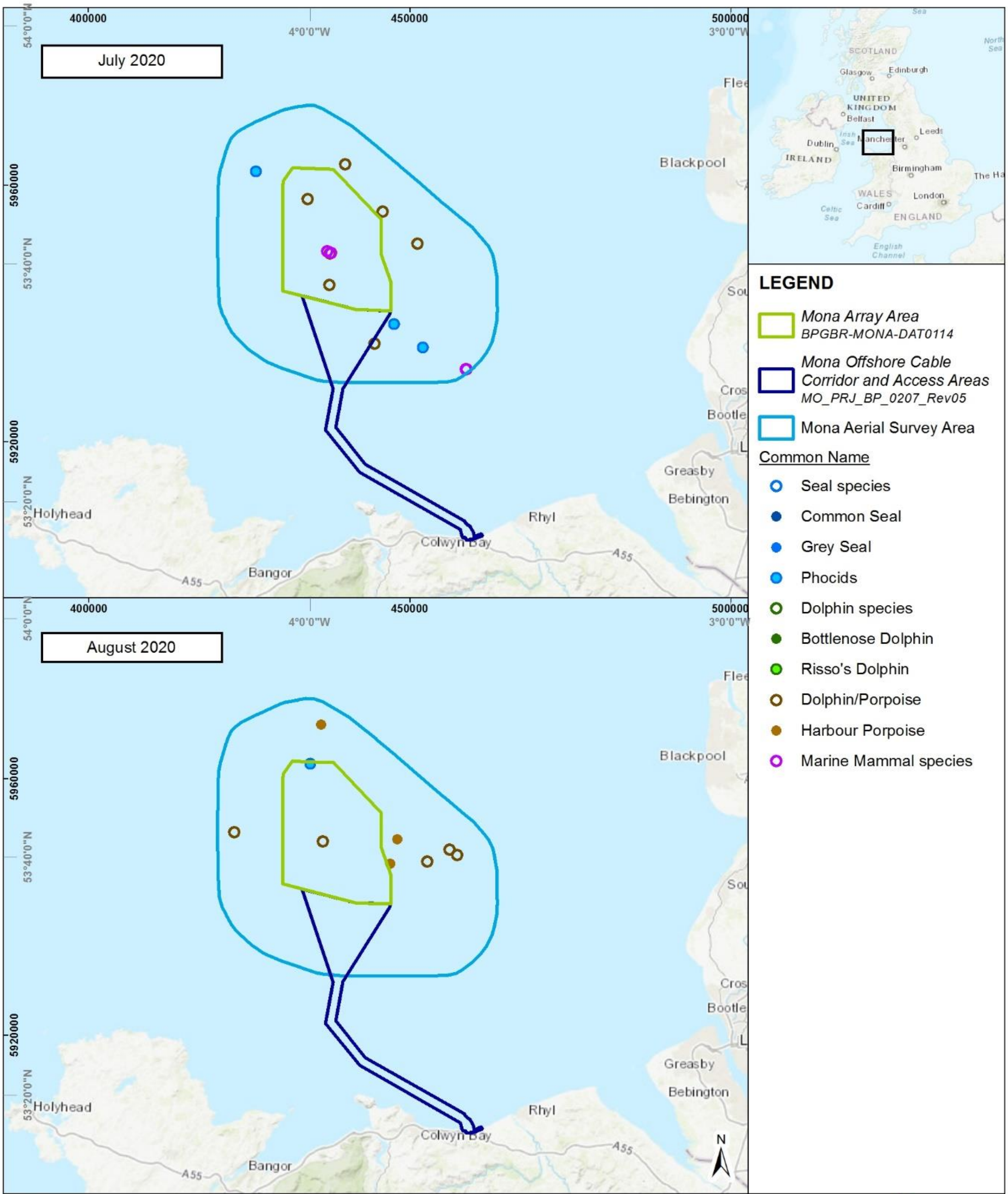
Drawing Number:
RPSE-MN-ES-MAM-042-01

Drawing Title:
DISTRIBUTION OF SIGHTINGS OF MARINE MAMMALS IN THE AERIAL SURVEY AREA (MONA) OVERLAID ON TRANSECTS FLOWN EACH MONTH: MAY AND JUNE 2020

Geodetic Information:
Datum: ETRS 1989
Projection: ETRS 1989 UTM Zone 30N
Scale@160mmx220mm: 1:1,000,000

VER	DATE	DETAILS	BY	CHECK
00	27/07/23	First Issue	NA	BP
01	29/09/23	Revision	MJ	TGB

Figure A.7: Distribution of sightings of marine mammals in the Mona Aerial Survey Area: May and June 2020.



Service Layer Credits: Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

Data Sources: Client, APEM

Project Name:
MONA OFFSHORE WIND PROJECT

Scale: 0 5 10 nm; 0 10 20 km

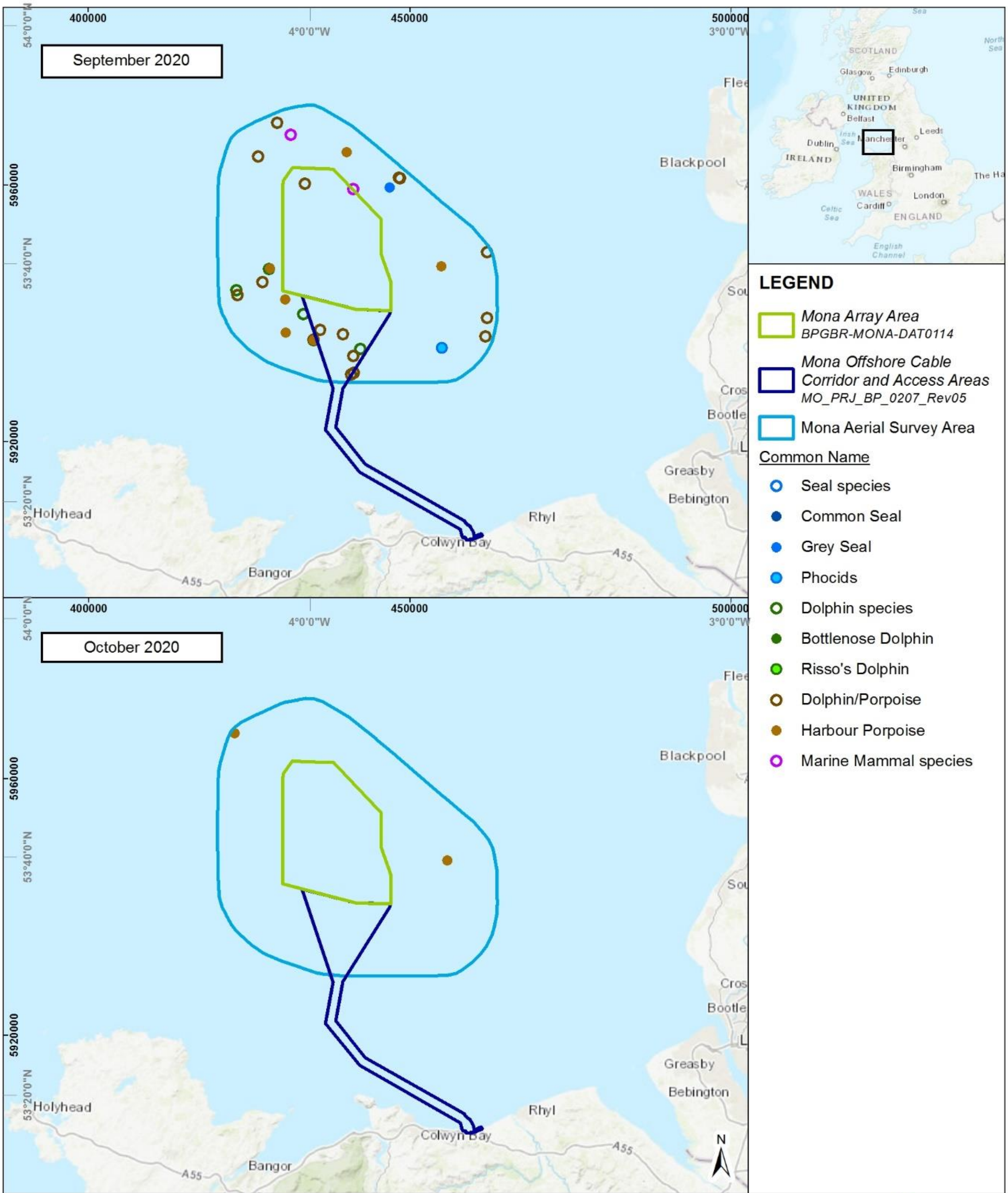
Drawing Number:
RPSE-MN-ES-MAM-043-01

Drawing Title:
DISTRIBUTION OF SIGHTINGS OF MARINE MAMMALS IN THE AERIAL SURVEY AREA (MONA) OVERLAID ON TRANSECTS FLOWN EACH MONTH: JULY AND AUGUST 2020

Geodetic Information:
Datum: ETRS 1989
Projection: ETRS 1989 UTM Zone 30N
Scale@160mmx220mm: 1:1,000,000

VER	DATE	DETAILS	BY	CHECK
00	27/07/23	First Issue	NA	BP
01	29/09/23	Revision	MJ	TGB

Figure A.8: Distribution of sightings of marine mammals in the Mona Aerial Survey Area: July and August 2020.



Service Layer Credits: Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

Data Sources: Client, APEM

Project Name: MONA OFFSHORE WIND PROJECT

Scale: 0 5 10 nm; 0 10 20 km

Drawing Number: RPSE-MN-ES-MAM-044-01

Drawing Title: DISTRIBUTION OF SIGHTINGS OF MARINE MAMMALS IN THE AERIAL SURVEY AREA (MONA) OVERLAID ON TRANSECTS FLOWN EACH MONTH: SEPTEMBER AND OCTOBER 2020

Geodetic Information: Datum: ETRS 1989; Projection: ETRS 1989 UTM Zone 30N; Scale@160mmx220mm: 1:1,000,000

VER	DATE	DETAILS	BY	CHECK
00	27/07/23	First Issue	NA	BP
01	29/09/23	Revision	MJ	TGB

Figure A.9: Distribution of sightings of marine mammals in the Mona Aerial Survey Area: September and October 2020.

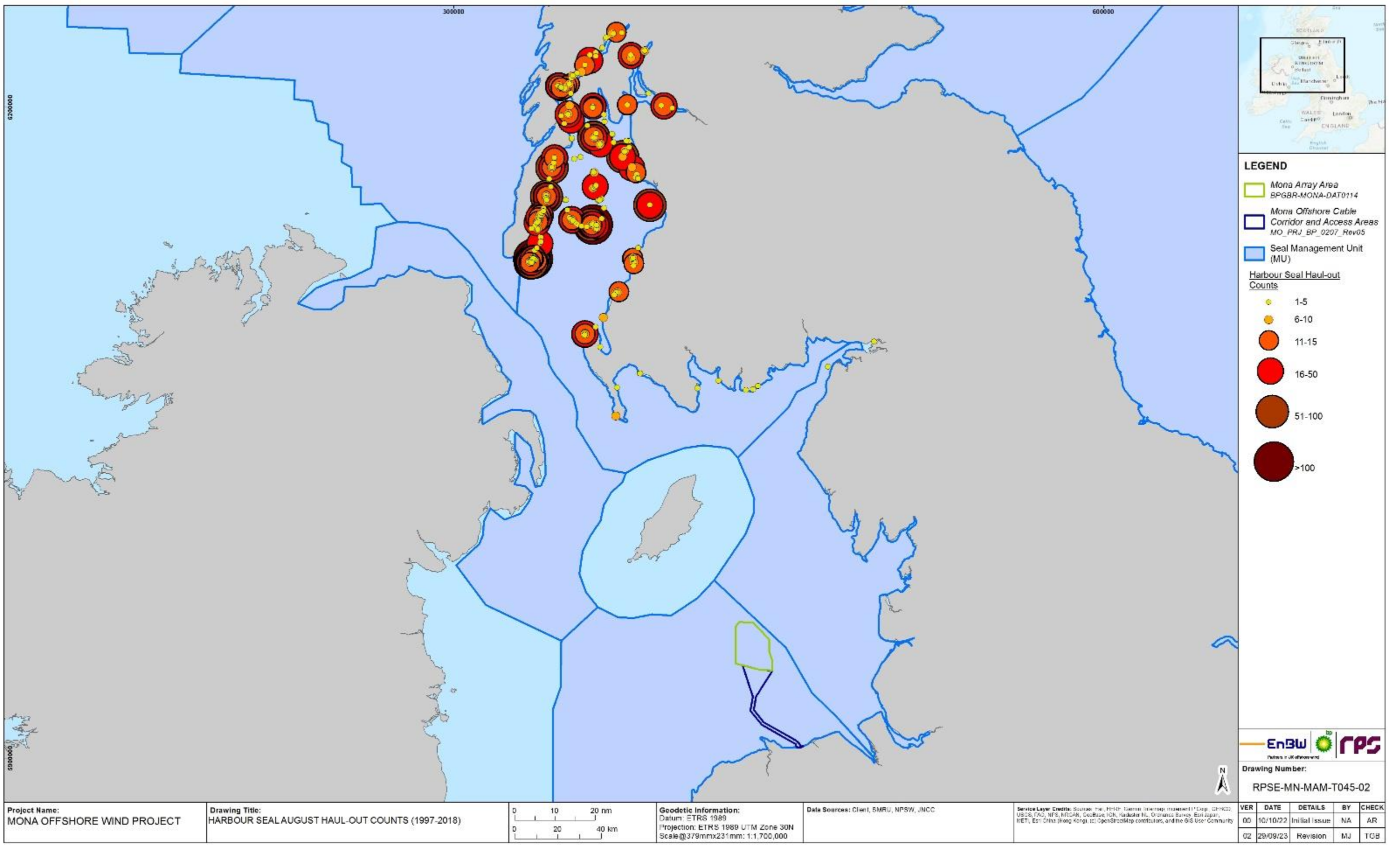
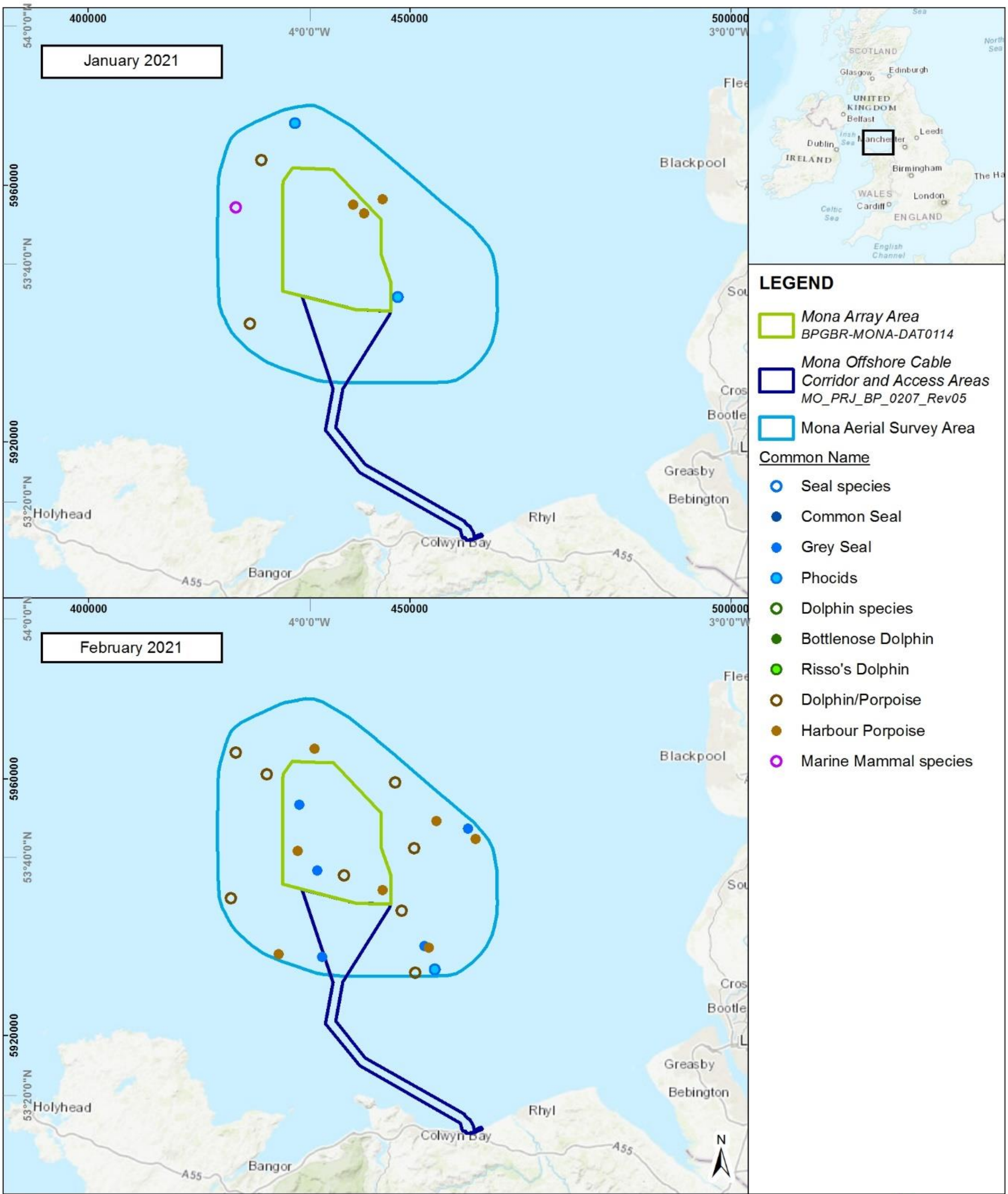


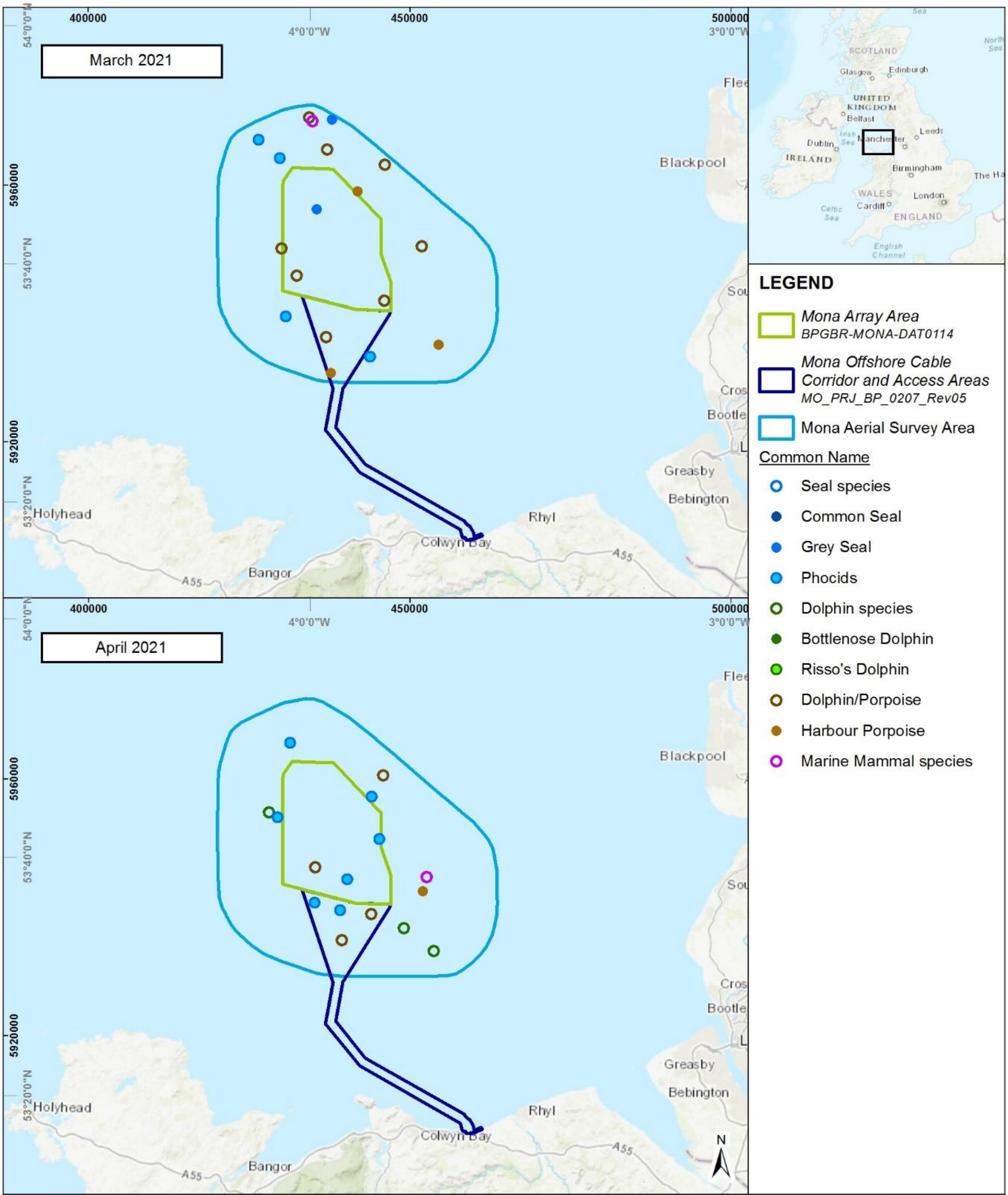
Figure A.10: Distribution of sightings of marine mammals in the Mona Aerial Survey Area: November and December 2020.



Service Layer Credits: Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community	**Data Sources:** Client, APEM	
Project Name: MONA OFFSHORE WIND PROJECT	0 5 10 nm / 0 10 20 km	**Drawing Number:** RPSE-MN-ES-MAM-046-01
Drawing Title: DISTRIBUTION OF SIGHTINGS OF MARINE MAMMALS IN THE AERIAL SURVEY AREA (MONA) OVERLAID ON TRANSECTS FLOWN EACH MONTH: JANUARY AND FEBRUARY 2021	**Geodetic Information:** Datum: ETRS 1989 Projection: ETRS 1989 UTM Zone 30N Scale@160mmx220mm: 1:1,000,000	

VER	DATE	DETAILS	BY	CHECK
00	27/07/23	First Issue	NA	BP
01	29/09/23	Revision	MJ	TGB

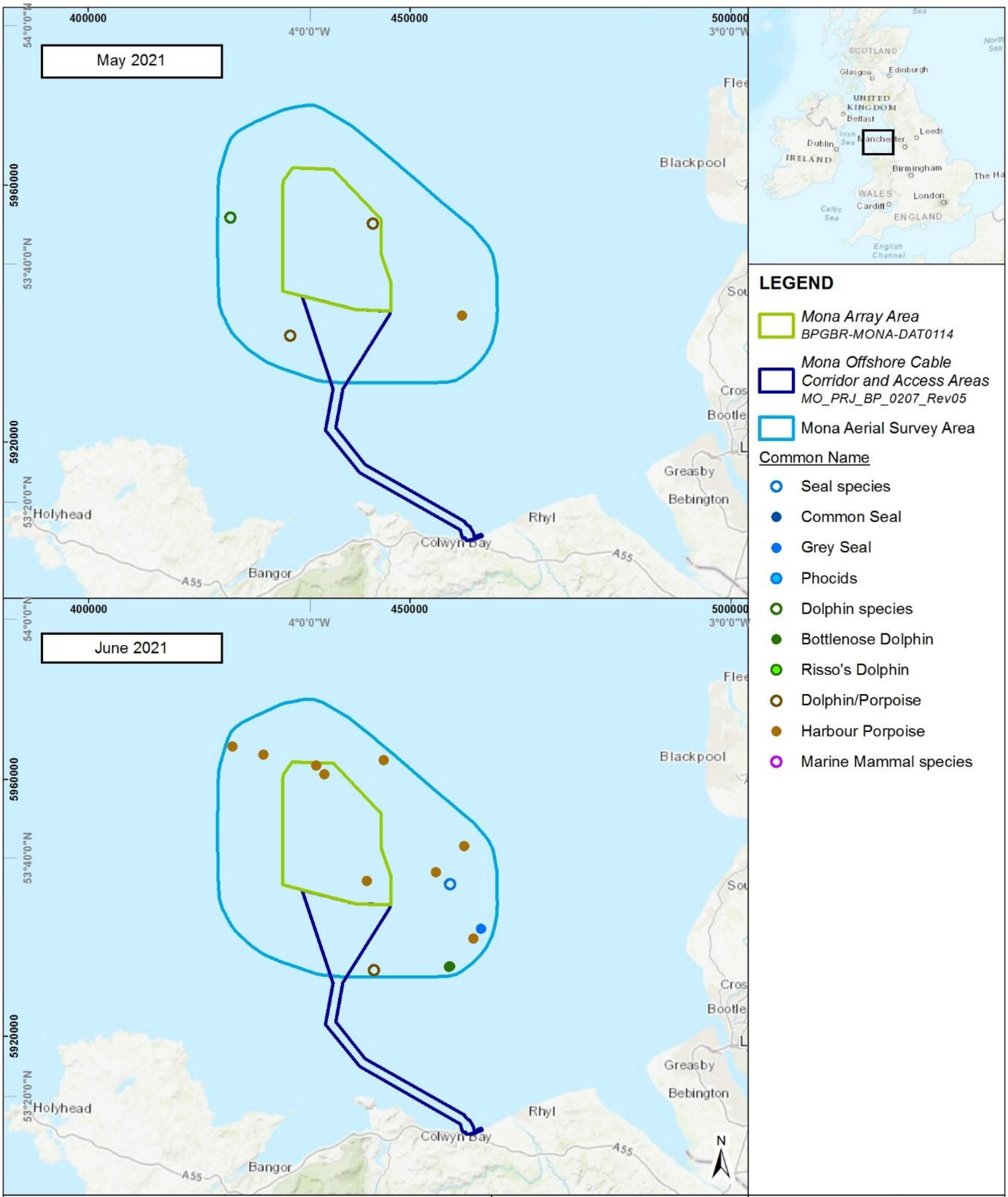
Figure A.11: Distribution of sightings of marine mammals in the Mona Aerial Survey Area: January and February 2021.



Service Layer Credits: Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community	**Data Sources:** Client, APEM	
Project Name: MONA OFFSHORE WIND PROJECT	0 5 10 nm / 0 10 20 km	**Drawing Number:** RPSE-MN-ES-MAM-047-01
Drawing Title: DISTRIBUTION OF SIGHTINGS OF MARINE MAMMALS IN THE AERIAL SURVEY AREA (MONA) OVERLAID ON TRANSECTS FLOWN EACH MONTH: MARCH AND APRIL 2021	**Geodetic Information:** Datum: ETRS 1989; Projection: ETRS 1989 UTM Zone 30N; Scale@160mmx220mm: 1:1,000,000	

VER	DATE	DETAILS	BY	CHECK
00	27/07/23	First Issue	NA	BP
01	29/09/23	Revision	MJ	TGB

Figure A.12: Distribution of sightings of marine mammals in the Mona Aerial Survey Area: March and April 2021.



