Code: UKCAL-CWF-CON-EIA-RPT-00007-7B46

Volume 7B Proposed Development (Offshore) Appendices

Appendix 7-1 Marine Mammals Baseline Characterisation

Caledonia Offshore Wind Farm Ltd

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OCEAN WINDS

Volume 7B Appendix 7-1 Marine Mammals Baseline Characterisation

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Acronyms and Abbreviations

BEIS	Department for Business Energy and Industrial Strategy
CES	Coastal East Scotland
CGNS	Celtic and Greater North Sea
CRRU	Cetacean Research and Rescue Unit
DAS	Digital Aerial Survey
DPO	Draft Plan Option
ECOMMAS	East Coast Scotland Marine Mammal Acoustic Array Surveys
EEZ	Exclusive Economic Zone
EIA	Environmental Impact Assessment
EIAR	Environmental Impact Assessment Report
GNS	Greater North Sea
GPS	Global Positioning System
IAMMWG	Inter Agency Marine Mammal Working group
IMMA	Important Marine Mammal Area
JCP	Joint Cetacean Protocol
MERP	Marine Ecosystems Research Programme
MMO	Marine Mammal Observer
MMPATF	Marine Mammal Protected Areas Task Force
MPA	Marine Protected Area
MU	Management Unit
NAMMCO	North Atlantic Marine Mammal Commission
NERC	Natural Environment Research Council

NS	North Sea
OECC	Offshore Export Cable Corridor
OWF	Offshore Wind Farm
PAM	Passive Acoustic Monitoring
SAC	Special Area of Conservation
SCANS	Small Cetaceans in European Atlantic waters and the North Sea
SCOS	Special Committee on Seals
SMRU	Sea Mammal Research Unit
SMU	Seal Management Unit
WTG	Wind turbine generator

Executive Summary

The purpose of the baseline characterisation report is to examine data sources on marine mammals relative to the Proposed Development (Offshore) in order to select the best species-specific abundance and density estimates to take forward to the quantitative impact assessment in the Environmental Impact Assessment Report (EIAR).

The data presented in this technical baseline report is applicable to the Proposed Development (Offshore) as well as both Caledonia North and Caledonia South in isolation.

The baseline data have been compiled through a literature review in addition to consideration of data obtained from site-specific baseline surveys for Caledonia conducted from May 2021 to April 2023. The Offshore Scoping Report stated that the baseline characterisation report, submitted alongside the EIAR, would provide "*detailed information on all data sources examined, assumptions and limitations of the different surveys and resulting density and abundance estimates for each species*".

In order to focus this baseline characterisation report on the most relevant data sources, the following structure to data sections has been applied:

- Section 4 outlines the key data sources considered in this assessment (including a table of all data sources examined).
- Sections 5 to 10 details all data sources and the evidence base for each of the most common cetacean species. Section 11 and 12 outline the evidence base for harbour and grey seals respectively. In each case, the section details the data sources that were considered to be the most appropriate to focus on, given their proximity to the Proposed Development (Offshore), the period over which they were collected and most appropriate methodology for the purposes of informing impact assessment. Each section identifies the most appropriate density and abundance estimates to be used in the quantitative impact assessment. Less common species are summarised in Section 13,
- Conclusions are provided in Section 14, followed by Section 15 which provides a full record of other data sources examined and considered. This includes information on why these were not considered to be key data sources for the baseline characterisation (e.g., age of data, lack of absolute density estimate, inappropriate scale of surveys).

This appendix identified that the site-specific baseline surveys alongside the literature review of other data sources confirmed the presence of eight marine mammal species regularly present in proximity to the Proposed Development (Offshore) (Table 1–1). These eight species have been taken forward to the quantitative impact assessment. Whilst not expected to be present in high densities, there was evidence that humpback whales could be present within the Proposed Development (Offshore) and, therefore, they have been assessed qualitatively within the impact assessment.

In addition to identifying the Management Unit (MU) and density estimate to take forward to quantitative impact assessment (Table 1–1), this baseline has also identified Marine Protected Areas (MPAs) that have been given further consideration:

- Moray Firth Special Area of Conservation (bottlenose dolphins); and

- Southern Trench MPA (minke whale).

It is important to note that marine mammals present in the Moray Firth have already experienced impacts associated with the construction and operation of wind farms. The Beatrice Demonstrator Wind Farm, which comprises two wind turbine generators (WTGs), was constructed in 2007 and is due to be decommissioned between 2024 and 2029. The Beatrice Offshore Wind Farm (OWF) (84 WTGs) was installed between 2017 and 2018, the Moray East OWF (100 WTGs) was installed between 2019 and 2021 and the Moray West OWF is currently under construction. Therefore, the current baseline for marine mammals does not represent a pristine unimpacted population. For this reason, many of the older baseline datasets are not considered to be appropriate.

Table 1–1: Species, MU size and density estimates recommended for the use in the quantitative assessment of the Proposed Development (Offshore).

Species	MU	MU Size / UK MU Size	MU Ref	Density (#/km^2)	Density Reference
Harbour porpoise	North Sea	346,601 / 159,632	IAMMWG (2023[1])	Grid cell specific	SCANS III density surface (Lacey *et al.*, 2022[2])
				0.2813 (CS-K)* 0.5156 (NS-E)	SCANS IV survey blocks (Gilles *et al.*, 2023[3])
Bottlenose dolphin	Coastal East Scotland	245 / N/A	Cheney *et al.* (2024[4])	Grid cell specific within the Moray Firth (max 0.0543)	Calculated (Quick *et al.*, 2014[5]; Thompson *et al.*, 2015a[6]; Cheney *et al.*, 2024)
				0.142 within 2km of the coast south of the Moray Firth	
	Greater North Sea	2,022 / 1,885	IAMMWG (2023[1])	0.003 - beyond Moray Firth and 2km buffer	Calculated (IAMMWG, 2023[1])
White-beaked dolphin	Celtic and Greater North Seas	43,951 / 34,025	IAMMWG (2023[1])	Grid cell specific	SCANS III density surface (Lacey *et al.*, 2022[2])
				0.1352 (CS-K)* 0.1775 (NS-E)	SCANS IV survey blocks (Gilles *et al.*, 2023[3])
Common dolphin	Celtic and Greater North Seas	102,656 / 57,417	IAMMWG (2023[1])	Grid cell specific	SCANS III density surface (Lacey *et al.*, 2022[2])

Species	MU	MU Size / UK MU Size	MU Ref	Density (#/km^2)	Density Reference
Risso's dolphin	Celtic and Greater North Seas	12,262 / 8,687	IAMMWG (2023[1])	0.0376 (CS-K) 0.0702 (NS-E)	SCANS IV survey blocks (Gilles *et al.*, 2023[3])
Minke whale	Celtic and Greater North Seas	20,118 / 10,288	IAMMWG (2023[1])	Grid cell specific	SCANS III density surface (Lacey *et al.*, 2022[2])
				0.0116 (CS-K) 0.0100 (NS-E)	SCANS IV survey blocks (Gilles *et al.*, 2023[3])
Harbour seal	Moray Firth	958 / 958	Scaled Special Committee on Seals (SCOS (2023[7]) counts	Grid cell specific	Habitat preference map (Carter *et al.*, 2020[8]; 2022[9])
	East Scotland	364 / 364			
	North Coast & Orkney	1,951 / 1,951			
Grey seal	Moray Firth	7,380 / 7,380	Scaled SCOS (2023[7]) counts	Grid cell specific	Habitat preference map (Carter *et al.*, 2020[8]; 2022[9])
	East Scotland	10,783 / 10,783			
	North Coast & Orkney	34,191 / 34,191			
Humpback whale	Qualitative assessment only				
Killer whale	Screened out				
* SCANS IV survey blocks: the Proposed Development (Offshore) is in block CS-K and is adjacent to block NS-E (Gilles *et al.*, 2023[3]).					

1 Introduction

1.1 The Proposed Development (Offshore)

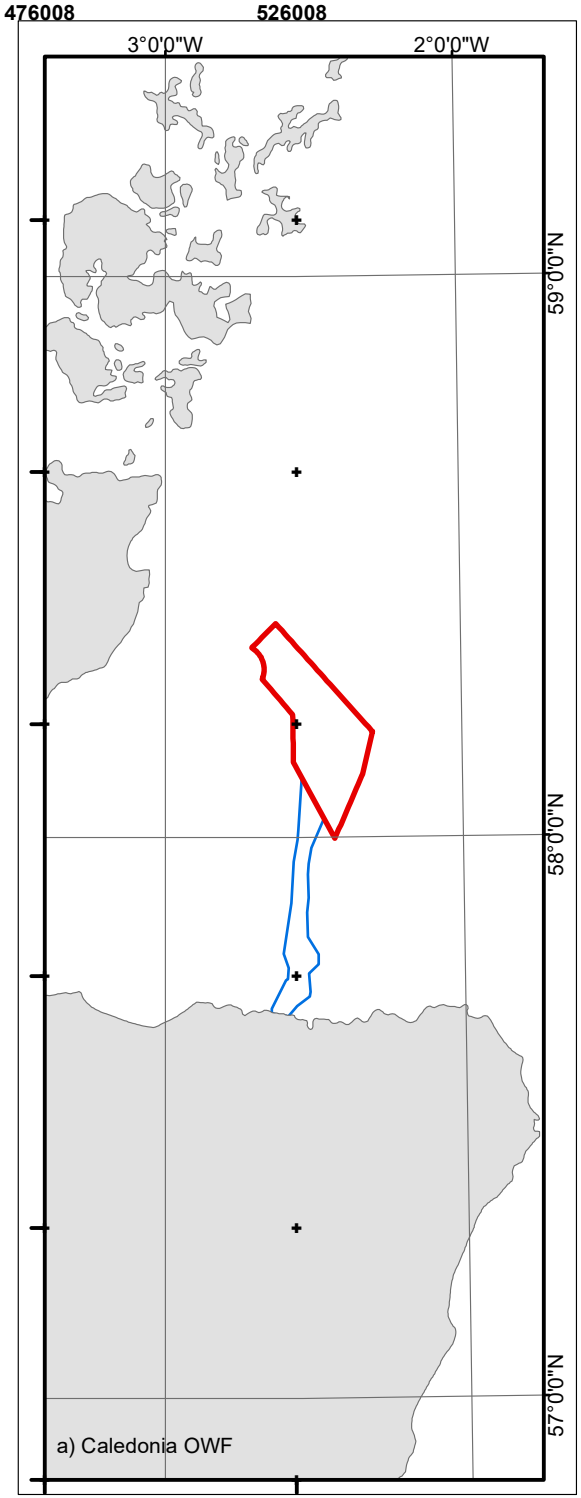
1.1.1.1 This appendix outlines the marine mammals baseline characterisation for the Proposed Development (Offshore), located in the Moray Firth, Scotland. This includes the Caledonia Offshore Wind Farm (OWF) (i.e., Array Area) and the Caledonia Offshore Export Cable Corridor (OECC) seaward of Mean High-Water Springs (MHWS). It is located within the NE4 Plan Option identified in the Scottish Government's Sectoral Marine Plan for Offshore Wind Energy (Scottish Government, 2020[10]).

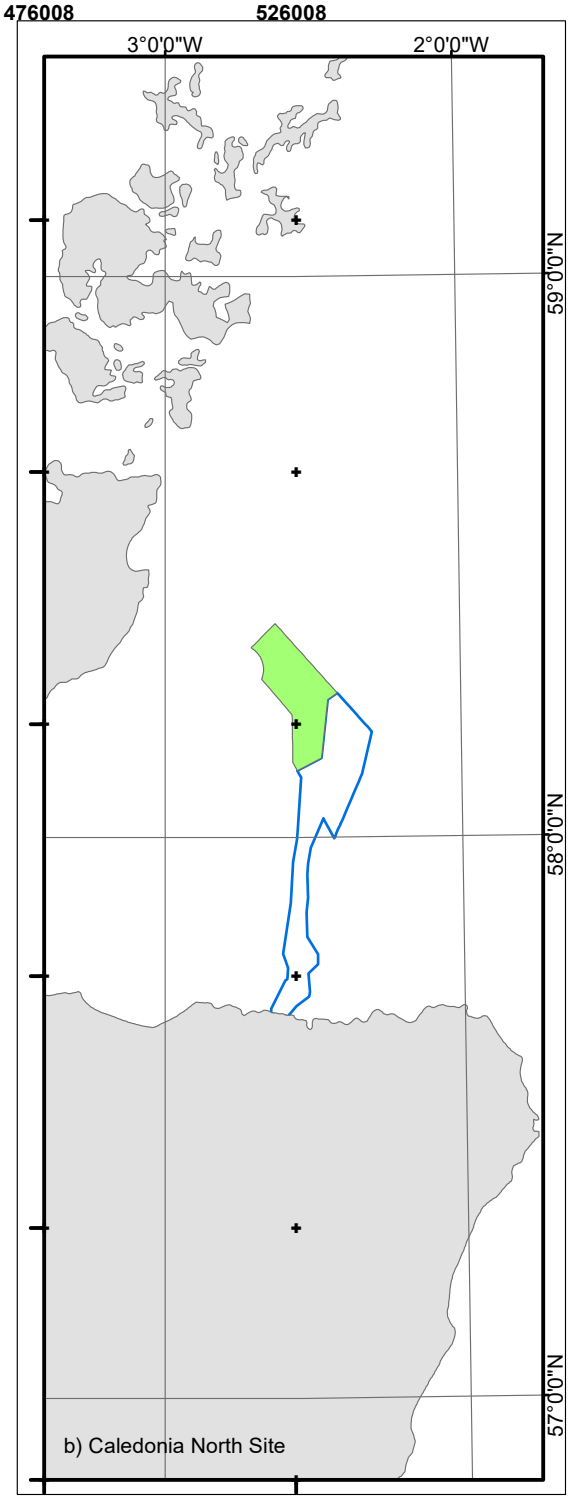
1.1.1.2 The Proposed Development (Offshore) will be developed in two phases (see Volume 1, Chapter 5: Proposed Development Phasing), referred to as Caledonia North and Caledonia South (Figure 1-1). The Array Areas of the two phases are referred to as the Caledonia North Site and the Caledonia South Site. Site selection and technical evaluation has resulted in a total project scale of 140 Wind Turbine Generators (WTGs) within the Caledonia OWF. The Design Envelope includes both bottom-fixed and floating foundation technology.

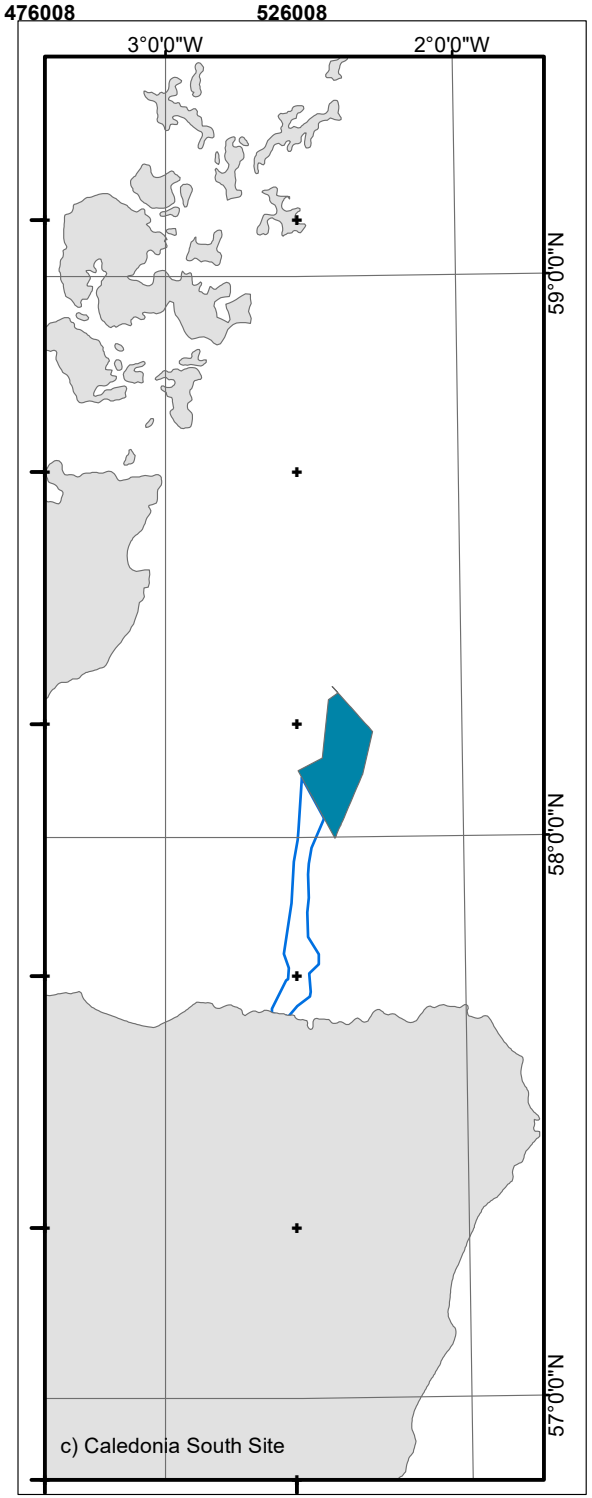
1.1.1.3 The baseline characterisation described in this appendix has been prepared to inform the following chapters of the Environmental Impact Assessment Report (EIAR):

- Volume 2, Chapter 7: Marine Mammals, relating to the Proposed Development (Offshore) which includes the following:
  - Caledonia OWF (Array Area); and
  - Caledonia OECC.
- Volume 3, Chapter 7: Marine Mammals, relating to Caledonia North which includes the following:
  - Caledonia North Site (Array Area); and
  - Caledonia North OECC.
- Volume 4, Chapter 7: Marine Mammals, relating to Caledonia South which includes the following
  - Caledonia South Site (Array Area); and
  - Caledonia South OECC.

1.1.1.4 The relatively shallower Caledonia North Site is proposed to contain bottom-fixed WTG technology, while the relatively deeper Caledonia South Site is proposed to contain either bottom-fixed WTG technology only, or a combination of bottom-fixed and floating WTG technology. The total footprint of the Caledonia OWF is approximately 423km^2.

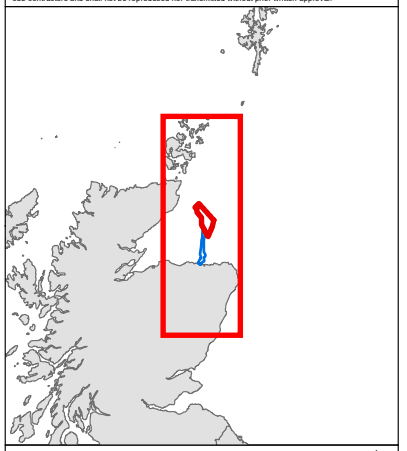






Legend

- Caledonia OWF
- a) OECC, b) Caledonia North OECC, c) Caledonia South OECC
- Caledonia North Site
- Caledonia South Site



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CALEDONIA Offshore Wind Farm

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CONTRACTOR DRAWING NO	CONTRACTOR REV
SMRUC-001	01

GEODETIC PARAMETERS: WGS 84 / UTM zone 30N (EPSG: 32630)

DRAWING TITLE

Figure 1.1: The location and extent of the Proposed Development (offshore), including Caledonia North and Caledonia South

STATUS	SCALE	
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DRAWING NUMBER	SHEET NO	REV
N/A	01 of 01	N/A

1.2 Purpose of Document

1.2.1.1 The purpose of the baseline characterisation report is to examine data sources on marine mammals relative to the Proposed Development (Offshore) in order to select the best species-specific abundance and density estimates to take forward to the quantitative impact assessment in the EIAR. The data presented in this technical baseline report is applicable to the Proposed Development (Offshore) as well as both Caledonia North and Caledonia South in isolation.

1.2.1.2 The baseline data have been compiled through a literature review in addition to consideration of data obtained from the Digital Aerial Surveys (DAS) conducted from May 2021 to April 2023 (Volume 7, Appendix 19: Caledonia OWF Digital Aerial Surveys). The Offshore Scoping Report (Volume 7, Appendix 2) states that the baseline characterisation report, submitted alongside the EIAR, will provide "*detailed information on all data sources examined, assumptions and limitations of the different surveys and resulting density and abundance estimates for each species*".

1.2.1.3 In order to focus this baseline characterisation report on the most relevant data sources, the following structure to data sections has been applied:

- Section 4 outlines the key data sources considered in this assessment (including a table of all data sources examined).
- Sections 5-10 details all data sources and the evidence base for each of the most common cetacean species. Section 11 and 12 outline the evidence base for harbour and grey seals respectively. In each case, the section details the data sources that were considered to be the most appropriate to focus on, given their proximity to the Proposed Development (Offshore), the period over which they were collected and most appropriate methodology for the purposes of informing impact assessment. Each section identifies the most appropriate density and abundance estimates to be used in the quantitative impact assessment. Less common species are summarised in Section 13.
- Conclusions are provided in Section 14, followed by Section 15 which provides a full record of other data sources examined and considered, including information on why they were not considered to be key data sources for the baseline characterisation (e.g., age of data, lack of absolute density estimate, inappropriate scale of surveys).

