Bowdun Offshore Wind Farm, Offshore EIA Report

Volume 3, Technical Appendix 10.1: Marine Mammals Technical Report

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Glossary

Defined Term	Definition
Annex II	Species of community interest whose conservation requires the designation of Special Areas of Conservation (SACs) as identified in Annex II of Habitats Directive (Council Directive 92/43/EEC).
Applicant (the)	Bowdun Offshore Wind Farm Limited (BOWFL).
Array Area	The Array Area is the area in which the Offshore Generation Assets will be located and is shown.
Bowdun Offshore Wind Farm Limited (BOWFL)	A Special Purpose Vehicle (SPV) (legal entity) for the purpose of developing the Project. BOWFL are the Applicant for the Offshore Application.
Cetacean	Marine mammals that are entirely aquatic. These include whales, dolphins, and porpoises.
Digital Aerial Surveys (DAS)	A method for undertaking baseline ornithological and marine mammal data collection surveys. Usually undertaken over a period of 24 months.
Environmental Impact Assessment (EIA)	Process for the assessment of likely significant environmental effects of a project on the physical, biological and human environment during construction, Operation and Maintenance (O&M) and decommissioning.
Environmental Impact Assessment Regulations (EIA Regulations)	Terminology used in this Offshore EIA Report to refer to three sets of regulations: • The Electricity Works (Environmental Impact Assessment) (Scotland) Regulations 2017; • The Marine Works (Environmental Impact Assessment) (Scotland) Regulations 2017; and • The Marine Works (Environmental Impact Assessment) Regulations 2007.
European Protected Species	Species of plants and animals that are protected by law throughout the European Union. These species are listed in Annexes II and IV of the European Habitats Directive. The Directive aims to ensure the conservation of these species by prohibiting activities that could harm them, such as deliberate capture, killing, or disturbance, as well as the destruction of their habitats.
European Sites	This term recognises SACs, candidate SACs (cSACs), Sites of Community Importance (SCIs), Special Protection Areas (SPAs), possible SACs (pSACs), potential SPAs (pSPAs) and Ramsar sites (where also designated as another European Site), which protect species and habitats shared across Europe and were originally designated under European legislation.
Export Cable Corridor	The area seaward of MHWS which connects the Array Area with the Landfall within which the Offshore Export Cables will be installed.
Haul-Out Site	Haul-out site is a location on land or ice where seals come ashore to rest, moult, or breed.
Impact	A change caused by an action that occurs during a project's lifetime.
Inter-Array Cables (IAC)	Cables which link the Wind Turbines to each other and with the Offshore Substation Platforms (OSP).

Defined Term	Definition
Landfall	The area in which the Offshore Export Cables make landfall and is also the transitional area between the Offshore Transmission Assets and the Onshore Transmission Assets. Located in the Intertidal Area at Benholm.
Marine Directorate (MD)	The Marine Directorate of the Scottish Government, formerly known as Marine Scotland. The planning and licensing authority for Scotland's seas and custodian of Scotland's National Marine Plan (NMP). The Marine Directorate - Licensing Operations Team (MD-LOT) are specifically responsible for managing Section 36 Consent and Marine Licence Applications seaward of MHWS.
Marine Protected Areas (MPAs)	MPAs are designated under the Marine (Scotland) Act 2010 and the Marine and Coastal Access Act (MCAA) 2009. The MPA network protects nationally and internationally important marine wildlife, habitats, geology, and underwater landforms. Scotland's MPAs are significantly important for European, North-East Atlantic, and global MPA networks.
Marine (Scotland) Act 2010	Legislation that sets a framework to manage the competing demands made on marine resources within Scottish seas.
Member State	A country that has joined the EU and is subject to its treaties and regulations.
Mysticete	An animal that belongs to a family of whales which use keratinaceous baleen plates in their mouths to sieve planktonic creatures from the water, a sub-group of the order Cetacea.
Odontocete	An animal that belongs to the family of toothed whales, a sub-group of the order Cetacea.
Offshore Application	Term used to refer to the applications associated with the Proposed Development. The Applicant will apply for: • A Section 36 Consent under the Electricity Act 1989; and • Marine Licence(s) under Marine Scotland Act 2010 and Marine and Coastal Access Act 2009.
Offshore Environmental Impact Assessment (EIA) Report (hereafter, 'Offshore EIA Report')	Document prepared to report the findings of the EIA for the Proposed Development and produced in accordance with the EIA Regulations. The Offshore EIA Report is submitted to support the Offshore Application for the Proposed Development, and to comply with EIA Regulations.
Offshore Export Cables	Subsea cables used to transmit electricity generated offshore by the Wind Turbines from the OSPs to shore. The Transition Joint Bay (TJB) is the location where the Offshore Export Cables terminate, and the onshore cabling begins.
Offshore Generation Assets	The infrastructure of the Proposed Development required to generate electricity comprising of the Wind Turbines, Wind Turbine foundations and associated infrastructure e.g. IACs.
Offshore Infrastructure	All of the Offshore Infrastructure associated with the Proposed Development that is located seaward of MHWS, comprising the Offshore Generation Assets and the Offshore Transmission Assets.
Offshore Scoping Report	The report that presents the findings of the EIA scoping process undertaken for the Proposed Development with the purpose of obtaining a Scoping Opinion. The Offshore Scoping Report defines what is intended to be assessed and reported as part of the EIA.

Defined Term	Definition
Offshore Substation Platform(s) (OSPs)	OSPs comprise the support structure, topside and electrical components used for collecting and/or converting electricity generated by the Wind Turbines for transmission by the Offshore Export Cables.
Offshore Transmission Assets	The infrastructure of the Proposed Development required to transmit the generated electricity comprising of the OSPs, Offshore Export Cables and associated infrastructure up to MHWS.
Operation and Maintenance (O&M)	The phase of the Proposed Development following completion of construction. This phase of development includes routine inspections, repairs and replacement of infrastructure and equipment (including Interconnector Cables and IACs), Scour Protection replenishment or replacement, major component replacement, painting and/or other coating works, removal of marine growth, and replacement of access ladders.
Pathway	Describes the means or route by which a receptor (such as the seabed) can be affected by an identified impact source (such as Wind Turbine foundations).
Plan Option Area (POA)	A location identified in the Sectoral Marine Plan (SMP) as a preferred area for commercial scale offshore wind development.
Project (the)	An overarching term for the Bowdun Offshore Wind Farm (Bowdun OWF) comprising the offshore and onshore infrastructure required to generate and transmit electricity from the Array Area to the onshore Grid Connection Point (GCP). The Project includes the Offshore Generation Assets, the Offshore Transmission Assets and the Onshore Transmission Assets.
Proposed Development	Term used to define the Offshore Infrastructure associated with the Project seaward of MHWS for which consent is being sought. Further details of the parameters are included in Volume 1, Chapter 3: Project Description.
Scoping Opinion	A document produced by MD-LOT which is issued in response to submission and review of the Offshore Scoping Report. The Scoping Opinion is supported with feedback and advice from consultees, which details what is expected to be included in the Offshore EIA Report and what can be scoped out of the EIA process.
Scoping Workshop	A series of sessions preceding the finalisation of the Offshore Scoping Report to provide an opportunity for the Applicant to consult on the draft scope and for stakeholders to request additional information on key issues.
Sectoral Marine Plan (SMP)	A plan developed by the Scottish Government which provide the strategically planned spatial footprint for offshore wind development in Scotland.
Site Boundary	The boundary within which all elements of the Proposed Development will be located. The Site Boundary comprises the Array Area and Export Cable Corridor which ends at MHWS.
Special Areas of Conservation (SACs)	SACs are areas designated for the conservation of certain plant and animal species listed in the Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora.

Defined Term	Definition
Study Area	For each environmental topic, the baseline environment will be characterised, and the potential environmental impacts will be described within a topic-specific study area. Specific study areas are defined for each topic and are based on the maximum spatial extent across which potential impacts of the Project may be experienced by the relevant receptors (i.e. Zone of Influence).
Thistle Wind Partners (TWP)	Company established for the development of the Project.
Wind Turbines	Structures comprising of a tubular tower, rotor blades, and a nacelle which houses the Wind Turbine generator.

Acronyms

Acronym	Definition
CGNS	Celtic and Greater North Seas
CI	Confidence Interval
CL	Confidence Limit
C-POD	Cetacean Porpoise Detector
CV	Coefficient of Variance
DAS	Digital Aerial Surveys
ECOMMAS	East Coast Marine Mammal Acoustic Study
EIA	Environmental Impact Assessment
EU	European Union
GIS	Geographical Information System
HiDef	HiDef Aerial Surveying Limited
HWDT	Hebridean Whale & Dolphin Trust
IAC	Inter-Array Cable
IAMMWG	Inter-Agency Marine Mammal Working Group
IUCN	International Union for Conservation of Nature
JNCC	Joint Nature Conservation Committee
MD-LOT	Marine Directorate - Licensing Operations Team
MHWS	Mean High Water Spring
MPA	Marine Protected Area
MRSea	Marine Renewables Strategic environmental assessment
MU	Management Unit
MWDW	Manx Whale and Dolphin Watch
ncMPA	Nature Conservation Marine Protected Area
NERC	Natural Environment Research Council
NMPi	National Marine Plan interactive
NNG	Neart na Gaoithe
ORCA	UK-based marine conservation organisation charity
OSP	Offshore Substation Platform
OWF	Offshore Wind Farm
OWFL	Offshore Wind Farm Limited
POA	Plan Option Area
SAC	Special Area of Conservation
SCANS	Small Cetaceans in European Atlantic Waters in the North Sea
SCOS	Special Committee on Seals
SD	Standard Deviation
SMASS	Scottish Marine Animal Stranding Scheme
SMP	Sectoral Marine Plan

Acronym	Definition
SMRU	Sea Mammal Research Unit
SMU	Seal Management Unit
SPAN	Scottish Passive Acoustic Network
SST	Sea Surface Temperature
SWF	Sea Watch Foundation
TWP	Thistle Wind Partners Limited
UK	United Kingdom
WDC	Whale and Dolphin Conservation
ZoI	Zone of Influence

Table of Units

Units	Definition
%	Percent
°	Degree
°C	Degree Celsius
km	Kilometre
km²	Square kilometre
kg	Kilogram
kt	knot
m	Metre
m/s	Metres per second
nm	Nautical Mile

1 Introduction

1.1.1 This Marine Mammal Technical Report presents the baseline characterisation of marine mammal ecology for the offshore elements of the Bowdun Offshore Wind Farm (OWF) Project (hereafter referred to as the Proposed Development). The Proposed Development covers the Option Lease Area (OLA) comprises of the Array Area, which is located in the E3 Plan Option Area (POA) detailed in the Scottish Sectoral Marine Plan (SMP) (Scottish Government, 2020), and the Export Cable Corridor. The Array Area is located 38 km from the Aberdeenshire coast at its closest point, covering an area of 187 km^2. The Proposed Development will comprise of Wind Turbines (fixed foundations), Inter-Array Cables (IACs), Offshore Substation Platforms (OSPs), Interconnector Cables, Offshore Export Cables and any necessary scour/cable protection. The Export Cable Corridor will include a maximum of three High Voltage Alternating Current (HVAC) Offshore Export Cables, each with a length of up to 70 km and will make Landfall at Benholm, Aberdeenshire.

1.1.2 Data were collated through a detailed desktop study of existing resources available for marine mammals within the region, incorporating data from third party organisations, as well as data from the 24-month programme of site-specific Digital Aerial Surveys (DAS) (March 2022 to February 2024) (Volume 3, Technical Appendix 10.2: Marine Mammal Digital Aerial Survey Report). In addition, the Sea Mammal Research Unit (SMRU) provided telemetry maps and Haul-Out counts for harbour seal *Phoca vitulina* and grey seal *Halichoerus grypus* relevant to the Proposed Development, which have also been used to inform baseline characterisation (Annex A; Marwood and Stevens, 2024).

1.1.3 The aim of this Marine Mammal Technical Report is to provide a robust baseline description of the marine mammals likely to be present within the Marine Mammal Study Areas (Section 2). This will inform the assessment of potential effects of the Proposed Development on marine mammal receptors.

1.1.4 This report accompanies the Environmental Impact Assessment (EIA), Volume 2, Chapter 10: Marine Mammals, to support the consent application for the Proposed Development. This report should be read in conjunction with Volume 3, Technical Appendix 10.2: Marine Mammals Digital Aerial Survey Report, and Annex A (Marwood and Stevens, 2024). Consultation relevant to this Marine Mammal Technical Report is set out in Section 10.4 of Volume 2, Chapter 10: Marine Mammals.

2 Marine Mammal Study Area

2.1.1 Marine mammals are highly mobile and wide-ranging species, with varied behaviour and ecology between species. To account for this and to provide a wider geographic context, the Marine Mammal Study Area proposed for the purpose of baseline characterisation has been defined at two spatial scales (Figure 2.1):

- The Local Marine Mammal Study Area is defined as the Site Boundary plus a 12 km buffer. A site-specific DAS campaign was conducted over a 24-month period (March 2022 to February 2024), which covered the original E3 POA plus a 12 km buffer; the buffer has been extended to surround the Site Boundary. Between April and August the coverage of DAS flights extended west to the Aberdeenshire coast (defined in Section 4.3 as the 'Extended DAS Area'); and
- The Regional Marine Mammal Study Area is defined as the area encompassing the Site Boundary and extending further into the Northern North Sea towards Scandinavia. This was informed by species-specific Management Units (MU) for cetaceans as defined by the Inter-Agency Marine Mammal Working Group (IAMMWG) and the seal Management Units (SMU) as defined by the Special Committee on Seals (SCOS) (IAMMWG, 2023; SCOS, 2023). The MU boundaries are intended to inform the spatial scale for marine mammal population impact assessment. Further details and geographical extent of the species-specific relevant MUs is provided in Section 6. Due to the highly mobile nature of marine mammals, the Regional Marine Mammal Study Area is used to provide a wider geographic context compared to the Local Marine Mammal Study Area. Relevant MUs considered were the North Sea MU for harbour porpoise *Phocoena phocoena*¸ the Coastal East Scotland MU and Greater North Sea (GNS) MU for bottlenose dolphin *Tursiops truncatus* and the Celtic and Greater North Seas (CGNS) MU for minke whale *Balaenoptera acutorostrata*, Risso's dolphin *Grampus griseus* and white-beaked dolphin *Lagenorhynchus albirostris,* together with the East Scotland SMU for both grey seal and harbour seal and Moray Firth SMU and North Coast and Orkney SMU for grey seal only. The Regional Marine Mammal Study Area is informed by the North Sea MU for harbour porpoise and the CGNS MU for bottlenose dolphin, and is extended across the North Sea, broadly to encompass the relevant Small Cetaceans in European Atlantic waters and the North Sea (SCANS) survey blocks (Figure 4.2; Figure 4.3). This provides an area which is representative of the potential species connectivity with the Proposed Development.

2.1.2 Further details and geographical extent of the relevant MUs is provided in Section 6.

2.1.3 The Marine Mammal Study Areas defining both spatial scales were presented in the Bowdun OWF Scoping Report (BOWFL, 2024), and the Scoping Opinion agreed these areas broadly captured the Zone of Influence (ZoI) for marine

mammals (Marine Directorate – Licensing Operations Team (MD-LOT), 2024). These were also presented at the Scoping Workshop held on 25 April 2024.

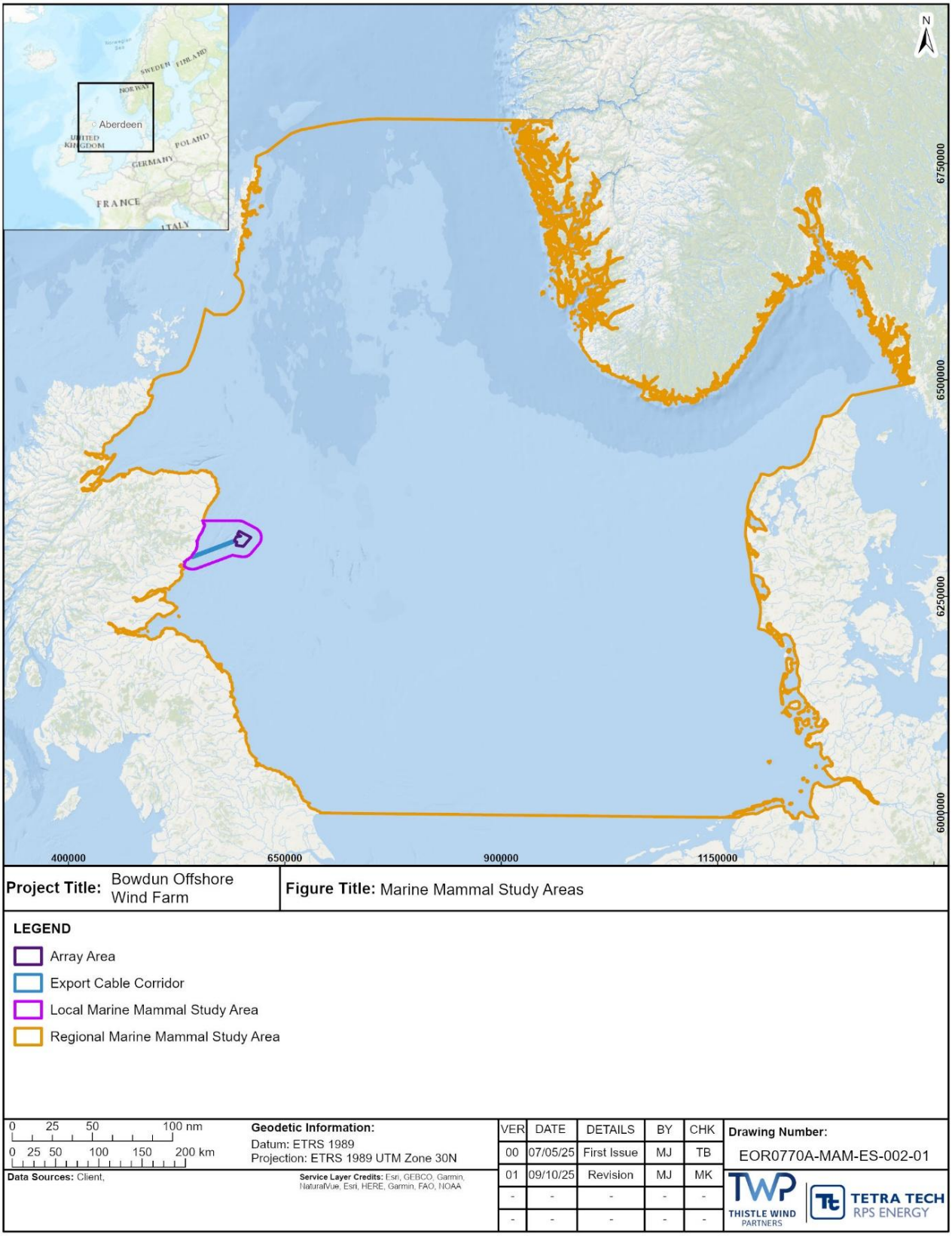


Figure 2.1: Marine Mammal Study Areas

3 Legislation and Conservation Designations

3.1 Legal Framework

3.1.1 The Conservation (Natural Habitats, &c.) Regulations 1994 (as amended) make it an offence to disturb a cetacean intentionally or recklessly in Scottish inshore waters (within 12 nm of the coast), and the Conservation of Offshore Marine Habitats and Species Regulations 2017 in offshore waters (greater than 12 nm). Improved protection for seal is provided in the Marine (Scotland) Act 2010. In the United Kingdom (UK), all species of cetaceans (porpoise, dolphin, and whale) out to 12 nm are protected under the Wildlife and Countryside Act (1981).

3.1.2 Several marine mammal species present in UK waters are listed in Annex II of the Habitats Directive (Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora) as species whose conservation requires the designation of Special Areas of Conservations (SAC). In Scotland, the Habitats Directive is translated into legal obligations by the Conservation (Natural Habitats, etc.) Regulations 1994 (as amended), the Conservation of Habitats and Species Regulations 2017, the Conservation of Offshore Marine Habitats and Species Regulations 2017, the Offshore Petroleum Activities (Conservation of Habitats) Regulations 2001 and the Wildlife and Countryside Act 1981 (Scottish Government, 2015). Annex II marine mammal species for which SACs are designated within Scottish waters include harbour porpoise, grey seal, harbour seal and bottlenose dolphin. Under Annex IV of the Habitats Directive, all cetacean species are protected wherever they occur within a Member State's territory, both inside and outside designated protected areas. Here, they are termed European Protected Species (EPS).

3.1.3 The Marine (Scotland) Act 2010 and The UK Marine and Coastal Access Act 2009 include provisions to designate Marine Protected Areas (MPA) (within territorial and offshore waters, respectively). MPAs are areas of the sea with special controls to protect species and habitats and to support the wider marine ecosystem. A total of 36 Nature Conservation MPAs (ncMPA) have been designated in Scotland's seas (NatureScot, 2023).

3.2 Conservation Designations

3.2.1 There are several designated areas within the Regional Marine Mammal Study Area that have marine mammals as protected interest features. The Regional Marine Mammal Study Area has been screened to identify the UK sites that require further consideration due to potential connectivity with the Proposed Development (Table 3.1; Figure 3.1).

Table 3.1: Designated Sites Within the Regional Marine Mammal Study Area

Designated Site	Distance to the Array Area (km)	Distance to the Export Cable Corridor (km)	Protected Interest Features
Southern Trench MPA	35.9	44.9	Minke whale
Firth of Tay and Eden Estuary SAC	89.1	40.4	Harbour seal
Isle of May SAC	104.5	67.1	Grey seal
Berwickshire and North Northumberland Coast SAC	116.2	92.1	Grey seal
Moray Firth SAC	157.5	164.1	Bottlenose dolphin
Dornoch Firth and Morrich More SAC	195.4	201.7	Harbour seal
Southern North Sea SAC	203.4	212.7	Harbour porpoise

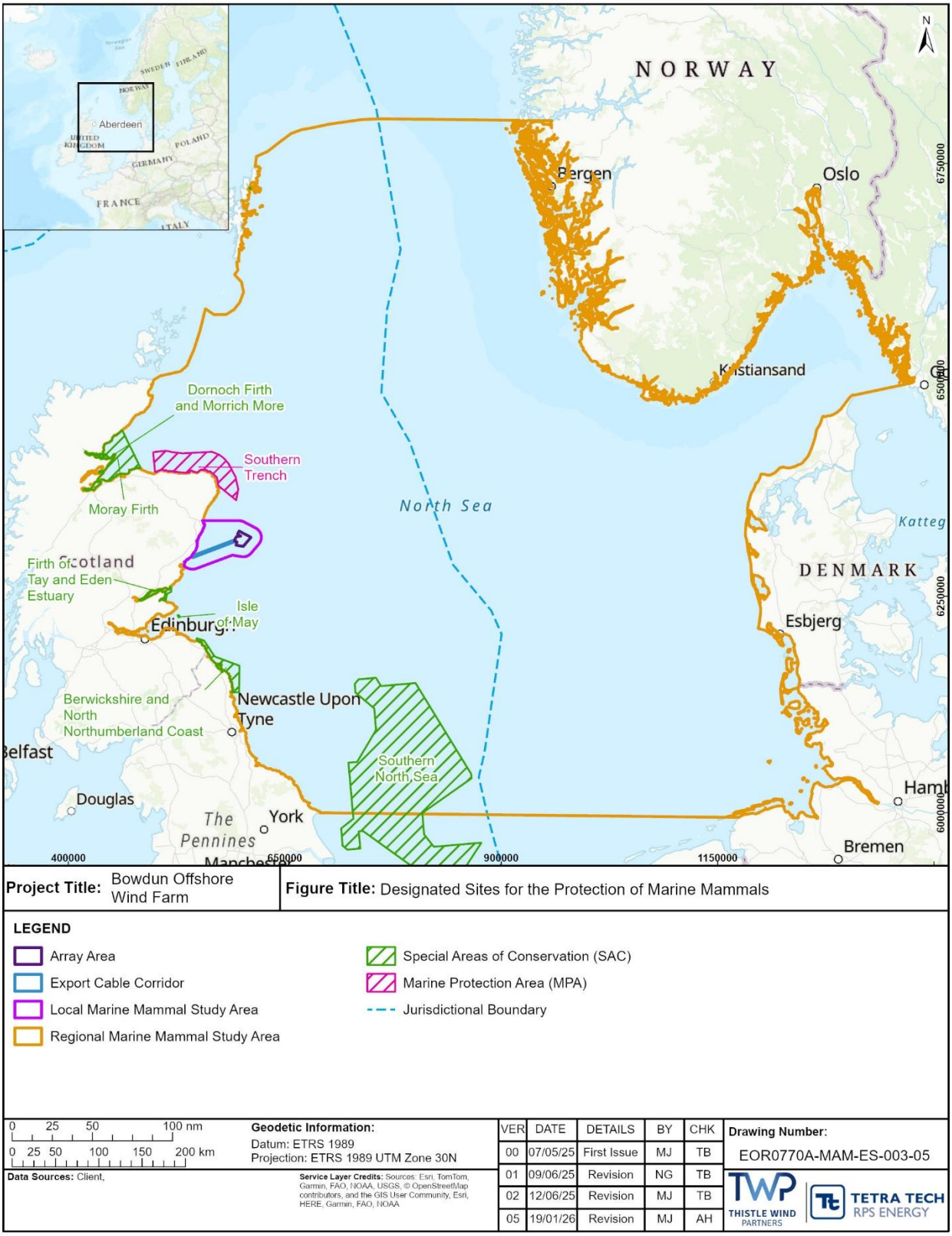


Figure 3.1: Designated Sites for the Protection of Marine Mammals

4 Methodology

4.1.1 The baseline characterisation of marine mammals within the Marine Mammal Study Area is based on site-specific data, information available from adjacent offshore wind site-specific studies, and a detailed desktop review of existing studies and data sets relevant to the Proposed Development.

4.2 Desktop Study

4.2.1 Key sources of existing marine mammal distribution, abundance and densities reviewed to inform the marine mammal baseline characterisation are summarised in Table 4.1.

Table 4.1: Summary of Key Desktop Datasets and Reports for Marine Mammals

Title	Source	Extent	Year	Author
East Coast Marine Mammal Acoustic Array Surveys (ECOMMAS)	The Scottish Government	East Scotland	n.d.	Marine Scotland
Harbour seal and grey seal: distribution maps for Scotland	The Scottish Government	UK	2025	Carter *et al.*
Spatial models of cetacean density in European Atlantic waters based on SCANS-IV summer 2022 survey data	SCANS IV	European Atlantic waters, North Sea	2025	Gilles *et al.*
Whale and Dolphin Conservation (WDC) Sightings Network	Whale and Dolphin Conservation	UK (2005 – present)	2025	WDC
Ossian Offshore Wind Farm, Array EIA Report, Chapter 10: Marine Mammals	Ossian OWF Limited	UK	2024	Ossian Offshore Wind Farm Limited (OWFL)
ORCA, The State of Cetaceans 2024	ORCA	UK	2024	ORCA
Site Condition Monitoring of bottlenose dolphins within the Moray Firth Special Area of Conservation 2017-2022	NatureScot	East Scotland	2024	Cheney *et al.* (2024)
Scottish Marine Animal Stranding Scheme (SMASS) Database	The Scottish Government	Scotland	2023	Brownlow *et al.*
Estimates of Cetacean Abundance in European Atlantic Waters in Summer 2022 from the SCANS IV Aerial and Shipboard Surveys	SCANS IV	European Atlantic waters, North Sea	2023	Gilles *et al.*
Morven Offshore Wind Array Project EIA Scoping Report	Morven Offshore Wind Limited	UK	2023	Morven Offshore Wind Farm Limited

Title	Source	Extent	Year	Author
Scientific Advice on Matters Related to the Management of Seal Populations: 2022	SCOS	UK	2023	SCOS
Sympatric Seals Satellite Tracking and Protected Areas: Habitat-Based Distribution for Conservation and Management	Frontiers in Marine Science	UK	2022	Carter *et al.*
Updated Abundance Estimates for cetacean MUs in UK waters	IAMMWG	UK	2022	IAMMWG
Modelled Density Surfaces of Cetaceans in European Atlantic Waters in Summer 2016 from the SCANS III Aerial and Shipboard Surveys	University of St. Andrews	European Atlantic waters	2022	Lacey *et al.*
Production of Seabird and Marine Mammal Distribution Models for the East of Scotland	The Scottish Government	East Scotland	2022	Paxton *et al.*
Scientific Advice on Matters Related to the Management of Seal Populations: 2021	SCOS	UK	2022	SCOS
Berwick Bank Wind Farm Offshore EIA Report, Chapter 10 Marine Mammals	SSE Renewables	UK	2022	SSE Renewables
Estimates of Cetacean Abundance in European Atlantic Waters in Summer 2016 from the SCANS III Aerial and Shipboard Surveys. Revised June 2021.	SCANS III	European Atlantic waters	2021	Hammond *et al.*
Regional baselines for marine mammal knowledge across the North Sea and Atlantic areas of Scottish waters	The Scottish Government	UK	2020	Hague *et al.*
Distribution Maps of Cetacean and Seabird Populations in the North-East Atlantic	Journal of Applied Ecology	North-East Atlantic	2020	Waggitt *et al.*
Neart na Gaoithe (NNG) OWF Environmental Statement (ES), Chapter 13 Marine Mammals	NNG OWF	UK	2019	Mainstream Renewable Power
The Identification of Discrete and Persistent Areas of Relatively High	Joint Nature Conservation Committee (JNCC)	UK	2015	Heinänen and Skov

Title	Source	Extent	Year	Author
Harbour Porpoise Density in the Wider UK Marine Area				
Seagreen Firth of Forth Round 3 Zone Marine Mammal Surveys	Seagreen Alpha and Bravo OWFs (have since been renamed to Seagreen 1 and Seagreen 1A)	UK	2012	Sparling
Analysis of The Crown Estate Aerial Survey Data for Marine Mammals for the Forth and Tay Offshore Wind Developers Group Region	SMRU	UK	2011	Grellier and Lacey

4.3 Bowdun OWF Site-Specific Surveys

4.3.1 A summary of the surveys undertaken to inform the marine mammal baseline is outlined in Table 4.2 below.

4.3.2 The DAS campaign (conducted by APEM Limited.) commenced in March 2022 and continued monthly until February 2024 to allow 24 months of data collection. This included any additional surveys to account for delayed survey flights.

4.3.3 The DAS for the Bowdun OWF marine mammal DAS data collection applied slightly different areas dependant on the season. During the winter months (September to March, inclusive), the study area for the DAS campaign was delineated as the ScotWind E3 POA plus a 12 km buffer (hereafter known as 'DAS Area') (Figure 4.1). During the summer months (April to August, inclusive) the area was extended to the Aberdeenshire coastline (hereafter known as the 'Extended DAS Area') (Figure 4.1).

4.3.4 In total, for the DAS Area, 408 survey transects were used in the analysis (17 flight lines, over 24 months), covering a total survey area of 8,282.04 km^2 and incorporating 258,484 images (mean 0.035 km^2 (Standard Deviation (SD) = 0.005) coverage per image). For the Extended DAS Area, 170 survey transects were used in the analysis (17 flight lines, for ten months) covering a total survey area of 4,851.44 km^2 and incorporating 150,749 images (mean 0.035 km^2 (SD = 0.004) coverage per image).

4.3.5 A mean coverage of 17.32% (345.08 km^2) of the DAS Area[1] (1,991.59 km^2) and 17.51% (485.14 km^2) of the Extended DAS Area[2] (2,770.91 km^2) was processed by APEM Limited across the 24 months of the DAS campaign, with a minimum coverage of 16.44% (327.39 km^2) in November 2023 (DAS Area) and a maximum coverage of 17.69% (490.16 km^2) in June 2022 (Extended DAS Area).

4.3.6 Across the 24-month DAS campaign a total of 3,511 marine mammals were observed, with animals identified into seven species. DAS assumptions and limitations and further detail can be found in Volume 3, Technical Appendix 10.2: Marine Mammal Digital Aerial Survey Report.

Table 4.2: Summary of Site-Specific Surveys Undertaken for Marine Mammals

Survey number	Survey month	Survey coverage[1] (km^2)	Percentage of relevant DAS area[2]
1	March 2022	345.94	17.37
2	April 2022	486.15	17.54
3	May 2022	484.40	17.48
4	June 2022	490.16	17.69
5	July 2022	482.03	17.40
6	August 2022	485.67	17.53
7	September 2022	345.22	17.33
8	October 2022	348.18	17.48
9	November 2022	339.99	17.07
10	December 2022	345.77	17.36
11	January 2023	335.86	16.86
12	February 2023	345.19	17.33
13	March 2023	346.58	17.40
14	April 2023	485.87	17.53
15	May 2023	484.54	17.49
16	June 2023	485.62	17.53
17	July 2023	481.27	17.37
18	August 2023	485.73	17.53
19	September 2023	351.91	17.67
20	October 2023	341.87	17.17

[1] Due to the nature of applying different geographical projections in calculating area, the numerical value used in estimating abundance and density (1991.59 km^2) differed from the value reported in the survey reports (1,977 km^2). However, both values are considered to be accurate and relevant.
[2] Due to the nature of applying different geographical projections in calculating area, the numerical value used in estimating abundance and density (2770.91 km^2) differed from the value reported in the survey reports (2,775 km^2). However, both values are considered to be accurate and appropriate.

Survey number	Survey month	Survey coverage[1] (km^2)	Percentage of relevant DAS area[2]
21	November 2023	327.39	16.44
22	December 2023	348.22	17.48
23	January 2024	343.21	17.23
24	February 2024	345.35	17.34
Overall total (All surveys)		9,662.11	n/a
Overall mean (DAS Area)		345.08	17.32
Overall mean (Extended DAS Area)		485.14	17.51

[1] Survey coverage is calculated from the area covered by all survey images within each survey flight, dissolved to remove overlap, and clipped to the DAS Area.
[2] Percentage coverage is calculated from the corresponding survey value used in estimating abundance and density (1,991.59 km^2 for the DAS Area and 2,770.91 km^2 for the Extended DAS Area).

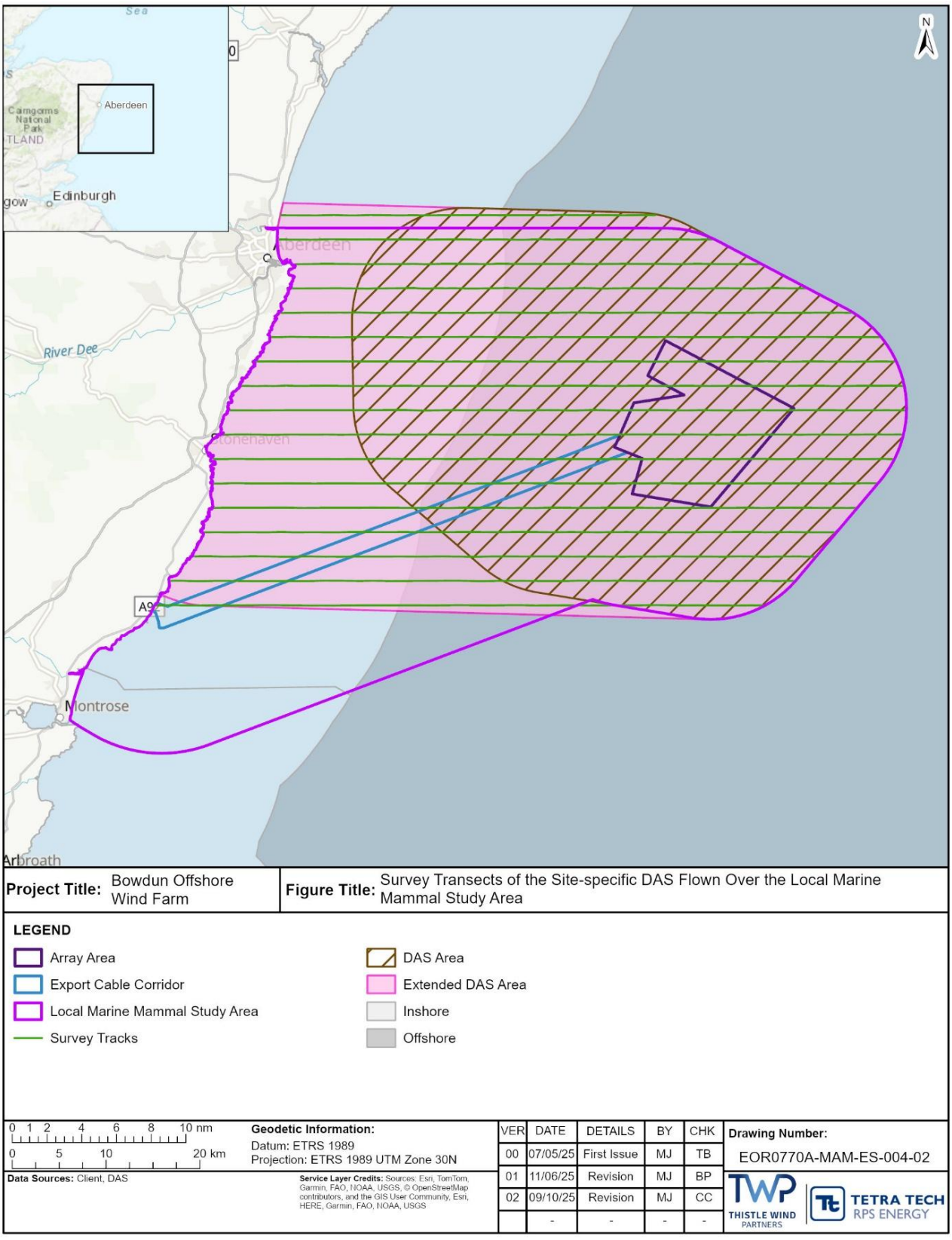


Figure 4.1: Survey Transects of the Site-specific DAS Campaign Flown Over the Local Marine Mammal Study Area

4.4 Adjacent Site-Specific Surveys

Ossian OWF

4.4.1 Ossian OWF is located off the Aberdeenshire coast, approximately 25.4 km from the Proposed Development. Site-specific DAS were conducted by HiDef Aerial Surveying Limited (HiDef) between March 2021 and February 2023 (Ossian OWFL, 2024), providing 24 months of data collection, including additional surveys to account for delayed survey flights. The DAS study area encompassed the Ossian array area site boundary plus an 8 km buffer. Surveys followed 31 transects, each spaced 2.5 km apart, aligned broadly north-east to south-west, perpendicular to coastal depth contours – across the Ossian array area marine mammal study area. The total survey effort covered was approximately 5,439.85 km^2, with a monthly mean of approximately 22.66 km^2. Five marine mammal species relevant to the Proposed Development were identified: harbour porpoise, white-beaked dolphin, minke whale, harbour seal and grey seal. Density estimates for harbour porpoise, white-beaked dolphin and grey seal were adjusted for availability bias, enabling the calculation of absolute abundance estimates (Ossian OWFL, 2024).

Morven OWF

4.4.2 The Morven OWF is located approximately 10.1 km from the Proposed Development. Information on DAS was included in the Morven Offshore Wind Array Project EIA Scoping Report. At the time of submission 15 months of DAS data was available. Surveys were conducted by APEM Limited from January 2021 to March 2021. Although the Scoping Report for the Morven OWF did not include specific sighting counts, the following marine mammal species were recorded: harbour porpoise, white-beaked dolphin, grey seal, and minke whale (Morven Offshore Wind Limited, 2023). Species densities were reported to be highest during the summer months (Morven Offshore Wind Limited, 2023).

Berwick Bank Wind Farm

4.4.3 The Berwick Bank Wind Farm is located in the outer Firth of Forth, approximately 46.4 km from the Proposed Development. The EIA for the project includes a marine mammal baseline technical report which details the site-specific survey methodology and results (SSE Renewables, 2022). DAS were conducted by HiDef between March 2019 and April 2021, resulting in 25 months of survey. The survey design consisted of 37 transects, spaced 2 km apart, covering the Offshore Array Area and an approximately 16 km buffer. The total survey area amounted to 4,980 km^2, with approximately 620 km^2 surveyed each month (equivalent to 12.5% of the total area). Six species of marine mammal were identified during the surveys: harbour porpoise, minke whale, white-beaked dolphin, bottlenose dolphin, grey seal and harbour seal. Monthly density estimates were provided for each species and adjusted for availability bias using the following correction factors: 0.425 for harbour porpoise (Teilmann, 2013), 0.156 for grey seal (Ørsted, 2018), 0.443 for minke whale (McGarry, 2017) and 0.180 for white-beaked dolphin (Rasmussen, 2013).

Neart na Gaoithe (NNG) OWF

4.4.4 The NNG OWF is approximately 15.5 km east of Fife Ness and approximately 80.5 km from the Proposed Development. Marine mammal and ornithology surveys were conducted over a two-year period within the NNG OWF study area, using a combination of boat-based, acoustic and aerial survey methods. A total of six marine mammal species were recorded during the surveys: harbour porpoise, white-beaked dolphin, minke whale, killer whale *Orcinus orca*, grey seal and harbour seal. Boat-based surveys were undertaken from November 2010 to October 2011, following transects spaced 2 km apart and aligned in a north-west to south-east direction across the study area. While full coverage was generally achieved, no surveys were conducted in November 2011 due to adverse weather conditions, The total area surveyed across both years was approximately 7,552 km^2. Acoustic surveys were introduced in December 2010, employing a towed hydrophone system developed by EcologicUK to improve the detection of small odontocetes and to facilitate the estimation of absolute abundance. In addition, aerial surveys (commissioned by The Crown Estate) were conducted across the Firth of Forth and Firth of Tay during 2009 and 2010 (Grellier and Lacey, 2011). Data were collected monthly, except for April, September and October. Data analysis was carried out by SMRU Limited, and results were presented in the relevant species assessments (MacLeod, 2011).

Seagreen OWF

4.4.5 The Seagreen OWF, comprising Seagreen 1 and 1A, is located approximately 27 km off the coast of Angus in the North Sea and approximately 19.5 km from the Proposed Development. Visual boat-based surveys for marine mammals and seabirds were commissioned by Seagreen Wind Energy Limited and conducted by ECON Energy between May 2010 and November 2011. The surveys covered the Firth of Forth Round 3 Zone, an area approximately 2,850 km^2, located approximately 25 km offshore from the Firth of Forth. Monthly surveys followed a system of transect lines spaced 3.7 km apart, distributed across four different routes (east, west, north, south), with parallel lines spaced at 300 m apart (Sparling, 2012). Over the course of 19 surveys, a total of 17,017 km^2 of survey effort was undertaken (Sparling, 2012), during which six species of marine mammals were recorded: harbour porpoise, bottlenose dolphin, white-beaked dolphin, minke whale, grey seal and harbour seal. In addition, incidental sightings of marine mammals were also recorded during visual, boat-based ornithology surveys for the former Seagreen Alpha/Bravo project area (renamed 'Seagreen' in 2018), from May to August 2017 (Seagreen Wind Energy Limited, 2018).

4.5 Other Studies and Data Sources

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

4.5.1 The first SCANS survey was conducted in the summer of 1994 to provide estimates of the abundance and density of small cetaceans in the North Sea and European Atlantic continental shelf waters. The SCANS II surveys were completed in July 2005, and SCANS III in July 2016. All surveys comprised a combination of vessel and aerial surveys. Both aerial and boat-based survey methodologies were designed to correct availability and detection bias and allow absolute abundance estimation. The original SCANS III data were published by Hammond *et al.* (2017), which has been revised following the discovery of some analytical errors, and the updated version by Hammond *et al.* (2021) is used for the purpose of this baseline characterisation. SCANS IV was carried out in the summer of 2022, and the results of surveys are presented in Gilles *et al.* (2023).

4.5.2 The Proposed Development is located in the SCANS III survey area R and SCANS IV survey area NS-D (Figure 4.2; Figure 4.3), both of which were surveyed by visual aerial surveys (Hammond *et al.*, 2021; Gilles *et al.*, 2023).

4.5.3 The most recent data from SCANS III and SCANS IV has been referred to in Section 6 together with indicating trends in species abundance across survey years where relevant (Hammond *et al.*, 2021; Gilles *et al.*, 2023).

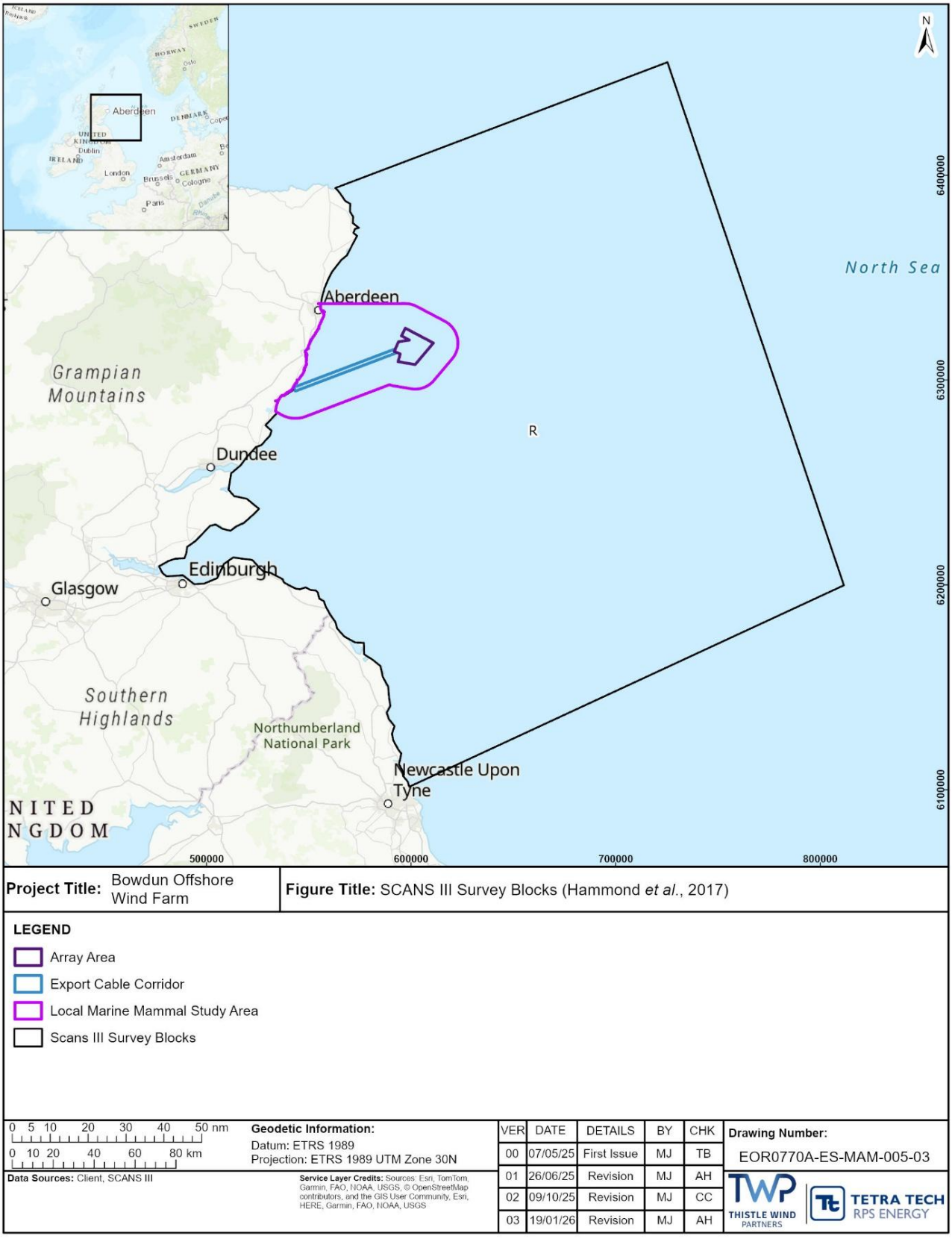


Figure 4.2: SCANS III Survey Blocks (Hammond *et al.*, 2017)

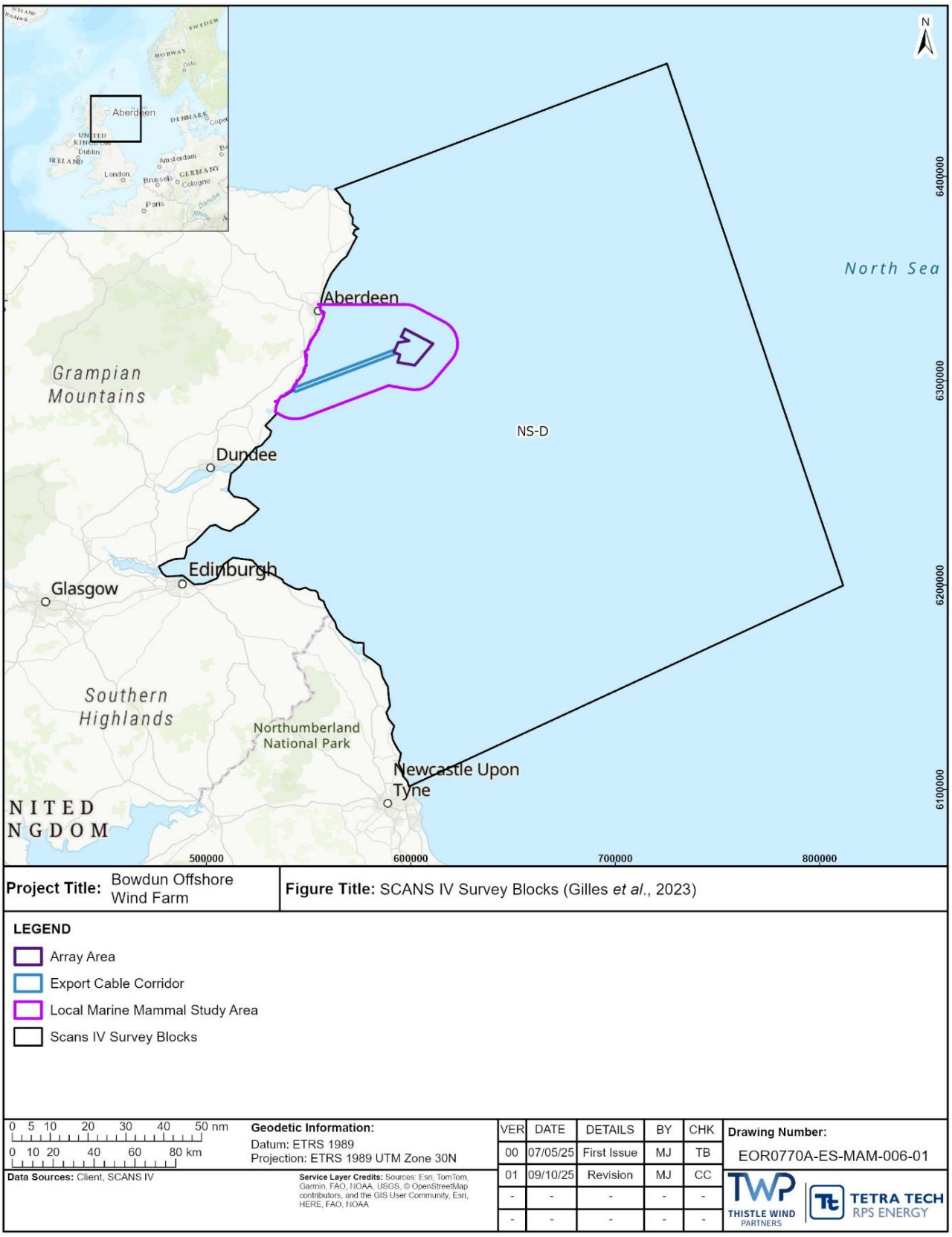


Figure 4.3: SCANS IV Survey Blocks (Gilles *et al.*, 2023)

SCANS Density Surface Estimates

4.5.4 SCANS III data were used by Lacey *et al.* (2022) and SCANS IV data were used by Gilles *et al.* (2025) to generate density surface estimate maps for those cetacean species for which there were sufficient data. The density surface estimate maps provide information on summer distribution by modelling the data in relation to spatially linked environmental features.

4.5.5 Lacey *et al.* (2022) present density surface modelling for harbour porpoise, bottlenose dolphin, common dolphin *Delphinus delphis* and minke whale. Density surface 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 (i.e. the difference between recorded sea level and mean sea level) and Sea Surface Temperature (SST). Consecutive records made along the aerial survey transects were combined into 10 km segments of search effort to allow density estimates to be predicted to a spatial grid of 10 km x 10 km resolution.

4.5.6 Figures showing surfaces of predicted density and Coefficient of Variation (CV) of predicted density estimates were produced for each species for SCANS III, with patterns of predicted density estimates influenced by model covariates, fitted smooth functions and spatial variation in the values of the covariates in the prediction grid (Lacey *et al.*, 2022). To note, the density surface estimates are for summer distribution only, as this is when SCANS III was carried out. The figures allow density surface estimate maps to be overlaid with the Local Marine Mammal Study Area to generate local density estimates and are discussed in Section 6 for relevant species.

4.5.7 More recently, SCANS IV survey data and analyses have provided updated distribution and abundance estimates for cetaceans across the north-east Atlantic. Gilles *et al.* (2025) expanded upon the SCANS III framework by incorporating additional environmental variables such as chlorophyll-a concentration and dynamic oceanographic features (e.g. eddy kinetic energy), and also included data from autonomous acoustic recorders to complement visual observations. This has enhanced temporal and spatial resolution, particularly for species such as harbour porpoise.