Service Layer Credits: Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

Data Sources: Client, APEM

Partners in UK offshore wind

Project Name:
MONA OFFSHORE WIND PROJECT

0 5 10 nm
0 10 20 km

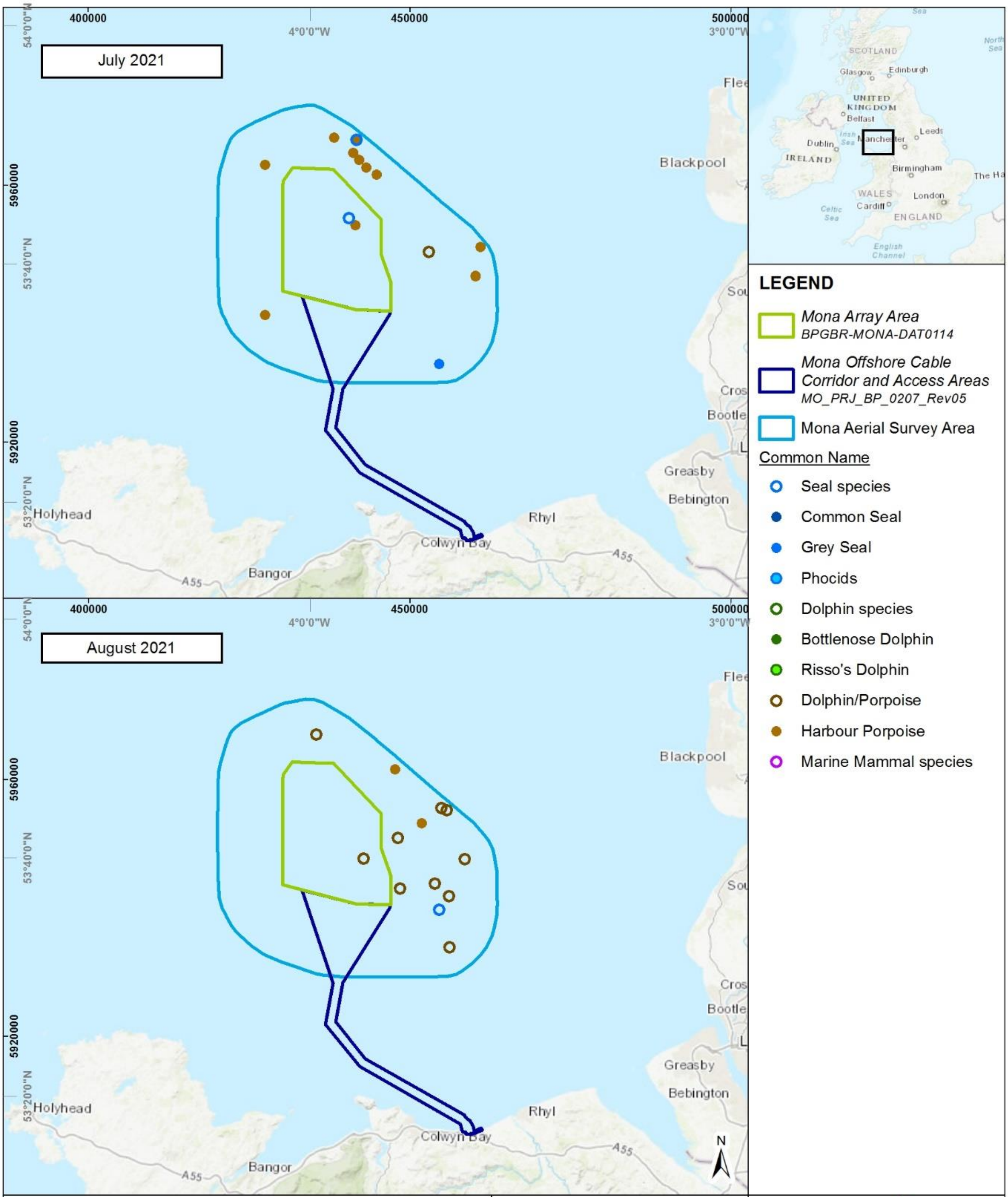
Drawing Number:
RPSE-MN-ES-MAM-048-01

Drawing Title:
DISTRIBUTION OF SIGHTINGS OF MARINE MAMMALS IN THE AERIAL SURVEY AREA (MONA) OVERLAID ON TRANSECTS FLOWN EACH MONTH: MAY AND JUNE 2021

Geodetic Information:
Datum: ETRS 1989
Projection: ETRS 1989 UTM Zone 30N
Scale@160mmx220mm: 1:1,000,000

VER	DATE	DETAILS	BY	CHECK
00	27/07/23	First Issue	NA	BP
01	29/09/23	Revision	MJ	TGB

Figure A.13: Distribution of sightings of marine mammals in the Mona Aerial Survey Area: May and June 2021.



Service Layer Credits: Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

Data Sources: Client, APEM

Project Name:
MONA OFFSHORE WIND PROJECT

0 5 10 nm
0 10 20 km

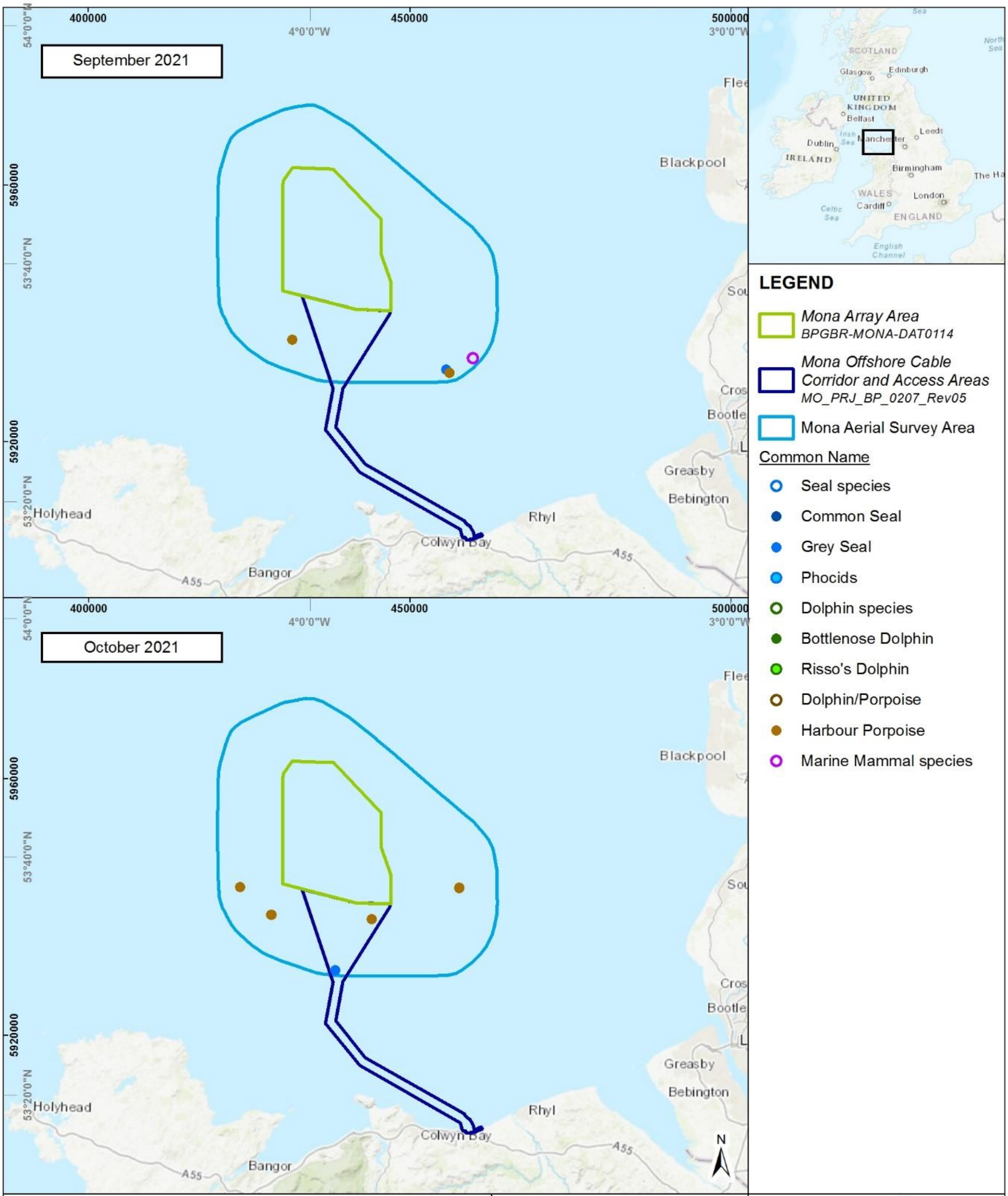
Drawing Number:
RPSE-MN-ES-MAM-049-01

Drawing Title:
DISTRIBUTION OF SIGHTINGS OF MARINE MAMMALS IN THE AERIAL SURVEY AREA (MONA) OVERLAID ON TRANSECTS FLOWN EACH MONTH: JULY AND AUGUST 2021

Geodetic Information:
Datum: ETRS 1989
Projection: ETRS 1989 UTM Zone 30N
Scale@160mmx220mm: 1:1,000,000

VER	DATE	DETAILS	BY	CHECK
00	27/07/23	First Issue	NA	BP
01	29/09/23	Revision	MJ	TGB

Figure A.14: Distribution of sightings of marine mammals in the Mona Aerial Survey Area: July and August 2021.



Service Layer Credits: Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

Data Sources: Client, APEM

Project Name:
MONA OFFSHORE WIND PROJECT

0 5 10 nm
0 10 20 km

Drawing Number:
RPSE-MN-ES-MAM-050-01

Drawing Title:
DISTRIBUTION OF SIGHTINGS OF MARINE MAMMALS IN THE AERIAL SURVEY AREA (MONA) OVERLAID ON TRANSECTS FLOWN EACH MONTH: SEPTEMBER AND OCTOBER 2021

Geodetic Information:
Datum: ETRS 1989
Projection: ETRS 1989 UTM Zone 30N
Scale@160mmx220mm: 1:1,000,000

VER	DATE	DETAILS	BY	CHECK
00	27/07/23	First Issue	NA	BP
01	29/09/23	Revision	MJ	TGB

Figure A.15: Distribution of sightings of marine mammals in the Mona Aerial Survey Area: September and October 2021.

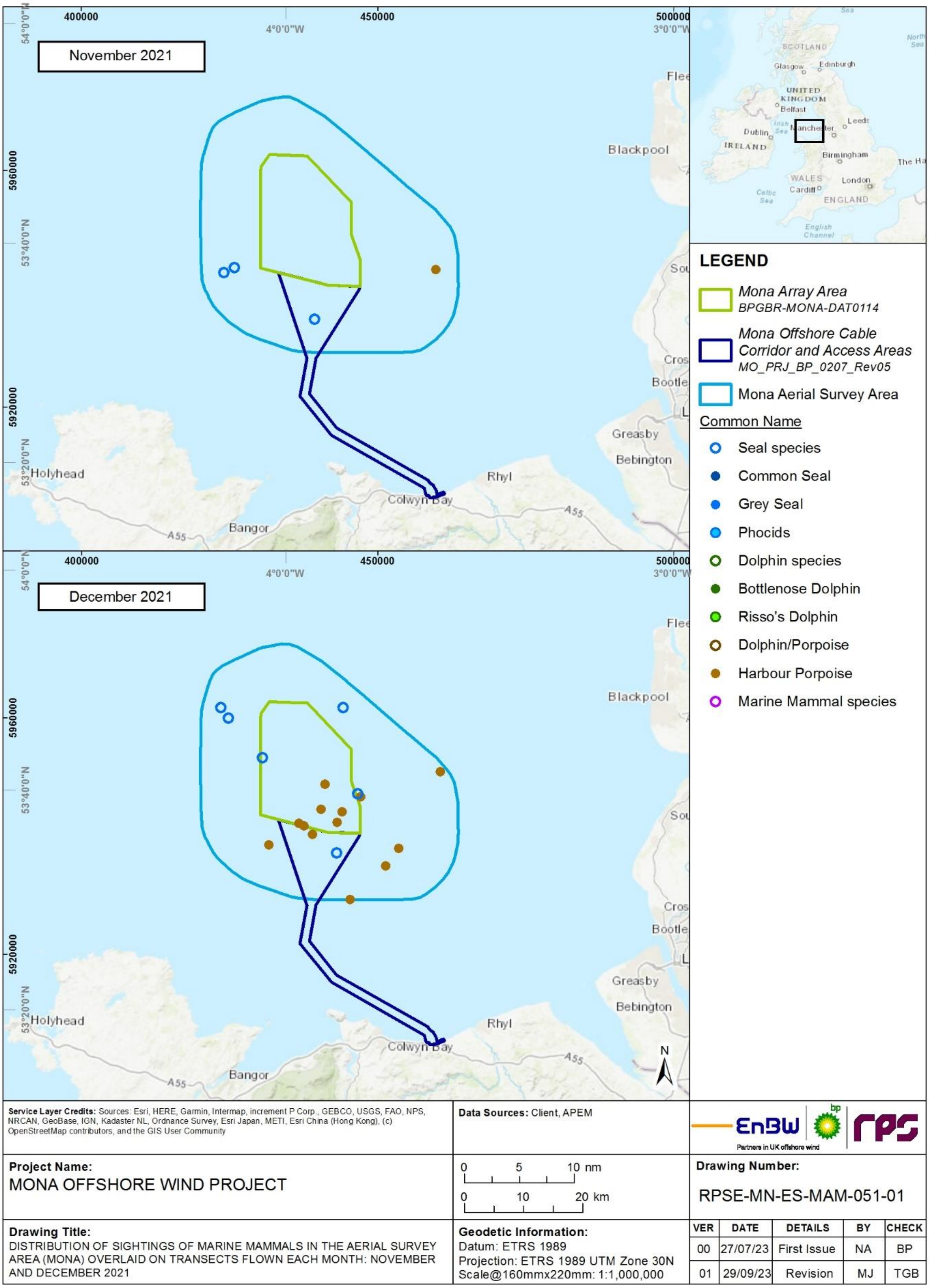
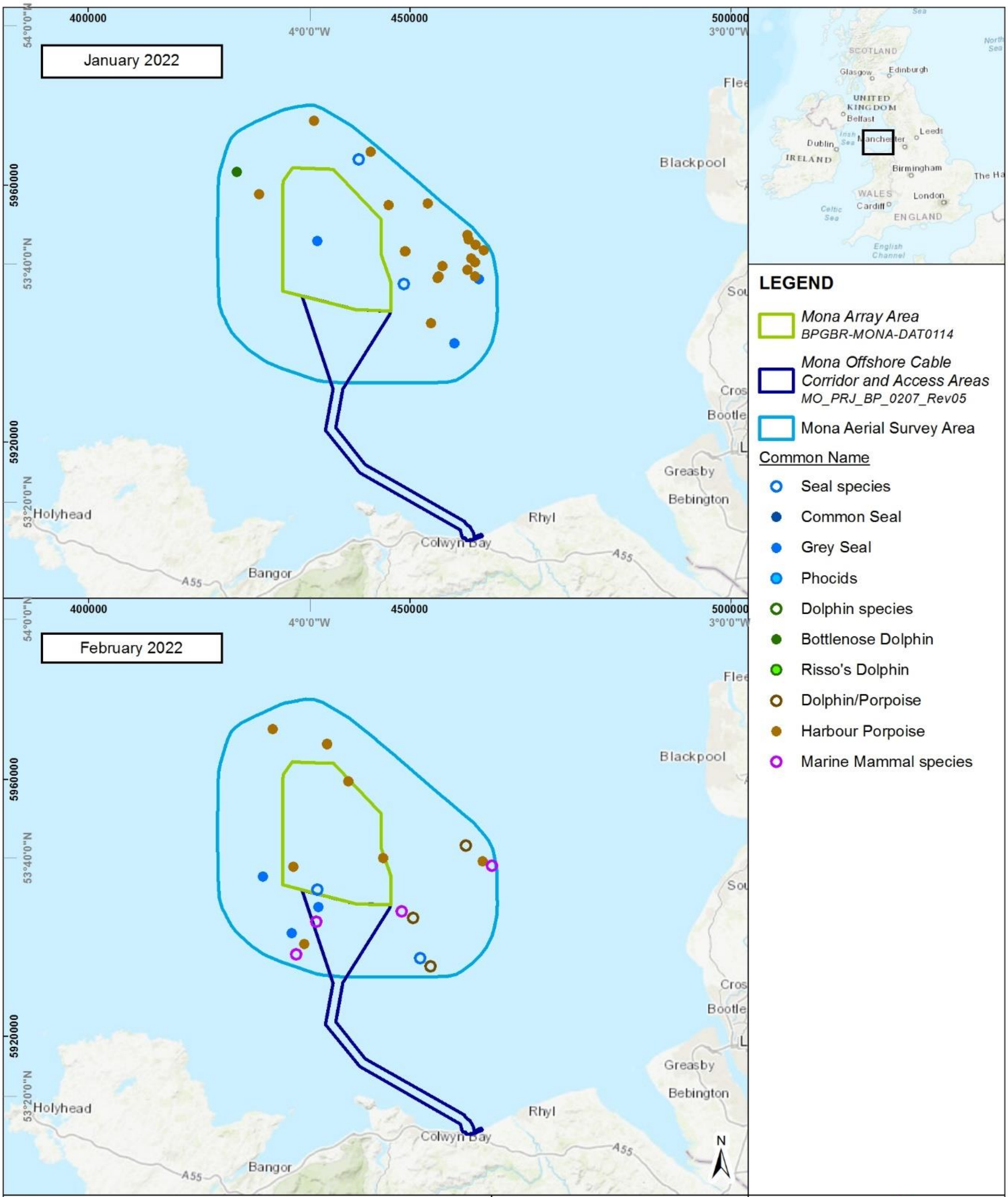


Figure A.16: Distribution of sightings of marine mammals in the Mona Aerial Survey Area: November and December 2021.



Service Layer Credits: Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community	**Data Sources:** Client, APEM	EnBW bp Partners in UK offshore wind rps
Project Name: MONA OFFSHORE WIND PROJECT	0 5 10 nm; 0 10 20 km	**Drawing Number:** RPSE-MN-ES-MAM-052-01
Drawing Title: DISTRIBUTION OF SIGHTINGS OF MARINE MAMMALS IN THE AERIAL SURVEY AREA (MONA) OVERLAID ON TRANSECTS FLOWN EACH MONTH: JANUARY AND FEBRUARY 2022	**Geodetic Information:** Datum: ETRS 1989; Projection: ETRS 1989 UTM Zone 30N; Scale@160mmx220mm: 1:1,000,000	

VER	DATE	DETAILS	BY	CHECK
00	27/07/23	First Issue	NA	BP
01	29/09/23	Revision	MJ	TGB

Figure A.17: Distribution of sightings of marine mammals in the Mona Aerial Survey Area: January and February 2022.

A.3.5 Density estimates with bootstrapping

A.3.5.1 Design-based approach

A.3.5.1.1 Monthly mean densities of marine mammals were produced from the count data. Previously published density estimated for marine mammals are discussed and presented in Volume 6, Annex 4.1: Marine mammal technical report of the Environmental Statement; this report focuses on densities derived from the recent aerial surveys only. Densities were calculated by dividing abundance counts for the month by the Mona Aerial Survey Area (1,447km^2).

A.3.5.1.2 Whilst confidence limits (CLs) for abundance were provided by the aerial survey subcontractor, no CLs were provided for densities. Bootstrapping was undertaken (1,000 simulations) to produce confidence intervals from the mean monthly densities for harbour porpoise and grey seal (Wessa, 2019) and for bottlenose dolphin these were derived from using the abundance CLs and dividing by the Mona Aerial Survey Area to get densities.

Harbour porpoise

A.3.5.1.3 Estimated relative mean densities for harbour porpoise over the Mona Aerial Survey Area are given in Figure A.18 with simulation of mean for monthly relative density estimates of harbour porpoise presented in Figure A.19. Due to the large variance in the data across months, the seasonal patterns are not easy to interpret from a linear scale and were replotted showing the mean density on a log scale. Seasonality is clearer, with peaks in harbour porpoise density were observed in Winter and June.

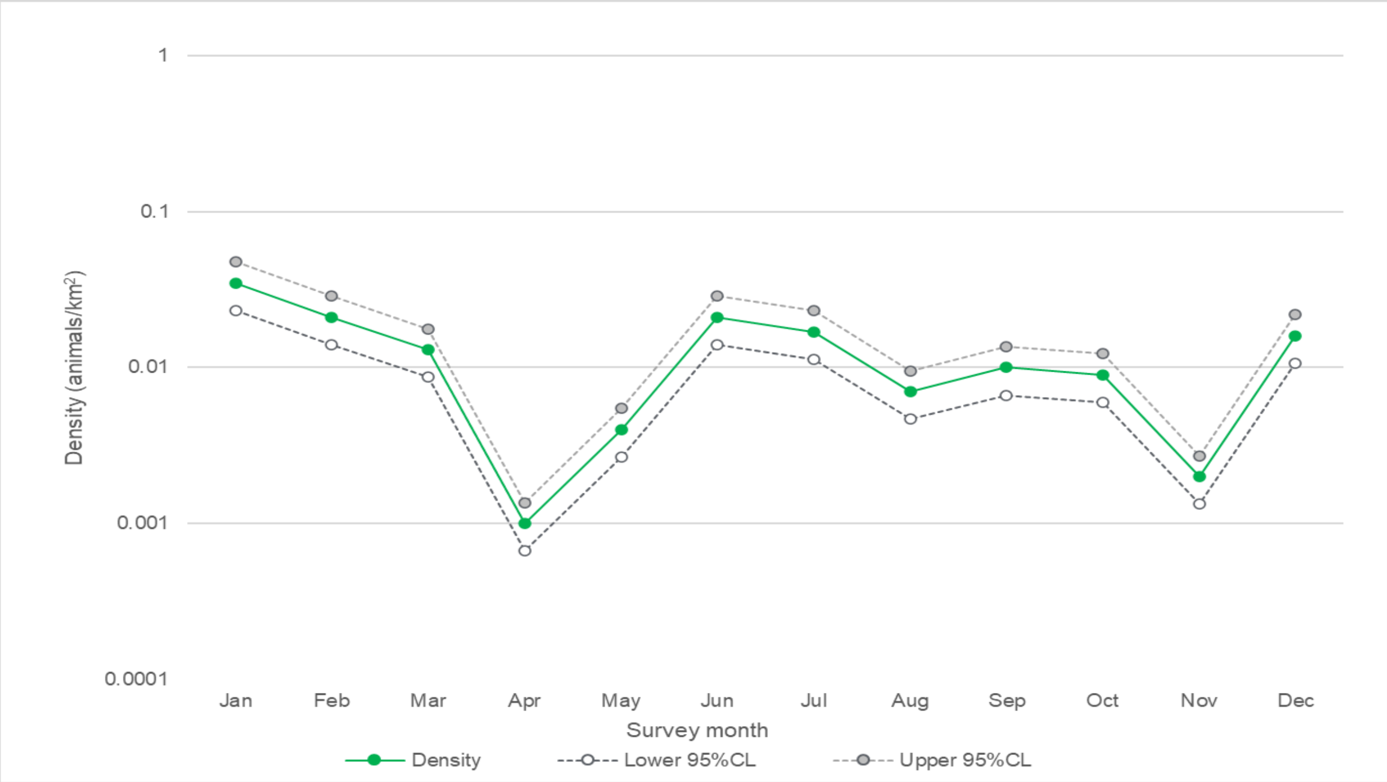


Figure A.18: Estimated monthly mean relative density of harbour porpoise over the Mona Aerial Survey Area (log scale) from design-based approach, with lower and upper confidence limits estimated using bootstrapping.

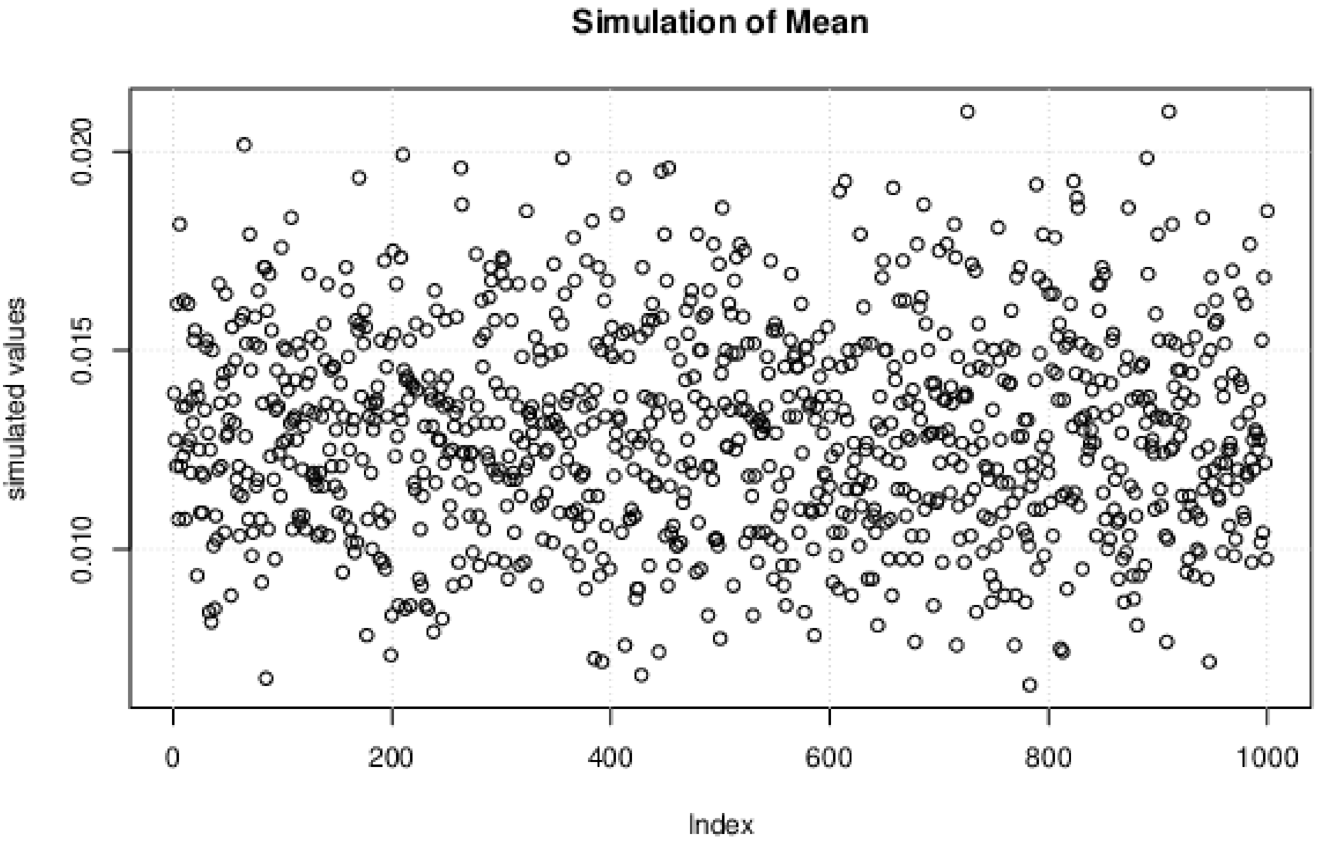


Figure A.19: Simulation of mean for monthly relative density estimates of harbour porpoise from design-based approach.

Bottlenose dolphin

A.3.5.1.4 Estimated mean densities (relative) for bottlenose dolphin over the Mona Aerial Survey Area is given in Figure A.20. Only two sighting occurrences means temporal data estimates are limited.

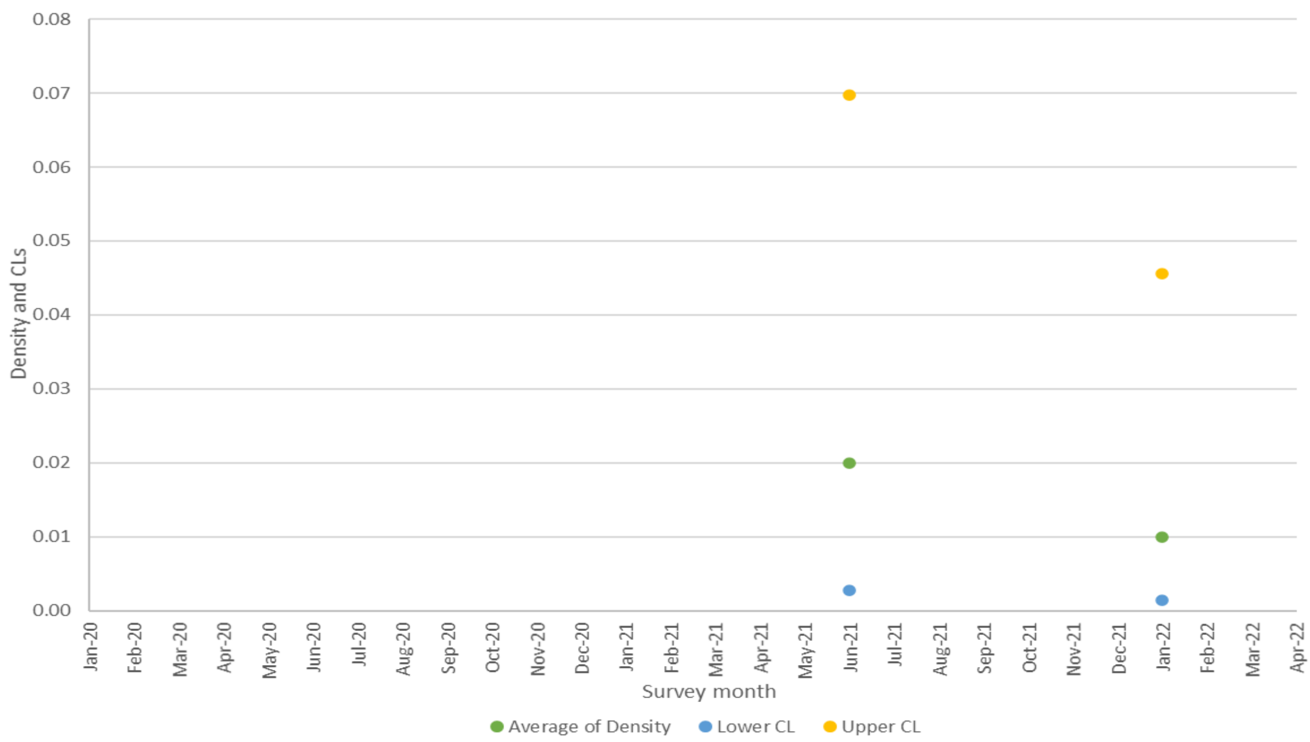


Figure A.20: Estimated monthly mean relative density of bottlenose dolphin over the Mona Aerial Survey Area, with lower and upper confidence limits.