2 Study Area

2.1.1.1 For all species, the study area covers the Proposed Development (Offshore) and is extended over an appropriate area considering the scale of movement and population structure for each species. The marine mammal study area has been defined at two spatial scales; the local study area and a regional scale study area using species Management Units (MUs) (IAMMWG, 2023[1]; SCOS, 2023[7]).

2.1.1.2 The local study area is informed by monthly DAS comprising transect lines within the Caledonia OWF plus a 4km buffer (which cover the Caledonia North Site plus a 4km buffer and the Caledonia South Site plus a 4km buffer)[i] to provide an indication of the species present (and density estimates where available). These were conducted from May 2021 to April 2023 by APEM Ltd. Full details of DAS are provided in the final survey report (Volume 7, Appendix 19: Caledonia OWF Digital Aerial Surveys). The extent of DAS for the Caledonia OWF, the Caledonia North Site and the Caledonia South Site is shown in Figure 2-1.

2.1.1.3 The regional scale study area (Figure 2-2) encompasses a wider geographic context in terms of species presence and their estimated densities and abundance. This scale defines the appropriate reference populations for the assessment. The regional study area for each species is as follows:

- Harbour porpoise (*Phocoena phocoena*): North Sea (NS) MU;
- Bottlenose dolphin (*Tursiops truncatus*): Coastal East Scotland (CES) and Greater North Sea (GNS) MUs;
- White-beaked dolphin (*Lagenorhynchus albirostris*): Celtic and Greater North Seas (CGNS) MU;
- Short-beaked common dolphin (*Delphinus delphis*): CGNS MU;
- Risso's dolphin (*Grampus griseus*): CGNS MU;
- Minke whale (*Balaenoptera acutorostrata*): CGNS MU;
- Harbour seal (*Phoca vitulina*): East Scotland, Moray Firth and North Coast & Orkney Seal Management Units (SMU); and
- Grey seal (*Halichoerus grypus*): East Scotland, Moray Firth and North Coast & Orkney SMUs.

2.1.1.4 In addition to the eight marine mammal species listed above, recognition is also given to the less common species including the following:

- White-sided dolphin (*Lagenorhynchus acutus*);

[i] For the purpose of the baseline characterisation, the local study area is based on the largest extent of survey (e.g., Caledonia OWF plus a 4km buffer).

- Killer whale (*Orcinus orca*);
- Pilot whale (*Globicephala melas*);
- Humpback whale (*Megaptera novaengliae*);
- Fin whale, (*Balaenoptera physalus*);
- Sperm whale (*Physeter macrocephalus*); and
- Northern bottlenose whale (*Hyperoodon ampullatus*).

2.1.1.5 Further consideration within this technical baseline has been given to species where surveys within the Caledonia OWF or Caledonia OECC indicate their presence.

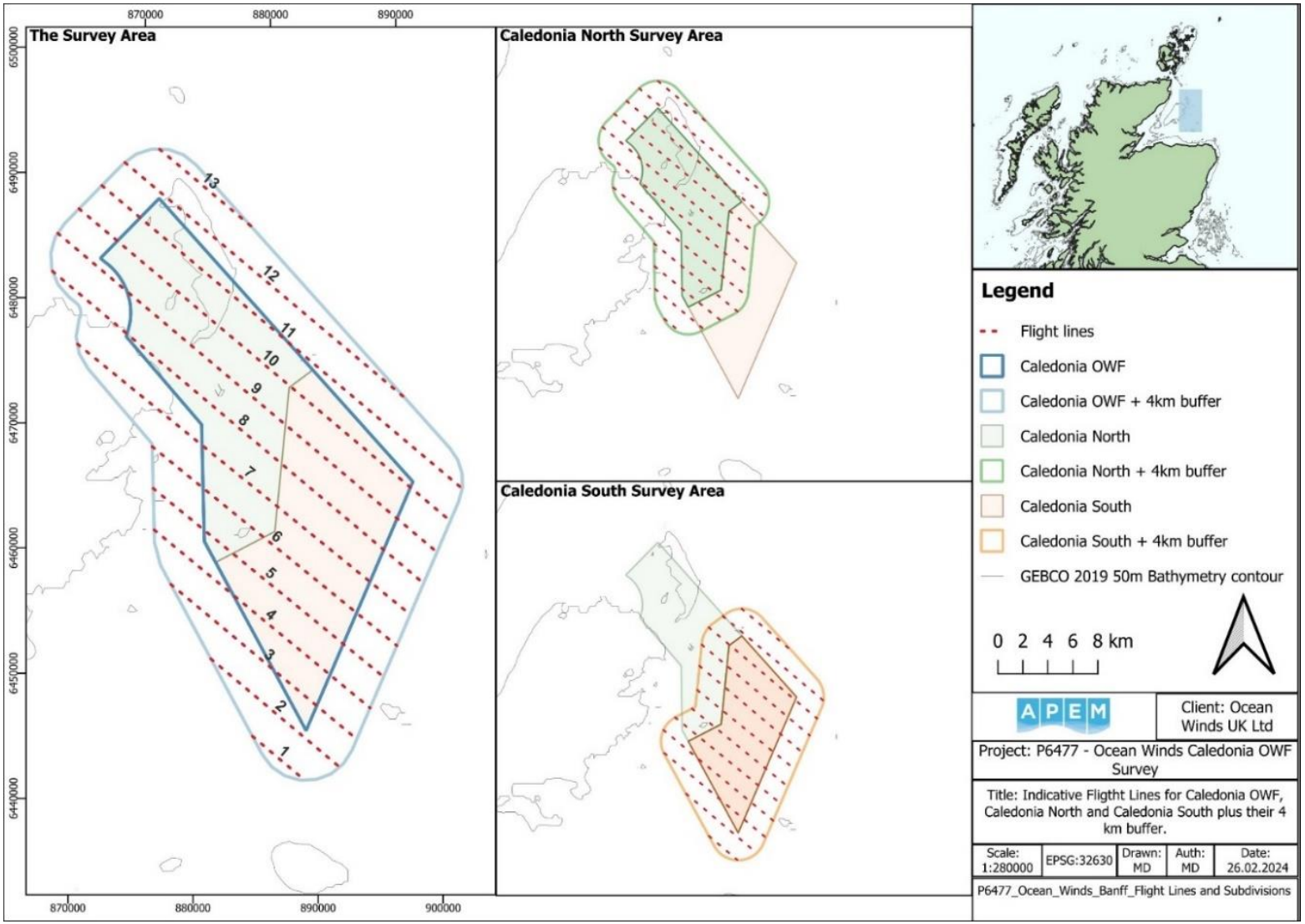
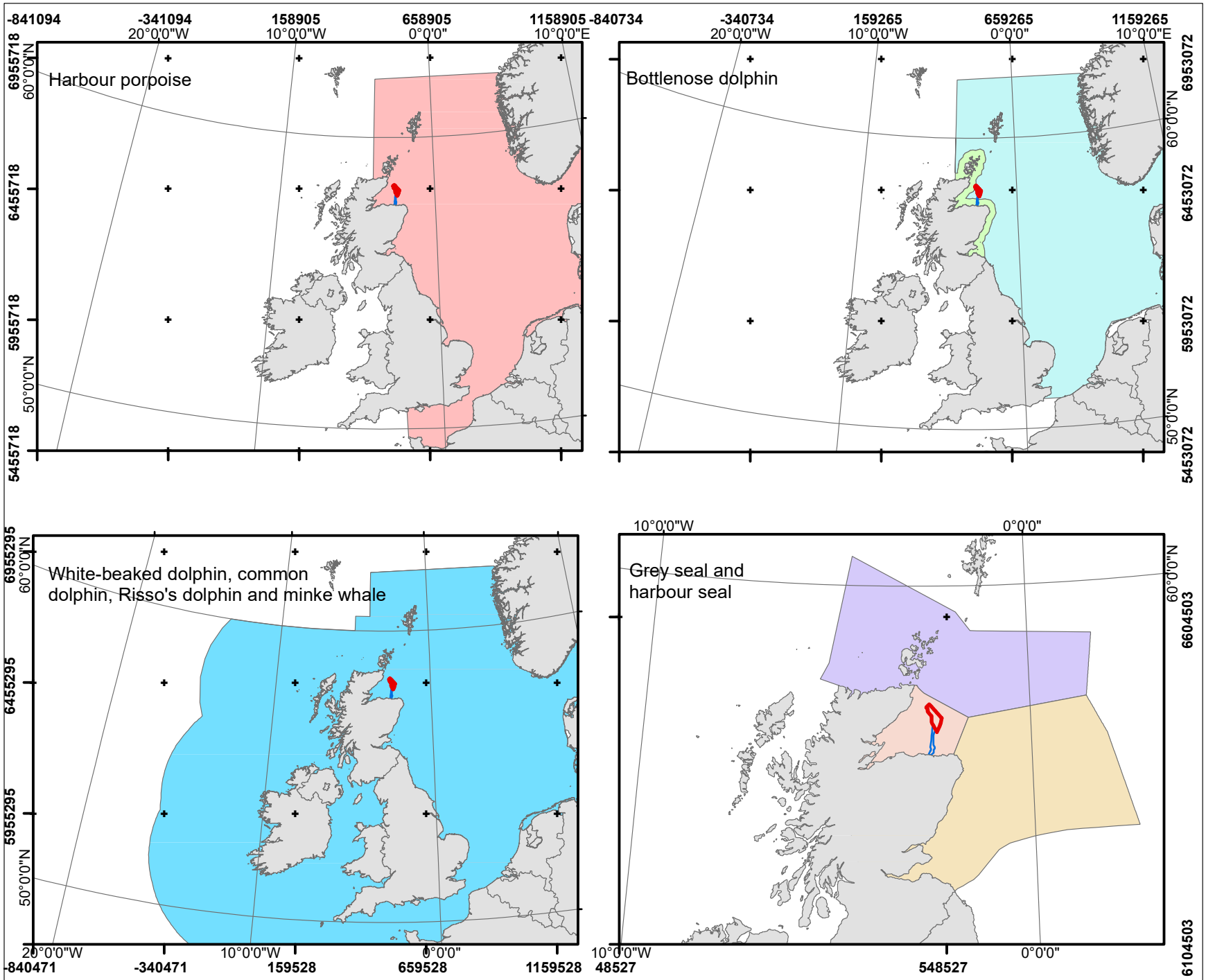
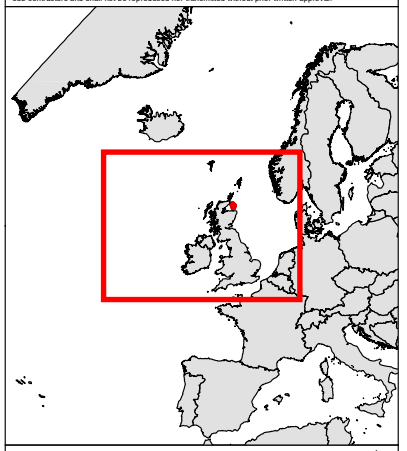


Figure 2-1: Indicative flight lines for Caledonia OWF, Caledonia North and Caledonia South plus their 4km buffer. Source: Volume 7, Appendix 19: Caledonia OWF Digital Aerial Surveys.



Legend

- Caledonia OWF
- OECC
- North Sea MU
- Coastal East Scotland MU
- Greater North Sea MU
- Celtic and Greater North Seas MU
- East Scotland SMU
- Moray Firth SMU
- North Coast and Orkney SMU



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CALEDONIA Offshore Wind Farm

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SMRUC-002	01

GEODETIC PARAMETERS: WGS 84 / UTM zone 30N (EPSG: 32630)

DRAWING TITLE

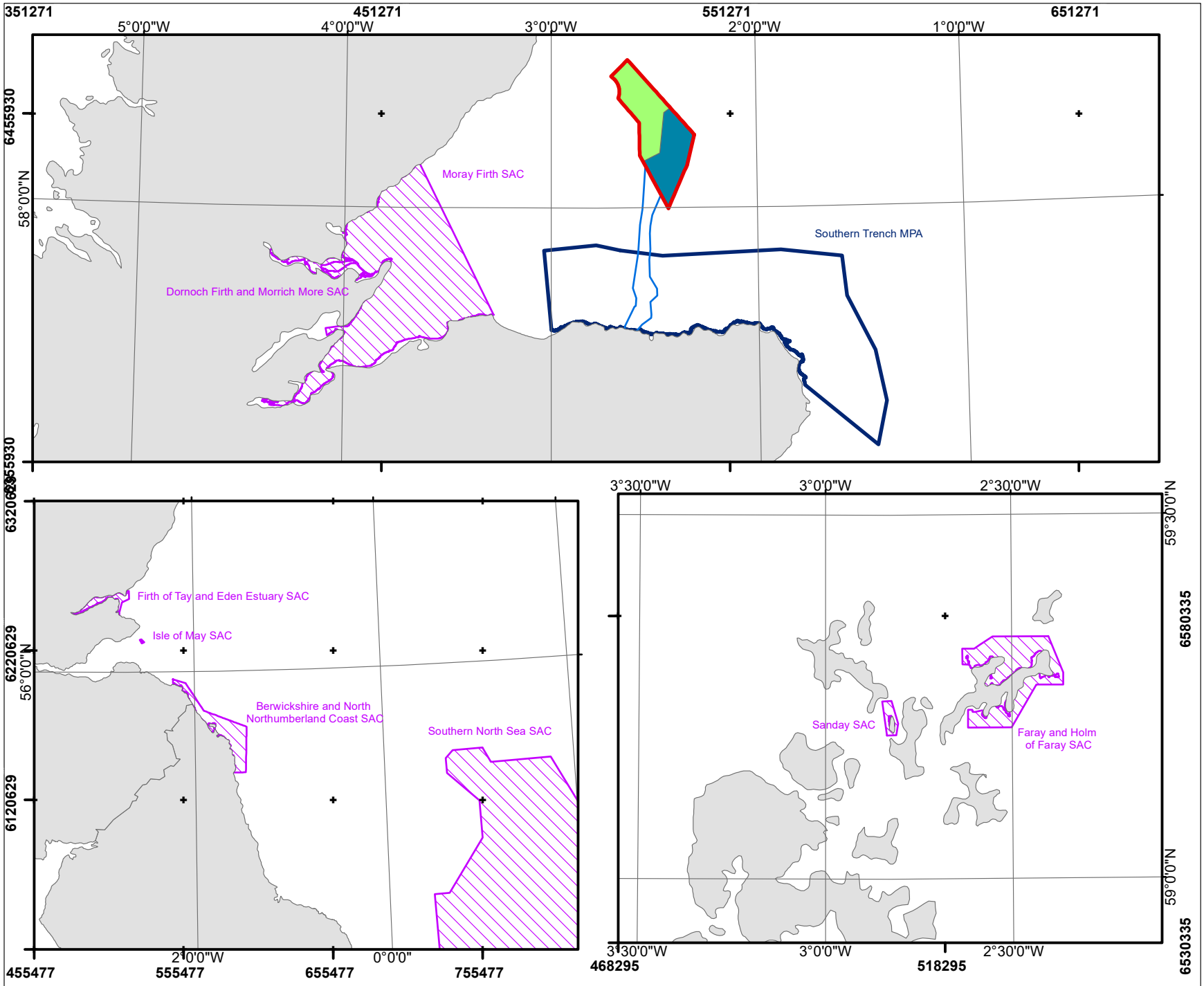
Figure 2-2: Marine mammal Management Units

STATUS	SCALE	
Approved	1:20,000,000	
DRAWING NUMBER	SHEET NO	REV
N/A	01 of 01	N/A

3 Protected Areas

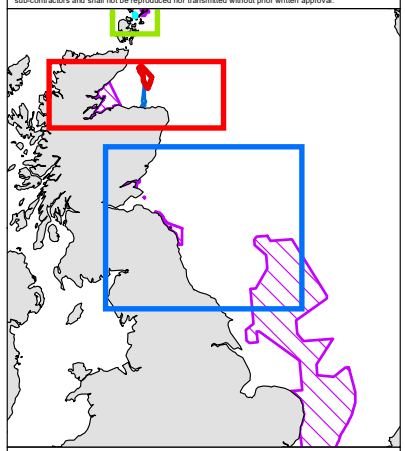
3.1 Overview

3.1.1.1 There are several protected areas for marine mammals within their respective MUs (Table 3–1). The Caledonia OWF is not located within any protected areas. However, the Caledonia OECC passes through the Southern Trench Nature Conservation MPA, designated for minke whales (Figure 3-1).



Legend

- Caledonia OWF
- OECC
- Caledonia North Site
- Caledonia South Site
- Special Area of Conservation (SAC)
- Marine Protected Area



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CALEDONIA Offshore Wind Farm

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CONTRACTOR DRAWING NO: SMRUC-003	CONTRACTOR REV: 01
GEODETIC PARAMETERS: WGS 84 / UTM zone 30N (EPSG: 32630)	
DRAWING TITLE: Figure 3-1: Marine mammal protected areas within the MUs of the marine mammal species assessed	
STATUS: Approved	SCALE: 1:1,500,000
DRAWING NUMBER: N/A	SHEET NO: 01 of 01 / REV: N/A

Table 3–1: Designated protected areas for marine mammals located within their respective MUs.

Species	MU	Designated Site	Distance from Caledonia North Site (km)	Distance from Caledonia South Site (km)	Distance from Caledonia OECC (km)
Harbour porpoise	NS	Southern North Sea SAC	354.6	341.5	333.6
Bottlenose dolphin	CES	Moray Firth SAC	57.5	57.5	37.6
Minke whale	CGNS	Southern Trench Nature Conservation MPA	26.2	13.5	Within
Harbour seal	Moray Firth	Dornoch Firth and Morrich More SAC	86.4	86.7	81.5
	North Coast & Orkney	Sanday SAC	92.3	106.3	123.3
	East Scotland	Firth of Tay and Eden Estuary SAC	214.5	200.6	198.6
Grey seal	North Coast & Orkney	Faray and Holm of Faray SAC	95.7	109.3	126.9
	East Scotland	Isle of May SAC	241.5	225.0	219.8
	East Scotland	Berwickshire and North Northumberland Coast SAC	262.2	247.3	237.1

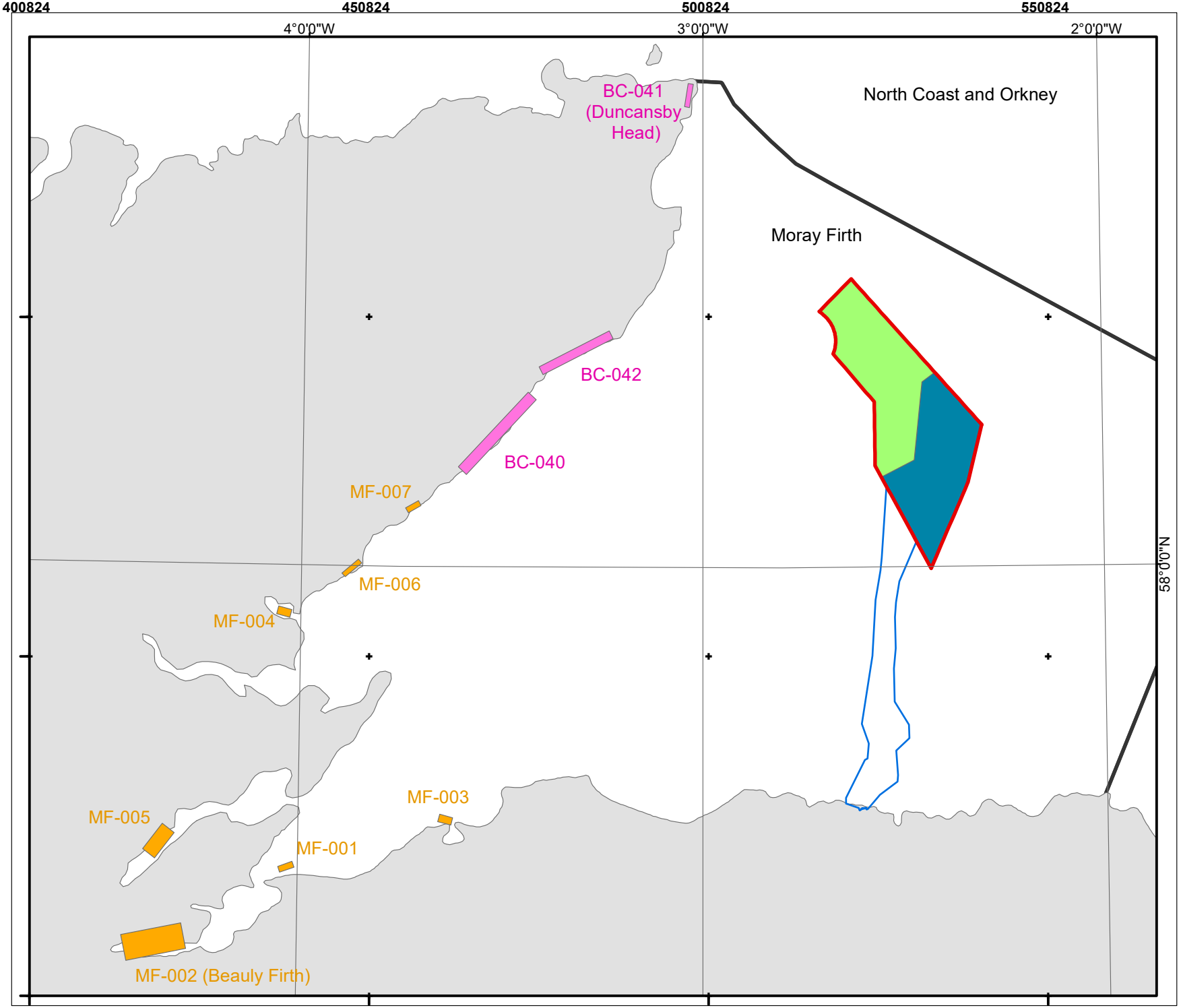
3.2 Seal Designated Sites

3.2.1.1 Under Section 117 of the Marine (Scotland) Act 2010 (Scottish Parliament, 2010[11]), Scottish Ministers are permitted to designate seal haul-out sites to provide additional protection for seals from intentional or reckless harassment. These were designated through the Protection of Seals (Designation of Haul-Out Sites) (Scotland) Order 2014 (Scottish Parliament, 2014[12]) and updated in the Protection of Seals (Designation of Haul-Out Sites) (Scotland) Order 2017 (Scottish Parliament, 2017[13]). Designated sites were identified based on August haul-out counts for both grey and harbour seals, and grey seal breeding colony counts. The potential impacts to designated seal haul-out sites will be included in the EIAR.