4.5.8 The updated density surface models from SCANS IV confirm broad patterns observed in SCANS III but also reveal potential shifts in some species' core distribution areas, potentially linked to changing oceanographic conditions and prey availability. For instance, harbour porpoise density was found to have increased in some offshore areas, while bottlenose dolphin showed a more fragmented coastal distribution compared to SCANS III. As with SCANS III, predicted density and associated Coefficient of Variance (CV) surfaces were generated at 10 km × 10 km resolution, and these were used to generate local density estimates within the Local Marine Mammal Study Area, as presented in Section 6.

Special Committee on Seals (SCOS)

4.5.9 The Natural Environment Research Council (NERC) provides scientific advice to the government on matters related to the management of seal populations (under the Conservation of Seals Act 1970 and the Marine (Scotland) Act 2010). NERC has appointed SCOS to formulate this advice, which is provided by SMRU through a series of scientific briefing papers and meetings, and an annual report is produced. The annual report includes advice on matters related to the management of seal populations, including general information on British seals and information on their current status. Upfront sections of the report often address specific questions raised by regulators and stakeholders. The latest available SCOS report is the 'Scientific Advice on Matters Related to the Management of Seal Populations: 2022' (SCOS, 2022) which presents data collected and population estimates up to and including 2022[3].

Sea Mammal Research Unit (SMRU) Seal Surveys

4.5.10 SMRU carries out surveys of the harbour seal and grey seal in Scotland and on the East Coast of England to contribute to the NERC's statutory obligation under the Conservation of Seals Act 1970 through the provision of scientific advice on matters related to the management of seal populations to the UK Government. These surveys form the routine monitoring of seal populations around the UK. Most surveys are carried out in August from the air by either light aircraft or helicopter and record seals that are hauled out on shore. Although both species are surveyed during the month of August, on account of differences in the breeding behaviour of harbour seal and grey seal, these surveys correspond to different points in the two species' annual cycles.

4.5.11 A bespoke site-specific SMRU report was commissioned to support the baseline assessment for the Proposed Development and associated Local Marine Mammal Study Area. The report provided a detailed account of grey seal and harbour seal Haul-Out sites and telemetry tracks within the vicinity of the Array Area, as well as North Coast and Orkney SMU, Moray Firth SMU, and East Scotland SMU (Figure 4.4) (Annex A; Marwood and Stevens, 2024).

Harbour Seal

4.5.12 Surveys of harbour seal are carried out during the summer and early autumn months. Two types of surveys were conducted: breeding season counts and August moult counts. The most recent August Haul-Out count for the whole of Scotland is for the count period 2016 to 2021, where a total of 26,378 harbour seal were counted (includes data from the 2016-2019 count period for Scottish SMUs one to five and from 2021 for SMUs six and seven, including the SMUs considered relevant for Proposed Development) (Annex A; Marwood and Stevens, 2024).

[3] Although the SCOS 2024 report has recently been published, it was not published in time to enable use for this assessment. The reference population estimates were provided in the SMRUC Seal Telemetry report (see Annex A; Marwood and Stevens, 2024)

Grey Seal

4.5.13 In the UK, grey seal are surveyed during their breeding season (August to December), wherein pup counts are conducted at known breeding colonies. Most breeding colonies are surveyed by SMRU by fixed wing aerial vertical photography (Hebrides, Orkney, North Scotland, North-east Scotland and most of the Firth of Forth) while other colonies are surveyed by ground count by other organisations (including NatureScot, Natural England, Natural Resources Wales, National Trust, and Lincolnshire Wildlife Trust) (Annex A; Marwood and Stevens, 2024). The grey seal pup production database contains data from 1996 to 2021 and includes 74 breeding colonies, 70 of which are in Scotland and one of which is in North-east England (though not all colonies have been surveyed consistently since 1989, and some smaller colonies are surveyed more sporadically than others). The most recent complete grey seal pup production survey (covering Orkney, Inner and Outer Hebrides and the North Sea colonies) was conducted in 2019. It should be noted that grey seal distribution during the breeding season is very different to their distribution at other times of the year.

4.5.14 Grey seal are also counted during SMRU's harbour seal August moult surveys. However, counts of grey seal during the summer months can be highly variable. Although these counts are not used as a population index, they provide useful information on the summer and non-breeding season distribution of grey seal. The most recent data available for the North Coast and Orkney SMU are from 2016 to 2019 (SCOS, 2020), and Moray Firth SMU are from 2021 (SCOS, 2022).

Designated Seal Haul-Out Sites

4.5.15 Seal Haul-Out sites are locations on land where seal come ashore to rest, moult or breed. In Scotland, designated seal Haul-Out sites are places designated under Section 117 of the Marine (Scotland) Act 2010. 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 seal at these sites. Harassment involves any activity that *"pesters, torments, troubles or attacks a seal on a designated Haul-Out site. Specifically, it would include any action that causes a significant proportion of seal 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, 2014).

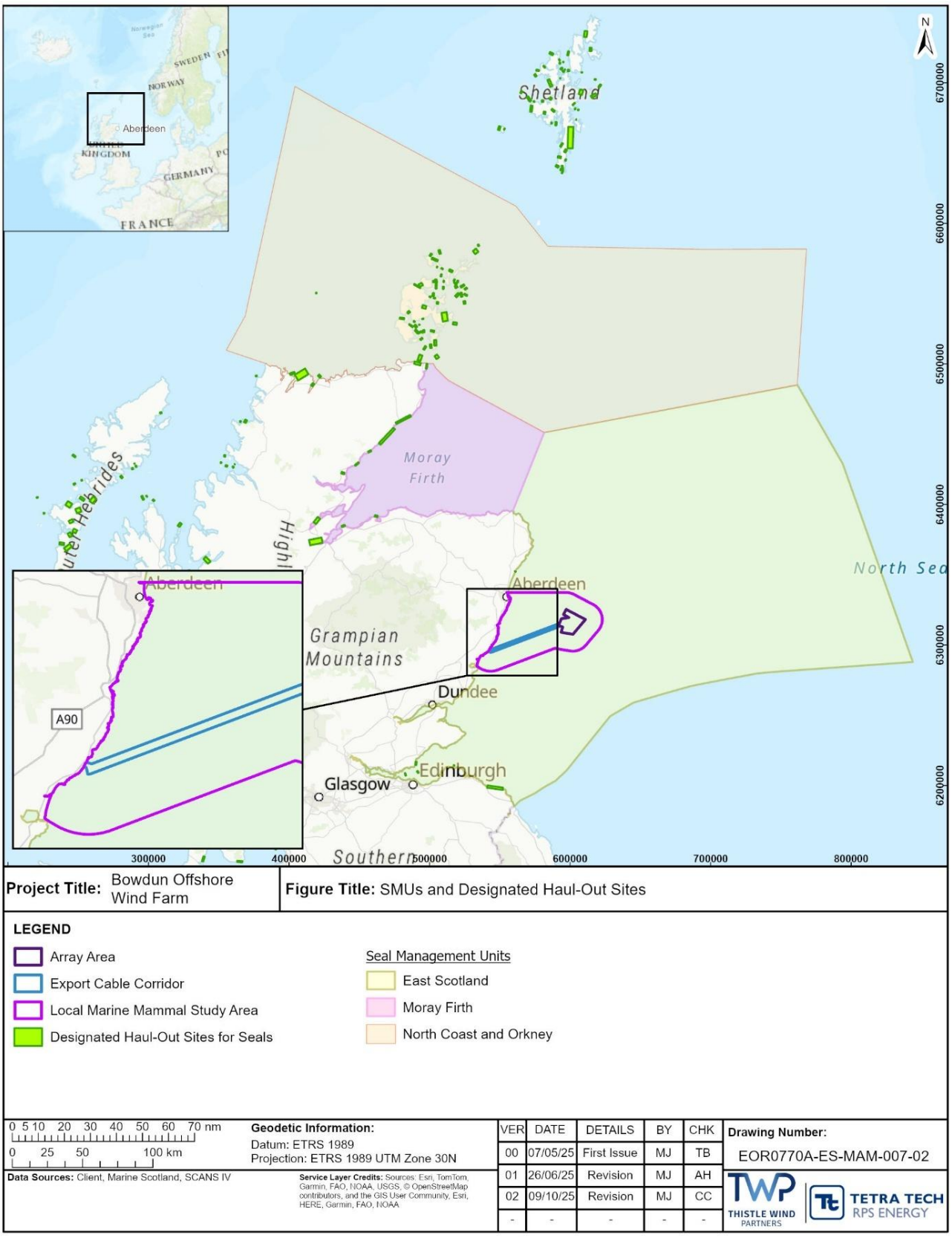


Figure 4.4: SMUs and Designated Haul-Out Sites

Seal Telemetry Data

4.5.16 SMRU has deployed telemetry tags on harbour seal and grey seal in the UK since 1988 and 2001, respectively. 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 duration (number of days) varying between individual deployments. Data obtained during telemetry studies provide information on seal movement patterns on the foraging behaviour of seal at sea and demonstrate connectivity between areas.

4.5.17 Telemetry data presented in this report for harbour seal and grey seal (Section 6.4; Annex A) draws on the commissioned site-specific SMRU study (Annex A; Marwood and Stevens, 2024), which presents an analysis of existing satellite data to describe the movements of harbour seal and grey seal within the vicinity of the Local Marine Mammal Study Area.

Habitat-Based Distribution Estimates for Seals at Sea

4.5.18 Carter *et al.* (2022; 2025) present UK waters' most up-to-date seal at sea distribution maps. Carter *et al.* (2025) utilised a high-resolution GPS tracking dataset (222 harbour seal and 169 grey seal) and wide spatial coverage to model habitat preference and generate at sea distribution estimates for both species of seal around the British Isles (UK, Isle of Man and Republic of Ireland). Additionally, Carter *et al.* (2022) provides SAC specific estimates of at sea distribution, demonstrating that hotspots of at sea density cannot always be apportioned to the nearest SAC. The at sea usage maps represent the number of harbour seal and grey seal estimated to be in the water in each 5 km x 5 km grid cell at any one time. The Carter *et al.* (2025) report presents values as spatial predictions of relative density and absolute density.

Distribution Maps of Cetacean and Seabird Populations in the North-east Atlantic

4.5.19 Waggitt *et al.* (2020) collated and standardised data from 2.68 million km of cetacean and seabird surveys carried out in the north-east Atlantic between 1980 and 2018. The study consisted of three stages: collating survey data, linking differences among surveys with various parameters (platform type, transect design, observation method and weather) to calculate the variations in the surface area covered, and generating species distribution models. As a result, distribution maps were provided for 12 cetacean and 12 bird species at 10 km resolution and monthly frequency in the north-east Atlantic. However, these density estimates require careful interpretation. Bottlenose dolphin maps reflect the offshore ecotype only, and other smaller sub-populations are not well reflected in the model (e.g. Risso's dolphin). There have been substantial changes in distribution over the timeframe of the study (e.g. harbour porpoise, movement from the northern to the southern North Sea). The authors caveat the study to say that outputs should not be used as representative of absolute densities at the present time but used to reflect a general illustration of relative densities and broad-scale distribution over several decades.

JNCC Report 544: Harbour Porpoise Density

4.5.20 Heinänen and Skov (2015) conducted a detailed analysis of the majority of the standardised Joint Cetacean Protocol (JCP) data resources to identify "discrete and persistent areas of high density" that might be considered important for harbour porpoise, with the goal of determining SACs for the species. The analysis grouped data into three subsets: 1994 to 1999, 2000 to 2005 and 2006 to 2011 to account for patchy survey effort. To explore whether distribution patterns differed between seasons, the study separately analysed summer (April to September) and winter (October to March) data. The analysis presented in Heinänen and Skov (2015) relied on extensive extrapolation of survey data over space and time. Any extrapolation is sensitive to the covariates used in models and assumes that these relationships hold true outside the surveyed areas. Given the uneven survey effort over the modelled period, modelled distributions had a large degree of uncertainty.

East Coast Marine Mammal Acoustic Study (ECOMMAS)

4.5.21 The ECOMMAS is a long-term project to understand the impact of underwater noise from offshore industries on dolphin and porpoise along Scotland's east coast. Acoustic recorders, known as C-PODs (Cetacean Porpoise Detectors), were deployed at 30 locations to monitor dolphin and porpoise echolocation clicks. At ten of these locations, broadband recorders (which record all marine mammal vocalisations, unlike C-PODs which only detect cetacean echolocation clicks) were also deployed. Data collection began in 2013, with two deployments per year since 2015 and is ongoing. The project has provided valuable insights into the distribution and habitat use of harbour porpoise and bottlenose dolphin, with harbour porpoise detected daily at most sites and less frequent dolphin detections (Marine Scotland, n.d.). ECOMMAS data is available for download (2013 to 2016) as an excel spreadsheet, together with map layers from Marine Scotland Maps (National Marine Plan Interactive (NMPi), 2023).

Scottish Passive Acoustic Network (SPAN)

4.5.22 SPAN commenced in December 2022 as an expansion of ECOMMAS. With the expansion of offshore wind development around Scotland, ScotMER broadened the scope to include additional monitoring locations on the western and Northern coasts of Scotland. The SPAN moorings use the newer F-POD click detectors (Full waveform capture Porpoise Detector). These data are not yet publicly available as processed data. Raw data may be available from Marine Directorate – Science, Evidence, Data and Digital (MD-SEDD) directly (SPAN, 2024).

Scottish Marine Animal Stranding Scheme (SMASS)

4.5.23 SMASS is a national initiative dedicated to monitoring and investigating marine animal strandings across Scotland. Established in 1992, SMASS provides a systematic approach to the surveillance of Scotland's marine species by collating, analysis, and reporting data on stranded whale, dolphin, porpoise, seal, marine turtle, and basking shark *Cetorhinus maximus*. SMASS encourages public participation in reporting standings and has developed tools like the 'Beachtrack' app to facilitate the collection of high-resolution data on marine

strandings and other key metrics of marine environmental health around the Scottish coastline. In recent years, SMASS has expanded its capabilities through funding from the Nature Restoration Fund via the Scottish Marine Environmental Enhancement Fund. This support has enabled the renovation of facilities to support marine strandings investigation work in the Highlands and Islands region and the development of a web-accessible database (which organises data into tables with defined relationships) for storage of key SMASS datasets. SMASS publishes annual reports and summaries on their website detailing strandings, species affected, post-mortem results, and emerging threats (SMASS, 2023; 2025).

Whale and Dolphin Conservation (WDC)

4.5.24 WDC Shorewatch and the WDC Sightings Network are complementary citizen science initiatives which were established in 2005 and focused on monitoring cetaceans in UK waters. WDC Shorewatch is a network of trained volunteers who conduct standardised, land-based watches from designated sites across Scotland. These watches typically last ten minutes and involve recording all cetacean sightings, including species identification, number of individuals, behaviour, and environmental conditions (Shorewatch, 2025). The WDC Sightings Network collates reports of whale, dolphin, and porpoise sightings from a wide range of contributors, including the public, boat operators, researchers, and WDC volunteers. With especially strong coverage in Scottish seas, such as the Moray Firth, the Hebrides, Orkney and Shetland, and eastern coastal areas like Aberdeen and Fife, the network plays a key role in tracking species distribution, seasonal patterns, and unusual events such as strandings or large aggregations (WDC, 2025). Data from both initiatives contribute to broader national datasets used by organisations such as the JNCC, NatureScot, and the Marine Directorate. Although raw data is not publicly available by default, it can be accessed through formal requests submitted via the WDC contact page (WDC, 2025).

ORCA

4.5.25 ORCA is a UK-based marine conservation organisation charity dedicated to monitoring and protecting whale, dolphin, and porpoise in UK and European waters. The organisation operates a comprehensive sightings network that leverages citizen science to gather data on cetacean distribution and abundance. In Scotland, ORCA's sightings network contributes valuable information on cetacean presence and distribution, including in the North Sea and the east of Scotland. These regions are known for sightings of species such as harbour porpoise, minke whale, various dolphin species and occasionally killer whales and humpback whales. The data collected aid in understanding seasonal patterns and habitat use and contribute to defining conservation strategies. Additionally, events like "Orca Watch", organised in collaboration with the Sea Watch Foundation, focus on monitoring cetacean activity in Northern Scotland, including Caithness, Sutherland, and around the Orkney islands and the Shetland islands. These initiatives engage the public in marine conservation and enhance the data available for scientific analysis. Summary data is

published in their State of Cetaceans reports which can be accessed on their website (ORCA, 2025a).

4.6 Comparison of Data Sources

4.6.1 Densities from Lacey *et al.* (2022) are derived from the same resolution as Waggitt *et al.* (2020) (10 km x 10 km) and are comparable to the design and model-based densities from the Bowdun DAS campaign. Predicted estimates of mean density for the Local Marine Mammal Study Area from Waggitt *et al.* (2020) are not comparable to the SCANS III block R (Hammond *et al.,* 2021) or SCANS IV block NS-D (Gilles *et al.,* 2023) estimates but provide densities at a higher resolution (10 km x 10 km) and monthly frequency, rather than a single estimate over a wide area (as is the case with SCANS surveys which use large blocks). It should be noted that SCANS densities do not consider variability in cetacean density associated with environmental covariates (such as depth, slope, distance from the coast). Additionally, both Gilles *et al.* (2023) and Hammond *et al.* (2021) highlight that the very short timeframe over which the SCANS surveys are conducted (summer) means that there is limited understanding of species distribution and abundance in other seasons. Density estimates reported in Gilles *et al.* (2025) are lower overall in comparison to surface density estimates by Lacey *et al.* (2022) and density estimates reported in Waggitt *et al.* (2020).

5 Baseline Characterisation

5.1 Marine Mammals Present within Study Areas

Regional Marine Mammal Study Area

5.1.1 There are 16 species of cetacean and two species of pinniped that have been encountered within the Regional Marine Mammal Study Area (Table 5.1) (Hammond, 2021; Hammond, 2013; National Marine Plan Interactive, 2023; Weir, 2001).

5.1.2 Within the waters of the eastern Scotland, the more commonly recorded cetaceans include harbour porpoise, bottlenose dolphin, white-beaked dolphin and minke whale. Other species of cetacean have been recorded as occasional or rare visitors to this region (Table 5.1).

5.1.3 The east coast of Scotland support multiple Haul-Out sites for grey seal and harbour seal (SCOS, 2022; Weir, 2001). Although densities of these species might be expected to be higher in the vicinity of Haul-Outs at certain times of the year, Carter *et al.* (2022) reported that links between harbour seal and grey seal distribution at sea and use of land-based sites have not been researched in detail. One of the reasons for this is that grey seal exhibit partial migration and may move between regions for breeding and foraging (e.g. seal that breed in a given SAC do not necessarily forage nearby (Carter *et al.,* 2022)).

Table 5.1: Summary of Cetacean Species Found in the Regional Marine Mammal Study Area. Weir (2001), Hammond *et al.* (2013), Hammond *et al.* (2021), NMPI (2023) and Citizen Projects[4]

Species	Occurrence in the northern North Sea	Description
Odontocetes		
Harbour porpoise	Abundant	Abundant and widespread throughout the northern North Sea and is the most frequently reported cetacean in the North Sea.
White-beaked dolphin	Abundant	Abundant and widespread throughout the northern North Sea and is the second most frequently reported cetacean in the North Sea.
Bottlenose dolphin	Common	Occurs within the northern North Sea. However, bottlenose dolphin are more likely to be observed in inshore waters less than 30 m deep, in waters between 2 m and 20 m deep and within 2 km from the coast (Quick *et al.*, 2014, Paxton *et al.*, 2016, Palmer *et al.*, 2019).
Atlantic white-sided dolphin *Lagenorhynchus acutus*	Occasional	Occurs typically in deep waters along continental shelf although regularly enters the North Sea over summer months.

[4] https://storymaps.arcgis.com/stories/0b06dab9522e4efcb1ca5c8392c15626

Species	Occurrence in the northern North Sea	Description
Common dolphin	Occasional	Occasionally sighted along the east coast of the UK and is mostly associated with warmer waters to the south and west of the UK.
Killer whale	Occasional	Largely distributed in the northern North Sea but most sightings are from around Shetland or the Norwegian coast. Occasional sightings on the west coast of Scotland mostly during summer.
Risso's dolphin	Occasional	Widely distributed around the Northern Isles; sightings along the east coast of the UK are rare.
Sperm whale *Physeter macrocephalus*	Occasional	Mostly around the 1,000 m isobath to the north and west of Scotland and this is likely to be related to the distribution of their prey, particularly cephalopod populations that occur in intermediate and deep waters.
Long-finned pilot whale *Globicephala melas*	Rare	Rarely recorded off the continental shelf edge and is mainly distributed in the colder waters of the North Atlantic.
Mysticetes		
Minke whale	Common	Ranges widely and can be observed throughout the northern North Sea.
Humpback whale *Megaptera novaeangliae*	Occasional	Ranges widely and can be observed throughout the northern North Sea.
Fin whale *Balaenoptera physalus*	Rare	More typical of the deep waters to the north and west of Scotland rather than the North Sea, small numbers reported in the northern North Sea.
Beaked whale		
Sowerby's beaked whale *Mesoplodon bidens*	Rare	Associated with deep water off the shelf edge to the north and west of Scotland and is rarely recorded in the northern North Sea.
Cuvier's beaked whale *Ziphius cavirostris*	Rare	Associated with deep water off the shelf edge to the north and west of Scotland.
Gervais beaked whale *Mesoplodon europaeus*	Rare	Associated with deep water off the shelf edge to the north and west of Scotland.
Northern bottlenose whale *Hyperoodon ampullatus*	Rare	The distribution of northern bottlenose whale to be centred in cold, deep waters near or seaward of the 1,000 m isobath.

5.1.4 DAS data collected at the Ossian OWF, Morven OWF, Berwick Bank Wind Farm, NNG OWF, and Seagreen OWF demonstrate that several marine mammal species occur regularly in inshore and offshore waters surrounding the Proposed Development, with harbour porpoise the most frequently recorded

cetacean during all adjacent site-specific surveys. Other species recorded included minke whale, white-beaked dolphin, bottlenose dolphin, common dolphin, Risso's dolphin, grey seal and harbour seal.

Local Marine Mammal Study Area

5.1.5 The marine mammal species information relevant to the Local Marine Mammal Study Area is informed both by the site-specific DAS, and information gathered in the desktop study.

DAS Results

5.1.6 Site-specific DAS were conducted monthly within the Local Marine Mammal Study Area between March 2022 and February 2024 (24-months) (Volume 3, Technical Appendix 10.2: Marine Mammal Digital Aerial Survey).

5.1.7 A summary of marine mammal counts observed in each calendar month during the DAS campaign (i.e. number of marine mammals identified in DAS imagery), is presented in Table 5.2. Based on raw count data, harbour porpoise (n = 2,412) accounted for the highest number of sightings identified to species level across the Local Marine Mammal Study Area and was recorded in all survey months (Table 5.2). Grey seal (n = 332) accounted for the second highest number of sightings and was recorded in 23 months over the 24-month survey period, followed by white-beaked dolphin (n=291) with individuals recorded over ten months. For minke whale (n=42), bottlenose dolphin (n = 12), Risso's dolphin (n = 11) and harbour seal (n = 3), the number and frequency of sightings was low (Table 5.2). No humpback whale or fin whale were observed during any of the surveys, though one sighting was recorded as 'whale species".

Table 5.2: Monthly Raw Sightings Data (Number of Animals) Across the DAS Area and Extended DAS Area. Blue Shaded Rows Are Surveys of the Extended DAS Area

Month	Harbour porpoise	White-beaked dolphin	Minke whale	Bottlenose dolphin	Risso's dolphin	Grey seal	Harbour seal	Dolphin/porpoise	Whale species	Seal species	Marine Mammal species	Total
March 2022	269		1			18	2	1		8	2	**301**
April 2022	117		4	6		13		3		20	5	**168**
May 2022	290		1			140		12	1	101	6	**551**
June 2022	64	1	2			11	1	2		10	3	**94**
July 2022	61	10	1			17		2		68		**159**
August 2022	37	112	18			2		6		29		**204**
September 2022	50	6	1			2				4	4	**67**
October 2022	103				4	6		2		3		**118**
November 2022	43					1		7		3	1	**55**
December 2022	8				3	7					2	**20**
January 2023	4				1							**5**
February 2023	41					10				2	1	**54**
March 2023	50	5				4		8		4	4	**75**
April 2023	540		5			31				10	4	**590**
May 2023	104		2			10				24		**140**

Month	Harbour porpoise	White-beaked dolphin	Minke whale	Bottlenose dolphin	Risso's dolphin	Grey seal	Harbour seal	Dolphin/porpoise	Whale species	Seal species	Marine Mammal species	Total
June 2023	49	29	3			9				3	1	**94**
July 2023	20	12		6		4				3	2	**47**
August 2023	157	48	2		1	16						**224**
September 2023	253	63	2			8		6		6	2	**340**
October 2023	64					9				2		**75**
November 2023	32				2	5				5		**44**
December 2023	6	5				1					2	**14**
January 2024	27					5		2		4		**38**
February 2024	23					3				6	2	**34**
Total	**2,412**	**291**	**42**	**12**	**11**	**332**	**3**	**51**	**1**	**315**	**41**	**3,511**

Density Estimates

Design-based Analysis

5.1.8 Raw counts of harbour porpoise, grey seal, white-beaked dolphin and minke whale were adjusted for survey effort to estimate mean relative abundance and density across various time scales (monthly, seasonal, bio-seasonal, and annual) (Table 5.4). These estimates were corrected for availability bias using a correction factor (Table 5.3) resulting in absolute abundance and density estimates with 95% confidence limits (CL) obtained via bootstrapping (1,000 simulations) (see Volume 3, Technical Appendix 10.2: Marine Mammal Digital Aerial Survey Report for full details).

Table 5.3: Correction Factors Used for Harbour Porpoise, Grey Seal, White-beaked Dolphin and Risso's Dolphin for the Design-based Density Estimates

Species	Correction factor	Time scale	Reference
Harbour porpoise	0.425	Summer bio-season, Winter bio-season	Teilmann *et al.*, 2013
Grey seal	0.156	Summer bio-season, Winter bio-season	Ørsted, 2018
White-beaked dolphin	0.180	Summer meteorological season, Winter meteorological season	Rasmussen *et al.*, 2013
Minke whale	0.440	Summer meteorological season, Winter meteorological season	McGarry *et al.*, 2017

Model-based Analysis

5.1.9 The model-based density estimates used the DAS Area only, for consistency across the 24 months of surveys, to allow for the most robust models.

5.1.10 Harbour porpoise were present in sufficient numbers for modelling when considered across the whole 24-month DAS period (using the DAS Area only) and when pooled by bio-season and meteorological season. Model-based analysis was not carried out for the Extended DAS Area. When considered at a monthly scale (i.e. the period between surveys), harbour porpoise did not occur in sufficiently consistent numbers for modelling to be possible.

5.1.11 The Marine Renewables Strategic environmental assessment (MRSea) is a statistical model of marine mammal densities within defined spatial areas. Within the model, only distance from coast was used as an explanatory environmental variable (Table 5.4).

5.1.12 As for harbour porpoise, grey seal were present in sufficient numbers for modelling only when considered across the whole 24-month DAS Area period and when pooled by bio-season. The MRSea models included water depth, terrain ruggedness and distance from coast as explanatory environmental variables (Table 5.4).

5.1.13 Modelling of white-beaked dolphin was only possible when pooled across the whole 24-months of data, due to the comparative low frequency of occurrence and identification of this species during the DAS campaign. The MRSea model included water depth and seabed ruggedness as explanatory environmental variables (Table 5.4).

5.1.14 Minke whale was not identified during the 24-month DAS period in sufficient numbers for robust modelling to be undertaken, and as such density estimates and abundance in the DAS Area can only be estimated via design-based methods (Table 5.4). The number of observations for Risso's dolphin and bottlenose dolphin were too low for design-based or model-based density estimates to be calculated.

Table 5.4: Design-based Estimated Densities Based on the DAS Data for the DAS Area (not the Extended DAS Area), Model-based Densities are Shown in Parentheses

Temporal division	Mean absolute density (animals per km^2)	Lower 95% CL	Upper 95% CL	CV
Harbour porpoise				
Winter bio-season	0.381 (0.562)	0.216 (0.415)	0.624 (0.737)	1.310 (0.801)
Summer bio-season	0.889 (1.320)	0.505 (1.00)	1.454 (1.740)	1.118 (0.801)
Overall estimate	0.635 (0.580)	0.361 (0.365)	1.039 (0.856)	1.290 (0.724)
Grey seal				
Breeding bio-season	0.091 (0.213)	0.062 (0.121)	0.123 (0.343)	0.778 (0.775)
Non-breeding bio-season	0.134 (0.312)	0.091 (0.196)	0.181 (0.478)	0.882 (0.775)
Overall estimate	0.120 (0.056)	0.081 (0.11)	0.161 (0.201)	0.852 (1.117)
White-beaked dolphin				
Winter meteorological season	0.013	0.004	0.025	2.449
Summer meteorological season	0.463	0.134	0.872	1.036
Overall estimate	0.168 (0.156)	0.048 (0.084)	0.316 (0.286)	2.068 (1.25)
Minke whale				
Winter meteorological season	0.000	0.000	0.000	-
Summer meteorological season	0.023	0.008	0.042	1.487
Overall estimate	0.010	0.004	0.018	1.964

6 Species Account

6.1.1 The following section provides information on general ecology, distribution and occurrence, density and abundance information and any information on seasonality for each of the key species identified as common within the Local Marine Mammal Study Area and Regional Marine Mammal Study Area (Section 5.1).

6.1.2 These are:

- harbour porpoise;
- bottlenose dolphin;
- white-beaked dolphin;
- minke whale;
- grey seal; and
- harbour seal.

6.1.3 In addition, Risso's dolphin, humpback whale and fin whale are also scoped into the assessment, based on advice received in the Scoping Opinion (MD-LOT, 2024); however, these species are assessed qualitatively in Volume 2, Chapter 10: Marine Mammals, due to data and population density limitations.

6.2 Odontocetes

Harbour Porpoise

Ecology

6.2.1 The harbour porpoise is a small odontocete inhabiting coastal temperate and boreal waters of the northern hemisphere. It reaches a maximum length of 1.9 m (Bjørge and Tolley, 2009), with females growing to an average length of 1.6 m while males reach 1.45 m in length (Lockyer, 1995). Although the recorded longevity is 24 years, most individuals do not live past 12 years of age (Lockyer, 2013).

6.2.2 Harbour porpoise have a large extensible stomach (up to six times the relaxed size). Harbour porpoise can ingest up to 90% of their daily energetic requirements in one hour and can feed again shortly afterwards (Kastelein, 2019b; Booth, 2023). Harbour porpoise feed on a wide range of fish species, but mainly small shoaling species from demersal or pelagic habitats (Santos, 2003). There are regional and seasonal differences in diet, interannual variation depending on the availability of prey species as well as variation according to individual age, with juveniles targeting smaller species such as gobies *Gobiidae* or smaller individuals of the same prey species targeted by adults (Santos, 2003). A harbour porpoise's metabolic rate 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, 2018).

6.2.3 Ransijn *et al.* (2019) produced energy maps for various harbour porpoise prey species and found that the energy available in the North Sea is highest in the summer and the main energic contributions were from sandeels *Ammodytidae* and whiting *Merlangius merlangus*. During the winter, European sprat *Sprattus sprattus* and Atlantic herring *Clupea harengus* also contributed to overall energy density (Ransijn, 2019). This study corroborated previous findings that the predominant prey item of harbour porpoise during the summer off the east coast of Scotland is sand eel (Santos, 1998; Santos and Pierce, 2003). Although harbour porpoise generally hunts alone or in small groups, this species can be seen in larger aggregations of 50 or more individuals during seasonal migrations or associated with increased concentrations of prey. Within these aggregations, segregation may occur, with females travelling with their calves and yearlings and immature animals of each sex segregating into groups.

6.2.4 The geographic range of harbour porpoise coincides with cool, high-latitude waters. Because harbour porpoise have a greater body surface area to volume ratio than other, larger cetacean species, this causes them to potentially lose energy through radiation and conduction to the surrounding water (Kastelein *et al.*, 2018; Kastelein, 2019a; Lambert, 2020). To maintain their body temperature and other energy needs, they must feed frequently and consume enough prey per unit of body weight (Rojano-Doñate, 2018). For this reason, harbour porpoise may be susceptible to changes in the abundance of prey species or disturbance from foraging areas. Since harbour porpoise are predated on by killer whale and grey seal, they often flee when encountering predators (Kastelein, 2019b). As such, it can be anticipated that harbour porpoise have adaptive mechanisms over certain time scales, and the time when harbour porpoise are not feeding may extend up to nine to 12 hours (Kastelein, 2019b). Recent studies in Iceland suggest that despite ecosystem changes in the study region, harbour porpoise show no long-term changes in trophic ecology, indicating that this species may be able to adapt to spatial changes in prey distribution or shift to other prey at similar trophic levels (Samarra, 2022).

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

Distribution and Occurrence

6.2.6 Harbour porpoise are widespread throughout the cold and temperate seas of Europe, including the North Sea, the Skagerrak, Kattegat, Irish Sea, the seas west of Ireland and Scotland, northwards to Orkney and Shetland and off the coasts of Norway (JNCC, 2023). Heinänen and Skov (2015) found that in the North Sea MU water depths and hydrodynamic variables are the most important factors predicting the presence of harbour porpoise. Animals were predicted to avoid well-mixed areas during summer, preferring more stable areas. Heinänen and Skov (2015) indicated a lower presence of harbour porpoise with lower salinity, reflecting an avoidance of estuarine water masses.

6.2.7 The Heinänen and Skov (2015) analysis concluded that in the summer months, harbour porpoise presence in the North Sea MU was best predicted by season, water depth and salinity of surface waters. In the winter months, the presence of harbour porpoise was best predicted by the season, water depth and seabed surface sediments. A presence peak was observed in winter at 30 m to 40 m water depths. Williamson *et al.* (2016) found that the proportion of hours with acoustic detection of harbour porpoise in muddy habitats within the Moray Firth increased during hours of darkness by 18%. Harbour porpoise detections also differed in response to depth in different sediment types between the hours of darkness and daylight. In muddy areas with a water depth of between 50 m to 60 m, detections at night were almost double those during daylight hours (Williamson *et al.*, 2016). Therefore, it can be concluded that harbour porpoise use different types of habitats during hours of daylight and darkness, and their distribution may change accordingly.

6.2.8 Harbour porpoise accounted for the highest number of sightings across all species in the DAS, with a total of 2,412 animals recorded across 24 months. Harbour porpoise was the most sighted cetacean species during DAS at Ossian OWF, Berwick Bank Wind Farm, NNG OWF and Seagreen OWF. During Ossian OWF DAS, harbour porpoise sightings overall were greater in number within the east and north of the array. The distribution of harbour porpoise across the array area was varied between seasons, with greater numbers of sightings in the south and west of the array area during the 'winter' (October to March) bio-season and a more even and widespread distribution during the 'summer' (April to September) bio-season. During the Berwick Bank Wind Farm DAS harbour porpoise were distributed throughout the Berwick Bank marine mammal study area. The NNG OWF DAS showed that across the two years of surveys there were few sightings of harbour porpoise within the offshore site but sightings were scattered throughout the 8 km buffer area. The Seagreen OWF DAS showed that harbour porpoise sightings were distributed widely with some concentrations observed within the north of the site around Scalp Bank and in the central and south parts of Marr Bank. For Morven OWF, no specific information was available on the distribution of harbour porpoises within the survey areas (Sparling, 2012; Mainstream Renewable Power, 2019; SSE Renewables, 2022; Morven Offshore Wind Limited, 2023; Ossian OWFL, 2024).

Density/Abundance

Site-Specific DAS

6.2.9 Relative density estimates of harbour porpoise from DAS were corrected for availability bias using the most conservative conversion factor of 42.5% based on Teilmann *et al.* (2013) (see Volume 3, Technical Appendix 10.2: Marine Mammal Digital Aerial Survey Report for more detail). A robust method was developed by combining the data by bio-season specific to harbour porpoise ("winter" (October to March) and "summer" (April to September) seasons), as the most biologically relevant approach (Heinänen and Skov, 2015).

6.2.10 For the DAS Area, design-based approaches gave mean absolute density estimates of 0.381 and 0.889 animals per km^2 for winter and summer bio-seasons, respectively. The mean absolute density estimate across all transects and all monthly surveys for the 24-month survey period, with bootstrapping, was estimated as 0.635 animals per km^2 (CV = 1.290). The mean absolute density from the model-based approach was 0.562 for the winter bio-season (CV = 0.801) and 1.320 for summer bio-season (CV = 0.801). The MRSea model-based approach showed higher harbour porpoise density hotspots in the west of the Array Area Site Boundary during both summer and winter bio-seasons, though densities were higher during the summer bio-season (Figure 6.1). This is consistent with findings presented by Waggitt *et al.* (2020) which show a higher density of harbour porpoise during summer months in the Local Marine Mammal Study Area.

6.2.11 For the Extended DAS Area, which was surveyed in summer months only, the design-based approach gave a mean absolute density estimate of 2.615 animals per km^2 (95% CL: 1.239 to 4.488). The overall mean absolute density estimate across all transects and all summer surveys for the 24-month survey period, with bootstrapping, was estimated as 0.698 animals per km^2 (CV = 1.110).

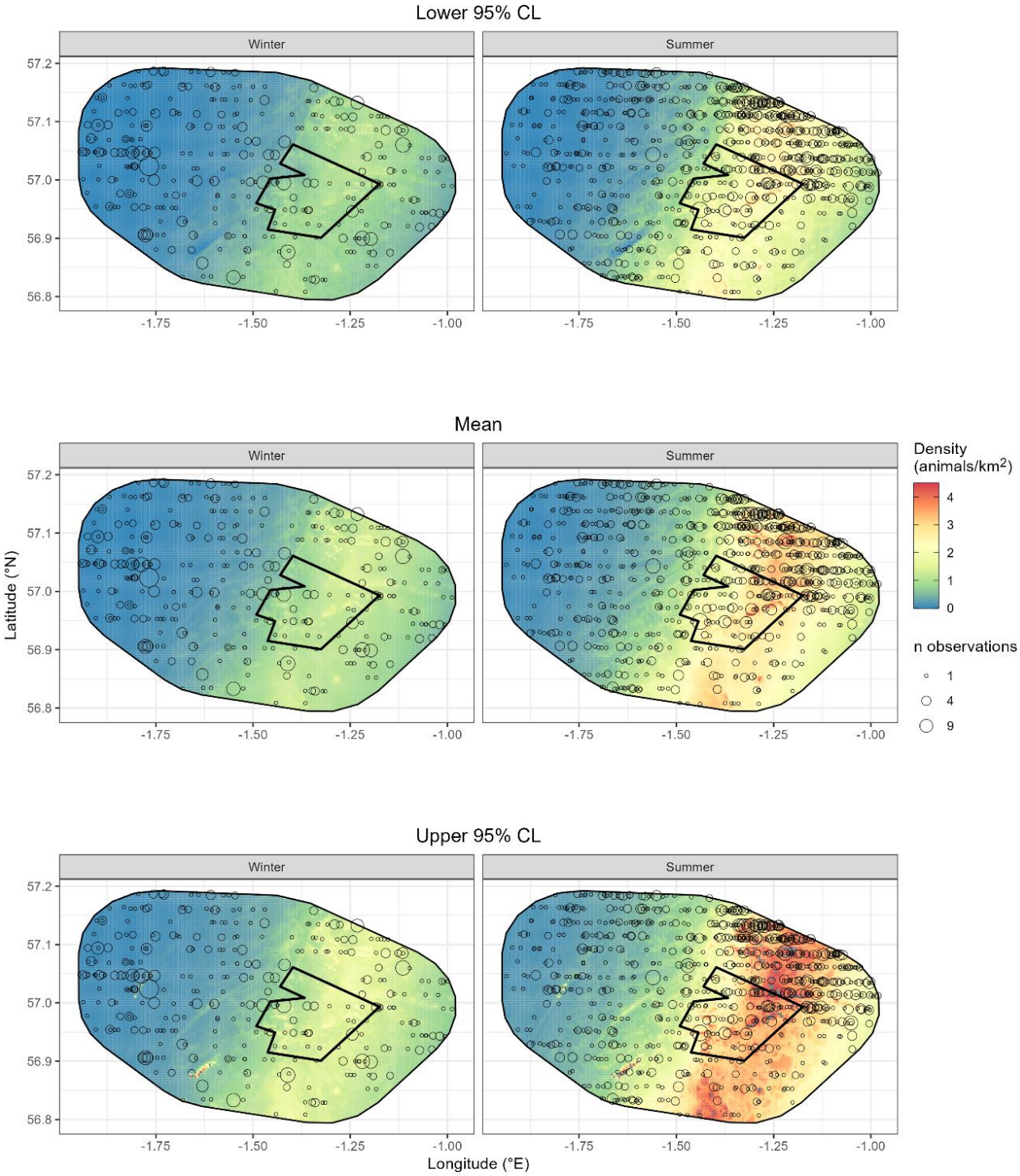


Figure 6.1: Predicted Mean Absolute Density of Harbour Porpoise, with 95% CLs, Across the DAS Area Split Between Bio-Seasons. Bold Line Indicates the Array Area Site Boundary, Points Represent DAS Observations

Seasonality

6.2.12 Across datasets, harbour porpoise counts were consistently higher during spring and summer.

6.2.13 Harbour porpoise were the most frequently observed marine mammal species present at the Ossian OWF Array Area, recorded in all but three of the 24 months of DAS. The highest number of individuals was observed in July 2021, with a total count of 140 harbour porpoise recorded. Estimated absolute abundance densities peaked during the summer bio-season (April to September), reaching 0.651 animals per km^2 (95% Confidence Interval (CI) = 0.365 to 0.931), and declined during the winter bio-season (October to March), averaging 0.062 animals per km^2 (95% CI: 0.035 to 0.089). The overall annual average density estimate was 0.357 animals per km^2 (95% CI: 0.200 to 0.510) (Ossian OWFL, 2024).

6.2.14 Preliminary data from site-specific aerial surveys at Morven OWF suggest increased harbour porpoise activity during the spring and summer months, with reduced sightings in autumn and winter (Morven Offshore Wind Limited, 2023).

6.2.15 Harbour porpoise were recorded during every survey throughout the 25 months of survey at Berwick Bank Wind Farm, resulting in a cumulative total of 2,034 individual sightings (SSE Renewables, 2022). The mean corrected density estimate across all surveys was 0.299 animals per km^2. Seasonal variation was observed, with the highest densities recorded in spring (0.826 animals per km^2), and lower densities in summer (0.179 animals per km^2), autumn (0.096 animals per km^2), and winter (0.092 animals per km^2).

6.2.16 Harbour porpoise were the most frequently recorded species of cetacean during monthly boat-based surveys conducted between November 2009 and October 2012 at NNG OWF (Mainstream Renewable Power, 2019). The majority of these recordings occurred within the 8 km buffer area surrounding the NNG OWF array area during the two years of boat-based surveys. Slight seasonal variation was observed with no harbour porpoise sightings during Jun and July, but no other distinct seasonal patterns were observed. Estimated densities from both acoustic and visual surveys concluded a density estimate between 0.27 animals per km^2 and 0.39 animals per km^2 (Mainstream Renewable Power, 2019).

6.2.17 Boat-based surveys at Seagreen OWF (Seagreen Wind Energy Limited, 2018) indicate that morphological features such as Scalp Bank may be particularly important to harbour porpoise, likely serving as key foraging areas. These sandy banks support prey species including sandeel and whiting, both of which are important components of the harbour porpoise diet along the east coast of Scotland. The relative abundance of these prey species is known to vary seasonally (Santos, 2003). Boat-based survey data at Seagreen OWF showed higher encounter rates within spring and summer months and lower encounter rates in autumn and winter months. This was supported by aerial surveys which also recorded higher numbers (31 out of a total of 50 individuals over two years of survey) of harbour porpoise during summer months. The density estimate for harbour porpoise from the Seagreen OWF based on aerial surveys was 0.08

animals per km^2. The minimum density estimate for summer was 0.099 animals per km^2 and 0.048 animals per km^2 in winter, reflecting the seasonal variation in sightings (Seagreen Wind Energy Limited, 2018).

6.2.18 The monthly encounter rate for harbour porpoise for the DAS Area varied across months, displaying no clear seasonal pattern, with a peak in April 2023 and smaller peaks in March 2022, May 2022 and September 2023 (Table 5.2).

Published Literature

6.2.19 Density and abundance estimates for harbour porpoise are available from various studies carried out across a broad area within the Regional Marine Mammal Study Area. IAMMWG (2022) estimated abundance for the North Sea MU (Figure 6.2) as 346,601 animals (95% CI: 289,498 to 419,967). The SCANS III data (Hammond *et al.*, 2021) estimated the abundance of harbour porpoise within block R (Figure 4.2) as 38,646 animals (95% CI: 20,584 to 66,524). The abundance of harbour porpoise within SCANS IV block NS-D is 38,577 (95% CL: 18,017 to 76,361) individuals, indicating little fluctuation in harbour porpoise abundance for this area (Gilles *et al.*, 2023).

6.2.20 Hammond *et al.* (2021) reported densities for harbour porpoise for block R as 0.599 animals per km^2 (CV = 0.287). Modelled density surface estimates using SCANS III data (Lacey *et al.*, 2022) gave a mean density estimate of 0.541 animals per km^2 and a maximum density estimate of 0.649 animals per km^2 for the Local Marine Mammal Study Area (Figure 6.3). The more recent harbour porpoise density estimates for SCANS IV block NS-D are also 0.599 animals per km^2 (CV = 0.367) (Gilles *et al.*, 2023). Modelled density surface estimates using SCANS IV data (Gilles *et al.,* 2025) gave a mean density estimate of 0.230 animals per km^2 and a maximum density estimate of 0.286 animals per km^2 for the Local Marine Mammal Study Area (Figure 6.4).

6.2.21 Monthly predicted distribution maps of harbour porpoise from Waggitt *et al.* (2020) suggest that harbour porpoise densities are higher throughout the autumn and summer months (Figure 6.5 to Figure 6.7). The highest density estimate within the Local Marine Mammal Study Area was predicted in August, with a mean of 0.409 animals per km^2 (Figure 6.6) with a minimum of 0.193 animals per km^2 in March (Figure 6.5).

6.2.22 The Heinänen and Skov (2015) analysis concluded that the density estimates within the Local Marine Mammal Study Area region were predicted to be relatively high compared to other parts of the North Sea. The ECOMMAS data shows that harbour porpoise occur regularly within the Regional Marine Mammal Study Area (Marine Scotland, n.d.). Harbour porpoise were detected at all ECOMMAS sites in every survey year from 2013 to 2016. The Proposed Development is geographically closest to the ECOMMAS sites at Cruden Bay and Fraserburgh. C-POD data collected at these locations indicate seasonal variation in harbour porpoise presence however, no clear patterns emerged in detection positive hours or detection positive days relative to distance from shore at either site (Brookes, 2017; Marine Scotland, n.d.; Seagreen Wind Energy Limited, 2018).

6.2.23 In 2023, SMASS recorded 151 harbour porpoise strandings, representing 34% of that year's cetacean strandings which was an increase of 11% from 2022 (Brownlow *et al.,* 2023). Strandings exhibit seasonal variation; juveniles and sub-adults are more commonly stranded between January and June, likely due to challenges in surviving winter months (Brownlow *et al.,* 2023) whereas neonates are typically found during the calving season (June to October), while adult strandings peak in June and July, possibly linked to reproductive stress in females (Brownlow *et al.,* 2020). Post-mortem examinations have identified several primary causes of death among stranded harbour porpoise: predation, starvation/hypothermia, interspecies aggression and live strandings. Grey seal attacks were the leading cause in both 2023 and 2019, accounting for 20 and nine cases respectively. Such attacks often result in distinctive spiral wounds, known as "corkscrew" lesions (Brownlow *et al.,* 2023; Brownlow *et al.,* 2020). Along the East Grampian coast, encompassing Aberdeen, harbour porpoise and grey seal are the most commonly stranded marine mammals (SMASS, 2025).

6.2.24 Harbour porpoise are among the most frequently sighted species in the Shorewatch program (Shorewatch, 2025). The ORCA database also shows harbour porpoise are among the most sighted in Scottish waters (ORCA, 2025b).