Risso's dolphin

A.3.5.1.5 Only one sighting occurrence means temporal data estimates are limited for Risso's dolphin and as such no figure is given for mean density.

Grey seal

A.3.5.1.6 Estimated mean densities (relative) for grey seal over the Mona Aerial Survey Area is given in Figure A.21, with upper and lower confidence limits, with simulation of mean for monthly relative density estimates of grey seal presented in Figure A.22 . Grey seal densities peaked in February 2021 and January to February 2022.

Figure A.21: Estimated monthly mean relative density of grey seal over the Mona Aerial Survey Area, with lower and upper confidence limits.

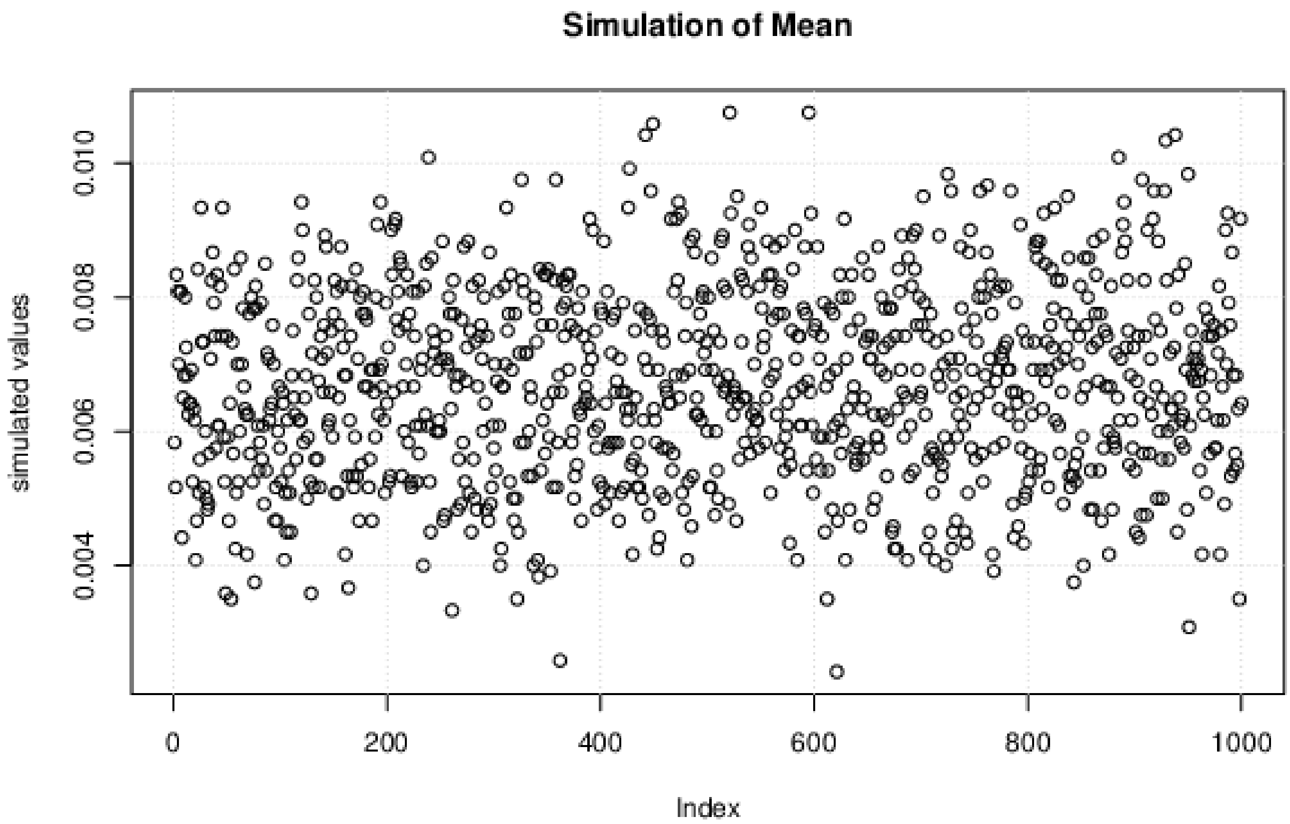


Figure A.22: Simulation of mean for monthly relative density estimates of grey seal from design-based approach.

A.3.6 Model based density estimates

A.3.6.1.1 When carrying out model-based density estimates, as described in paragraph A.3.1.2.1, based on the frequency of occurrence of known species across the Mona Aerial Survey Area, unidentified seal species were considered most likely to be grey seal and as such were grouped together to produce a more conservative estimate of grey seal density. Whilst unidentified seals were assigned to grey seal, it is noted that this does not discount the possibility that unidentified seal species may have been harbour seal. For this species, the Sea Mammal Research Unit (SMRU) published at-sea densities of harbour seal were, instead, available to provide densities for the baseline characterisation within Volume 6, Annex 4.1: Marine mammal technical report of the Environmental Statement (e.g. Carter *et al*., 2022).

A.3.6.1.2 Harbour porpoise was initially modelled as a variable in its own right, but to increase sample size and improve model robustness, this was also pooled with animals identified as “Dolphin/Porpoise”; labelled together as “porpoise species”. As with grey seal, this grouping does not discount the possibility that some individuals may have been dolphin species, but by pooling the data a more conservative density for harbour porpoise could be estimated. For other species of dolphin published densities in this region (e.g. Waggitt *et al*., 2020) have been sourced to provide a robust baseline characterisation within Volume 6, Annex 4.1: Marine mammal technical report of the Environmental Statement.

A.3.6.1.3 Similarly, there were a small number of unidentified cetacean species and unidentified seal/small cetacean species, but the uncertainty around these meant that they could not be confidently included in a suitable grouping and were excluded from the modelling.

A.3.6.1.4 Mean relative abundance (i.e. raw count) and density estimates (number of individual animals divided by survey area) were calculated across the Mona Aerial Survey Area. Uncertainty in the data is given as 95% confidence intervals (CI), and coefficients of variation (CV) (standard deviation divided by the mean). These measures were given for monthly and seasonal (meteorological and bio-season) divisions, and aggregated across all surveys, for Mona Aerial Survey Area. Coefficient of variation was not calculated for "total" density, as more than one value would be required.

A.3.6.1.5 Relative density estimates of harbour porpoise can be corrected for availability bias (paragraph A.2.6.2.1) using a published correction factors based on the proportion of time individuals are likely to be at or near the surface and available for detection. For example, availability bias was estimated based on a tagging study in the Baltic/North Sea which looked at the proportion of time that harbour porpoise spent surfacing or in the top 0 to 2m (Teilman *et al*., 2013). Notably, in this study Teilman *et al*. (2013) found no significant difference in diving behaviour between geographic areas or in relation to the size of the animals, although there was a significant seasonal difference in diving behaviour. The correction factor which gave the lowest estimate of availability (i.e. most conservative) was 42.5%, based on winter months, when surfacing time was found to be lower than in other seasons (Teilman *et al*., 2013).

A.3.6.1.6 Similarly, fine scale movements of harbour porpoise in the Danish North Sea were investigated by van Beest *et al*. (2018). GPS and dive recorder (V-tags) were used to record the diving behaviour of tagged individuals and the study estimated a mean dive duration of 53s (min = 10.1s, max = 250.0s) and a mean surfacing time of 39s (min = 2s, max = 309s). Using the mean values, the availability bias was calculated as 42.4% (mean surfacing time as a proportion of the mean surfacing time plus mean dive time) which is the same as to the value estimated by Teilman et al. (2013).

A.3.6.1.7 A tracking study of three male grey seals in the Farne Islands (northeast England) found that the average proportion of time animals were submerged as they travelled was 84.3%, and this was slightly lower during short duration trips (83.4%) (Thompson et al., 1991). Therefore, it follows that the average proportion of time a travelling grey seal would be available for detection ranges between 15.7% and 16.6%.

A.3.6.1.8 Similarly, telemetry data from tags deployed by SMRU on grey seals in the North Sea recorded 1,551 grey seal dives. These data were analysed for the Hornsea Three Offshore Wind Farm (to estimate detection probability) and showed that 60% of surfacing periods were between 15 and 45 seconds, with an average of 40 seconds (Ørsted, 2018). Dive durations varied between 20 and 496 seconds with an average of 216 seconds (Ørsted, 2018). The average values reported from the telemetry data were used to estimate the proportion of time that grey seal were surfacing compared to diving to give an indication of the availability bias for the site-specific aerial surveys. The estimated availability was calculated as 15.6% and was therefore similar to the figures cited by Thompson *et al*. (1991).

A.3.6.1.9 As with harbour porpoise, it was assumed that all animals on (or near) the surface were available for detection during the aerial surveys (i.e. no perception bias) (A.2.6.2.4). The correction factor for availability bias, based on the telemetry studies described above, was 15.6% as the most conservative estimate.

Harbour porpoise

A.3.6.1.10 For harbour porpoise relative abundance/density was modelled by month, within meteorological seasons, and within the “winter” (October to March) and “summer” (April to September) divisions described by Heinänen and Skov (2015), for clarity referred to here as “bio-seasons”.

A.3.6.1.11 Harbour porpoise abundance varied through time, with higher densities across the Mona Aerial Survey Area observed during the winter (December to February) and summer (June to August) months.

A.3.6.1.12 As described previously (paragraph A.2.5.1.3) sample sizes divided by month and meteorological season were too small for robust modelling using the MRSea package (n > 30 required), so data was instead modelled according to bio-season. Even with pooling data into just two bio-seasons, results from the MRSea analysis provided low predictive power, such that estimates of spatial density were caveated with relatively high uncertainty.

A.3.6.1.13 Due to the lower than expected predictive power of the MRSea model, relative density was calculated from generalised linear models, following a quasi-poisson error structure to facilitate analysis of the preponderance of zero counts in the data. Global models were built for each temporal division (month, meteorological season, bio-season) and included harbour porpoise abundance as a response, with survey effort and all environmental covariates discussed in paragraph A.2.5.1.7 included as predictors. A final model was generated via backwards stepwise reduction, based upon removal of non-significant (α = 0.05) covariates, until survey effort, and latitude/longitude remained as predictors.

Table A.6: Model-based monthly, seasonal, and total relative density estimates of harbour porpoise, including Lower and Upper 95% confidence intervals (CI), and coefficient of variation (cv). Mean seasonal abundance is estimated for the Mona Aerial Survey Area.

Temporal division	Mean relative abundance	Mean relative density [design] (animals/km^2)	Mean relative density [model] (animals/km^2)	Lower CI	Upper CI	Coefficient of Variation
Month						
Jan	107	0.074	0.028	0.017	0.041	0.297
Feb	64	0.044	0.011	0.007	0.016	0.534
Mar	43	0.029	0.005	0.003	0.007	0.487
Apr	7	0.005	0.001	0.001	0.001	-
May	13	0.009	0.002	0.001	0.003	0.621
Jun	64	0.045	0.011	0.007	0.016	0.377
Jul	107	0.074	0.012	0.007	0.018	0.510
Aug	21	0.015	0.005	0.003	0.007	0.260
Sep	32	0.022	0.004	0.002	0.006	0.593
Oct	28	0.020	0.004	0.002	0.006	0.699

Temporal division	Mean relative abundance	Mean relative density [design] (animals/km^2)	Mean relative density [model] (animals/km^2)	Lower CI	Upper CI	Coefficient of Variation
Nov	14	0.010	0.002	0.001	0.003	-
Dec	99	0.068	0.007	0.004	0.010	0.425
Meteorological season						
Winter	88	0.061	0.015	0.003	0.028	0.462
Spring	24	0.016	0.003	0.000	0.005	0.522
Summer	56	0.038	0.009	0.005	0.014	0.428
Autumn	27	0.019	0.003	0.002	0.005	0.643
Bio-season						
Winter	60	0.041	0.009	0.002	0.017	0.500
Summer	37	0.026	0.006	0.002	0.010	0.478
Year	48	0.033	0.006	0.003	0.012	0.491

A.3.6.1.14 Bio-season was determined to be the most appropriate division as harbour porpoise have been seen to change their distribution patterns between these two 'seasons' (Heinänen and Skov, 2015), and these patterns form part of the evidence base upon which SACs are designated.

A.3.6.1.15 Harbour porpoise densities were estimated from the "bio-season" model, which predicted a mean relative density of 0.009 animals/km^2 (95% CI: 0.006, 0.013) during the winter bio-season, and 0.006 animals/km^2 (95% CI: 0.006, 0.013) during the summer bio-season. Since bio-season is the most biologically relevant, density distributions within the Mona Aerial Survey Area were generated according to bio-season and are presented in Figure A.23.

A.3.6.1.16 Relative abundance and density values were adjusted to account for availability bias, using the most conservative correction factor of 0.425 (Teilman *et al.*, 2013), to provide estimates of absolute abundance and density, and 95% confidence intervals (Table A.7).

Table A.7: Model-based monthly, seasonal, and total absolute density estimates of harbour porpoise, including Lower and Upper 95% confidence intervals (CI), and coefficient of variation (cv). Mean seasonal abundance is estimated for the Mona Aerial Survey Area.

Temporal division	Mean absolute abundance	Mean absolute density [design] (animals/km^2)	Mean absolute density [model] (animals/km^2)	Lower CI	Upper CI	Coefficient of Variation
Month						
Jan	252	0.174	0.066	0.040	0.096	0.297

Temporal division	Mean absolute abundance	Mean absolute density [design] (animals/km^2)	Mean absolute density [model] (animals/km^2)	Lower CI	Upper CI	Coefficient of Variation
Feb	150	0.104	0.026	0.016	0.038	0.534
Mar	100	0.069	0.012	0.007	0.017	0.487
Apr	17	0.012	0.002	0.001	0.003	-
May	32	0.022	0.005	0.003	0.007	0.621
Jun	152	0.105	0.027	0.016	0.039	0.377
Jul	253	0.175	0.028	0.017	0.041	0.510
Aug	50	0.034	0.011	0.007	0.016	0.260
Sep	75	0.052	0.009	0.005	0.013	0.593
Oct	67	0.046	0.010	0.006	0.015	0.699
Nov	33	0.023	0.005	0.003	0.007	-
Dec	232	0.160	0.016	0.010	0.023	0.425
Meteorological season						
Winter	207	0.143	0.035	0.006	0.066	0.462
Spring	56	0.039	0.007	0.001	0.012	0.522
Summer	131	0.090	0.022	0.011	0.033	0.428
Autumn	63	0.044	0.008	0.005	0.011	0.643
Bio-season						
Winter	140	0.097	0.022	0.0045	0.0405	0.500
Summer	88	0.061	0.013	0.0047	0.0226	0.478
Year	114	0.079	0.014	0.008	0.028	0.491

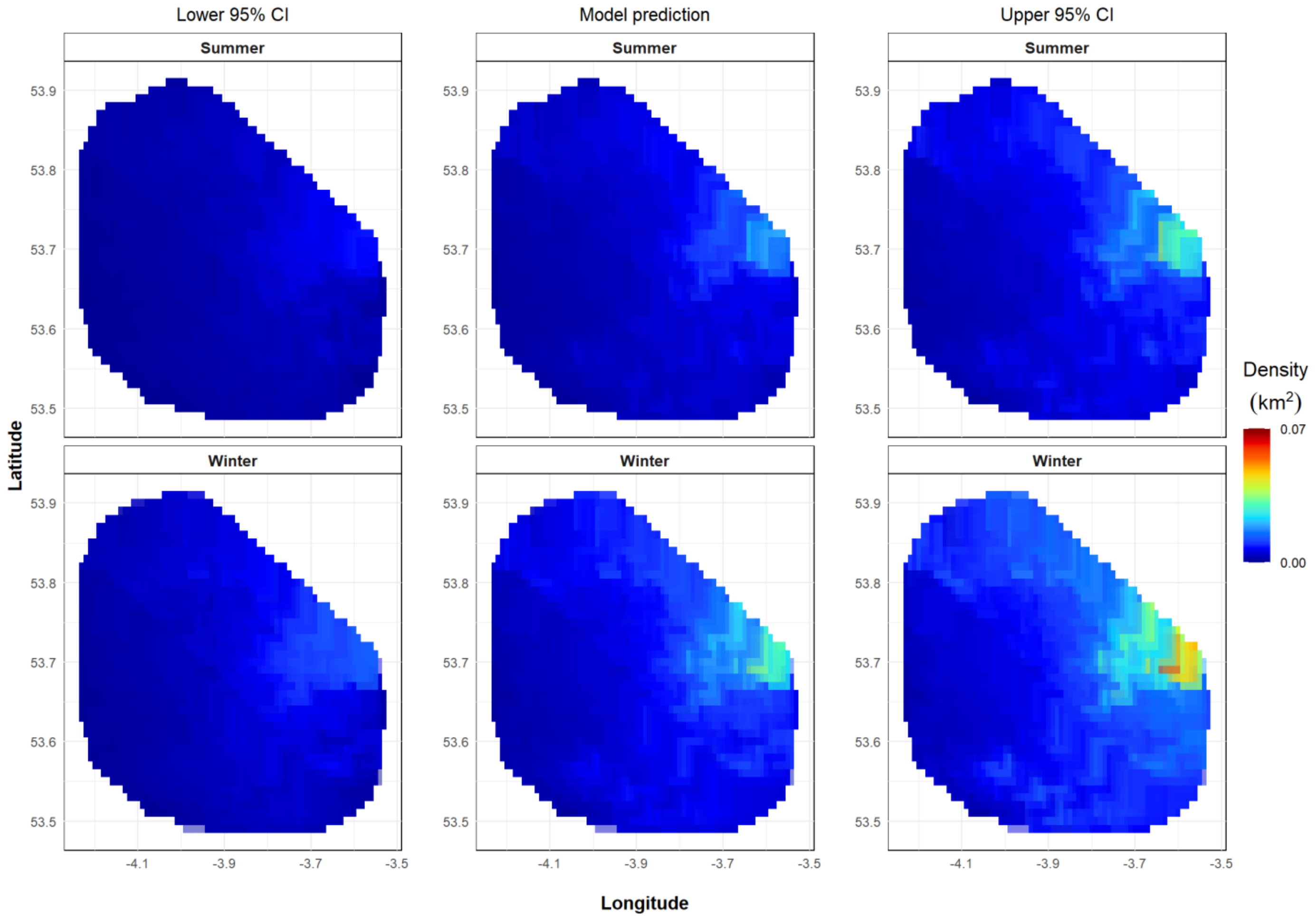


Figure A.23: GLM-estimated harbour porpoise density (centre panels) for the Mona Aerial Survey Area, with lower and upper 95% confidence intervals, split by bio-season.

A.3.6.1.17 Harbour porpoise density appears uniformly low (Figure A.23), with a concentration of occurrence in the eastern part of the Mona Aerial Survey Area, particularly in the winter bio-season (October to March).

A.3.6.1.18 In all cases mean relative and absolute densities, derived from the linear models, are lower than equivalent densities obtained from the design-based approach, and high coefficients of variation indicate a great deal of variability between estimates. These are likely due to the difficulty of the linear model to incorporate environmental covariates, leaving much of the variance unexplained, and contributing to the low predictive power of these models.

A.3.6.1.19 The linear models are not sufficiently robust to make predictions of harbour porpoise density, and as such should not be relied upon to estimate patterns of spatial distribution within the Mona Aerial Survey Area. For this reason estimates of occurrence and density should be based upon estimates of abundance obtained from the design-based approach.

Grey seal

A.3.6.1.20 Grey seal abundance (i.e. pooled counts of grey seal, “seal species” and “phocid”) varied across months and seasons, with lowest abundance observed during the winter (December to February) months, and greater abundance during the rest of the year. 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 here as “bio-seasons”.

A.3.6.1.21 Mean relative abundance and density estimates, 95% confidence intervals, and coefficients of variation were calculated (see paragraph A.3.6.1.4) for monthly and seasonal (meteorological and bio-season) divisions, and aggregated across all surveys, for the Mona Aerial Survey Area (1,447 km^2). These estimates are presented in Table A.8.

A.3.6.1.22 Sample sizes divided by month and season (meteorological and bio-season) were too small for robust modelling using the MRSea package (n > 30 required), so grey seal relative density was instead estimated from generalised linear models, following the method described in paragraph A.3.6.1.13. Bio-season was determined to be the most appropriate division, as grey seal spatial distribution changes between the pupping and non-pupping seasons

A.3.6.1.23 Grey seal densities were estimated from the “bio-season” model, which predicted a mean relative density of 0.004 animals/km^2 (95% CI: 0.002, 0.005) during the pupping season, and 0.003 animals/km^2 (95% CI: 0.001, 0.004) during the non-pupping season.

A.3.6.1.24 Relative abundance and density values were adjusted to account for availability bias of grey seals, using the most conservative correction factor of 0.156 (Thompson *et al.,* 1991; Ørsted, 2018), to provide estimates of absolute abundance and density, and 95% confidence intervals (Table A.9).

Table A.8: Model-based monthly, seasonal, and total relative density estimates of grey seal, including Lower and Upper 95% confidence intervals (CI), and coefficient of variation (cv). Mean seasonal abundance is estimated for the Mona Aerial Survey Area.

Temporal division	Mean relative abundance	Mean relative density [design] (animals/km^2)	Mean relative density [model] (animals/km^2)	Lower CI	Upper CI	Coefficient of Variation
Month						
Jan	25	0.017	0.003	0.001	0.006	0.257
Feb	39	0.027	0.006	0.002	0.011	0.294
Mar	46	0.032	0.007	0.002	0.011	0.245
Apr	36	0.025	0.004	0.001	0.008	0.300
May	7	0.005	0.000	0.000	0.001	-
Jun	14	0.010	0.001	0.000	0.003	0.288
Jul	21	0.015	0.003	0.000	0.007	0.302

Temporal division	Mean relative abundance	Mean relative density [design] (animals/km²)	Mean relative density [model] (animals/km²)	Lower CI	Upper CI	Coefficient of Variation
Aug	7	0.005	0.001	0.000	0.003	0.204
Sep	11	0.007	0.002	0.000	0.004	0.483
Oct	7	0.005	0.001	0.000	0.002	-
Nov	18	0.012	0.003	0.000	0.005	0.077
Dec	42	0.029	0.006	0.002	0.011	0.261
Meteorological season						
Winter	35	0.025	0.005	0.003	0.007	0.273
Spring	34	0.023	0.004	0.000	0.007	0.270
Summer	14	0.010	0.002	0.000	0.003	0.257
Autumn	13	0.009	0.002	0.001	0.003	0.298
Bio-season						
Pupping	11	0.008	0.003	0.001	0.004	0.264
Non-pupping	31	0.022	0.004	0.002	0.006	0.274
Year	25	0.017	0.003	0.002	0.004	0.268

Table A.9: Model-based monthly, seasonal, and total absolute density estimates of grey seal including Lower and Upper 95% confidence intervals (CI), and coefficient of variation (cv). Mean seasonal abundance is estimated for the Mona Aerial Survey Area.

Temporal division	Mean absolute abundance	Mean absolute density [design] (animals/km²)	Mean absolute density [model] (animals/km²)	Lower CI	Upper CI	Coefficient of Variation
Month						
Jan	160	0.111	0.022	0.015	0.030	0.257
Feb	250	0.173	0.040	0.026	0.054	0.294
Mar	296	0.205	0.042	0.028	0.057	0.245
Apr	228	0.158	0.028	0.019	0.038	0.300
May	43	0.030	0.003	0.002	0.004	-
Jun	92	0.063	0.007	0.005	0.009	0.288
Jul	138	0.095	0.022	0.015	0.030	0.302
Aug	45	0.031	0.007	0.005	0.009	0.204

Temporal division	Mean absolute abundance	Mean absolute density [design] (animals/km^2)	Mean absolute density [model] (animals/km^2)	Lower CI	Upper CI	Coefficient of Variation
Sep	68	0.047	0.012	0.008	0.016	0.483
Oct	46	0.031	0.004	0.003	0.005	-
Nov	113	0.078	0.016	0.011	0.022	0.077
Dec	271	0.187	0.042	0.028	0.057	0.261
Meteorological season						
Winter	227	0.157	0.035	0.022	0.047	0.273
Spring	215	0.148	0.024	0.002	0.047	0.270
Summer	91	0.063	0.012	0.002	0.022	0.257
Autumn	82	0.057	0.011	0.004	0.018	0.298
Bio-season						
Pupping	71	0.049	0.016	0.005	0.026	0.264
Non-pupping	201	0.139	0.023	0.015	0.036	0.274
Year	158	0.109	0.020	0.012	0.029	0.268

A.3.6.1.25 Since bio-season is the most biologically relevant, density distributions within the Mona Aerial Survey Area were generated according to bio-season and are presented in Figure A.24.

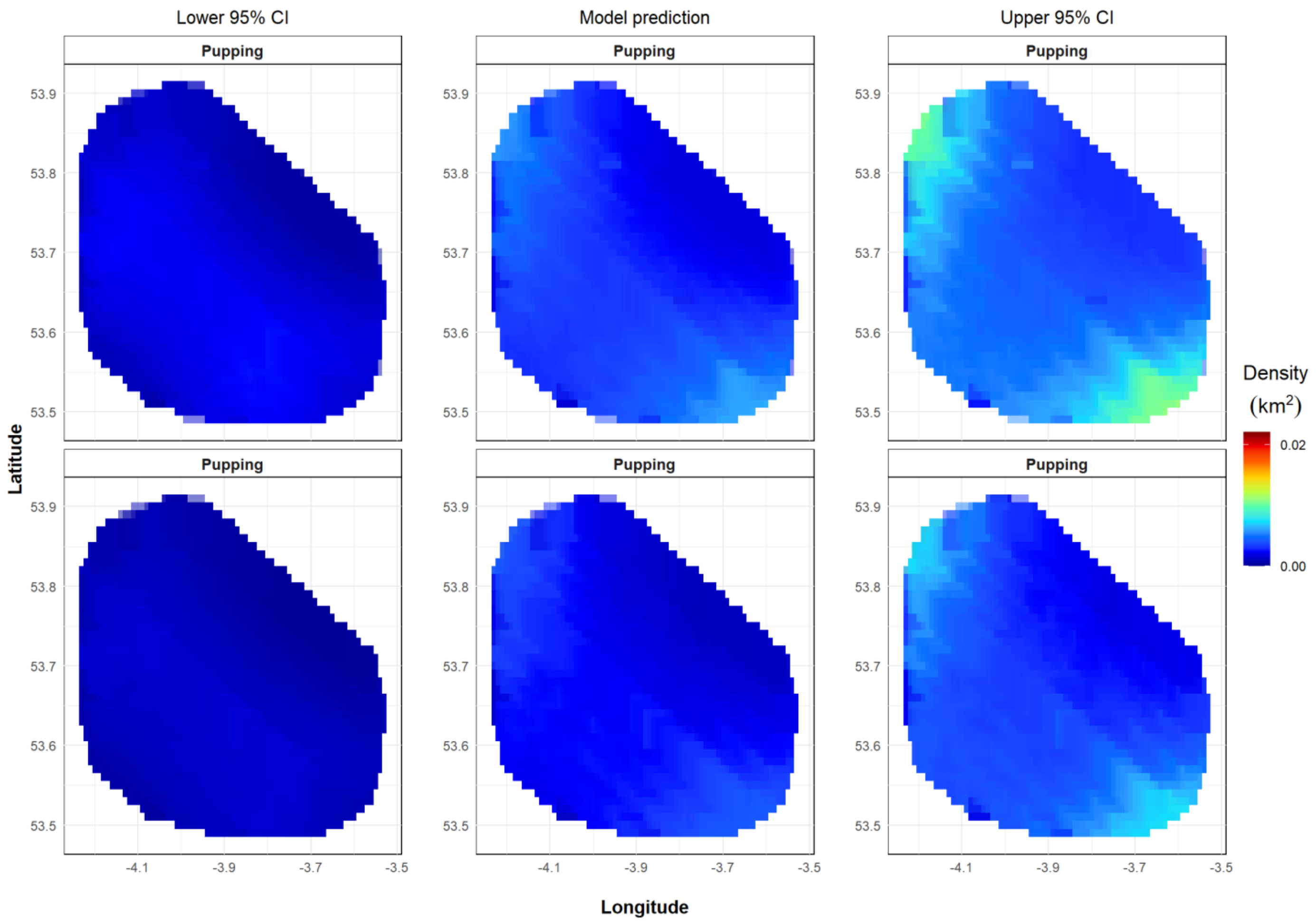


Figure A.24: GLM-estimated grey seal density (centre panels) for the Mona Aerial Survey Area, with lower and upper 95% confidence intervals, split by “bio-season”.

A.3.6.1.26 In all cases mean relative and absolute densities, derived from the generalised linear models, are lower than equivalent densities obtained in the design-based approach, and high coefficients of variation indicate a great deal of variability between estimates. These are likely due to the difficulty of the models to incorporate environmental covariates, leaving much of the variance unexplained, and contributing to the low predictive power of these models.