3.2.1.2 In the Moray Firth SMU, there are seven designated haul-out sites based on August counts and three seasonal grey seal breeding sites (Figure 3-2). The closest designated haul-out site (Dunbeath - Wick, BC-042) is located approximately 30.5km from the Proposed Development (Offshore); the furthest designated haul-out site is the Beauly Firth (MF-002) which is 126.7km swimming distance away from the Proposed Development (Offshore).

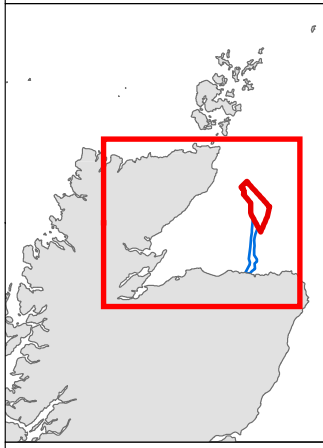
3.2.1.3 In the East Scotland SMU, there are three designated haul-out sites based on August counts and three seasonal grey seal breeding sites (Figure 3-3). The closest designated haul-out site (Ythan River Mouth, EC-003) is located approximately 100km from the Proposed Development (Offshore), with all other sites being over 250km swimming distance away from the Proposed Development (Offshore).

3.2.1.4 In the Northeast Coast & Orkney SMU, there are 20 designated haul-out sites based on August counts and 40 seasonal grey seal breeding sites (Figure 3-4). The closest designated haul-out site (Pentland Skerries, NOO-033) is located approximately 36km away from the Caledonia OWF, with sites ranging up to 135km away. 52 of the 60 sites are in and around the Orkney islands.



Legend

- Caledonia OWF
- OECC
- Caledonia North Site
- Caledonia South Site
- Designated grey seal and harbour seal haul-outs
- Designated seasonal grey seal haul-outs
- Seal Management Unit



0 5 10 15 20 km

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CALEDONIA Offshore Wind Farm

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SMRUC-004	01

GEODETIC PARAMETERS: GCS_WGS_1984 / World Geodetic System (WGS84)

DRAWING TITLE

Figure 3-2: Designated seal haul-out sites in the Moray Firth SMU

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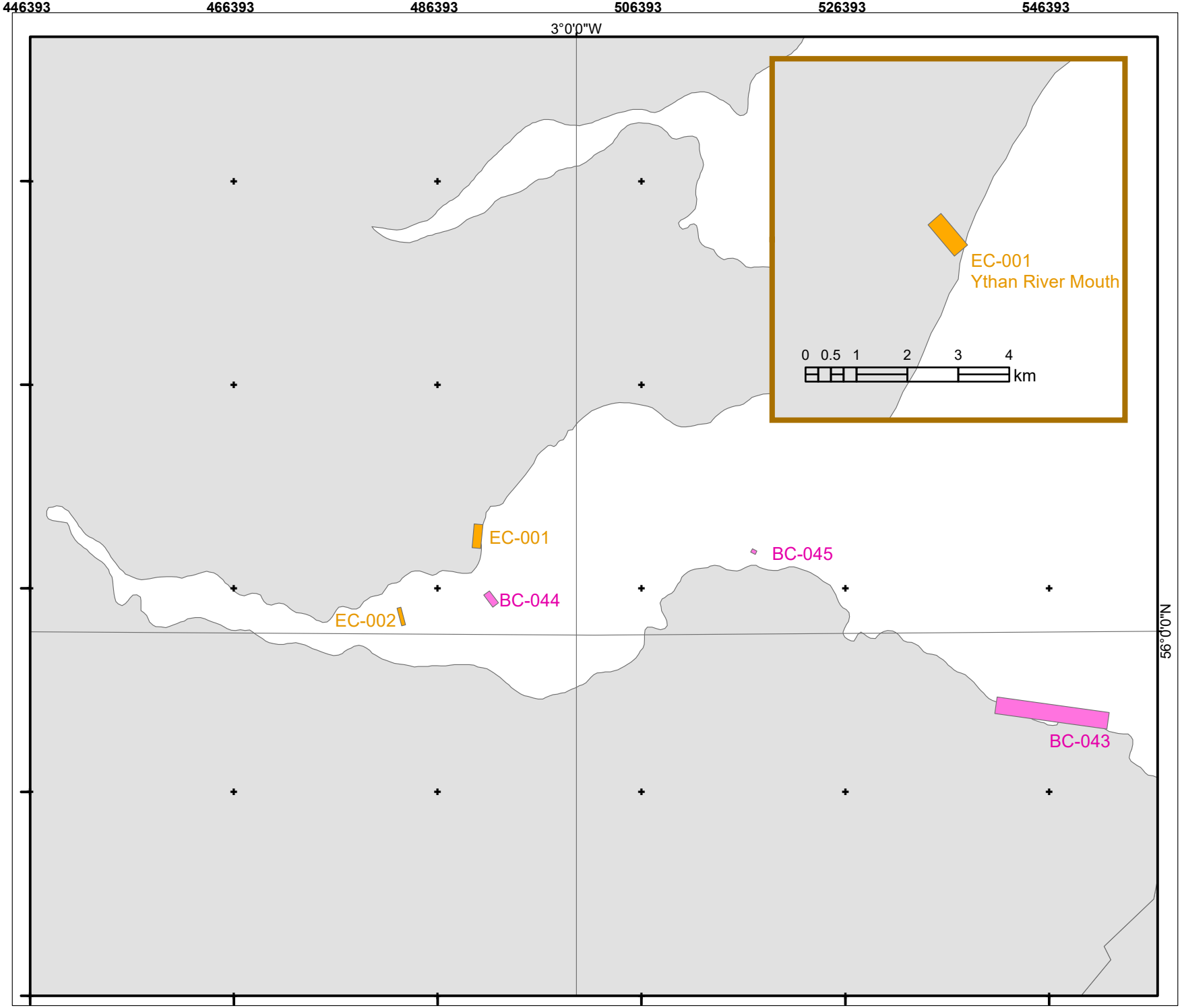
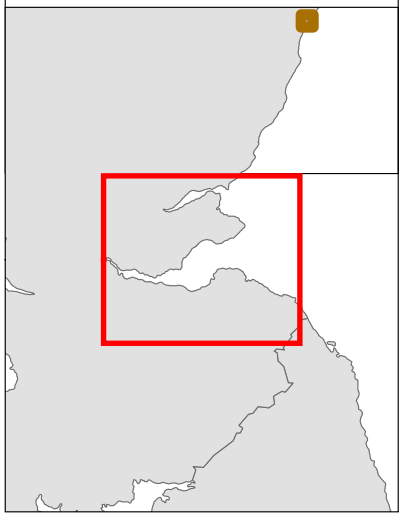


Legend

- Designated grey seal and harbour seal haul-outs
- Designated seasonal grey seal haul-outs



0 5 10 15 20 km

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CALEDONIA Offshore Wind Farm

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CONTRACTOR DRAWING NO	CONTRACTOR REV
SMRUC-005	01

GEODETIC PARAMETERS: GCS_WGS_1984 / World Geodetic System (WGS84)

DRAWING TITLE

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

STATUS	SCALE	
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DRAWING NUMBER	SHEET NO	REV
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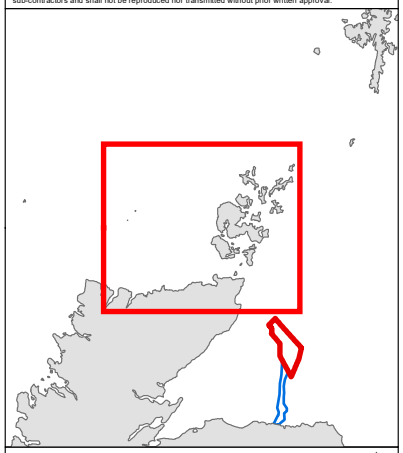
Legend

- Caledonia OWF
- OECC
- Designated grey seal and harbour seal haul-outs
- Designated seasonal grey seal haul-outs
- Seal Management Units



0 5 10 15 20 km

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CALEDONIA Offshore Wind Farm

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SMRUC-006	01

GEODETIC PARAMETERS: GCS_WGS_1984 / World Geodetic System (WGS84)

DRAWING TITLE

Figure 3-4: Designated seal haul-out sites in the North Coast & Orkney SMU

STATUS	SCALE	
Approved	1:650,000	
DRAWING NUMBER	SHEET NO	REV
N/A	01 of 01	N/A

3.3 Important Marine Mammal Areas

3.3.1.1 Important Marine Mammal Areas (IMMAs; Marine Mammal Protected Areas Task Force (MMPATF), 2021[14]) are areas defined as:

"*Discrete portions of habitat, important to marine mammal species, that have the potential to be delineated and managed for conservation*".

3.3.1.2 They were created by the MMPATF, who ran a series of regional workshops from 2016-2021 to identify IMMAs, and are continuing to identify more areas (MMPATF, 2021[14]). The Proposed Development (Offshore) overlaps with the Moray Firth to Humber Estuary IMMA which covers an area of 12,888km^2 around the coastal waters of Scotland and England between Helmsdale and the Humber estuary. The IMMA contains the following four qualifying species which are included in this assessment:

- Bottlenose dolphins;
- Minke whales;
- Harbour seals; and
- Grey seals.

3.3.1.3 While the area has been identified as important for marine mammals, there are currently no conservation measures identified, and it is recognised that not all suggested IMMAs will be granted any form of protection in the future.

4 Data Sources

4.1 Overview

4.1.1.1 Table 4–1 provides a list of all data sources that were examined to inform this baseline characterisation report.

4.1.1.2 Section 4.2 provides detail on the key data sources used to characterise the baseline study area for the marine mammals in relation to the Proposed Development (Offshore). This section details the survey and analysis methodology implemented in each study and the potential limitations associated with these. The actual results of the surveys in terms of the species presence are detailed in subsequent species-specific sections.

4.1.1.3 For full record of other data sources examined and considered, including information on why they were not considered to be key data sources for the baseline characterization (e.g., age of data, lack of absolute density estimate, inappropriate scale of surveys) see Section 15.

Table 4–1: Data sources examined to inform the baseline characterisation for marine mammals.

Data Source	Description	Spatial Coverage
Regional baselines for marine mammal knowledge across the North Sea and Atlantic areas of Scottish waters (Hague *et al.*, 2020[15])	Collation of up-to-date information on the distribution and abundance of marine mammal species in the Scottish Northern North Sea region and Scottish Atlantic waters.	This report covers the whole of Scotland, inclusive of the marine mammal study area for the Proposed Development (Offshore).
Digital Aerial Surveys (DAS) (Volume 7, Appendix 19: Caledonia OWF Digital Aerial Surveys)	DAS conducted by APEM Ltd. from May 2021 – April 2023.	Caledonia OWF plus 4km buffer (covering the Caledonia North Site plus 4km buffer and Caledonia South Site plus 4km buffer).
Geophysical survey MMO and PAM reports (Gardline, 2023a[16]; 2023b[17]; 2023c[18])	Marine mammal observer (MMO) and passive acoustic monitoring (PAM) reports of marine mammal observations and detections made during geophysical surveys undertaken at the Proposed Development (Offshore).	Caledonia OWF plus 2.5km buffer and Caledonia OECC.
SCANS III (Hammond *et al.*, 2021[19])	Combination of vessel and aerial surveys of the North Sea and European Atlantic	The Proposed Development (Offshore) is located

Data Source	Description	Spatial Coverage
	continental shelf waters conducted in July 2016.	within SCANS III block S.
SCANS III density surfaces (Lacey *et al.*, 2022[2])	Modelled density surfaces of cetaceans in European Atlantic waters in summer 2016 using the SCANS III data.	The Proposed Development (Offshore) is located within SCANS III block S.
SCANS IV (Gilles *et al.*, 2023[3])	Combination of vessel and aerial surveys of the North Sea and European Atlantic waters conducted from June to October 2022.	The Proposed Development (Offshore) is located within SCANS IV survey block CS-K.
Revised Phase III Data Analysis of Joint Cetacean Protocol (JCP) Data Resources (Paxton *et al.*, 2016[20])	Effort-linked sightings data contained within the JCP data resource have been used to estimate spatio-temporal patterns of abundance for seven species of cetacean over a 17-year period from 1994–2010 over a 1.09 million km^2 prediction region from 48°N to c. 64°N and from the continental shelf edge west of Ireland to the Kattegat in the east.	38 data sources between 1994-2010 covering cetacean trends in the North Sea and includes the Proposed Development (Offshore).
JCP data analysis tool	The JCP Phase III Data Analysis Product was used to extract abundance estimates averaged for summer 2007-2010 and scaled to the SCANS III estimates for user specified areas.	UK waters. User specified area for data extraction.
Distribution Maps of Cetacean and Seabird Populations in the North-East Atlantic, Marine Ecosystems Research Programme (MERP) (Waggitt *et al.*, 2019[21])	Aerial and vessel survey data were collated between 1980 and 2018. Distributional maps for 12 cetacean species were produced at 10km resolution.	Modelled density surfaces include the entirety of Scotland and thus, includes the Proposed Development (Offshore).
Strategic Marine Mammal Monitoring Programme (completed on behalf of Moray East OWF and Beatrice OWF)	Various pre-construction monitoring reports and various construction phase monitoring reports.	Moray Firth
Various Moray Firth visual and PAM surveys	Various visual and PAM surveys conducted in the Moray Firth. Used to estimate relative distribution of porpoise and dolphins in Brookes *et al.*	Moray Firth

Data Source	Description	Spatial Coverage
	(2013[22]) and Thompson *et al.* (2015a[6]).	
East Coast Scotland Marine Mammal Acoustic Array Surveys (ECOMMAS) (data provided by Marine Directorate)	ECOMMAS began in 2013 and is inclusive of 30 PAM sites along the East coast of Scotland. Data are presented in detection-positive days and detection-positive hours.	Two sites are in proximity to the Proposed Development (Offshore), inclusive of Cruden Bay and Fraserburgh.
Various reports and papers on the distribution and abundance of bottlenose dolphins in Scottish waters (Cheney *et al.*, 2012[23]; 2013[24]; 2014a[25]; 2014b[26]; Quick *et al.*, 2014[5]; Graham *et al.*, 2015[27]; 2016[28]; 2017[29]; Cheney *et al.*, 2018[30]; Arso Civil *et al.*, 2019[31]; 2021[32]; Cheney *et al.*, 2024[4])	These include: ▪ Condition monitoring of bottlenose dolphins within the Moray Firth SAC ▪ Reports from photo-ID surveys and PAM surveys. ▪ Moray Firth Marine Mammal Monitoring Programme developed in 2014 (studies of reproduction, survival rates, assessments of trends in abundance and patterns of distribution) ▪ Wider east coast of Scotland population inclusive of photo-ID data in the Firth of Forth and Firth of Tay.	Covers the CES MU for bottlenose dolphins, and the Moray Firth SAC.
Cetacean Research and Rescue Unit (CRRU) data	Various papers from the CRRU from surveys of Risso's dolphins, minke whales and killer whales (Robinson *et al.*, 2017[33]; 2023[34]; Hodgins *et al.*, 2024[35]).	Moray Firth
Statistical approaches to aid the identification of Marine Protected Areas (MPAs) for minke whale, Risso's dolphin, white-beaked dolphin and basking shark (Paxton *et al.*, 2014[36])	JCP dataset plus additional data sourced by Scottish Natural Heritage were used to generate estimated densities for minke whale (2000 – 2012), Risso's dolphin (1994 – 2012) and white-beaked dolphin (1994 – 2012).	Generated estimated densities per area surveyed which includes the North Sea and includes the Proposed Development (Offshore).
Site-specific survey information from nearby OWFs	Baseline survey data from nearby OWFs.	▪ Moray West OWF ▪ Moray East OWF ▪ Beatrice OWF ▪ Green Volt OWF
Special Committee on Seals report (SCOS, 2023[7])	Scientific Advice on Matters Related to the Management of Seal Populations. This outlines	UK wide.

Data Source	Description	Spatial Coverage
	the current status of both harbour and grey seals in the UK.	
Seal telemetry data (Sea Mammal Research Unit; SMRU)	Data collated by multiple authors and gathered through a consortium of funders. Used to assess connectivity and habitat associations of seal species with at-sea and on-land locations.	Data encompasses the entirety of Scotland and thus, includes the Proposed Development (Offshore).
Seal August haul-out data (SMRU)	August haul-out surveys of harbour and grey seals.	Data covers the entirety of Scotland and, thus, includes the Proposed Development (Offshore).
Designated haul-out sites for grey and harbour seals (Protection of Seals Orders) (Scottish Parliament, 2017[13])	Seal haul-out sites are designated under section 117 of Marine (Scotland) Act 2010 (Scottish Parliament, 2010[11]). Seal haul-outs are locations on land where seals come ashore to rest, moult or breed.	The closest designated seal haul-out site to the Proposed Development (Offshore) is Dunbeath-Wick which is located approximately 30.5km from Caledonia OWF.
Seal habitat preference maps (Carter *et al.*, 2020[8]; 2022[9])	Telemetry and haul-out data were used in habitat modelling to generate predictions of seal distribution at sea.	Report covers the entirety of the British Isles and, thus, includes the Proposed Development (Offshore).

4.2 Key Data Sources Examined

4.2.1 Digital Aerial Surveys

4.2.1.1 The DAS were conducted monthly by APEM from May 2021 to April 2023. The aim of the surveys was to collect data on the abundance and distribution of marine mammals to characterise the baseline environment to inform Environmental Impact Assessment (EIA). Full details of these site-specific surveys can be found in the final survey report (Volume 7, Appendix 19: Caledonia OWF Digital Aerial Surveys).

4.2.1.2 Surveys were designed to encompass the Caledonia OWF plus a 4km buffer, covering an area of 884km^2. There were 13 transects conducted within the Caledonia OWF plus 4km buffer, totalling 338.25km, 11

transects conducted within the Caledonia North Site plus a 4km buffer, totalling 211.71km, and 12 transects conducted within the Caledonia South Site plus a 4km buffer, totalling 205.95km. These transects are presented in Figure 2-1.

4.2.1.3 Over year 1 and 2 of the surveys, there were 345 marine mammal sightings within the Caledonia OWF plus 4km buffer:

- 141 harbour porpoise (41% of marine mammal sightings)
- 2 bottlenose dolphins (1% of marine mammal sightings)
- 64 white-beaked dolphins (19% of marine mammal sightings)
- 39 common dolphins (11% of marine mammal sightings)
- 2 Risso's dolphins (1% of marine mammal sightings)
- 12 minke whales (3% of marine mammal sightings)
- 26 grey seals (8% of marine mammal sightings)
- 3 unidentified dolphins (1% of marine mammal sightings)
- 39 unidentified dolphin/porpoise (11% of marine mammal sightings)
- 4 unidentified marine mammals (1% of marine mammal sightings)
- 13 unidentified seals (4% of marine mammal sightings)

4.2.1.4 Overall, 17% of the sightings were not identified to species level. There were a high number of unidentified dolphin/porpoise sightings, which limits the ability of the surveys to inform the baseline characterisation for a site where it is known that there are multiple small cetacean species (porpoise and multiple dolphin species) in the area.

4.2.1.5 Density estimates are provided for all marine mammal species observed. For harbour porpoise the correction factor from Voet *et al.* (2017[37]) was applied to the total monthly abundance estimates for porpoise to account for the availability bias (animals not at the surface when images are captured). This correction factor considered the probability of an animal being within the upper 2m of the water column where it is assumed to be detected by aerial surveys (Teilmann *et al.*, 2013[38]). This assumption remains unverified and thus the correction factor could result in either significant over or under-estimates in the density, making them unreliable. No correction factor is available for the remaining species detected and, therefore, the data presented for these marine mammal species are relative density only and are thus not suitable to take forward to the quantitative impact assessment.

4.2.1.6 Another key limitation of this dataset is that it is spatially limited to the Caledonia OWF plus 4km buffer and therefore, so are the density estimates. There is no evidence that they are representative of marine mammal densities outside of this area and across wider impact ranges.