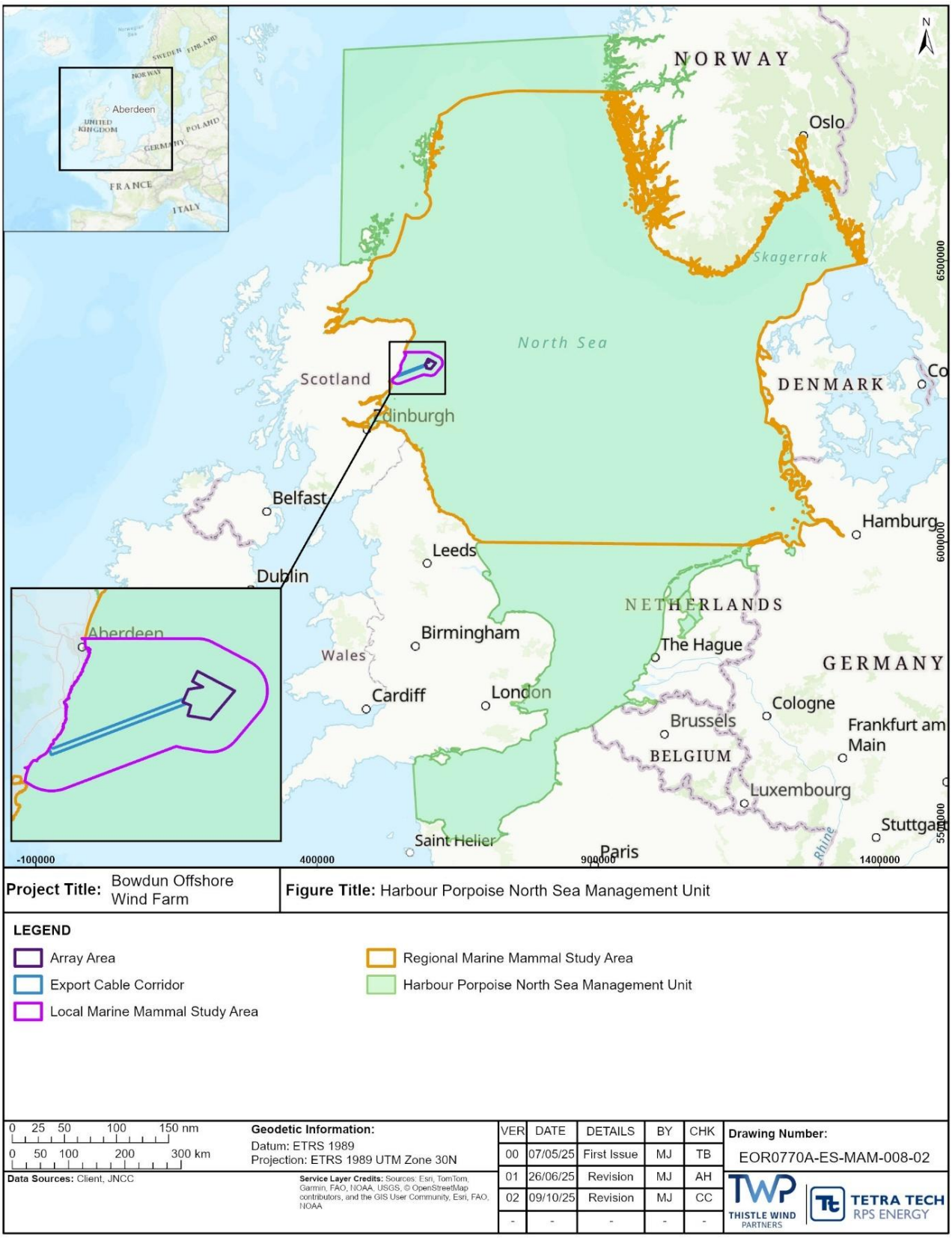


Figure 6.2: Harbour Porpoise North Sea Management Unit

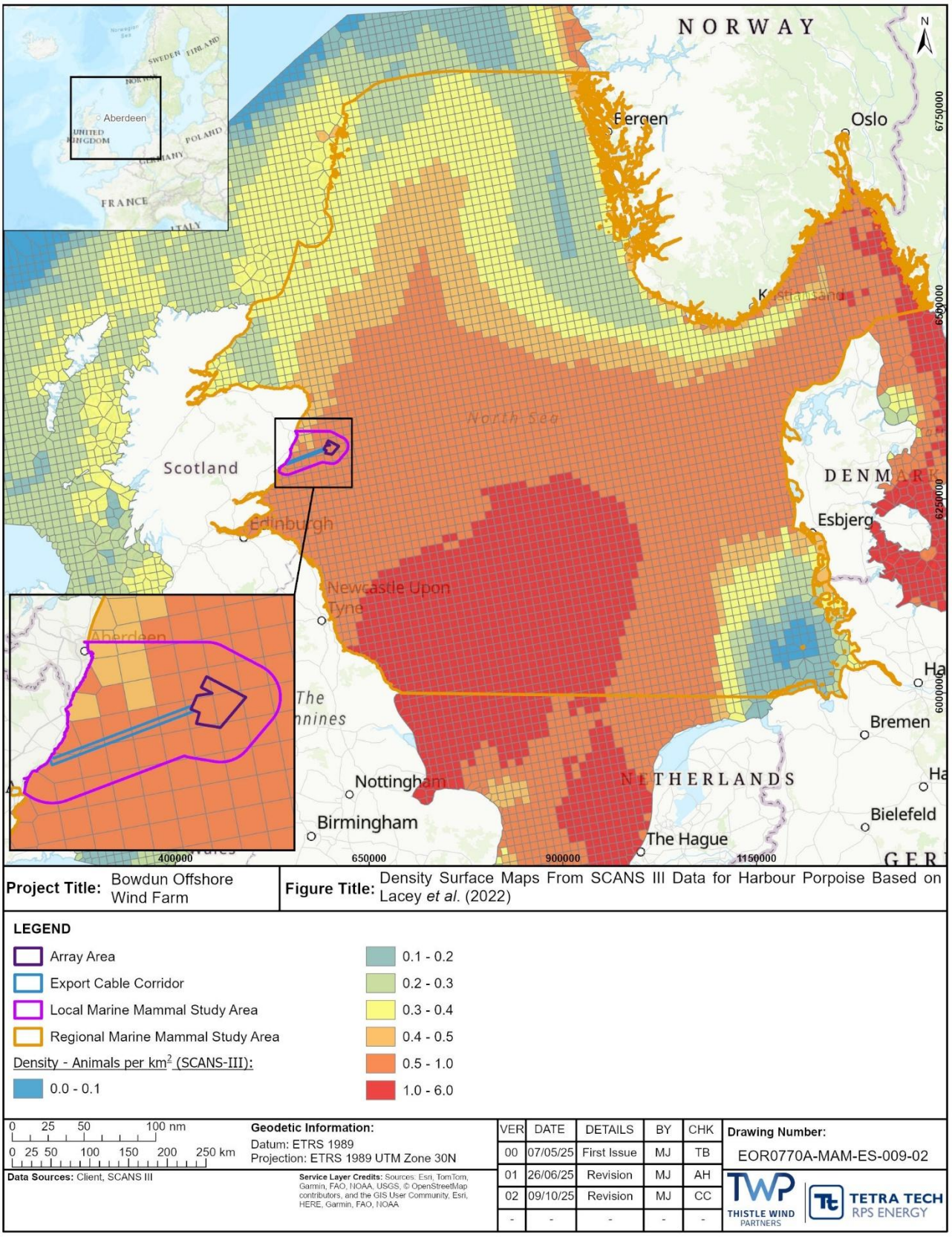


Figure 6.3: Density Surface Maps From SCANS III Data for Harbour Porpoise Based on Lacey *et al.* (2022)

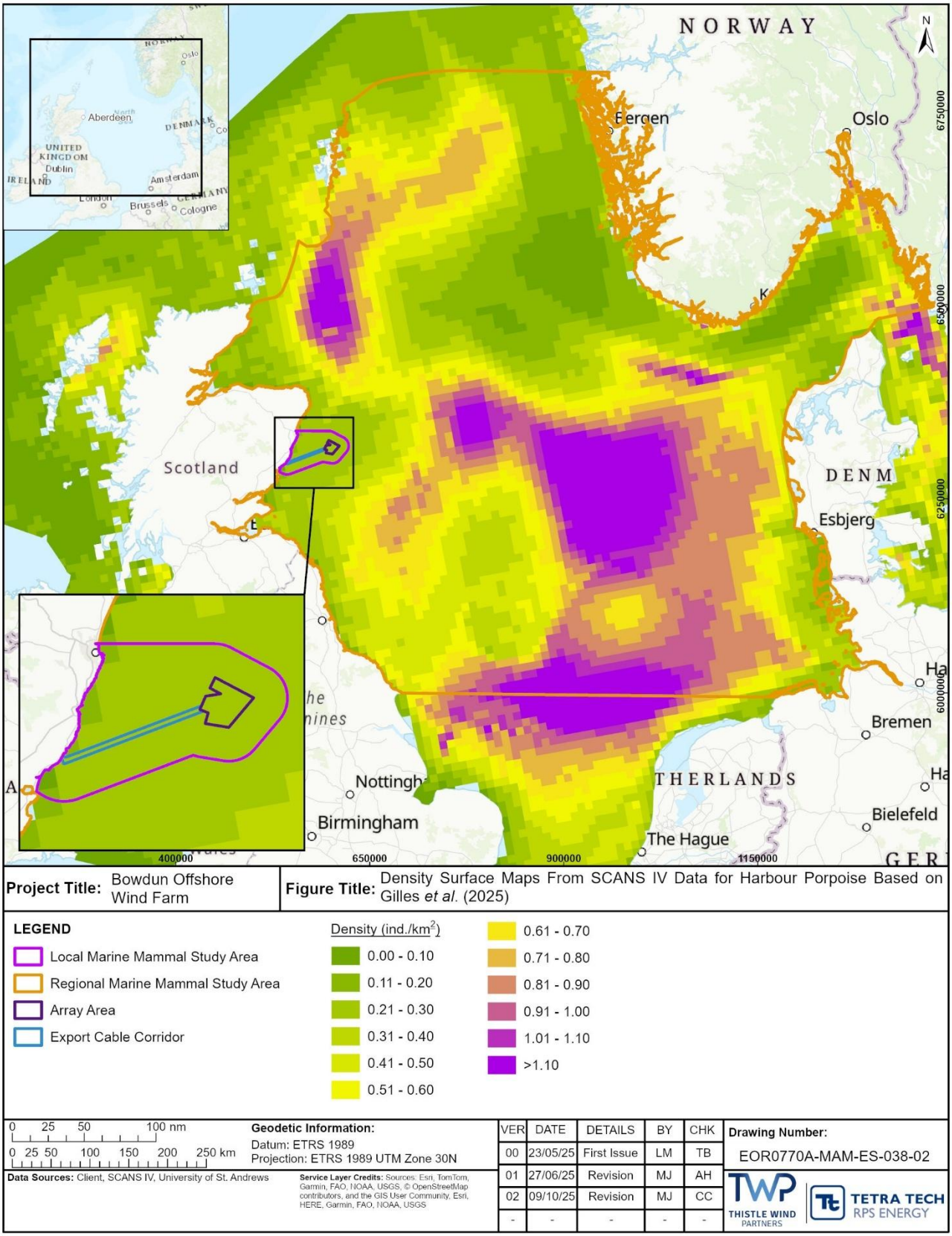


Figure 6.4: Density Surface Maps From SCANS IV Data for Harbour Porpoise Based on Gilles *et al.* (2025)

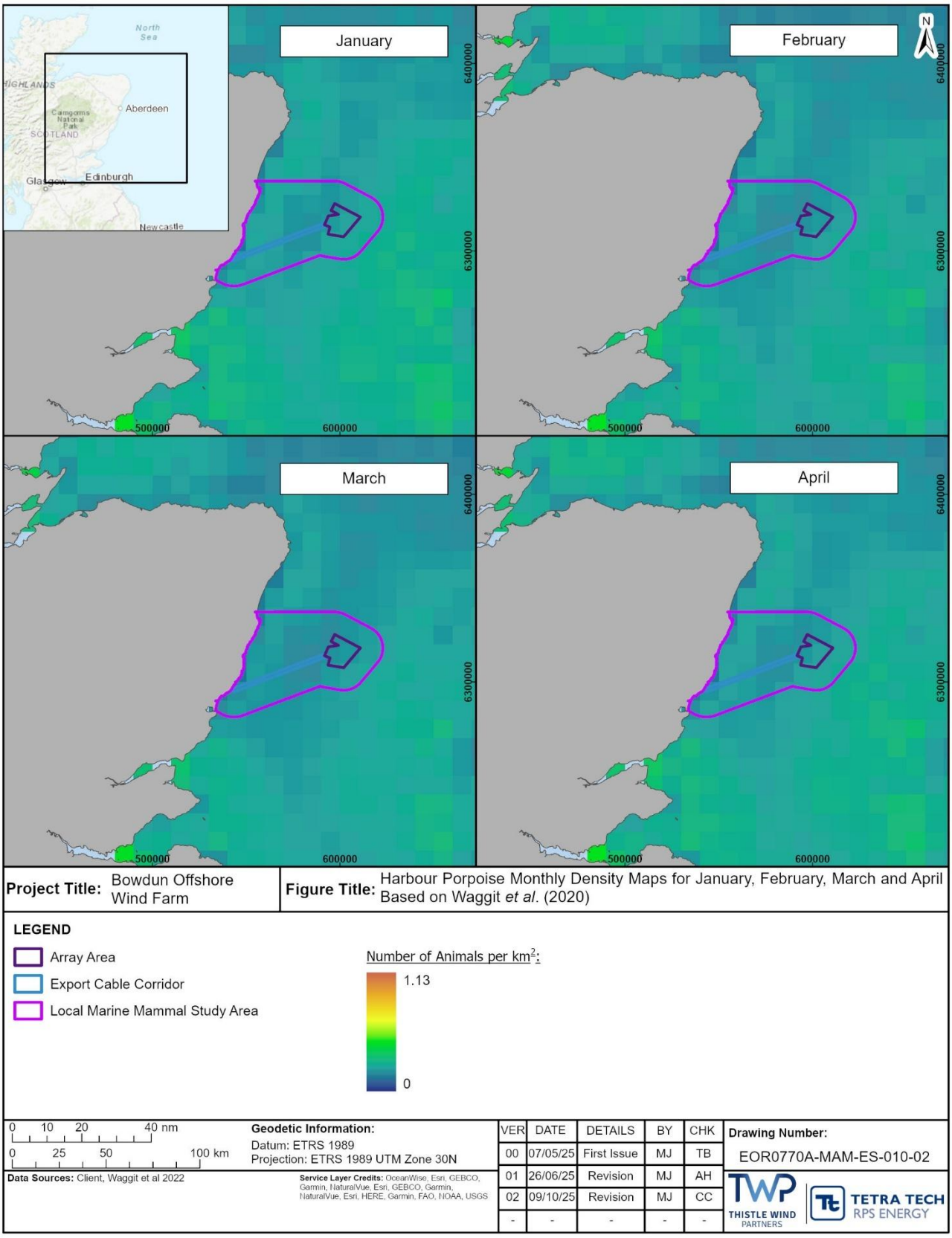


Figure 6.5: Harbour Porpoise Monthly Density Maps for January, February, March and April Based on Waggitt *et al.* (2020)

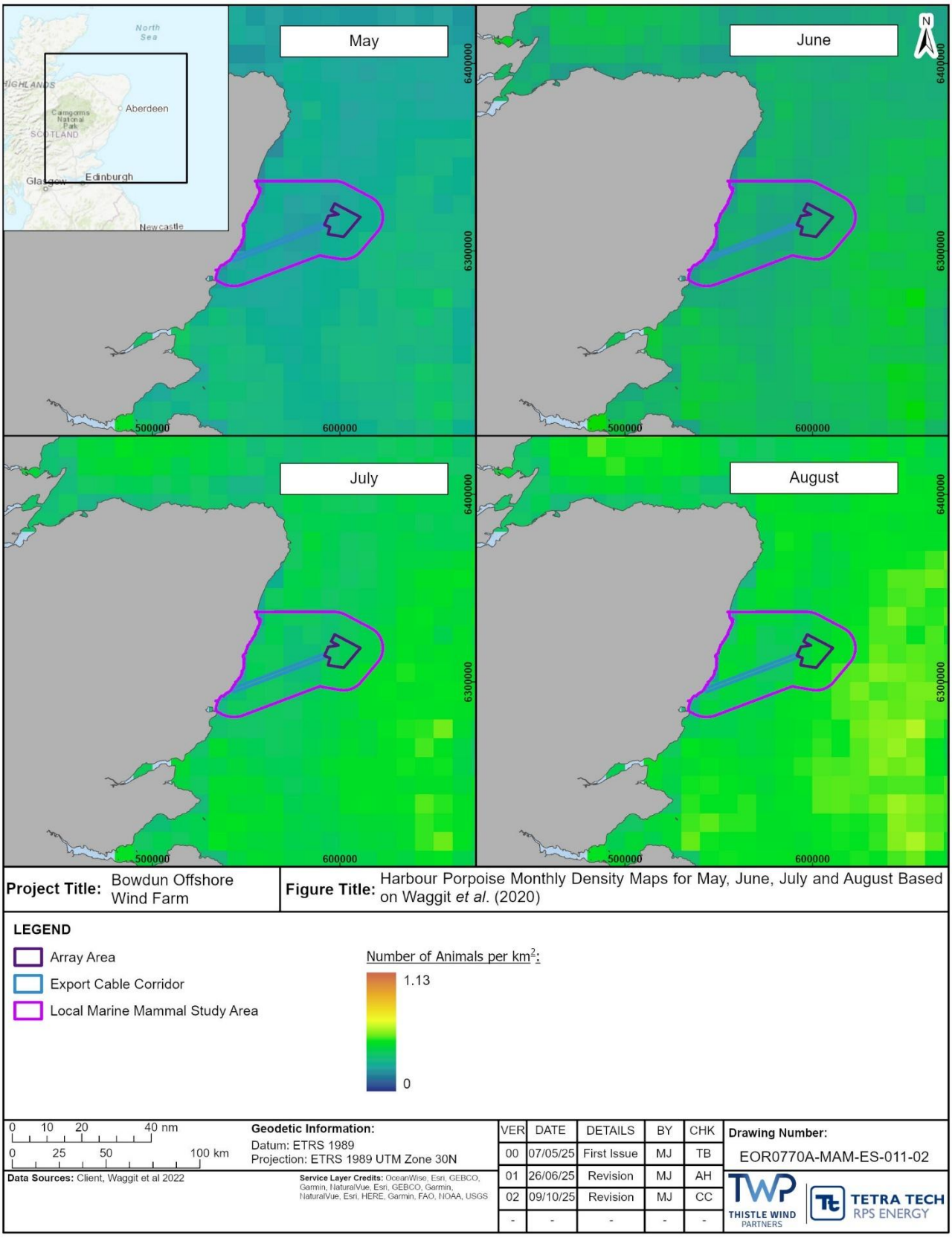


Figure 6.6: Harbour Porpoise Monthly Density Maps for May, June, July and August Based on Waggitt *et al.* (2020)

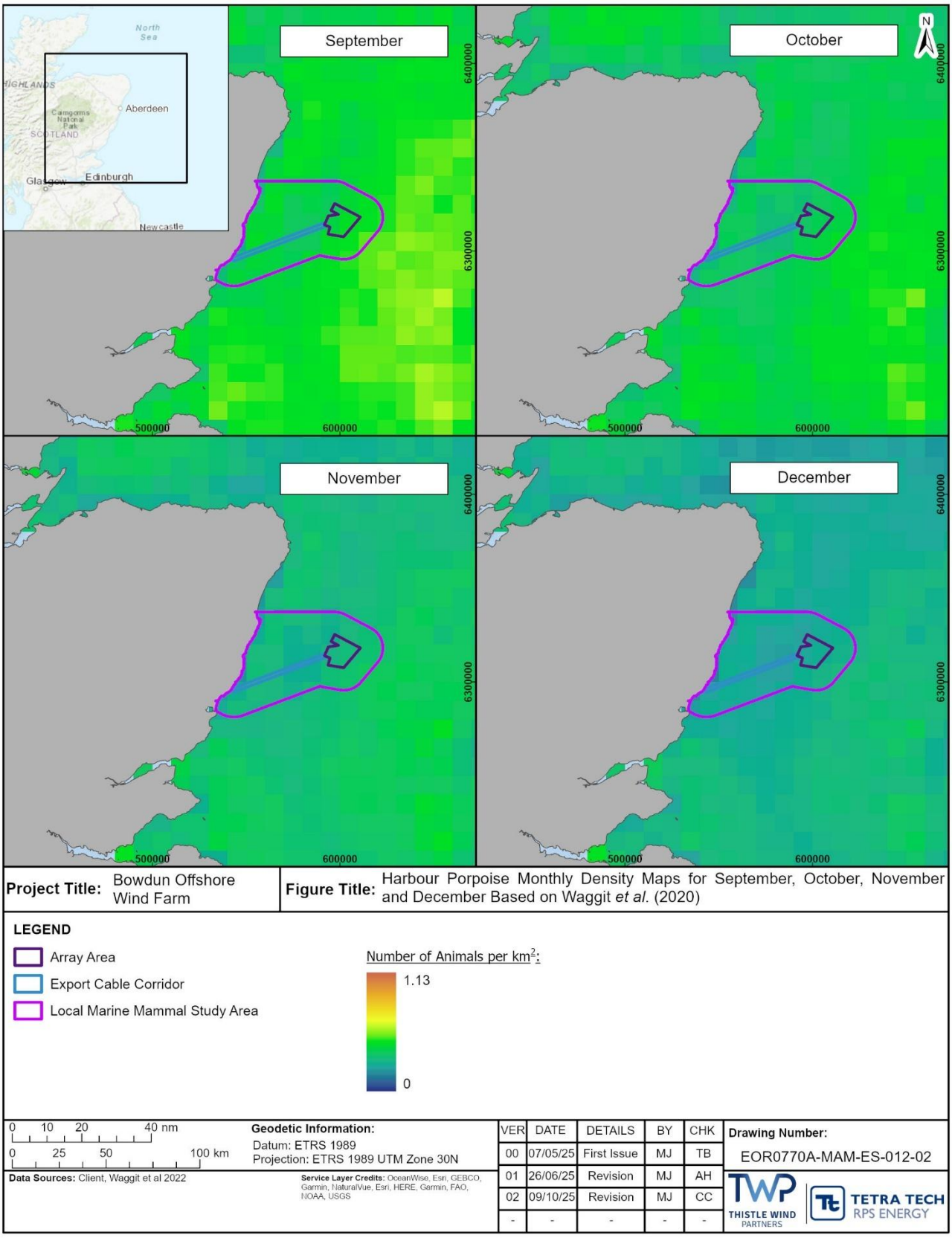


Figure 6.7: Harbour Porpoise Monthly Density Maps for September, October, November and December Based on Waggitt *et al.* (2020)

Summary of the Densities

6.2.25 Heinänen and Skov (2015) reported that depth, amongst other parameters, is an important predictor for harbour porpoise distribution. As such, studies that consider environmental factors are perhaps more robust when predicting harbour porpoise density.

6.2.26 Waggitt *et al.* (2020) state that the work's outputs should not be used as a representation of absolute densities and fine-scale distributions at the present time. Instead, it is recommended that outputs be used as a general illustration of relative densities and broad-scale distribution over several decades. Waggitt *et al.* (2020) densities are therefore presented for context only.

6.2.27 While ongoing surveys such as the SCANS campaigns (and associated density surface modelling subsequently presented in Lacey *et al.,* 2022 and Gilles *et al.,* 2025) provide an overview of harbour porpoise distribution across the wider region, these surveys were undertaken during summer months only. SCANS IV, as the most recent broad-scale survey effort, provides updated regional data, including a density estimate for harbour porpoise of 0.599 animals per km² in block NS-D (Gilles *et al.,* 2023), which is the same density estimate reported for the same block (Block R) for SCANS III (Hammond *et al.,* 2021). This data is valuable for contextualising distribution at a regional scale, and SCANS IV remains a key source for understanding broader population trends.

6.2.28 The harbour porpoise density estimate drawn from SCANS IV density surface estimates are lower than that presented in Lacey *et al.,* (2022) and Gilles *et al.* (2023).

6.2.29 In contrast, density estimates obtained from design-based analysis of DAS data have been collected at monthly intervals across a 24-month survey period, and as such provide a more representative estimate of harbour porpoise density. Given that the design-based density estimates derived from the DAS data are also the most precautionary (but very similar to density estimates for SCANS IV block NS-D (Gilles *et al.,* 2023)) it is considered that a mean absolute density of 0.635 animals per km² is the most appropriate to take forward to the assessment (Table 6.1).

Table 6.1: Comparison of Main Data Sources Density Estimates for Harbour Porpoise

Source		Density (Animals per km²)
SCANS III	Block R (Hammond *et al.,* 2021)	0.599
	(Lacey *et al.,* 2022)	0.541
SCANS IV	Block NS-D (Gilles *et al.,* 2023)	0.599
	(Gilles *et al.,* 2025)	0.230
Waggitt *et al.* (2020)		0.409
Site-specific DAS	Overall design-based (absolute) for the DAS Area	0.635
	Overall model-based (absolute) for the DAS Area	0.580
Adjacent Site-specific DAS	Ossian Offshore Wind Farm	0.357
	Berwick Bank Wind Farm	0.299

Bottlenose Dolphin

Ecology

6.2.30 Bottlenose dolphin are members of the family Delphinidae (oceanic dolphin), which are odontocete cetaceans found in temperate and tropical waters worldwide. This species is the largest of the beaked dolphin and ranges in size from 1.9 m to 3.8 m. Bottlenose dolphin 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; Vollmer and Rosel, 2013).

6.2.31 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), and there is variation in the patterns of habitat use, even within a population. The ideal habitat for bottlenose dolphin in the Moray Firth, Scotland, is characterised by nearshore waters less than 25 m deep. These coastal areas provide a suitable environment for the dolphin, supporting their preference for shallow waters. The habitat is further influenced by the availability of their primary prey, which includes cod *Gadus morhua*, saithe *Pollachius virens*, whiting, salmon *Salmo salar* and haddock *Melanogrammus aeglefinus* (Boyse *et al.,* 2024).

6.2.32 Bottlenose dolphin are more frequently seen in groups rather than individually, although group size in coastal populations may be smaller than in offshore populations. Two distinct ecotypes of bottlenose dolphin are recognised in UK waters, a wide-ranging offshore ecotype, and an inshore ecotype. Several inshore groups (considered inshore populations) have been identified in UK and Irish waters, and there is limited interchange between them (Robinson *et al.,* 2012; Cheney *et al.,* 2013; ICES 2014; IAMMWG 2015; Lohrengel *et al.,* 2018). It should be noted that very little is known about offshore populations (Rogan *et al.*, 2018), and this assessment will focus on the coastal bottlenose dolphin population.

Distribution and Occurrence

6.2.33 Evans *et al.* (2015) conclude, based on land watches, that inshore bottlenose dolphin are concentrated in eastern Scotland from Brora to Carnoustie. Thompson *et al.* (2015) suggest that bottlenose dolphin are more likely to be observed in coastal waters within 5 km of shore and, therefore, are unlikely to be present in offshore areas that may be exposed to significant construction noise from OWFs. These results were corroborated by Quick *et al.* (2014), who reported that dolphin were mostly encountered in waters less than 30 m deep, generally in waters between 2 m and 20 m and within 2 km from the coast. Paxton *et al.* (2016) also describe bottlenose dolphin distribution as coastal.

6.2.34 Bottlenose dolphin were not recorded or identified during surveys for the Ossian OWF (Ossian OWFL, 2024), Morven OWF (Morven Offshore Wind Limited, 2023), NNG OWF (MacLeod and Sparling, 2011), and Seagreen OWF projects (Sparling, 2012).

Density/Abundance

Site-Specific DAS

6.2.35 A total of 12 bottlenose dolphin were recorded during the Bowdun DAS campaign (in April 2022 and July 2023), however the number of sightings was too low for design or model-based density and abundance estimates to be calculated.

Seasonality

6.2.36 Across datasets, bottlenose dolphin counts were consistently not recorded year-round, except for Berwick Bank Wind Farm which recorded one individual in October 2019 and six individuals in April 2021 during DAS (SSE Renewables, 2022). During the Bowdun DAS campaign sightings of bottlenose dolphin were in the months of April and July only.

Published Literature

6.2.37 Cheney *et al.* (2013) reported that the population estimate of bottlenose dolphin for the Coastal East Scotland MU (Figure 6.8) was 195 individuals (95% CI: 162 to 253) based on photo-ID counts between 2006 and 2007. Following this publication, Cheney *et al.* (2018) estimated that the bottlenose dolphin population on the east coast of Scotland is increasing and varied from 129 (95% CI: 104 to 155) in 2001 to 189 (95% CI: 155 to 216) in 2015. IAMMWG (2022) published the most up-to-date bottlenose dolphin population estimate for Coastal East Scotland MU of 226 individuals (based on Cheney *et al.*, 2024). Cheney *et al.* (2018) reported that the proportion of the population that uses the Moray Firth SAC has declined due to an overall increase in population size and expansion of the range. IAMMWG (2022) estimated abundance for the GNS MU Figure 6.8) as 2,022 animals (95% CI: 548 to 7,453), with 1,885 animals (95% CI: 476 to 7,461) in the UK portion of the GNS MU. The ECOMMAS data shows that bottlenose dolphin occur occasionally within the Regional Marine Mammal Study Area (Marine Scotland, n.d.).

6.2.38 The Proposed Development lies within SCANS III survey block R. This block had an estimated abundance of 1,924 bottlenose dolphin (95% CI: 0 to 5,048) and a corresponding estimated density of 0.0298 animal per km^2 (CV = 0.861) (Hammond *et al.*, 2021). Modelled density surface estimates using SCANS III data (Lacey *et al.*, 2022) gave a mean density estimate of 0.007 animals per km^2 and a maximum of 0.010 animals per km^2 for the Local Marine Mammal Study Area (Figure 6.9).

6.2.39 The Proposed Development is located within the SCANS IV survey block NS-D, there were no bottlenose dolphin sightings in this survey block (Gilles *et al.*, 2023). Modelled density surface estimates using SCANS IV data (Gilles *et al.*, 2025) gave a mean density estimate of 0.004 animals per km^2 and a maximum density estimate of 0.009 animals per km^2 for the Local Marine Mammal Study Area (Figure 6.10).

6.2.40 It is important to note that both the SCANS III and IV surveys do not distinguish between inshore and offshore bottlenose dolphin populations, as the large-scale transect surveys design is not tailored to detecting smaller, inshore

populations (Hammond *et al.,* 2021; Lacey *et al.,* 2022; Gilles *et al.,* 2025). For such populations, mark-recapture methods such as photo-identification studies by Arso Civil *et al.* (2019) and Cheney *et al.* (2018) are more appropriate for estimating abundance and density. Studies suggest that inshore and offshore populations are often ecologically and genetically discrete (Cheney *et al.*, 2013).

6.2.41 Predicted distribution maps of bottlenose dolphin at monthly scales by Waggitt *et al.* (2020) demonstrated bottlenose dolphin densities to be consistently low throughout the year (Figure 6.11 to Figure 6.13). The highest densities within the Local Marine Mammal Study Area were predicted in August, with a mean of 0.002 animals per km^2 (Figure 6.12). However, as a limitation, the authors of this study highlight that small and isolated sub-populations would have little influence on these broad-scale models and that there may have been substantial changes in populations across the study period. As such, density estimates provided by Waggitt *et al.* (2020) may not be a true reflection of densities for the Coastal East Scotland MU bottlenose dolphin population due to its small size and recent southward expansion.

6.2.42 Bottlenose dolphin detection rates were low across all ECOMMAS sites between 2013 and 2016. The Proposed Development is geographically closest to the ECOMMAS sites at Cruden Bay and Fraserburgh. C-POD data collected at Cruden Bay provided no evidence in seasonal variation in detections and no obvious pattern in dolphin detection rate in relation to the distance from the shore (Brookes, 2020; Seagreen Wind Energy Limited, 2018). However, there was evidence to suggest that bottlenose dolphin frequent the more inshore areas around Fraserburgh, with higher averages present in the western side of sites monitored around Fraserburgh (approximately 2 km off the coast) (Brookes, 2017; Marine Scotland, n.d.),

6.2.43 SMASS recorded 98 dead stranded bottlenose dolphin along Scotland's east coast between 2001 and 2022. Annual strandings varied from one to 16 individuals, with a notable spike in 2021 due to a mass stranding event in the inner Moray Firth, where 15 dolphin were found dead. Notably, only four of these stranded dolphin were matched to the east coast bottlenose dolphin catalogue, suggesting that many may have originated from other populations (Cheney *et al.,* 2024).

6.2.44 The bottlenose dolphin population along Scotland's east coast has expanded over recent decades. WDC Shorewatch have recorded frequent bottlenose activity, especially around the entrance to Aberdeen Harbour which has dolphin present over 80% of the time in late spring (Shorewatch, 2025). No specific sightings were available from ORCA's citizen science efforts in this area. However, studies by the University of Aberdeen and the SMRU have utilised photo-ID techniques to monitor individual bottlenose dolphin, revealing a resident population of nearly 190 animals ranging from the Moray Firth to the Firth of Tay. These studies have confirmed that dolphin observed off Aberdeen are part of this wider population, exhibiting site fidelity and seasonal movement patterns (Cheney *et al.,* 2013; Weir *et al.,* 2008).

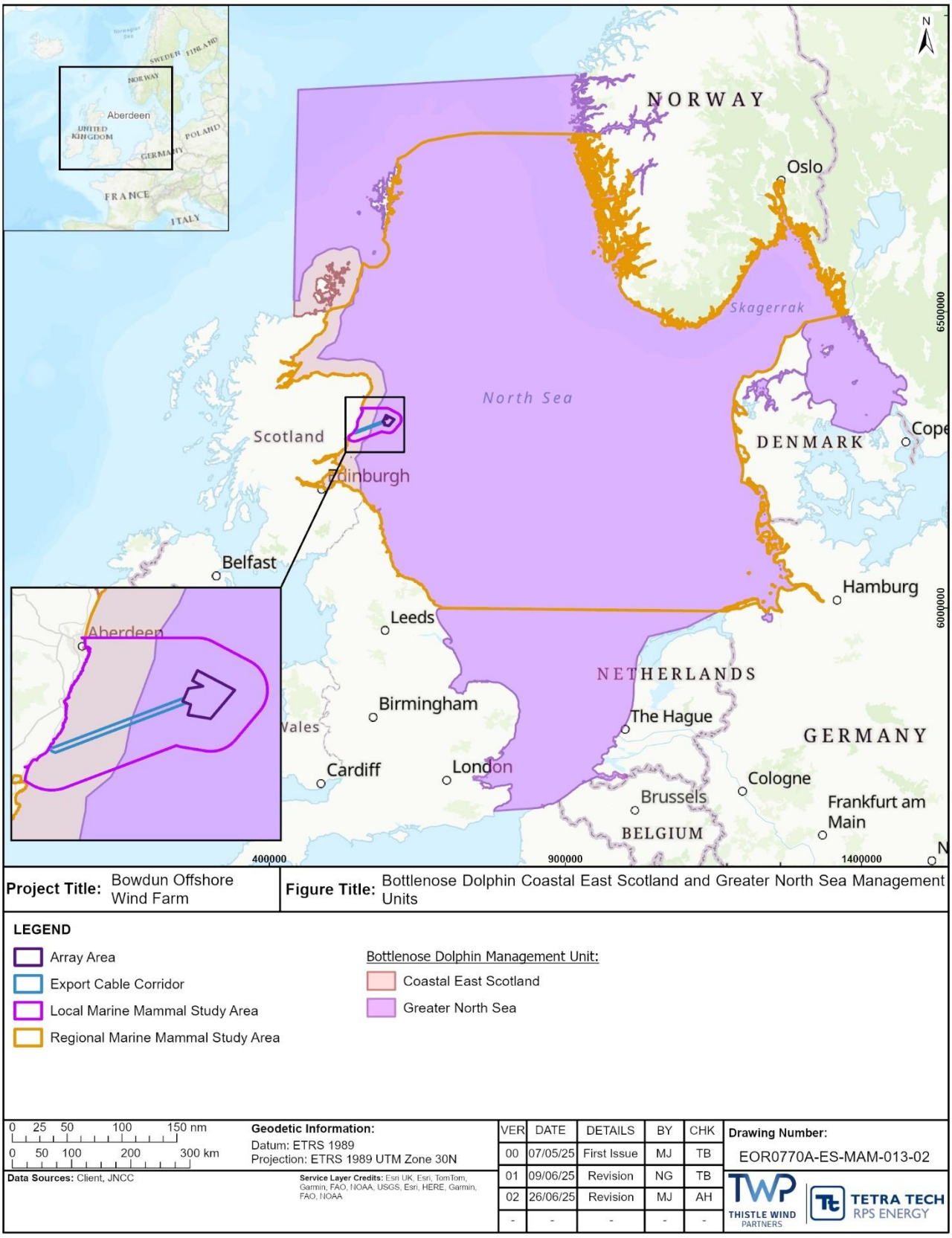


Figure 6.8: Bottlenose Dolphin Coastal East Scotland Management Unit and Greater North Sea Management Unit

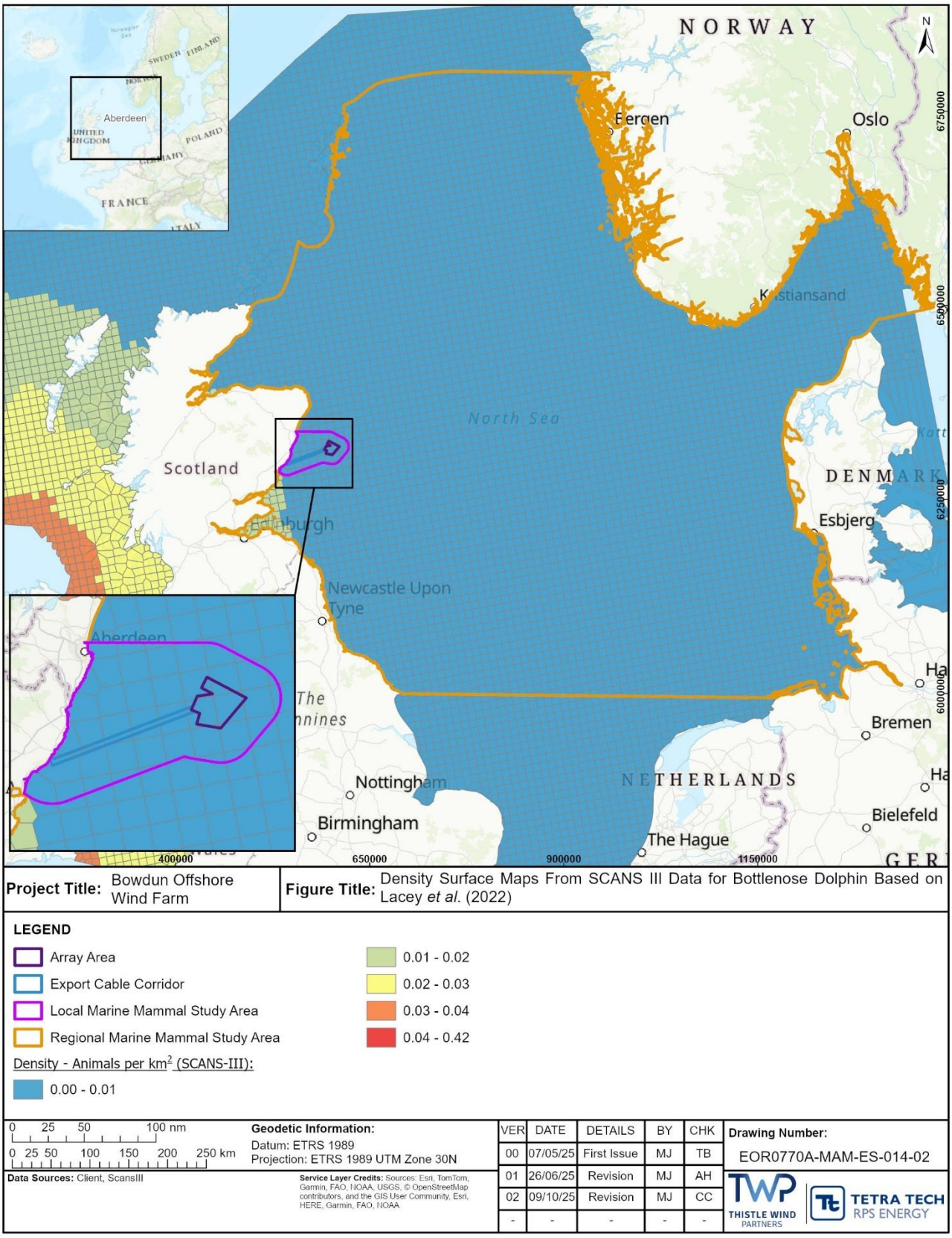
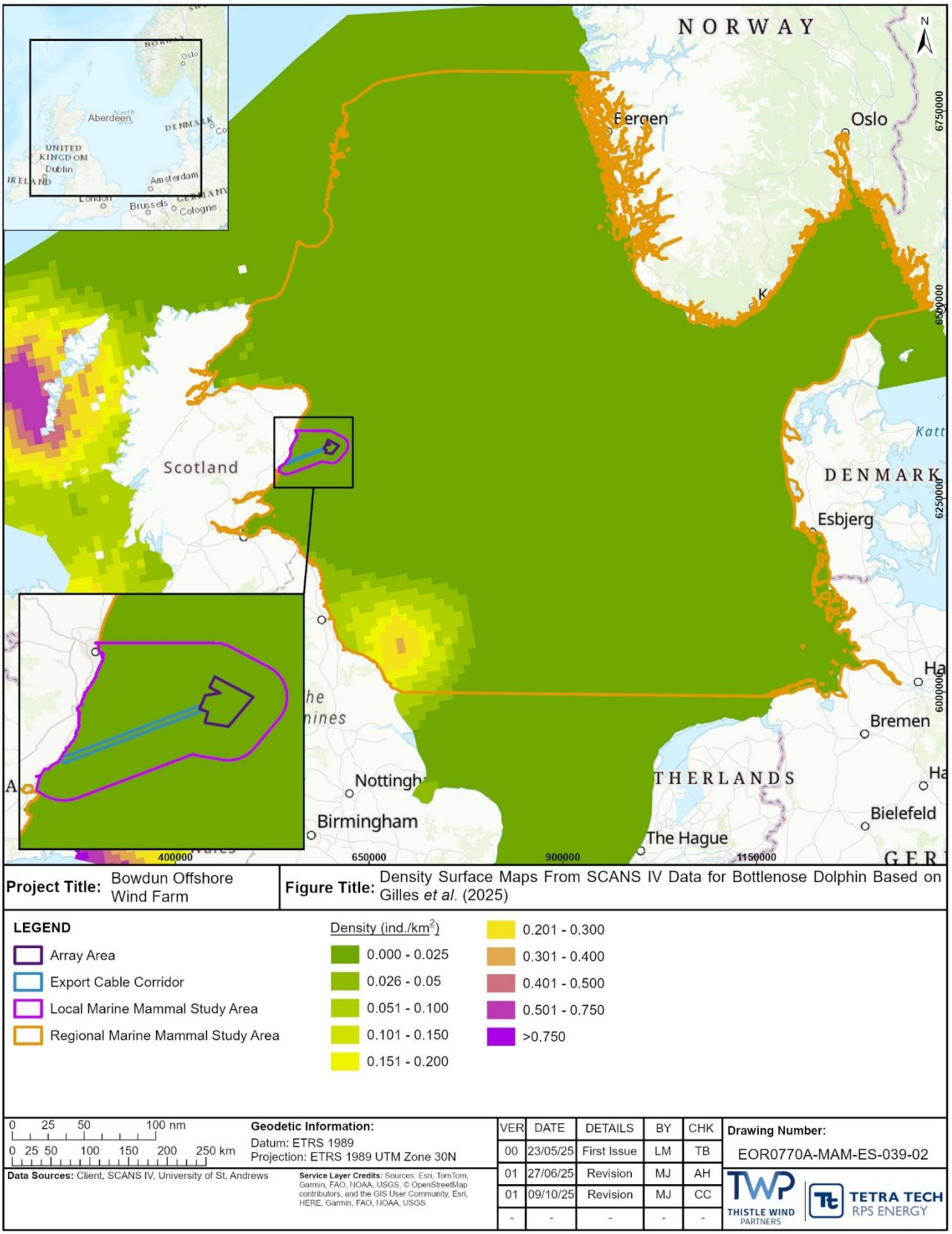


Figure 6.9: Density Surface Maps From SCANS III Data for Bottlenose Dolphin Based on Lacey *et al.* (2022)



VER	DATE	DETAILS	BY	CHK
00	23/05/25	First Issue	LM	TB
01	27/06/25	Revision	MJ	AH
01	09/10/25	Revision	MJ	CC
-	-	-	-	-

Figure 6.10: Density Surface Maps From SCANS IV Data for Bottlenose Dolphin Based on Gilles *et al.* (2025)

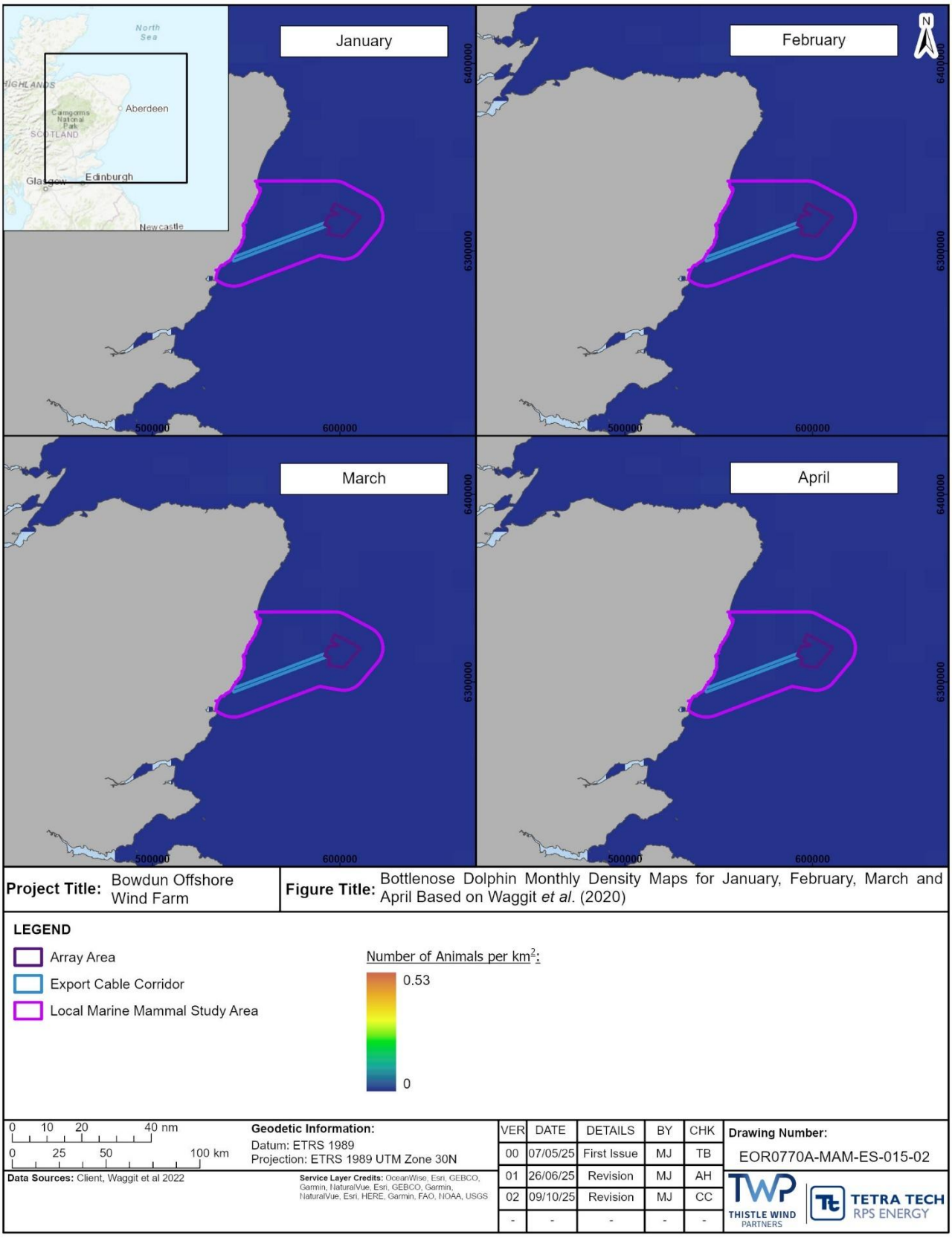


Figure 6.11: Bottlenose Dolphin Monthly Density Maps for January, February, March and April Based on Waggitt *et al.* (2020)

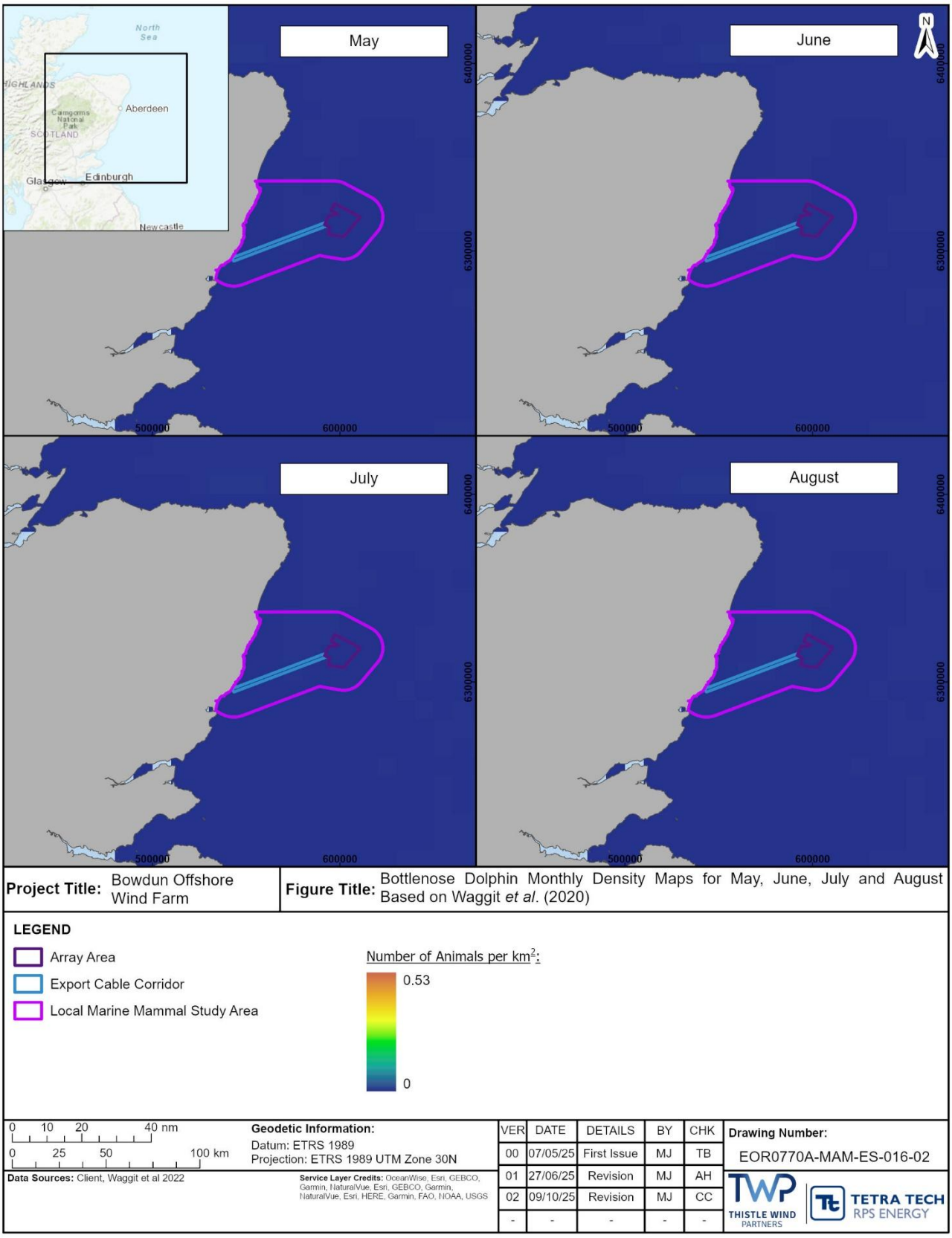


Figure 6.12: Bottlenose Dolphin Monthly Density Maps for May, June, July and August Based on Waggitt *et al.* (2020)

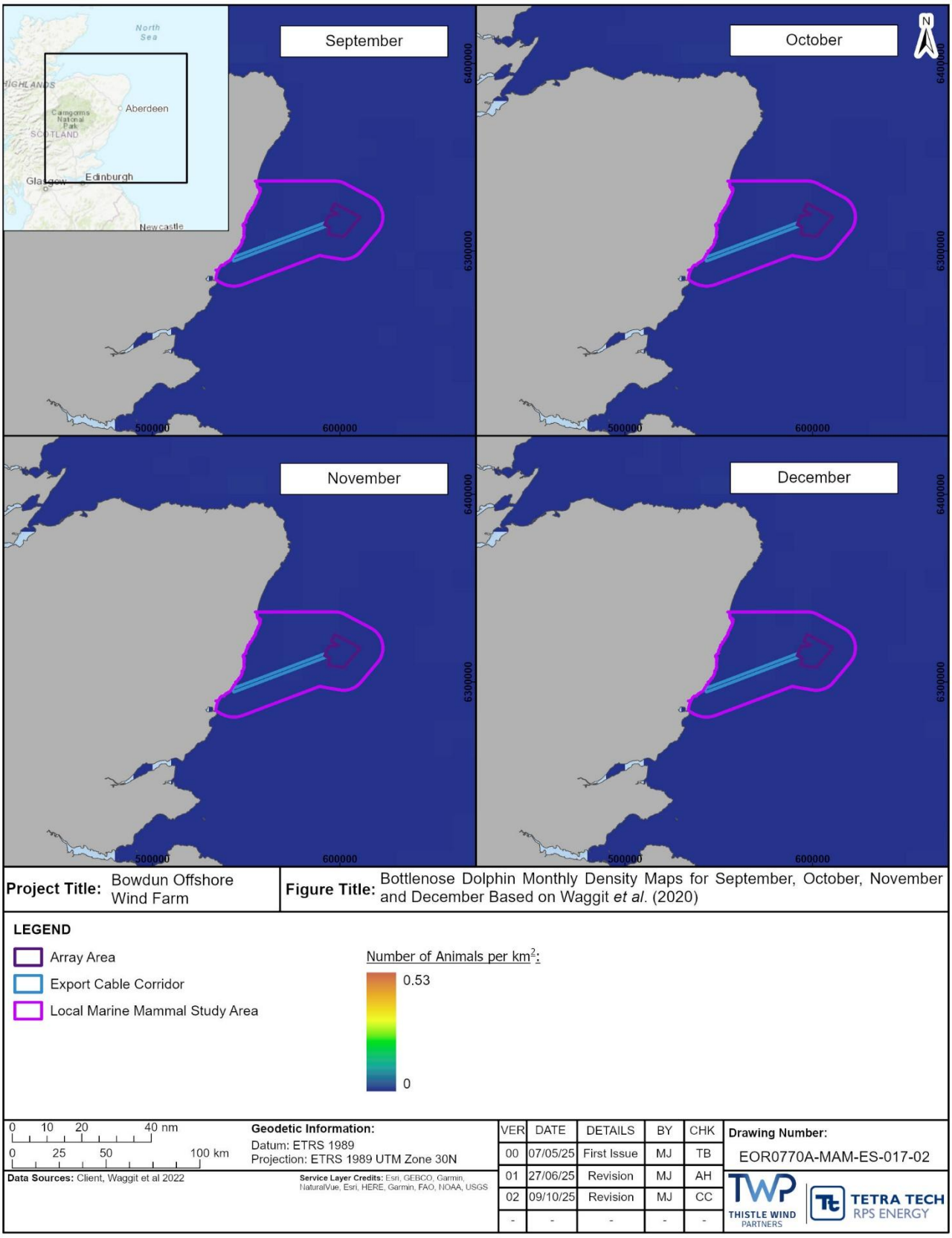


Figure 6.13: Bottlenose Dolphin Monthly Density Maps for September, October, November and December Based on Waggitt *et al.* (2020)

Summary of the Densities

6.2.45 Overall, bottlenose dolphin are present across the northern North Sea; however, only the inshore population, distributed within the 2 m to 20 m depth contour and approximately 2 km from the shore, is well documented in the literature. Table 6.2 compares key data sources for bottlenose dolphin.

6.2.46 As discussed in Paragraph 6.2.34, design or model-based density and abundance estimates for bottlenose dolphin based on DAS are unavailable.

6.2.47 The distribution of bottlenose dolphin within the Coastal East Scotland MU is restricted to inshore areas within 2 km to 5 km of the shore. Therefore, the density estimate within these areas is expected to be higher than offshore.

6.2.48 Lacey *et al.* (2022) maps reflect the inshore distribution of the Coastal East Scotland MU bottlenose dolphin population. Moreover, it should be noted that Lacey *et al.* (2022) used SCANS III data alongside the environmental covariates such as depth and slope in the density surface modelling. Depth is an important predictor for bottlenose dolphin distribution. Therefore, studies that consider the environmental conditions allowing to discriminate among different habitats (e.g. shallow vs deep) are preferrable to be used when predicting bottlenose dolphin density.

6.2.49 Compared to other available data sources, the density estimate of 0.007 animals per km² reported by Lacey *et al.* (2022) is slightly higher than values reported by Hammond *et al.* (2021) for SCANS III Block R (0.0023 animals per km²), and Waggitt *et al.* (2020) (0.002 animals per km²). The density estimate derived from Gilles *et al.* (2025) for the Local Marine Mammal Study area from SCANS IV is 0.004 animals per km² for bottlenose dolphin. While these estimates are broadly consistent and within the same order of magnitude, the density estimate derived from Lacey *et al.* (2022) is considered more precautionary and better suited for assessing potential impacts in offshore waters, and will therefore be taken forward to the assessment, as it reflects the best available data in terms of both methodological robustness and ecological relevance for bottlenose dolphins in offshore waters.