A.3.6.1.27 The linear models are not sufficiently robust to make predictions of grey seal density, and as such should not be relied upon to estimate distribution within the Mona Aerial Survey Area. For this reason estimates of grey seal occurrence and density should be based upon estimates of abundance obtained from the design-based approach.

Porpoise species

A.3.6.1.28 “Porpoise species” (harbour porpoise plus porpoise/dolphin species; see paragraph A.3.6.1.2) abundance occurred in similar patterns to harbour porpoise across the Mona Aerial Survey Area, with a slightly greater incidence at the east of the survey area, and relatively low variability between bio-season.

A.3.6.1.29 Sample sizes divided by month and meteorological season were sufficient for modelling using the MRSea package. However, results from this analysis, including when divided into bio-season, provided insufficient predictive power and could not be used to predict robust estimates of spatial density.

A.3.6.1.30 Due to the lower than expected predictive power of the MRSea model, relative density was calculated from generalised linear models, as described in paragraph A.3.6.1.13.

A.3.6.1.31 Mean relative abundance and density estimates, 95% confidence intervals, and coefficients of variation were calculated for monthly and seasonal (meteorological and bio-season) divisions, and aggregated across all surveys, for the Mona Aerial Survey Area (1,447 km^2). These estimates are presented in Table A.10

A.3.6.1.32 Relative abundance and density values were adjusted to account for availability bias, using the most conservative correction factor of 0.425, to provide estimates of absolute abundance and density, and 95% confidence intervals (Table A.11).

A.3.6.1.33 As for harbour porpoise when identified to species level, the most biologically relevant “porpoise species” densities were estimated from the “bio-season” model, which predicted a mean relative density of 0.015 animals/km^2 (95% CI: 0.010, 0.019) during the winter bio-season, and 0.013 animals/km^2 (95% CI: 0.009, 0.015) during the summer bio-season. These density values are approximately double those estimated for harbour porpoise alone.

A.3.6.1.34 Since bio-season is the most biologically relevant, density distributions within the Mona Aerial Survey Area were generated according to bio-season and are presented in Table A.11.

A.3.6.1.35 "Porpoise species” density appears broadly uniform low across the Mona Aerial Survey Area, with a concentration of occurrence in the eastern part of the aerial survey area, with little difference in estimated density between summer and winter bio-seasons.

A.3.6.1.36 In all cases mean relative and absolute densities, derived from the linear models, are lower than equivalent densities obtained in the design-based approach. High coefficients of variation indicate a great deal of variability between estimates. These are likely due to the difficulty of the linear model to incorporate environmental covariates, leaving much of the variance unexplained, and contributing to the low predictive power of these models.

A.3.6.1.37 As for harbour porpoise identified with confidence to species level, the linear models for “porpoise species” are not sufficiently robust to make predictions of density, and as such should not be relied upon to estimate distribution within the Mona Aerial Survey Area. For this reason estimates of occurrence and density should be based upon the estimates of abundance obtained from the design-based approach.

Table A.10: Model-based monthly, seasonal, and total relative density estimates of “porpoise species”, including Lower and Upper 95% confidence intervals (CI), and coefficient of variation (cv). Mean seasonal abundance is estimated for the Mona Aerial Survey Area.

Temporal division	Mean relative abundance	Mean relative density [design] (animals/km^2)	Mean relative density [model] (animals/km^2)	Lower CI	Upper CI	Coefficient of Variation
Month						
Jan	114	0.079	0.027	0.019	0.034	0.476
Feb	110	0.076	0.019	0.014	0.025	0.450
Mar	174	0.120	0.025	0.018	0.033	0.327
Apr.	39	0.027	0.005	0.004	0.006	0.263

Temporal division	Mean relative abundance	Mean relative density [design] (animals/km^2)	Mean relative density [model] (animals/km^2)	Lower CI	Upper CI	Coefficient of Variation
May	30	0.021	0.005	0.003	0.006	0.450
Jun	104	0.072	0.017	0.012	0.022	0.392
Jul	93	0.064	0.017	0.013	0.022	0.595
Aug	88	0.061	0.018	0.013	0.023	0.368
Sep	103	0.071	0.015	0.011	0.020	0.343
Oct	28	0.020	0.004	0.003	0.006	0.428
Nov	14	0.010	0.003	0.002	0.004	0.642
Dec	56	0.039	0.010	0.007	0.012	0.402
Meteorological season						
Winter	93	0.065	0.018	0.009	0.028	0.479
Spring	80	0.055	0.012	0.000	0.025	0.341
Summer	95	0.066	0.017	0.017	0.018	0.458
Autumn	48	0.033	0.008	0.000	0.015	0.442
Bio-season						
Winter	83	0.057	0.015	0.006	0.023	0.469
Summer	76	0.052	0.013	0.008	0.018	0.442
Year	79	0.055	0.011	0.009	0.018	0.403

Table A.11: Model-based monthly, seasonal, and total absolute density estimates of “porpoise species”, including Lower and Upper 95% confidence intervals (CI), and coefficient of variation (cv). Mean seasonal abundance is estimated for the Mona Aerial Survey Area.

Temporal division	Mean absolute abundance	Mean absolute density [design] (animals/km^2)	Mean absolute density [model] (animals/km^2)	Lower CI	Upper CI	Coefficient of Variation
Month						
Jan	269	0.186	0.063	0.047	0.080	0.476
Feb	259	0.179	0.045	0.034	0.057	0.450
Mar	410	0.283	0.060	0.045	0.077	0.327
Apr	92	0.064	0.012	0.009	0.015	0.263
May	71	0.049	0.011	0.008	0.014	0.450
Jun	244	0.169	0.040	0.030	0.051	0.392
Jul	219	0.151	0.041	0.031	0.052	0.595
Aug	207	0.143	0.041	0.031	0.052	0.368
Sep	242	0.167	0.036	0.027	0.046	0.343

Temporal division	Mean absolute abundance	Mean absolute density [design] (animals/km²)	Mean absolute density [model] (animals/km²)	Lower CI	Upper CI	Coefficient of Variation
Oct	67	0.046	0.010	0.007	0.013	0.428
Nov	33	0.023	0.008	0.006	0.010	0.642
Dec	133	0.092	0.022	0.016	0.028	0.402
Meteorological season						
Winter	220	0.152	0.043	0.020	0.067	0.479
Spring	189	0.131	0.027	0.017	0.059	0.341
Summer	223	0.154	0.041	0.040	0.041	0.458
Autumn	114	0.079	0.018	0.000	0.036	0.442
Bio-season						
Winter	195	0.135	0.034	0.015	0.054	0.469
Summer	178	0.123	0.030	0.019	0.042	0.442
Year	186	0.129	0.027	0.021	0.043	0.403

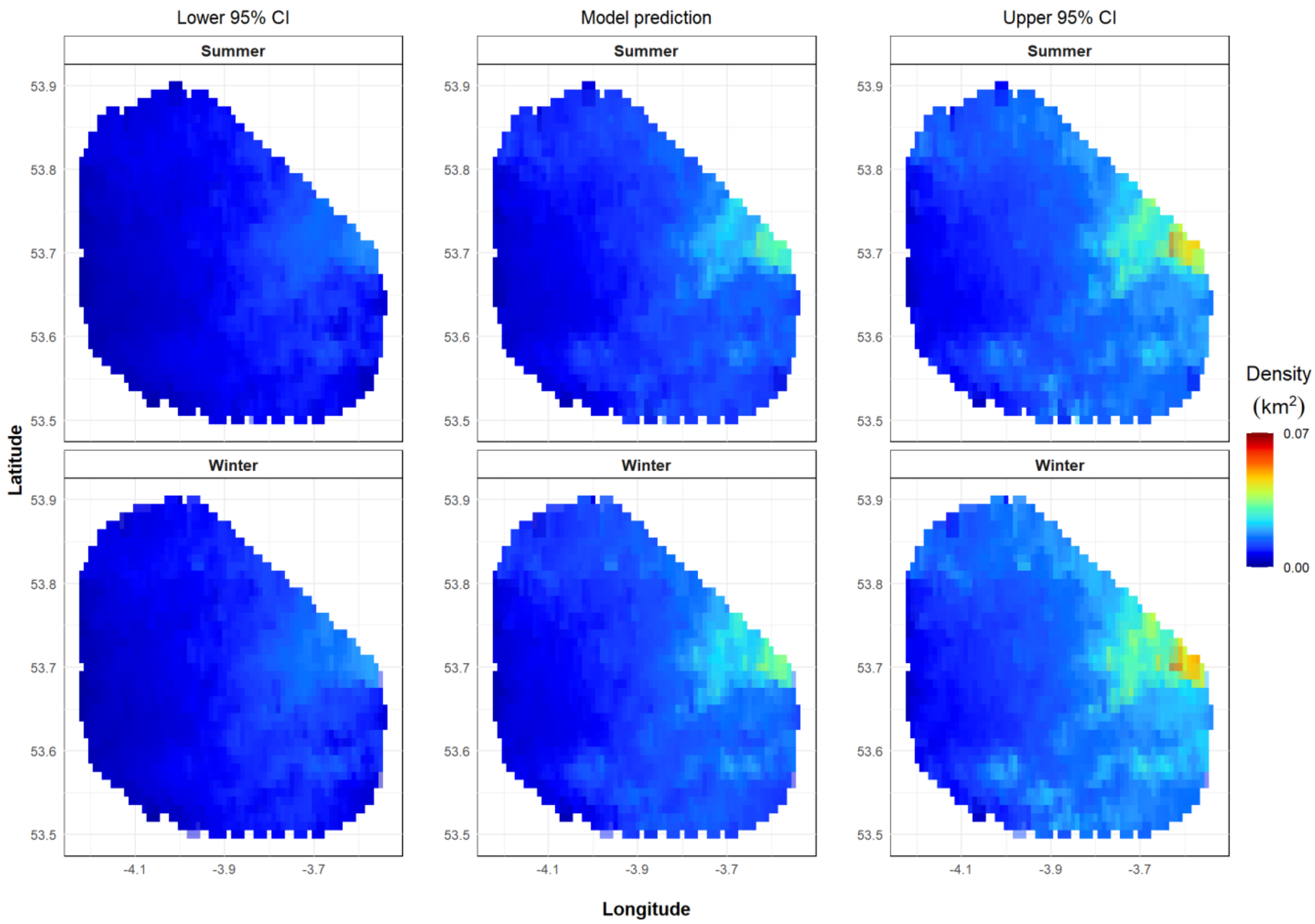


Figure A.25: GLM-estimated "porpoise species" density (centre panels) for the Mona Aerial Survey Area, with lower and upper 95% confidence intervals, split by "bio-season".

Summary

A.3.6.1.38 This report provides a summary of marine mammal activity recorded during the aerial digital surveys across the Mona Array Area plus buffer (the Mona Aerial Survey Area).

A.3.6.1.39 A target coverage of 12% of the Mona Aerial Survey Area was processed by APEM Ltd. The mean area actually processed was 15.2% (± 0.12%). Figures in parentheses are standard errors.

A.3.6.1.40 The division of the year into two bio-seasons for harbour porpoise, based upon bimodal patterns of spatial distribution ("Winter" and "Summer") is an approach intended to address the difficulties in implementing criteria for designating SACs (Heinänen & Skov, 2015). This approach has also been applied to biologically relevant seasons for grey seal ("Pupping" and "Non-pupping") and is the approach to be taken forward to the Environmental Impact Assessment.

A.3.6.1.41 Harbour porpoise accounted for the highest number of individuals identified to species level (n = 137, based on raw count data) across the Mona Aerial Survey Area, and were recorded in all survey months except for July, November and December 2020. Grey seal accounted for the second highest number of sightings (n = 70) but were not recorded in every month over the survey period. Bottlenose dolphin were encountered for two months of the year (June 2021 and January 2022), with highest in June 2021 with four animals. Risso's dolphin were encountered in just one month of the year (November 2020), with two animals sighted together. Harbour seals were only encountered once, with one animal in March 2020. There were also a number of cetacean sightings ('dolphin species', 'dolphin/porpoise') that could not be assigned to species level (n = 163), which had high sightings and frequency. Similarly, there were a large number of sightings classified as 'seal species' or 'phocid species' due to the issue of identifying to species level from aerial survey data.

A.3.6.1.42 Peaks in harbour porpoise abundance were estimated to occur in the winter bio-season (Table A.12). Grey seal (including animals identified as "seal species" and "phocids") densities peaked during the non-pupping season (Table A.12).

Table A.12: Summary table of estimated absolute (corrected for availability bias) abundance and density, per species/grouping, for "bio-seasons" within the Mona Aerial Survey Area.

	Mean absolute abundance	Mean absolute density [design] (animals/km^2)	Mean absolute density [model] (animals/km^2)	Lower CI	Upper CI	Coefficient of Variation
Harbour porpoise						
Winter	140	0.097	0.022	0.005	0.041	0.500
Summer	88	0.061	0.013	0.005	0.023	0.478
Year	114	0.079	0.014	0.008	0.028	0.491
"Porpoise species"						
Winter	195	0.135	0.034	0.015	0.054	0.469
Summer	178	0.123	0.030	0.019	0.042	0.442
Year	186	0.129	0.027	0.021	0.043	0.403
Grey seal						
Pupping	71	0.049	0.016	0.005	0.026	0.264
Non-pupping	201	0.139	0.023	0.015	0.036	0.274
Year	158	0.109	0.020	0.012	0.029	0.268

A.3.6.1.43 Where possible, relative density estimates were corrected for availability bias to give absolute densities. Telemetry studies of the diving behaviour of different species were useful in indicating the average proportion of time that individuals of a species may be on, or near, the surface and available for detection. Note that the limitations of using availability bias estimates from published studies are recognised (e.g. potentially subject to geographic, seasonal, diurnal, and individual animal variation) and therefore absolute densities are considered to be approximations only.

A.3.6.1.44 There was no clear spatial pattern in distribution for any of the species across the Mona Aerial Survey Area although some higher concentrations of harbour porpoise sightings in the eastern portion of the Mona Aerial Survey Area was visible in the estimated density plots. Grey seal were relatively evenly distributed in the Mona Aerial Survey Area, with a higher concentration along the north-east boundary.

A.3.6.1.45 The model-based approach using the MRSea package for R was unable to robustly predict the distribution of marine mammal density from these data for the Mona Aerial Survey Area. As an alternative, generalised linear models were employed to make simple estimates based only on seasonal and spatial covariates, since these models were unable to incorporate environmental information (bathymetry, distance to coast).

A.3.6.1.46 The generalised linear models, unable to incorporate environmental information, are based entirely upon observations of marine mammal species within the Mona Aerial Survey Area. Although these are a useful tool in estimating distribution based upon confirmed occurrence, these models do not provide sufficient statistical power for predictions of spatial distribution, abundance or density to be made for any of the species considered.

A.3.6.1.47 As a result of the simplified model-based approach, and the “snap-shot” nature of the aerial surveys, interpretation of the suggested seasonality and spatial distribution of marine mammals should be undertaken with caution, and preference given to estimates obtained via the design-based approach.

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Appendix B: SMRU seal haul out and telemetry data in relation to the Mona Array Area

SMRU Consulting

understand ♦ assess ♦ mitigate

Seal haul-out and telemetry data in relation to the Mona Offshore Wind Project

Authors:	Philippa Wright & Rachael R Sinclair
Report Code:	SMRUC-RPS-2022-004
Date:	April 2023

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Contents

Figures

Tables

1 Introduction

SMRU Consulting was contracted by RPS to provide seal haul-out count and telemetry data in relation to the Mona Offshore Wind Project. At the time of enquiry (June 2022), the area of interest for the data request was the regional marine mammal study area, bounded by the limits of the Irish Sea[1]. This overlaps with the Northwest England, Wales, Southwest Scotland and Northern Ireland seal MUs and the combined area of these MUs are hereafter referred to as the 'seal telemetry and haul-out study area'. The following data was requested:

- Harbour seal (*Phoca vitulina*) haul-out count data from August moult census surveys between 1996 and 2018 to examine site specific abundance and interannual patterns in counts over time. This will cover all haul-outs within the seal telemetry and haul-out study area.
- Associated grey seal (*Halichoerus grypus*) haul-out counts from these same August surveys (although please note that during the summer months grey seal distribution is highly variable and these counts, while giving a single snapshot of local summer distribution, are not a reliable census of population size).
- Provision of regional and national context for these counts.
- Grey seal pup production estimates from all regularly surveyed breeding sites within the seal telemetry and haul-out study area.
- Provision of seal satellite tracking data from tagged harbour and grey seals - either animals tagged at the Special Areas of Conservation (SACs) and visiting the seal telemetry and haul-out study area or visiting the seal telemetry and haul-out study area and also hauling-out at the SACs.
- Provision of satellite tracking data from all harbour or grey seals which cross the seal telemetry and haul-out study area regardless of where tagged, if not already included in the datasets specified above.
- A basic quantification of the degree of connectivity between the seal telemetry and haul-out study area and protected haul out sites.

Note: SMRU do not carry out haul-out counts in the Northwest England MU or the Wales MU. Estimates of seals hauled-out in these MUs are "*compiled from counts shared by other organisations or found in reports & on websites*" (SCOS, 2021).

1.1 Seal telemetry and haul-out study area

The seal telemetry and haul-out study area comprises the total area of four MUs, namely the Northwest England, Wales, Southwest Scotland and Northern Ireland seal MUs (Figure 1). The Mona Offshore Wind Project and its associated Offshore Cable Corridor is entirely located within the Wales MU, with areas of the Marine Mammal Study Area extending into the Northwest England MU (Figure 1).

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[1] In the Marine Mammals Technical Report, the regional marine mammal study area has been subsequently widened to cover the Irish Sea and wider Celtic Sea after this report was requested.

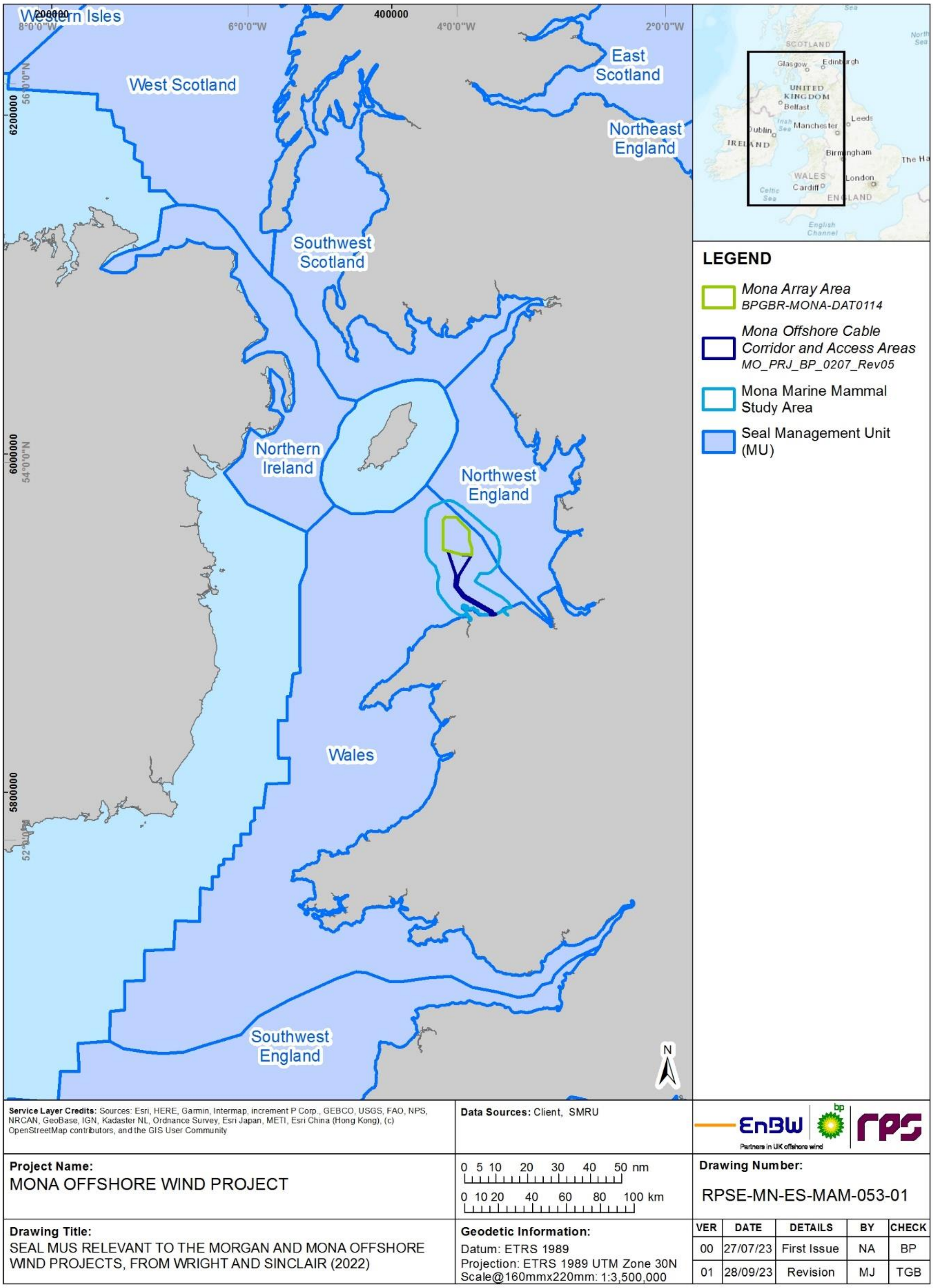

Figure 1 Mona marine mammal study area and relevant seal MUs.

2 Methods

2.1 Haul-out Surveys

2.1.1 Sea Mammal Research Unit (SMRU) Surveys

The Sea Mammal Research Unit (SMRU) carries out surveys of harbour (or common) and grey seals in Scotland and on the east coast of England to contribute to the Natural Environment Research Council's (NERC's) statutory obligation under the Conservation of Seals Act 1970 '*to provide the (UK government) with scientific advice on matters related to the management of seal populations*'. These SMRU surveys, as well as surveys by other organisations (including NatureScot, Natural England, the Natural Resources Wales, the National Trust and the Lincolnshire Wildlife Trust) form the routine monitoring of seal populations around the UK. The annually submitted 'Advice', which includes information on recent changes in grey and harbour seal numbers, can be found in the Special Committee on Seals (SCOS) reports on SMRU's website[2].

Seals are widely distributed around the UK coast and most surveys are carried out from the air by either light aircraft or helicopter. SMRU does not survey the entire UK coast; surveys are concentrated in Scotland and on the east coast of England (Lincolnshire and Norfolk) where seals are relatively abundant and easy to survey. All surveys are of seals that are hauled-out on shore.

On account of differences in the breeding behaviour of harbour and grey seals, the two species are surveyed at different times in their annual cycle. Harbour seals tend to be dispersed when breeding and aggregate, to an extent, when moulting, so the main harbour seal surveys are carried out during their annual moult in August. In contrast, grey seals aggregate at traditional colonies when breeding and, therefore, grey seal surveys are designed to estimate the numbers of pups born at these colonies, during the autumn breeding season (between August and December). Harbour seals are also surveyed in a few areas during their breeding season in June and July. While grey seals are counted on all harbour seal surveys, harbour seals are very rarely seen on any of the grey seal breeding colony surveys.

2.1.1.1.1 Harbour Seals

Surveys of harbour seals are carried out during the summer and early autumn months. There are two types of surveys conducted: breeding counts and moult counts.

Breeding seals are surveyed in June and July. Breeding season surveys are carried out (almost) annually in the Moray Firth and, in recent years, in Lincolnshire and Norfolk. A very limited number of breeding season surveys have been carried out on behalf of NatureScot in areas designated as SACs for harbour seals in Scottish waters. Given that there are no harbour seal breeding surveys conducted in the marine mammal study area, these are not considered further in this report.

The main population surveys are carried out when harbour seals are moulting, during the first three weeks of August. The greatest and most consistent numbers of harbour seals are hauled-out ashore during their annual moult. To maximise the numbers of seals on shore and to reduce the effects of environmental variables, surveys are restricted to within two hours either side of low tides and are not conducted in the rain.

The frequency of surveys differs by area. In general, moult surveys that are conducted annually are carried out in Lincolnshire and Norfolk (England), the Moray Firth and the Firth of Tay (Scotland). The remainder of the Scottish coast is surveyed approximately every four to five years, although there is considerable variation between areas.

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[2] http://www.smru.st-andrews.ac.uk/research-policy/scos/

Harbour seals inhabiting rocky shores are surveyed using a helicopter equipped with a thermal imaging camera that can detect seals hauled out ashore at a distance of up to 3km. It is possible to differentiate between the two species using their thermal profiles, the group structure on shore, a 'real' image from a camcorder, directly using binoculars or retrospectively from high resolution digital photographs. In some instances, however, species identity is still uncertain, and the seals are classified as 'species unknown'.

The moult counts represent the number of harbour seals that were on shore at the time of the survey and are an estimate of the minimum size of the population. They do not represent the total size of the local population since a number of seals would have been at sea at the time of the survey. Note that these data refer to the numbers of seals found within the surveyed areas only at the time of the survey; numbers and distribution are likely to differ at other times of the year (such as the breeding period).

Numbers of grey seals are also counted during the harbour seal August moult surveys. Counts of greys seals during the summer months are highly variable and are not used as a population index in this species, however they provide useful information on the summer and non-breeding season distribution of grey seals. It is possible to differentiate between the two species using thermal profiles and their group structure on shore. Species identity is confirmed using a 'real' image from a camcorder and directly using binoculars. The most recent data for the marine mammal study area are from the period 2016 to 2019.

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

2.1.1.1.2 Grey seals

Grey seals aggregate in the autumn (August to December) to breed at traditional colonies, and therefore their distribution during the breeding season is very different to their distribution at other times of the year (such as the annual moult – December to April, or other times of the year where they spend less time hauled-out and travel further between haul-outs sites).

It is estimated that 23.9% of the total grey seal population are hauled-out and available to count during August surveys (Russell *et al.*, 2016) and therefore the total number of grey seals in the population for any given count period can be estimated by using the proportion of seals hauled-out.

2.1.1.1.3 Scotland

Grey seals are surveyed during their breeding season (Aug to Dec). Most breeding colonies are surveyed by SMRU by fixed wing aerial vertical photography (Hebrides, Orkney, North Scotland the Northeast Scotland, and most of the Firth of Forth) while others are surveyed by ground count by other organisations (Shetland and Incholm in the Firth of Forth). The grey seal pup production database contains data from 1989 to 2019 and includes 74 breeding colonies (though not all colonies have been surveyed consistently since 1989 and some smaller colonies are surveyed more sporadically than others). Most breeding colonies used to be surveyed annually, however from 2010 most colonies switched to biennial surveys instead due to reductions in funding combined with increased aerial survey cost (SCOS, 2015) (Note: surveys in southeast England remain annual).

There are no known breeding colonies within the Southwest Scotland MU.

2.1.1.1.4 Wales

In Wales, grey seals are difficult to count at haul-out sites from aerial surveys as, during the pupping season, many haul-out in caves and in "*cryptic habitats where topographic features completely or partially obscure the habitat from aerial view*"; therefore ground and vessel-based surveys are more likely to result in accurate estimates, but are challenging due to cost, personnel and resource limitations (Stringell *et al.*, 2014).

Grey seals haul-out around the Welsh coastline which Natural Resources Wales (NRW) monitors partly through the maintenance of the EIRPHOT database of photo-ID data from 246 haul-out sites around the Welsh coast and islands.

2.1.1.1.5 Northwest England

In the Northwest England MU, there are no dedicated SMRU seal haul-out surveys conducted due to the low numbers of seals (SCOS, 2021). The Cumbria Wildlife Trust and Walney Bird Observatory have recorded seal counts at the South Walney haul-out during the breeding and moulting seasons, and the area has been considered a pupping site since 2015. Since 2019, Cumbria Wildlife Trust have provided SMRU with breeding counts of grey seals during low tide.

2.1.1.1.6 Northern Ireland

The National Trust monitors the grey seal haul-outs in Northern Ireland, specifically the Strangford Lough haul-out where the majority of pups are born. August haul-out surveys conducted by SMRU are not completed annually in Northern Ireland. In 2002, 2011 and 2018 August surveys conducted by SMRU were commissioned by the Department of Agriculture, Environment and Rural Affairs, Northern Ireland) (Duck and Morris, 2019).