4.2.2 Moray Firth Surveys

Marine Mammal Monitoring Programme

4.2.2.1 A Marine Mammal Monitoring Programme was developed for the Moray Firth in 2014 to address strategic research and monitoring questions as well as project-specific questions prior to the start of OWF development in the Moray Firth.

4.2.2.2 The pre-construction Marine Mammal Monitoring Programme provided baseline data against which any population changes can be quantified (Graham *et al.*, 2015[27]; 2016[28]; 2017[29]). This monitoring comprised two work packages to provide baseline data for two priority species: 1) bottlenose dolphins (photo-ID surveys) and 2) harbour seals (photo ID haul-out counts and telemetry data). The results of the pre-construction Marine Mammal Monitoring Programme are highlighted in the bottlenose dolphin and harbour seal sections of this report (Section 6 and 11 respectively).

4.2.2.3 As part of the Moray East Construction Marine Mammal Monitoring Plan, Moray East participated in a regional program of marine mammal monitoring in the Moray Firth (Graham *et al.*, 2020[39]; 2021[40]). This monitoring comprised the same two work packages as the pre-construction monitoring surveys, with the addition of 2 further work packages: 1) harbour porpoise monitoring (responses to construction) and 2) noise measurement during construction. As the Construction Marine Mammal Monitoring Plan was more concerned with assessing the impacts of the construction of the Moray East OWF rather than providing a baseline dataset, the results of the Construction Marine Mammal Monitoring Plan are detailed in the main marine mammal EIAR chapter to inform the impact assessment conclusions, rather than here in the baseline characterisation report.

Other Visual and Passive Acoustic Monitoring (PAM) Surveys

4.2.2.4 Various visual (vessel and aerial) and PAM surveys were conducted across the Moray Firth to improve understanding of the distribution of marine mammals within the Moray Firth. These include:

- Beatrice demonstrator baseline surveys: vessel-based marine mammal baseline surveys were conducted from August to October 2004 and April to July 2005 to characterise the habitat use and abundance of bottlenose dolphins and harbour porpoise across the Moray Firth SAC.
- Outer Moray Firth boat surveys conducted during August and September 2010. Surveys covered four blocks: a survey block covering the Beatrice OWF and Moray East development areas, a block in the central Moray Firth, a coastal survey block in the

southern Moray Firth, and a coastal survey block in the northern Moray Firth. The primary aim of the surveys was to assess the impact of seismic surveys on cetacean distribution at an impact and control site, both before and during survey activities.

- Various PAM surveys across the Moray Firth (T-PoDS and CPoDs):
  - PAM was conducted for the Beatrice Demonstrator project in August and October in 2005, 2006 and 2007.
  - Scottish Natural Heritage and Scottish Environmental and Rural Affairs Department funded PAM surveys between 2006 and 2009 to assess the relative abundance and distribution of bottlenose dolphins in coastal waters in the Moray Firth.
  - Department of Energy and Climate Change funded a PAM survey conducted from May to November in 2009 and July to December 2010 to support the assessment of cetacean distribution in relation to the planned oil and gas activities in the Moray Firth.
  - Between 2009 and 2011, the University of Aberdeen were contracted to collect acoustic data at the Moray Offshore Renewables Limited and Beatrice Offshore Wind Limited sites in the winter months to supplement the other acoustic data collection which primarily occurred from July to November.

4.2.2.5 These visual and PAM data were all used to provide information on bottlenose dolphin and porpoise distribution in the Moray Firth in subsequent publications: Thompson *et al.* (2015a[6]) and Brookes *et al.* (2013[22]).

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

4.2.3.1 The main objective of the SCANS surveys was to estimate small cetacean abundance and density in the North Sea and European Atlantic continental shelf waters. To date, four SCANS surveys have been conducted and the results published. SCANS I occurred during summer 1994 (Borchers *et al.*, 1995[41]), SCANS II during summer 2005, SCANS III during summer 2016 (Hammond *et al.*, 2017[42]; 2021[19]) and SCANS IV during summer 2022 (Gilles *et al.*, 2023[3]).

4.2.3.2 The surveys comprised a combination of vessel and aerial surveys. Both aerial and boat-based survey methodologies were designed to correct for availability and detection bias and allow the estimation of absolute abundance (Hammond *et al.*, 2021[19]). Only results from the two most recent SCANS surveys have been considered within this Technical Appendix, with results from SCANS IV being used where possible as this contains the most up to date data, with SCANS III results also being

considered for species where no SCANS IV density estimate was available.

4.2.3.3 While the SCANS survey results provide sightings, density and abundance estimates at a wide spatial scale, the surveys were conducted during summer months only, and, therefore, do not provide any fine scale temporal or spatial information on species abundance and distribution and are not representative for other seasons in a year. This can be an issue for marine mammal species with seasonal distributions, and there is potential to overestimate average annual abundances for such species using the SCANS density estimates alone.

SCANS III (2016)

4.2.3.4 The Proposed Development (Offshore) is located in the SCANS III survey block S (Figure 4-1) which was surveyed using aircraft. During these surveys, most common cetacean sightings in block S included harbour porpoise, bottlenose dolphins, white-beaked dolphins and minke whales (Hammond *et al.*, 2021[19]). The closest neighbouring SCANS III survey block is T, and it is approximately 20km from the Caledonia OWF (Figure 4-1). Information will be provided for this block as well where appropriate.

SCANS III Density Surfaces

4.2.3.5 As part of SCANS III, the survey data were modelled in relation to spatially linked environmental features to produce density surface maps for the following cetacean species: harbour porpoise, bottlenose dolphin, white-beaked dolphin, common dolphin, striped dolphin, long-finned pilot whale, beaked whale species, minke whale and fin whale (Lacey *et al.*, 2022[2]). The cetacean data used in the models were the same as those obtained in 2016 that were used to provide block specific abundance estimates in Hammond *et al.* (2021[19]). The environmental covariates used in the density surface modelling were selected due to their potential to explain the additional variability in the cetacean density estimates (for example, depth of the seabed, sea surface temperature (see Lacey *et al.* (2022[2]) for the full list of environmental covariates). The models were fitted using a spatial resolution of 10km and predicted onto a 10x10km spatial grid. Using the predicted density estimates from the surface models, density and abundance estimates can be generated for an entire survey area or a defined area within it. Due to the area specific nature of the density estimates obtained from the density surface, data are presented for: Caledonia OWF, Caledonia North Site and Caledonia South Site.

SCANS IV (2022)

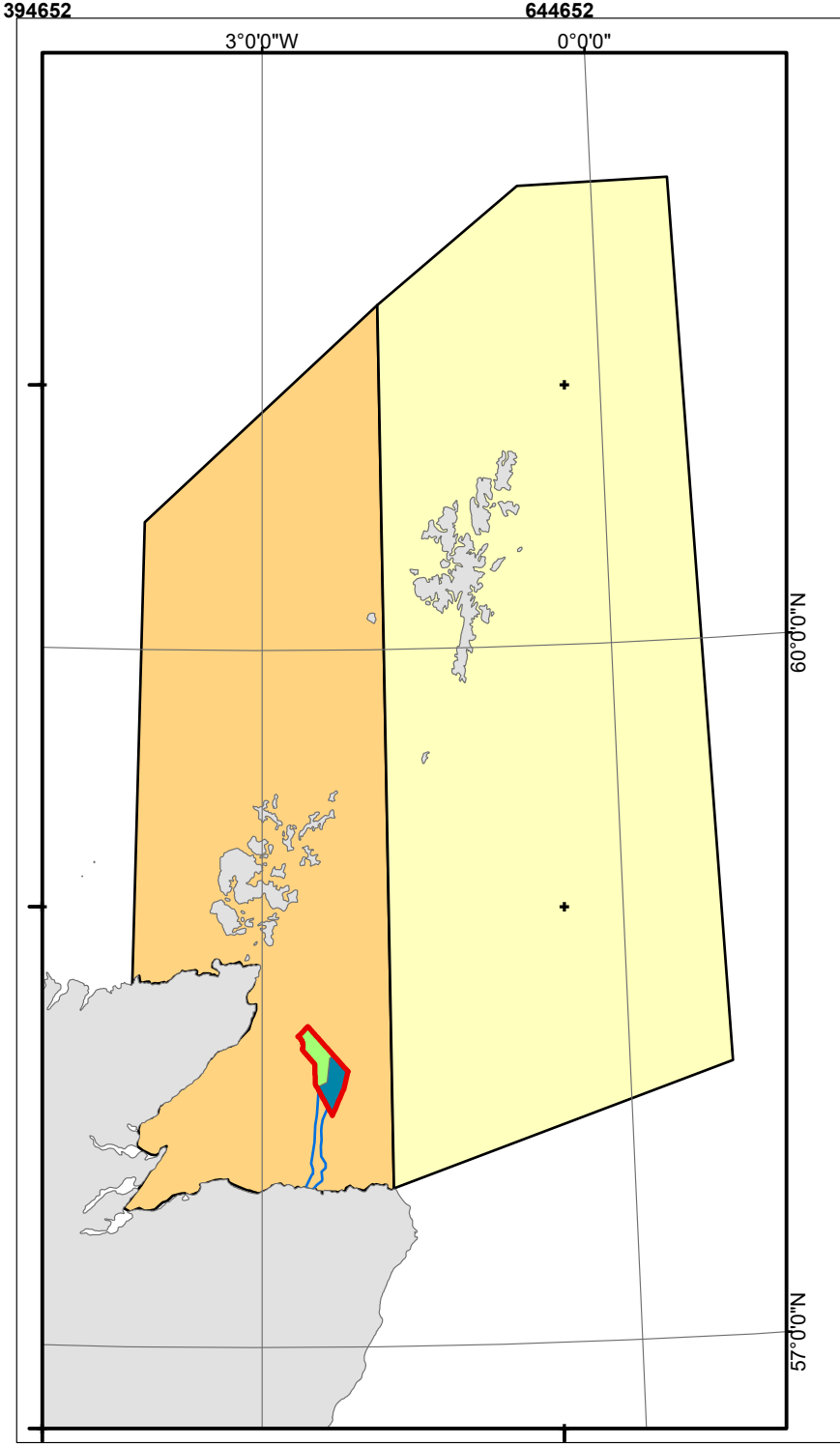
4.2.3.6 The Proposed Development (Offshore) is located in SCANS IV block CS-K which was surveyed using aircraft (Figure 4-1). The closest neighbouring survey block is NS-E. Given the proximity of the Proposed Development (Offshore) to the boundary of the survey blocks, information is provided for both survey blocks in this baseline characterisation.

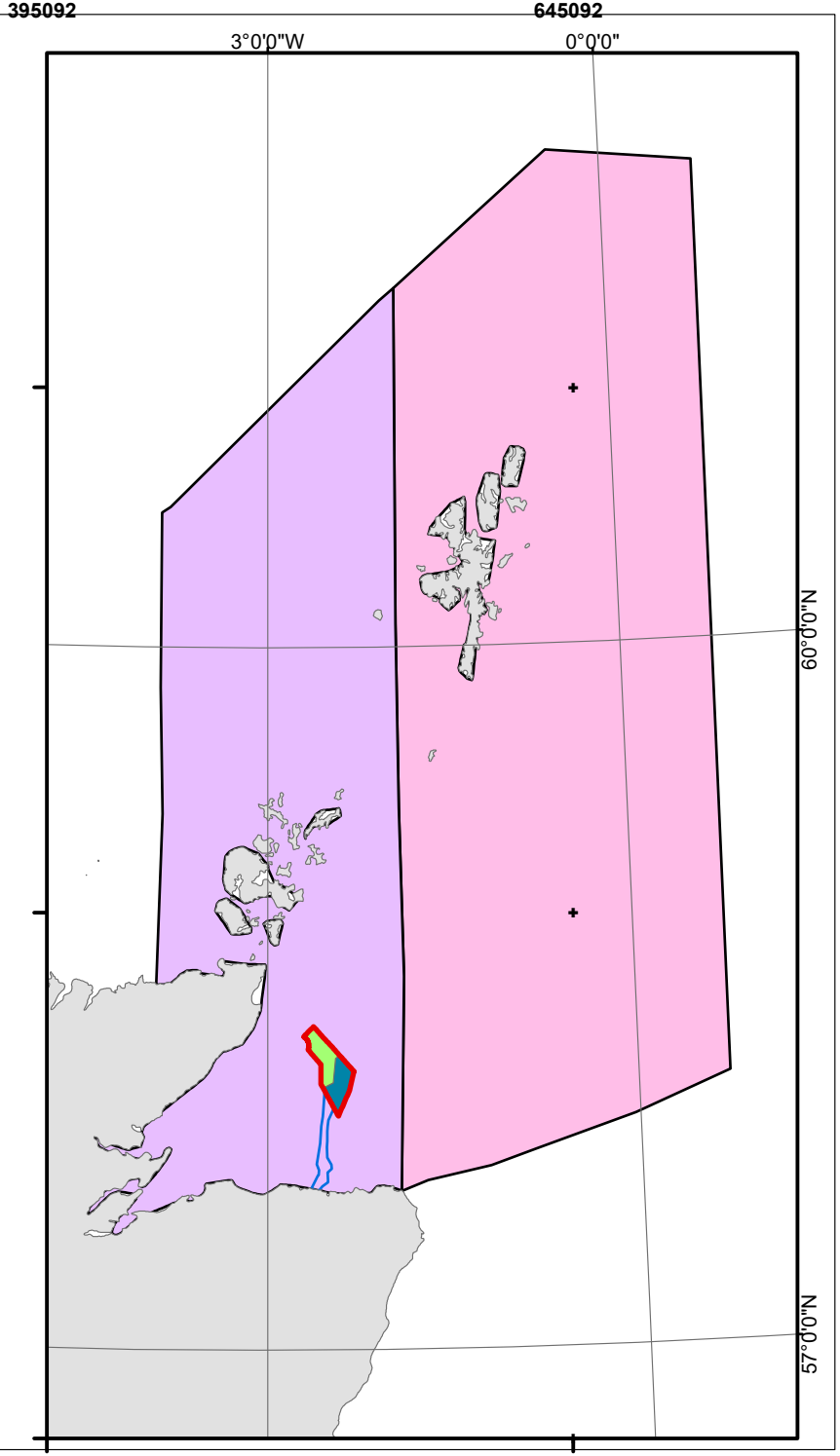
4.2.4 Bottlenose Dolphin SAC Condition Monitoring

4.2.4.1 There are two major coastal populations of bottlenose dolphins in UK waters, which includes the resident population of bottlenose dolphins found in the Moray Firth SAC. This SAC extends from the inner firths to Helmsdale on the north coast, and Lossiemouth on the south coast, including areas that are regularly utilised by the resident population of bottlenose dolphins along the east coast of Scotland. NatureScot is required to report on the condition of bottlenose dolphins within the Moray Firth SAC in six-year intervals, with the latest site condition monitoring report analysing data from 2017-2022 (Cheney *et al.*, 2012[23], Cheney *et al.*, 2014b[26]; 2018[30]; 2024[23]). In 1989, the University of Aberdeen, in collaboration with the Sea Mammal Research Unit (SMRU) at the University of St. Andrews began an intensive research programme to report on the condition of the site through the use of photo-identification surveys and PAM studies.

4.2.4.2 Alongside the research effort at the Moray Firth SAC, research programmes have been conducted on the wider east coast of Scotland population of bottlenose dolphins (Quick *et al.*, 2014[5]). These research efforts include the use of photo-identification data to provide information on bottlenose dolphin distribution, abundance, and population parameters along the east coast of Scotland. The areas of interest for these studies include the Firth of Forth and the Firth of Tay, as well as the Aberdeen coastline. Further to this research, the importance of St. Andrews Bay and the Tay Estuary for bottlenose dolphins found on the east coast of Scotland has been assessed (Arso Civil *et al.*, 2019[31]), with Arso Civil *et al.* (2021[32]) providing the most up-to-date estimates on the proportion of the Moray Firth SAC bottlenose dolphins which utilise these areas further south, giving insight as to the movement ecology and distributions of these individuals.

4.2.4.4 It is important to note that the purpose of these surveys has primarily been to estimate the size of the protected population and to monitor trends in the population size over time. Therefore, studies have primarily focused on photo-ID survey work to create a catalogue of known individual dolphins. These surveys differ significantly to those that would be required to estimate dolphin density within the survey area.





Legend

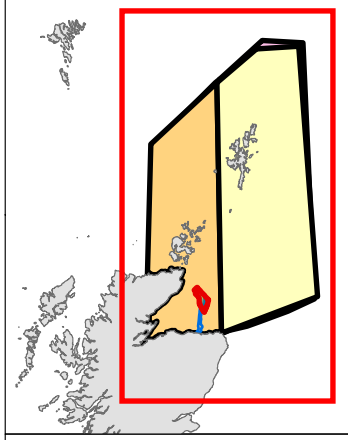
- Caledonia OWF
- OECC
- Caledonia North Site
- Caledonia South Site

SCANS III survey block

- S
- T

SCANS IV survey block

- CS-K
- NS-E



0 100 200 300 400 km

REV	DATE	DOC STATUS	ORIGIN	REVIEW	APP
01	31/05/2024	For Review	AS	XX	XX

CALEDONIA Offshore Wind Farm

SMRU Consulting understand • assess • mitigate

CONTRACTOR DRAWING NO	CONTRACTOR REV
SMRUC-007	01

GEODETIC PARAMETERS: GCS_WGS_1984 / World Geodetic System (WGS84)

DRAWING TITLE

Figure 4-1: SCANS III and SCANS IV survey blocks in relation to Caledonia OWF

STATUS	SCALE	
Approved	1:3,500,000	
DRAWING NUMBER	SHEET NO	REV
N/A	01 of 01	N/A

4.2.5 Special Committee on Seals

4.2.5.1 The SMRU carries out surveys of harbour (or common) and grey seals in Scotland and on the east coast of England to contribute to the Natural Environment Research Council's (NERC's) statutory obligation under the Conservation of Seals Act 1970 '*to provide the (UK government) with scientific advice on matters related to the management of seal populations*' (UK Parliament, 1970[43]). These SMRU surveys, as well as surveys by other organisations (including NatureScot, Natural England, Natural Resources Wales, National Trust and Lincolnshire Wildlife Trust) form the routine monitoring of seal populations around the UK. The annually submitted Advice, which includes information on recent changes in grey and harbour seal numbers, can be found in the Special Committee on Seals (SCOS) reports on SMRU's website (SMRU, 2024[44]).

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

August Haul-out Counts

4.2.5.3 The main harbour seal population surveys are carried out when harbour seals are moulting, during the first three weeks of August. The moult counts represent the number of harbour seals that were on shore at the time of the survey and are an estimate of the minimum size of the population. They do not represent the total size of the local population since a number of seals would have been at sea at the time of the survey. Note that these data refer to the numbers of seals found within the surveyed areas only at the time of the survey; numbers and distribution are likely to differ at other times of the year (such as the breeding period). 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[45]). The harbour seal counts can be scaled by the proportion of seals hauled-out at the time of the counts, providing an estimated population size for an MU.

4.2.5.4 Numbers of grey seals are also counted during the harbour seal August moult surveys. Counts of greys seals during the summer months are highly variable and are not used as a population index in this species, however they provide useful information on the summer and non-breeding season distribution of grey seals. It is estimated that 25.15% of the total grey seal population are hauled-out and available to count during August surveys (SCOS, 2022[46]) (see SCOS-BP 21/02) 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.

Grey Seal Pup Counts

4.2.5.5 Grey seals are surveyed during their breeding season (Aug – Dec). The grey seal pup production database contains data from 1989 to 2022 and includes 74 breeding colonies (though not all colonies have been surveyed consistently since 1989 and some smaller colonies are surveyed more sporadically than others). Most breeding colonies used to be surveyed annually, however from 2010 most colonies switched to biennial surveys instead due to reductions in funding combined with increased aerial survey cost (SCOS, 2015[47]).

4.2.6 Seal Telemetry

4.2.6.1 SMRU has developed telemetry tags that have been attached to grey seals and harbour seals in the UK since 1988 and 2001, respectively. 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[48]). The data presented in this baseline characterisation report are a combination of the SMRU and University of Aberdeen tag deployments.

4.2.6.2 This Technical Appendix focuses on the telemetry data provided by SMRU, which includes data on grey seals tagged between 1988 and 2018, and harbour seals tagged between 2001 and 2018. Additionally, it provides information on harbour seals tagged at Loch Fleet between 2014 and 2017 by the University of Aberdeen (as part of the Moray Firth Marine Mammal Monitoring Plan). It should be noted that other telemetry studies have been conducted over the years within the Moray Firth, e.g. Thompson *et al.* (1996); however, these studies used VHF radio-tags which do not provide such precise information on seal distribution when at sea as they only provide one location per day for 6 days a week, instead of approximately 10 locations per day using Argos tags or 37 locations per day (mean) using GPS-GSM tags (Bailey *et al.*, 2014[49]).

4.2.8 Seal at-sea Distribution

4.2.8.1 To estimate seal at-sea distribution, a habitat modelling approach was used, matching seal telemetry data (from 114 grey seals and 239 harbour seals, Figure 4-2) to habitat variables (such as water depth, seabed topography, sea surface temperature) to understand the species-environment relationships that drive seal distribution. Haul-out- count data (Figure 4-3) were then used to generate predictions of seal distribution at sea from all known haul-out sites in the British Isles. This resulted in predicted distribution maps on a 5x5km grid. The estimated density surface gives the percentage of the British Isles at-sea population (excluding hauled-out animals) estimated to be present in each grid cell at any one time during the main foraging season (Carter *et al.*, 2020[8]).