Table 6.2: Comparison of Main Data Sources Density Estimates for Bottlenose Dolphin

Source		Density (Animals per km²)
SCANS III	Block R (Hammond *et al.*, 2021)	0.0023
	(Lacey *et al.*, 2022)	0.007
SCANS IV	(Gilles *et al.*, 2025)	0.004
Waggitt *et al.* (2020)		0.002

White-beaked Dolphin

Ecology

6.2.50 The white-beaked dolphin belongs to the family Delphinidae in the suborder Odontoceti. It is a robust species that can grow up to 3.5 m for males and 3.05 m for females. Adults become sexually mature at a length of approximately 2.6 m and at approximately 12 to 13 years of age (Reeves *et al.*, 1999). The mating season for white-beaked dolphin is in July and August with the gestation period lasting about 11 months (Culik, 2010).

6.2.51 Little is known about the reproductive behaviour of this species and while it was thought that births often occur offshore in the northern North Sea, there is also evidence to suggest that females move into inshore waters to give birth (Canning *et al.*, 2008; Weir *et al.*, 2007).

6.2.52 The white-beaked dolphin is of Least Concern on the International Union for Conservation of Nature (IUCN) Red List of species. However, there are concerns about the potential impact of climate change causing a reduction in its range (MacLeod *et al.*, 2005). In general, white-beaked dolphin is only found in waters cooler than around 18˚C and is most common in waters below about 13˚C (Tetley and Dolman, 2013). It has been suggested that due to the increase in SST between 1948 and 2003, the suitable habitat of white-beaked dolphin in Scottish waters decreased, which resulted in reduced species presence (van Weelden *et al.*, 2021; MacLeod *et al.*, 2005).

6.2.53 The white-beaked dolphin is known to have a broad diet (Samarra *et al.*, 2022), however, the main prey species for this species in Scottish waters is whiting and in lesser extent other clupeids *Clupeidae* (e.g. herring), gadoids (e.g. haddock and cod) and shad (*Alosa spp.*) (Canning *et al.*, 2008). Although the distribution and abundance of prey species affects the distribution and abundance of white-beaked dolphin, this species tends to be influenced by temperature with larger numbers and group sizes associated with cooler temperatures (Evans, 1991; Canning *et al.*, 2008; Weir *et al.*, 2007). Recent studies in Iceland demonstrate that despite ecosystem changes in the study region, white-beaked dolphin showed no long-term changes in trophic ecology, suggesting that it adapts to spatial changes in prey distribution or shifts to other prey at similar trophic levels (Samarra *et al.*, 2022).

Distribution and Occurrence

6.2.54 The white-beaked dolphin inhabits the temperate and subarctic waters of the North Atlantic (Schick *et al.*, 2020). It is the second most numerous cetacean in the North Sea, recorded more frequently in the western sector of the central and northern North Sea across to western Scotland and is generally sighted in small groups of three to four animals (Reid *et al.*, 2003).

6.2.55 In the north-east Atlantic white-beaked dolphin are generally restricted to shelf waters and prefer waters less than 120 m deep (Tetley and Dolman, 2013). However, Weir *et al.* (2009) suggested that individuals were encountered in significantly deeper waters around Scotland, ranging from 106.5 m to 134.5 m and with no sightings in waters of less than 70 m. This indicates the preference of white-beaked dolphin to inhabit open waters outside the immediate coastal

zone. Moreover, other habitat variables, such as slope and seabed aspect, were considered important factors in driving occurrence (Tetley and Dolman, 2013). White-beaked dolphin can show long-range regional movements, although individuals can also show repeated interannual site fidelity.

Density/Abundance

Site-Specific DAS

6.2.56 Relative density estimates of white-beaked dolphin from DAS were corrected for availability bias using the most conservative correction factor of 0.180 (Volume 3, Technical Appendix 10.2: Marine Mammal Digital Aerial Survey Report).

6.2.57 For the DAS Area, design-based approaches gave absolute densities of 0.013 and 0.463 animals per km^2 for winter and summer (meteorological season, rather than bio-season) respectively. The mean absolute density estimate across all transects and all monthly surveys for the 24-month survey period, with bootstrapping, was estimated as 0.168 animals per km^2 (CV = 2.068). The mean absolute density from the model-based approach was 0.156 across the 24-month survey period (CV = 1.25).

6.2.58 For the Extended DAS Area, for summer months only, the mean absolute design-based density estimate across all transects and all monthly surveys for the 24-month survey period, with bootstrapping, was estimated as 0.243 animals per km^2 (CV = 1.680). No model-based estimates were calculated for white-beaked dolphin.

Seasonality

6.2.59 Across datasets, white-beaked dolphin counts were consistently higher during the summer, autumn and winter months.

6.2.60 White-beaked dolphin were seen in seven of the 24 site-specific surveys conducted at Ossian OWF, with a peak of 12 dolphin recorded in July 2021. Absolute densities were highest during the summer meteorological season (June to August) at 0.057 animals per km^2 (95% CI: 0.021 to 0.101) and lower during winter (December to February) at 0.024 animals per km^2 (95% CI: 0.009 to 0.043). The average annual estimate was 0.031 animals per km^2 (95% CI: 0.011 to 0.054) (Ossian OWFL, 2024).

6.2.61 White-beaked dolphin were sighted in six of the monthly surveys completed for Berwick Bank Wind Farm. These animals were sighted only in summer months (June to September) most often in the south-east section of the survey area and resulted in a total of 45 white-beaked dolphin sightings. The mean corrected density of white-beaked dolphin across all surveys at the site was 0.050 animals per km^2 (SSE Renewables, 2022).

6.2.62 During Seagreen OWF boat-based surveys, white-beaked dolphin occurred often in groups: with a mean group size of three and a maximum group size of 15 individuals with most sightings occurring further offshore (Sparling, 2012). White-beaked dolphin were not recorded during surveys conducted at Morven OWF or NNG OWF surveys to date.

6.2.63 The monthly encounter rate for white-beaked dolphin from the Proposed Development DAS data was higher during summer and autumn months, compared to winter months (Table 5.2).

Published Literature

6.2.64 Density and abundance estimates of white-beaked dolphin are available from various studies carried out across a broader area within the Regional Marine Mammal Study Area. IAMMWG (2022) estimated abundance for the CGNS MU (Figure 6.14) as 43,951 animals (95% CI: 28,439 to 67,924). The SCANS III data (Hammond *et al.*, 2021) estimated the abundance of white-beaked dolphin within block R as 15,694 animals (95% CI: 3,022 to 33,340). The abundance of white-beaked dolphin within SCANS IV block NS-D is lower than data reported for SCANS III block R, with an estimate of 5,149 (95% Cl: 961 to 10,586) individuals indicating changes in white-beaked dolphin abundance (Gilles *et al.*, 2023).

6.2.65 Hammond *et al.* (2021) reported densities for white-beaked dolphin across block R as 0.243 animals per km^2 (CV = 0.48). Recently modelled density surface estimates using the SCANS III data (Lacey *et al.*, 2022) gave a mean density estimate of 0.155 animals per km^2 and a maximum of 0.267 animals per km^2 for the Local Marine Mammal Study Area (Figure 6.15). The white-beaked dolphin density estimates for SCANS IV block NS-D are 0.0799 animals per km^2 (CV = 0.481) (Gilles *et al.*, 2023). The mean density estimate derived from Gilles *et al.* (2025) for the Local Marine Mammal Study area from SCANS IV is 0.071 animals per km^2 (Figure 6.16).

6.2.66 Monthly predicted distribution maps of white-beaked dolphin from Waggitt *et al.* (2020) suggest white-beaked dolphin densities are higher throughout autumn and summer months (Figure 6.17 to Figure 6.19). The highest densities within the Local Marine Mammal Study Area were predicted in August, with a mean of 0.117 animals per km^2 (Figure 6.18).

6.2.67 While specific data on white-beaked dolphin from ECOMMAS is limited, their presence is acknowledged in Scottish waters, particularly along the east coast. However, detailed acoustic detection records for this species are not readily available in the public domain.

6.2.68 Between 2011 and 2018, SMASS recorded 109 strandings of white-beaked dolphin along the Scottish coastline (Brownlow *et al.,* 2019). This represents a significant portion of cetacean strandings in the region during that period. The consistent number of strandings over the years suggest a stable presence of this species in Scottish waters (Brownlow *et al.,* 2023).

6.2.69 The WDC and ORCA sightings databases show the widespread distribution of this species (ORCA, 2025b). While the WDC's Shorewatch program volunteers observed white-beaked dolphin breaching near the island of Noss (Munro, 2024).

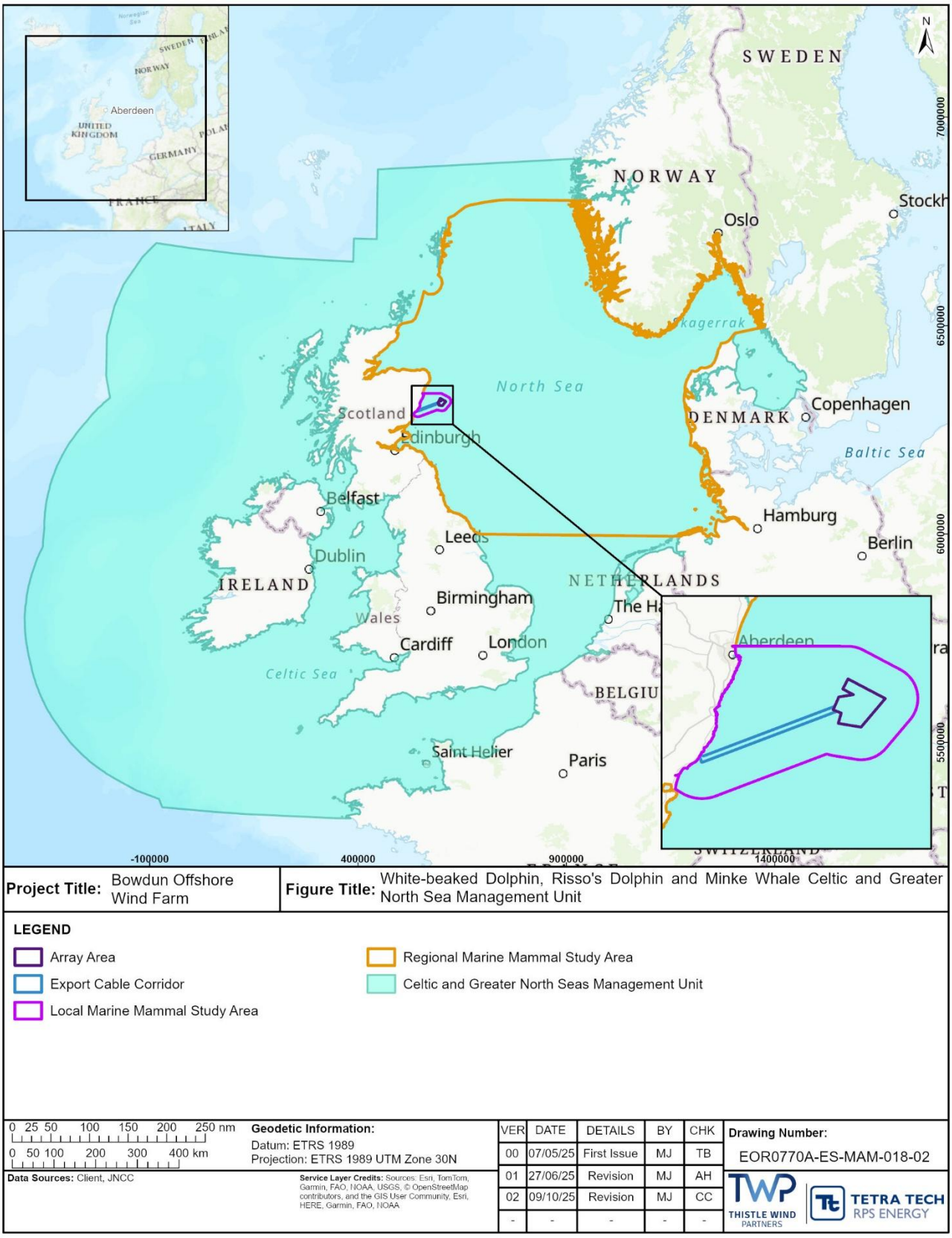


Figure 6.14: White-beaked Dolphin, Risso's Dolphin and Minke Whale Celtic and Greater North Sea Management Unit

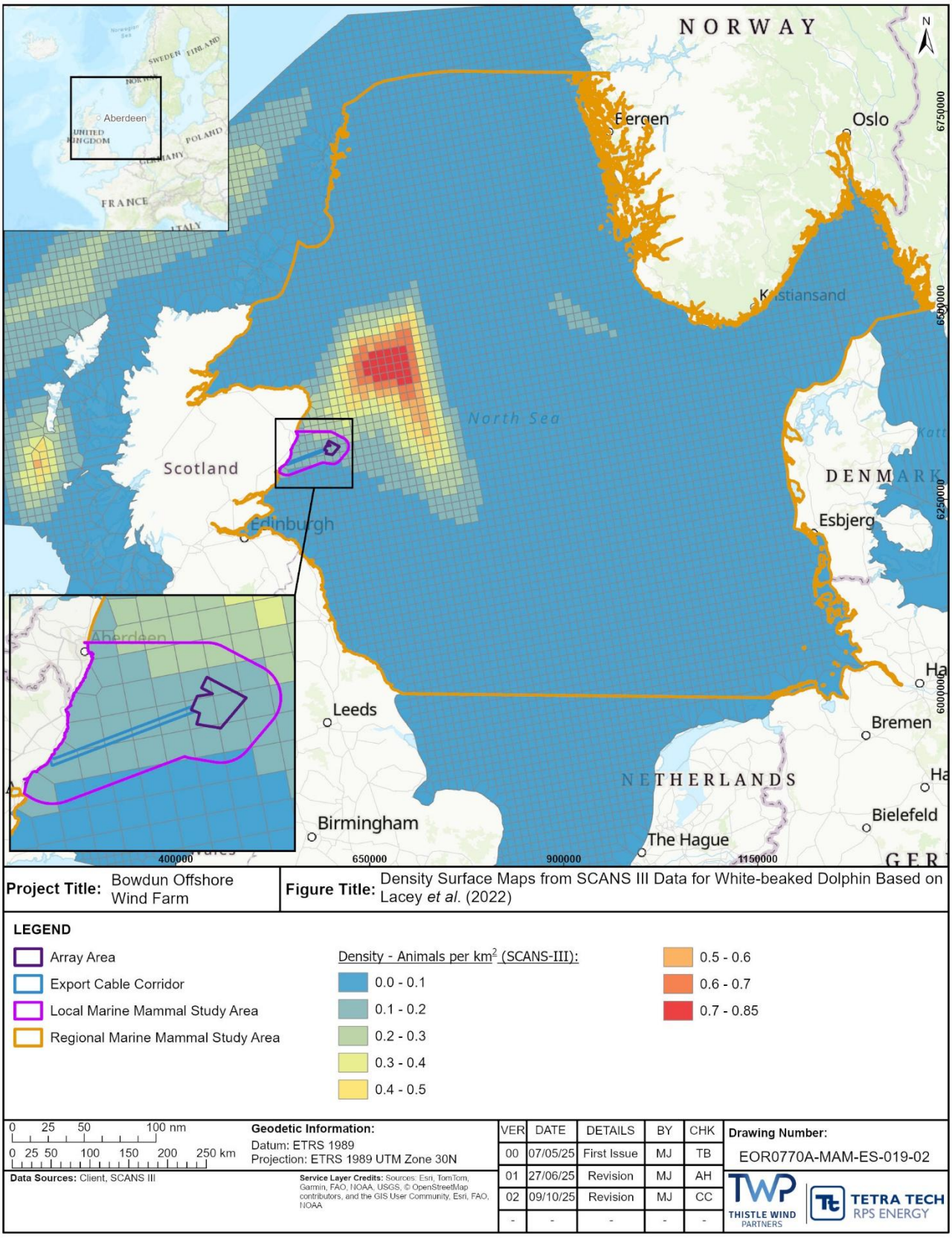


Figure 6.15: Density Surface Maps From SCANS III Data for White-beaked Dolphin Based on Lacey *et al.* (2022)

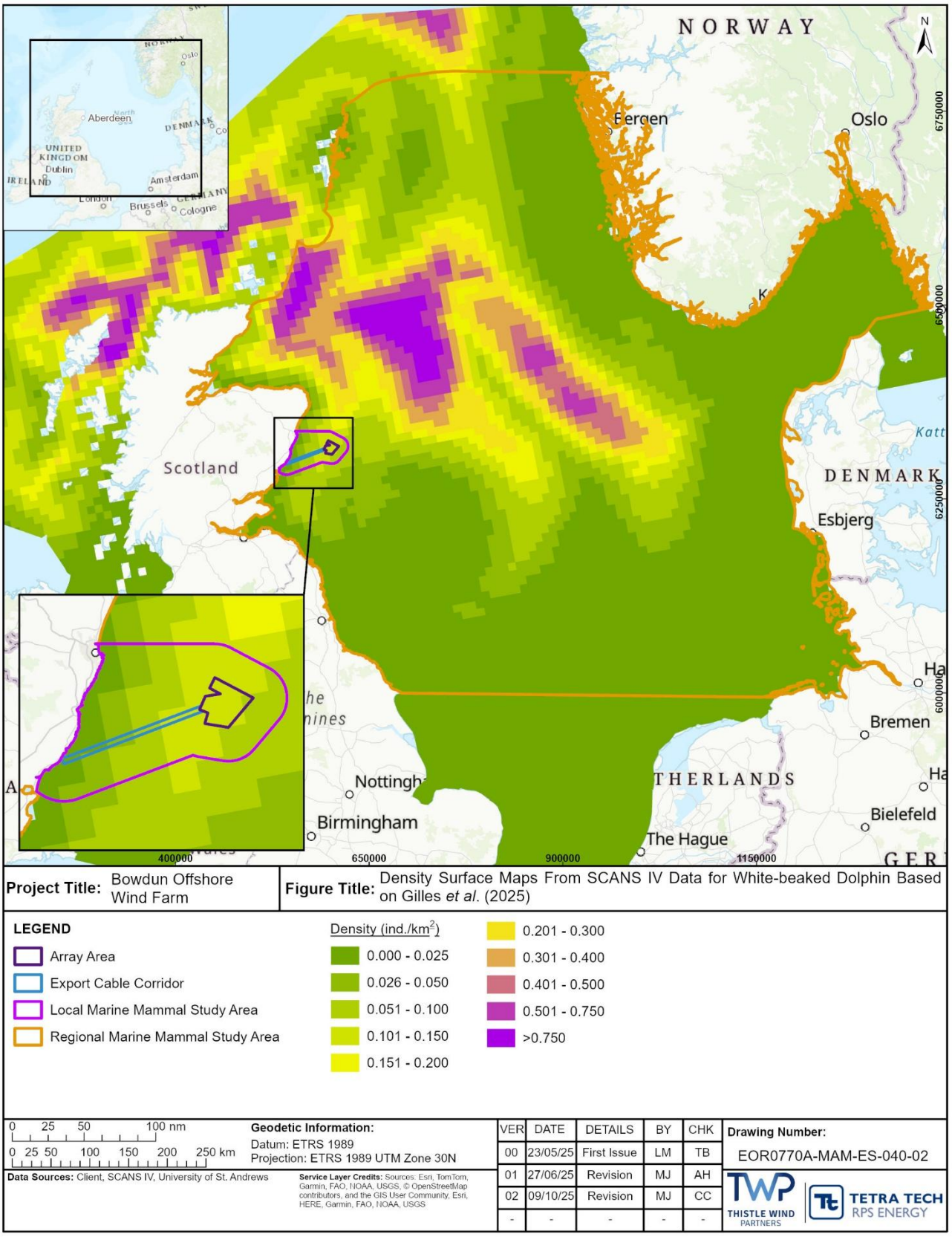


Figure 6.16: Density Surface Maps From SCANS IV Data for White-beaked Dolphin Based on Gilles *et al.* (2025)

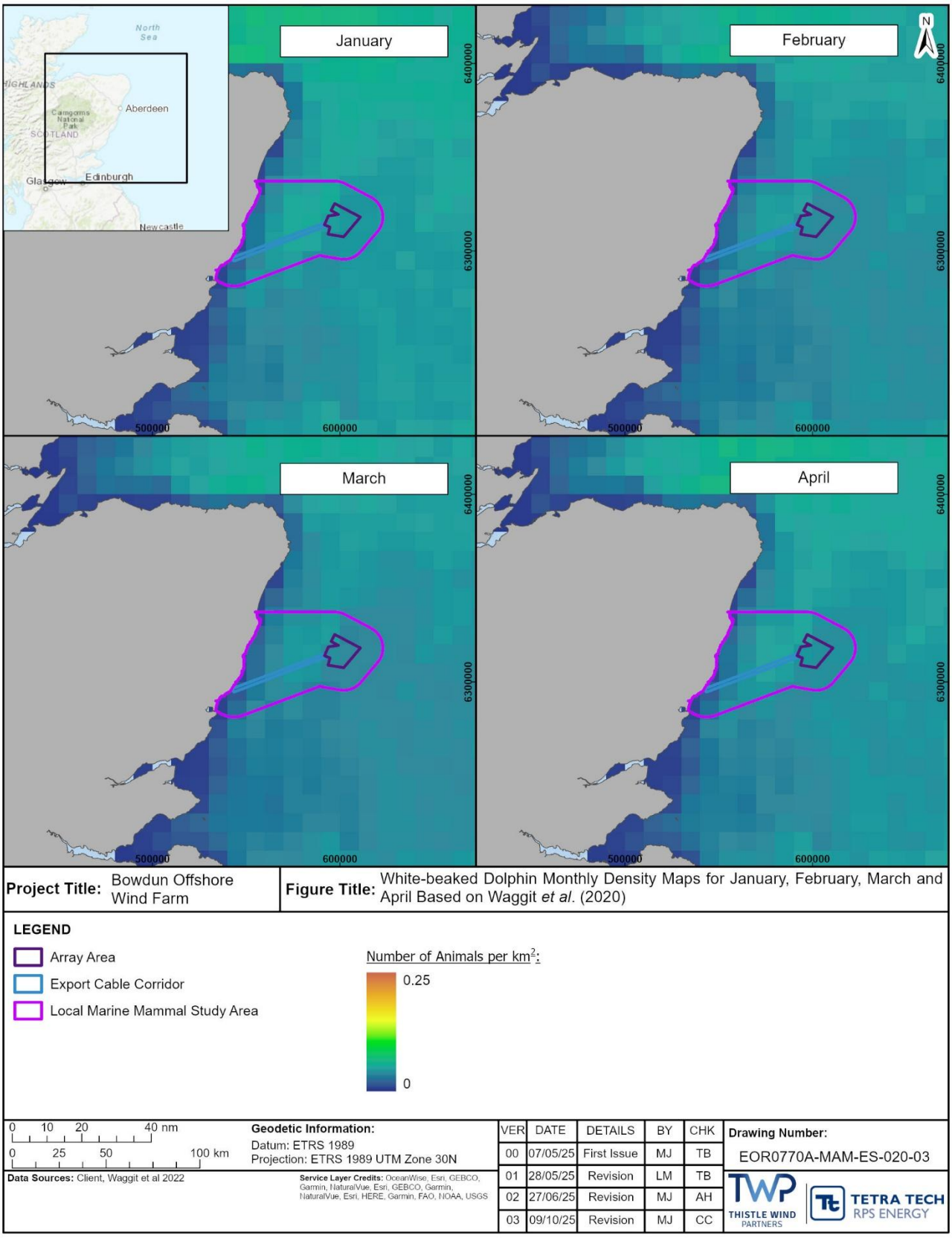


Figure 6.17: White-beaked Dolphin Monthly Density Maps for January, February, March and April Based on Waggitt *et al.* (2020)

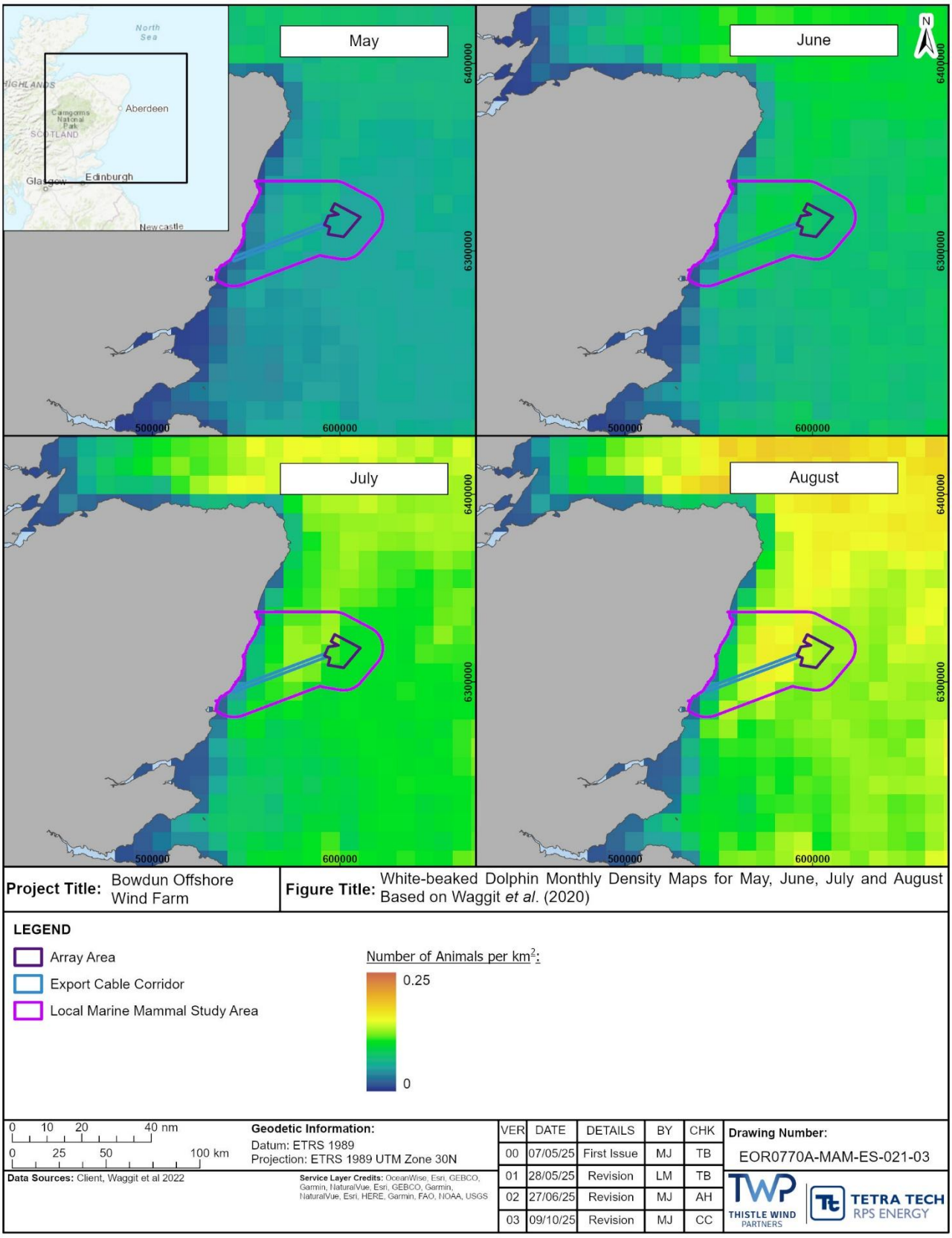


Figure 6.18: White-beaked Dolphin Monthly Density Maps for May, June, July and August Based on Waggitt *et al.* (2020)

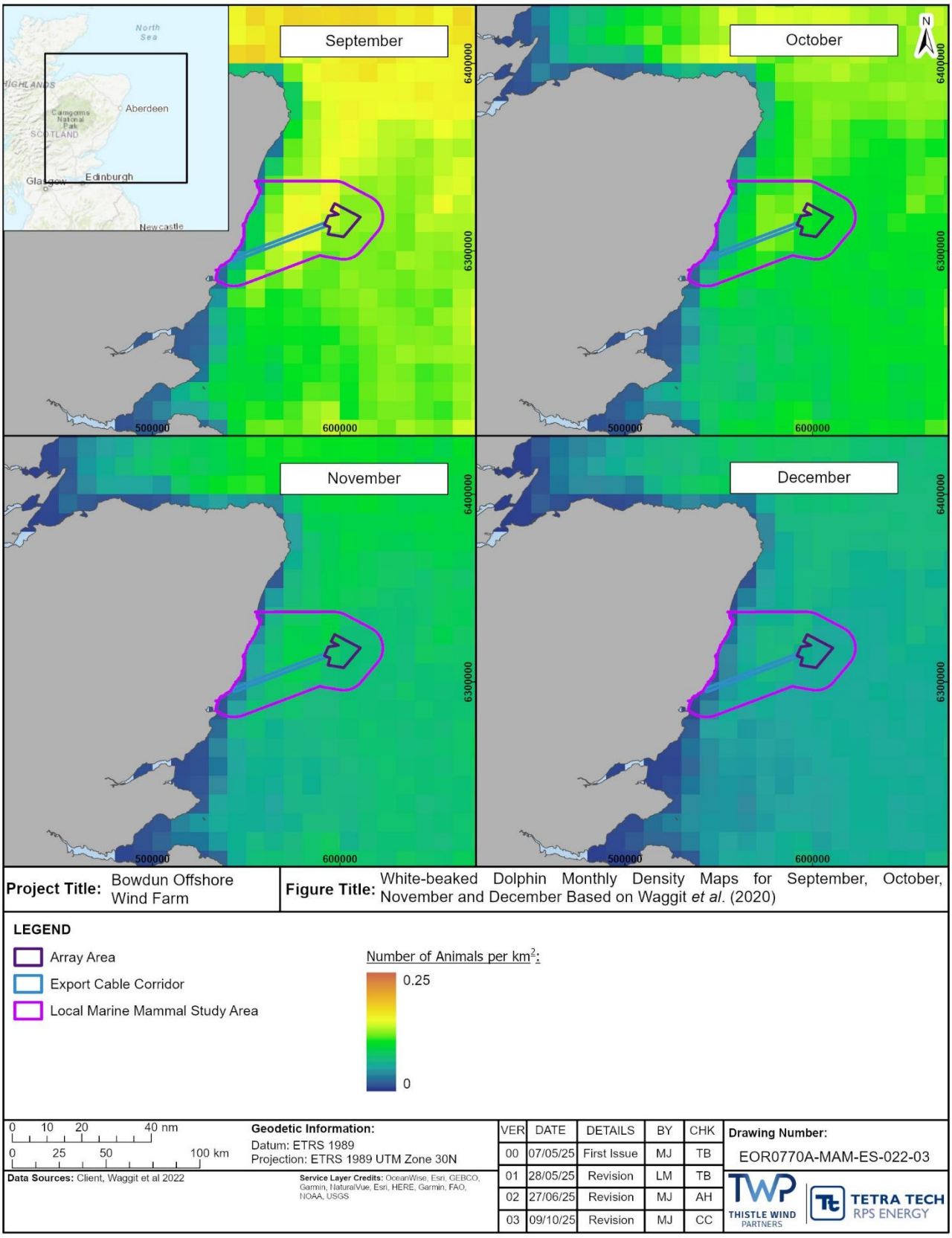


Figure 6.19: White-beaked Dolphin Monthly Density Maps for September, October, November and December Based on Waggitt *et al.* (2020)

Summary of the Densities

6.2.70 White-beaked dolphin is abundant and widespread throughout the northern North Sea and is the second most frequently reported cetacean in the North Sea.

6.2.71 It should be noted that Lacey *et al.* (2022) used SCANS III data alongside the environmental covariates such as depth and slope in the density surface modelling. As such, studies that consider environmental factors are deemed more robust when predicting white-beaked dolphin density.

6.2.72 Although the model-based approach (Volume 3, Technical Appendix 10.2: Marine Mammals Digital Aerial Survey Report) provides the highest estimated density for white-beaked dolphin, this is not considered reliable, due to the low predictive power across all species, particularly white-beaked dolphin.

6.2.73 The density estimate from SCANS III (Hammond *et al.*, 2021) is the most precautionary estimate for white-beaked dolphin, however the short timeframe over which observations were made, as well as the broad spatial scale of this estimate (SCANS-III block R), suggest that it is unlikely to be representative of the density of white-beaked dolphin within the Site Boundary.

6.2.74 The modelled estimate of 0.155 animals per km^2 presented by Lacey *et al.* (2022) is therefore considered the most appropriate density to be taken forward to assessment for white-beaked dolphin, given the ability of the model to incorporate ecologically relevant environmental conditions, while providing a more precautionary estimate than the more recent estimates from the SCANS IV surveys (Gilles *et al.*, 2023; Gilles *et al.*, 2025) (Table 6.3).

Table 6.3: Comparison of Main Data Sources Density Estimates for White-beaked Dolphin

Source		Density (Animals per km^2)
SCANS III	Block R (Hammond *et al.*, 2021)	0.243
	(Lacey *et al.*, 2022)	0.155
SCANS IV	Block NS-D (Gilles *et al.*, 2023)	0.0799
	(Gilles *et al.*, 2025)	0.071
Waggitt *et al.* (2020)		0.117
Site-specific DAS	Overall design-based mean (absolute) for the DAS Area	0.168

Risso's Dolphin

6.2.75 During the two years of Proposed Development DAS campaign, Risso's dolphin were sighted in five survey months, with a total of 11 animals recorded (Volume 3, Technical Appendix 10.2: Marine Mammal Digital Aerial Survey Report). However, the number of observations for Risso's dolphin were too low for model-based density estimates to be calculated.

Ecology

6.2.76 Risso's dolphin is a large, deep-diving cetacean typically found in temperate and tropical oceans, with a strong preference for offshore waters along continental shelf edges, escarpments, and steep slopes. The species primarily feeds on cephalopods, including squid and cuttlefish, and distribution closely mirrors the availability of these prey species (Baird, 2009; Blanco *et al.,* 2006). In Scottish waters, areas with complex bathymetry, such as the west coast around the Hebrides and Shetland, are particularly important due to their high cephalopod abundance. In contract, the shallow, sandy seabed off the east coast supports lower prey densities. However, seasonal shifts in prey availability or oceanographic conditions may occasionally draw Risso's dolphin into nearshore areas, including the Aberdeenshire coast.

6.2.77 Risso's dolphin are oceanic dolphin widely distributed in tropical and temperate seas and the only member of their genus. Risso's dolphin 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 m to 100 m (Evans *et al.*, 2003). The majority of Risso's dolphin sightings in UK waters have been reported around the Hebrides, the Celtic Sea, western English Channel and the Irish Sea. The species is uncommon but regularly sighted in the southern Irish Sea, particularly of Wales's north-west and south-west coast and around the Isle of Man (Evans *et al.*, 2003).

6.2.78 Risso's dolphin 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. Risso's dolphin narrow tail stocks with a median notch and concave trailing edge (Evans, 2008). 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 made by other Risso's or prey species (squid).

6.2.79 Adults typically range from 2.6 m to 3.7 m in length and can weigh up to 500 kg. Lifespan averages between 20 and 30 years. Females reach sexual maturity at eight to ten years and males at ten to 12 years. Gestation lasts approximately 13 to 14 months, with a calving interval of 2.4 years (Baird, 2009).

6.2.80 Risso's dolphin 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 has 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.*, 2018).

6.2.81 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 content 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* (Blanco *et al.,* 2006). There do 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). Sea Watch Foundation (SWF) have observed individuals travelling in a line formation, which is thought to improve the effectiveness of hunting (SWF, 2012a).

Distribution and Occurrence

6.2.82 Risso's dolphin are distributed worldwide in temperate and tropical oceans and appear to prefer 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 2°C and rarely found in waters below 10°C. The species is uncommon but regularly sighted in the southern Irish Sea, particularly off the north-west and south-west coast of Wales and around the Isle of Man (Evans *et al.*, 2003). Risso's dolphin are frequently observed along the west coast of Scotland and the Outer Hebrides, likely due to the abundance of prey such as squid and the proximity of the continental shelf where they feed (Marine Scotland, n.d.).

6.2.83 Although Risso's dolphin are more widespread in other waters they have been sighted just north of the Local Marine Mammal Study Area near Peterhead and within the Moray Firth (Grampian waters) but are considered to be a rare visitor and are more commonly sighted around the West and North of Scotland as well as Shetland, Orkney (Couzens *et al.,* 2017; North East Scotland Biological Records Centre, 2025) and the Irish Sea. More information is available on Risso's dolphin in the Irish Sea and therefore this has been included below for context.

6.2.84 Risso's dolphin appears to have a localised distribution in the Irish Sea, in a wide band running from south-west to north-east which encompasses west Pembrokeshire, the western end of the Lleyn Peninsula and Anglesey, the south-east coast of Ireland, and around the north of the Isle of Man (Baines and Evans, 2012). This general distribution appears to have persisted over the long-term, although numbers visiting the coasts of Wales have varied greatly between years. Risso's dolphin 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).

6.2.85 Sighting data from Manx Whale and Dolphin Watch (MWDW) shows Risso's dolphin are widespread in Manx waters around the Isle of Man. Studies conducted by SWF, Whale and Dolphin Conservation and MWDW indicate movements of recognisable individuals of Risso's dolphin between Cornwall, Pembrokeshire, the Lleyn 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).

6.2.86 Risso's dolphin were not recorded or identified during site-specific surveys at the adjacent OWFs (MacLeod and Sparling, 2011; Sparling, 2012; SSE Renewables, 2022; Morven Offshore Wind Limited, 2023; Ossian OWFL, 2024). Whilst sightings have suggested the presence of Risso's dolphin north of the Local Marine Mammal Study Area, there is not enough empirical evidence currently available to support the inclusion of a quantitative assessment of this species due to a lack of MU size or density estimate. Therefore, this species will be assessed qualitatively within the impact assessment.

6.3 Mysticetes

Minke Whale

Ecology

6.3.1 Minke whale is the smallest mysticete (baleen whale) found in UK waters, measuring 7 m to 10 m when fully grown, with females usually slightly longer than males. Minke whale typically live up to 60 years and reach sexual maturity at the age of five to eight years (males) and six to eight years (females). 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 (SWF, 2012b). Calves usually nurse for a period of four to six months.

6.3.2 Minke whales tend to be observed either individually, or in pairs or threes. However, in higher latitudes, including northern Scotland, larger groups of ten to 15 individuals can be observed, particularly in areas of high prey density (Anderwald and Evans, 2007). This species mostly inhabits continental shelf waters, occurs in depths of less than 200 m and can often be seen close to land. Minke whale follow prey distribution, and sandeel is the key food resource throughout the North Sea, with sprat, shad, and herring also preferred prey items (Robinson and Tetley, 2005). 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 and, to a lesser extent, mackerel *Scomber scombrus* (Robinson and Tetley, 2007). Around Scotland (including the Moray Firth) the primary constituent 70% of the diet of minke whale was sandeel (Tetley *et al.*, 2008) as well as herring and sprat (Robinson *et al.*, 2021). A recent study in Moray Firth, Scotland, has shown that juveniles tend to exploit passive (low energy) feeding methods, targeting low-density patches of inshore prey, while adult minke whale use a range of active entrapment specialisations, exhibiting seasonal flexibility in targeted prey with interindividual variation

(Robinson *et al.*, 2021). Regional differences exist with respect to diet (Eerkes-Medrano *et al.*, 2021).

Distribution and Occurrence

6.3.3 Minke whale is the most frequently sighted mysticete species in UK waters and is particularly common around the Northern Isles and in regions of the North Sea (Weir, 2001; Robinson *et al.*, 2007). Although there are no obvious latitudinal trends in migration and distribution based on the Sea Watch database (SWF, 2023), sightings in the north and east of Scotland have increased since the 1990s (Evans *et al.*, 2003), most likely due to an increase in prey availability. The Moray Firth attracts above-average densities of minke whale relative to the adjacent and wider North Sea waters (Paxton *et al.*, 2014), likely due to rich feeding grounds during summer and autumn months, with the Southern Trench ncMPA designated for the species along the southern coast of the outer Moray Firth. The boundaries of the Southern Trench ncMPA enclose deep shelf waters (~200 m in depth) and core frontal systems, which concentrate nutrients and plankton attracting fish species, and geodiversity features (such as burrowed mud) provide optimal nursery areas.

6.3.4 Robinson *et al.* (2009) analysed data from boat-based studies in the Moray Firth (2001 to 2006) and reported that the spatial and temporal distribution of minke whale was highly variable and non-uniform. Monthly encounter rates were highly inconsistent from one year to the next, with annual encounter frequencies ranging from 0 to 0.042 individuals per km^2 across the six-year study period. Robinson *et al.* (2009) highlighted that such variability is common in studies of baleen whale on their feeding grounds. Robinson *et al.* (2021) reported that in 2006, disproportionate numbers of both adult and juvenile minkes were sighted inshore within the Moray Firth study area. This coincided with the introduction of the European Union (EU) wide ban in March 2024 on the North Sea sandeel fisheries in Scottish Waters, and therefore, it has been hypothesised that minke whale were profiting from high densities of sandeel prey.

6.3.5 Following the Geographic Information System (GIS) analysis of sightings data, Robinson *et al.* (2009) estimated that over 70% of the whale recorded in the Moray Firth study area occurred in steeply sloped areas at depths of between 20 m and 50 m. The arrival of whale each year appeared to be synchronised with the emergence of sandeels into the water column to feed, and in the GIS results over 66% of the whale encounters showed a clear spatial preference for sandy gravel sediments (i.e. optimal sandeel habitat). The study proved a strong correlation between the sediment type and the distribution of whales. Robinson *et al.* (2021) corroborated the fact that the occurrence of minke whale on their feeding grounds is linked to the environmental variables which influence the distribution of their prey. The study reported that the benthic slope, water depth and proximity to shore were found to be significant predictors for the occurrence of adult minke whale, while proximity to shore, water depth and sediment type were the most important predictors for juveniles (Robinson *et al.*, 2021). More recently, Robinson *et al.* (2023) suggested that the partitioning between the age classes in the Southern Trench ncMPA was largely based on

the differing proximity of animals to the shore, with juveniles showing a preference for the shallower, gentler seabed slopes and adults preferring deeper offshore waters with greater slope. Both adults and juveniles show a similar preference for sandy gravel sediment types (optimal sandeel habitat).

Density/Abundance

Site-specific DAS

6.3.6 Minke whale were recorded during DAS (a total of 42 sightings across 12 months), and therefore design-based density and abundance estimates were calculated, however sightings were too low for model-based density estimates to be calculated.

6.3.7 Relative design-based density estimates of minke whale from DAS were corrected for availability bias using the most conservative conversion factor of 0.44 based on McGarry *et al.* (2017) (see Volume 3, Technical Appendix 10.2: Marine Mammal Digital Aerial Survey Report for more detail).

6.3.8 For the DAS Area, the overall mean absolute density estimate for minke whale for the DAS Area was 0.010 animals per km^2 (95% CL: 0.004, 0.018, CV = 1.964). Highest seasonal density estimates were estimated for summer, at 0.023 animals per km^2 (CV = 1.487).

6.3.9 For the Extended DAS Area, the overall mean absolute density of minke whale was estimated as 0.018 animals per km^2 (CV = 1.369).

Seasonality

6.3.10 By far 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). Across datasets, minke whale counts varied.

6.3.11 There were 12 minke whale observed over four months of the site-specific surveys conducted at Ossian OWF, with a peak in July 2022 of five whale. However, insufficient data was available to calculate density estimates for minke whale (Ossian OWFL, 2024).

6.3.12 Minke whale were sighted in 11 of the monthly surveys (mainly April-September) conducted at Berwick Bank Wind Farm, resulting in a total of 57 minke whale. The mean corrected density of minke whale across all surveys at the site was 0.016 animals per km^2 (SSE Renewables, 2022).

6.3.13 Preliminary data from aerial surveys at Morven OWF recorded low number of minke whale during summer months only. A comprehensive two-year survey incorporating both design-based and model-based analyses is planned for the Array Project, however, these data are not yet available (Morven Offshore Wind Limited, 2023).

6.3.14 The results of the analysis of sightings data from Seagreen OWF boat-based surveys are in line with previous studies of Aberdeenshire coastal waters that reported minke whale to be highly seasonal (Sparling, 2012). Encounter rates were highest in the spring and summer and relatively low in autumn and winter. A similar pattern was reflected in the NNG OWF boat-based surveys and Berwick Bank Wind Farm aerial surveys, with sightings recorded only between

May and November (Mainstream Renewable Power, 2019) and between April and September (SSE Renewables, 2022), respectively.

6.3.15 The monthly encounter rate for minke whale from the Proposed Development DAS data varied, with encounters in spring, summer and autumn (Table 5.2). Peak sightings were observed in August 2022, where 18 minke whale were observed.

Published Literature

6.3.16 All minke whale in UK waters are part of the CGNS MU (Figure 6.14). Based on the most up-to-date estimates, the abundance of minke whale in this MU is 20,118 animals (95%CI: 14,061 to 28,786) (IAMMWG, 2022). The SCANS III estimated abundance for block R (Figure 6.20) was 2,498 minke whale (95% CI: 604 to 6,791) (Hammond *et al.*, 2021). SCANS IV reported minke whale abundance within block NS-D of 2,702 (95% CI = 547 to 7,357) (Gilles *et al.*, 2023).

6.3.17 Hammond *et al.* (2021) reported densities for minke whale across block R as 0.0387 animals per km^2 (CV = 0.614). Recently modelled density surface estimates using the SCANS III data (Lacey *et al.*, 2022) gave a mean density estimate of 0.022 animals per km^2 and a maximum of 0.026 animals per km^2 for the Local Marine Mammal Study Area (Figure 6.20). The SCANS IV surveys reported a density estimate of 0.0419 minke whale per km^2 (CV = 0.594) for block NS-D (Gilles *et al.*, 2023). The mean density estimate derived from Gilles *et al.* (2025) for the Local Marine Mammal Study area from SCANS IV is 0.030 animals per km^2 (Figure 6.21).

6.3.18 Monthly predicted distribution maps of minke whale from Waggitt *et al.* (2020) suggest that minke whale densities are higher throughout the summer and autumn months (Figure 6.22 to Figure 6.24). The highest density within the Local Marine Mammal Study Area was predicted in August, with a mean of 0.023 animals per km^2 (Figure 6.23).

6.3.19 While specific data on minke whale from ECOMMAS is limited, their presence is acknowledged in Scottish waters, particularly along the east coast (Marine Scotland, n.d.). However, detailed acoustic detection records for this species are not readily available in the public domain.

6.3.20 SMASS has documented several minke whale strandings along the Scottish coastline including a seven-metre whale found dead on Irvine Beach in Ayrshire in 2024 (BBC, 2024).

6.3.21 Minke whale are commonly recorded by the WDC Shorewatch program and Sightings Network. In 2022, ORCA recorded 13 sightings of minke whale, totally 14 individual animals, primarily in the Hebrides region (SWF, 2022). In 2023, minke whale were observed on almost all CalMac ferry routes surveyed by ORCA, with the Mallaig-Lochboisdale route being the only exception (CalMac, 2023).