2.1.2 Summary of methods

1. Population surveys of harbour seals are carried out during their annual moult in August.
2. Harbour seal August moult surveys provide an estimate of the minimum size of the population, not the total population size.
3. In general, harbour seal population (August moult) surveys are carried out once every four to five years in most of Scotland but annually in Lincolnshire, Norfolk, the Moray Firth and the Firth of Tay. Surveys are conducted less frequently in Wales and Northern Ireland.
4. The main grey seal surveys are conducted in the autumn to estimate the number of pups born at the main breeding colonies around the UK. These pup counts are used by SMRU to estimate the total grey seal population size.
5. Grey seals are also counted during harbour seal August moult surveys. Their numbers are highly variable in the summer months and provide information on the summer distribution and abundance of grey seals. These data also feed into the population model alongside pup data in order to estimate grey seal total population size.
6. Population estimates of seals can be obtained by scaling the August haul-out count data by the proportion of the total population hauled-out and available for the count (harbour seal: 72%, grey seal: 23.9%).
7. Results of all surveys are presented annually to the UK Government as part of NERC's statutory obligation under the Conservation of Seals Act 1970. These results are available in the SCOS documents on SMRU's website[3].
8. In Wales, grey seals are counted using aerial, ground and vessel-based surveys due to hauling out in caves and "cryptic habitats". NRW monitors and commissions monitoring of grey seals partly through the maintenance of the EIRPHOT database of photo-ID data (Russell and Morris, 2021).

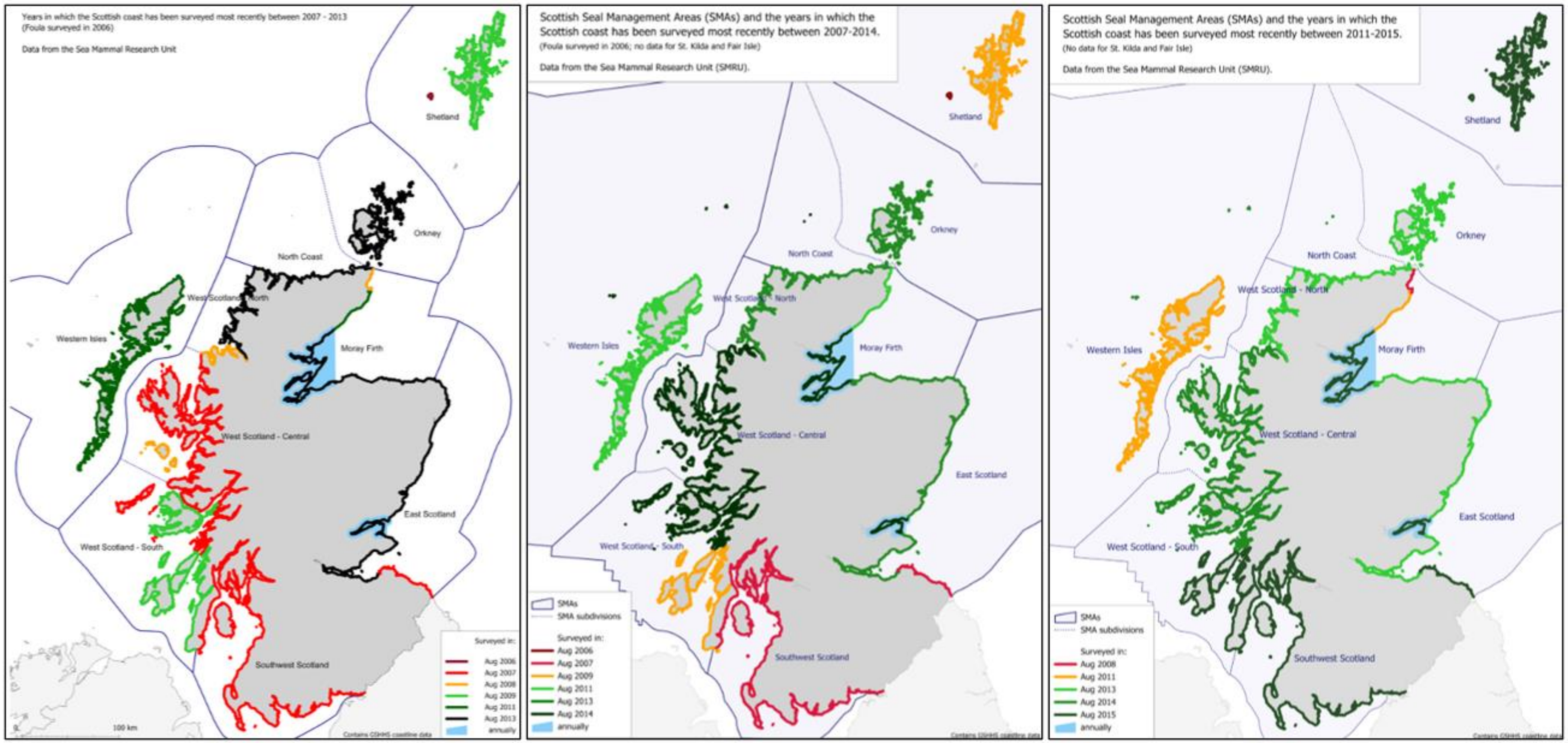
[3] http://www.smru.st-andrews.ac.uk/research-policy/scos/

9. In Northwest England, 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 2019. The area has been considered a pupping site since 2015.
10. In Northern Ireland, The National Trust monitors the grey seal haul-outs at Strangford Lough. SMRU August haul-out surveys are not conducted annually.

The haul out count data from the annual SMRU surveys are not appropriate for assessing fine scale distribution of haul out sites – the data we have are a snapshot of a single day in August in each of the surveyed years and it is only appropriate to interpret these on a regional scale. The numbers present at any one location can be highly variable between months and years and as such the data should not be used to inform decisions relating to micro-siting infrastructure.

Note: Only a part of the Scottish coast can be surveyed in one year, resulting in big differences in the area covered annually. Ideally, the entire Scottish coast is completed every five years. Figures are provided in SCOS reports (and are duplicated here for information - Figure 2, Figure 3 and Figure 4) to highlight which part of the Scottish coastline has been surveyed each year. In SCOS reporting, tables of the most recent haul-out counts are provided by "survey period" (1996 to 1997, 2000 to 2006, 2007 to 2009, 2011 to 2015 and 2016 to 2019) as these represent periods within which the entire Scottish coastline was surveyed.

a) b) c)

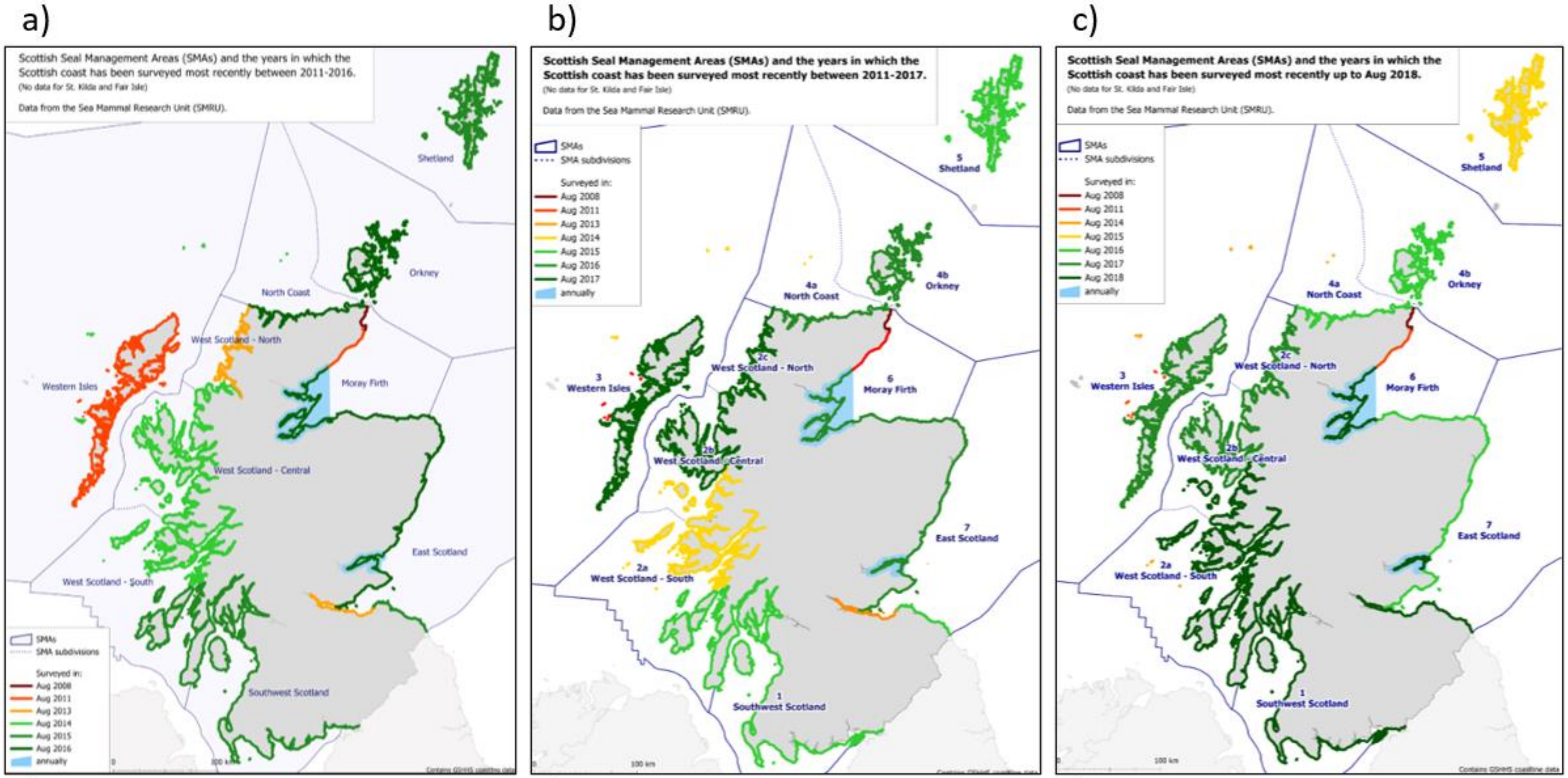


a) Most areas were surveyed between 2007 and 2013. Foula, off Shetland, was last surveyed in 2006. The enclosed areas of the Firth of Tay and the Moray Firth (between Findhorn and Helmsdale) are surveyed every year, usually by fixed-wing aircraft.

b) Most areas were surveyed between 2007 and 2014. Foula, off Shetland, was last surveyed in 2006. The enclosed areas of the Firth of Tay and the Moray Firth (between Findhorn and Helmsdale) are surveyed every year, usually by fixed-wing aircraft.

c) Most areas were surveyed between 2011 and 2015. The enclosed areas of the Firth of Tay and the Moray Firth (between Findhorn and Helmsdale) are surveyed every year, usually by fixed-wing aircraft.

Figure 2 Years in which different parts of Scotland were surveyed by helicopter using a thermal imaging camera. a) 2006-2013 (SCOS, 2015), b) 2007-2014 (SCOS, 2016), c) 2011-2015 (SCOS, 2017).



a) Most areas were surveyed between 2011 and 2015. The enclosed areas of the Firth of Tay and the Moray Firth (between Findhorn and Helmsdale) are surveyed every year, usually by fixed-wing aircraft.

b) Most areas were surveyed between 2013 and 2017. The blue shaded areas of the Firth of Tay and the Moray Firth (between Findhorn and Helmsdale) are surveyed every year, usually by fixed-wing aircraft.

c) Most areas were surveyed between 2015 and 2018. The blue shaded areas of the Firth of Tay and the Moray Firth (between Findhorn and Helmsdale) are surveyed every year, usually by fixed-wing aircraft.

Figure 3 Years in which different parts of Scotland were surveyed by helicopter using a thermal imaging camera. a) 2011-2016 (SCOS, 2018), b) 2011-2017 (SCOS, 2019), c) 2011-2018 (SCOS, 2020).

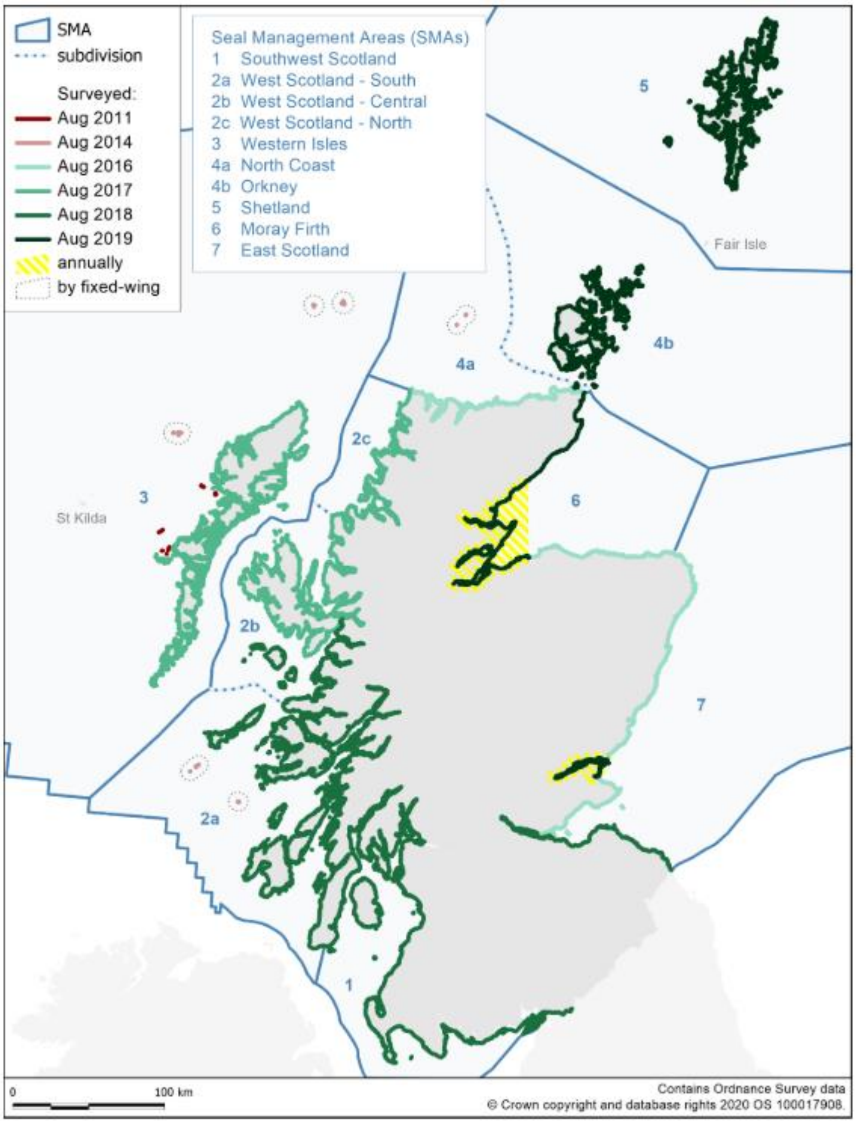


Figure 4 The most recent aerial surveys carried out during the harbour seal moult in August (SCOS, 2021).

Most areas were last surveyed between 2016 and 2019. The yellow shaded areas of the Firth of Tay and the Moray Firth (between Helmsdale and Findhorn) are surveyed every year, usually by fixed-wing aircraft. Offshore islands were last surveyed in 2014 by fixed-wing aircraft. However, only very small numbers of harbour seals are found on islands last surveyed pre-2016. St Kilda and Fair Isle have not been covered properly by aerial surveys.

2.2 Telemetry data

Relevant data were available for harbour and grey seals from telemetry tags deployed by SMRU. Tags are glued to the fur on the back of the seal's neck and fall off with the fur during the annual moult, if not before. These tags transmit data on seal locations with the tag duration (number of days) varying between individual deployments. It is worth noting that the timing of the tag deployment can be important, especially for grey seals, since movement patterns can differ between the breeding and non-breeding seasons (Russell *et al.*, 2013).

There are data from two types of telemetry tag presented in this report 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 (GSM) phone network. Both types of transmission result in location estimates, but the spatial and temporal resolution of the locational data varies with deployment. Argos location tags can have an error of >2.5km (Vincent *et al.*, 2002) while GPS location tags have a better location accuracy, with a typical error of <50 m (Patterson *et al.*, 2010). Data from GPS phone tags also provide more frequent locations by the incorporating the Fastloc GPS system (Wildtrack Telemetry Systems, UK) which obtains locational data within a fraction of a second and therefore can collect data even when the animal surfaces for a short period. The GPS tags attempt to collect location data every 5 to 20 minutes (depending on the parametrisation at set-up). Data are stored on board the tags and then relayed to SMRU by a satellite (Argos tags) or by quad-band GSM mobile phone module when the animal is within range of the GSM mobile phone network. The data are then stored in databases, cleaned according to methods described in Russell *et al.* (2011).

3 Legislation

In the UK, seals are protected under the Conservation of Seals Act 1970 in England and Wales, The Wildlife (Northern Ireland) Order 1985 in Northern Ireland and the Marine (Scotland) Act 2010.

The Conservation of Seals Act 1970 prohibits the taking of seals and killing of seals using any poisonous substance or use of any firearm other than a rifle with specified ammunition. It is an offence to take or kill a seal unless a specific License has been granted. Licences can be granted by Natural England (England) and NRW (Wales) under powers conferred by the Secretary for State. The Fisheries Act 2020 amended the Conversation of Seals Act 1970 and the Wildlife (Northern Ireland) Order 1985, to prohibit the international or reckless killing, injuring or taking of seals. In addition, the legislative changes removed the provision to grant licenses for the purposes of protection, promotion or development of commercial fisheries or aquaculture. Under Article 10 of the Wildlife (Northern Ireland) Order 1985, it is an offense to disturb seals intentionally or recklessly at any haul-out site in Northern Ireland.

In Scotland, seals are protected under the Marine (Scotland) Act 2010 (which supersedes the Conservation of Seals Act). Part 6 of this Act prohibits the taking of seals except under licence. Licences can be granted for scientific and welfare reasons[4]. NERC, through the SCOS and the SMRU, provides advice on all licence applications and haul out designations. Part 6 of this Act also prohibits harassment and injury to seals. The Protection of Seals (Designation of Haul-Out Sites) (Scotland) Order 2014 laid in the Scottish Parliament on 26 June 2014 which, from 30 September 2014, makes it an offence to harass seals at these sites. Harassment involves any activity that pesters, torments, troubles or attacks a seal on a designated haul-out site. In particular, it would include any action that causes a significant proportion of seals on a haul-out site to leave that site either more than once or repeatedly or, in the worst cases, to abandon it permanently (Marine Scotland, 2014a, b).

In Ireland, seals are protected under the Irish Wildlife Act 1976. The National Parks & Wildlife service (NPWS) is the regulatory body responsible for designating and advising on protected habitats and species in Ireland.

3.1 SACs

The European Union's Council Directive 92/43/EEC (commonly known as the 'Habitats Directive') requires the creation of a Europe-wide network of SACs for designated species. This network of SACs is designed to ensure that the species listed in Annex II of the Habitats Directive, which includes both grey and harbour seals, are maintained in a favourable conservation status in their natural range (Article 3(1)). Information on the SACs which have been designated for harbour seals can be found on

[4] Note: the Animals and Wildlife (Penalties, Protections and Powers) (Scotland) Act 2020 amended the Marine (Scotland) Act 2010. The change removed the granting licenses to kill or take seals for the protection of the health and welfare of farmed fish, and to prevent serious damage to fisheries or fish farms.

the JNCC website[5]. Information on the SACs which have been designated for grey seals can be found on the JNCC website[6].

The Habitats Directive requires the creation of a Europe-wide network of SACs. The network of SACs is designed to ensure that the species listed in Annex II of the Directive are restored at a favourable conservation status in their natural range (Article 3(1)). The EU Habitats Directive (1992) lists both grey and harbour seals in Annex II and Annex V and requires that SACs be established for their protection (Table 1).

Table 1: SACs designated for their seal populations within the seal telemetry and haul-out study area.

MU	SAC	Marine mammal species
Wales MU	Pembrokeshire Marine/Sir Benfro Forol	Grey seal (designated)
	Cardigan Bay	Grey seal (qualifying feature)
	Pen Llŷn a'r Sarnau/ Lleyn Peninsula and the Sarnau	Grey seal (qualifying feature)
Northern Ireland MU	The Maidens	Grey seal (qualifying feature)
	Murlough	Grey seal (qualifying feature)
	Strangford Lough	Harbour seals (qualifying feature)
Ireland[1]	Saltee Islands	Grey seal (designated)
	Roaringwater Bay and Islands	Grey seal (designated)
	Blasket Islands	Grey seal (designated)
	Slaney River Valley	Harbour seal (designated)
	Lambay Island	Harbour and grey seal (qualifying)
There are no designated SACs for the harbour seal in Wales. There are no designated SACs for seals in the Northwest England MU [1] It should be noted that these SACs are not located within the specified marine mammal study area, however some are referred to later in the report.		

3.2 Designated haul-out sites

In the Southwest Scotland MU, there are seven designated seal haul-out sites, one of which overlaps into the Northwest England MU (Table 2 and Figure 6). However, these haul-outs are over ~74km swimming distance away from the Mona Offshore Wind Project (Table 2), and therefore there is expected to be no direct impacts to seals while hauled-out at these designated sites. There are no designated grey seal breeding colonies in the vicinity of the Mona Offshore Wind Project or surrounding MUs.

[5] https://sac.jncc.gov.uk/species/S1365/

[6] https://sac.jncc.gov.uk/species/S1364/

Table 2: Designated seal haul-out sites in the Southwest Scotland MU based on August survey counts (both species).

Site ID	Site Name	Location	Distance from Mona Offshore Wind project by sea
SW-001	**Sanda & Sheep Island**	**Mull of Kintyre**	**~175 km**
Intertidal sandbanks and rocky coastline of Sanda and Sheep Island and associated rocky outcrops.			
SW-002	**Sound of Pladda Skerries**	**South Arran**	**~190 km**
Intertidal sandbanks and rocky coastline between Port a Ghillie Ghlais and Port Dearg and associated rocky outcrops.			
SW-003	**Rubha nan Sgarbh**	**Kilbrannan Sound, East Kintyre**	**~197 km**
Intertidal sandbanks and rocky coastline between Pluck Point and Sgorshuil and associated rocky outcrops.			
SW-004	**Yellow Rock**	**Ardnacross Bay, East Kintyre**	**~185 km**
Intertidal sandbanks and rocky coastline between Macringan's Point and the north end of Yellow Rock and associated rocky outcrops.			
SW-005	**Lady Isle**	**Firth of Clyde, West of Troon**	**~200 km**
Entire island of Lady Isle and associated rocky outcrops.			
SW-006	**Little Scares**	**Luce Bay, between Mull if Galloway and Burrow Head**	**~74 km**
Entire islands of the Big Scares and the Little Scares.			
SW-007	**Solway Firth Outer Sandbank**	**Solway Firth, between Southerness Point and Dubmill Point**	**~87 km**
Intertidal mud banks south-east of Southerness Point in the Solway Estuary.			

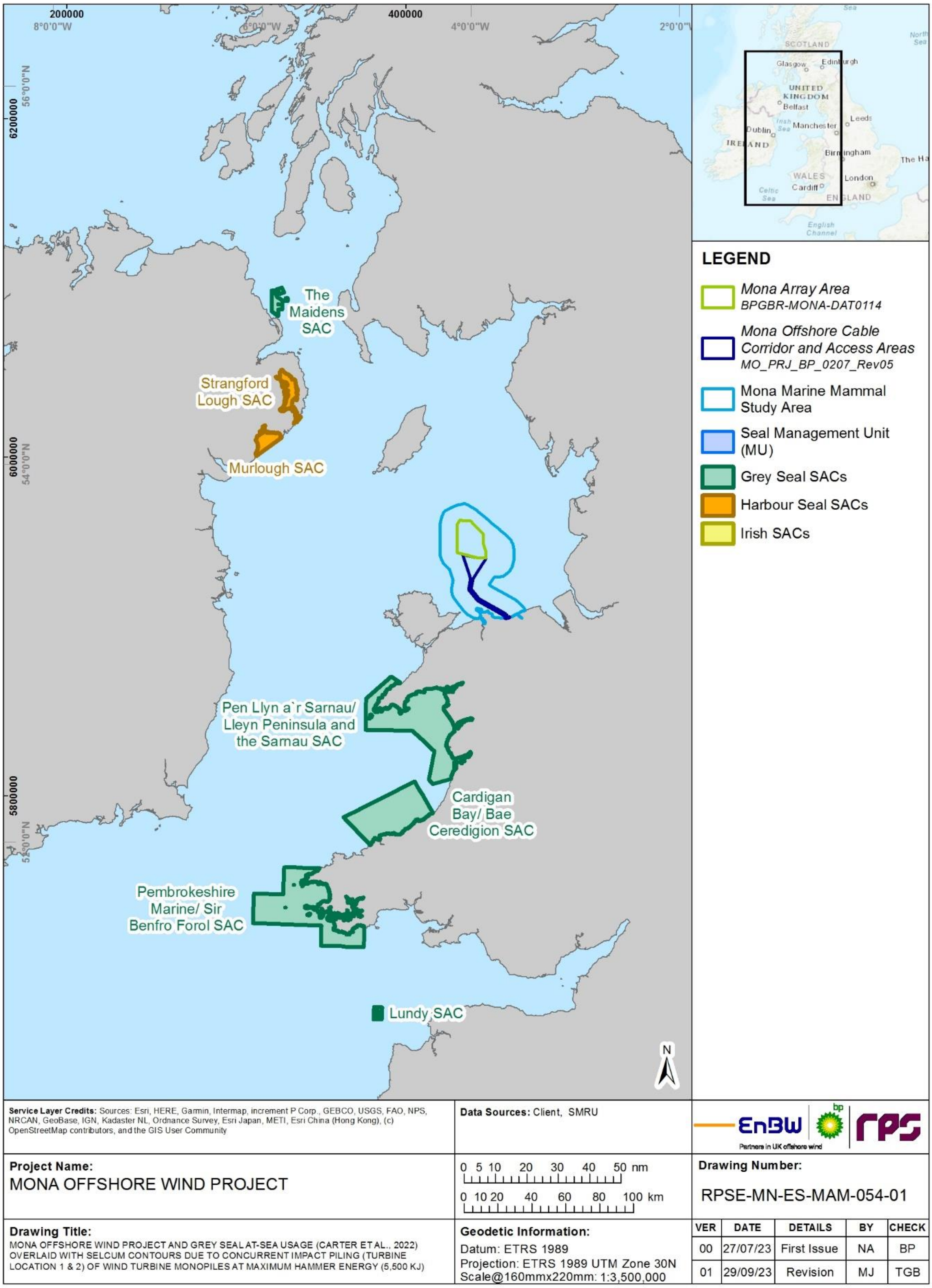


Figure 5 Harbour and grey seals SACs – labels are provided for those SACs mentioned in the report text

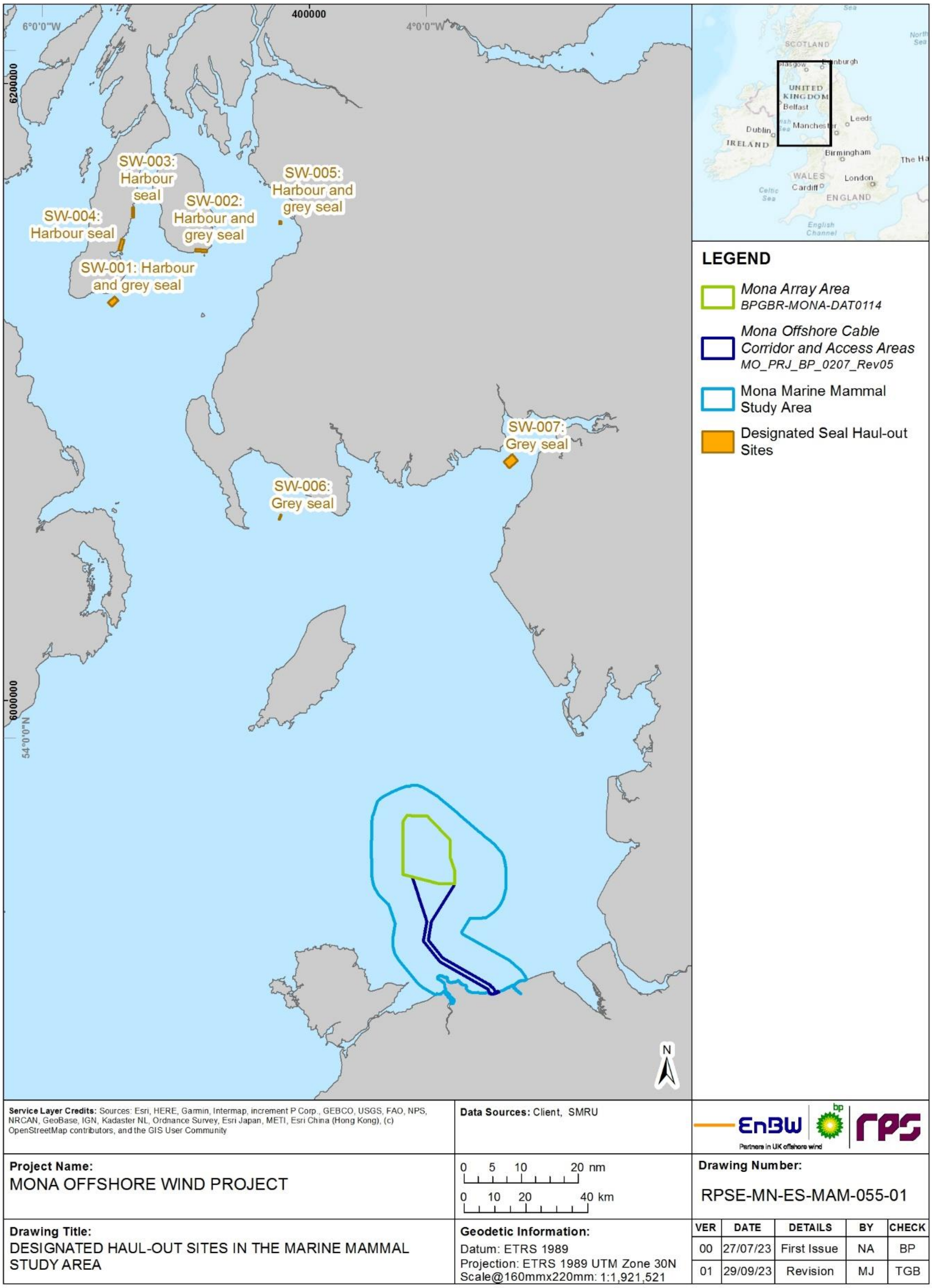


Figure 6 Designated seal haul-out sites in the vicinity of the Mona Offshore Wind Project

4 August haul-out counts

4.1 Harbour seal

4.1.1 National counts

The most recent August haul-out count for the whole of Scotland is for the count period 2016 to 2019, where a total of 26,846 harbour seals were counted. For England and Wales, a further 3,886 harbour seals were counted and in Northern Ireland 1,012 were counted. This results in a total count of 31,744 harbour seals in the UK (and 35,751 including the Republic of Ireland) (Figure 7) (SCOS, 2021) and an estimated population of ~44,100 harbour seals[7] in the UK (~49,700 including the Republic of Ireland).