4.2.8.2 The predicted habitat usage data is representative of spring distributions for harbour seals and summer distributions for grey seals since the majority of telemetry tracking data were collected in these seasons (Carter *et al.*, 2020[8]). This is likely to be representative of seal distribution during the main foraging season, but is not considered to be representative of expected distributions during the breeding season where seal haul-out and movement patterns are markedly different. It is assumed in the habitat preference maps that there is temporal stability in the distribution of seals outside of the breeding season.

4.2.8.3 In order to estimate the number of seals present in a specific area, the value provided in the relevant cell(s) (percentage of the British Isles at-sea population excluding hauled-out animals) were scaled by the total British Isles at-sea population estimate (~150,700 grey seals and ~42,800 harbour seals) (Carter *et al.*, 2020[8]) to estimate the number of animals present within the 5x5km cell. This value can then be divided by 25 to obtain the density of seals per km^2.

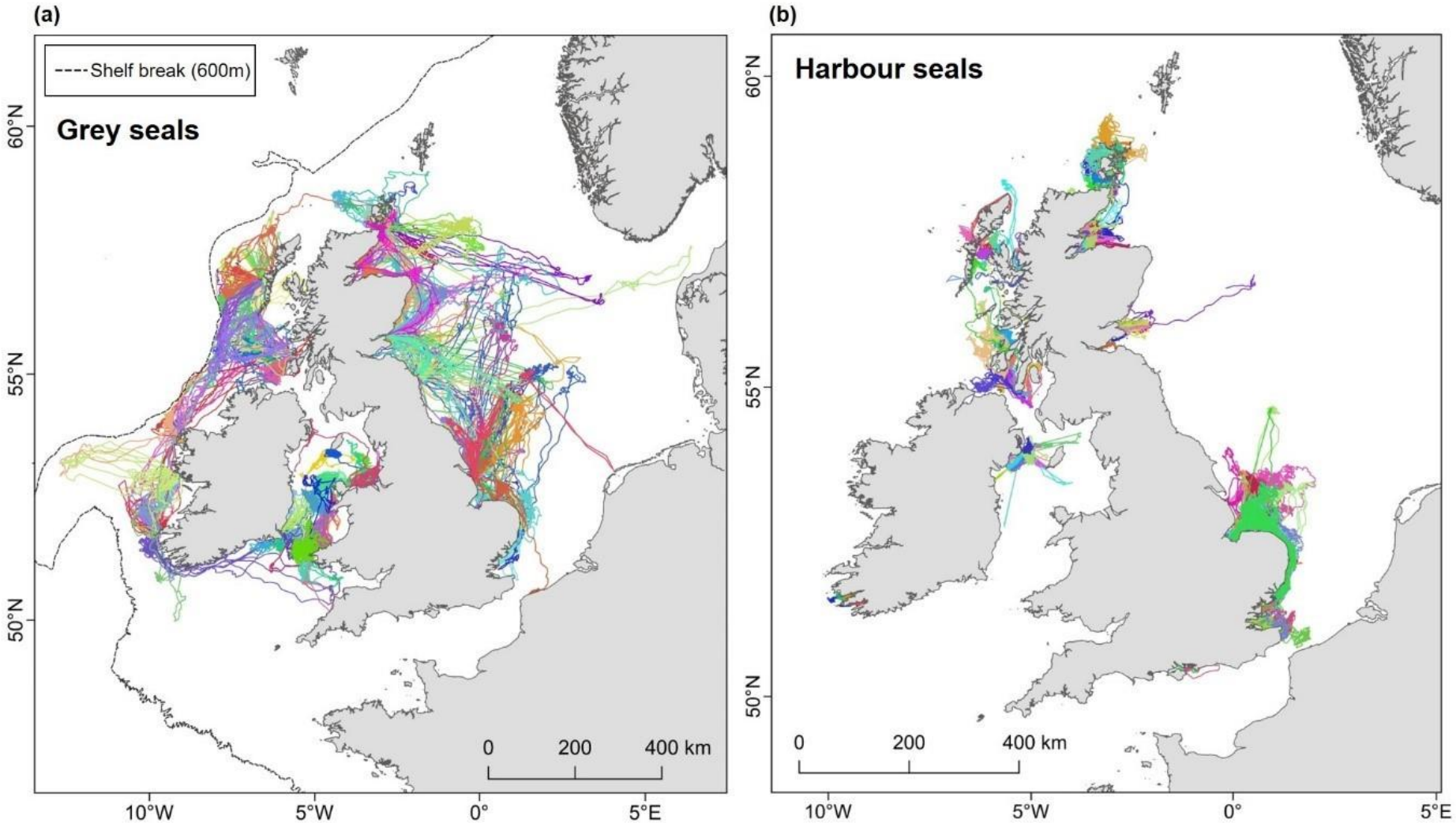


Figure 4-2: GPS tracking data for grey and harbour seals available for habitat preference models. Source: Carter *et al.* (2020[8]).

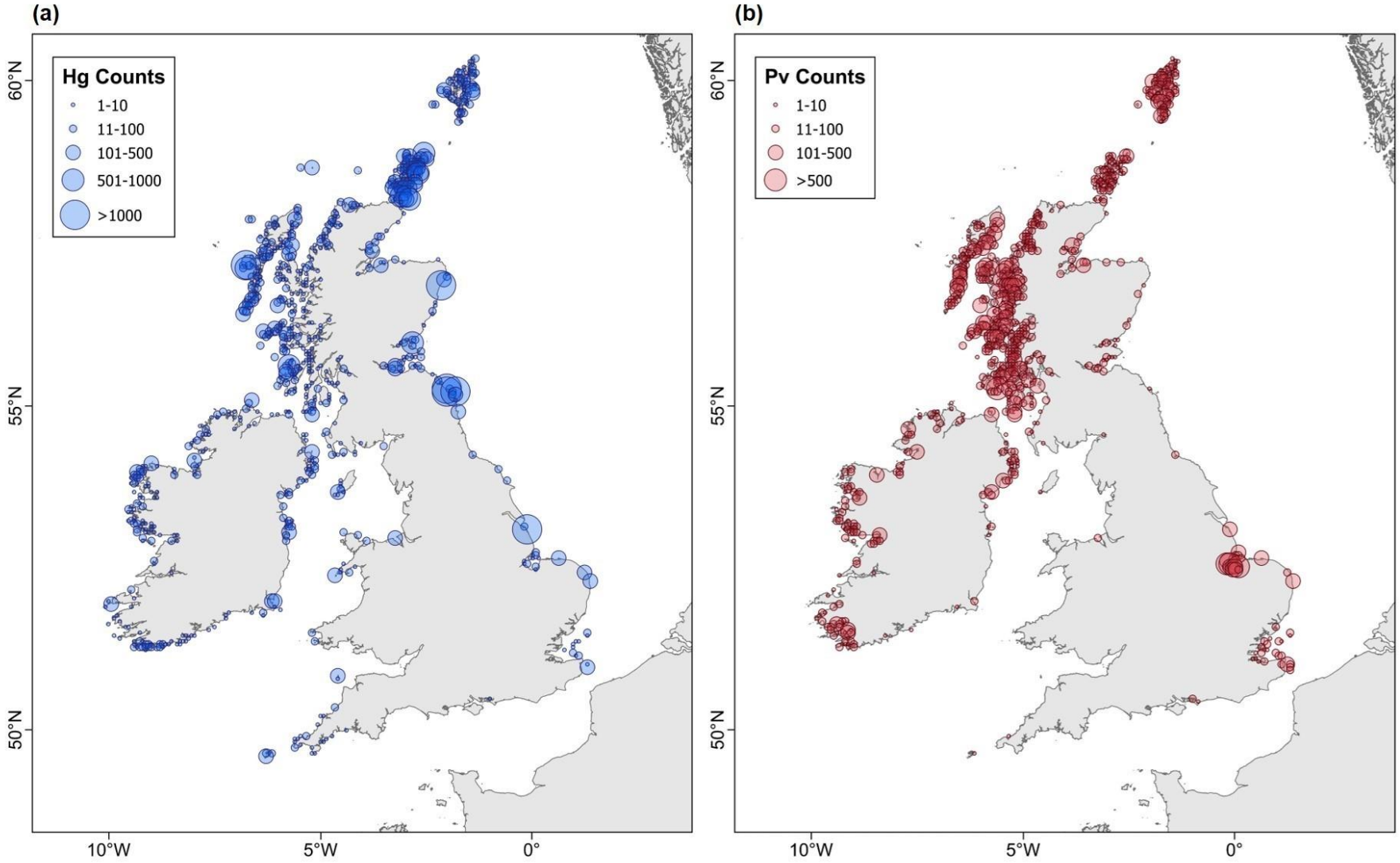


Figure 4-3: Most recent available August count data for (a) grey and (b) harbour seals per 5x5km haul-out cell used in the distribution analysis. Source: Carter *et al.* (2020[8]).

5 Harbour Porpoise

5.1 Overview

5.1.1.1 Harbour porpoise are present in Scottish waters year-round and are the most frequently sighted species, with their distribution overlapping with all Draft Plan Option (DPO) regions and sites (Hague *et al.*, 2020[15]). The series of SCANS surveys shows the southward change in distribution of harbour porpoises over the years and the most recent of the surveys suggest a density range of 0.058 – 0.599 harbour porpoise/km^2 in Scottish waters (Hammond *et al.*, 2021[19]). There is one SAC designated for harbour porpoise within the NS MU, the Southern North Sea SAC (Figure 3-1).

5.2 Management Unit

5.2.1.1 The population estimate for the NS MU is 346,601 harbour porpoise (95% CI: 289,498- 419,967, CV: 0.09) (IAMMWG, 2023[1]). The UK portion of this MU is 159,632 harbour porpoise (95% CI: 127,442-199,954, CV: 0.12) (IAMMWG, 2023[1]). The conservation status of harbour porpoise in UK waters was updated in JNCC (2019d[50]) which concludes a favourable assessment of future prospects and range, but an unknown conclusion for population size and habitat. This resulted in an overall assessment of conservation status of "Unknown" and an overall trend in Conservation status of "Unknown".

5.2.1.2 Across the four SCANS abundance estimates for harbour porpoise in the NS MU (1994, 2005, 2016 and 2022) there is no evidence of a significant change in abundance, although data have limited power to detect trends (power analysis indicates a minimum annual rate of decline of 0.88% that could be detected with a high (80%) statistical power) (Gilles *et al.*, 2023[3]).

5.3 Digital Aerial Surveys

5.3.1.1 Full results for the DAS are presented in Volume 7, Appendix 19: Caledonia OWF Digital Aerial Surveys and are summarised below for harbour porpoise.

5.3.1.2 Harbour porpoise were the most frequently observed marine mammal species observed during the DAS, with 141 recorded. Harbour porpoise were present in all but three months of DAS (November 2021, January and October 2022). The peak estimated abundance was 293 porpoise and the 2-year average density estimate (corrected) was 0.09 porpoise/km^2 (Table 5–1). There was no apparent pattern of distribution of harbour porpoise throughout the Caledonia OWF plus 4km buffer, with sightings occurring throughout the extent of the area.

5.3.1.3 During the two years of DAS there were also total of 39 unidentified dolphin and/or porpoise sightings, equating to 11% of marine mammal sightings.

5.3.1.4 The density estimates from the DAS resulted in much lower density estimates than was found at other OWFs in the Moray Firth which estimated average densities of 0.35 – 0.76 porpoise/km^2 (Table 5–2).

5.3.1.5 The density estimates provided by the DAS are much lower than those estimated by the SCANS III block densities, the SCANS III density surface and the SCANS IV block densities (see section 5.6). That, in combination with the spatial limitations of the data, combined with the uncertainty in the correction factor and the uncertainty in species identification means that this data source is not suitable to take forward to the quantitative impact assessment.

Table 5–1: Harbour porpoise peak abundance and average density estimates from DAS.

Location	Peak Abundance	Corrected Absolute Density (#/km^2) – 2-year Average
Caledonia OWF + 4km buffer	293 (95% CI: 111 – 508)	0.09
Caledonia North Site + 4km buffer	227 (95% CI: 39 – 602)	0.08
Caledonia South Site + 4km buffer	229 (95% CI: 40 – 624)	0.11

Table 5–2: Harbour porpoise density estimates from baseline surveys at other nearby OWFs.

OWF Site	Data	Density	Source
Green Volt	24 D between May 2020 and April 2022 of the Green Volt site plus 4km buffer.	Average absolute density estimate over the 24 months of surveys was 0.76 porpoise/km^2	Royal HaskoningDHV (2023[51])
Moray West	12 months of DAS between April 2016 and March 2017 of the Moray West site plus 4km buffer.	Average density across the survey period was 0.35 porpoise/km^2	Moray Offshore Windfarm (West) Limited (2018[52])
Moray East	28 vessel surveys between April 2010 and March 2012 of the Moray East site plus 4km buffer.	Corrected density of 0.72 porpoise/km2 (95% CI: 0.57-0.91) at the site and 0.63 porpoise/km^2 (95% CI: 0.47-0.85) in the buffer area	Moray East ES (2012[53])

OWF Site	Data	Density	Source
Beatrice	14 vessel-based surveys between April and September 2010.	Not calculated	Moray East ES (2012[53])

5.4 Presence of Existing OWF

5.4.1.1 Fernandez-Betelu *et al.* (2022[54]) presented new data regarding harbour porpoise presence at offshore structures. PAM was carried out around Smith Bank in the outer Moray Firth in August 2021 for 31 days at a gradient of distances from existing structures including the Jacky Wellhead platform (installed in 2008), Beatrice Bravo O&G platform (installed in 1983) and the two Beatrice Demonstrator turbines (installed in 2007). Harbour porpoise detection data was compared to historic baseline data from August 2005 at the Beatrice Demonstrator site prior to its construction.

5.4.1.2 This study provided some evidence of an effect of structures. Harbour porpoise occurrence and foraging activity was suggested to increase significantly closer to the offshore structures. Additionally, an increase in foraging activity at the structures in the night-time was indicated. In the baseline data, porpoise foraging activity did not change with the diel cycle. The authors indicated:

"*These findings provide evidence that marine mammals are attracted to man-made structures and that porpoises modify their diel patterns of occurrence and foraging activity around them. This research suggests that offshore structures play an important role as foraging areas for some marine mammals*".

5.4.1.3 Additionally, work has been conducted to determine if there has been a change in porpoise occurrence at Moray East and Beatrice between pre-construction baseline surveys (2009 to 2011) and post-construction surveys (2022) (Iorio-Merlo *et al.*, 2024[55]). The analysis of CPoD data from post-construction surveys confirmed that harbour porpoise were regularly detected throughout the study area for between 6 and 19 hours a day. The results suggested that, when compared to baseline surveys, porpoise occurrence remained slightly lower at these windfarm sites after construction. The authors highlighted that this difference can be largely attributed to particularly high detections at Beatrice Offshore Windfarm, in two of the three baseline years (Iorio-Merlo *et al.*, 2024[55]).

5.5 Moray Firth Distribution

5.5.1.1 Brookes *et al.* (2013[22]) used data from five visual survey sources (90 survey days between 2004 – 2010) to create a habitat association model for harbour porpoise in the Moray Firth, which was then tested and verified over longer timescales using data from CPoDs (April – October 2009 and 2010). The verification showed that harbour porpoise were detected on the CPoDs more often in grid cells where the habitat model predicted higher numbers. In general, within the Moray Firth, porpoise sighting rates were higher offshore, especially at and around Smith Bank (Figure 5-1), where the habitat is suitable for key prey species such as sandeels. The lower sightings rates in inshore waters were considered to likely be due to the presence of bottlenose dolphins in the coastal waters, which are known to aggressively interact with harbour porpoise.

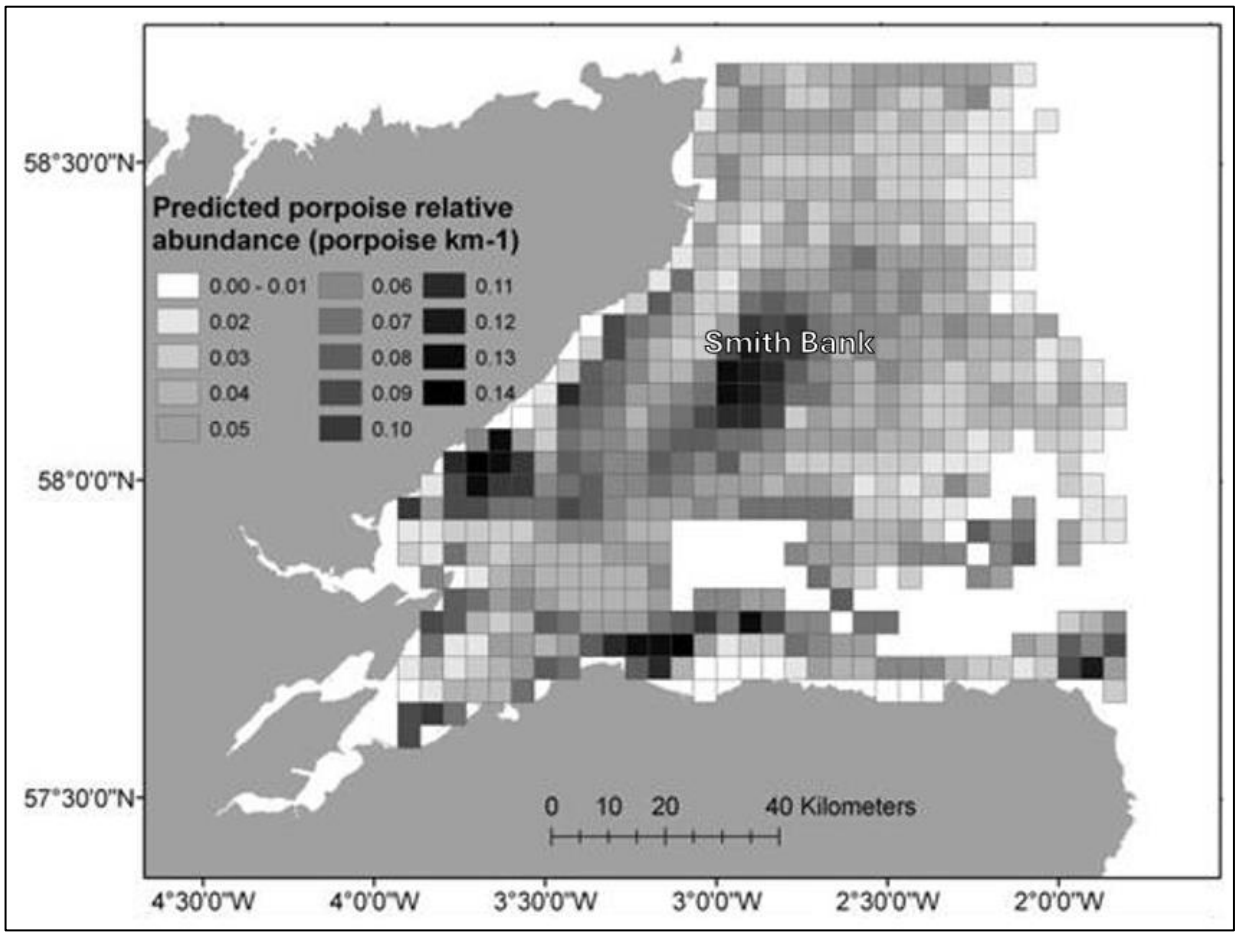


Figure 5-1: Predicted relative abundance of harbour porpoise (individuals per kilometer of survey transect). Predictions were not made in cells where depth was greater than 80 m because no survey data were available to inform these predictions (white areas). Source: Brookes *et al.* (2013[22]).

5.5.1.3 Since then, additional CPoD monitoring across the Moray Firth has furthered understanding on porpoise distribution. Williamson *et al.* (2022[56]) used data from CPoDs deployed within the Moray Firth between July and October 2009 to 2011 to further characterise porpoise distribution. CPoD data were available for between 33 and 58 sites in each month in the outer Moray Firth, the central Moray Firth, the inner Moray Firth and the coastal Moray Firth. Porpoise detections were highest at Smith Bank in the outer Moray Firth (15-23 hr/day), moderate in the central Moray Firth (8-12 hr/day) and low in the inner Moray Firth (1-5 hr/day). Harbour porpoise were detected more frequently in the offshore waters where bottlenose dolphin density is lower, though they were still present in coastal waters (Figure 5-2). In the inner Moray Firth, porpoise detections were lowest 1 hour before dolphin clicks were detected, suggesting porpoise can potentially detect that dolphins are arriving and can thus potentially avoid overlapping spatially.