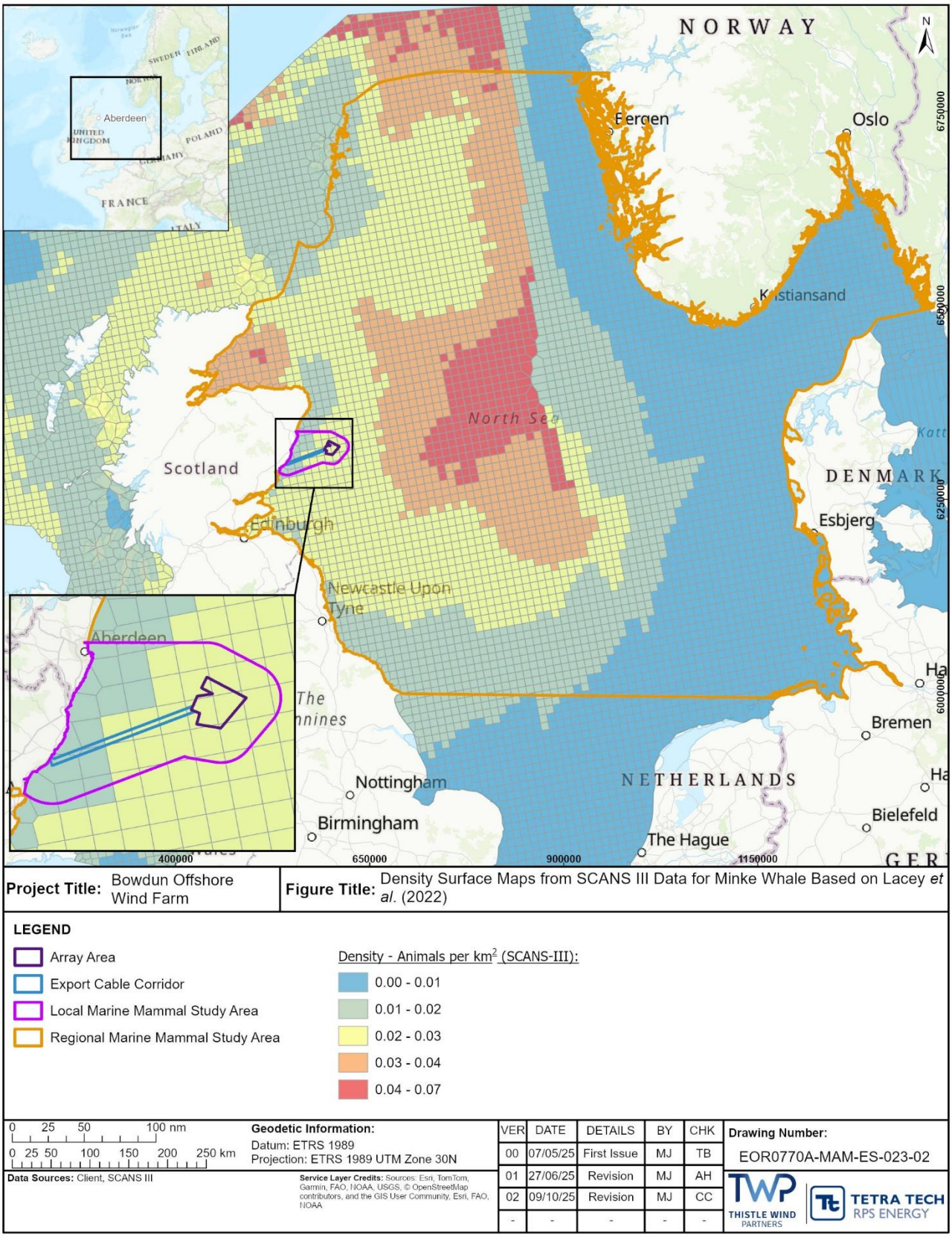


Figure 6.20: Density Surface Maps From SCANS III Data for Minke Whale Based on Lacey *et al.* (2022)

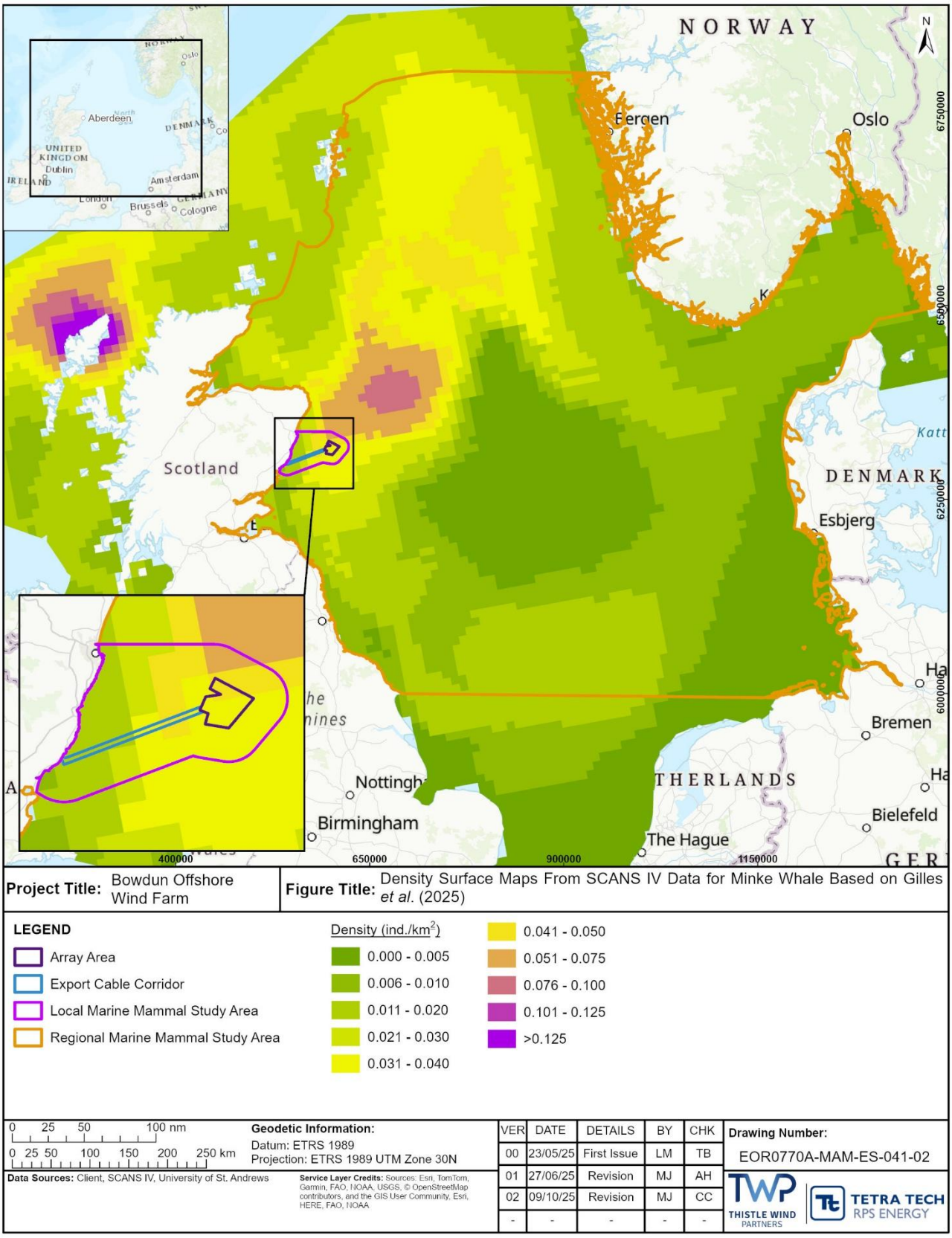


Figure 6.21: Density Surface Maps From SCANS IV Data for Minke Whale Based on Gilles *et al.* (2025)

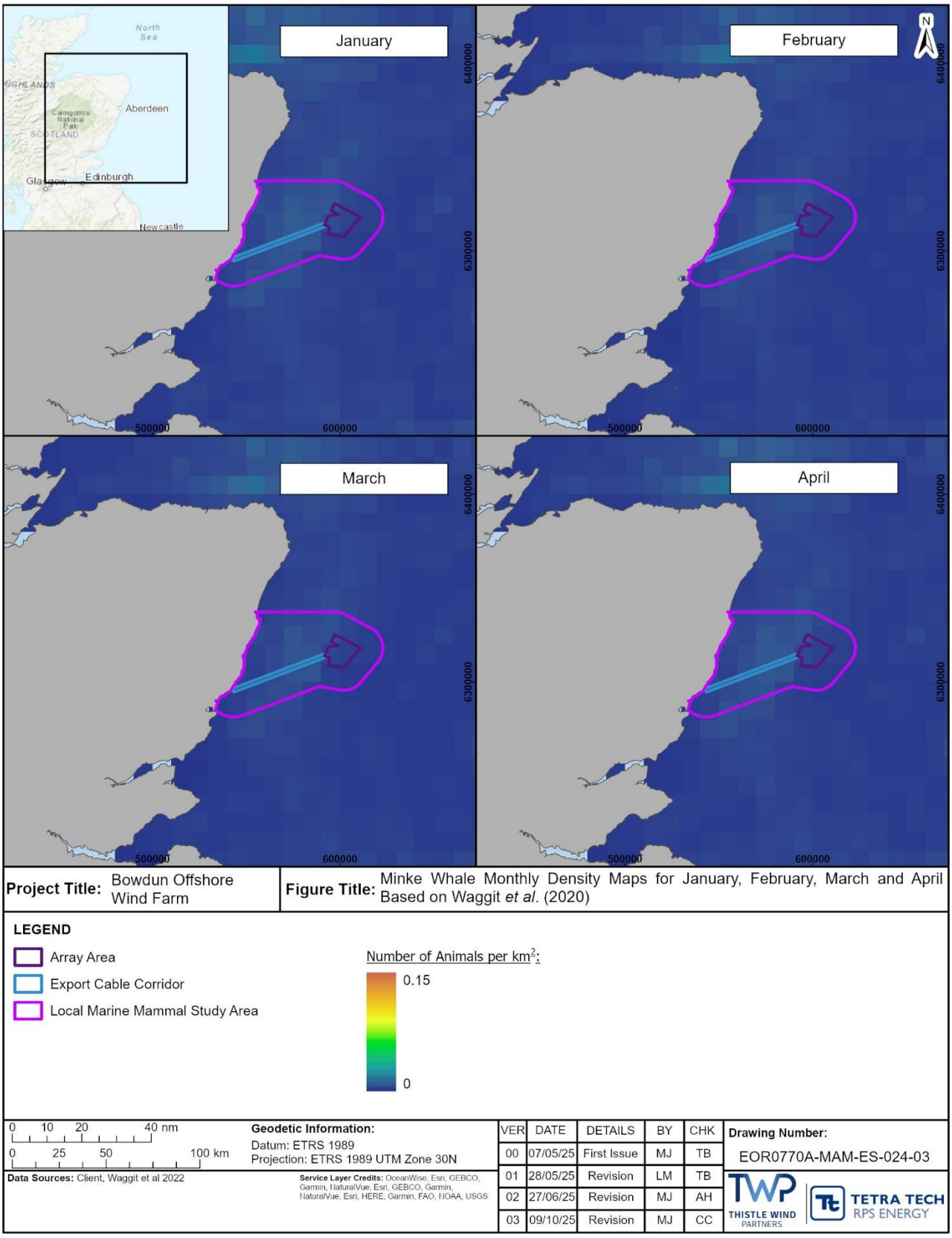


Figure 6.22: Minke Whale Monthly Density Maps for January, February, March and April Based on Waggitt *et al.* (2020)

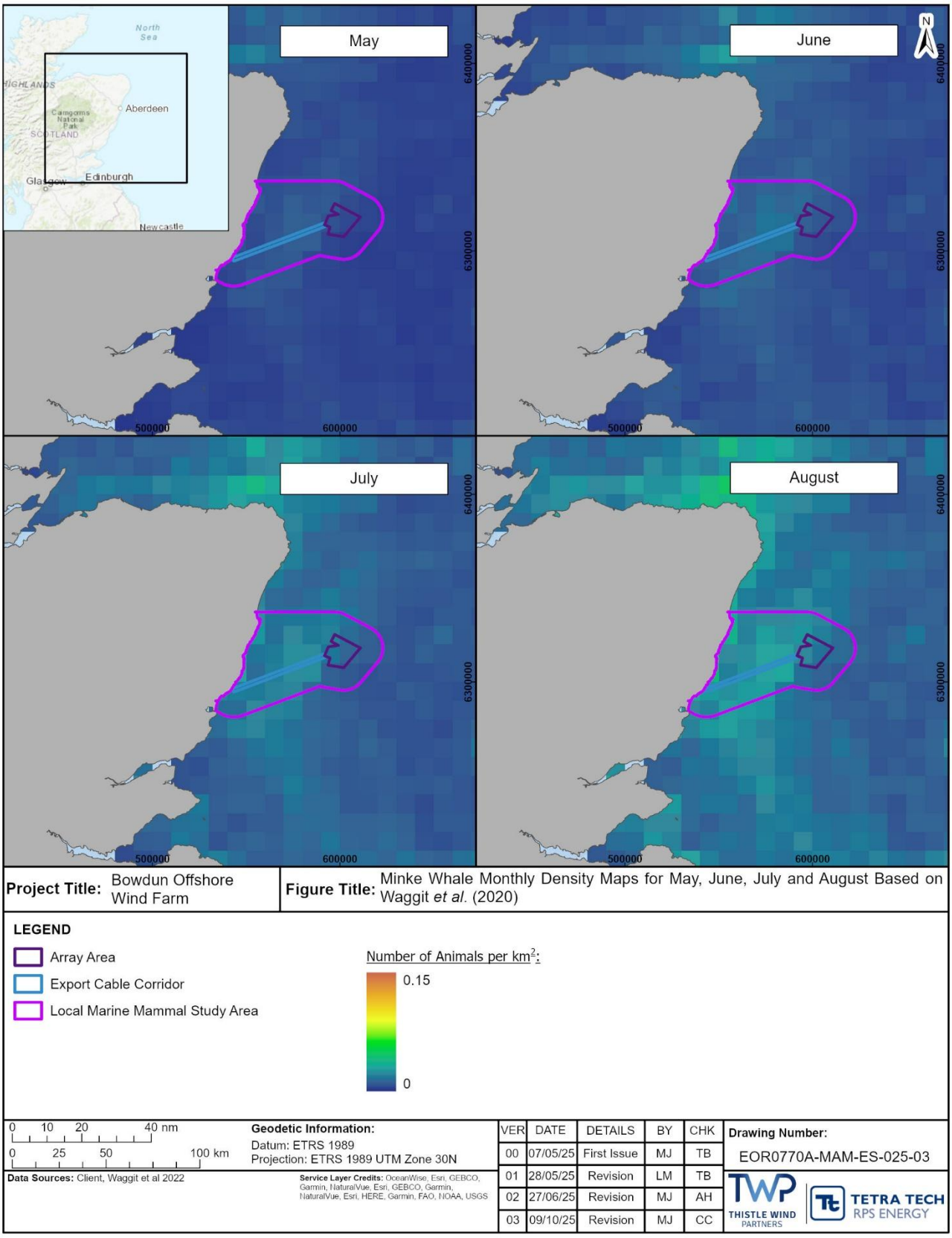


Figure 6.23: Minke Whale Monthly Density Maps for May, June, July and August Based on Waggitt *et al.* (2020)

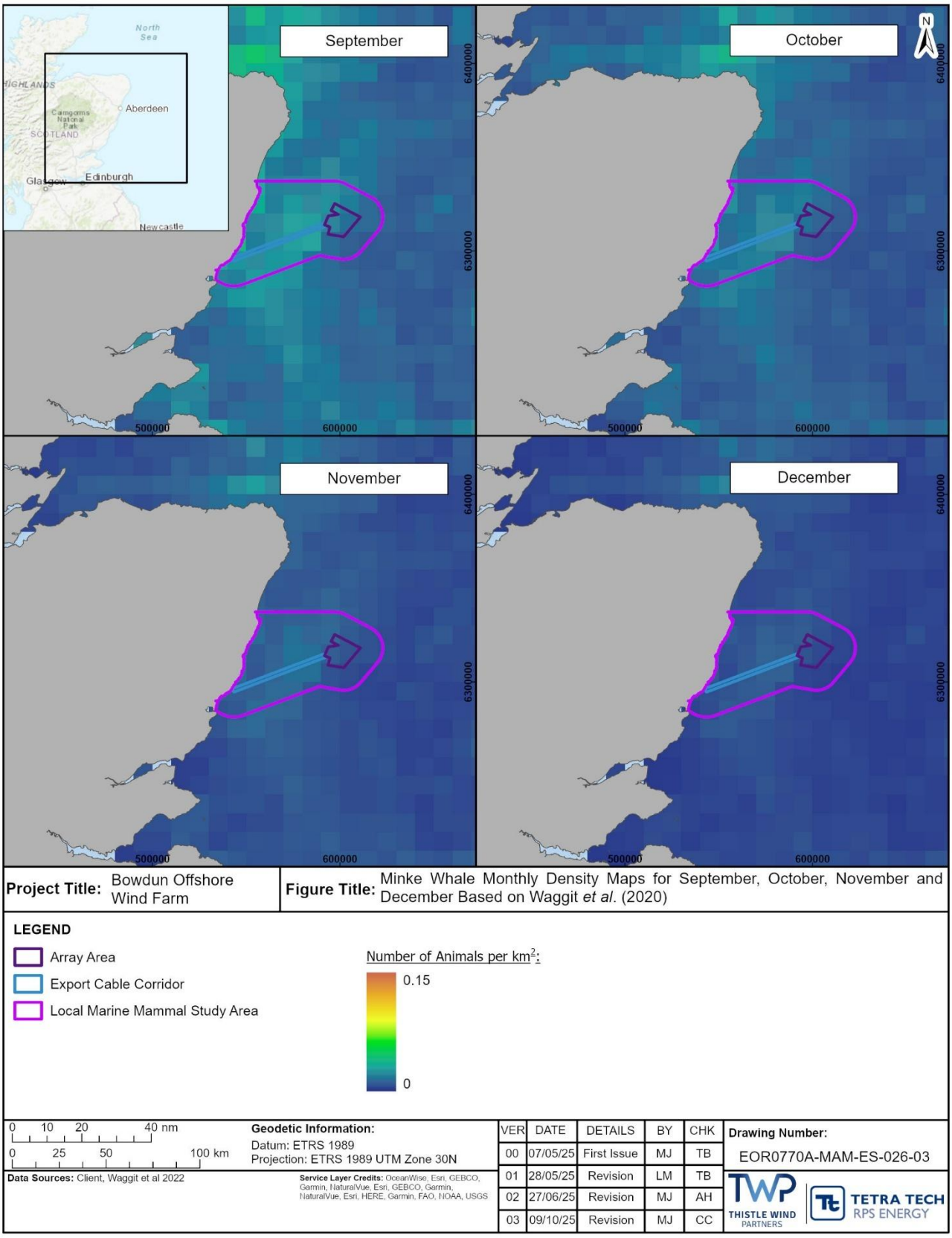


Figure 6.24: Minke Whale Monthly Density Maps for September, October, November and December Based on Waggitt *et al.* (2020)

Summary of the Densities

6.3.22 Minke whale ranges widely and can be observed throughout the northern North Sea.

6.3.23 When comparing available density estimates, all fall within the same order of magnitude. The density estimate derived from Lacey *et al.* (2022) for the Local Marine Mammal Study area from SCANS III reported a is 0.022 animals per km², while the SCANS III block R estimate from Hammond *et al.* (2021) was slightly higher at 0.0387 animals per km². Gilles *et al.* (2023) reported densities of 0.0419 animals per km² in block NS-D. The density estimate derived from Gilles *et al.* (2025) for the Local Marine Mammal Study area from SCANS IV is 0.030 animals per km², which aligns well with previous findings but represents a more precautionary value for this species.

6.3.24 While the higher density estimate in block NS-D reflects a snapshot of local conditions and should be interpreted in that context, the broader SCANS IV dataset analysed by Gilles *et al.* (2025) is considered more representative of regional conditions and therefore more suitable for informing impact assessments. Design-based density estimates from the Proposed Development DAS data indicate a lower mean density of 0.010 animals per km², and Waggitt *et al.* (2020) reported an estimate of approximately 0.023 animals per km². Nevertheless, given the comprehensive scope and recent nature of the SCANS IV data, along with its more conservative estimate for minke whale, a density of 0.030 animals per km² is considered the most appropriate and robust for minke whale, and will be applied to the impact assessment (Table 6.4).

Table 6.4: Comparison of Main Data Sources Density Estimates for Minke Whale

Source		Density (Animals per km²)
SCANS III	Block R (Hammond *et al.*, 2021)	0.0387
	(Lacey *et al.*, 2022)	0.022
SCANS IV	Block NS-D (Gilles *et al.*, 2023)	0.0419
	(Gilles *et al.*, 2025)	0.030
Site-specific DAS	Overall design-based mean (absolute) for the DAS Area	0.010
Waggitt *et al.* (2020)		0.023

Fin Whale

6.3.25 No fin whale were observed during the two years of Proposed Development DAS (Volume 3, Technical Appendix 10.2: Marine Mammal Digital Aerial Survey Report) and no density estimates are currently available for this region.

Ecology

6.3.26 The fin whale is a large mysticete belonging to the Balaenopteridae family, which includes all rorquals such as the blue whale *Balaenoptera musculus*, minke whale, and humpback whale. It is the second-largest animal on Earth, found in all major oceans, predominantly in deep, offshore waters of temperate and polar regions (Aguilar, 2009). At maturity, fin whale can reach lengths of up

to 27 m and weigh up to 80 tonnes (Jefferson *et al.,* 2008). Fin whale are characterised by their streamlined body, tall falcate dorsal fin located far back on the body, and distinctive asymmetrical colouring of the lower jaw; white on the right side and dark on the left (Aguilar, 2009; Evans and Waggitt, 2020).

6.3.27 Fin whale behaviour is largely influenced by seasonal changes, particularly relating to migration and feeding patters. Fin whale undertake long-distance migrations between high-latitude feeding grounds in summer and low-latitude breeding areas in winter (Aguilar, 2009). Fin whale are fast swimmers and are often seen alone or in small, fluid groups. Unlike humpback whale, fin whale are not known for acrobatic surface behaviours but may occasionally breach or produce powerful blows up to 6 m high (Evans and Waggitt, 2020). Fin whale are lunge feeders and feed by engulfing large volumes of water rich in prey. Fin whale diet includes small schooling fish (e.g. herring and capelin *Mallotus villosus*), squid, and zooplankton, especially euphasuiids such as krill (Watkins *et al.,* 1984; Løviknes *et al.,* 2021). There is limited data on prey availability in Scottish waters, but fin whale have been observed foraging on herring and other small pelagic species in the North Sea (Evans and Waggitt, 2020).

6.3.28 Historically, fin whale populations suffered severe declines due to intensive commercial whaling throughout the 19th and 20th centuries. Despite global bans, recovery has been slow and uneven across regions (Aguillar, 2009). In the North Atlantic, including UK waters, populations are showing signs of gradual recovery, with increasing sighting reports west of Scotland, and, more recently, off the east coast of the North Sea (Evans and Waggitt, 2020; Brownlow *et al.,* 2023). Fin whale remain vulnerable to anthropogenic threats such as ship strikes, entanglement in fishing gear, and acoustic disturbance from naval exercises and offshore developments (Edwards *et al.,* 2015; Espanda *et al.,* 2024).

Distribution and Occurrence

6.3.29 In the North Atlantic, fin whale predominately inhabit deep offshore waters beyond the continental shelf edge, favouring depths between 200 m and 2,000 m (Druon *et al.,* 2012). Fin whale distribution is closely linked to areas of high productivity, such as upwelling ones and frontal systems, where prey like krill and small school fish are abundant (Løviknes *et al.,* 2021). In UK waters, they are more frequently encountered off the west coast (particularly around the Hebrides and deep channels like the Rockall Trough), but occasional sightings have been reported in the North Sea (Boisseau *et al.,* 2011; Embling, 2008). Fin whale have been recorded in the Moray Firth, Aberdeen coast, and Firths of Forth and Tay (Brownlow *et al.,* 2023).

6.3.30 Long-term surveys and studies have indicated that fin whale distribution in the North Atlantic has remained relatively stable over the past few decades (Aguilar, 2009; Evans and Waggitt, 2020). However, occasional strandings and sightings along the east coast of Scotland suggest sporadic presence in these waters. Notably, a fin whale stranded on Balmedie Beach in June 2021, and another individual was observed off the Collieston coast in August 2021 (Brownlow *et al.,* 2023; SWF, 2024). These rare occurrences may be influenced by factors such

as prey availability, oceanographic conditions, and climatic changes affecting their migratory routes (Evans and Waggitt, 2020).

6.3.31 Fin whale were not recorded or identified during surveys for the Ossian OWF, Morven OWF, Berwick Bank Wind Farm, NNG OWF, and Seagreen OWF projects (MacLeod and Sparling, 2011; Sparling, 2012; SSE Renewables, 2022; Morven Offshore Wind Limited, 2023; Ossian OWFL, 2024). Whilst sightings and strandings of fin whale along the east coast of Scotland suggest their presence, there is not enough empirical evidence currently available to support the inclusion of a quantitative assessment of this species due to a lack of MU size or density estimate. Therefore, this species will be assessed qualitatively within the impact assessment.

Humpback Whale

6.3.32 No humpback whale were observed during the two years of DAS (Volume 3, Technical Appendix 10.2: Marine Mammal Digital Aerial Survey Report) and no density estimates are currently available for this region.

Ecology

6.3.33 The humpback whale is a medium-sized mysticete of the Balaenopteridae family, which includes all the rorquals and is found in all oceans of the world (Johnson and Wolman, 1984). At maturity, the humpback whale reaches lengths of up to 17 m and weighs approximately 40 tonnes (Hebridean Whale & Dolphin Trust (HWDT), 2023). Humpback whale are easy to distinguish from other baleen whale due to their distinctive appearance with exceptionally long flippers, which are one-fourth to one-third of their total body length (Johnson and Wolman, 1984, HWDT, 2023).

6.3.34 The behaviour of humpback whale varies according to the season (HWDT, 2023). During breeding periods in the tropics, humpbacks fast, relying on their large fat reserves built up during feeding season (Rizzo and Schulte, 2009). Male humpback whale sing long, complex songs during the breeding season, presumably to attract females and warn off rival males. These songs are known to vary between populations and change over time (HWDT, 2023). Humpback whale are normally seen as solitary individuals or in small groups of up to seven animals, and long-term associations are rare. Humpback whale can dive for up to 40 minutes and raise their tail fluke when making a deep dive (HWDT, 2023). There are no studies on the prey presence within the Scottish waters, however, humpback whale were reported to prefer sprat and herring in the Celtic Sea (Ryan *et al.*, 2014).

6.3.35 Following a severe decline due to commercial whaling, humpback whale populations in the North Atlantic region have been undergoing steady recovery during the latter part of the twentieth century (Johnson and Wolman, 1984, O'Neil *et al.*, 2019). In the western North Atlantic, entanglement in static fishing gear, namely crab and lobster creels (pots), is currently considered to be the largest source of anthropogenic mortality and injury for this species (Ryan *et al.*, 2016, Leaper *et al.*, 2022).

Distribution and Occurrence

6.3.36 Humpback whale are known for travelling long annual migration distances (Rizzo and Schulte, 2009). During summer, they spend their time in high latitudes, feeding as much as they can to create a thick blubber layer, but do not mate. In winter, they travel to low latitude areas, in tropical waters, where they mate and calve, fasting for long periods such as weeks or even months (Rizzo and Schulte, 2009). Studies focussing on humpback whale in feeding areas found preferences for areas of upwelling, high chlorophyll-a concentration and frontal areas with changes in temperature, depth and currents, where prey can be found in high concentration (Meynecke *et al.*, 2021). Preferred calving grounds were identified as shallow, warm and with slow water movement to aid the survival of calves (Meynecke *et al.*, 2021). Although they favour inshore waters and continental shelf areas, humpback whale travel through open waters during their migration (HWDT, 2023).

6.3.37 Ramp *et al.* (2015) investigated the temporal variation in the occurrence of humpback whale in a North Atlantic summer feeding ground, the Gulf of St. Lawrence (Canada), from 1984 to 2010 using a long-term study of individually identifiable animals. The study found that humpback whale shifted their date of arrival at a previously undocumented rate of more than one day per year earlier over the study period and that the departure date also shifted earlier (Ramp *et al.*, 2015). The analysis revealed that the trend in arrival was strongly related to earlier ice break-up and rising SST, likely triggering earlier primary production. The findings presented by Ramp *et al.* (2015) suggest that further changes to humpback whale distribution or annual life cycle may occur with ongoing climatic changes.

6.3.38 The first match from the British Isles to any breeding ground was made when a humpback whale photographed off Shetland, Scotland in 2016 was identified as having been seen off Guadeloupe in 2015 (Jones *et al.*, 2017). The calculated great-circle distance between these sighting locations is approximately 6,900 km. As reported by Ryan *et al.* (2022), humpback whale in Scottish waters have been matched within both recovering (western North Atlantic) and non-recovering (Cape Verde) breeding populations (HWDT, 2022).

6.3.39 In recent years, humpback whale sightings in the east of Scotland have been increasing. In 2017 and 2018 humpback whale were sighted in the Firth of Forth in the winter months, and given the seasonality of the sightings it was speculated that the Firth of Forth could be a migratory stopover or alternative destination for humpback whale on their migration south (O'Neil *et al.*, 2019). Since then, public sightings of humpback whale in the Firth of Forth have become more numerous, and sightings have occurred in the summers of 2021, 2022 and 2023 (Hague, 2023). Occasional public sightings of humpback whale have also occurred in the Moray Firth over the years (Marwood *et al.*, 2022).

6.3.40 Humpback whale were not sighted during the DAS (Volume 3, Technical Appendix 10.2: Marine Mammal Digital Aerial Survey Report) and no density estimates are available for humpback whale. While opportunistic sightings have suggested an increase of sightings of humpback whale in the Firth of Forth during winter months, there is not enough empirical evidence currently

available to support the inclusion of a quantitative assessment of this species due to a lack of MU size or density estimate. Therefore, this species will be assessed qualitatively within the impact assessment.

6.4 Pinnipeds

Grey Seal

Ecology

6.4.1 Grey seal is the larger of the two pinniped species that occur around the British Isles. Males weigh up to 300 kg, and females weigh up to 200 kg. The average lifespan for this species is between 20 and 30 years, however, females tend to live longer than males. Females mature between three and five years old, and males around six years, although they are probably not socially mature until eight years old (Hall and Thompson, 2009).

6.4.2 Grey seal breed, rest, moult and engage in social activity when they gather in colonies on land (known as Haul-Outs). Haul-Out events also occur at sea on exposed sandbanks, but their frequency is low, and their duration is, on average, shorter than those events on land (Russell and Lonergan, 2012).

6.4.3 Female grey seals tend to return to the same breeding site at which they were born to give birth. Preferred breeding locations in the UK include remote, uninhabited islands or coasts and a small number in caves (SCOS, 2022). These sites allow females with young pups to move away from busy beaches and storm surges inland. Seal may also breed on exposed, cliff-backed beaches, but these locations limit the opportunity to avoid storm surges, and it may result in higher levels of pup mortality (SCOS, 2022). In the UK, grey seal breed in the autumn, but there is a clockwise incline in the mean birth date around the UK (SCOS, 2022). Most pups in south-west Britain are born between August and October, in north and west Scotland, pupping occurs mainly between September and late November, in east Scotland, between August and December, and in eastern England, pupping occurs mainly between early November to mid-December. Grey seal give birth to a single, white-coated pup, which is weaned over a period of 17 to 23 days (SCOS, 2022). Pups shed their white natal coat (lanugo) and develop their first adult coat, with moult occurring when weaning, after which pups remain on the breeding colony for up to two to three weeks before going to sea. Following this, the female comes into oestrus and mating occurs, after which adult females return to sea to forage and build up fat reserves.

6.4.4 Along the Scottish coast, grey seal exhibit offshore foraging behaviour (Damseaux *et al.*, 2021). Wyles *et al.* (2022) studied the influence of geomorphological features of the seabed on the at sea behaviour of grey seal. The study found that features such as slopes, foot slopes and hollows attract grey seal individuals as these may host prey aggregations and/or lead to increased prey capture success. Grey seals have a selective diet. A study on the diet of grey seals in Scottish waters found that 50% of prey items were plaice *Pleuronectes platessa* and sole *Solea solea* and 46% of prey items were sandeels (Damseaux *et al.*, 2021). Hammond *et al.* (2005) also highlighted that the grey seal diet comprises primarily sandeels, gadoids and flatfish (in order

of importance) but varying seasonally and from region to region. Gosch (2017) also reported that there are significant regional and temporal differences in the diet of grey seal. Seal in shallow waters show a preference for demersal and groundfish species such as cephalopods and flatfish, while seal foraging in deeper waters, over sandy substrates, will target pelagic and benthopelagic species such as blue whiting *Micromesistius poutassou* and sandeels (Gosch, 2017).

6.4.5 Grey seals 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, 2022). During breeding season, grey seals tend to forage within 20 km from the breeding site (pers. comm. with NatureScot).

Distribution and Occurrence

6.4.6 Globally, grey seals concentrate in three regions: eastern Canada and the north-east USA, around the coast of the UK, especially in Scottish coastal waters, and the Baltic Sea. All populations are known to be increasing, however, numbers are still relatively low in the Baltic, where the population was reduced by human exploitation and pollution (SCOS, 2022; Galatius *et al.*, 2020).

6.4.7 The Proposed Development is located within the East Scotland SMU, and although no clear patterns in the distribution of grey seal across the Local Marine Mammal Study Area can be concluded based on DAS sightings the telemetry data suggest connectivity between the East Scotland SMU, the Moray Firth SMU and the North Coast and Orkney SMU. Therefore, all three SMUs are presented here.

6.4.8 The latest Haul-Out counts for the East Scotland SMU and the Moray Firth SMU are from 2021 (SCOS, 2022), the latest counts for the North Coast and Orkney SMU are from 2019 (SCOS, 2020). In the North Coast and Orkney SMU, grey seal Haul-Out sites are concentrated around Orkney (Figure 6.25). Within the Moray Firth SMU, the largest concentrations of Haul-Outs can be found around Helmsdale (Figure 6.25). In the East Scotland SMU, Haul-Out sites are concentrated around sites in the Firth of Forth and the Tay and Eden estuaries as well as further north around Peterhead and Fraserburgh (Figure 6.25).

6.4.9 In the North Coast and Orkney SMU, the largest Haul-Out count around Orkney was 268 at Seal Skerry (North Ronaldsay, south-west Westray) and along the North Coast were 97 seals at St John's Point. The most recent August count of grey seals in the North Coast and Orkney SMU is 8,599 (SCOS, 2020). The largest Haul-Out count in the Moray Firth SMU in 2021 was 482 grey seals made around Gizzen Briggs. The largest Haul-Out count in the East Scotland SMU was in 2016 where 1,924 grey seals were found at the mouth of the River Ythan (Annex A; Marwood and Stevens, 2024). The most recent August count of grey seals in the East Scotland SMU is 2,712 (SCOS, 2022). In 2021, the largest Haul-Out site in the East Scotland SMU was at Abertay Sands where 1,360 grey seals were counted (Annex A; Marwood and Stevens, 2024). A further 98 grey seals were counted within the Isle of May SAC (Annex A; Marwood and Stevens 2024). The

most recent August count of grey seals in the Moray Firth SMU is 1,856 (SCOS, 2022).

6.4.10 In order to provide detail on seal movement patterns at sea and potential connectivity between areas, such as SMUs, a report was authored by SMRU Consulting (see Paragraphs 4.5.16 to 4.5.17) (Annex A; Marwood and Stevens, 2024) within the vicinity of the Local Marine Mammal Study Area. A total of 74 grey seals of all ages were tagged in the East Scotland SMU between 1990 and 2014 (Annex A; Marwood and Stevens, 2024). Of these tagged individuals, 44 were adults and juveniles (>1 year old), one was of unknown age (also >1 year old) and 29 were pups. A further 48 grey seals were tagged outside the East Scotland SMU but were tracked within it: 16 were tagged in the North Coast and Orkney SMU, one in the Southeast England SMU, five in the Moray Firth SMU and 26 in the Northeast England SMU (Annex A; Marwood and Stevens, 2024). This resulted in a total of 122 grey seal tracks within the East Scotland SMU (Annex A; Marwood and Stevens, 2024).

6.4.11 From this telemetry report (Annex A; Marwood and Stevens, 2024), of the total 77 adult and juvenile grey seal that were either tagged in or entered into the East Scotland SMU, 22 were tracked within the Local Marine Mammal Study Area as well as at least one grey seal SAC (Figure 6.26). Connectivity between the Local Marine Mammal Study Area and the Isle of May SAC was observed in ten adult grey seal, whilst 18 adult grey seal were observed to have connectivity with the Berwickshire and North Northumberland SAC. Of these individuals, 11 entered both the Isle of May SAC and Berwickshire and North Northumberland SAC, whilst only one adult grey seal recorded in the Berwickshire and North Northumberland SAC was also detected in the Humber SAC (Annex A; Marwood and Stevens, 2024). Two adults recorded in the Berwickshire and North Northumberland SAC as well as the Local Marine Mammal Study Area were also the only individuals recorded in the North Rona SAC and Monarch Islands SAC. Connectivity was also noted between the Local Marine Mammal Study Area and the Faray and Holm of Faray SAC, as this site was visited by three adult grey seals, two of which were also detected in the Berwickshire and North Northumberland SAC (Annex A; Marwood and Stevens, 2024).

6.4.12 Movement data was also obtained from the telemetry tags on 44 pups and juveniles, with individuals tagged in the East Scotland SMU (Figure 6.27). It is important to note that pup and juvenile movements 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 (Annex A; Marwood and Stevens, 2024).

6.4.13 Over the ten surveys conducted for Ossian OWF, grey seals were observed year-round, with a total of 26 individuals recorded. June 2021 had the highest number of grey seals sighted, six, with numbers ranging between one and four individuals in other months. Telemetry data indicated low to moderate grey seal usage across most of the Array Area, with densities ranging from >1 to 5 animals per 25km^2, increasing to >10 to 50 animals per 25km^2 in certain western sections (Stevens, 2023).

6.4.14 Surveys at the Berwick Bank Wind Farm recorded 180 grey seals. Telemetry data from 69 adult grey seals tagged on the east coast of Scotland showed that 59 had tracks within the Array Area. A significant proportion of these seals were tracked between Berwick Bank Wind Farm and the Berwickshire and North Northumberland SAC (73%) and the Isle of May SAC (41%), indicating strong connectivity. Density estimates within the Array Area averaged 1.2 seal per km^2, with higher densities (up to 4.35 animals per km^2) nearshore along the Export Cable Corridor (SSE Renewables, 2022).

6.4.15 While specific grey seal data for the NNG OWF and Seagreen OWF are not detailed in the public domain, historical surveys in the Firth of Forth Round 3 area, which includes these sites, recorded 992 grey seals and 97 unidentified seal species (Sparling, 2012). These findings suggest that grey seal are present and likely to occur year-round within these areas.

6.4.16 Specific information regarding grey seal sightings at the Morven OWF was not available.

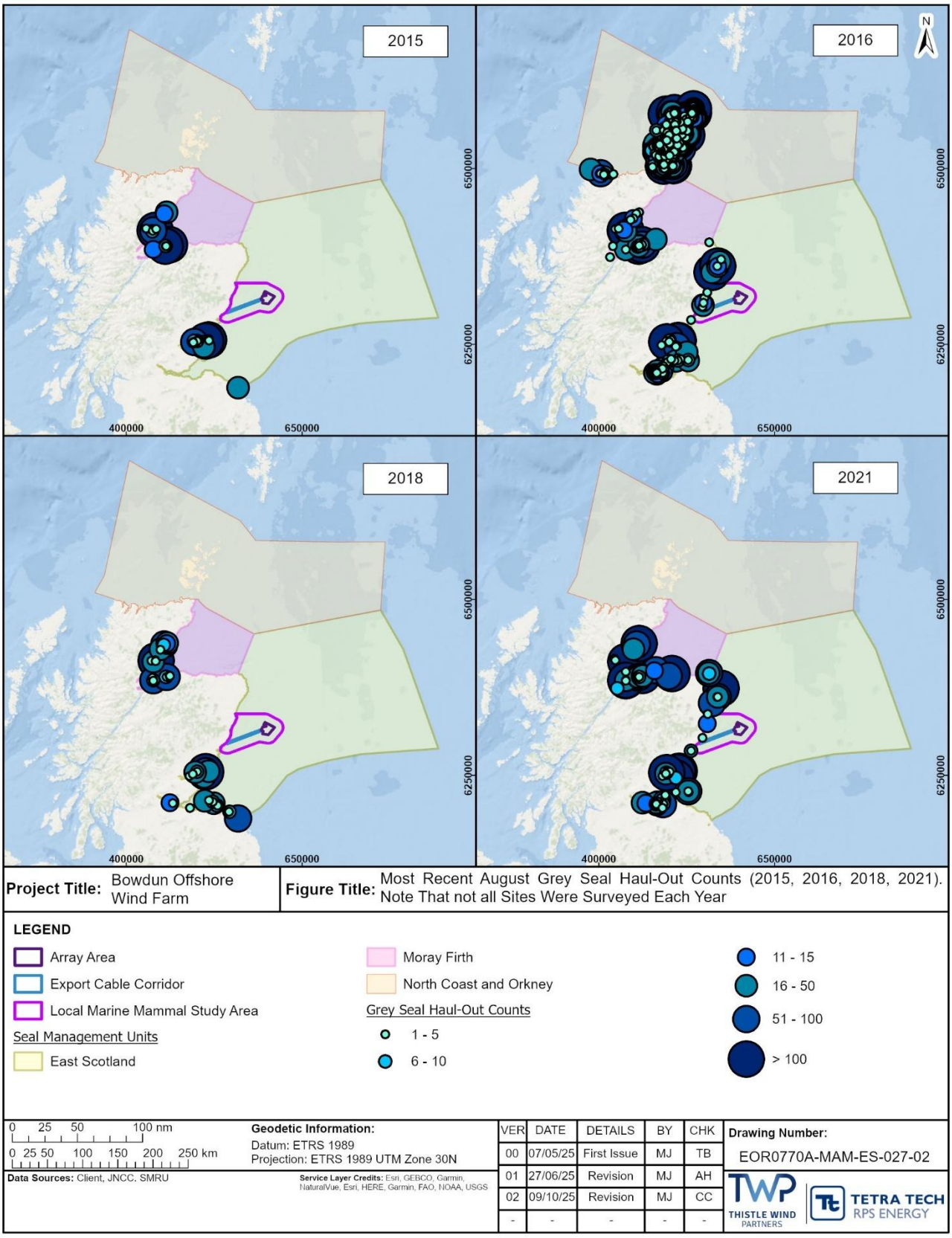


Figure 6.25: Most Recent August Grey Seal Haul-Out Counts (2015, 2016, 2018, 2021). Note That not all Sites Were Surveyed Each Year

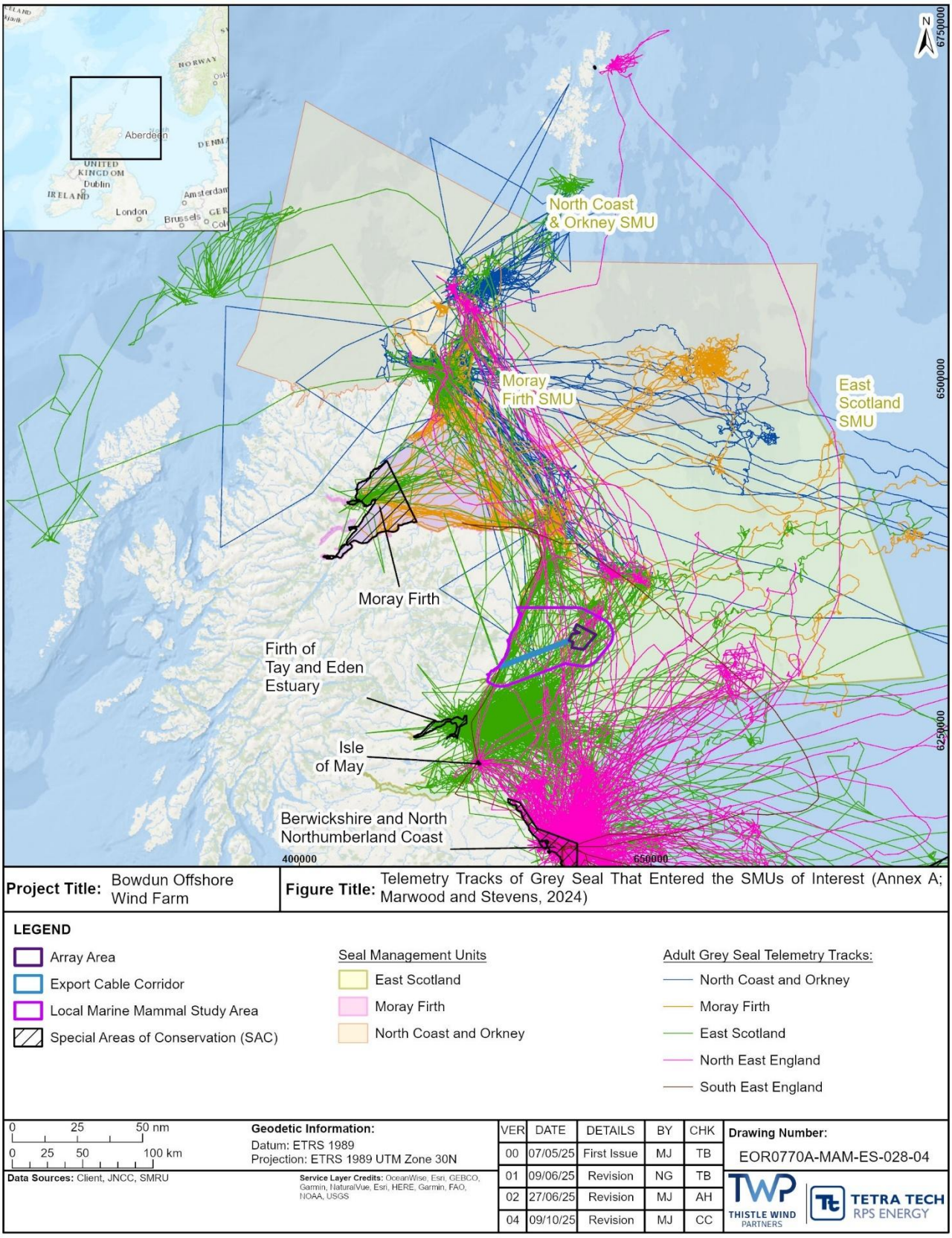


Figure 6.26: Telemetry Tracks of Grey Seal That Entered the SMUs of Interest (Annex A; Marwood and Stevens, 2024)

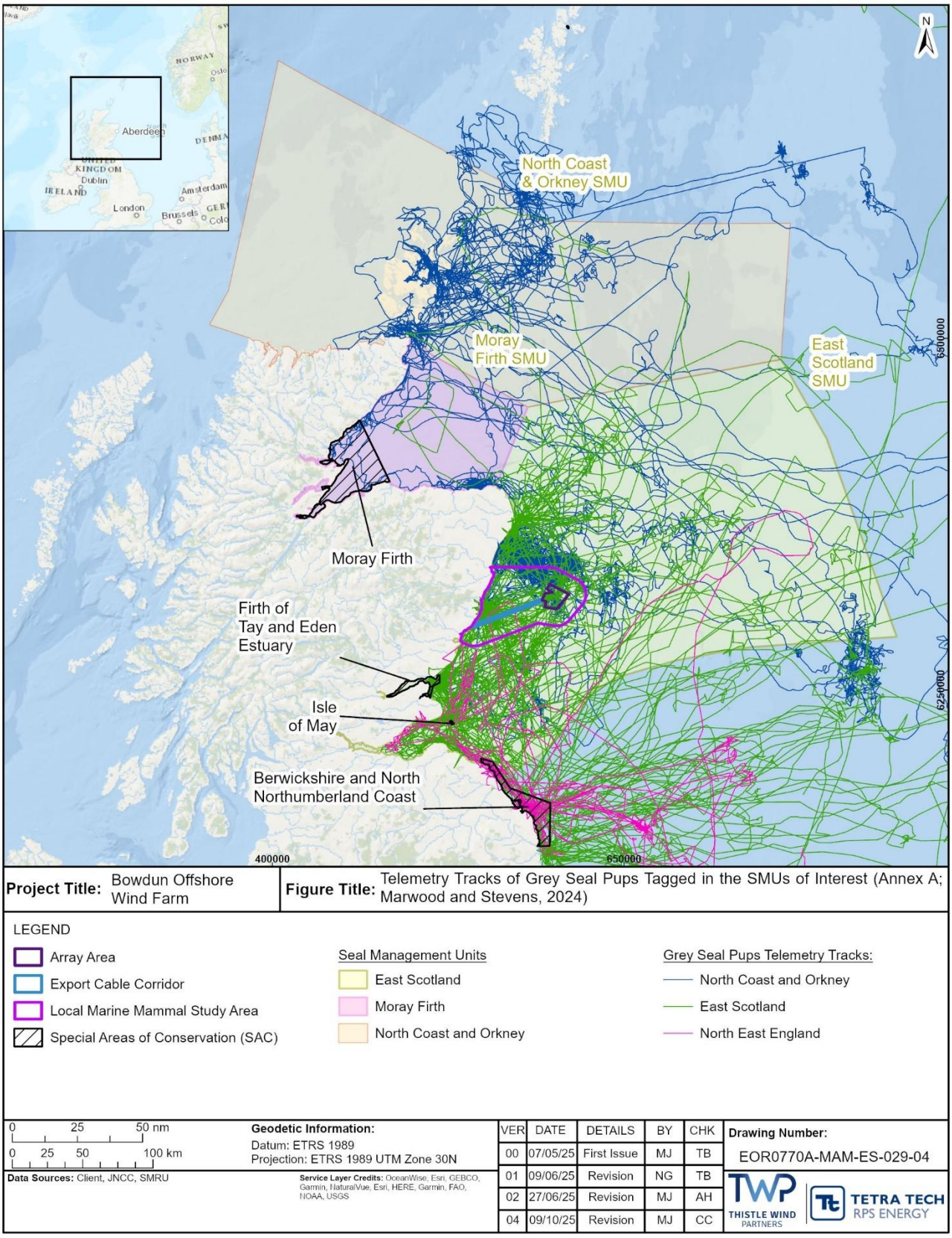


Figure 6.27: Telemetry Tracks of Grey Seal Pups Tagged in the SMUs of Interest (Annex A; Marwood and Stevens, 2024)

Density/Abundance

Site-specific DAS

6.4.17 Grey seals were observed in high numbers during the DAS with no clear temporal trends visible in monthly surveys.

6.4.18 For the DAS Area, the design-based approach gave mean absolute densities of 0.091 and 0.134 animals per km^2 for the breeding and non-breeding season, respectively. The mean absolute density estimate across all transects and all monthly surveys for the 24-month survey period, with bootstrapping, was estimated as 0.120 animals per km^2 (CV = 0.852). The mean absolute density from the model-based approach was 0.213 for the breeding season (CV = 0.775) and 0.312 for the non-breeding season (CV = 0.775). The overall mean density estimate was 0.056 animals per km^2 (CV = 1.117).

6.4.19 For the Extended DAS Area, the mean design-based absolute density was 0.332 animals per km^2 (95% CL: 0.106, 0.706; CV = 1.644).

Seasonality

6.4.20 Based on the Proposed Development DAS, no clear temporal trends or seasonality were visible in monthly DAS sightings of grey seal (Table 5.2) though densities were higher during the non-breeding season (see Paragraph 6.4.18).

6.4.21 Higher encounter rates of grey seals at sea during summer are likely to be related to the capital breeding habit of grey seals and possibly indicative of a period of intense foraging where adult seals are at sea, gaining energy reserves prior to the breeding season (Russell and McConnell, 2014). During autumn (August to December), grey seals aggregate to breed at traditional colonies between August and December (Annex A; Marwood and Stevens, 2024), and therefore, the number of seals at sea might be expected to be low as a large proportion of the population will be hauled out to breed.

Published Literature

6.4.22 Grey seals encountered during harbour seal August moult surveys are counted during SMRU surveys as these provide valuable information on their summer distribution. However, at this time of year, grey seal numbers at Haul-Outs can be more variable from day to day and, therefore, are not an accurate reflection of grey seal abundance in each region. The UK-wide grey seal population is estimated using a population model that combines regional pup production estimates and August Haul-Out counts scaled to population estimates (Annex A; Marwood and Stevens, 2024).

6.4.23 In 2019, total UK pup production was estimated at 67,850 (95% CI: approximately 60,500 to 75,100) based primarily on estimates from less frequently aerial surveyed colonies as well as ground count data (Annex A; Marwood and Stevens, 2024). Pup production in Scotland in 2019 was estimated at 54,050 individuals, equating to approximately 79.7% of all pups born in the UK (Annex A; Marwood and Stevens, 2024). The overall trend in pup production in the East Scotland SMU has been increasing in recent years, with an increase of approximately 28% observed between 2014 and 2019 (SCOS, 2022). The total estimated pup count across all grey seal colonies in the East Scotland SMU is

7,268 pups (SMRU pup database, from Annex A; Marwood and Stevens, 2024). However, the distribution of pup production appears to be changing (Annex A; Marwood and Stevens, 2024). Prior to the 1990s, the Isle of May SAC was the dominant location for pup production, but since 2012, pup production estimates at the Isle of May have been overtaken by the Fast Castle colony (Annex A; Marwood and Stevens, 2024). Pup production estimates at the Isle of May are now considered to be stable or potentially declining (SCOS, 2022).

6.4.24 The latest population estimate for the entire East Scotland SMU (scaled to account for those at sea at the time of the count) is 10,784 grey seals, based on 2016-2019 survey counts).

6.4.25 The latest population estimate for the entire North Coast and Orkney SMU (scaled to account for those at sea at the time of the count) is 34,191 grey seals, based on 2016-2019 survey counts). The population has fluctuated over recent survey periods but appears to be increasing, with the 2016 to 2019 population estimate having increased by 6% from the previous survey period (Annex A; Marwood and Stevens, 2024).

6.4.26 The latest population estimate for the entire Moray Firth SMU (scaled to account for those at sea at the time of the count) is 7,380 grey seals, based on 2021 survey counts. The population has fluctuated over recent survey periods but appears to be increasing, with the 2021 population estimate having increased by 12% from the previous survey period. The UK total grey seal population size at the start of the 2022 breeding season was estimated to be 162,000 grey seals, of which 129,100 (approximately 80%) were in Scotland (Annex A; Marwood and Stevens, 2024).

6.4.27 Mean grey seal at-sea usage within the Local Marine Mammal Study Area is high (Figure 6.28). The average value of the mean at-sea usage within the Local Marine Mammal Study Area was estimated at 14.02 animals per 5 x 5 km grid cell, equating to a density estimate of 0.56 animals per km^2 (Carter *et al.*, 2022) (Figure 6.28). In comparison, Carter *et al.* (2025) reported a lower average mean at sea usage of 9.89 animals per 5 x 5 km grid cell, equating to a density estimate of 0.40 animals per km^2 (Figure 6.29).