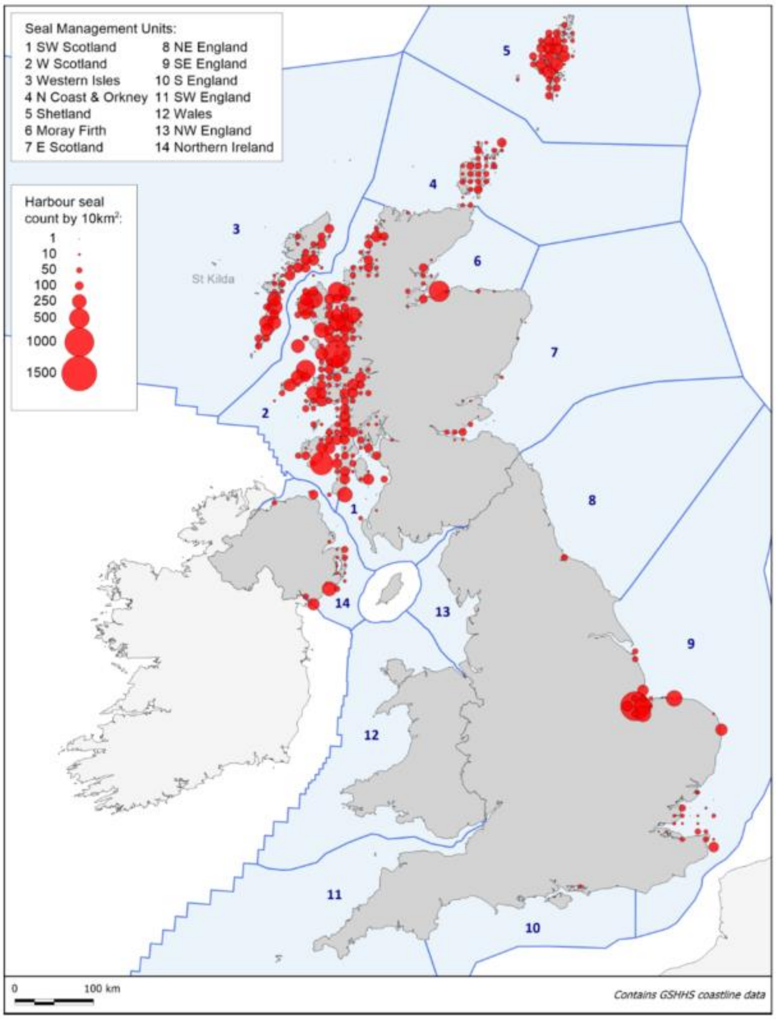


Figure 7 August distribution of harbour seals around the British Isles by 10km squares based on the most recent available haul-out count data collected up until 2019. Limited data available for seal management units 10-13; no data available for St Kilda. Figure obtained from SCOS (2021).

4.1.2 MU counts

In the Wales and Northwest England MUs, there are no dedicated harbour seal surveys routinely carried out due to the very low numbers of seals (SCOS, 2021). Harbour seal haul-out counts for the

[7] Calculated as: (31,744/72)*100

Wales and Northwest England MU have remained steady over the survey periods (Table 3). It has been suggested that the slight increase in the most recent survey periods could be due to improved species identification and increased reporting of seal counts (SCOS, 2021). In the most recent survey period 2016 to 2019, the harbour seal haul-out counts for the Wales and Northwest England MUs were ten and five, respectively. This results in an estimated population size of 14 harbour seals for the Wales MU and seven for the Northwest England MU.

The Northern Ireland MU is not surveyed annually, with only three full surveys of the harbour seal population having been conducted since 2002 (2002, 2011 and 2018). A full survey of the MU was most recently conducted in 2018 which showed a haul-out count of 1,012, a 6.8% increase from the previous survey period of 2011-2015 (Table 3) (SCOS, 2021). The population size of the MU can be estimated by scaling the 2018 haul-out count (1,012) by the proportion of seals hauled-out at the time of the count, resulting in an estimate of 1,406 harbour seals in the Northern Ireland MU.

Sites within the Southwest Scotland MU are not surveyed annually, with surveys conducted in 1996, 2005, 2007, 2009, 2015 and 2018 (Table 3). Harbour seal haul-out counts from the 2005 August survey, showed a decline from the 1996 count. Since 2007 the harbour seal counts have recovered with a 12% per annum (SCOS, 2021) increase between 2015 and 2018, suggesting a rapidly increasing population (Figure 8). The most recent August haul-out count of 1,709 harbour seals for the 2016-2019 count period results in a population estimate of 2,374 harbour seals in the Southwest Scotland MU.

Table 3 Harbour seal August haul-out counts for various survey periods. Data from SCOS (2021).

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 and improved species identification.

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).

HARBOUR SEAL		1996 to 1997	2000 to 2006	2007 to 2009	2011 to 2015	2016 to 2019
Wales[1]	Count	2	5	5	10	10
	Population estimate	3	7	7	14	14
NW England[1]	Count	2	5	5	5	5
	Population estimate	3	7	7	7	7
Northern Ireland[2]	Count	-	1,176	1,101	948	1,012
	Population estimate	-	1,633	1,529	1,317	1,406
Southwest Scotland	Count	929	623	923	1,200	1,709
	Population estimate	1,290	865	1,282	1,667	2,374

Figure 8 August haul-out counts of harbour seals within each of the MUs within the seal telemetry and haul-out study area. Data from SCOS (2021).

4.1.3 Distribution of haul-outs

Figure 9 and Figure 10 show the distribution of harbour seal August haul-out counts across the seal telemetry and haul-out study area. The main harbour seal haul-outs where seals have been counted are located in the northern region of the seal telemetry and haul-out study area, in the Southwest Scotland MU. The majority of the haul-out counts are in the north of the MU with a maximum of nine harbour seals counts along the southern coast of the MU in 2007. From 1997 to 2018, the counts have remained relatively consistent and stable, with the exception of 2009, where only one site, Sanda Island, on the west of the MU has recorded counts.

There is no information on the location of harbour seals hauled-out in the Wales and Northwest England MUs.

Most harbour seal haul-out locations in Northern Ireland are located in the southeast of the country, with most harbour seals being counted at Carlingford Lough, Murlough SAC and Rathlin Island (Figure 11) (Duck and Morris, 2019).

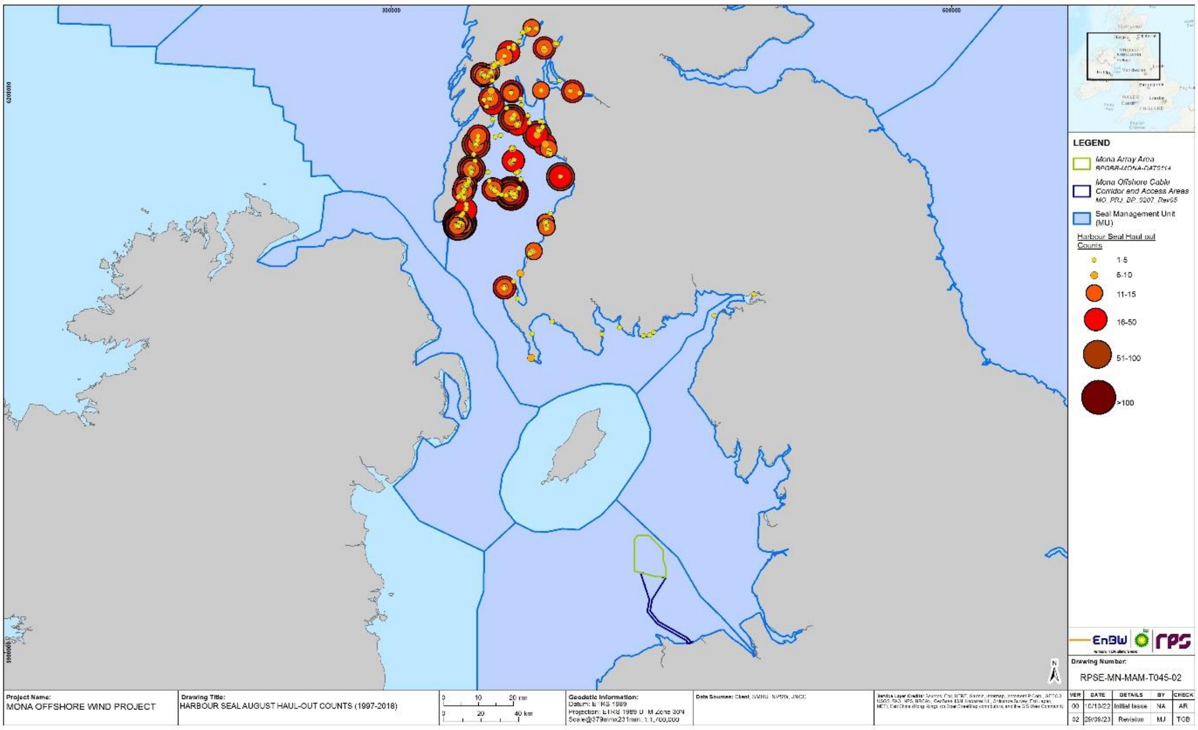


Figure 9 All August harbour seal haul-out counts in the Southwest Scotland MU between 1997 and 2018 combined. Data provided by SMRU.

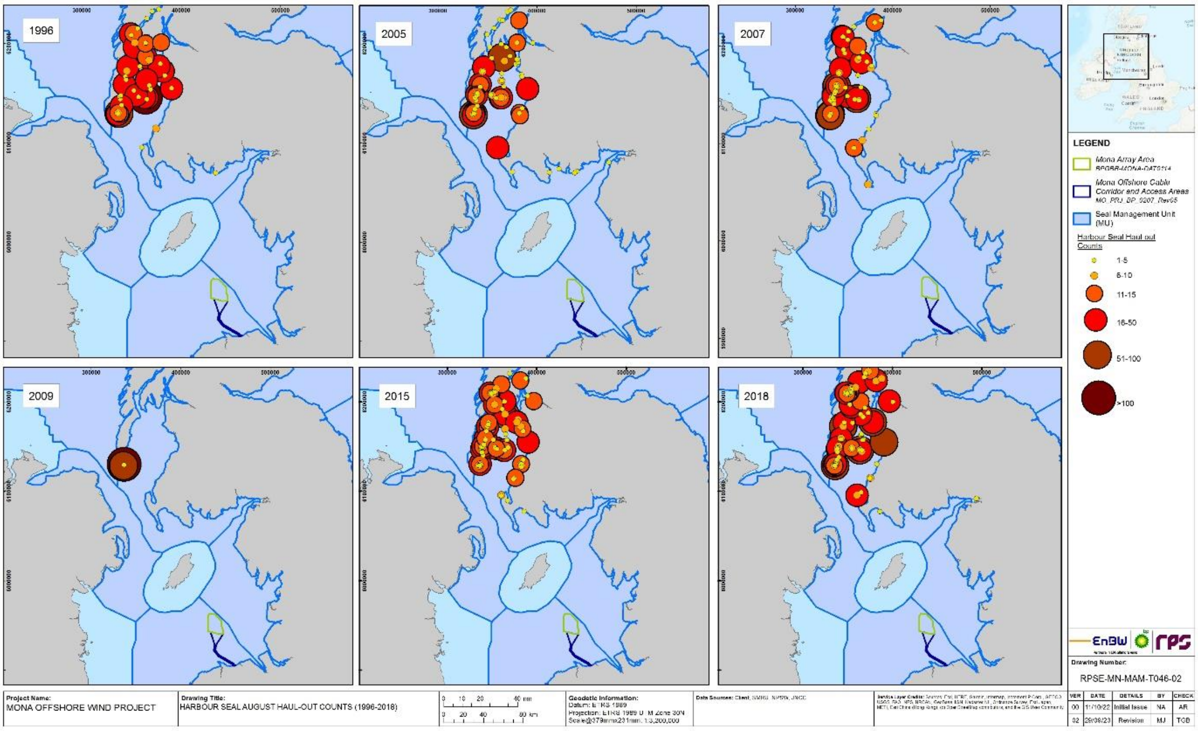


Figure 10 Annual August harbour seal haul-out counts in the Southwest Scotland MU between 1997 and 2018. Data provided by SMRU.

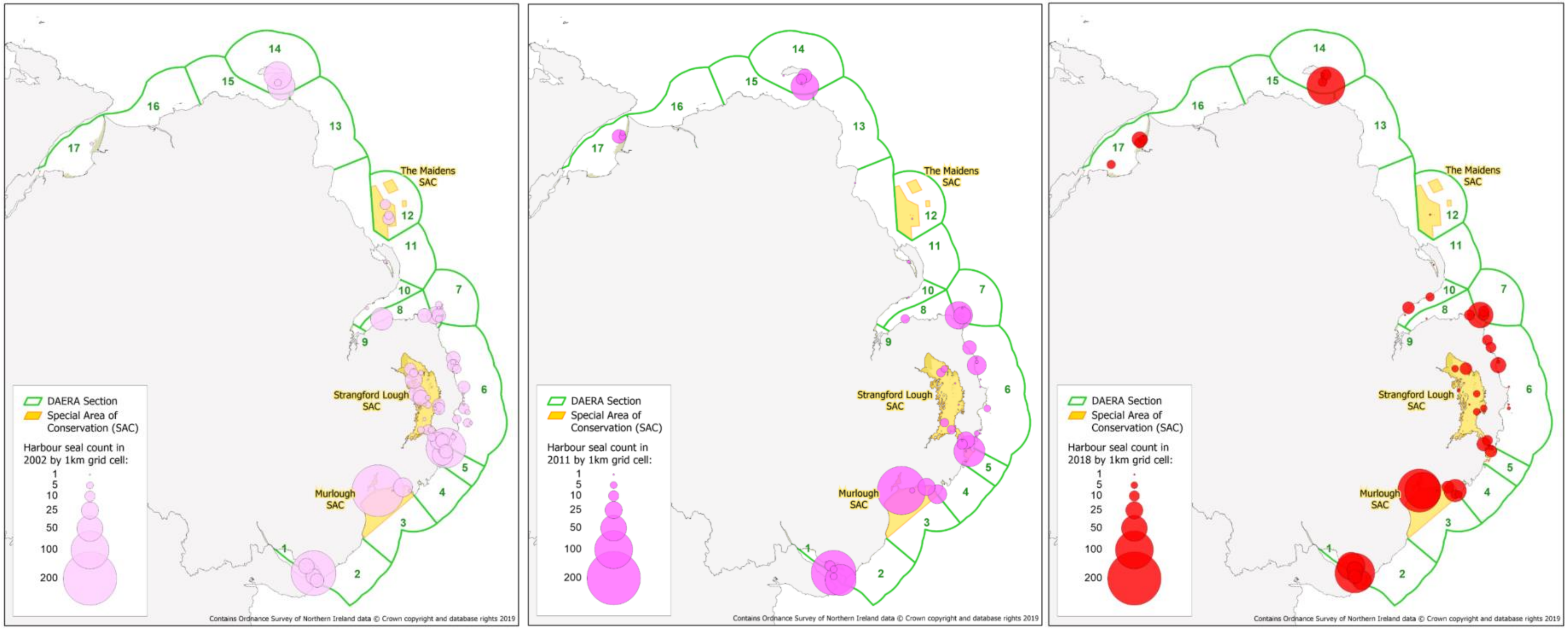


Figure 11 The distribution of harbour seals, by 1km squares, in Northern Ireland in August 2002 (left), 2011 (middle) and 2018 (right). Aerial survey by the Sea Mammal Research Unit. Figure obtained from Duck and Morris (2019).

4.2 Grey seal

4.2.1 National Counts

The most recent August haul-out count for the whole of Scotland is for the count period 2016 to 2019, where a total of 25,412 grey seals were counted. In addition, in England and Wales a further 16,848 grey seals were counted and a further 505 were counted in Northern Ireland. This resulted in a total count of 42,260 grey seals in Britain (46,463 including the Republic of Ireland) across this four-year survey period (Figure 12) (SCOS, 2021). The population estimate for Britain is ~176,820 grey seals[8] 7(~179,000 in the UK and ~194,500 including Ireland).

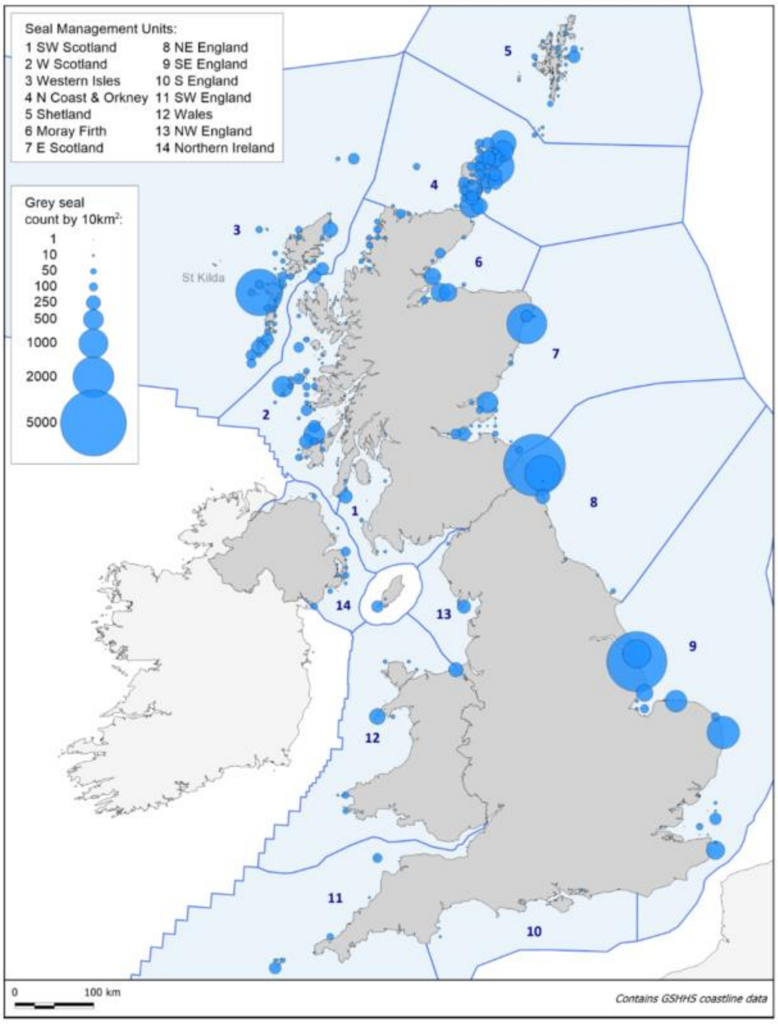


Figure 12 August distribution of grey seals around the British Isles by 10km squares based on the most recent available haul-out count data collected up until 2019. Limited data available for SMUs 10-13; no data available for St Kilda. Figure obtained from SCOS (2021).

4.2.2 MU Counts

Estimates of grey seals counted in August 2018 in the Wales MU and Northwest England MU are 900 and 250, respectively (Table 4). There is indication of an increase in haul-out counts (Table 4 and Figure 13), however, it is suggested this could be due to an increase in species reporting (SCOS, 2021).

8 Calculated as: (42,260/23.9)*100

Accounting for the grey seals at-sea at the time of the count, the grey seal estimates for the Wales and Northwest England MUs are approximately 3,766 and 1,046 grey seals, respectively. However, given the lack of dedicated surveys in these areas, this estimate should be considered with caution due to the limited data used to inform the estimate. In addition to the data presented in Table 4, the Cumbria Wildlife Trust started conducting low tide counts of grey seals in 2019. Thus far, a total of 248 and 300 grey seals have been counted in 2019 and 2020 respectively (counts are not yet available for 2021).

In the Southwest Scotland MU, grey seal August haul-out counts have been lower than harbour seal counts (Table 4) (SCOS, 2021). Overall, counts within the MU have seen a steady increase from 75 in the 1997 to 1997 period to 517 in the 2016 to 2019 period (Figure 13). The August haul-out count of 517 results in a population estimate of 2,163 grey seals in the Southwest Scotland MU.

In the Northern Ireland MU, the most recent August haul-out survey conducted in 2018 showed an estimated count of 505 grey seals (Table 4) (SCOS, 2021). This haul-out count can be scaled to account for the proportion of the population at sea at the time of the survey, resulting in a population estimate of 2,113 grey seals in the Northern Ireland MU. There is an indication of an increasing population within these areas (Table 3 Figure 13), however due to the lack of dedicated surveys, a population trend could not be estimated (SCOS, 2021).

Table 4 Grey seal August haul-out counts for various survey periods. Data from SCOS (2021).

GREY SEAL		1996 to 1997	2000 to 2006	2007 to 2009	2011 to 2015	2016-to 019
Wales[1]	Count	-	750	750	850	900
	Population estimate	-	3,138	3,138	3,556	3,766
Northwest 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
Southwest 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).

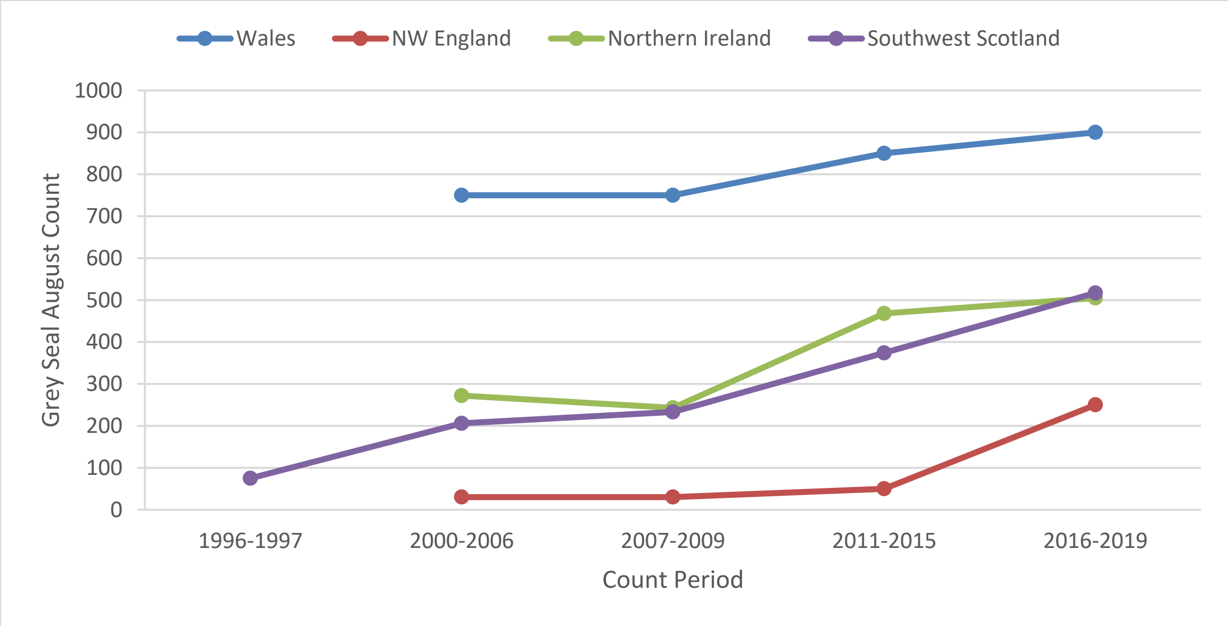


Figure 13 August haul-out counts of grey seals within each of the MUs within the seal telemetry and haul-out study area. Data from SCOS (2021).

4.2.3 Distribution of haul-outs

Figure 14 and Figure 15 (SW Scotland MU), Figure 19 (Wales MU) and Figure 20 (Northern Ireland MU) show the distribution of grey seal August haul-out counts across the marine mammal study area.

In the Southwest Scotland MU (Figure 14 and Figure 15), the main haul-out sites where grey seals have been counted are located in the northern region of the MU, with comparatively higher counts than harbour seals along the southern coast of the MU. From 1997 to 2018, the August grey seal haul-out counts have increased, and the haul-out locations have remained consistent throughout the years. Like the harbour seal counts, the haul-out counts for grey seals in 2009 are only recorded for Sanda Island on the west of the MU.

In the Northwest 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 (Figure 12).

In North Wales, grey seals mainly haul-out around the coast of Anglesey (including the Skerries), around Llandudno (Angel Bay) and the Dee Estuary (Hilbre North and West Hoyle Sandbank) (Figure 16). 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 seals by the Angel Bay Seal Volunteer Group, supported by the North Wales Wildlife Trust, has been conducted at Angel Bay, Llandudno (Porth Dyniewaid) since 2016 and are now additionally monitoring at Pigeon’s Cave, on Great Orme (Angel Bay Seal Volunteer Group, 2021)[9]. These locations are visited all year round by seals, with the sites used for pupping, mating and moulting from mid-August to April. During the 2020 to 2021 season, the maximum seal haul-out count in one instance was 247 seals at Angel Bay in November 2020 (Figure 17). Though far fewer surveys have been conducted at Pigeon’s Cave, the sightings confirm grey seal presence in 2020-2021 (Figure 19). The haul-out count data

9 As referenced in: Awel y Môr Offshore Wind Farm Category 6: Environmental Statement Volume 4, Annex 7.1: Marine Mammal Baseline Characterisation Application Reference: 6.4.7.1

highlights that both Angel Bay and Pigeon’s Cave are known grey seal pupping areas, and for Angel Bay, the counts have shown an overall increasing trend since records began in 2016 (Figure 18).

In Northern Ireland, grey seals mainly haul out in Carlingford Lough, Murlough SAC, Strangford Narrows, North and South Rocks (east of the Ards), the Copeland Islands and Rathlin Island (Figure 20) (Duck and Morris, 2019).

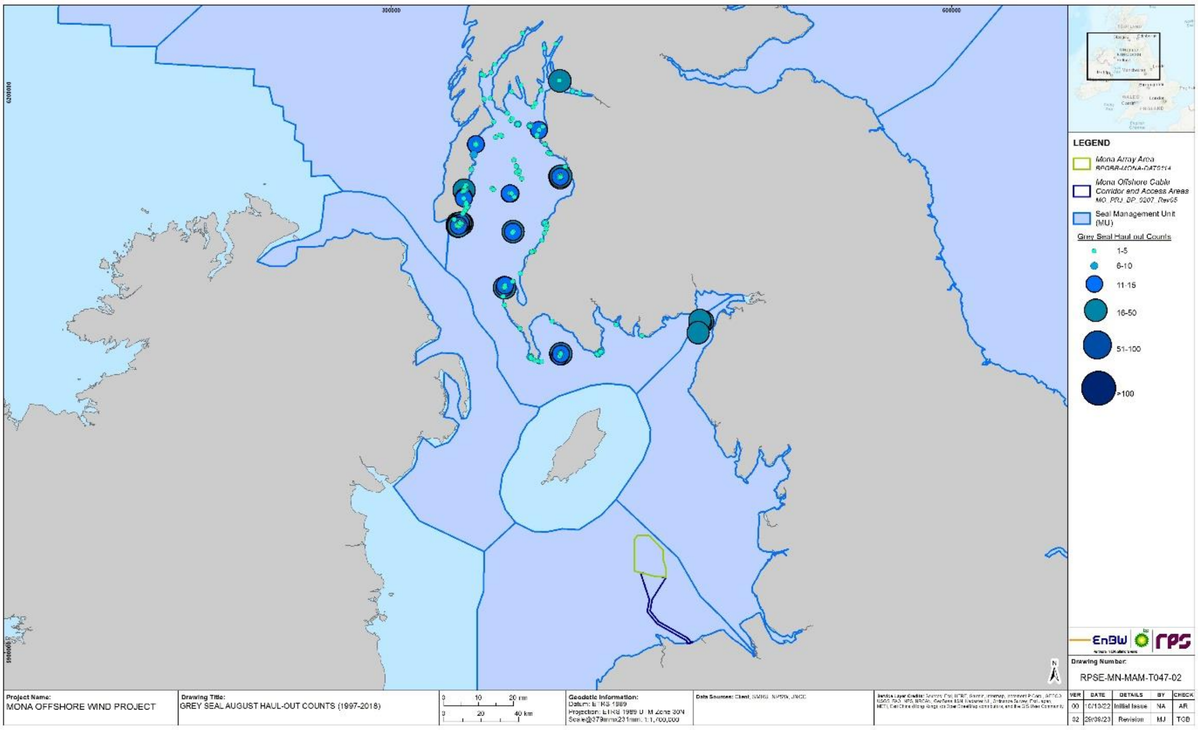


Figure 14 All August grey seal haul-out counts in the Southwest Scotland MU between 1997 and 2018 combined.