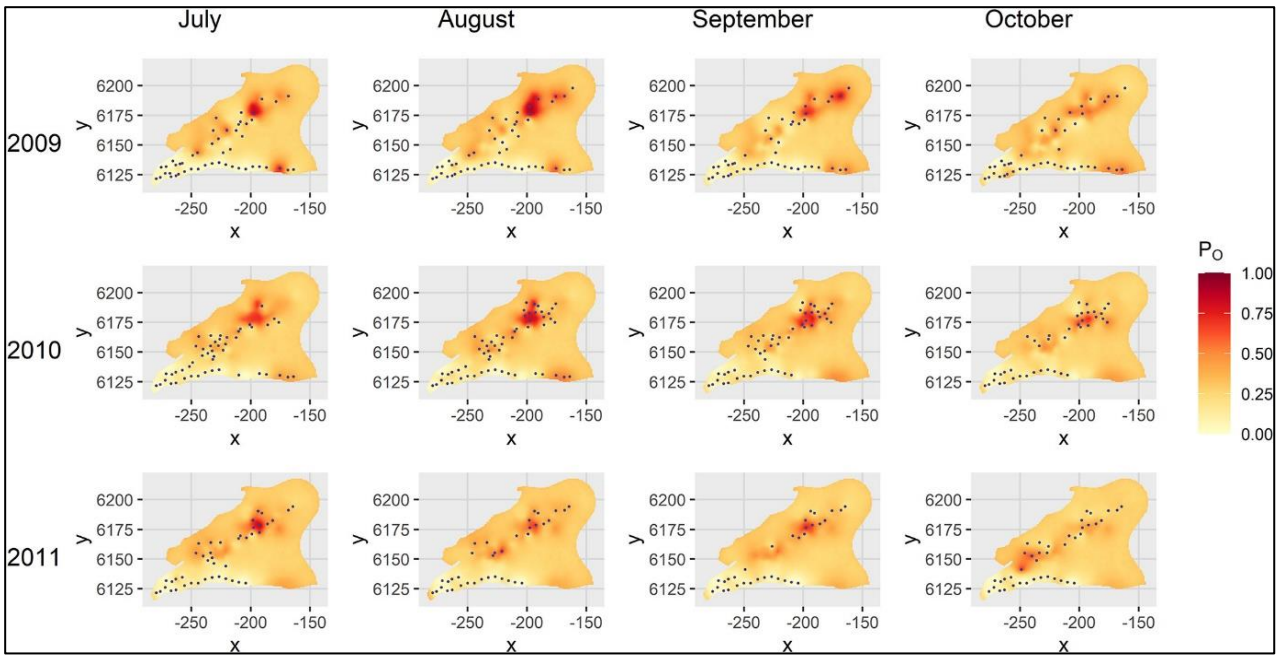


Figure 5-2: Probability of porpoise occurrence (PO) in July–October 2009–2011. All figures are scaled from 0 to 1, indicating low to high probability. Dots represent the locations of CPoDs deployed in that month. Source: Williamson *et al.* (2022[56]).

5.5.1.4 While these data sources provide valuable information on the relative abundance, distribution and probability of porpoise detection in the Moray Firth, they do not provide absolute density. Additionally, while they provide data for the Moray Firth, they represent only a small portion of the very large disturbance areas that are predicted for piling using the porpoise dose-response function. More recent, wider scale absolute density data are considered to be the most suitable source to take forward to the quantitative impact assessment.

5.6 SCANS Surveys

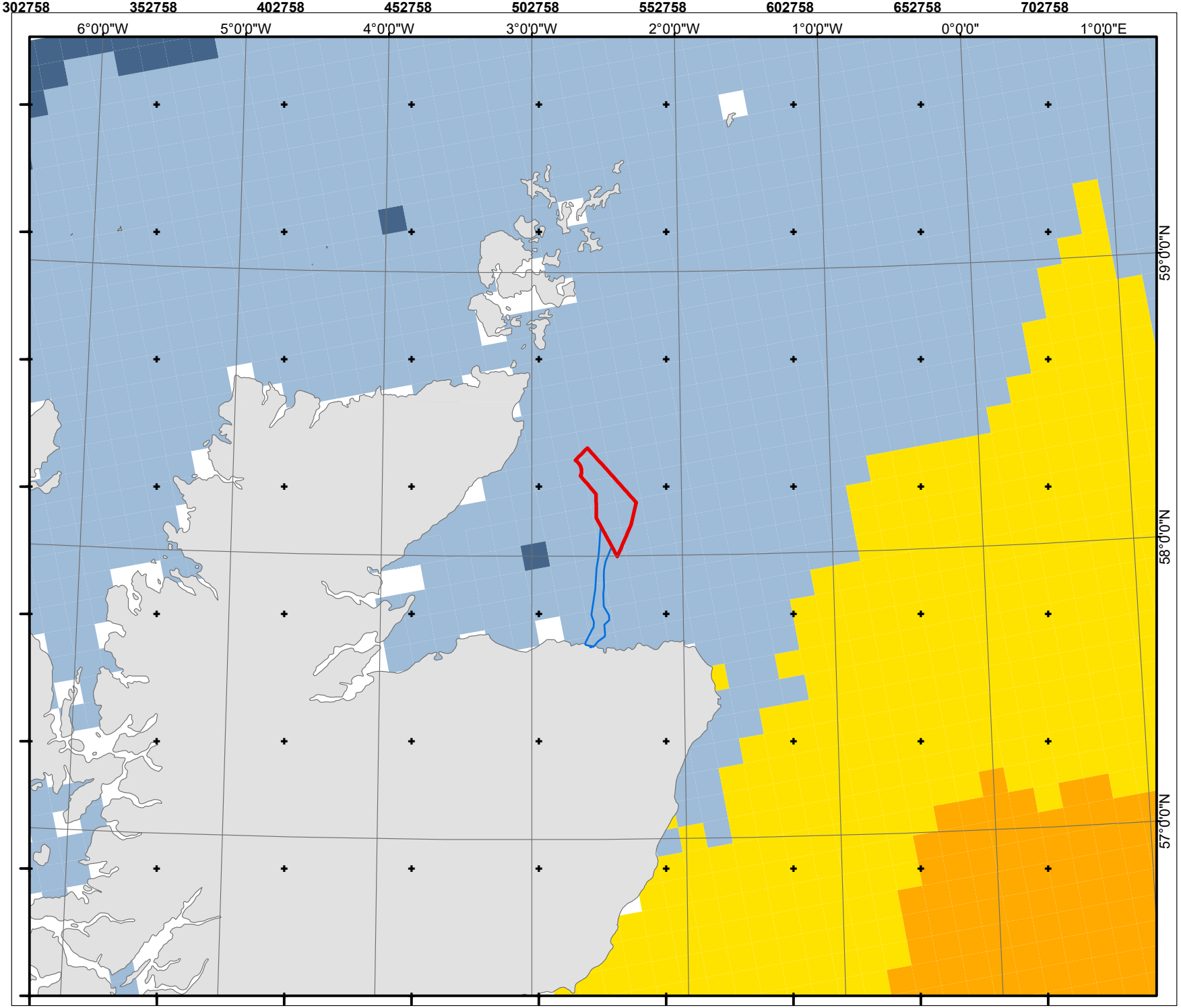
5.6.1 SCANS III

5.6.1.1 The Proposed Development (Offshore) is located within the SCANS III survey block S, where there was an estimated block-wide abundance of 6,147 harbour porpoise (95% CI: 3,401 – 10,065) and an estimated density of 0.152 (CV = 0.279) harbour porpoise/km^2 in July 2016 (Hammond *et al.*, 2021[19]). The SCANS III block-wide density estimates have not been taken forward to be used in the quantitative impact assessment as the data have been superseded by the more recent SCANS IV surveys.

5.6.1.2 Lacey *et al.* (2022[2]) used the SCANS III data and spatially referenced environmental features to predict density estimates for harbour porpoises (Figure 5-3). The highest densities around the UK are predicted in the central and southern North Sea. Around Scotland, high densities were predicted around east and southeast Scotland, which are still considerably lower compared to the central and southern North Sea values. Densities in the Moray Firth were predicted to be lower than those estimated for the rest of the east coast of Scotland. Densities at the Proposed Development (Offshore) are listed in Table 5–3. This dataset represents the most recent spatially explicit density surface for harbour porpoise and is, therefore, taken forward to be used in the quantitative impact assessment.

Table 5–3: Harbour porpoise density estimates using the SCANS III density surface (Lacey *et al.*, 2022[2]).

Area Selected	Density Range (#/km^2)
Caledonia OWF	0.275 - 0.345
Caledonia North Site	0.275 - 0.341
Caledonia South Site	0.275 - 0.345
Caledonia OECC	0.271 – 0.336
Caledonia South OECC	0.271 – 0.336
Caledonia North OECC	0.271 – 0.345

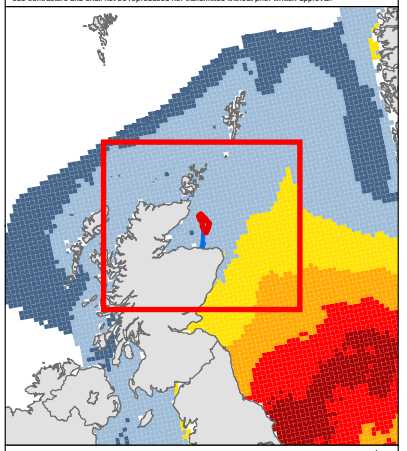


Legend

- Caledonia OWF
- OECC

Harbour porpoise predicted density surface (#/km²)

- <0.25
- 0.25 - 0.5
- 0.5 - 0.75
- 0.75 - 1.0



0 15 30 45 60 km

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SMRUC-008	01

GEODETIC PARAMETERS: GCS_WGS_1984 / World Geodetic System (WGS84)

DRAWING TITLE

Figure 5-3: Predicted surface of estimated density for harbour porpoise from SCANS III (Lacey et al., 2022)

STATUS	SCALE	
Approved	1:2,000,000	
DRAWING NUMBER	SHEET NO	REV
N/A	01 of 01	N/A

5.6.2 SCANS IV

5.6.2.1 The Proposed Development (Offshore) is located within the SCANS IV survey block CS-K, where there was an estimated block wide abundance of 11,357 harbour porpoise (95% CI: 4,946 – 21,173) and an estimated density of 0.2813 harbour porpoise/km^2 (CV: 0.354) (Gilles *et al.*, 2023[3]).

5.6.2.2 Larger scale impacts such as disturbance from pile driving may extend beyond block CS-K and into the adjacent block NS-E (where contours extend into the adjacent SCANS IV blocks, then the portion of the impact contour within respective block will be assigned to the block-specific density value). Abundance (33,309, 95% CI: 21,757 – 50,324) and density (0.5156 harbour porpoise/km^2, CV = 0.208) in the neighbouring block NS-E was higher than in the block CS-K. The SCANS IV data, while limited to summer months only, do provide a robust absolute density estimate for harbour porpoise, that has been corrected for availability and perception bias.

5.6.2.3 This dataset represents the most recent and reliable density estimates for harbour porpoise. Therefore, it is taken forward to be used in the quantitative impact assessment.

5.7 Harbour Porpoise Summary

5.7.1.1 It is recommended that two density estimates are taken forward to the quantitative assessment:

- The SCANS IV block estimates will be used as they represent the most recent and most robust absolute density estimate.
- The SCANS III modelled density surface for harbour porpoise (Lacey *et al.*, 2022[2]) (grid cell specific density estimates) will be used as this represents the most robust spatially explicit density surface.

6 Bottlenose Dolphins

6.1 Overview

6.1.1.1 There are two ecotypes of bottlenose dolphins within Scottish waters: the coastal and the offshore ecotype (Hague *et al.*, 2020[15]). This species is classified as a priority species under the UK Post- 2010 Biodiversity Framework, as well as listed as Least Concern on the IUCN red list. Bottlenose dolphins are also listed under Annex II of the EU Habitats Directive and as such, SACs must be assigned to aid the protection of this species. There is currently one bottlenose dolphin SAC in proximity to the project site, the Moray Firth SAC (Figure 3-1).

6.1.1.2 The conservation status in UK waters was updated in JNCC (2019b[50]). It concludes a favourable assessment of range, but an unknown conclusion for population size, habitat, and future prospects. This resulted in an overall assessment of conservation status of "Unknown" and an overall trend in conservation status of "Unknown".

6.2 Management Unit

6.2.1.1 The Proposed Development (Offshore) is located within two bottlenose dolphin MUs: the Caledonia OWF and part of the OECC is in the GNS MU, while the coastal part of the OECC is in the CES MU (Figure 2-2). The GNS MU population are considered 'offshore bottlenose dolphins' and the CES MU are considered the 'coastal protected east coast Scotland population'. The population estimate for the GNS MU is 2,022 bottlenose dolphins (95% CI: 548 – 7,453, CV: 0.75), of which 1,885 are within the UK portion of the MU (95% CI: 476 – 7,461) (IAMMWG, 2023[1]). The most recent site condition monitoring report provides an updated estimate of CES population of 245 dolphins (95% CI: 224-268) based on data from 2022 (Cheney *et al.*, 2024). Between 2009 and 2022, the CES population has been estimated to increase at a rate of 2.07% per year (Cheney *et al.*, 2024[23]).

6.3 Digital Aerial Surveys

6.3.1.1 Full results for the DAS are presented in Volume 7, Appendix 19: Caledonia OWF Digital Aerial Surveys and are summarised below for bottlenose dolphins.

6.3.1.2 During the Caledonia DAS, there were two sightings of bottlenose dolphins within the Caledonia OWF plus 4km buffer, both in May 2022. Over the 24 months, the average un-corrected relative density estimate was 0.002 bottlenose dolphins/km^2 (for Caledonia OWF plus a 4km buffer). No bottlenose dolphins were observed within the Caledonia South Site plus a

4km buffer. In addition, there were 39 unidentified dolphins and/or porpoise, and three unidentified dolphins (all during year 1 of surveys).

6.3.1.3 Given that there is no correction factor for bottlenose dolphins (so that estimates are relative not absolute), the spatial limitations of the data and the uncertainty in species identification means that this data source is not suitable to take forward to the quantitative impact assessment.

6.4 SCANS Surveys

6.4.1.1 The SCANS surveys do not differentiate the coastal and the offshore bottlenose dolphin as the large-scale line transect surveys are not designed for data collection on small coastal populations (Hammond *et al.*, 2021[19], Lacey *et al.*, 2022[2]). Therefore, they are unsuitable to provide information on the CES MU. On a wider scale they would have been more appropriate to consider for the GNS MU, however the SCANS IV density for bottlenose dolphins in both CS-K and NS-E was zero. Therefore, SCANS survey data are not considered further for bottlenose dolphins.

6.5 Coastal East Scotland Population

6.5.1 Population Size

6.5.1.1 The most recent site condition monitoring report provides an estimate of 245 dolphins (95% CI: 224-268) within the CES population based on data from 2022 (Cheney *et al.*, 2024[4]). Between 2009 and 2022, using a five-year weighted mean estimate, the CES population has significantly increased, resulting in an annual rate of change of λ=1.02 (95% CI: 1.01-1.03). The overall trend indicates population increase at a rate of 2.07% per year (Cheney *et al.*, 2024[4]), despite the recent large scale offshore developments within the Moray Firth (e.g. Moray East OWF).

6.5.2 Distribution within the MU

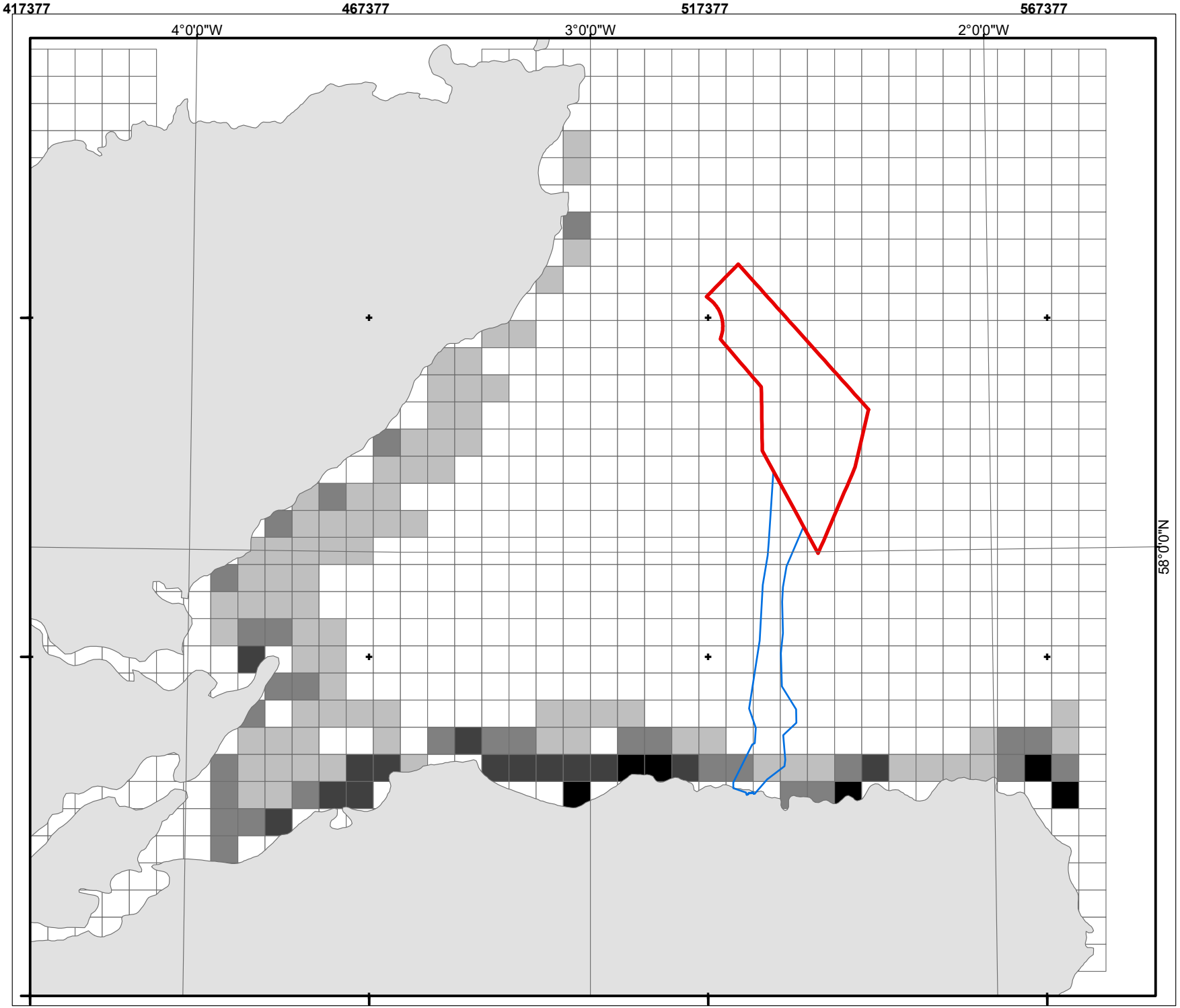
6.5.2.1 There has been a change in the distribution of the CES bottlenose dolphins within the MU. Since the 1990s, the CES population has been recorded ranging further south in the Tay Estuary and the Firth of Forth, with the number and proportion of dolphins using the Tayside and adjacent waters having increased from 144 (95% CI: 118-177) in 2017 to 195 (95% CI: 170-223) in 2022 (Cheney *et al.*, 2024). More recently, sightings have been recorded around the coast of northern England (Arso Civil *et al.*, 2019[31]; 2021[32]), indicating expanded home ranges of the Moray Firth bottlenose dolphins. This has consequently meant that the population within the Moray Firth SAC has decreased from 122 (95% CI: 111-134) to 94 (95% CI:84-106) over the same time period.

6.5.3 Distribution within the Moray Firth

6.5.3.1 Thompson *et al.* (2015a[6]) used broad scale PAM data across the Moray Firth (July-Oct 2009-2011) in combination with presence only data from visual surveys in a generalized estimating equation model to model the spatial variation in dolphin occurrence across the Moray Firth. Data from visual surveys (vessel and aerial surveys between 1980-2010) were then used to estimate which species of dolphin was most likely present in each cell. Combining these data allowed an estimate of the probability of bottlenose dolphin distribution within the Moray Firth (Figure 6-1). The acoustic data showed that dolphins were only rarely detected in the offshore areas and the visual data indicated that these offshore dolphins were more likely to be white-beaked, common, and Risso's dolphins, with bottlenose dolphins being almost exclusively restricted to the very coastal waters. These data represent predicted probabilities of occurrence, therefore they need to be scaled to the current bottlenose dolphin population size in order to convert the surface into a density surface. It has been assumed that 50% of the CES MU bottlenose dolphins are located within the Moray Firth at any one time (123 dolphins) (based on data presented in Arso Civil *et al.* (2021[32]) and Quick *et al.* (2014[5])). Therefore, the probability surface was scaled such that it represents a density surface containing 123 bottlenose dolphins, all of which are assumed to be associated with the CES MU (Figure 6-2). Within the Moray Firth density surface, the maximum bottlenose density is 1.614 dolphins/km^2. Within the Caledonia OWF, the maximum density is 0.0004 dolphins/km^2 and within the OECC the maximum density is 0.0543 dolphins/km^2 (Table 6–1).

Table 6–1: Bottlenose dolphin density estimates using the Moray Firth density surface.