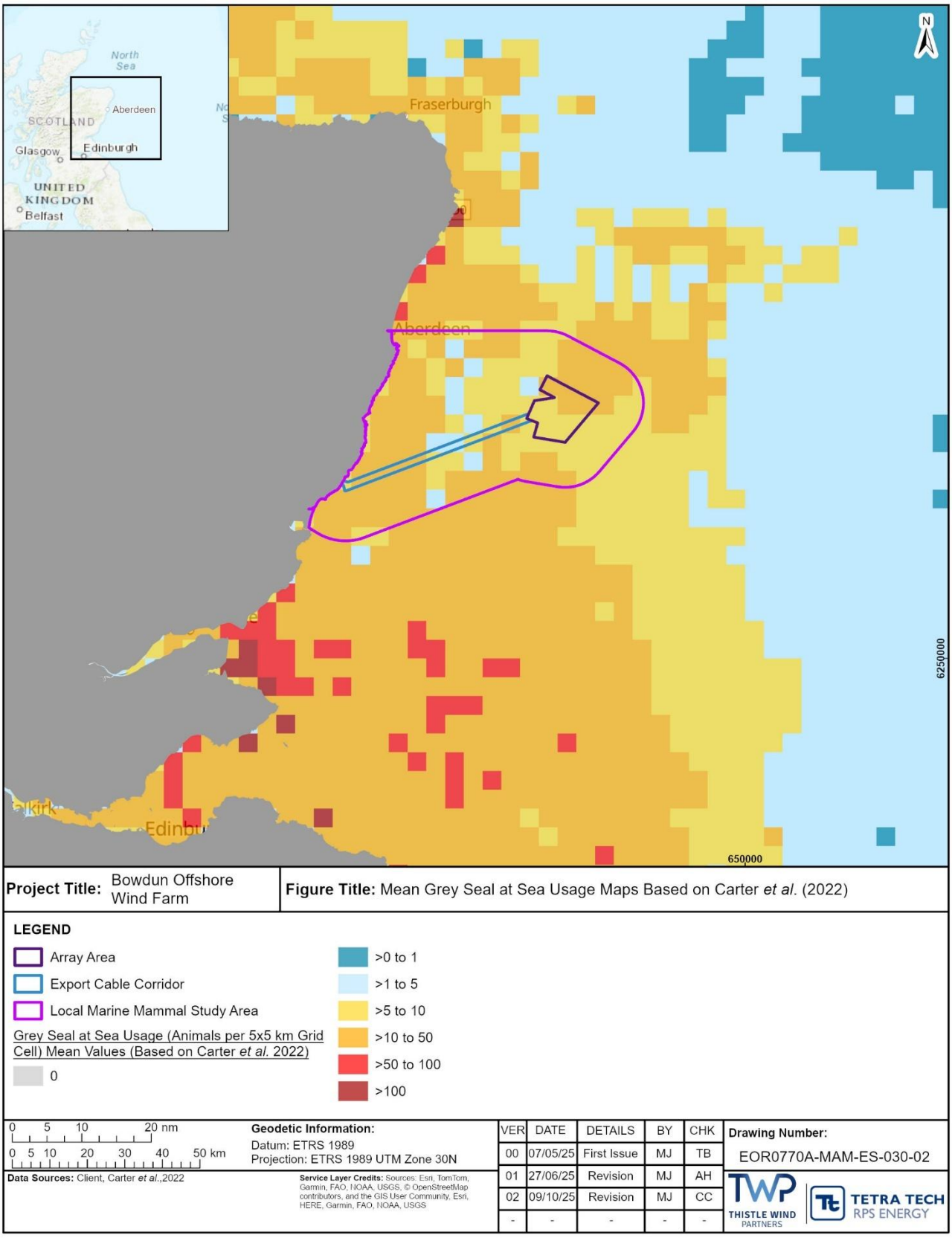


Figure 6.28: Mean Grey Seal At-Sea Usage Maps Based on Carter *et al.* (2022)

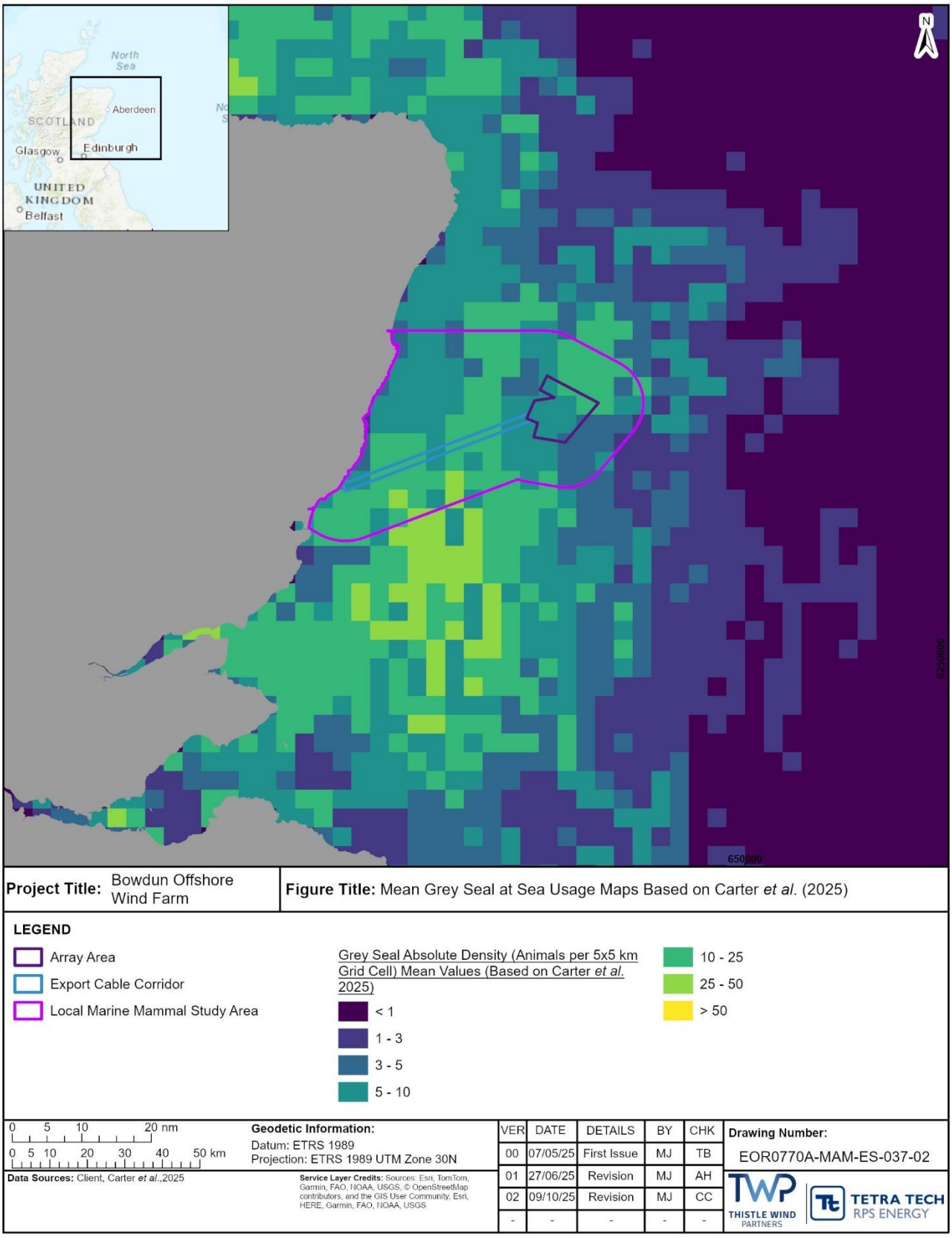


Figure 6.29: Mean Grey Seal At-Sea Usage Maps Based on Carter *et al.* (2025)

Summary of the Densities

6.4.28 The east coast of Scotland provides important breeding and Haul-Out habitats for grey seal (SCOS, 2023).

6.4.29 The density estimate derived from Carter *et al.* (2022) for the Local Marine Mammal Study Area of 0.56 animals per km^2 is more precautionary than both the equivalent density estimate derived from Carter *et al.* (2025) and the design-based (absolute) density estimate of 0.120 animals per km^2 (Table 6.5) from DAS data. As such, the density estimate of 0.56 animals per km^2 will be taken forward for assessment as it is more precautionary than the equivalent density estimate for grey seal derived from Carter *et al.* (2022) and represents more recent data

Table 6.5: Comparison of Main Data Sources Density Estimates for Grey Seal

Source		Density (Animals per km^2)
Carter *et al.* (2022)		0.56
Carter *et al.* (2025)		0.40
Site-specific DAS	Design-based (absolute)	0.120
	Model-based (absolute)	0.056

Harbour Seal

Ecology

6.4.30 Harbour seals typically weigh between 80 kg and 100 kg and are the smaller of the two species of pinniped that breed in the UK (SCOS, 2022). Harbour seals become sexually mature at four to six years old for males and three to five years of age for females (Lowry, 2016). Harbour seals are long-lived animals with individuals estimated to live to between 20 and 30 years (SCOS, 2022).

6.4.31 Harbour seals are central place foragers and come ashore in sheltered waters, often on sandbanks and in estuaries as well as rocky areas (SCOS, 2022). This species requires Haul-Out sites on land for resting, moulting, breeding, and dispersing from these sites to forage at sea. 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 seals persist in discrete metapopulations and tend to stay within 50 km of the coast (Carter *et al.*, 2022), although most foraging trips are over shorter ranges (Russell and McConnell, 2014). Harbour seal are generalist feeders, and their diet varies seasonally and regionally (Hammond *et al.*, 2005). The analysis of stable isotopic composition and concentration of mercury and selenium ions in blood of harbour seal from the North Sea demonstrated that harbour seal diet is comprised of 30% juvenile cod, 29% of plaice and 23% of monkfish *Lophius piscatorius* as well as European hake *Merluccius merluccius* and haddock (Damseaux *et al.*, 2021).

6.4.32 Harbour seals breed in small groups scattered along the coastline. Pups are born in June and July, having moulted their white coats prior to birth. 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, 1994). In recent years, 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 (Annex A; Marwood and Stevens, 2024). Given that no harbour seal breeding surveys were conducted in east Scotland, these are not considered further in this report.

6.4.33 The annual moult of harbour seals in Scotland occurs in August, when the greatest and most consistent numbers of harbour are hauled out ashore (SCOS, 2022). The main harbour seal population surveys are carried out when seal are moulting.

Distribution and Occurrence

6.4.34 Harbour seals are found around the North Atlantic and north Pacific coasts from the subtropics to the Arctic (SCOS, 2022). The largest population of harbour seals in Europe is in the Wadden Sea currently, approximately 32% of the harbour seal population are found in the UK (SCOS, 2022). Harbour seals are widespread around the west coast of Scotland and throughout the Hebrides and Northern Isles. On the east coast, their distribution is more restricted, with concentrations in the major estuaries of the Thames, the Wash, the Firths of Forth and Tay, and the Moray Firth.

6.4.35 Major declines have now been documented in several harbour seal populations along the east coast of England and around Scotland (SCOS, 2022). The pattern of declines is not universal, for example, the decline following the 1998 phocine distemper virus outbreak in England affected mostly the Wash population but had a limited impact elsewhere (SCOS, 2022). A sudden change in the East Scotland SMU population trend was observed in 2002, and the nature of this change remains unknown (Annex A; Marwood and Stevens, 2024).

6.4.36 The Proposed Development is located within the East Scotland SMU, and although no clear patterns in the distribution of harbour seal across the Local Marine Mammal Study Area can be concluded based on DAS sightings (as only three individuals were recorded) the telemetry data suggest connectivity between the East Scotland SMU and the Moray Firth SMU (Annex A; Marwood and Stevens, 2024). Therefore, both SMUs are presented here.

6.4.37 The most recent August Haul-Out count for the whole of Scotland is for the period 2016 to 2019 and 2021, where 26,378 harbour seals were counted (Annex A; Marwood and Stevens, 2024). There was a total count of 30,855 harbour seals in the UK from 2016 to 2021 equating to an estimated population of approximately 42,854 harbour seals in the UK (excluding the Republic of Ireland) (Annex A; Marwood and Stevens, 2024).

6.4.38 The latest Haul-Out counts for the East Scotland SMU are from 2021 (SCOS, 2022), with a count of 262 harbour seals. Within the East Scotland SMU, Haul-Out sites are concentrated around sites in the Firth of Forth and the Dee estuary as well as the Lunan Bay which are at the northern and southern, respectively, extent of the Local Marine Mammal Study Area on the coast of Scotland (Figure 6.30). Historically, the largest Haul-Out sites were located in the Firth of Forth Tay and Eden Estuaries, but have been declining since 1990 (Annex A; Marwood and Stevens, 2024). The largest Haul-Out count in the East Scotland SMU was in 2002 where 192 harbour seals were found at Outhead on the Eden Estuary (Annex A; Marwood and Stevens, 2024). In 2021, the largest Haul-Out site in the East Scotland SMU was at Chapel Garden Rocks in West Wemyss where 41 harbour seals were counted (Annex A; Marwood and Stevens, 2024).

6.4.39 In order to provide detail on seal movement patterns at sea and potential connectivity between areas, such as SMUs, a report authored by SMRU Consulting (see Paragraph 4.5.16 to 4.5.17) (Annex A; Marwood and Stevens, 2024) has provided this for seal within the vicinity of the Local Marine Mammal Study Area. This telemetry data confirmed that harbour seal usage within the Local Marine Mammal Study Area is very limited. Between 2001 and 2013, 46 harbour seals were tagged in the East Scotland SMU. All seals tagged within the East Scotland SMU were adults. In addition to these telemetry tracks, a further two harbour seals tagged in the Moray Firth SMU were tracked within the East Scotland SMU (Figure 6.31; Annex A; Marwood and Stevens, 2024). In total, there were 48 harbour seals tracked within the SMUs of interest and of these, nine had telemetry track data recorded within the Local Marine Mammal Study Area (Figure 6.31) (Annex A; Marwood and Stevens, 2024). All nine of these individuals were tagged within the Firth of Tay and Eden Estuary SAC in the East Scotland SMU, thus showing connectivity between the SAC and the Local Marine Mammal Study Area (Figure 6.32). None of these individuals showed connectivity with harbour seal SACs outside of the East Scotland SMU.

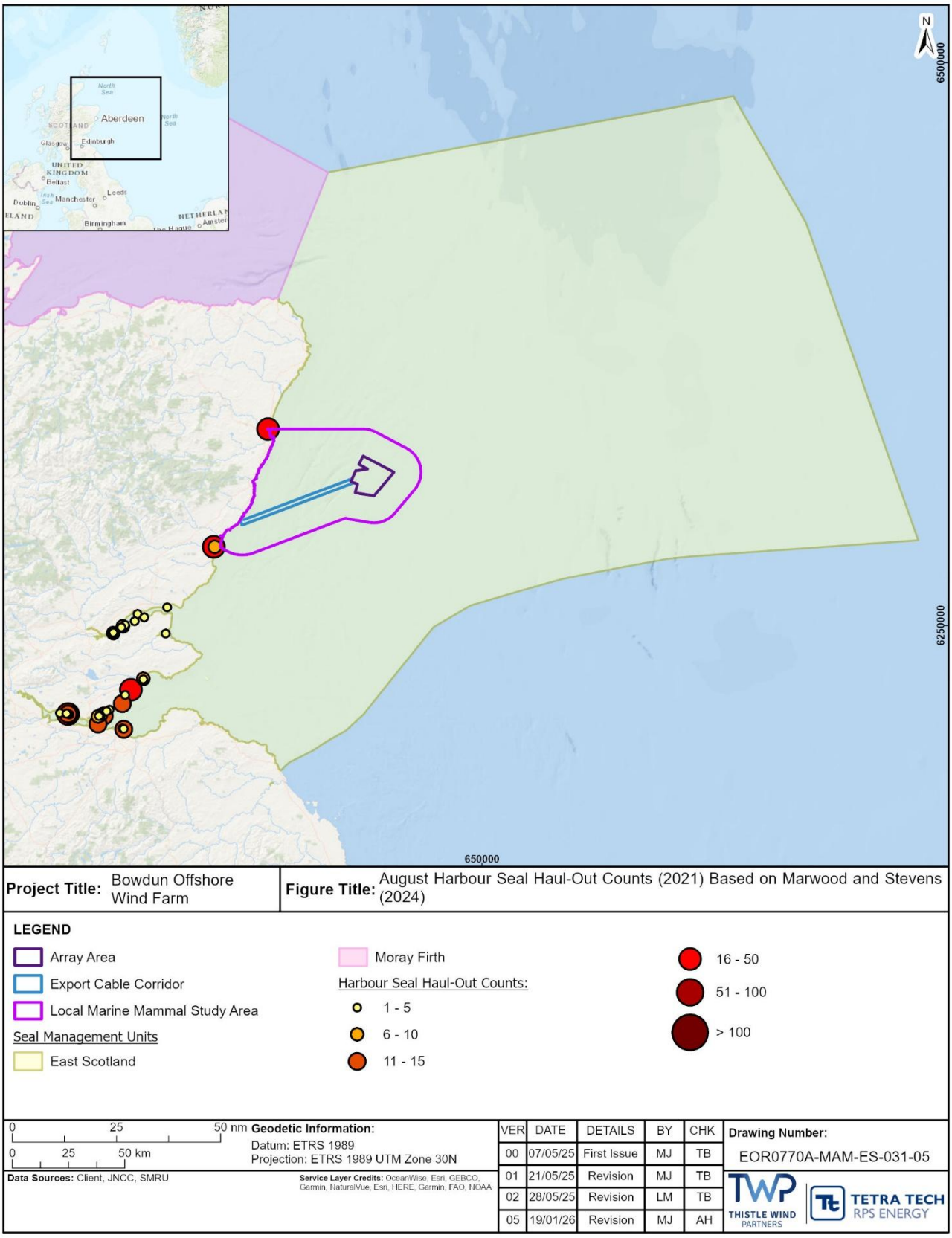


Figure 6.30: August Harbour Seal Haul-Out Counts (2021) Based on Marwood and Stevens (2024)

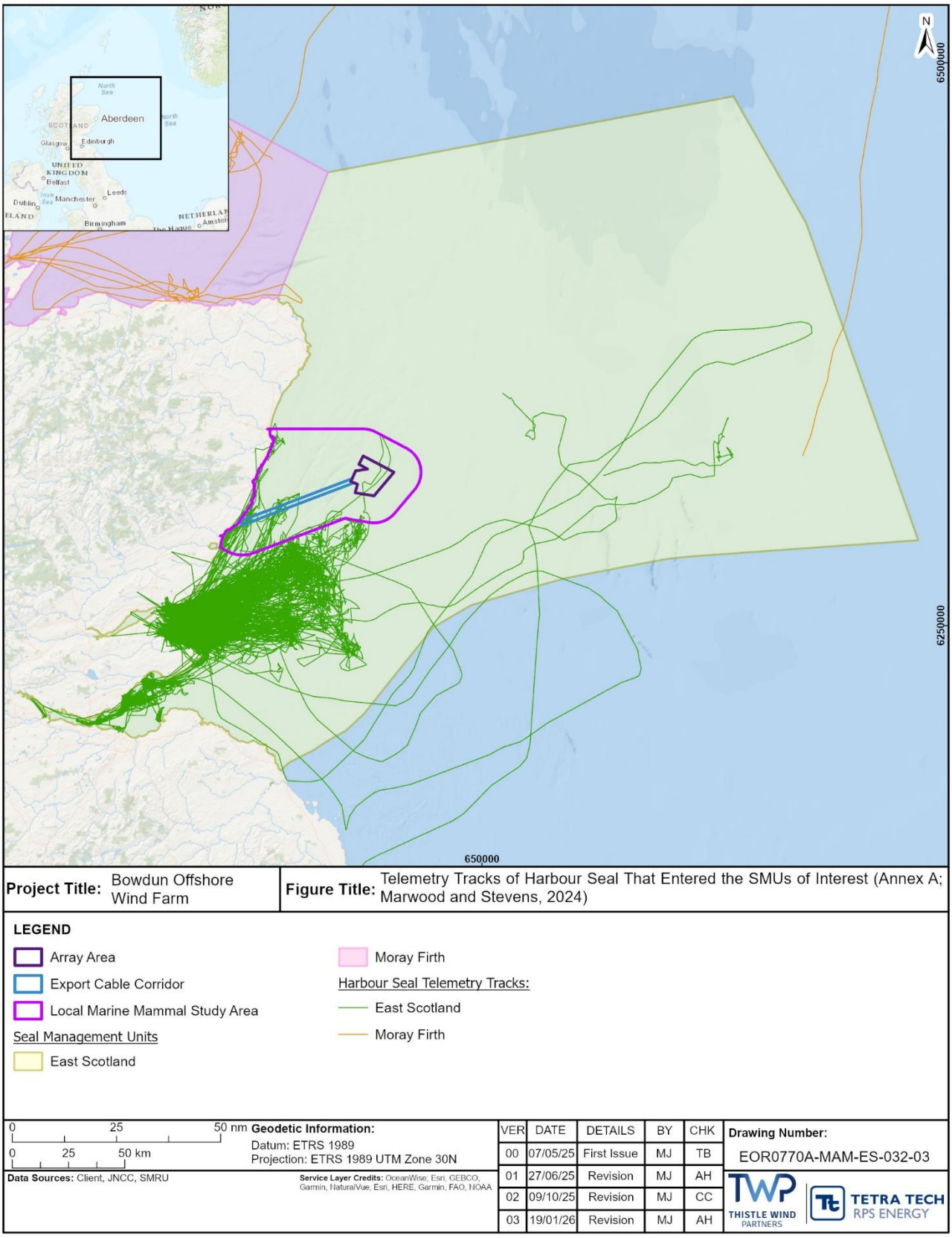


Figure 6.31: Telemetry Tracks of Harbour Seal That Entered the SMUs of Interest (Annex A; Marwood and Stevens, 2024)

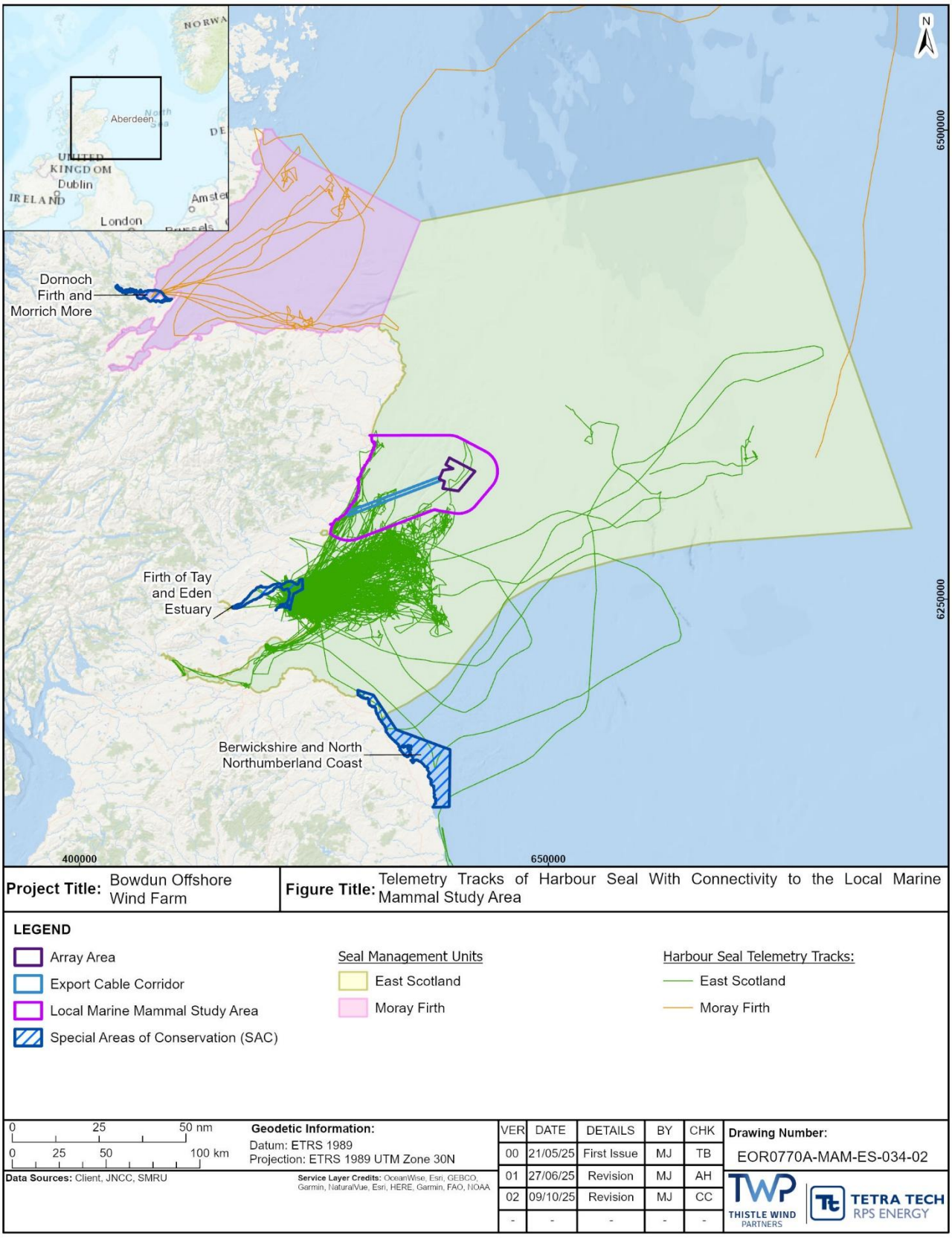


Figure 6.32: Telemetry Tracks of Harbour Seal With Connectivity to the Local Marine Mammal Study Area (Annex A; Marwood and Stevens, 2024)

Density/Abundance

Site-specific DAS

6.4.40 Harbour seal was only recorded in two surveys of DAS (March and June 2022), with a total of three harbour seal sighted. Therefore, given the low numbers recorded, neither design nor model-based density and abundance estimates for this species are available.

Seasonality

6.4.41 No clear patterns in seasonality of harbour seal can be concluded based on DAS or historic survey sightings (Figure 4.1) due to low numbers of animals identified to species level (Volume 3, Technical Appendix 10.2: Marine Mammal Digital Aerial Survey Report).

Published Literature

6.4.42 The main population surveys occur when harbour seal are moulting during the first three weeks of August. The most recent August Haul-Out count for the whole of Scotland is for the period 2016 to 2019 and 2021, where 26,378 harbour seals were counted (Annex A; Marwood and Stevens, 2024). There was a total count of 30,855 harbour seals in the UK from 2016 to 2021 equating to an estimated population of approximately 42,854 harbour seals in the UK (excluding the Republic of Ireland) (Annex A; Marwood and Stevens, 2024).

6.4.43 The latest population estimate for the entire East Scotland SMU (scaled to account for those at sea at the time of the count) is 364 harbour seals, based on 2021 survey counts (SCOS, 2022). This population has been in decline since the 1996 to 1997 survey period when the highest counts of 764 individuals were recorded. In the 2016-2019 survey block, the Haul-Out counts within the East Scotland SMU had increased for the first time since the decline, to 343 harbour seals but have since declined again in the most recent 2021 surveys to 262 individuals (SCOS, 2022).

6.4.44 The latest population estimate for the entire Moray Firth SMU (scaled to account for those at sea at the time of the count) is 958 harbour seals based on 2021 survey counts (SCOS, 2022). The Moray Firth SMU population has not shown any significant trend since 2003. The count declined by approximately 50% before 2005 and has fluctuated since, but it is stable at a depleted level after these recent declines (SCOS, 2022).

6.4.45 Mean harbour seal at-sea usage within the Local Marine Mammal Study Area is very low, with mean usage of 0.203 animals per 5 x 5 m grid cell, equating to a density estimate of 0.008 animals per km^2 (Carter *et al.*, 2022) (Figure 6.33). In comparison, Carter *et al.* (2025) reported a slighter higher average mean at-sea usage of 0.236 animals per 5 x 5 km grid cell, equating to a density estimate of 0.009 animals per km^2 (Figure 6.34).

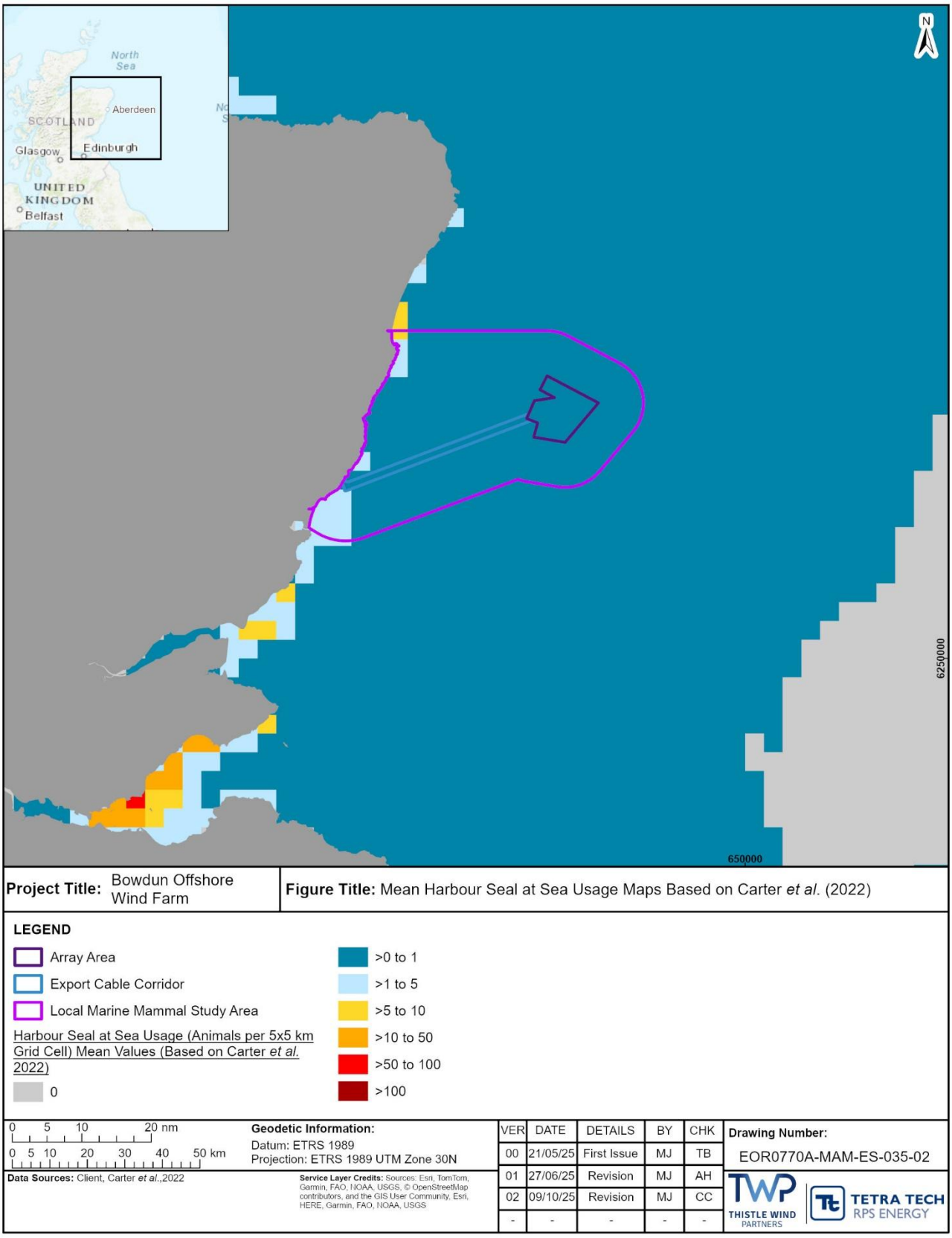


Figure 6.33: Mean Harbour Seal At-Sea Usage Maps Based on Carter *et al.* (2022)

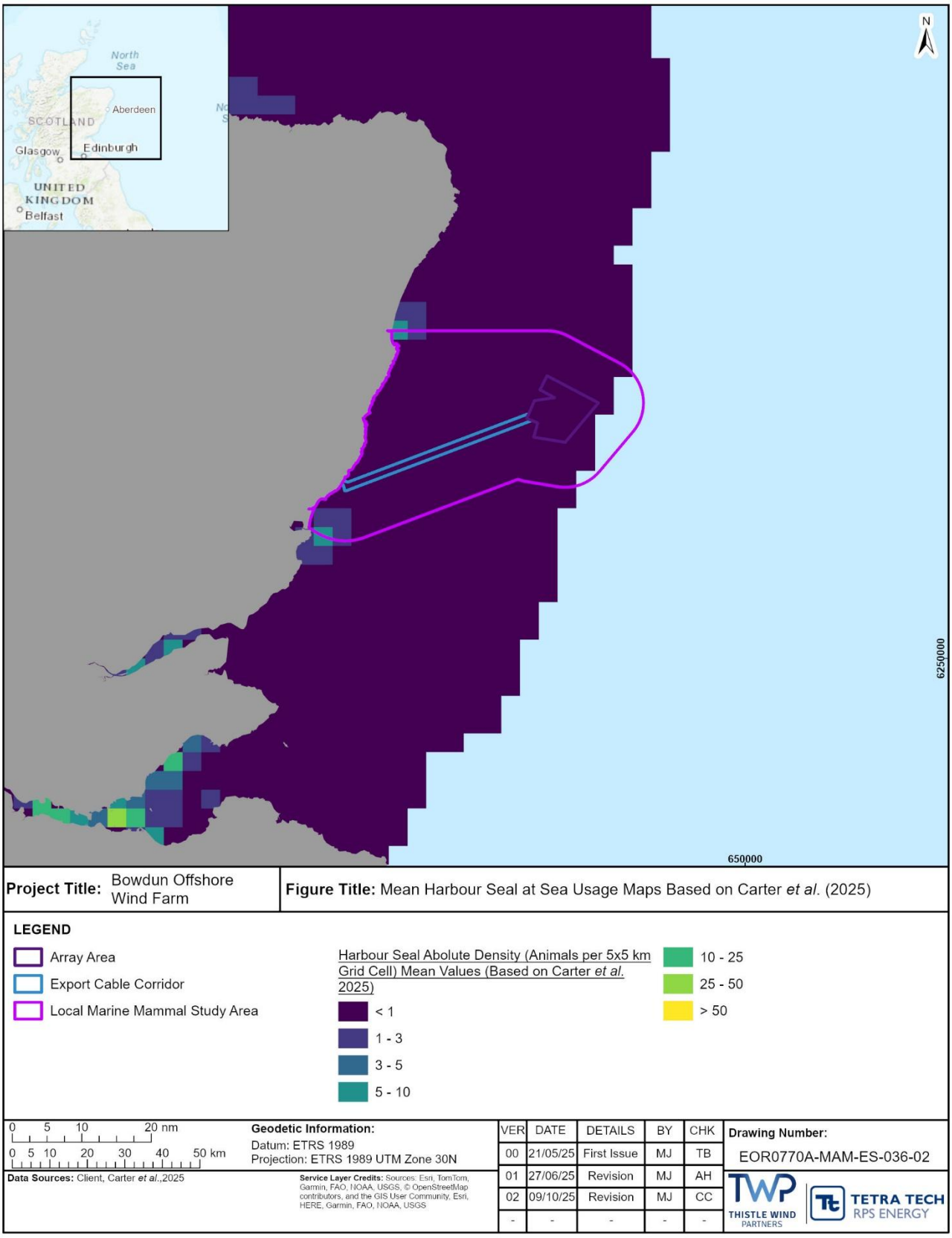


Figure 6.34: Mean Harbour Seal At-Sea Usage Maps Based on Carter *et al.* (2025)

Summary of the Densities

6.4.46 Harbour seal normally feed within 50 km around their Haul-Out sites, therefore, their presence in the offshore waters is limited (Table 6.6). There were only three harbour seal sightings during DAS, and therefore these numbers were too low to calculate design-based or model-based density estimates for this species. The density estimate derived from Carter *et al.* (2025) for the Local Marine Mammal Study Area is 0.009 animals per km^2. This density estimate will be taken forward for assessment as it is more precautionary than the equivalent density estimate for harbour seal derived from Carter *et al.* (2022) of 0.008 animals per km^2, and represents more recent data.

Table 6.6: Comparison of Main Data Sources Density Estimates for Harbour Seal

Source	Density (Animals per km^2)
Carter *et al.* (2022)	0.008
Carter *et al.* (2025)	0.009

7 Summary

7.1.1 This Marine Mammal Baseline Technical Report presents details of the relevant legislation and conservation designations, together with data gathered through a desktop review (publicly available sources and commercial survey results), and site-specific DAS.

7.1.2 This review has found that the northern North Sea supports several different marine mammal species with internationally important populations occurring within the vicinity of the Proposed Development. Key marine mammals identified with sufficiently robust data to be taken through for quantitative assessment include:

- harbour porpoise:
- bottlenose dolphin;
- white-beaked dolphin;
- minke whale;
- grey seal; and
- harbour seal.

7.1.3 Risso's dolphin, humpback whale, and fin whale are also proposed to be scoped into the assessment, however, due to a lack of density estimates and relevant quantitative population data for the east coast of Scotland, these species will be assessed qualitatively in the Offshore EIA Report.

7.1.4 Where possible, species-specific density estimates were generated using DAS data gathered during 24-months of surveys across the E3 POA plus a 12 km buffer, and the Extended DAS. Where it was not possible to estimate densities due to low sighting rates, data were sought from published sources, including regional studies of key species.

7.1.5 A summary of the densities for each species that will be taken forward for the quantitative assessment in Volume 2, Chapter 10: Marine Mammals is provided in Table 7.1, together with those species taken forward for qualitative assessment. In the EIA process, population-level effects will be considered for a given species-impact pathway and to the species-specific MUs (Table 7.1). Where relevant, the assessment will also be compared at a smaller scale against SCANS IV block NS-D population estimates (Gilles *et al.*, 2023).

7.1.6 Sites designated for the conservation of internationally important Annex II marine mammal populations within the Regional Marine Mammal Study Area include:

- the Southern North Sea SAC, designated for harbour porpoise;
- the Moray Firth SAC, designated for bottlenose dolphin;
- the Southern Trench MPA, designated for minke whale;
- the Isle of May SAC and Berwickshire and North Northumberland Coast SAC, designated for grey seal; and
- the Dornoch Firth and Morrich More SAC and Firth of Tay and Eden Estuary SAC, designated for harbour seal.

Table 7.1: Summary of Marine Mammal Receptors to be Considered in Volume 2, Chapter 10: Marine Mammals, Together With Relevant Densities, Reference Populations and Designated Sites

Species	Density (Animals per km^2)	MU	Population in MU	Population in the UK portion of MU	Relevant designated sites
Odontocetes					
Harbour porpoise	0.635[1]	North Sea MU	346,601 (IAMMWG, 2022)	159,632 (IAMMWG, 2022)	Southern North Sea SAC
Bottlenose dolphin	0.007[2]	Coastal East Scotland MU and Greater North Sea MU	226 + 2,022 = 2,248 (IAMMWG, 2022; Cheney *et al.*, 2024)	226 + 1,885 = 2,111 (IAMMWG, 2022; Cheney *et al.*, 2024)	Moray Firth SAC
White-beaked dolphin	0.155[2]	Celtic and Greater North Sea MU	43,951 (IAMMWG, 2022)	34,025 (IAMMWG, 2022)	N/A
Mysticetes					
Minke whale	0.030[3]	Celtic and Greater North Sea MU	20,118 (IAMMWG, 2022)	10,288 (IAMMWG, 2022)	Southern Trench MPA
Pinnipeds					
Grey seal	0.56[4]	North Coast and Orkney SMU, Moray Firth SMU, and East Scotland SMU	34,191 + 7,380 + 10,784 = 52,354	N/A	Isle of May SAC Berwickshire and North Northumberland Coast SAC
Harbour seal	0.009[5]	Moray Firth and East Scotland SMU	958 + 364 = 1,322	N/A	Dornoch Firth and Morrich More SAC Firth of Tay and Eden Estuary SAC
Risso's dolphin, humpback whale, and fin whale	Qualitative assessment				

[1] Design-based (absolute) density estimates, from DAS.
[2] Lacey *et al.*, 2022
[3] Gilles *et al.* (2025)
[4] Densities based on Carter *et al.* (2022)
[5] Densities based on Carter *et al.* (2025)

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ANNEX A. SMRU SEAL TELEMETRY REPORT

SMRU Consulting

understand ♦ assess ♦ mitigate

Seal haul-out and telemetry data in relation to the Bowdun Offshore Wind Farm

Authors:	Marwood, E. & Stevens, A
Report Code:	SMRUC-RPS-2024-015
Date:	Thursday, 09 April 2026

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Contents

Figures

Tables

1 Introduction

SMRU Consulting was contracted by Tetra Tech RPS Energy Limited to provide seal haul-out count and telemetry data in relation to the Bowdun Offshore Wind Farm and Seal Management Units (SMU) relevant to the local mammal study area. The following data were requested:

- Harbour seal (*Phoca vitulina*) haul-out count data from August moult census surveys since 1996 to allow the examination of site-specific abundance and interannual patterns in counts over time. These data will cover all haul-outs within the relevant SMUs.
- 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 marine mammal study area specified by the Applicant.
- Provision of seal satellite tracking data from tagged harbour and grey seals - either animals tagged or hauling out at Special Areas of Conservation (SACs) and visiting the Bowdun local marine mammal study area.
- Provision of satellite tracking data from all harbour or grey seals which cross the relevant SMUs regardless of where tagged, if not already included in the datasets specified above.
- A basic quantification of the degree of connectivity between the Bowdun local marine mammal study area and protected haul out sites.

1.1 Marine mammal study area

The Applicant specified the primary study area to be used for this data request as the “Bowdun local marine mammal study area”, encompassing the Bowdun array area, export cable corridor and an associated buffer (Figure 1-1). The wider area of interest for the data request was defined by the East Scotland SMU which intersected the Bowdun local marine mammal study area (Figure 1-1).

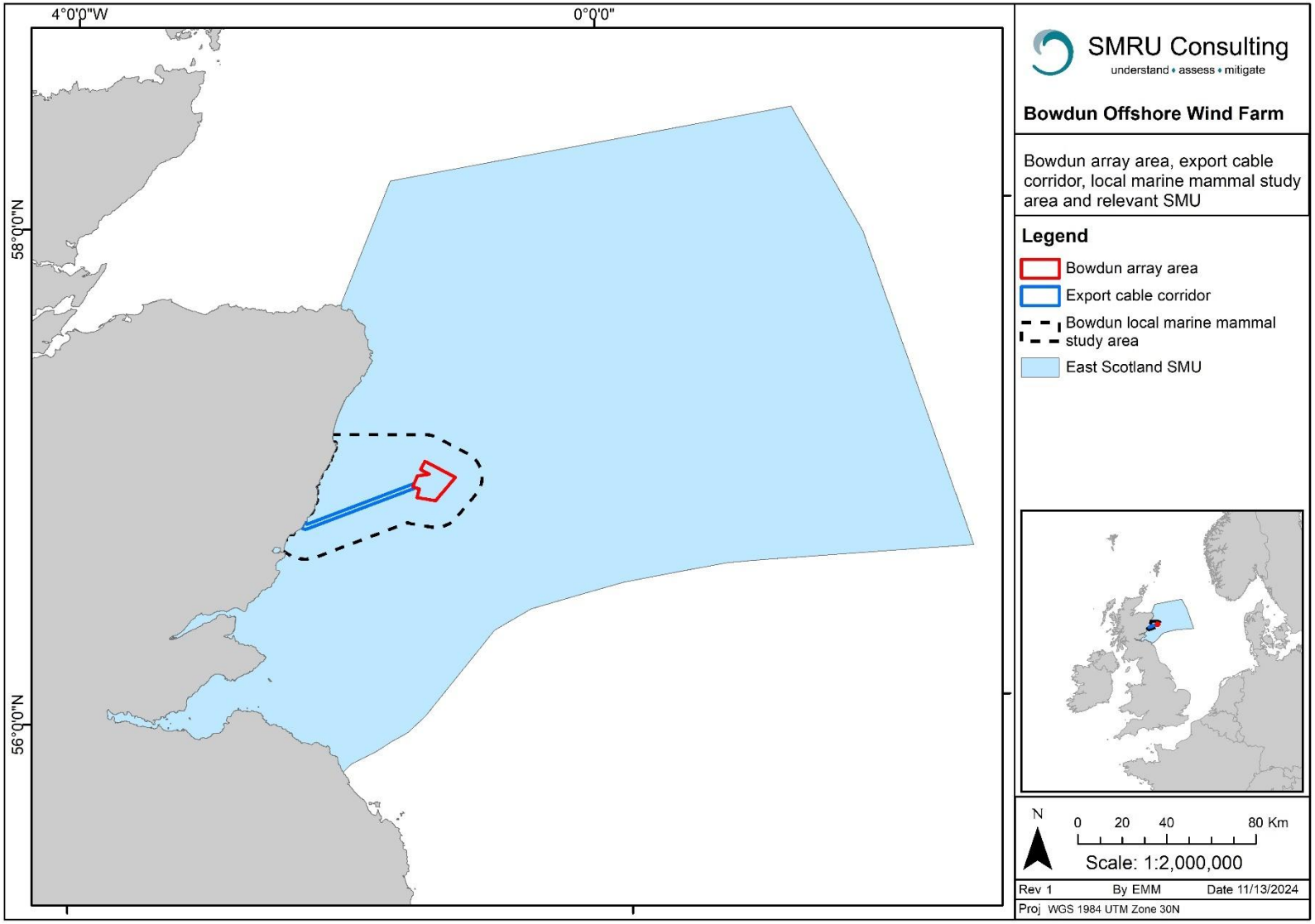


Figure 1-1 The Bowdun array area, export cable corridor, Bowdun local marine mammal study area, and East Scotland SMU.

2 Methods

2.1 Haul-out Surveys

2.1.1 Sea Mammal Research Unit (SMRU) Surveys

The Sea Mammal Research Unit (SMRU) carry 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, Natural Resources Wales, National Trust and Wildlife Trusts) 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[1].

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 (Northumberland, Lincolnshire and Norfolk) where seals are relatively abundant. 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 when moulting there is a relatively high and consistent proportion of population hauled out, meaning that 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 allow estimation of 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 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.

2.1.1.1.1 Breeding counts

In recent years, harbour seal breeding surveys have been almost entirely restricted to The Wash, 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 Scotland. Given that there are no harbour seal breeding surveys conducted in the East Scotland SMU, these are not considered further in this report.

2.1.1.1.2 Moult counts

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

The frequency of surveys differs by area. In general, moult surveys that are conducted annually in

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

Lincolnshire and Norfolk (England), the Moray Firth and the Firth of Tay and Eden SAC (Scotland). The remainder of the Scottish coast is surveyed approximately every four to five years, although there is considerable variation between areas.

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 3 km It is then possible to differentiate between the two species using the group structure on shore, a 'real' image from a camcorder, and 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 a minimum estimate of the size of the population. Note that these data refer to the numbers of seals found within the surveyed areas only at the time of the survey; numbers and distribution are likely to differ at other times of the year (such as the breeding period). The most recent data available presented in the SCOS (2022) report for the East Scotland SMU is from 2021 (SCOS, 2023).

It is estimated that 72% (95% CI: 54-88%) of the total harbour seal population are hauled-out and available to count during August surveys (Lonergan *et al.* 2013). The harbour seal counts can be scaled by the proportion of seals hauled-out at the time of the counts, providing an estimated population size for a SMU.

2.1.1.2 Grey seals

Grey seals aggregate in the autumn (August – 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-April, or other times of the year).

Numbers of grey seals are also counted during the harbour seal August haul-out count surveys. Counts of greys seals during the summer months are highly variable, however they provide useful information on the summer and non-breeding season distribution of grey seals. The most recent data presented in the SCOS (2022) report for the East Scotland SMU is from 2021 (SCOS, 2023).

It is estimated that 25.15% (95% CI: 21.45-29.07%) of the total grey seal population are hauled-out and available to count during the August haul-out count surveys (Russel and Carter, 2021) and, therefore, the total number of grey seals in the population for any given count period can be estimated by using the proportion of seals hauled-out.

2.1.1.2.1 Pup production

Grey seals are surveyed during their breeding season, with most breeding colonies surveyed by SMRU using 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 (data provided by SMRU) contains data from 1996 to 2021 and includes 74 breeding colonies, 70 of which are in Scotland and 1 of which is in Northeast England (though not all colonies have been surveyed consistently since 1989 and some smaller colonies are surveyed more sporadically than others, aerial surveys are now used on the English east coast with results expected in SCOS (2024)) (data provided by SMRU). Most breeding colonies used to be surveyed annually. However, from 2010, most colonies switched to biennial or triennial surveys instead due to reductions in funding combined with increased aerial survey cost and the extension on the survey programme into eastern England (SCOS, 2015).

2.1.2 Summary of methods

1. Population surveys of harbour seals are carried out during their annual moult in August.

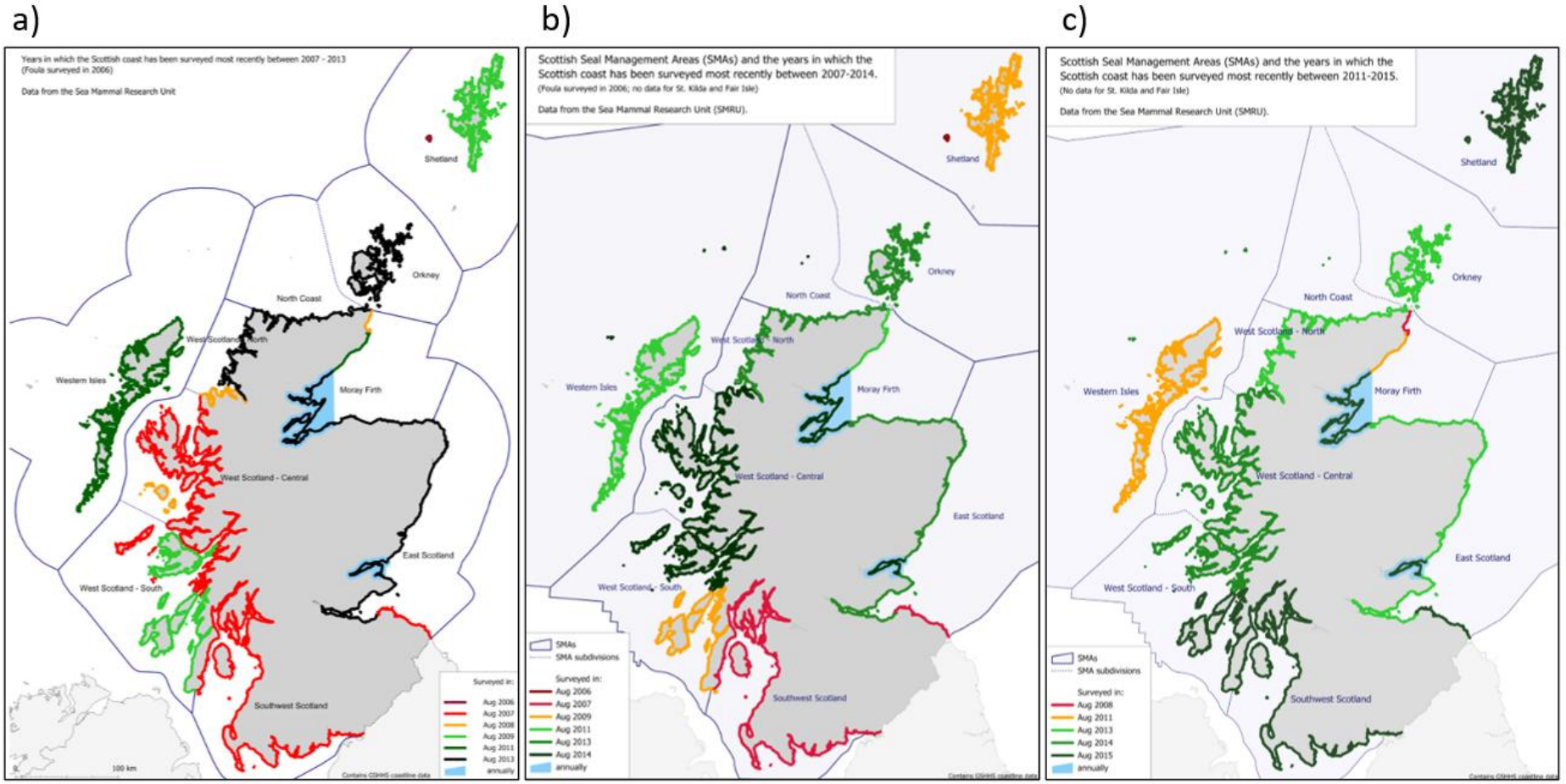
2. Harbour seal August haul-out count surveys provide a minimum estimate of the size of the population, not the total population size.
3. In general, August haul-out count surveys are carried out once every four to five years in most of Scotland but annually in Lincolnshire, Norfolk, the Moray Firth and the Firth of Tay.
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 UK population size.
5. Grey seals are also counted during harbour seal August haul-out count 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: 25.15%).
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[2].

The haul out count data from the annual SMRU surveys are not appropriate for assessing fine scale distribution of haul out sites – the data are a snapshot usually from 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 5 years. Figures are provided in SCOS reports (and are duplicated here for information: Figure 2-1, Figure 2-2 and Figure 2-3) to highlight which part of the Scottish coastline has been surveyed each year[3]. In SCOS reporting, tables of the most recent haul-out counts are provided primarily by "survey period" (1996-1997, 2000-2006, 2007-2009, 2011-2015 and 2016-2019) as these represent periods within which the entire Scottish coastline was surveyed, as well as the most recent data from 2021 where only the East Scotland and Moray Firth SMUs were surveyed along the Scottish coast.

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

[3] Note: no equivalent map was provided in SCOS (2022).

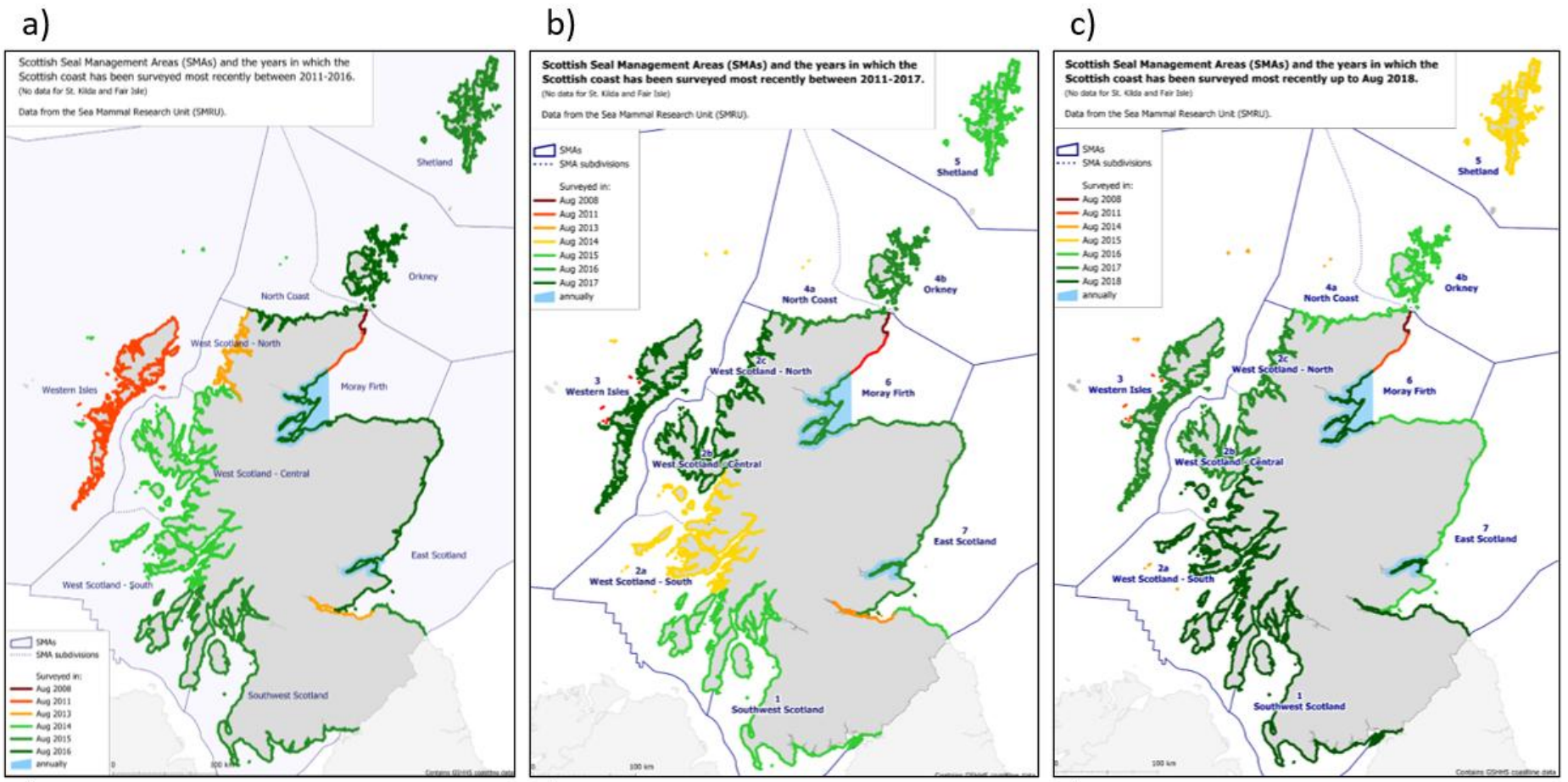


a) Most areas were surveyed between 2007 and 2013. Foula, off Shetland, was last surveyed in 2006. The enclosed areas of the Firth of Tay and the Moray Firth (between Findhorn and Helmsdale) are surveyed every year, usually by fixed-wing aircraft.