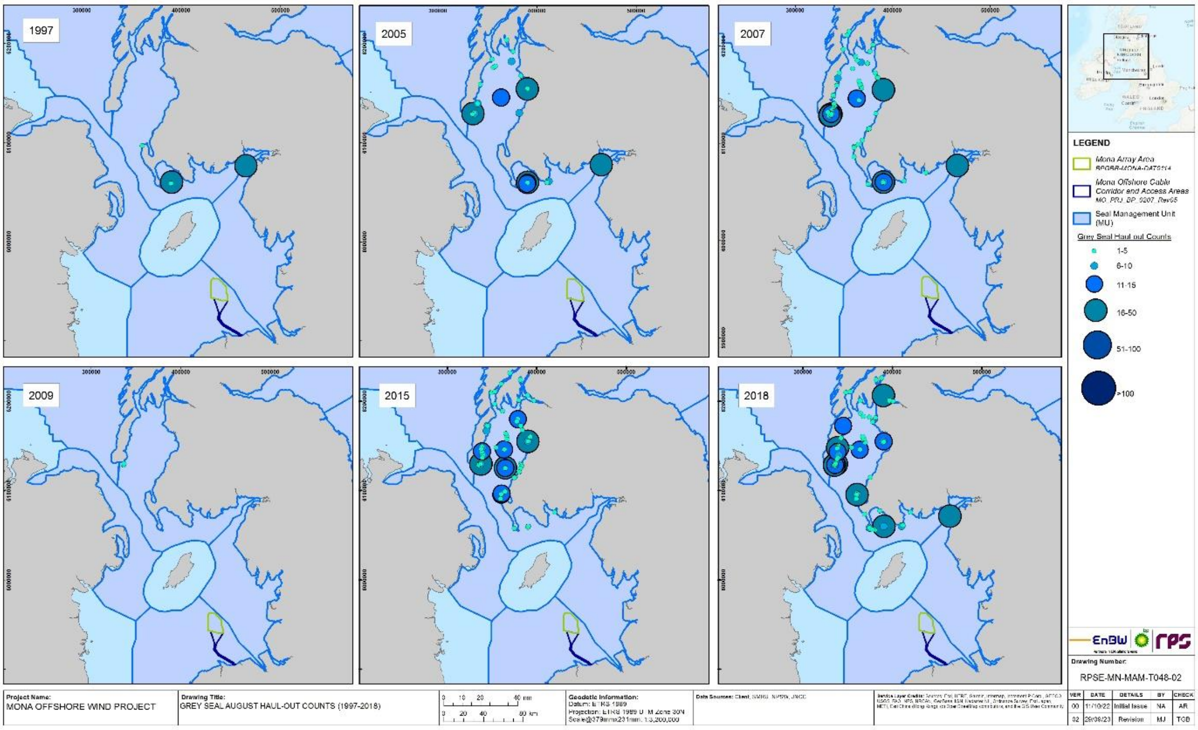


Figure 15 Annual August grey seal haul-out counts in the Southwest Scotland MU between 1997 and 2018.

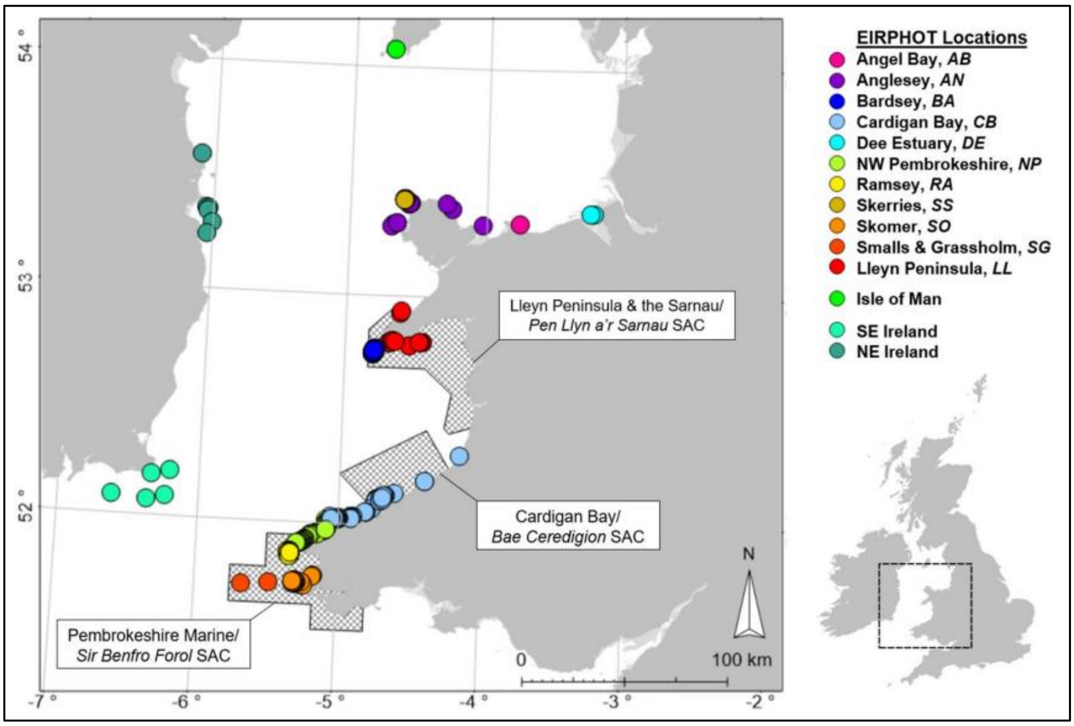


Figure 16 Celtic and Irish Sea grey seal haul-out sites covered by the EIRPHOT database (Langley *et al.*, 2020).

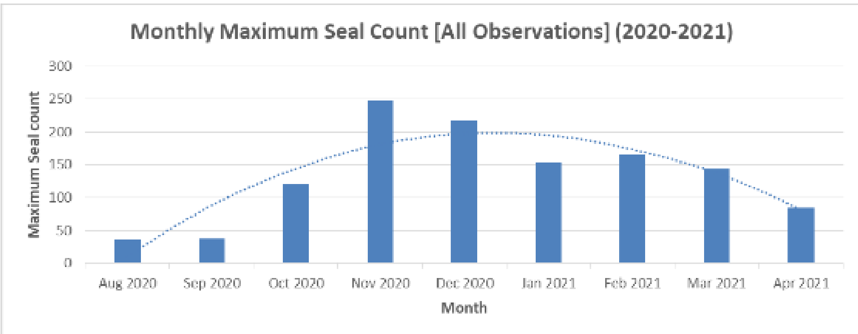


Figure 17 Monthly maximum seal count at Angel Bay from 2020-2021. Figure from the Angel Bay Seal Volunteer Group (2021).

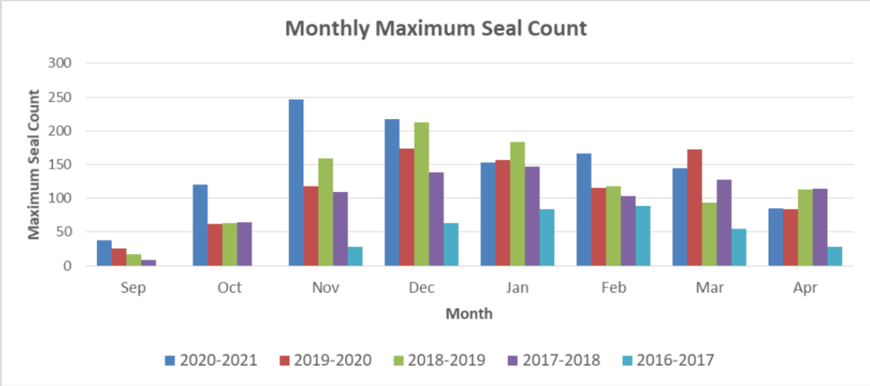


Figure 18 Monthly maximum seal count at Angel Bay from 2016-2021. Figure from the Angel Bay Seal Volunteer Group (2021).

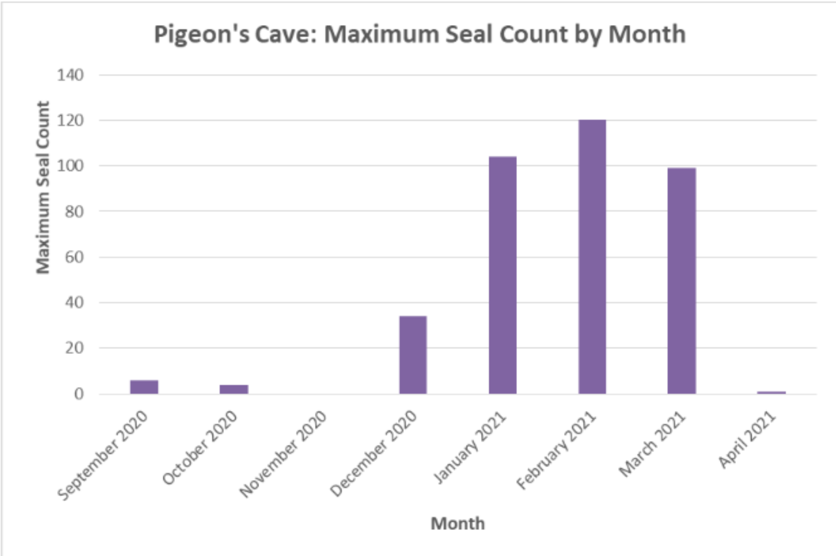


Figure 19 Monthly maximum seal count at Pigeon's Cave from 2020-2021. Figure from the Angel Bay Seal Volunteer Group (2021).

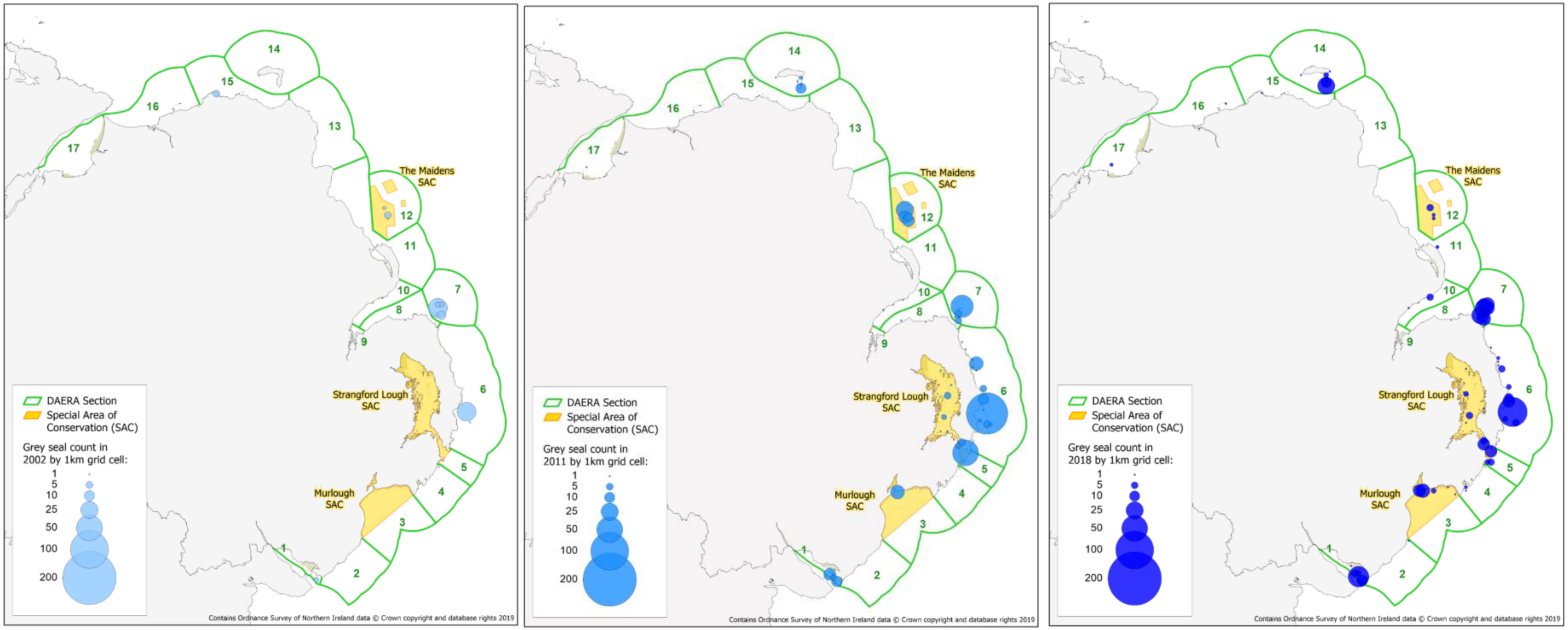


Figure 20 The distribution of grey seals, by 1 km squares, in Northern Ireland in August 2002 (left), 2011 (middle) and 2018 (right). Aerial survey by the Sea Mammal Research Unit. Figure obtained from (Duck and Morris 2019).

5 Grey Seal Pup Counts

Grey seals typically express a preference for remote breeding sites and cryptic habitats (Stringell *et al.*, 2014, SCOS, 2020, 2021) which can make pup abundance difficult to quantify. In 2018, total UK pup production was estimated at 68,050 (95% CI: 60,500–75,100) based on ground count data and estimates from less frequently aerial surveyed colonies (Figure 21).

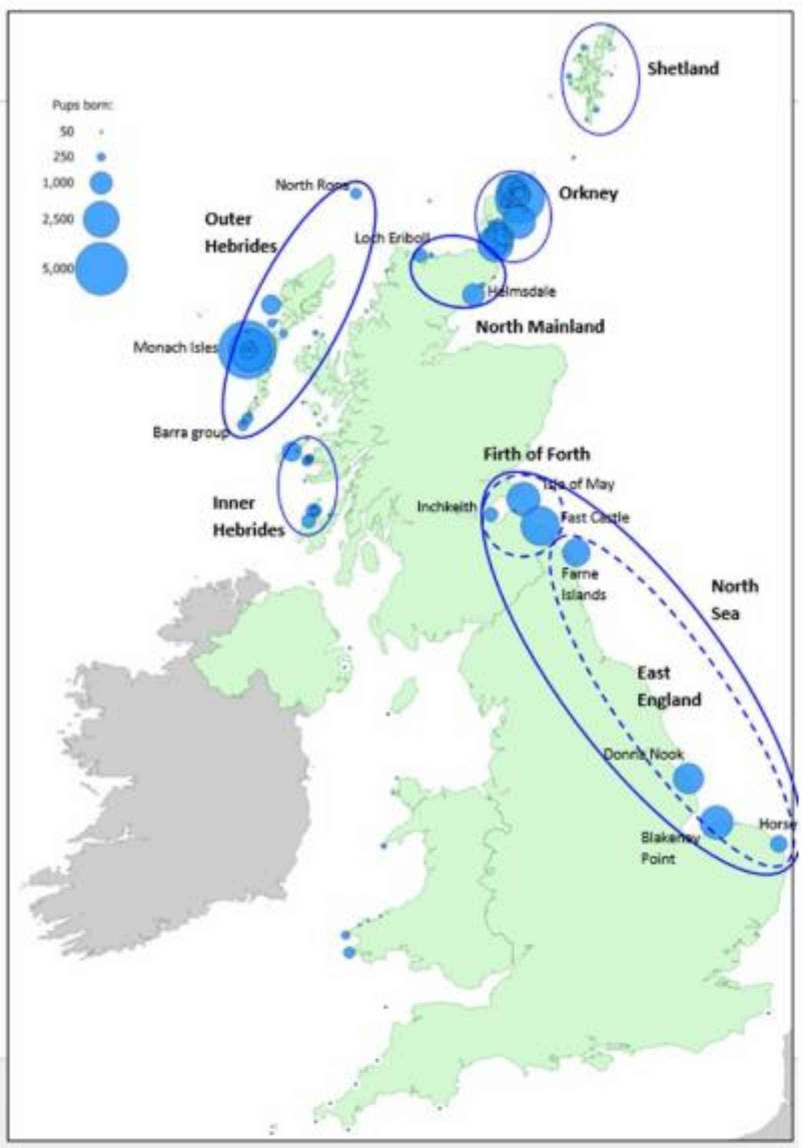


Figure 21 Distribution and size of the main grey seal breeding colonies in the UK. Blue ovals indicate groups of regularly monitored colonies within each region and blue circles represent number of pups born (SCOS, 2020). Note: the North Sea colonies are sub-divided into the Firth of Forth colonies, and the East England colonies (dashed blue ovals).

Grey seal pup production in 2016 in Wales was estimated as 2,250 pups, resulting in a population estimate for Wales of 5,000 grey seals at the start of the 2019 breeding season; though it is important to note that the pup production estimate for the Wales MU includes data from sites that have not been surveyed since the early 1990's and as such, there is considerable uncertainty in this estimate (SCOS, 2021).

The largest breeding population in the Irish Sea and south-west UK is located in Pembrokeshire (Figure 21), 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 Ynys Dewi/Ramsey Island and the north Pembrokeshire mainland coast between St Davids Head and the Teifi Estuary (Morgan *et al.*, 2018). In North Wales, smaller breeding populations can be found on the west coast of Anglesey and the Lleyn Peninsula and islands (Figure 22).

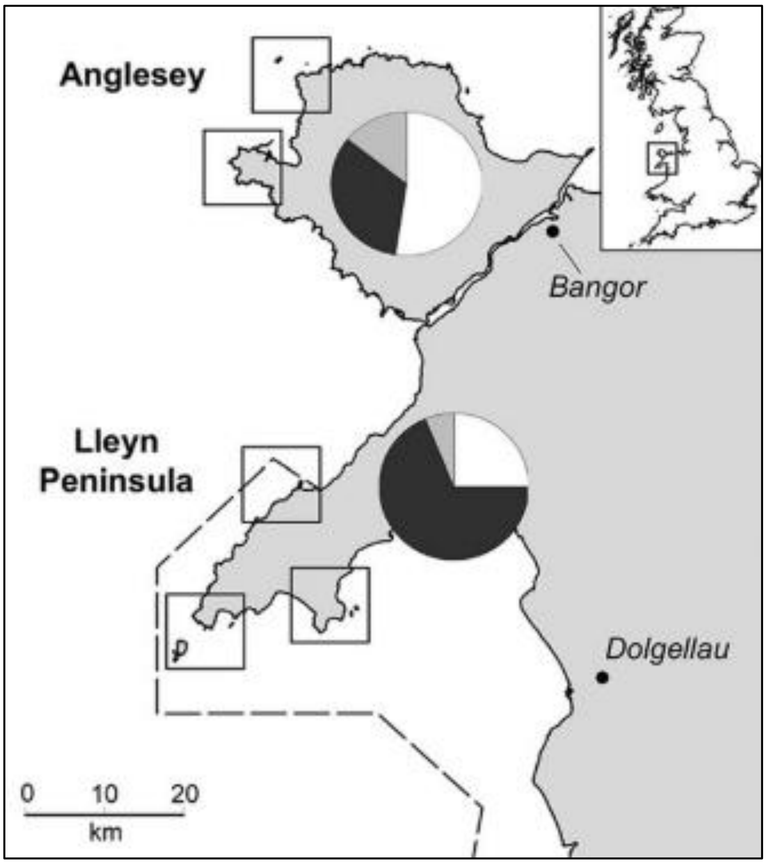


Figure 22 Grey seal pupping sites in North Wales (open boxes). Pie charts indicate the proportion of cave (black), other cryptic (grey) and non-cryptic/open onshore pupping habitats for Anglesey (n=21 sites) and the Lleyn Peninsula (n= 16 sites) (Stringell *et al.*, 2014).

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

Grey seal pup production in Northwest England is comparatively low to that of Wales. Since 2015, South Walney has been a pupping site, however, numbers counted by the Cumbria Wildlife Trust and Walney Bird Observatory are low at only 2 to 10 grey seal pups per year (SCOS, 2021).

In Northern Ireland, the majority of grey seal pups are born in Strangford Lough where the National Trust estimated a pup production of 181 in 2019, an increase from 10 in 1992 (Culloch *et al.*, 2018). However, monitoring across Northern Ireland is more sporadic and an overall pup production of 250 grey seal pups was estimated (SCOS, 2021).

There are no regularly monitored grey seal breeding sites in with Southwest Scotland MU.

6 Telemetry Data

6.1 Harbour seals

Harbour seals typically forage within 40 to 50 km from their haul-out sites (compared to >100km for grey seals) (SCOS, 2020). Between 2001 and 2017, no harbour seals were tagged in the Northwest England, Wales or Southwest Scotland MUs. In the Northern Ireland MU, 34 adult harbour seals were tagged from 2006 to 2010, and (given that the tagging location was within the marine mammal study area) all 34 harbour seals recorded telemetry tracks within the seal telemetry and haul-out study area (Table 5 and Figure 23). Note: these were all adult seals.

Whilst the focus of this report was on the seal telemetry and haul-out study area (the Northwest England, Wales, Southwest Scotland and Northern Ireland MUs), telemetry track data from 12 harbour seals (10 adults, 2 juvenile) tagged in the West Scotland MU were recorded within the seal telemetry and haul-out study area, specifically in the Southwest Scotland and Northern Ireland MUs north of the Mona Offshore Wind Project (Figure 23). This resulted in a total of 46 tagged animals recorded within the seal telemetry and haul-out study area.

Of the 46 tagged harbour seals that entered the seal telemetry and haul-out study area, five had telemetry track data recorded within the 50km buffer[10] of the Mona Offshore Wind Project (Figure 24). The telemetry tracks were recorded between 2006 and 2008 and were concentrated within the northwest region of the seal telemetry and haul-out study area. No tracks were recorded within or south of the Mona Offshore Wind Project Boundary (Figure 23 and Figure 24). All 34 harbour seals tagged in the Northern Ireland MU (Figure 23), including the five which entered the 50 km buffer of the Mona Offshore Wind Project (Figure 24), showed connectivity to the Strangford Lough SAC (tagging location).

Table 5 Summary information for the 34 harbour seals tagged in the Northern Ireland MU.

Date	Total	Location	Sex	Tag Type	Funders
April 2006	7	Strangford Lough	1x F 6x M	GPS GSM	NERC
May 2006	5	Strangford Lough	4x F 1x M	GPS GSM	NERC
March 2008	9	Strangford Lough	3x F 6x M	GPS GSM	BEIS
April 2008	1	Strangford Lough	F	GPS GSM	BEIS
April 2010	12	Strangford Lough	4x F 8x M	GPS GSM	BEIS and MCT

[10] 50 km buffer selected since harbour seals typically forage within 40 to 50 km from their haul-out sites.

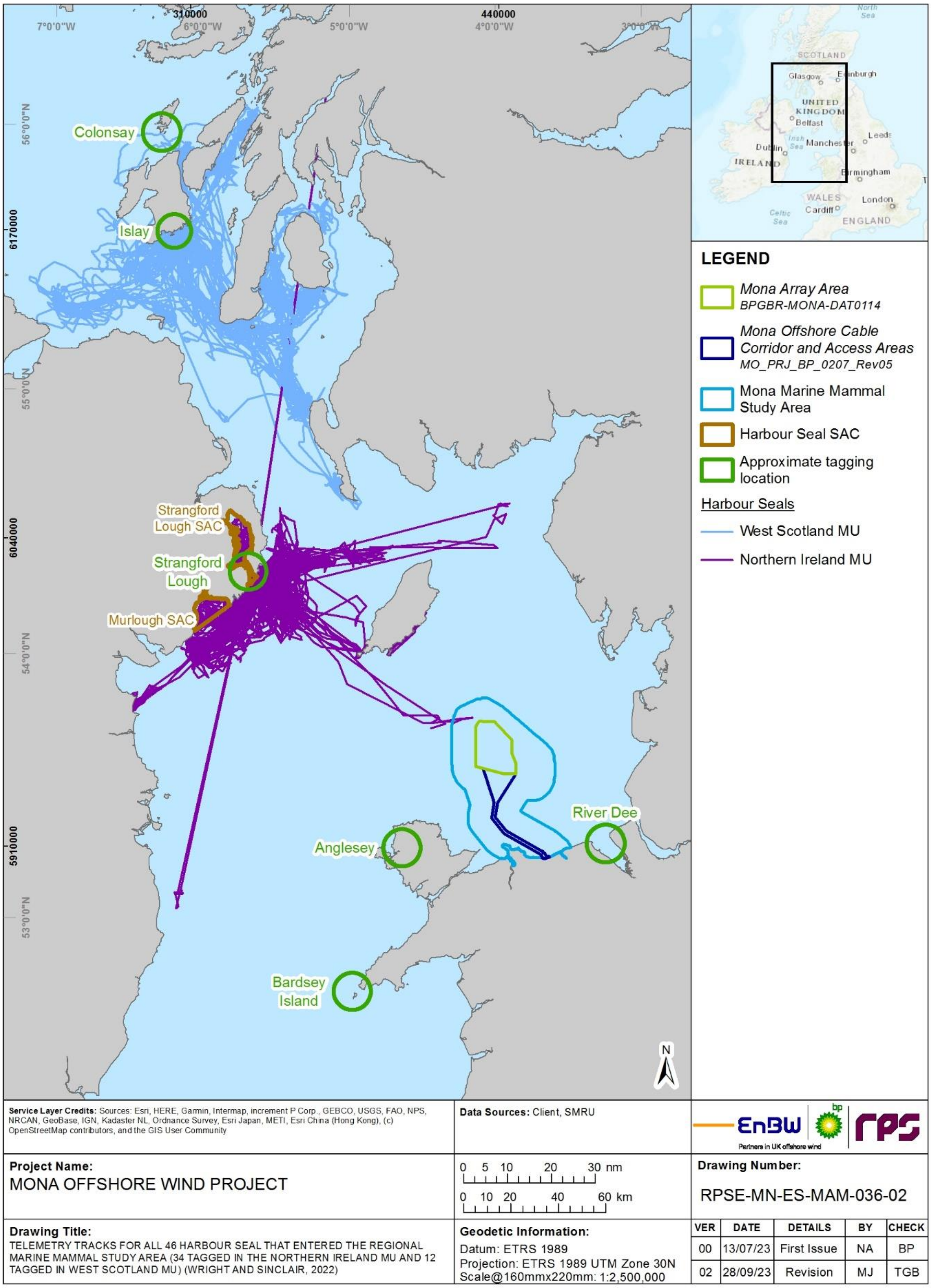


Figure 23 Telemetry tracks for all 46 harbour seals that entered the marine mammal study area (34 tagged in the Northern Ireland MU and 12 tagged in West Scotland MU).