Area Selected	Density Range (#/km^2)
Caledonia OWF	0.0000 – 0.0004
Caledonia North Site	0.0000 – 0.0001
Caledonia South Site	0.0000 – 0.0004
Caledonia OECC	0.000 – 0.0543

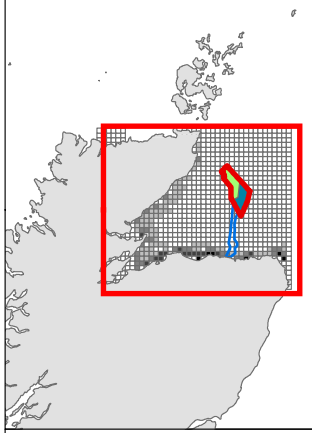


Legend

- Caledonia OWF
- OECC

Probability of bottlenose dolphin occurance (Thompson et al., 2015)

- 0.000 - 0.001
- 0.001 - 0.005
- 0.005 - 0.010
- 0.010 - 0.020
- >0.020



0 15 30 km

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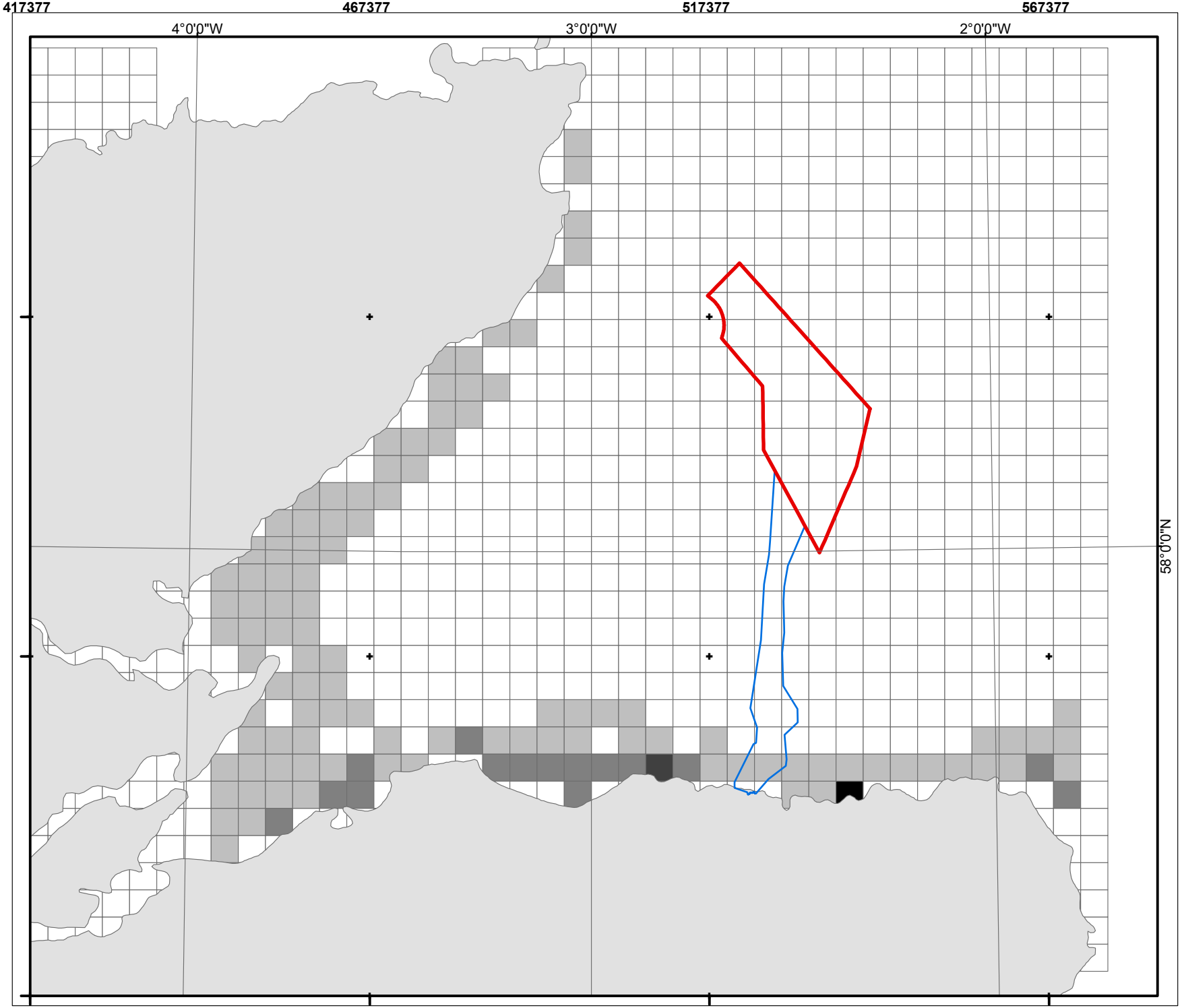
GEODETIC PARAMETERS: GCS_WGS_1984 / World Geodetic System (WGS84)	
DRAWING TITLE: Figure 6-1: Spatial variation in the predicted probability of bottlenose dolphin occurance across the Moray Firth	
STATUS: Approved	SCALE: 1:750,000
DRAWING NUMBER: N/A	SHEET NO: 01 of 01 / REV: N/A

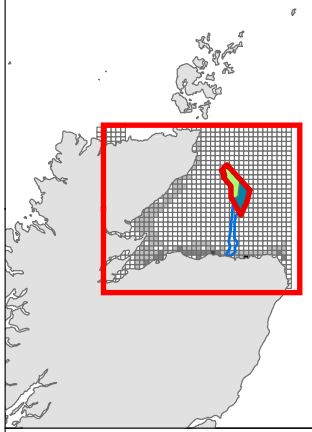


Legend

- Caledonia OWF
- OECC

Moray Firth density surface (#/km²)

- 0.00 - 0.01
- 0.01 - 0.10
- 0.10 - 0.20
- 0.20 - 0.50
- >0.50



0 15 30 km

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GEODETIC PARAMETERS: GCS_WGS_1984 / World Geodetic System (WGS84)	
DRAWING TITLE: Figure 6-2: Spatial variation in bottlenose dolphin density across the Moray Firth	
STATUS: Approved	SCALE: 1:750,000
DRAWING NUMBER: N/A	SHEET NO: 01 of 01 / REV: N/A

6.5.4 Distribution outside the Moray Firth

6.5.4.1 It has been reported that, outside of the Moray Firth (in both Tayside and Fife, and between Montrose and Aberdeen), bottlenose dolphins are encountered more often in waters less than 20m deep and within 2km of the coast (Quick *et al.*, 2014[5]). Therefore, a 2km buffer from the coast was created for the mainland Scotland part of the CES MU south of the Moray Firth density surface, and it was assumed that half of the CES population of bottlenose dolphins (122 dolphins) (based on data presented in Arso Civil *et al.* (2021[32]) and Quick *et al.* (2014[5])) were uniformly spread within this area. This results in a uniform density estimate of 0.142 bottlenose dolphins/km^2 within 2km from the mainland coast, south of the Moray Firth area in the CES MU (assuming half the CES MU is located south of the Moray Firth: 122 dolphins spread evenly over a 2km buffer south of the Moray Firth).

6.5.5 Greater North Sea (GNS) MU

6.5.5.1 According to IAMMWG (2023[1]), the latest abundance estimate for this MU is 2,022 dolphins. However, data on the distribution of these dolphins within the MU are lacking; therefore, the assumption will be made that bottlenose dolphins are uniformly (evenly) distributed across the entire MU. This results in a uniform density estimate of 0.003 bottlenose dolphins/km^2 across the GNS MU.

6.5.6 Assumption of Uniform Density

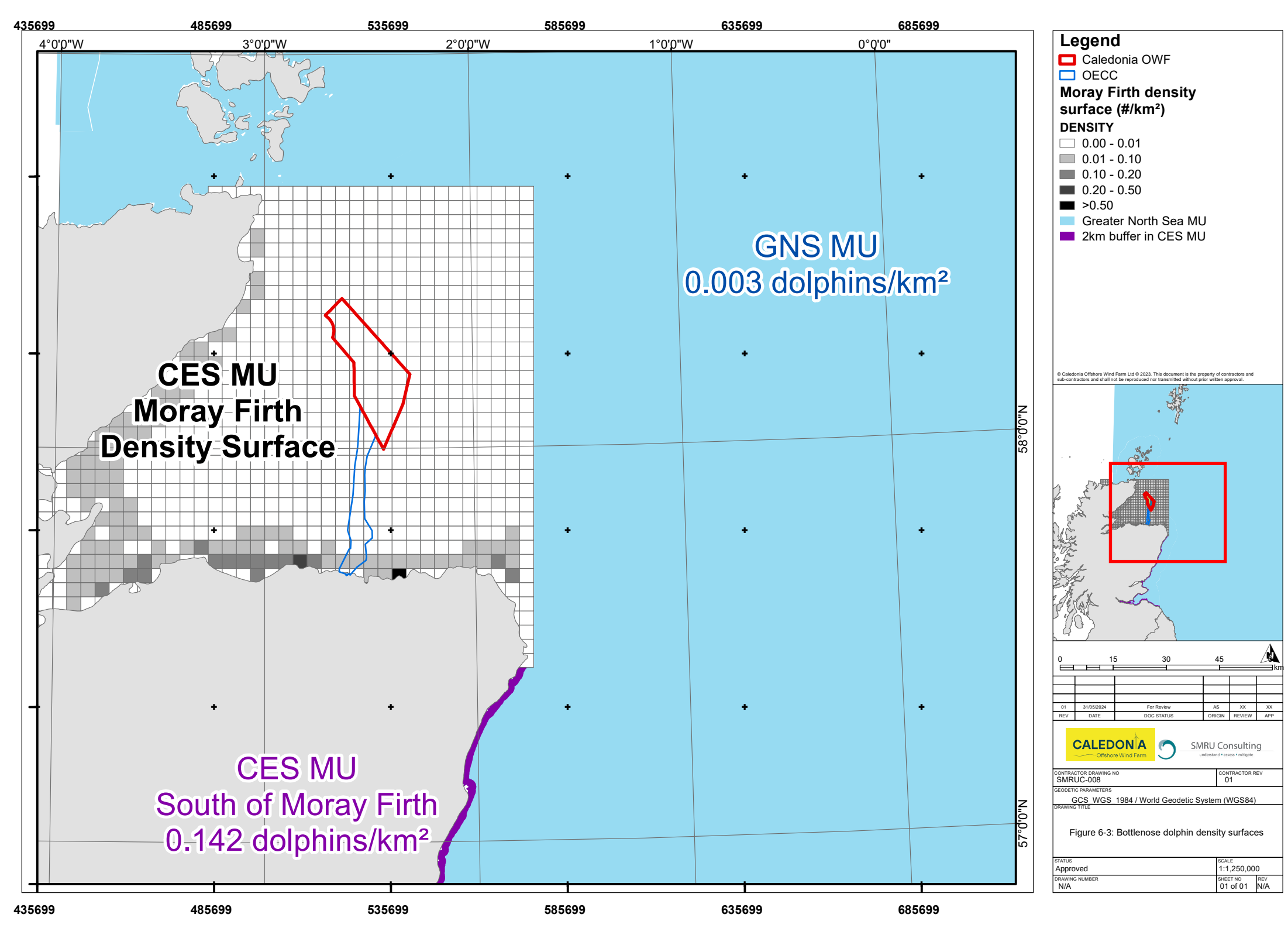
6.5.6.1 The key issue with using a uniform density estimate is that bottlenose dolphins are not distributed evenly throughout their range. They are most commonly encountered in groups; for example, between 2017 and 2019 in the Tay Estuary and adjacent waters, estimated group sizes ranged from 1 to 50 animals, with an average group size of 11 across 157 separate encounters (Arso Civil *et al.*, 2021[32]). Thus, a uniform density estimate is not suitable for a species that is known to have a patchy and highly changeable distribution within their range at any one time. While assuming a uniform density estimate is by no means ideal, it is currently considered the best way to estimate potential densities in the vicinity of the Project in the absence of any other reliable density data.

6.7 Bottlenose Dolphin Summary

6.7.1.1 A key issue with using large-scale survey estimates (such as SCANS III and IV) for bottlenose dolphins is that uniform density estimates do not take into consideration the habitat preferences for coastal populations of bottlenose dolphins, which have been found to be largely restricted to coastal waters (Quick *et al.*, 2014[5]), nor the fact that bottlenose dolphins aggregate in groups rather than being uniformly distributed. As such, a block wide uniform density estimate is not suitable for this species and will not reflect the true expected distribution and predicted impact numbers in the quantitative impact assessment. Therefore, three density estimates are recommended to be used in the quantitative impact assessment (Figure 6-3):

- The grid-specific Moray Firth density surface (containing half the CES MU: 123 dolphins)
- 0.142 bottlenose dolphins/km^2 within 2km of the coast south of the Moray Firth (half the CES MU: 122 dolphins) and
- 0.003 bottlenose dolphins/km^2 beyond Moray Firth and 2km buffer (GNS MU).

6.7.1.2 This approach allows the quantitative assessment to differentiate between higher densities in the Moray Firth and around the coast and lower densities further offshore. This is of particular importance as dolphins within the CES MU are part of the protected population from the Moray Firth SAC.



Legend

- Caledonia OWF
- OECC

Moray Firth density surface (#/km²)

DENSITY

- 0.00 - 0.01
- 0.01 - 0.10
- 0.10 - 0.20
- 0.20 - 0.50
- >0.50
- Greater North Sea MU
- 2km buffer in CES MU

0 15 30 45 km

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CONTRACTOR DRAWING NO: SMRUC-008	CONTRACTOR REV: 01
GEODETIC PARAMETERS: GCS_WGS_1984 / World Geodetic System (WGS84)	
DRAWING TITLE: Figure 6-3: Bottlenose dolphin density surfaces	
STATUS: Approved	SCALE: 1:1,250,000
DRAWING NUMBER: N/A	SHEET NO: 01 of 01 / REV: N/A

7 White-beaked Dolphins

7.1 Overview

7.1.1.1 White-beaked dolphins are a resident species in Scottish waters, present mostly across central and northern North Sea and northwest Scotland (Hague *et al.*, 2020[15]), and data suggest that white-beaked dolphin distribution is shifting northwards (Evans *et al.*, 2011[57]). During the most recent SCANS IV survey they were sighted offshore west Scotland, north of the Hebrides and north coast and at east coast of Scotland, and their density estimates ranged from 0-0.257 white-beaked dolphin/km^2 in Scottish waters (Gilles *et al.*, 2023[3]) .

7.1.1.2 The conservation status of white-beaked dolphin in UK waters was updated in JNCC (2019i[58]) which concludes a favourable assessment of range, but an unknown conclusion for future prospects, population size and habitat. This resulted in an overall assessment of conservation status of "Unknown" and an overall trend in Conservation status of "Unknown".

7.2 Management Unit

7.2.1.1 The relevant MU for white-beaked dolphins is the CGNS MU which has an estimated population size of 43,951 animals (95% CI 28,439 – 67,924) of which 34,025 (95% CI: 20,026 – 57,807) are estimated within the UK Exclusive Economic Zone (EEZ) (IAMMWG, 2023[1]).

7.3 Digital Aerial Surveys

7.3.1.1 Full results for the DAS are presented in Volume 7, Appendix 19: Caledonia OWF Digital Aerial Surveys and are summarised below for white-beaked dolphins.

7.3.1.2 White-beaked dolphins were recorded in 11 of the 24 DAS, with a total of 64 white-beaked dolphins recorded. Within the Caledonia OWF plus 4km buffer, the peak estimated abundance was 82 white-beaked dolphins and the 2-year average un-corrected relative density estimate was 0.02 dolphins/km^2.

7.3.1.3 Given that there is no correction factor for white-beaked dolphins (so that estimates are relative not absolute), the spatial limitations of the data and the uncertainty in species identification means that this data source is not suitable to take forward to the quantitative impact assessment.

7.4 Presence in the Moray Firth

7.4.1.1 Thompson *et al.* (2015a[6]) present data from visual surveys (vessel and aerial surveys between 1980-2010) to estimate which species of dolphin

was most likely present in grid cells across the Moray Firth. White-beaked dolphins were rarely sighted in the inner or coastal Moray Firth, with most sightings in the offshore waters (Figure 7-1).

7.4.1.2 There are no density estimates available for white-beaked dolphins specifically in the Moray Firth.

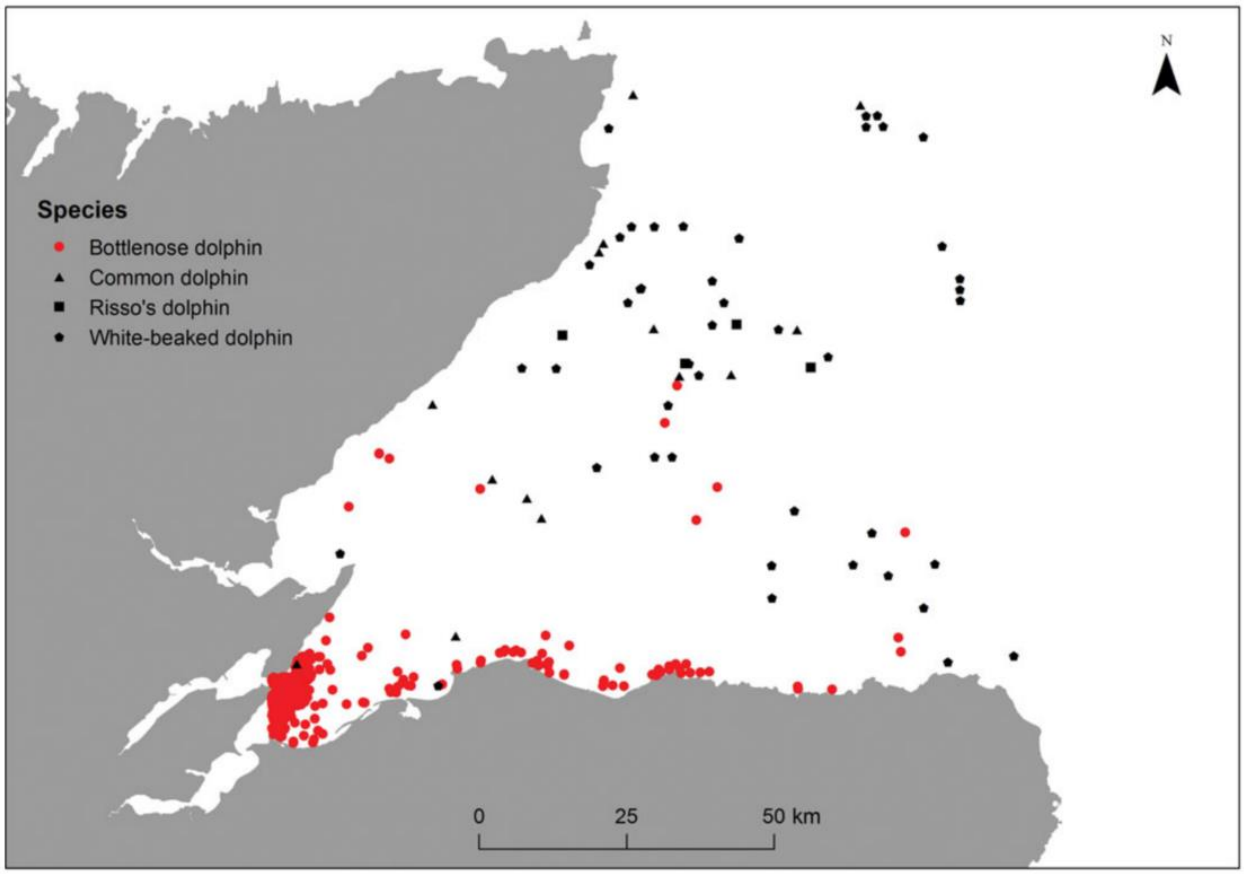


Figure 7-1: Locations of all the sightings of different dolphin species. Source: Thompson *et al.* (2015a[6]).