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 2-1 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 2-2 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).

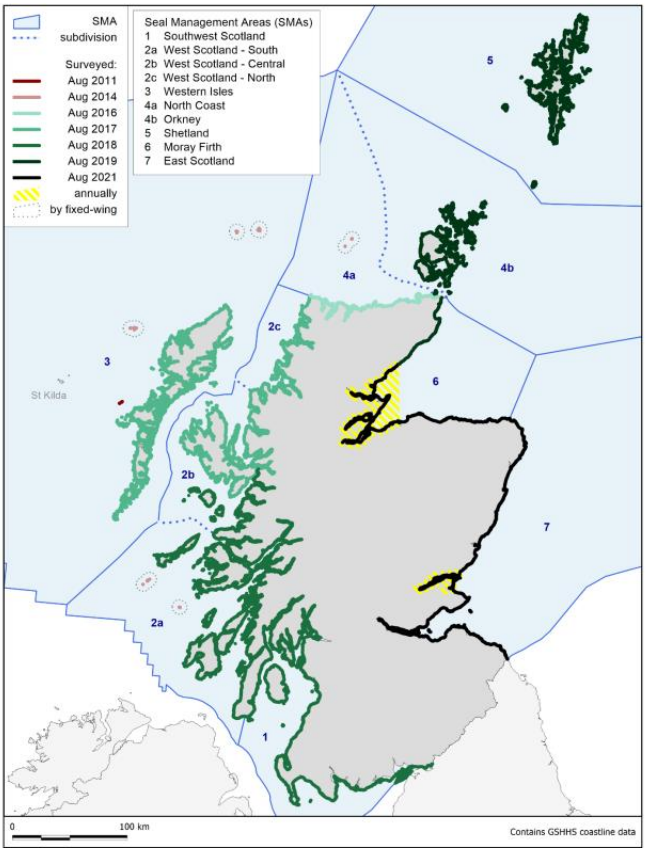


Figure 2-3 Aerial surveys carried out during the harbour seal moult in August (2011-2021). Most areas were last surveyed between 2016 and 2021. The yellow shaded areas of the Firth of Tay and the Moray Firth (between Helmsdale and Findhorn) are surveyed every year, usually by fixed-wing aircraft. Offshore 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 has not been covered by aerial surveys (SCOS, 2023).

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 >2.5 km (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 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 phone tags attempt to collect location data every 5-20 minutes (depending on the parametrisation at set-up). The Fastloc GPS tags attempt to collect locational data every 5-20 minutes (depending on the parametrisation at set-up). Data are stored on board the tags and then relayed by a satellite (via Argos

tags) or, more commonly, 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). Telemetry data obtained using Ultra High Frequency (UHF) tags are not included in the data presented as these tags are reliant on base stations to transmit data which results in potential bias.

3 Protected sites

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[4]. This network of SACs is designed to ensure that the species listed in Annex II of the EU Habitats Directive (1992), are maintained in a favourable conservation status in their natural range (Article 3(1)). This includes both grey and harbour seals (also Annex V species) and, therefore, SACs must be established for their protection. Information on the SACs which have been designated for harbour seals can be found on the JNCC website[5]. Information on the SACs which have been designated for grey seals can be found on the JNCC website[6].

Within the East Scotland SMU, there is one SAC designated for harbour seals (Firth of Tay and Eden Estuary SAC) and there are two SACs designated for grey seals: the Isle of May SAC and the Berwickshire and North Northumberland Coast SAC (which spans both the East Scotland SMU and the Northeast England SMU) (Table 3-1 and Figure 3-1). There are no SACs located within the Bowdun local marine mammal study area.

Table 3-1 SACs within the East Scotland SMU.

SMU	SAC	Marine mammal species
East Scotland SMU	Berwickshire and North Northumberland Coast SAC	Grey seal
	Firth of Tay and Eden Estuary SAC	Harbour seal
	Isle of May SAC	Grey seal

[4] The UK retained the fundamental requirements of the Habitats Directive in domestic law after leaving the EU in January 2021.

[5] https://sac.jncc.gov.uk/species/S1365/

[6] https://sac.jncc.gov.uk/species/S1364/

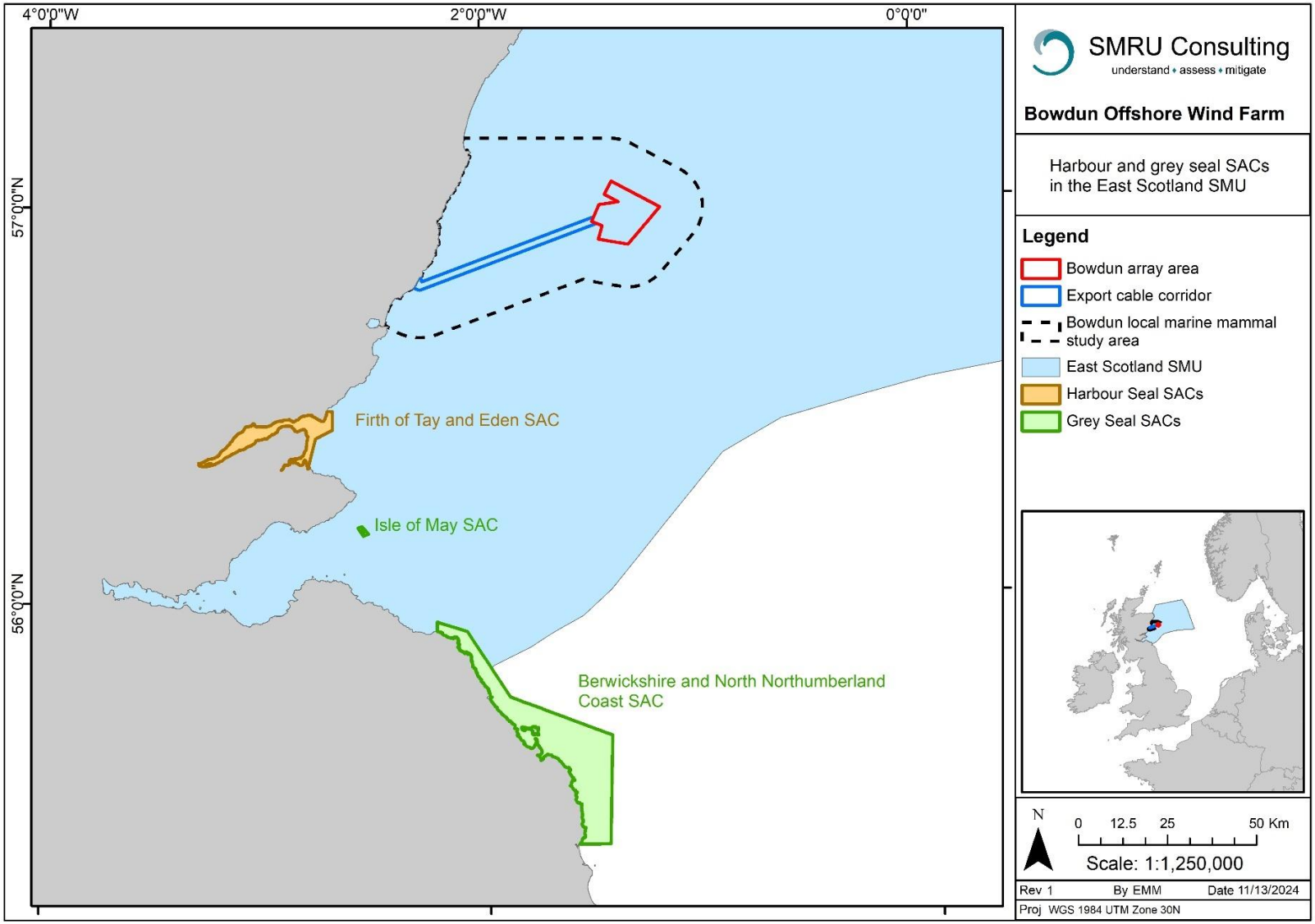


Figure 3-1 Harbour and grey seal SACs in the East Scotland SMU.

3.2 Designated haul-out sites

Seal haul-out sites are designated under section 117 of the Marine (Scotland) Act 2010 in the Protection of Seals (Designation od Seal Haul-out Sites) (Scotland) Order 2014. These sites are areas where seals are known to use for resting, moulting and/or breeding activities and have been selected by the Scottish Ministers in consultation with SMRU (on behalf of the Natural Environment Research Council). There are currently 195 designated haul-out sites within Scotland and intentionally or recklessly harassing seals hauled-out at these sites is considered an offence.

In the East Scotland SMU, there are three designated haul-out sites for both species (Ythan River Mouth, Kinghorn Rocks, and Inchmickery and Cow and Calves) and three seasonal grey seal haul-out sites (Table 3-2 and Figure 3-2). The closest designated haul-out site (Ythan River Mouth) is located approximately 44 km away from the Bowdun local marine mammal study area boundary, with all other sites being over 140 km swimming distance away from the Bowdun local marine mammal study area boundary.

Table 3-2 Designated seal (both species) and seasonal grey seal haul-out sites in the East Scotland SMU.

Site ID	Site Name	Location	Distance from Bowdun local marine mammal study area by sea
Designated harbour and grey haul-out sites			
EC-001	**Kinghorn Rocks**	**Firth of Forth North**	**141 km**
Intertidal mudbanks and rocky coastline between Long Craig and Linton Court and associated rocky outcrops.			
EC-002	**Inchmickery and Cow & Calves**	**Firth of Forth**	**151 km**
Rocky coastline around Inchmickery and entire islands of Cow, Calves and Oxcars.			
EC-003	**Ythan River Mouth**	**Ythan Estuary**	**44 km**
Areas of land above mean low water spring tide that fall within the areas of water and land adjacent to the mouth of the River Ythan.			
Seasonal grey seal haul-out sites			
BC-043	**Fast Castle**	**between Dunbar and Eyemouth**	**118 km**
Rocky coastline at the foot of the cliffs between Coldingham Loch and Cove Harbour.			
BC-044	**Inchkeith**	**halfway between Kinghorn and Leith**	**143 km**
Entire coast of Inchkeith.			
BC-045	**Craigleith**	**off North Berwick**	**120 km**
Southern half of Craigleith.			

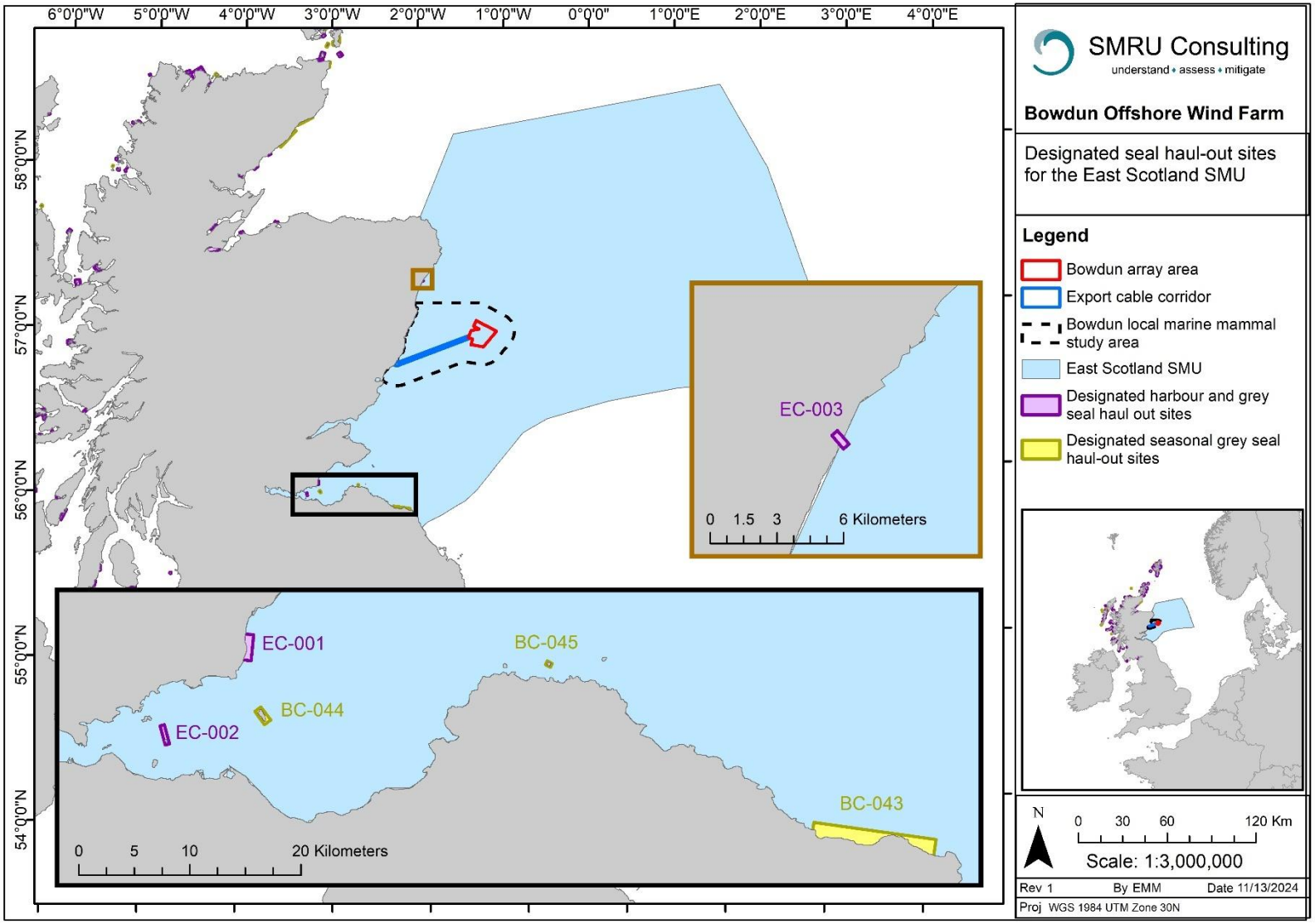


Figure 3-2 Designated seal haul-out sites in the East Scotland SMU.

4 August haul-out counts

4.1 Harbour seal

4.1.1 UK Population

The most recent August haul-out count for the whole of Scotland is for the count period 2016-2021, where a total of 26,378 harbour seals were counted (includes data from the 2016-2019 count period for SMUs 1-5 and from 2021 for SMUs 6 and 7). For England and Wales, in 2021 a further 3,659 harbour seals were counted and in Northern Ireland 818 were counted. This results in a total count of 30,855 harbour seals in the UK during the period 2016-2021 (34,862 including the Republic of Ireland) (Figure 4-1) (SCOS, 2023). 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) and, therefore, using these count data generates an estimated population of ~42,854 harbour seals[7] in the UK (~48,419 including the Republic of Ireland).

Around the UK, high concentrations of harbour seal haul-outs are located around the Scottish coastline, particularly around West Scotland (SMU 2), the Western Isles (SMU 3), Shetland (SMU 5) and the Moray Firth (SMU 6). In England, haul-out counts are greatest around The Wash (SMU 9; Figure 4-1).

[7] Calculated as: (30,855/72)*100

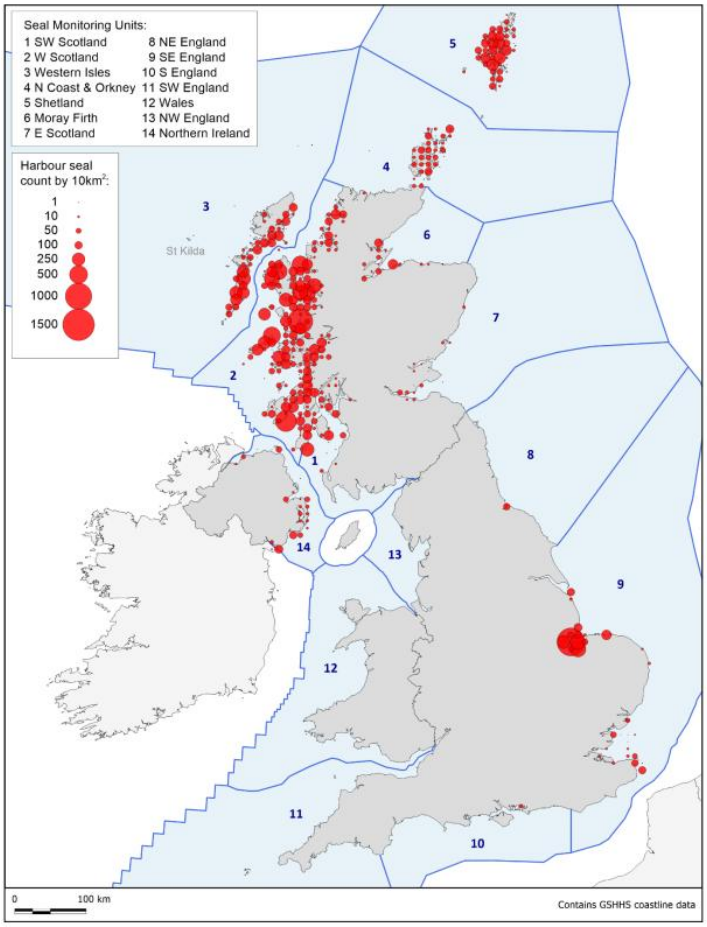


Figure 4-1 August distribution of harbour seals around the British Isles by 10 km squares based on the most recent available haul-out count data collected up until 2021. Limited data available for SMUs 10-13; no data available for St Kilda. Figure obtained from SCOS (2023).

4.1.2 SMU August counts

Not all sites within the East Scotland SMU are surveyed annually; however counts have been conducted in the Firth of Tay and Eden Estuary SAC on an almost annual basis since 2005. In the East Scotland SMU, the harbour seal population has been in decline since the 1996-1997 survey period when the highest counts of 764 individuals were recorded. In the 2016-2019 survey block, the haul-out counts within the East Scotland SMU had increased for the first time since the decline, to 343 (compared to 224 in 2011-2015) but have since declined again in the most recent 2021 surveys to 262 (SCOS, 2023). The current scaled population estimate for the East Scotland SMU is 364 harbour seals (Table 4-1).

A sudden change in the East Scotland SMU population trend was observed in 2002, but the decline is not thought to be related to Phocine Distemper Virus (PDV), and the nature of this change remains unknown. Within this SMU, the majority of the population was located within the Firth of Tay and Eden Estuary SAC, representing approximately 85% of the SMU count from 1990-2002 (SCOS, 2023). The population within the SAC then declined rapidly and consistently from 2002-2021 to a count of 41 individuals, representing an approximate 95% decline and now the SAC accounts for approximately 16% of the haul-out counts in the SMU. Such rapid population decline appears to be restricted to the SAC, and there is now evidence that this decline may be slowing (SCOS, 2023). There has also been a redistribution of harbour seals within the East Scotland SMU since the decline within the Firth of Tay and Eden Estuary SAC. Additional groups of harbour seals in the East Scotland SMU are located in the Firth of Forth, Montrose Basin and around the Aberdeenshire coast (SCOS, 2023).

Table 4-1 Harbour seal August haul-out counts and population estimates[8] for various survey periods. Data from SCOS (2023).

HARBOUR SEAL		1996-1997	2000-2006	2007-2009	2011-2015	2016-2019	2021
East Scotland	Count	764	667	283	224	343	262
	Population estimate	1061	926	393	311	476	364

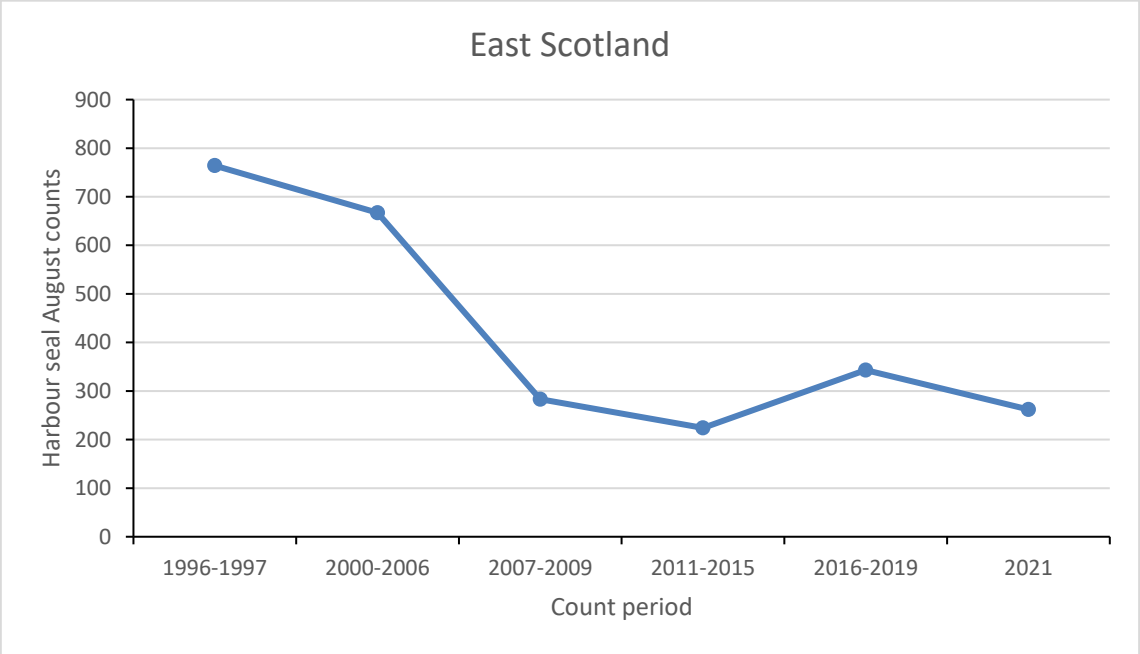


Figure 4-2 August haul-out counts of harbour seals within the East Scotland SMU. Data from SCOS (2023).

4.1.3 Distribution of August haul-outs

The August haul-out counts showing the historical distribution of harbour seals across the East Scotland SMU from 1996 – 2021 are presented in Figure 4-3. When looking at all years combined, historically the main harbour seal haul-outs were located in the Firth of Forth and the Tay and Eden estuaries. The largest haul-out count of 192 harbour seals was made at Outhead on the Eden Estuary in 2002. The harbour seal population in the Firth of Tay and Eden Estuary SAC has been in decline; and in 2021 the SAC count was 41 individuals (the same as the mean for the previous 5 years of counts in the SAC), representing a 94% decrease from the mean SAC count of 641 recorded between 1990 and 2002 (SCOS, 2023). Prior to 2002, the SAC contained approximately 85% of the population within the East Scotland SMU, but by 2016 was estimated to contain less than 15%, and this decline seems to be continuing (SCOS, 2022). It should, therefore, be noted that the historical combined haul-out count map is not representative of the current trends in harbour seal haul-out size and distribution.

Haul-out counts were highly variable between years. Haul-out counts are presented in Figure 4-4 for the years in which August haul-out count surveys were undertaken over the wider SMU (rather than years in which only the SAC was surveyed).

[8] Population estimates calculated as: (Count/72)*100

The most recent haul-out counts from 2021 are presented in Figure 4-5. In 2021, the largest haul-out site in the East Scotland SMU was at Chapel Garden Rocks in West Wemyss where 24 harbour seals were counted. The haul-out count within the Firth of Tay and Eden Estuary SAC in 2021 continues to be low with was 41 individuals counted (Figure 4-4), but has not declined further since the 2019 counts (also 41; SCOS, 2022). Note, the Northumberland coast was not surveyed in 2021.

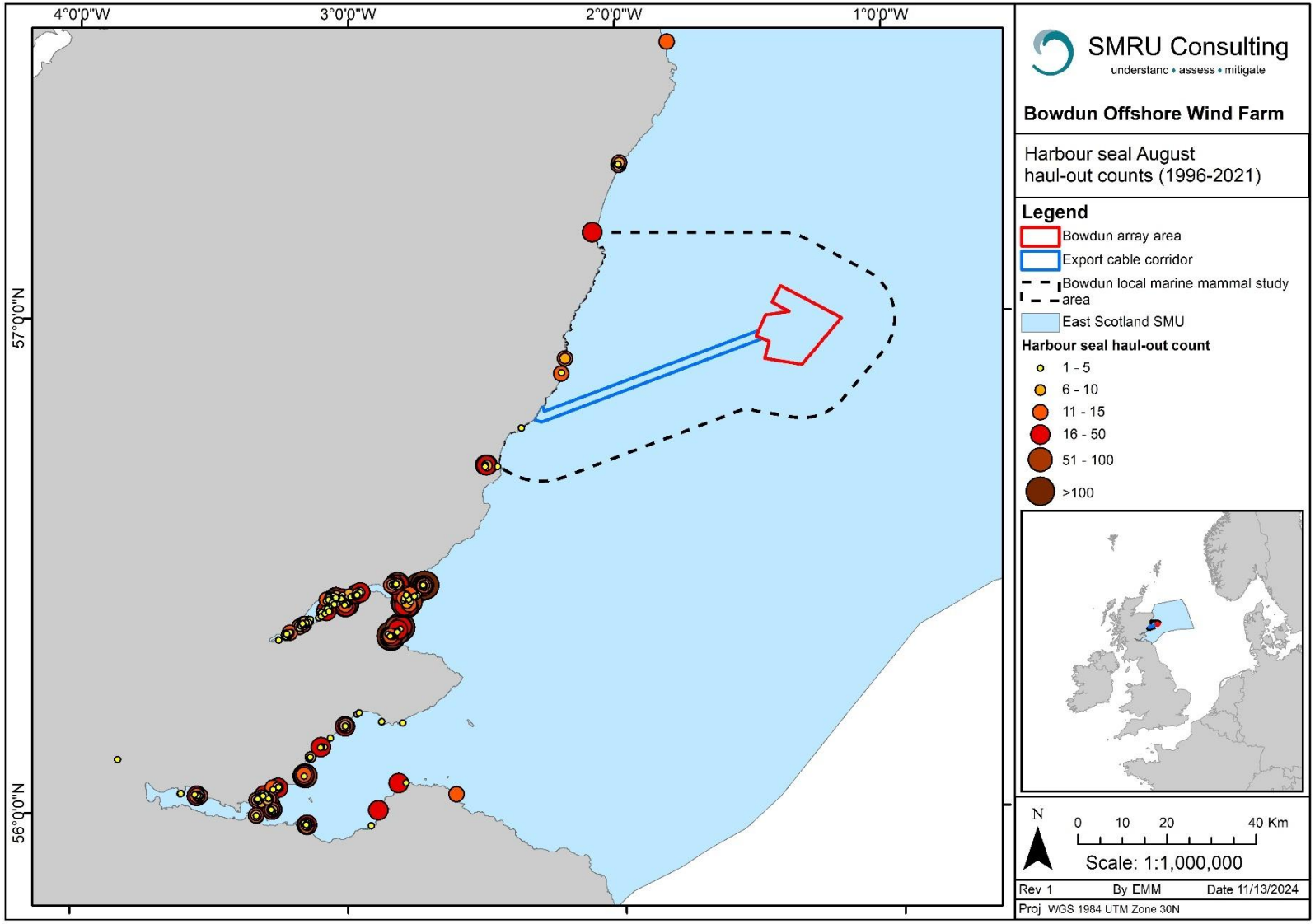


Figure 4-3 All historical August harbour seal haul-out counts in the East Scotland SMU between 1996 and 2021 combined. Data provided by SMRU.

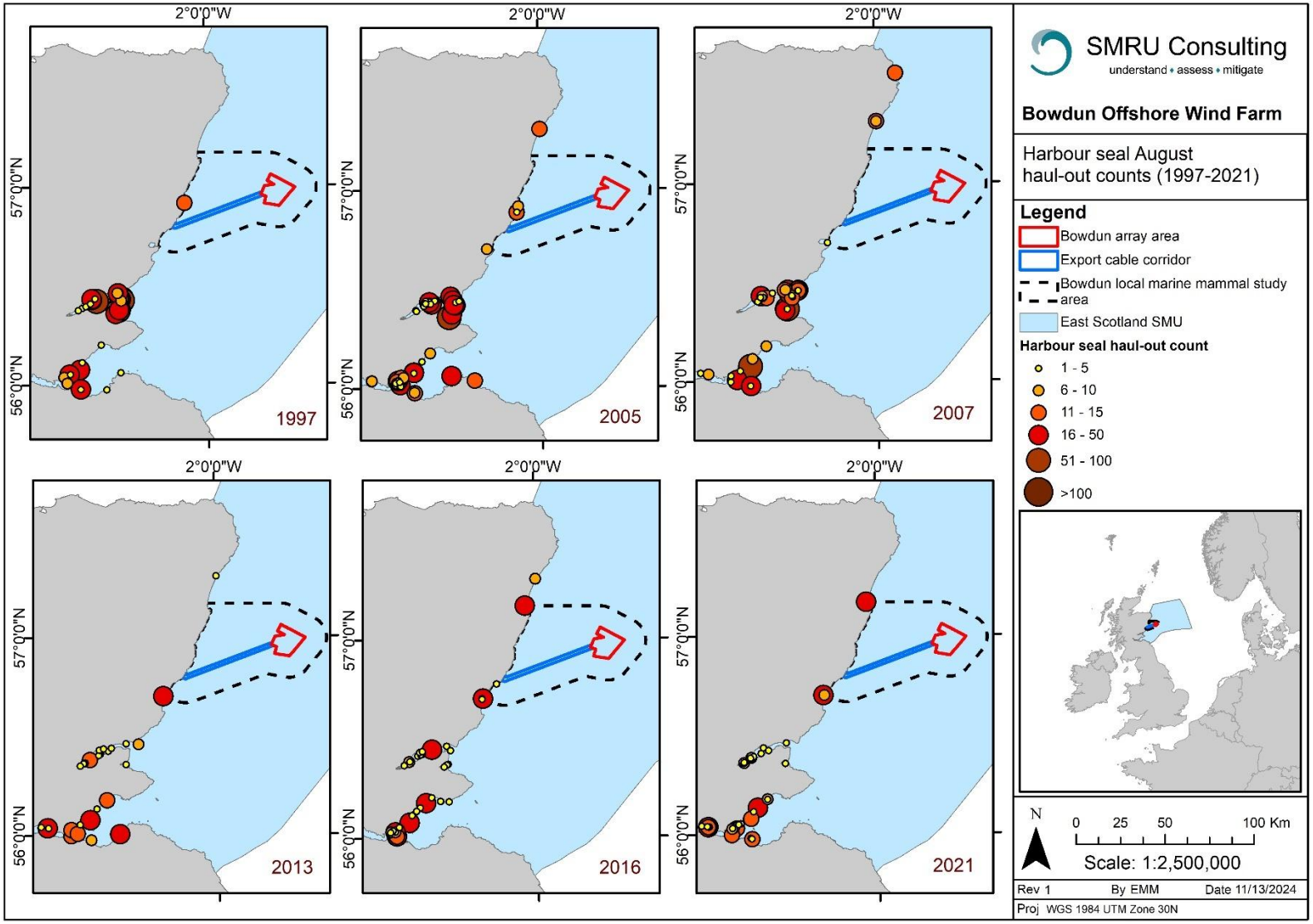


Figure 4-4 August harbour seal haul-out counts in the East Scotland SMU in 1997, 2005, 2007, 2013, 2016 and 2021. Data provided by SMRU.

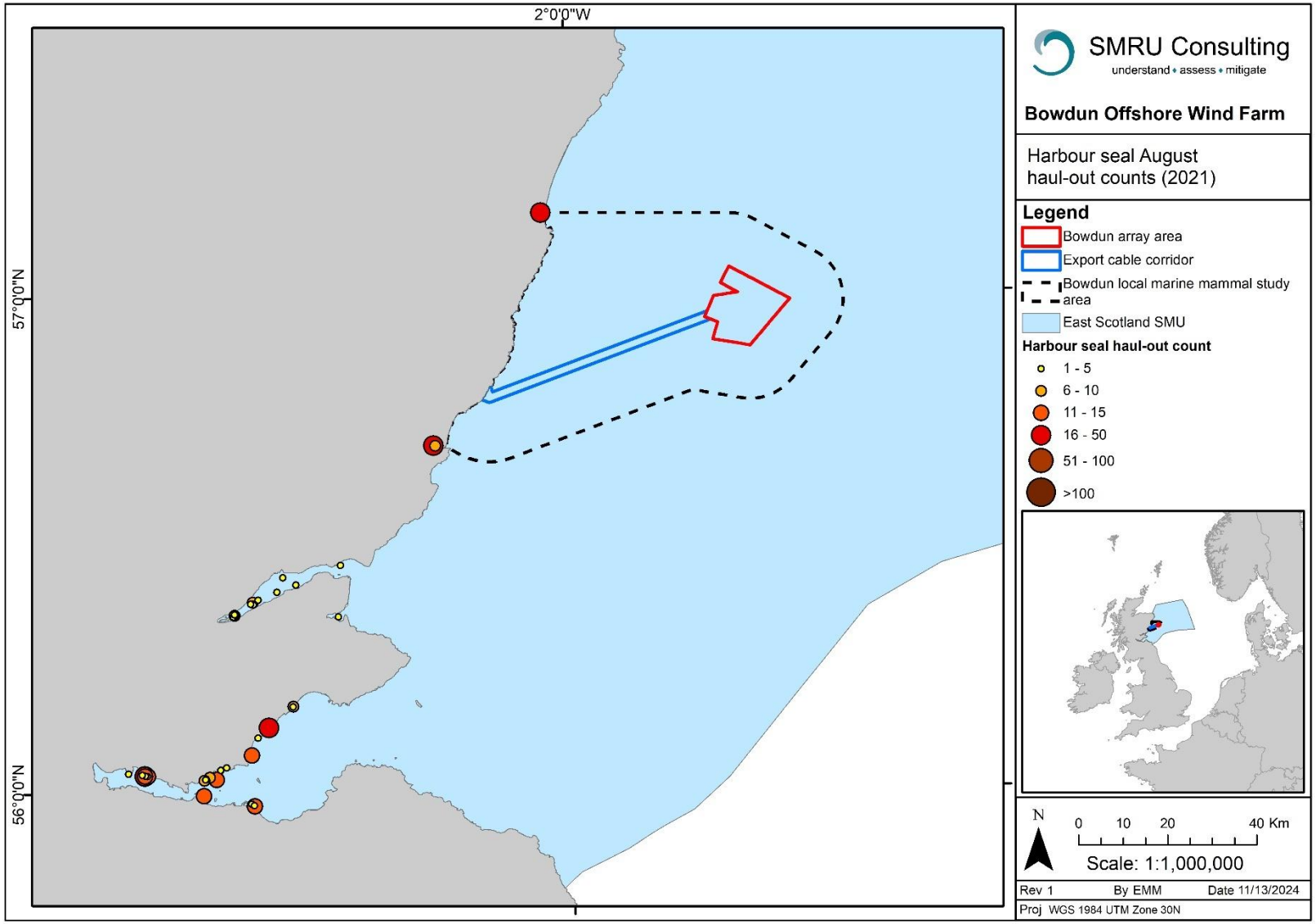


Figure 4-5 August harbour seal haul-out counts in the East Scotland SMU for 2021. Data provided by SMRU.

4.2 Grey seal

4.2.1 UK Population

The UK wide grey seal population is estimated using a population model that combines regional pup production estimates and August haul-out counts scaled to population estimates. The UK total grey seal population size at the start of the 2022 breeding season was estimated to be 162,000 grey seals (95% CI: 146,700-178,500) of which 129,100 were in Scotland (SCOS, 2023). Grey seals are widely distributed around the UK in August, with highest August haul-out counts in Scotland occurring in the North Coast and Orkney SMU (8,599 in 2019) and in England in the Southeast England SMUs (7,694 in 2021) (SCOS, 2023) (Figure 4-6). The most recent August haul-out count of grey seals in Scotland (across 2016 and 2021) is 24,640 grey seals, which is 9% higher than count from the surveys between 2011 and 2015 (SCOS, 2023).

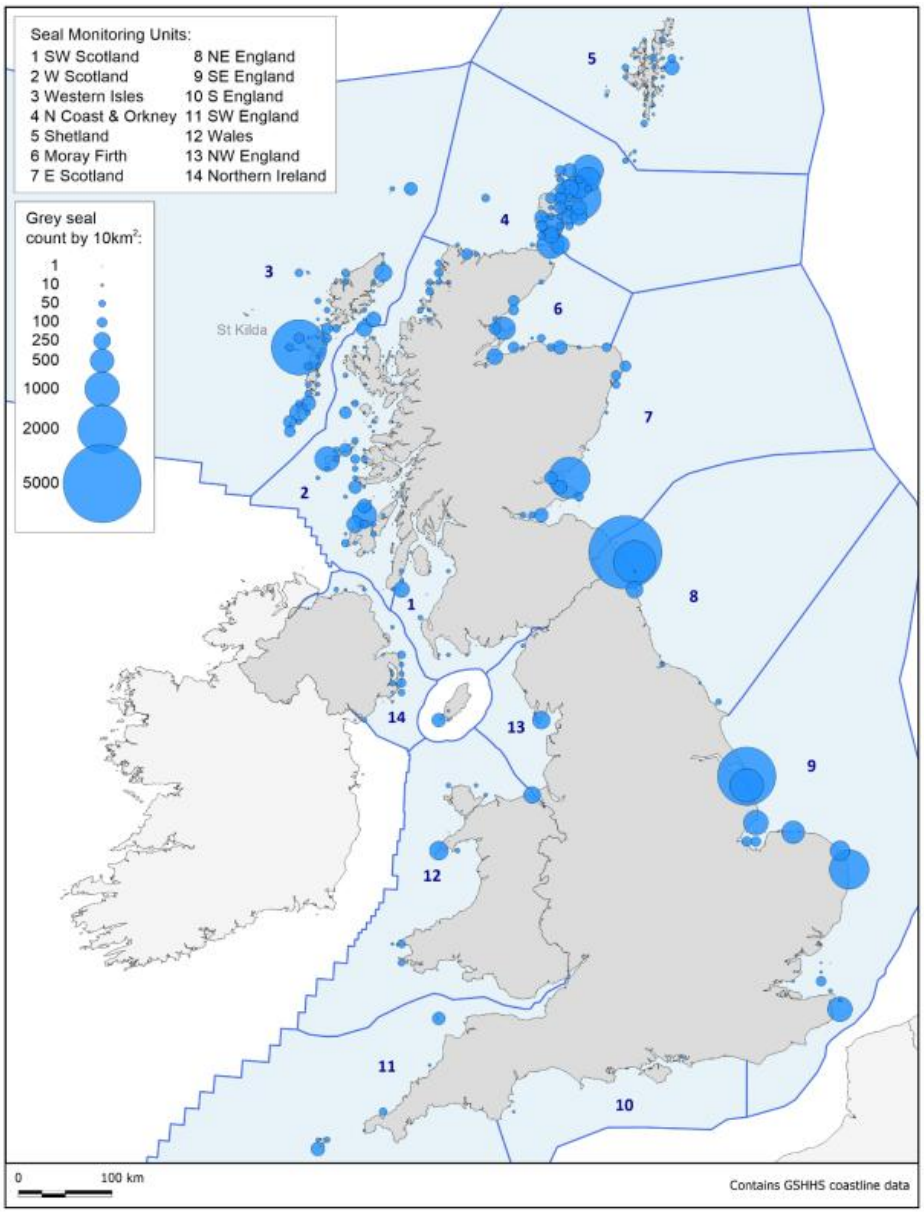


Figure 4-6 August distribution of grey seals around the British Isles by 10 km squares based on the most recent available haul-out count data collected up until 2021. Limited data available for SMUs 10-13; no data available for St Kilda. Figure obtained from SCOS (2023).

4.2.2 SMU August Counts

Grey seal August counts are estimated to be stable in the East Scotland SMU (SCOS, 2023). The most recent August grey seal count (2021) in the East Scotland SMU was 2,712 individuals (SCOS, 2023), equating to a scaled August population estimate of 10,783 grey seals. The population estimate represents a decrease since the previous August count period (2016-2019; Table 4-2 and Figure 4-7), though it should be noted that grey seal haul-outs in August are highly variable.

Table 4-2 Grey seal August haul-out counts and population estimates[9] for various survey periods. Data from SCOS (2023).

GREY SEAL		1996-1997	2000-2006	2007-2009	2011-2015	2016-2019	2021
East Scotland	Count	2,328	1,898	1,238	2,296	3,683	2,712
	Population estimate	9,256	7,547	4,922	9,129	14,644	10,783

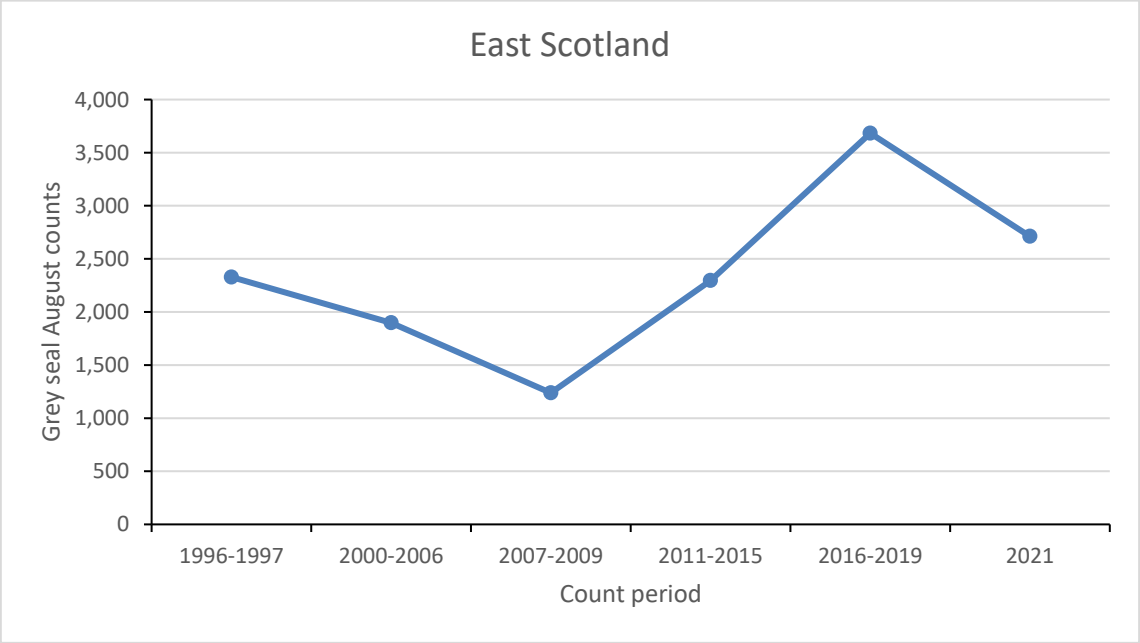


Figure 4-7 August haul-out counts of grey seals within the East Scotland SMU. Data from SCOS (2023).

4.2.3 Distribution of August haul-outs

The August haul-out counts showing the historical distribution of grey seals across the East Scotland SMU from 1997-2021 are presented in Figure 4-8 with the annual break down of their distribution presented in Figure 4-9 and Figure 4-10 (data provided by SMRU). In the East Scotland SMU, haul-out sites are concentrated around sites in the Firth of Forth and the Tay and Eden estuaries as well as further north around Peterhead and Fraserburgh. The largest haul-out count of 1,924 grey seals was made at the mouth of the River Ythan in 2016.

Haul-out counts were highly variable between years. Haul-out counts are presented below for the years in which haul-out surveys were undertaken over the wider SMUs, not just focussed on the SAC areas (Figure 4-9 and Figure 4-10). The most recent 2021 haul-out counts are presented in Figure 4-10.

[9] Population estimates calculated as: (Count/25.15)*100

In 2021, the largest haul-out site in the East Scotland SMU was at Abertay Sands where 1,360 grey seals were counted (Figure 4-10). A further 98 grey seals were counted within the Isle of May SAC.

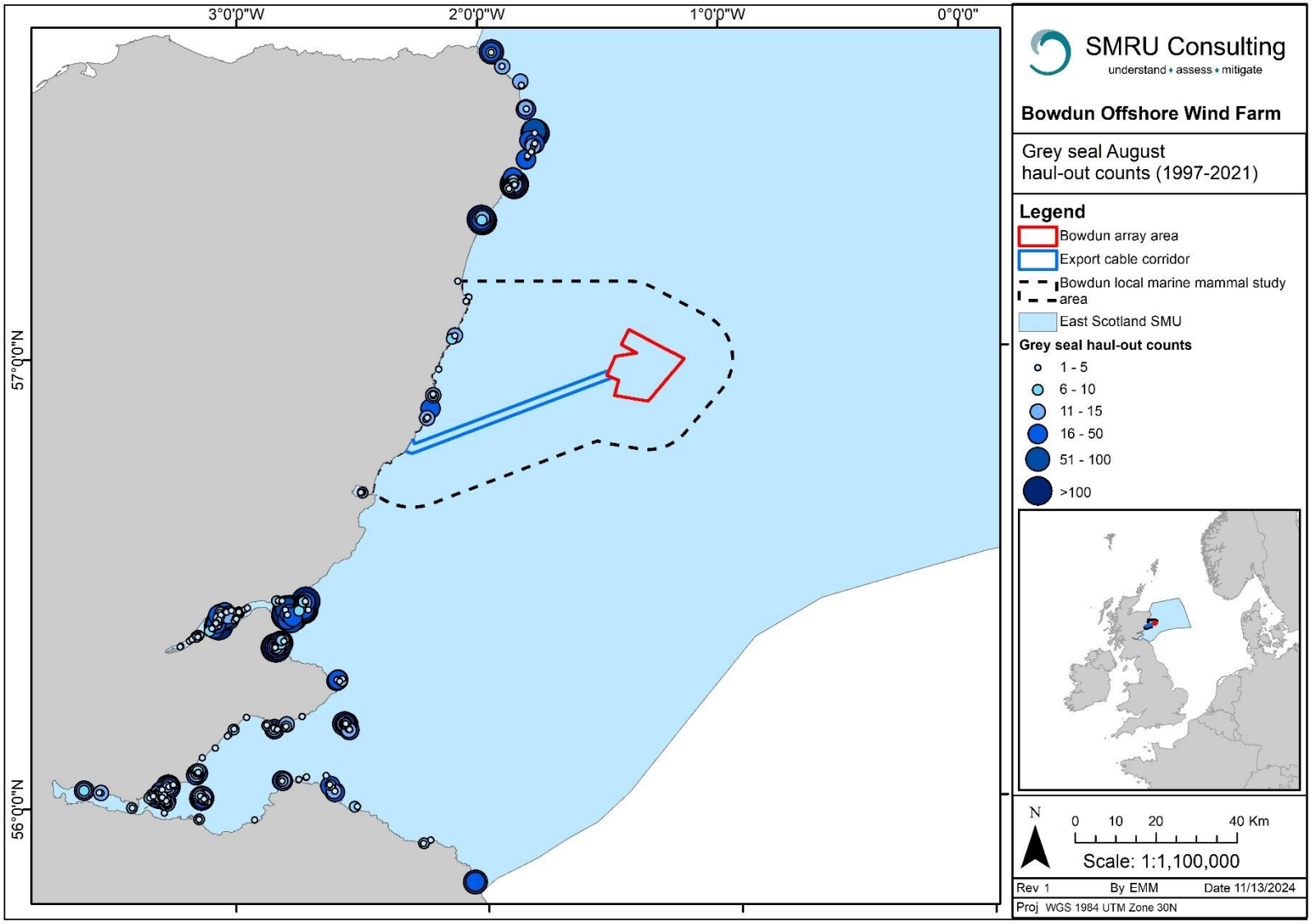


Figure 4-8 All August grey seal haul-out counts in the East Scotland SMU between 1997 and 2021 combined. Data provided by SMRU.

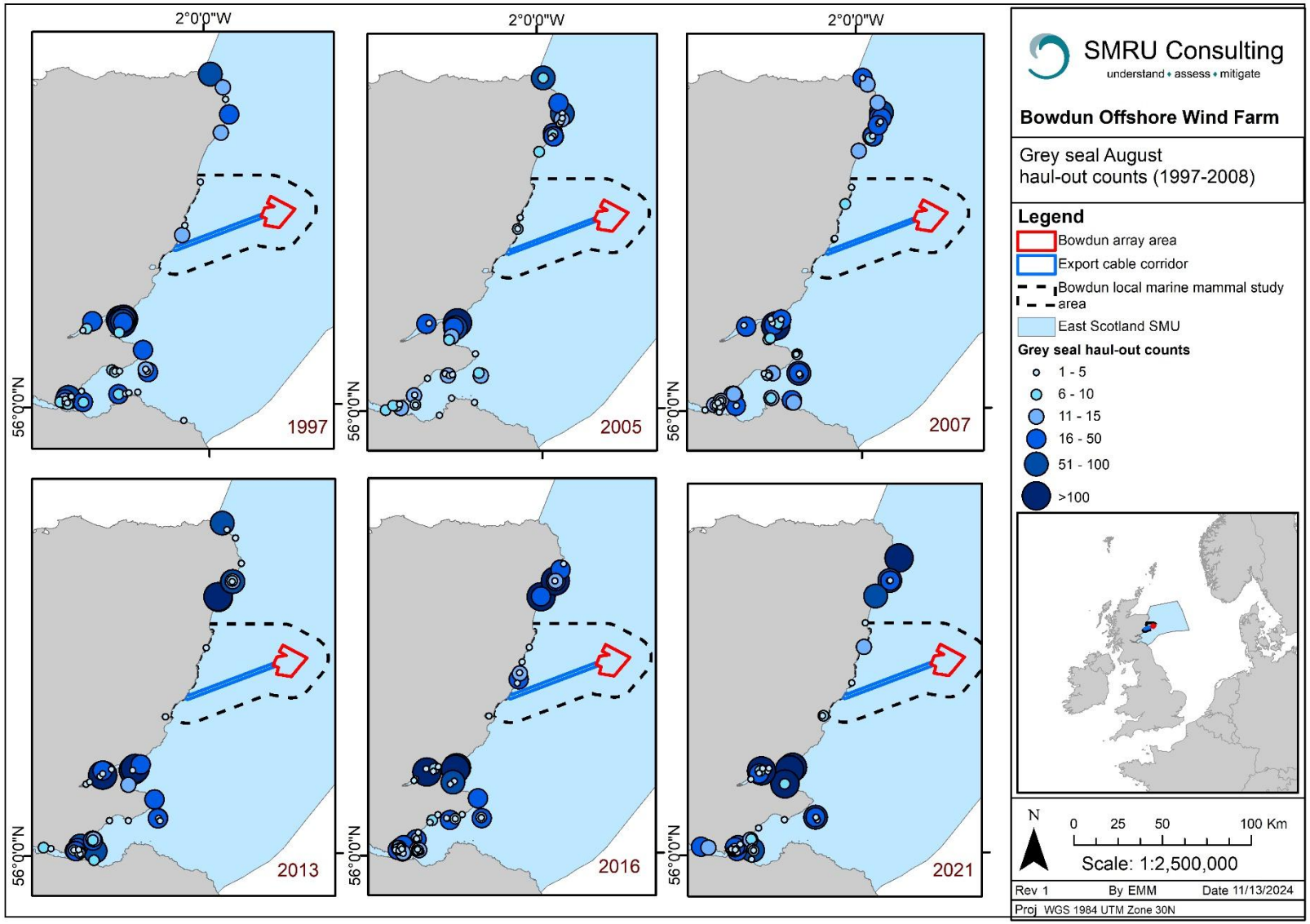


Figure 4-9 Annual August grey seal haul-out counts in the East Scotland SMU in 1997, 2005, 2007, 2013, 2016 and 2021. Data provided by SMRU.