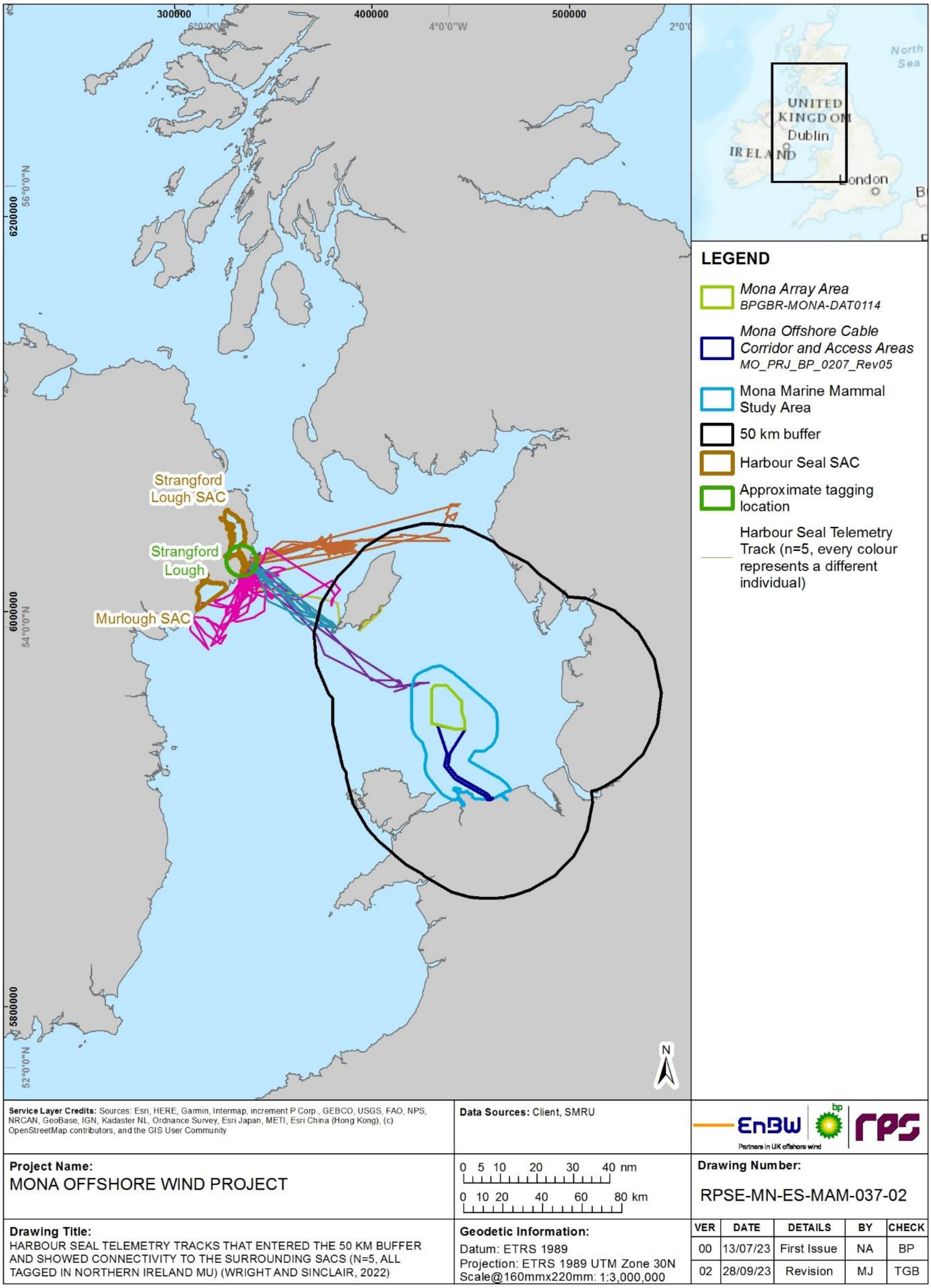


Figure 24 Harbour seal telemetry tracks that entered the 50km buffer and showed connectivity to the surrounding SACs (n=5, all tagged in Northern Ireland MU. Each colour represents an individual animal. Tagging period 2006-2010, tracks recorded 2006-2008).

6.2 Grey seals

6.2.1 Adults

Telemetry data have shown that grey seals travel further to forage and between haul-out sites than harbour seals. Grey seals typically forage within 100 km of a haul-out site and foraging trips can last for 30 days, however individual tracks have shown that some grey seals can make trips several hundred kilometres offshore (SCOS, 2020). In total, 39 adult grey seals and one juvenile grey seal have been tagged in the Wales MU between 2004 and 2018, and therefore recorded tracks in the seal telemetry and haul-out study area (Table 6). No adult grey seals have been tagged in the Northwest England, Southwest Scotland or Northern Ireland MUs.

All tagged adult grey seals recorded within the seal telemetry and haul-out study area were investigated to determine their origin (tagging location). In total, 44 adult/juvenile grey seals recorded telemetry data within the seal telemetry and haul-out study area, 40 of which were tagged in the Wales MU and four were tagged in the West Scotland MU (Figure 25). Grey seal tracks have been recorded throughout the seal telemetry and haul-out study area, with a higher density of tracks in the southern region of the seal telemetry and haul-out study area in the Northwest England and Wales MUs and a lower density in the northern region of the seal telemetry and haul-out study area. A higher density of grey seal tracks was shown within the extent of the Mona Offshore Cable Corridor compared to the Mona Array Area.

Of the 43 adult grey seals that were recorded within the seal telemetry and haul-out study area, there was connectivity with several UK and Irish grey seal SACs[11].

- 17 with Pen Llŷn a'r Sarnau/Lleyn Peninsula and the Sarnau SAC (38.6%)
- 14 with Pembrokeshire Marine/Sir Benfro Forol SAC (31.8%)
- 10 with Cardigan Bay SAC (22.7%)
- 4 with Saltee Islands SAC (Ireland) (9.1%)
- 1 with The Maidens SAC (2.3%)
- 1 with Lundy SAC (SouthWest England MU) (2.3%).

Of the 44 adult grey seals that recorded telemetry track data within the seal telemetry and haul-out study area, 36 recorded tracks within a 100 km buffer of the proposed Mona Offshore Wind Project, 19 of which showed connectivity to the surrounding SACs (Figure 26). The connectivity between the surrounding SACs and the 36 individuals within the 100 km buffer is similar to that of the seal telemetry and haul-out study area:

- 17 with Pen Llŷn a'r Sarnau/Lleyn Peninsula and the Sarnau SAC (47.2%)
- 8 with Pembrokeshire Marine/Sir Benfro Forol SAC (22.2%)
- 8 with Cardigan Bay SAC (22.2%)
- 3 with Saltee Islands SAC (8.3%)
- 1 with The Maidens SAC (2.8%).

Therefore, it can be concluded that there is a high level of connectivity between the seal telemetry and haul-out study area and the Pen Llŷn a'r Sarnau/Lleyn Peninsula and the Sarnau SAC and the

[11] Note: some seals showed connectivity with more than one SAC and therefore, the numbers reflect every SAC that was entered.

Pembrokeshire Marine/Sir Benfro Forol SAC and the Cardigan Bay SAC, and comparatively lower levels of connectivity with grey seals SACs at further distances from the Mona Offshore Wind Project.

6.2.2 Pups

The movement data obtained from telemetry tags on pups may not be representative of the typical movement patterns of adult grey seals, since recently weaned pups are known to disperse widely to haul-out locations far from their birth colony location (Brasseur *et al.*, 2015, Carter *et al.*, 2017, Peschko *et al.*, 2020). Therefore, their telemetry data has been shown separately here. In total, 17 grey seal pups have been tagged in the Wales MU between 2009 and 2017 (Table 6 and Figure 27). No grey seal pups have been tagged in the Northwest England, Southwest Scotland or Northern Ireland MUs.

As for the adult seals, any tagged grey seal pups within the seal telemetry and haul-out study area were investigated to determine their origin. The grey seal juvenile/pup telemetry tracks were concentrated in the Wales and Northwest England MUs of the seal telemetry and haul-out study area, with one pup entering the Northern Ireland MU and none recorded entering the Southwest Scotland MU.

These 17 pup grey seals showed connectivity with several UK and Irish grey seal SACs[12]:

- 11 with Pembrokeshire Marine/Sir Benfro Forol SAC (64.7%)
- 10 with Pen Llŷn a'r Sarnau/ Lleyn Peninsula and the Sarnau SAC (58.8%)
- 4 with Cardigan Bay SAC (23.5%)
- 4 with Saltee Islands SAC (Ireland) (23.5%)
- 2 with Isle of Scilly Complex SAC (11.8%).

Of the 17 grey seal pups recorded within the seal telemetry and haul-out study area, 13 recorded telemetry tracks within a 100 km buffer of the Mona Offshore Wind Project, 11 of which showed connectivity to surrounding SACs (Figure 28). The connectivity between the surrounding SACs and the 13 individual pups within the 10 km buffer is similar to that of the seal telemetry and haul-out study area:

- 10 with Pen Llŷn a'r Sarnau/ Lleyn Peninsula and the Sarnau SAC (76.9%)
- 6 with Pembrokeshire Marine/Sir Benfro Forol SAC (46.2%)
- 3 with Cardigan Bay SAC (23.1%)
- 3 with Saltee Islands SAC (Ireland) (23.1%)
- 2 with Isle of Scilly Complex SAC (15.4%).

[12] Note: some seals showed connectivity with more than one SAC.

Table 6 Summary information for the 57 grey seals tagged in the Wales MU.

MU	Year	#	Tagging Location	Sex	Tag Type
Adults (n=39) & Juveniles (n=1)					
Wales	June 2004	18 adult	4 x Bardsey 7 x Ramsey 7 x River Dee	9 x F, 9 x M	ARGOS SRDL
	June 2017	3 adult	River Dee	1 x F, 2x M	ARGOS GSM/SRDL
	July 2017	8 adult 1 juv	River Dee	6 x F, 3 x M	GPS GSM
	May 2018	10 adult	Bardsey	6 x F, 4 x M	9 x GSP GSM 1 x ARGOS SRDL
Pups (n=17)					
Wales	Oct 2009	5 pup	3 x Anglesey 2 x Bardsey	3 x F, 2 x M	GPS GSM
	Oct 2010	9 pup	2 x Anglesey 7 x Ramsey	5 x F, 4 x M	GPS GSM
	Nov 2010	3 pup	Anglesey	2 x F, 1 x M	GPS GSM

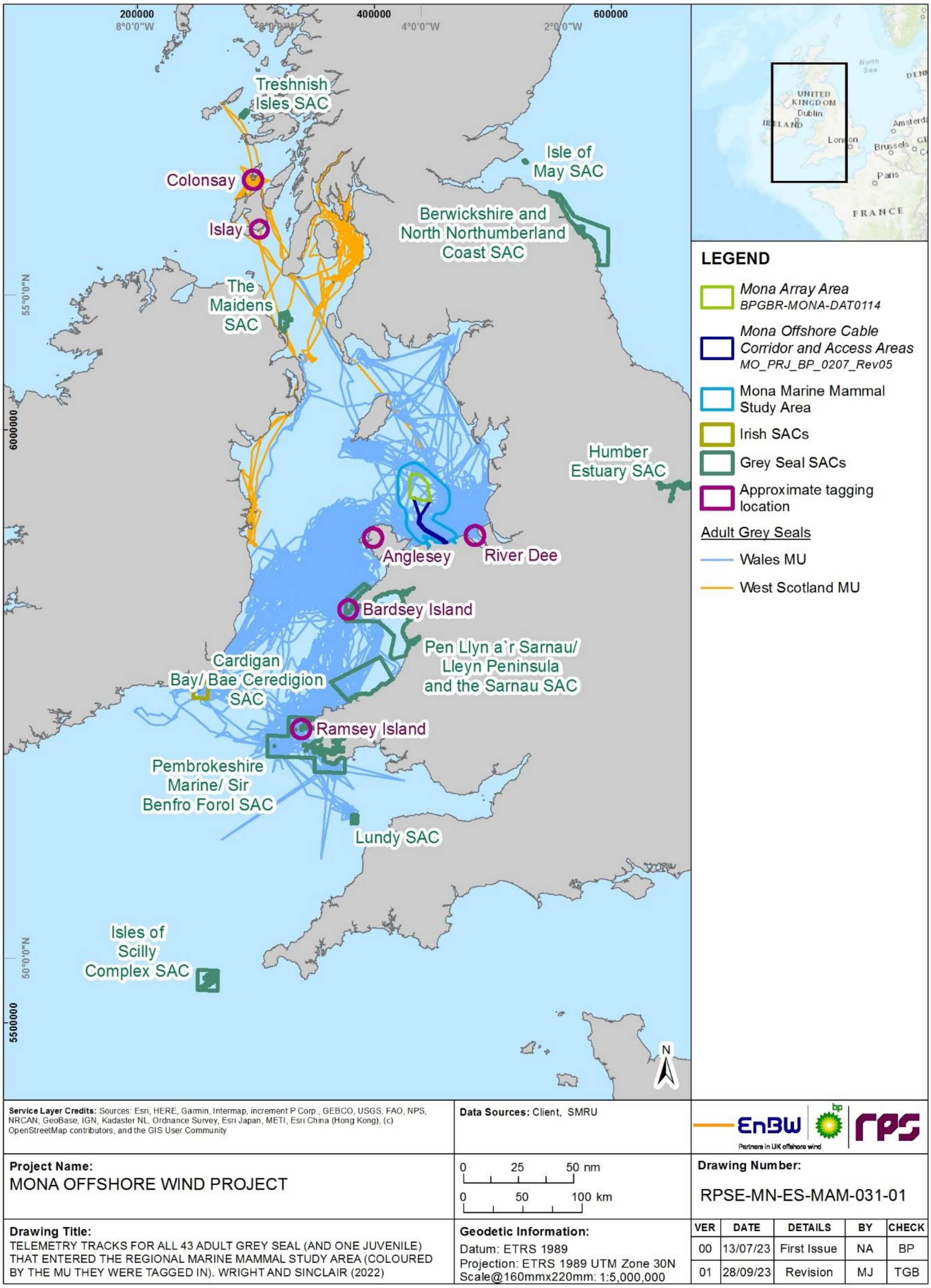


Figure 25 Telemetry tracks for all 43 adult grey seals (and one juvenile) that entered the seal telemetry and haul-out study area (coloured by the MU they were tagged in). To note, West Scotland MU is not within the seal telemetry and haul-out study area. West Scotland MU tracks recorded in 2003, Wales MU tracks recorded 2004 and 2017-2018).

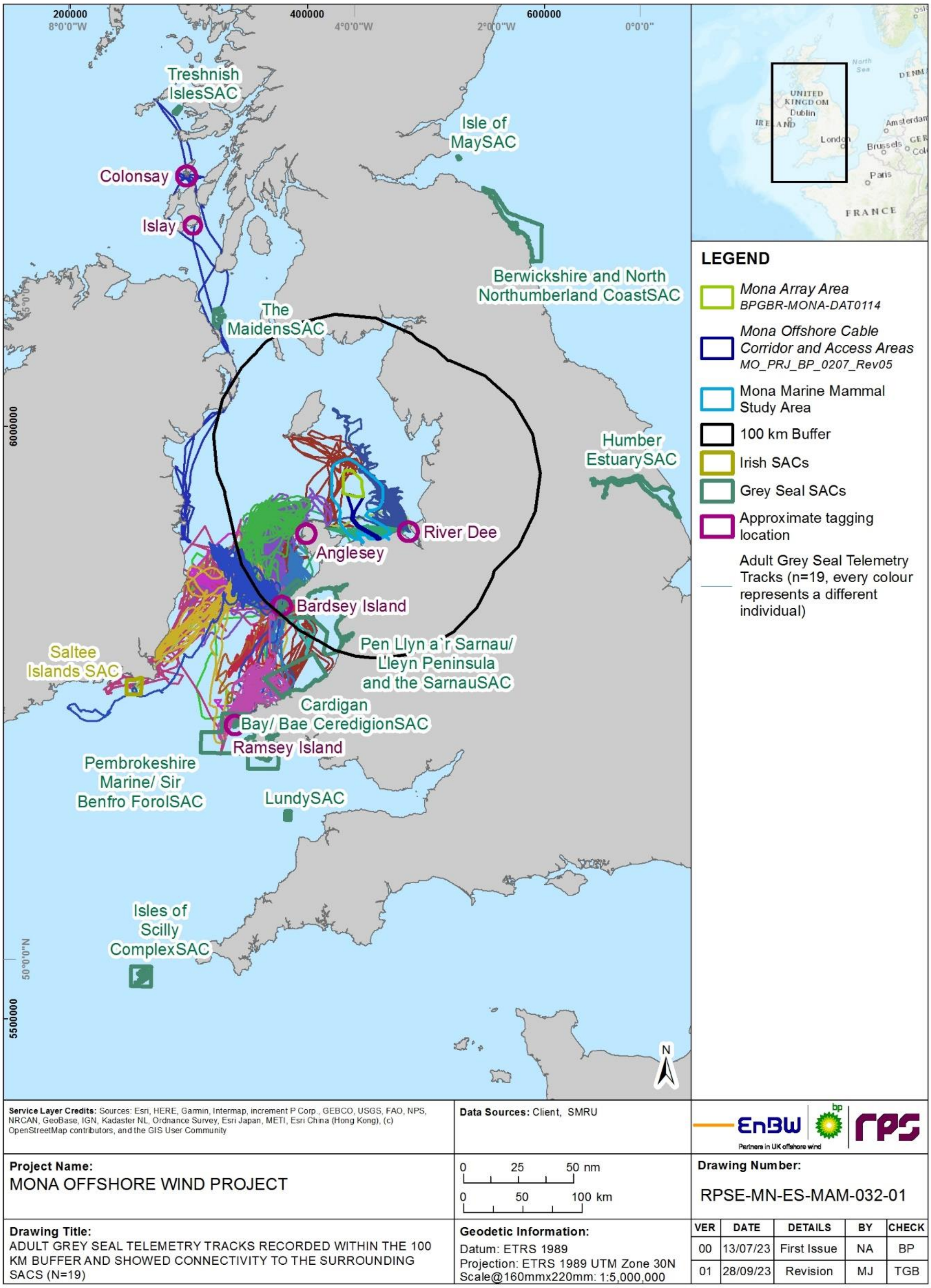


Figure 26 Adult grey seal telemetry tracks recorded within the 100km buffer and showed connectivity to the surrounding SACs (n=19, each colour represents an individual animal. Tracks recorded as per Figure 25).

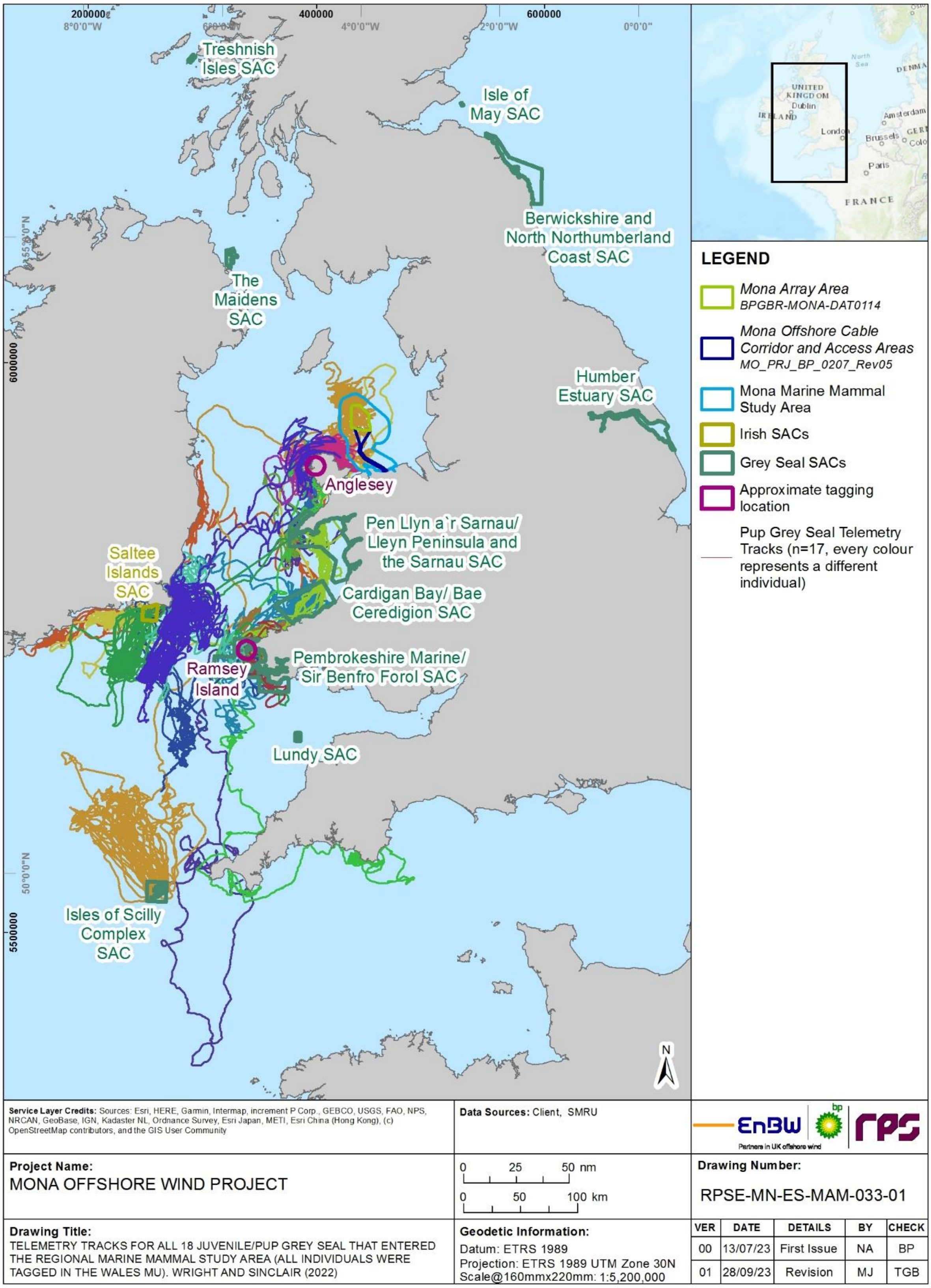


Figure 27 Telemetry tracks for all 17 pup grey seals that entered the regional marine mammal study area (all individuals were tagged in the Wales MU, each colour represents an individual animal. Tracks recorded 2009-2010).

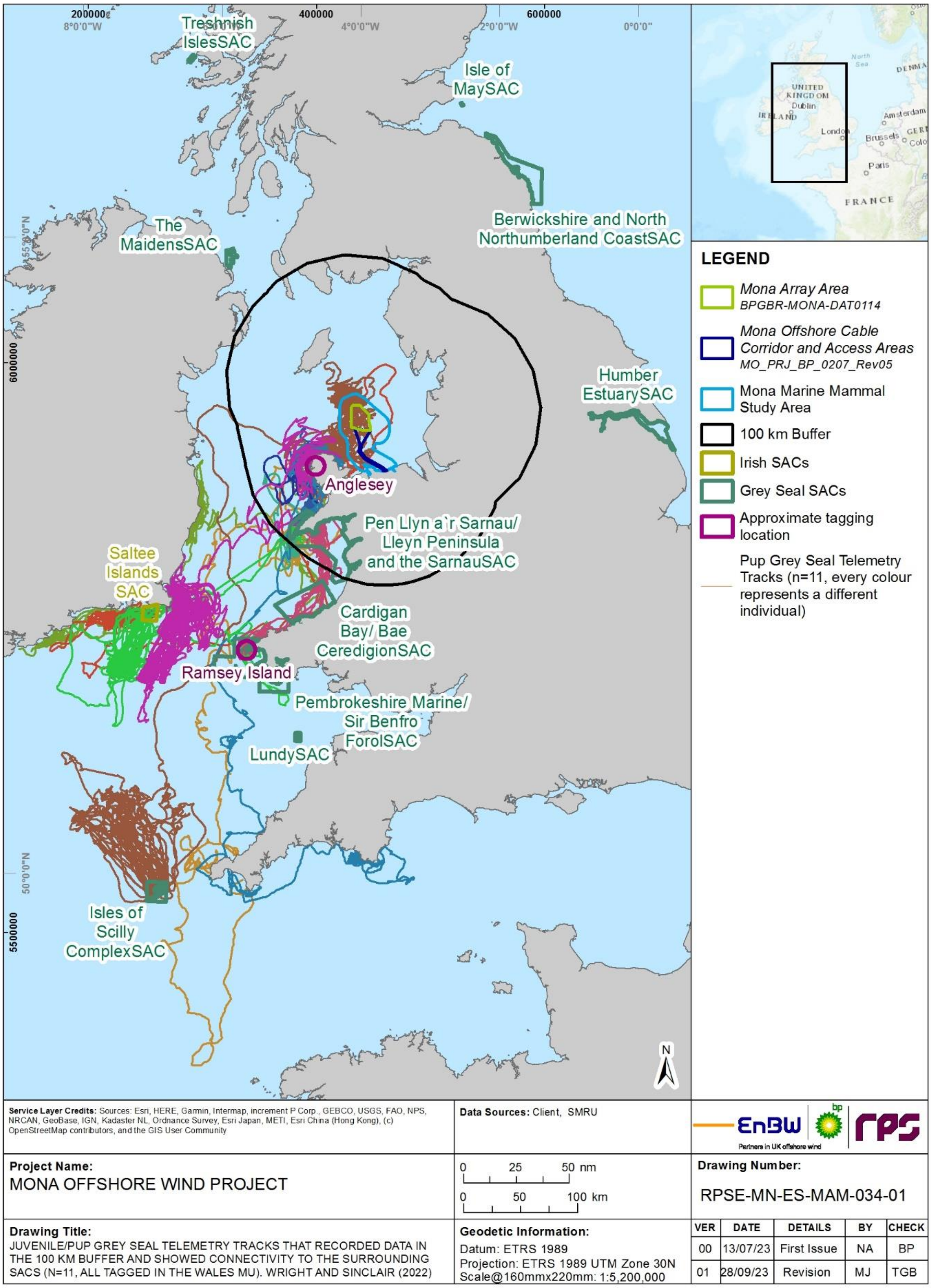


Figure 28 Pup grey seal telemetry tracks that recorded data in the 100km buffer and showed connectivity to the surrounding SACS (n=11, all tagged in the Wales MU, each colour represents an individual animal. Tracks recorded 2009-2010).

7 Summary

A summary of haul-out count data, grey seal pup count data and telemetry data (as presented in sections 1 to 6) is set out below.

7.1 Haul-out counts

- There are no dedicated SMRU surveys routinely carried in the Northwest England and Wales MUs, with "estimates compiled from counts shared by other organisations".
- No sites within the Southwest Scotland and Northern Ireland MUs are surveyed annually.
- Harbour seal:
    - Wales MU: The 2016 to 2019 August haul-out count of 10 can be scaled to account for the proportion of the population at sea at the time of the survey to result in a population estimate of ~14 harbour seals.
    - Northwest England MU: The 2016 to 2019 August haul-out count of five can be scaled to account for the proportion of the population at sea at the time of the survey to result in a population estimate of ~7 harbour seals.
    - Northern Ireland MU: The August haul-out count of 1,012 in 2018 can be scaled to account for the proportion of the population at sea at the time of the survey to result in a population estimate of ~1,406 harbour seals.
    - Southwest Scotland MU: The 2016 to 2019 August haul-out count of 1,709 can be scaled to account for the proportion of the population at sea at the time of the survey to result in a population estimate of ~2,374 harbour seals.
- Grey seal:
    - Wales MU: The August haul-out count of 900 in 2018 can be scaled to account for the proportion of the population at sea at the time of the survey to result in a population estimate of ~3,766 grey seals.
    - Northwest England MU: The August haul-out count of 250 in 2018 can be scaled to account for the proportion of the population at sea at the time of the survey to result in a population estimate of ~1,046 grey seals. A total of 248 and 300 grey seals were counted in 2019 and 2020, respectively by the Cumbria Wildlife Trust.
    - Northern Ireland MU: The August haul-out count of 505 in 2018 can be scaled to account for the proportion of the population at sea at the time of the survey to result in a population estimate of ~2,113 grey seals.
    - Southwest Scotland MU: The August haul-out count of 517 in 2018 can be scaled to account for the proportion of the population at sea at the time of the survey to result in a population estimate of ~2,163 grey seals.

7.2 Grey seal pup counts

- Wales MU: An estimated 2,000 pups were counted in 2018. The main breeding sites in Wales are in North Wales, Skomer and North Pembrokeshire. The largest breeding population in the Irish sea and south-west UK is in Pembrokeshire (Figure 21), accounting for 4% of the UK breeding population.
- Northwest England MU: Pup production at South Walney is low at only 2 to 10 grey seal pups per year.

- Northern Ireland MU: Overall, a pup production of 250 was estimated, specifically Strangford Lough has shown an increase in pup production from 10 in the early 1990s to 181 in 2019.

7.3 Telemetry

- Harbour seal:
    - Telemetry tracks were concentrated within the northwest region of the seal telemetry and haul-out study area and no tracks were recorded in the south of the Mona Offshore Wind Project.
    - All harbour seals within the 50km buffer of the development showed connectivity to the Strangford Lough SAC.
- Grey seal:
    - Telemetry tracks were recorded throughout the seal telemetry and haul-out study area, with a higher density of telemetry tracks in the southern region and a lower density in the northern region of the seal telemetry and haul-out study area.
    - There were higher levels of connectivity between the seal telemetry and haul-out study area and the Pen Llŷn a'r Sarnau/Lleyn Peninsula and the Sarnau SAC and the Pembrokeshire Marine/Sir Benfro Forol SAC and the Cardigan Bay SAC.
    - There were lower levels of expected connectivity between the seal telemetry and haul-out study area and grey seals SACs at further distances (e.g., Isle of Scilly Complex SAC, Lundy SAC, The Maidens SAC, and the Saltee Islands (SAC).

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