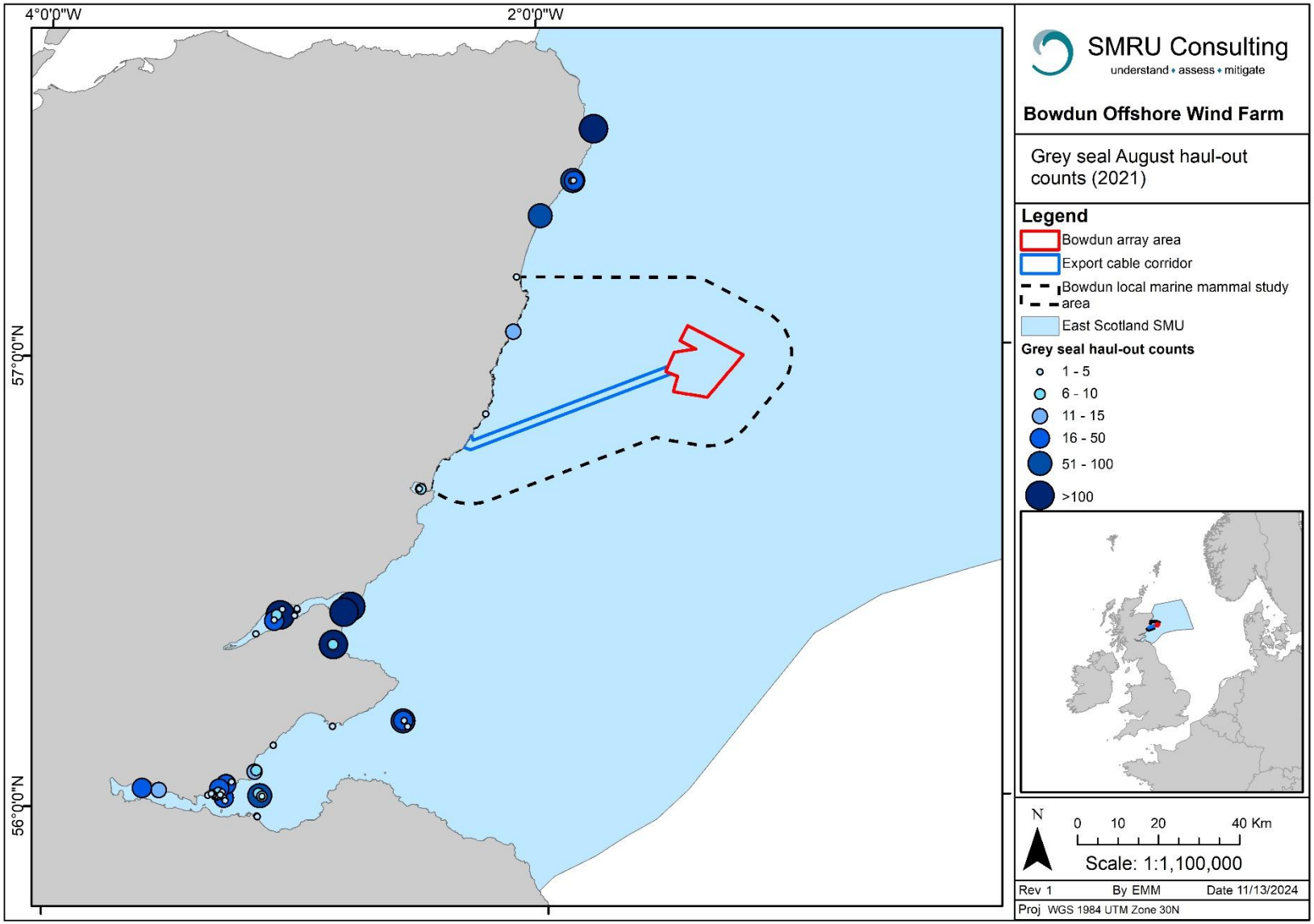


Figure 4-10 August harbour seal haul-out counts in the East Scotland SMU for 2021. Data provided by SMRU.

4.2.4 Grey seal pup production

Grey seals typically express a preference for remote breeding sites (SCOS, 2022). In 2019, total UK pup production was estimated at 67,850 (95% CI: ~60,500–75,100) based primarily on estimates from aerial surveys, which are used less frequently for surveying colonies, as well as ground count data (Figure 4-11). Pup production in Scotland in 2019 was estimated at 54,050 individuals (SCOS, 2023). It should be noted that pup production survey methodology changed in 2010, with new digital camera technology and reduced survey height improving the efficacy of counting and classification of moult stages in pups. These advancements coincide with the apparent step change in the observed numbers of pups (SCOS, 2023).

In the East Scotland SMU, the overall trend in pup production has been increasing in recent years, with an increase of approximately 28% observed between 2014 and 2019 (SCOS, 2023). The total estimated pup count across all grey seal colonies in the East Scotland SMU is 7,268 pups (SMRU pup database). However, the distribution of pup production within the East Scotland SMU appears to be changing. Prior to the 1990s, the Isle of May SAC was the dominant location for pup production, but pup production at this location is now considered to be stable or potentially declining (SCOS, 2023) (Figure 4-12). Since 2012, pup production estimates at the Isle of May have been overtaken by the Fast Castle colony that is showing a rapidly increasing pup population: the most recent 2019 pup count for Fast Castle was 4,499 individuals (SMRU pup database).

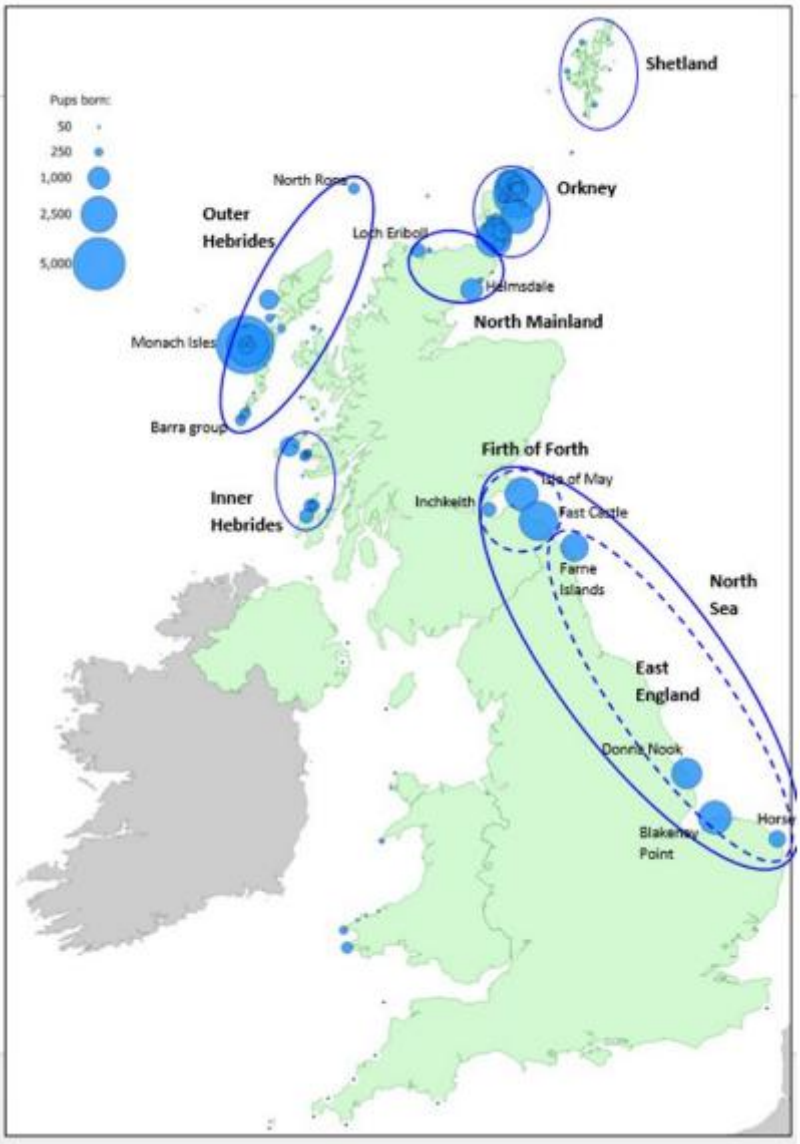


Figure 4-11 Distribution and size of the main grey seal breeding colonies in the UK. Blue ovals indicate groups of regularly monitored colonies within each region and blue circles represent number of pups born (SCOS, 2022). Note: the North Sea colonies are sub-divided into the Firth of Forth colonies, and the East England colonies (dashed blue ovals).

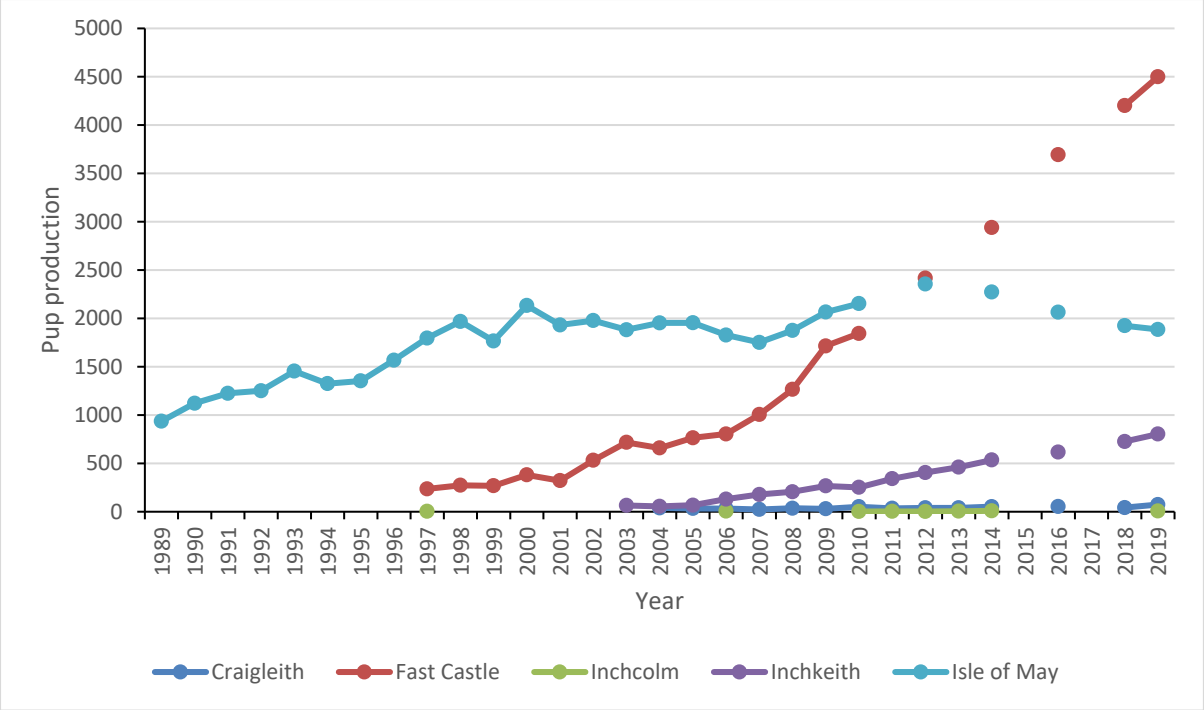


Figure 4-12 Grey seal colony pup production estimates in the East Scotland SMU from 1989 to 2019. Data provided by SMRU.

5 Telemetry Data

5.1 Harbour seals

Harbour seals typically forage within 40 - 50 km from their haul-out sites (SCOS, 2020) but have maximum foraging ranges of >250km recorded (Carter *et al.,* 2022). Between 2001 and 2013, 46 harbour seals[10] were tagged in the East Scotland SMU (Table 5-1 and Figure 5-1). All seals tagged within the East Scotland SMU were adults (> 1 year old), 29 of which were male and the remaining 17 of which were female. The majority of harbour seals were tagged at the Eden location (38), as well as Abertay (4) and Kirkcaldy (4).

In addition to these telemetry tracks, a further two harbour seals tagged in the Moray Firth SMU were tracked within the East Scotland SMU. However, it should be noted that all these tracks only just came into the East Scotland SMU and so their use of the area should be seen as limited. This resulted in a total of 48 harbour seal telemetry tracks within the East Scotland SMU all of which were adult seals. Harbour seal telemetry tracks were recorded throughout the SMU, but with a higher concentration around the Fife and Aberdeenshire coast, particularly in the south of the East Scotland SMU around the Tay and Eden estuaries (where most of the seals were tagged) (Figure 5-1).

Of the 48 tagged harbour seals with telemetry tracks within the East Scotland MU, nine had telemetry track data recorded within the Bowdun local marine mammal study area (Figure 5-2). All nine of these individuals (7 males and 2 females) were tagged within the Firth of Tay and Eden Estuary SAC in the East Scotland SMU, thus showing connectivity between the SAC and the Bowdun local marine mammal study area. None of these individuals showed connectivity with harbour seal SACs outside of the East Scotland SMU.

[10] Note: this does not include the 4 harbour seals tagged at the River Don in 2017 as they were tagged specifically for river studies and three were also tagged with Ultra High Frequency tags which would introduce bias by not including long trips.

Table 5-1 Summary information for the 46 harbour seals tagged in the East Scotland SMU (Satellite Relay Data Logger SRDL, Global System for Mobile Communications GSM or Global Positioning System GPS tags). Data provided by SMRU.

Date	Total	Location	Sex	Tag Type
Nov 2001	3	Abertay	3 x M	SRDL
	1	Eden	1 x M	SRDL
Jan 2002	6	Eden	5 x F 1 x M	SRDL
Oct 2002	1	Abertay	1 x M	SRDL
	4	Eden	1 x F 3 x M	SRDL
Jan 2003	2	Eden	2 x M	SRDL
Mar 2003	8	Eden	6 x F 2 x M	SRDL
May 2008	6	Eden	3 x F 3 x M	GSM
Feb 2011	5	Eden	1 x F 4 x M	GSM
May 2012	3	Eden	3 x M	GPS SRDL
Jul 2012	3	Eden	3 x M	GPS SRDL
Mar 2013	1	Kirkcaldy	1 x M	GSM
May 2013	3	Kirkcaldy	1 x F 2 x M	GSM

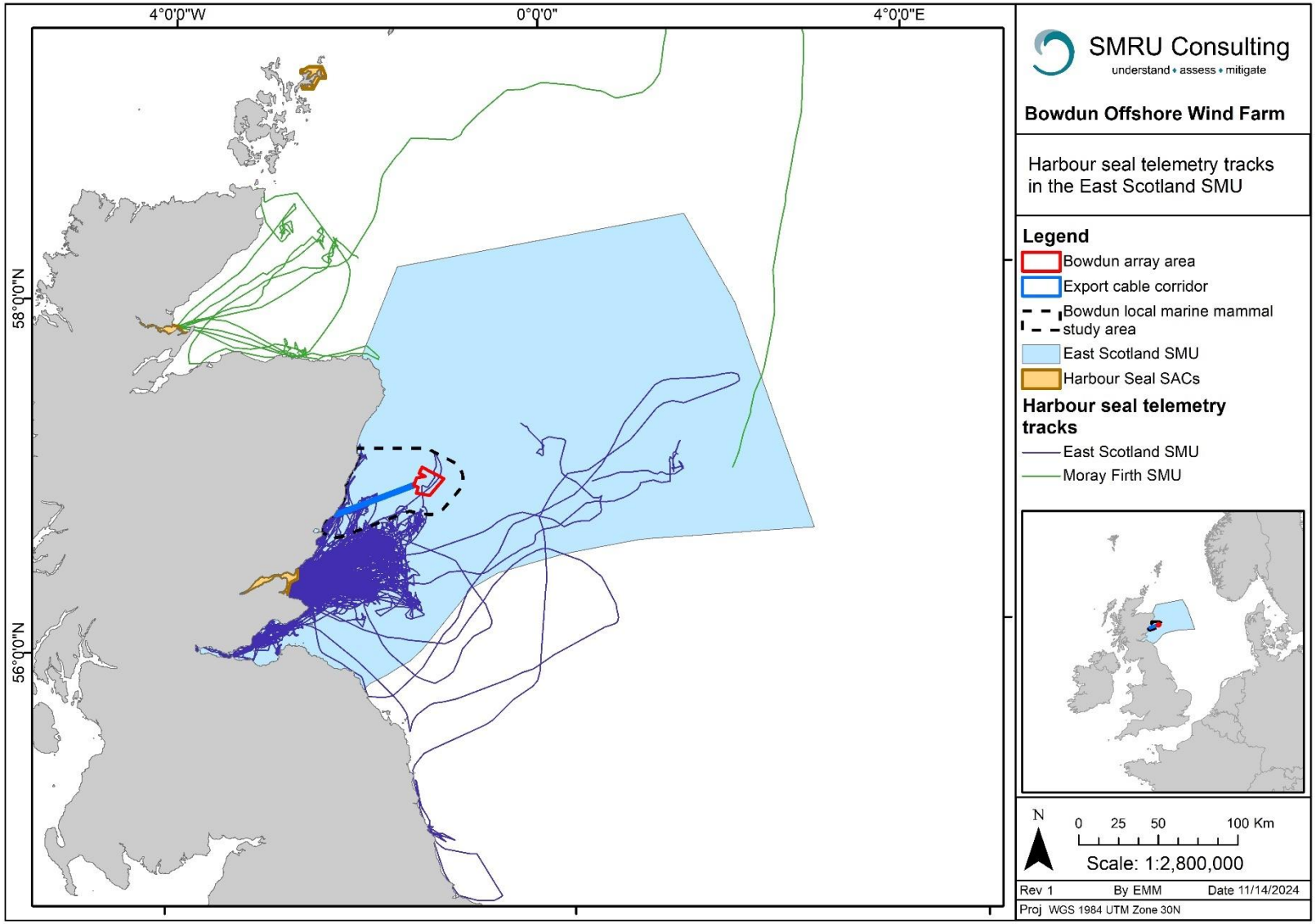


Figure 5-1 Telemetry tracks for all 48 harbour seals that entered the East Scotland SMU (46 tagged in the East Scotland SMU, 2 in the Moray Firth SMU). Data provided by SMRU.

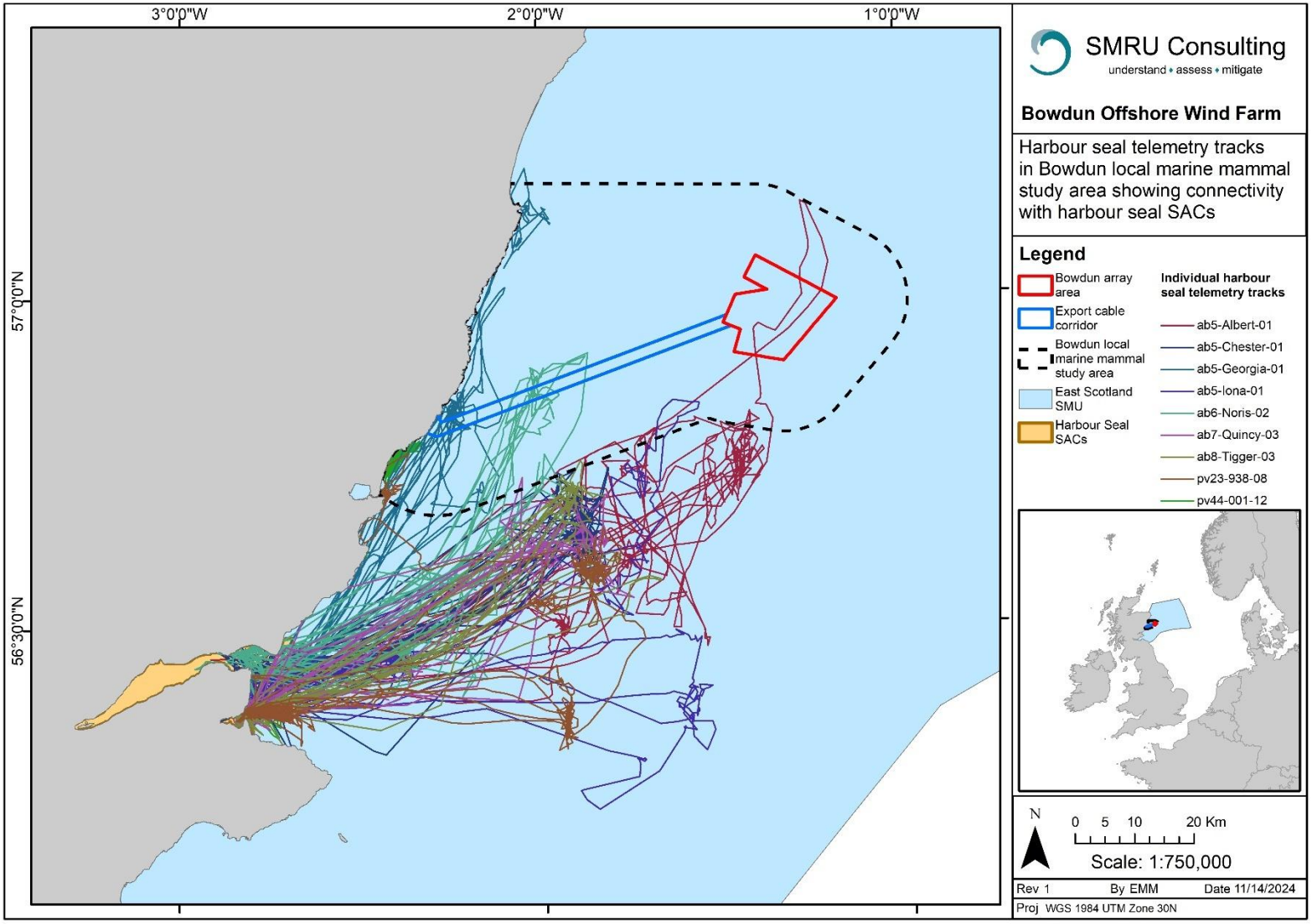


Figure 5-2 Harbour seal telemetry tracks that entered the Bowdun local marine mammal study area and showed connectivity to the Firth of Tay and Eden Estuary SAC (n=9, all tagged in East Scotland SMU). Data provided by SMRU.

5.2 Grey seals

A total of 74 grey seals were tagged in the East Scotland SMU between 1990 and 2014[11] (Table 5-2). Of these tagged individuals, 44 were adults and juveniles (>1 year old), 1 was of unknown age (also >1 year old) (Table 5-2, Figure 5-3) and 29 were pups (Table 5-2, Figure 5-6).

A further 48 grey seals were tagged outside the East Scotland SMU but were tracked within it: 16 were tagged in the North Coast & Orkney SMU, 1 in the Southeast England SMU, 5 in the Moray Firth SMU and 26 in the Northeast England SMU (Figure 5-5 and Figure 5-7). This resulted in a total of 122 grey seal telemetry tracks within East Scotland SMU.

Table 5-2 Summary information for the 74 grey seals tagged in the East Scotland SMU SMU (Satellite Relay Data Logger SRDL, Global System for Mobile Communications GSM or Global Positioning System GPS tags). Data provided by SMRU.

SMU	Year	#	Tagging Location	Sex	Tag Type
Adults and juveniles (n=44) & unknown (n=1)					
East Scotland	Nov 1990	3	Isle of May	3 x F	SRDL
	Jul 1993	2	Abertay	1 x F, 1 x F	SRDL
	Nov 1996	7	Isle of May	7 x F	SRDL
	Jun 1997	6	Abertay	3 x F, 3 x M	SRDL
	Jul 1997	1	Isle of May	1 x F	SRDL
	May 1998	10	Abertay	3 x F, 7 x M	SRDL
	Mar 2005	1	Tentsmuir	1 x unknown	GPS SRDL
	May 2005	2	Tentsmuir	1 x F, 1 x M	GPS SRDL
	Apr 2008	9	Abertay	5 x F, 4 x M	GSM
	Aug 2013	4	Abertay	2 x F, 2 X M	3 x GSM 1 x GPS SRDL
Pups (n=29)					
East Scotland	Nov 2001	1	Isle of May	1 x M	SRDL
	Dec 2001	10	Isle of May	5 x F, 5 x M	SRDL
	Nov 2002	3	Isle of May	2 x F, 1 x M	SRDL
	Dec 2002	7	Isle of May	3 x F, 4 x M	SRDL
	Nov 2014	5	Isle of May	2 x F, 3 x M	GSM
	Dec 2014	3	Isle of May	2 x F, 1 x M	GSM

5.2.1 Adults and juveniles

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 (Carter *et al.,* 2022).

In total, 44 adult and juvenile (>1 year old) grey seals were tagged within the East Scotland SMU (along with an additional 1 of unknown age; Table 5-2 and Figure 5-3). Both adult and juvenile grey seals were tagged in Abertay (31), Isle of May (11) and Tentsmuir (3) (Table 5-2). Several telemetry tracks covered large ranges: individuals that were tagged in the East Scotland SMU were tracked to the Shetland Isles and Western Isles as well as into the Danish North Sea (over 700 km from the UK coast; Figure 5-3).

A further 33 adult grey seals that were tagged elsewhere entered the East Scotland SMU (Figure 5-5): 19 tagged in the Northeast England SMU predominantly around Longstone, Wideopen, Kettle and

[11] Grey seals that were tagged and released following captive studies were removed from telemetry analysis as their movements are unlikely to be representative of animals that were tagged in the wild.

North and South Wamses, 8 tagged in the North Coast & Orkney SMU predominantly around Stroma and Sanday, one tagged in the Southeast England SMU around Donna Nook, and 5 tagged in the Moray Firth SMU predominantly around Dornoch Firth.

Out of the total 77 adult and juvenile grey seals that were either tagged in or entered into the East Scotland SMU, 22 were tracked within the Bowdun local marine mammal study area as well as at least one grey seal SAC (Figure 5-5). Connectivity between the Bowdun local marine mammal study area and the Isle of May SAC was observed in 10 adult grey seals, whilst 18 adult grey seals were observed to have connectivity with the Berwickshire and North Northumberland SAC. Of these individuals, 11 entered both the Isle of May SAC and Berwickshire and North Northumberland SAC, whilst only one adult grey seal recorded in the Berwickshire and North Northumberland SAC was also detected in the Humber SAC. Two adults recorded in the Berwickshire and North Northumberland SAC as well as the Bowdun local marine mammal study area were also the only individuals recorded in the North Rona and Monarch Islands SACs. Connectivity was also noted between the Bowdun local marine mammal study area and the Faray and Holm of Faray SAC, as both sites were visited by three adult grey seals, two of which were also detected in the Berwickshire and North Northumberland SAC.

5.2.2 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 presented separately here.

A total of 29 grey seal pups (14 female and 15 male) were tagged between 1993 and 2014 within the East Scotland SMU (Table 5-2 and Figure 5-6). All of these grey seal pups were tagged at the Isle of May SAC (Table 5-2).

A further 15 grey seal pups which had been tagged elsewhere were observed within the East Scotland MU (Figure 5-7). Of these, eight individuals were tagged in the North Coast & Orkney MU and seven were tagged in the Northeast England MU.

In a total, 44 grey seal pups were tracked within the East Scotland MU. Of these 44 grey seal pups, 17 were tracked within the Bowdun local marine mammal study area as well as at least one grey seal SAC (Figure 5-8). Connectivity with only the Isle of May SAC was observed in six grey seal pups, whilst five grey seal pups observed in the Bowdun local marine mammal study area were also recorded only in the Berwickshire and North Northumberland Coast SAC. A total of six pups showed connectivity between the Bowdun local marine mammal study area, the Isle of May SAC and the Berwickshire and North Northumberland Coast SAC.

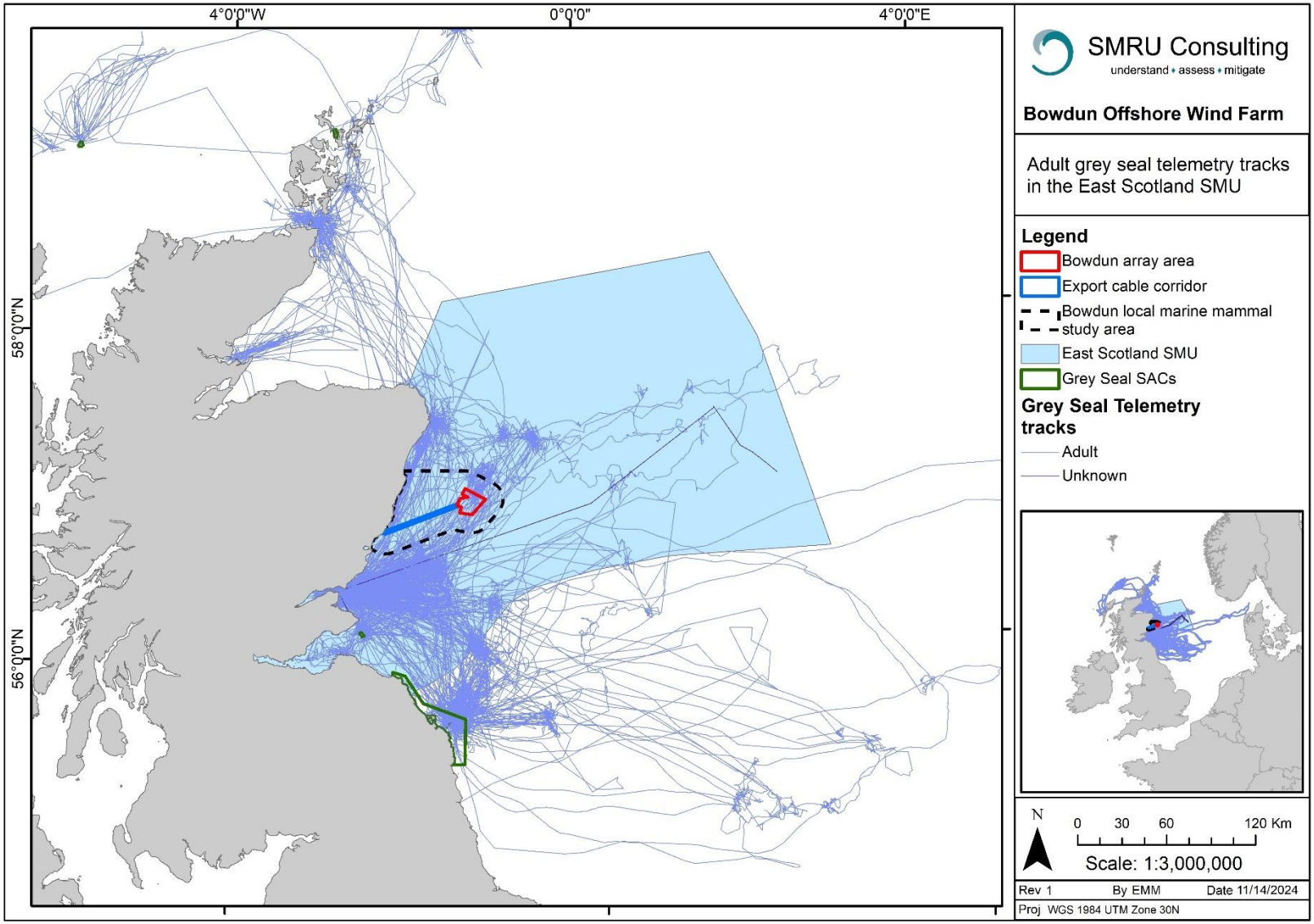


Figure 5-3 Telemetry tracks for the 45 grey seals (44 adults and 1 of unknown age) tagged in the East Scotland SMU. Data provided by SMRU.

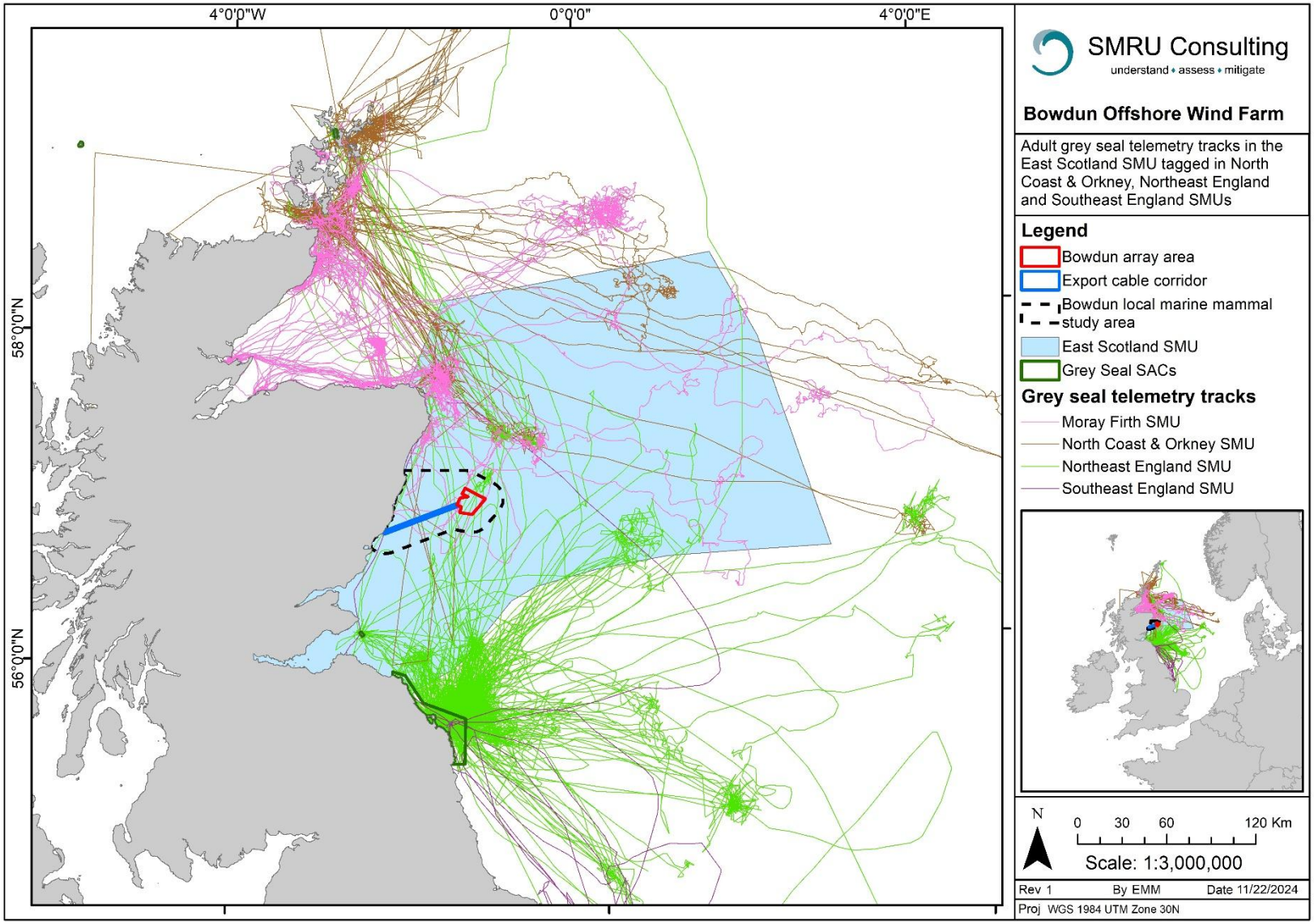


Figure 5-4 Telemetry tracks for the 33 adult grey seals tagged in other SMUs which entered the East Scotland SMU. Data provided by SMRU.

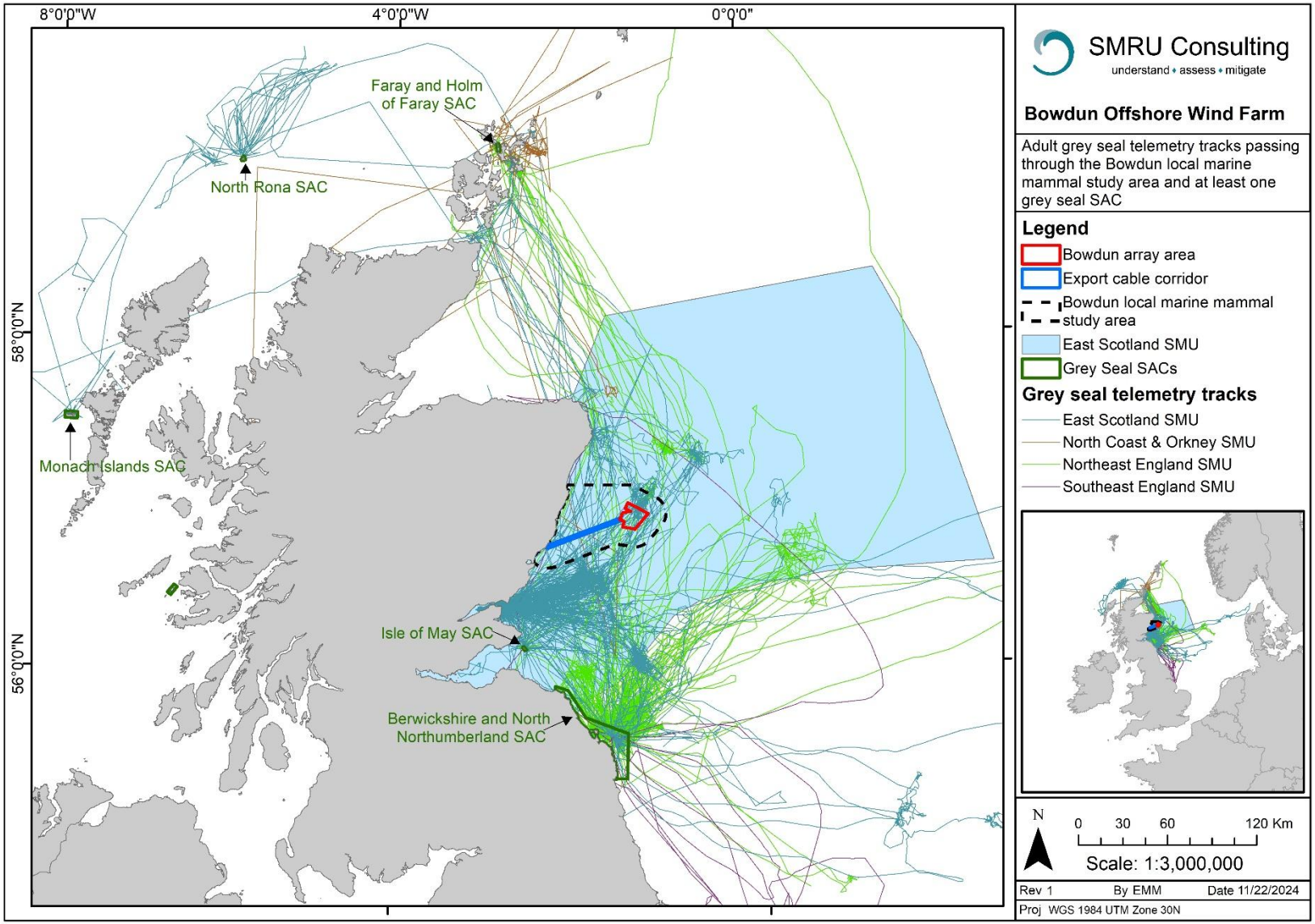


Figure 5-5 Telemetry tracks for the 22 adult grey seals which entered the Bowdun local marine mammal study area as well as at least one grey seal SAC. Data provided by SMRU.

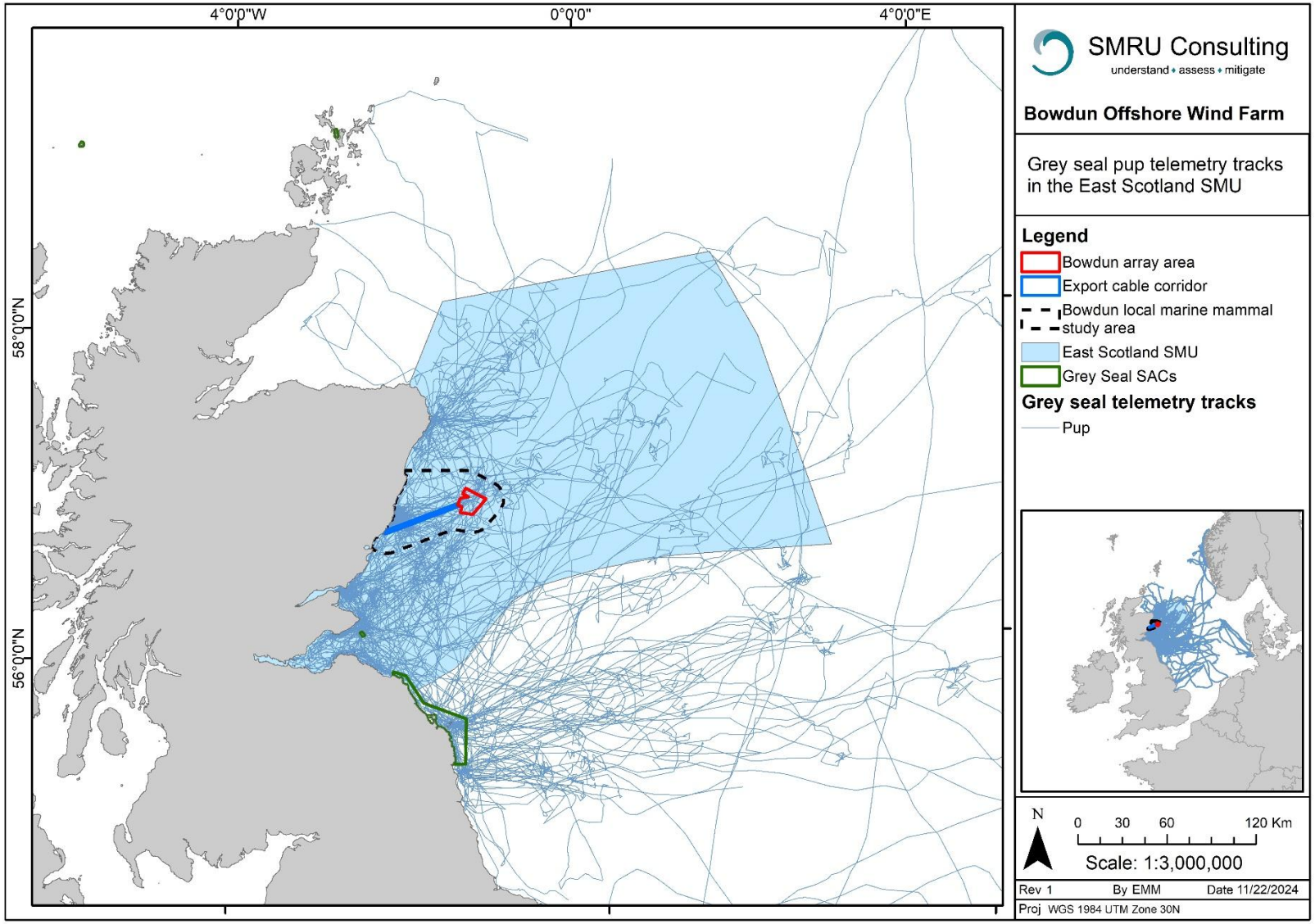


Figure 5-6 Telemetry tracks for the 29 grey seal pups tagged in the East Scotland SMU. Data provided by SMRU.

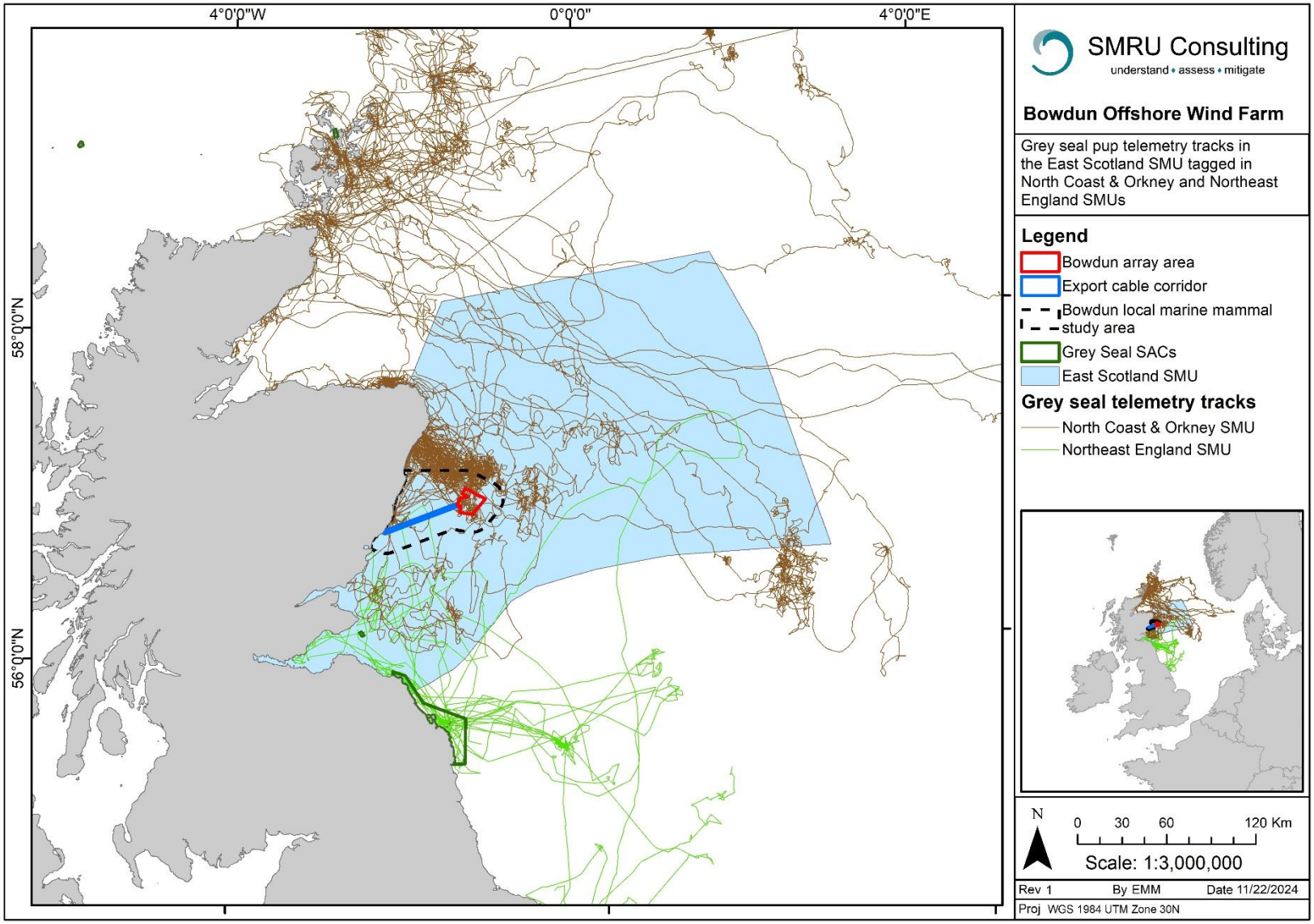


Figure 5-7 Telemetry tracks for the 15 grey seal pups from other SMUs which entered the East Scotland SMU. Data provided by SMRU.

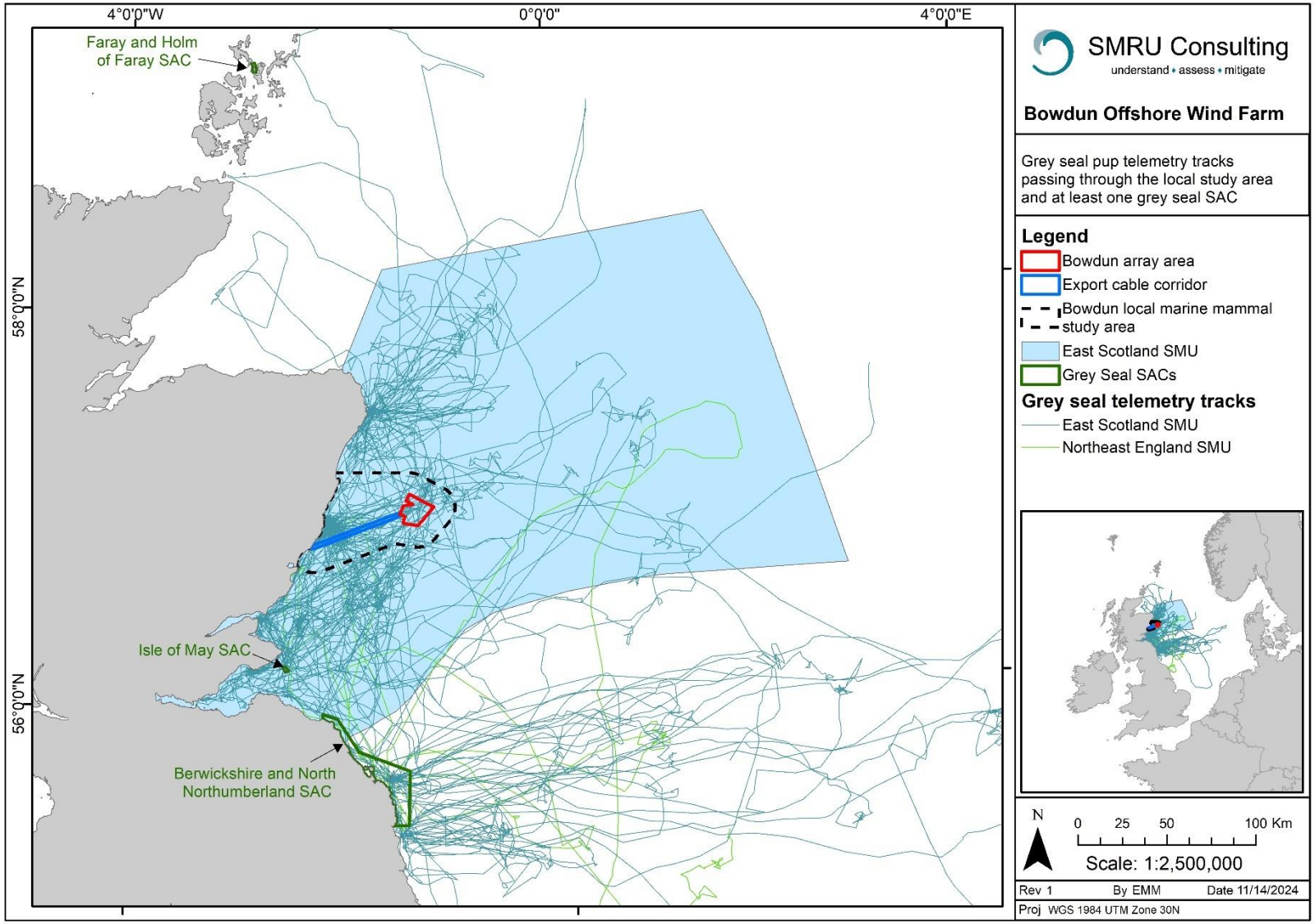


Figure 5-8 Telemetry tracks for the 17 grey seals pups which entered the Bowdun local marine mammal study area as well as at least one grey seal SAC. Data provided by SMRU.

6 Summary

6.1 Haul-out counts

- Not all sites within the East Scotland SMU are surveyed annually; however counts have been conducted in the Firth of Tay and Eden Estuary SAC on an annual basis since 2005.
- Harbour seals in the East Scotland SMU:
    - The 2021 August haul-out count of 262 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 364.
    - The East Scotland SMU population has been in decline, with a sudden change in the population trend was observed in 2002, but the decline is not thought to be related to PDV, and the nature of this change remains unknown.
- Grey seals in the East Scotland SMU:
    - The 2021 August haul-out count of 2,712 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 10,783.
    - The grey seal population is estimated to be stable in the East Scotland SMU. The most recent haul-out counts also indicated that the population may be increasing.

6.1.1 Grey seal pup counts

- East Scotland SMU:
    - Pup production is estimated at 7,268 pups from five grey seal colonies.
    - Prior to the 1990s, the Isle of May SAC was the dominant location for pup production, but pup production at this location is now considered to be stable or potentially declining.
    - Since 2012, pup production estimates have been overtaken by the Fast Castle colony located in the Berwickshire and North Northumberland Coast SAC, that is showing a rapidly increasing pup population: the most recent 2019 pup count for Fast Castle was 4,499 individuals (Figure 4 14).

6.2 Telemetry

- Harbour seal:
    - A total of 48 harbour seal telemetry tracks were recorded within the East Scotland SMU. Telemetry tracks were recorded throughout the East Scotland SMU but were more densely concentrated around the Fife and Aberdeenshire coast, particularly in the south of the East Scotland SMU around the Tay Estuary. The majority of harbour seals were tagged in the East Scotland SMU (46), as well as the Moray Firth (2).
    - Connectivity between the Bowdun local marine mammal study area and the Firth of Tay and Eden Estuary SAC was observed in 7 adult male and 2 adult female harbour seals.

- Grey seal:
    - There have been 122 grey seal tracks recorded throughout the East Scotland SMU. This comprised 77 adult grey seals and 44 grey seal pups, as well as one individual of unknown age.
    - Connectivity between the Bowdun local marine mammal study area and a grey seal SAC was observed in 39 grey seals, (22 adults and 17 pups). There were 10 showing connectivity with the Isle of May SAC and 19 with the Berwickshire and North Northumberland coast SAC, of which 11 individuals were observed in both SACs.
    - Connectivity was also observed between the Bowdun local marine mammal study area and the Faray and Holme of Faray SAC, the North Rona SAC, the Monarch Islands SAC and the Humber Estuary SAC.

7 Data Provided

All count data for the East Scotland SMUs can be found in the attached Excel Workbook:

- August Haulout Counts East Scotland SMU.xls
- Grey seal pup production East Scotland SMU.xls

Shapefiles of the August haul-out count data are provided in:

- Harbour_seal_haulout_counts_seal_management_units_1996to2021.shp
- Grey_seal_haulout_counts_seal_management_units_1997to2021.shp

Shapefiles of all individual seals with telemetry data within the East Scotland SMU and Bowdun local marine mammal study area are provided in:

- Harbour_seal_telem_within_seal_management_units.shp
- Harbour_seal_telem_within_Array_marine_mammal_study_area_connectivity_SACs.shp
- Grey_seal_telem_within_seal_management_units_adults.shp
- Grey_seal_telem_within_Array_marine_mammal_study_area_connectivity_SACs_adults.shp
- Grey_seal_telem_within_seal_management_units_pups.shp
- Grey_seal_telem_within_Array_marine_mammal_study_area_connectivity_SACs_pups.shp

A list of the data for each individual seal tagged in the East Scotland SMU:

- Telemetry Bios.xls

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