7.5 SCANS Surveys

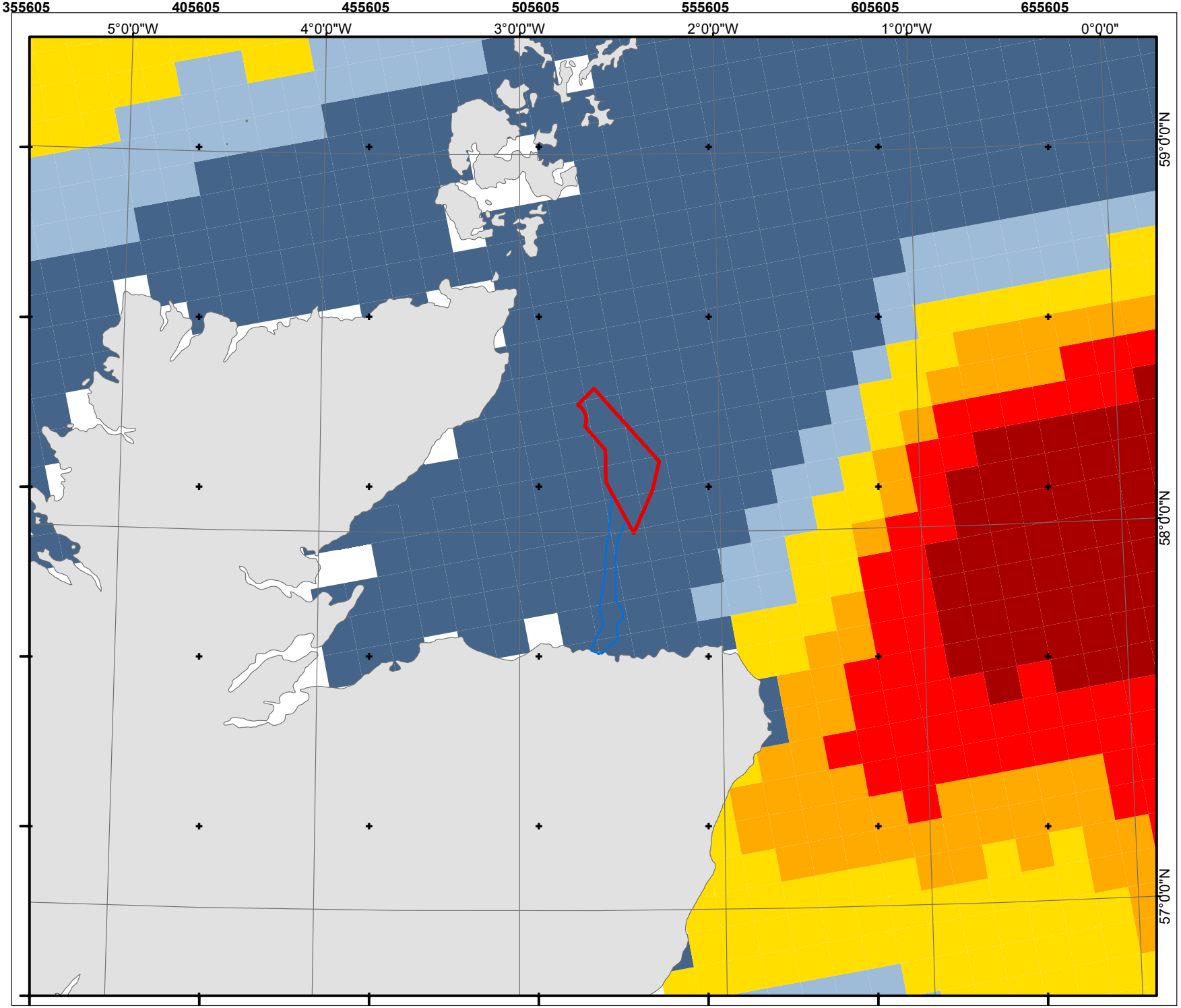
7.5.1 SCANS III

7.5.1.1 The Proposed Development (Offshore) is located within the SCANS III survey block S, where there was an estimated block-wide abundance of 868 white-beaked dolphins (95% CI: 0 - 2,258) and an estimated density of 0.021 (CV: 0.690) white-beaked dolphins/km^2 in July 2016 (Hammond *et al.*, 2021[19]). The SCANS III block-wide density estimates have not been taken forward to be used in the quantitative impact assessment as the data has been superseded by the more recent SCANS IV surveys.

7.5.1.2 Lacey *et al.* (2022[2]) used the SCANS III data and spatially referenced environmental features to predict density estimates for white-beaked dolphins (Figure 7-2). The highest densities were predicted further offshore off the east coast of Scotland and off the north/northwest coast of Scotland. Besides these two higher density areas, the predicted values are generally very low around the UK. Density estimates for the Proposed Development (Offshore) are presented in Table 7–1. This dataset represents the most recent spatially explicit density surface for white-beaked dolphin and is, therefore, taken forward to be used in the quantitative impact assessment.

Table 7–1: White-beaked dolphin density estimates using the SCANS III density surface (Lacey *et al.*, 2022[2]).

Area Selected	Density Range (#/km^2)
Caledonia OWF	0.007 - 0.019
Caledonia North Site	0.007 - 0.011
Caledonia South Site	0.009 - 0.019
Caledonia OECC	0 – 0.027
Caledonia South OECC	0 – 0.027
Caledonia North OECC	0 – 0.027

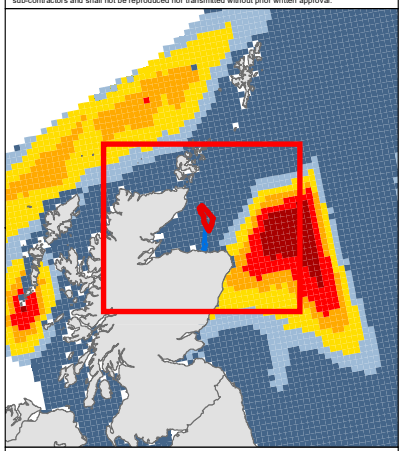


Legend

- Caledonia OWF
- OECC

White-beaked dolphin predicted density surface (#/km²)

- <0.05
- 0.05 - 0.1
- 0.1 - 0.2
- 0.2 - 0.3
- 0.3 - 0.5
- >0.5



0 15 30 45 60 km

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01	31/05/2024	For Review	AS	XX	XX

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SMRUC-009	01

GEODETIC PARAMETERS: GCS_WGS_1984 / World Geodetic System (WGS84)

DRAWING TITLE

Figure 7-2: Predicted surface of estimated density for white-beaked dolphin in SCANS III (Lacey et al., 2022)

STATUS	SCALE	
Approved	1:1,500,000	
DRAWING NUMBER	SHEET NO	REV
N/A	01 of 01	N/A

7.5.2 SCANS IV

7.5.2.1 The Proposed Development (Offshore) is located within the SCANS IV survey block CS-K, where there was an estimated block-wide abundance of 5,460 white-beaked dolphins (95% CI: 191 – 12,812) and an estimated density of 0.1352 white-beaked dolphins/km^2 (CV = 0.608) (Gilles *et al.*, 2023[3]).

7.5.2.2 Larger scale impacts such as disturbance from pile driving may extend beyond block CS-K and into the adjacent block NS-E (where contours extend into the adjacent SCANS IV blocks, then the portion of the impact contour within respective block will be assigned to the block-specific density value). Abundance (11,611, 95% CI: 3,875 – 10,586) and density (0.1775 white-beaked dolphins/km^2, CV = 0.383) in the neighbouring block NS-E were significantly higher.

7.5.2.3 This dataset represents the most recent and reliable density estimates for white-beaked dolphin. Therefore, it is taken forward to be used in the quantitative impact assessment.

7.6 White-beaked Dolphin Summary

7.6.1.1 It is recommended that two density estimates are taken forward to the quantitative assessment:

- The SCANS IV block estimates will be used as they represent the most recent and most robust absolute density estimate.
- The SCANS III modelled density surface for white-beaked dolphins (Lacey *et al.*, 2022[2]) (grid cell specific density estimates) will be used as this represents the most robust spatially explicit density surface.

8 Common Dolphins

8.1 Overview

8.1.1.1 Common dolphins most frequently occur in the Celtic Sea within UK waters, although the species is also recorded in the North Sea. Common dolphins are listed as Least Concern on the IUCN red list and have no designated SACs in UK waters.

8.1.1.2 The conservation status of common dolphins in UK waters concludes a favourable assessment of range, but an unknown conclusion for future prospects, population size and habitat. This resulted in an overall assessment of conservation status of "Unknown" and an overall trend in Conservation status of "Unknown" (JNCC, 2019c[59]).

8.2 Management Unit

8.2.1.1 The relevant MU for common dolphins is the CGNS MU which has an estimated population size of 102,656 (95% CI: 58,932-178,822) of which 57,417 (95% CI: 30,850-106,863) are estimated within the UK EEZ (IAMMWG, 2023[1]).

8.3 Digital Aerial Surveys

8.3.1.1 Full results for the DAS are presented in Volume 7, Appendix 19: Caledonia OWF Digital Aerial Surveys and are summarised below for common dolphins.

8.3.1.2 Common dolphins were recorded in only one of the 24 DAS, with a total of 39 common dolphins recorded in October 2022. Over the 24 months, this results in an average density of 0.01 common dolphins/km^2. No common dolphins were observed within the Caledonia North Site plus a 4km buffer.

8.3.1.3 Given that there is no correction factor for common dolphins (so that estimates are relative not absolute), the spatial limitations of the data and the uncertainty in species identification means that this data source is not suitable to take forward to the quantitative impact assessment.

8.4 Presence in the Moray Firth

8.4.1.1 Thompson *et al.* (2015a[6]) present data from visual surveys (vessel and aerial surveys between 1980-2010) to estimate which species of dolphin was most likely present in grid cells across the Moray Firth. Common dolphins were mainly sighted in the offshore waters (Figure 7-1). There are no density estimates available for common dolphins specifically in the Moray Firth.

8.5 SCANS Surveys

8.5.1 SCANS III

8.5.1.1 There were no sightings of common dolphins in block S or block T (Hammond *et al.*, 2021[19]).

8.5.1.2 Lacey *et al.* (2022[2]) used the SCANS III data and spatially referenced environmental features to predict density estimates for common dolphins (Figure 8-1). The highest densities were predicted further offshore off the southwest coast of England, but the predicted values are generally very low around the UK. The density range for grid cells within the Proposed Development (Offshore) is presented in Table 8–1.

Table 8–1: Common dolphin density estimates using the SCANS III density surface (Lacey *et al.*, 2022[2]).

Area Selected	Density Range (#/km^2)
Caledonia OWF	0.0002 – 0.0004
Caledonia North Site	0.0003 – 0.0004
Caledonia South Site	0.0002 – 0.0004
Caledonia OECC	0.0002 – 0.0004
Caledonia South OECC	0.0002 – 0.0004
Caledonia North OECC	0.0002 – 0.0004

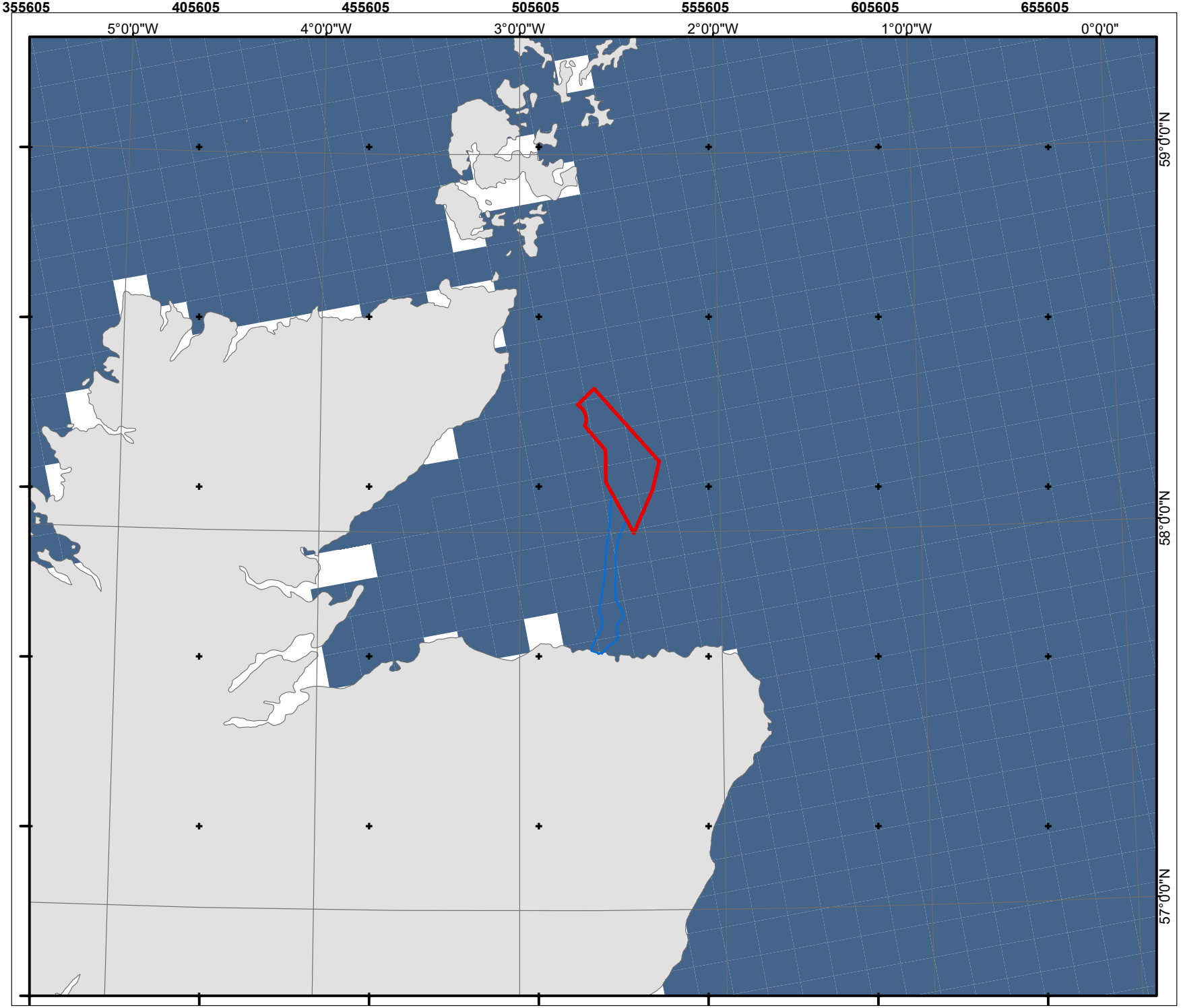
8.5.2 SCANS IV

8.5.2.1 No common dolphin sightings occurred in block CS-K or NS-E during SCANS IV (Gilles *et al.*, 2023[3]).

8.6 Common dolphin summary

8.6.1.1 There is only a single density estimate that is suitable to take forward to the quantitative impact assessment:

- The SCANS III modelled density surface for common dolphins (Lacey *et al.*, 2022[2]).

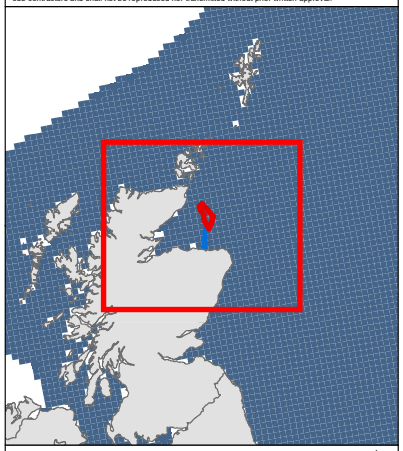


Legend

- Caledonia OWF
- OECC

Common dolphin predicted density surface (#/km²)

- <0.05



0 5 10 15 20 km

REV	DATE	DOC STATUS	ORIGIN	REVIEW	APP
01	31/05/2024	For Review	AS	XX	XX

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SMRUC-010	01

GEODETIC PARAMETERS: GCS_WGS_1984 / World Geodetic System (WGS84)

DRAWING TITLE

Figure 8-1: Predicted surface of estimated density for common dolphin in SCANS III (Lacey et al., 2022)

STATUS	SCALE	
Approved	1:1,500,000	
DRAWING NUMBER	SHEET NO	REV
N/A	01 of 01	N/A

9 Risso's Dolphins

9.1 Overview

9.1.1.1 Risso's dolphins are distributed sporadically in UK waters, with individuals commonly recorded around the Hebrides, and seasonally in the Celtic and Irish Seas. There are currently no SACs designated for Risso's dolphins in UK waters, and in 2018 they were updated from Data Deficient to Least Concern on the IUCN red list.

9.1.1.2 The conservation status of Risso's dolphins in UK waters concludes a favourable assessment of range, but an unknown conclusion for future prospects, population size and habitat. This resulted in an overall assessment of conservation status of "Unknown" and an overall trend in Conservation status of "Unknown" (JNCC, 2019h[60]).

9.2 Management Unit

9.2.1.1 A single MU is implemented for Risso's dolphins in UK waters, labelled the 'Celtic and Greater North Seas' MU. The current abundance estimate for this MU is 12,262 (95% CI: 5,227 – 28,764) of which 8,687 (95% CI: 2,810 – 26,852) (IAMMWG, 2023[1]). Prior to the estimate initially provided in IAMMWG (2021[61]), there was no abundance estimates for this species in the CGNS MU due to the low numbers of Risso's sightings (IAMMWG, 2015a[62]).

9.3 Digital Aerial Surveys

9.3.1.1 Full results for the DAS are presented in Volume 7, Appendix 19: Caledonia OWF Digital Aerial Surveys and are summarised below for Risso's dolphins.

9.3.1.2 Risso's dolphins were recorded in three of the 24 DAS, with a total of seven Risso's dolphins recorded. The un-corrected relative density estimate over the two year survey period was 0.002 Risso's dolphins/km^2.

9.3.1.3 Given that there is no correction factor for Risso's dolphins (so that estimates are relative not absolute), the spatial limitations of the data and the uncertainty in species identification means that this data source is not suitable to take forward to the quantitative impact assessment.

9.4 Presence in the Moray Firth

9.4.1.1 Thompson *et al.* (2015a[6]) present data from visual surveys (vessel and aerial surveys between 1980-2010) to estimate which species of dolphin was most likely present in grid cells across the Moray Firth. Risso's dolphin sightings were rare and were only located in the offshore waters (Figure 7-1).

9.4.1.2 There are no density estimates available for Risso's dolphins specifically in the Moray Firth.

9.5 SCANS Surveys

9.5.1 SCANS III

9.5.1.1 There were no sightings of Risso's dolphins in block S or block T (Hammond *et al.*, 2021[19]). Lacey *et al.* (2022[2]) did not provide a modelled density surface for Risso's dolphins.

9.5.2 SCANS IV

9.5.2.1 In SCANS IV block CS-K in which the Proposed Development (Offshore) is located, there was an estimated abundance of 1,519 (95% CI:9 – 5,099) Risso's dolphins, with a density estimate of 0.0376 Risso's dolphins/km^2 (CV: 0.972) (Gilles *et al.*, 2023[3]).

9.5.2.2 Larger scale impacts such as disturbance from pile driving may extend beyond block CS-K and into the adjacent block NS-E (where contours extend into the adjacent SCANS IV blocks, then the portion of the impact contour within respective block will be assigned to the block-specific density value). In neighbouring block NS-E, the estimated abundance of Risso's dolphins was 4,589 (95% CI: 31 – 16,458), with a density of 0.0702 Risso's dolphins/km^2 (CV: 0.974) (Gilles *et al.*, 2023[3]).

9.5.2.3 This dataset represents the most recent and reliable density estimates for Risso's dolphin. Therefore, it is taken forward to be used in the quantitative impact assessment.

9.6 Risso's Dolphin Summary

9.6.1.1 There is only a single density estimate that is suitable to take forward to the quantitative impact assessment:

- The SCANS IV block estimates will be used as this represents the most recent and most robust absolute density estimate.

10 Minke Whales

10.1 Overview

10.1.1.1 In Scottish waters, minke whales are sighted year-round with peak presence in summer months (Evans *et al.*, 2011[57], Hague *et al.*, 2020[15]). They were sighted in the southern Inner Hebrides and Outer Hebrides, Shetland and east coast of Scotland during the latest SCANS IV survey, with density estimates ranging from 0.008 – 0.042 in Scottish waters (Gilles *et al.*, 2023[3]).

10.1.1.2 The conservation status of minke whales in UK waters was updated in JNCC (2019j[63]) which concludes a favourable assessment of range, but an unknown conclusion for future prospects, population size and habitat. This resulted in an overall assessment of conservation status of "Unknown" and an overall trend in Conservation status of "Unknown". There are currently no designated European sites with minke whales as a notified interest feature. However, there is a MPA in Scottish waters, Southern Trench MPA (Figure 3-1), which the Caledonia OECC overlaps with.

10.2 Management Unit

10.2.1.1 All minke whales in UK waters are considered to be part of the CGNS MU. The abundance estimate for this MU is 20,118 animals (95% CI: 14,061 to 28,786), of which 10,288 (95% CI: 6,210 to 17,042) are estimated within the UK EEZ (IAMMWG, 2023[1]).

10.3 Digital Aerial Surveys

10.3.1.1 Full results for the DAS are presented in Volume 7, Appendix 19: Caledonia OWF Digital Aerial Surveys and are summarised below for minke whales.

10.3.1.2 Minke whales were recorded in four of the 24 DAS, with a total of 12 minke whales recorded. Within the Caledonia OWF plus 4km buffer the peak un-corrected abundance estimate of minke whales was 36 minke whales (95% CI: 8 –78) in July 2021 and the average un-corrected relative density estimate over the two year survey period was 0.003 minke whales/km^2 (Table 10–1).

Table 10–1: Minke whale peak abundance and average un-corrected relative density estimates from the DAS.

Location	Peak Un-corrected Abundance Estimate	2-year Average Un-corrected Relative Density Estimate (#/km^2)
Caledonia OWF + 4km buffer	36	0.003
Caledonia North Site + 4km buffer	12	0.0008
Caledonia South + 4km buffer	30	0.0005

10.4 Southern Trench MPA

10.4.1.1 The Southern Trench MPA was designated in December 2020 and one of the primary reasons for designation was minke whales. This site shows a continuous support of higher than average densities of minke whales compared to other UK sites (Figure 10-1), providing feeding grounds for juveniles and adults (NatureScot, 2020[64]). The MPA supports the high densities of minke whales in the majority of the designated area, with the densities decreasing towards the more southern part of the MPA, just east of Fraserburgh and Peterhead (Figure 10-1). The same trend is shown for predicted persistence of above mean densities during summer months. The density range within the Southern Trench MPA produced by Lacey *et al.* (2022[2]) using SCANS III data was 0.000-0.039 minke whales/km^2.

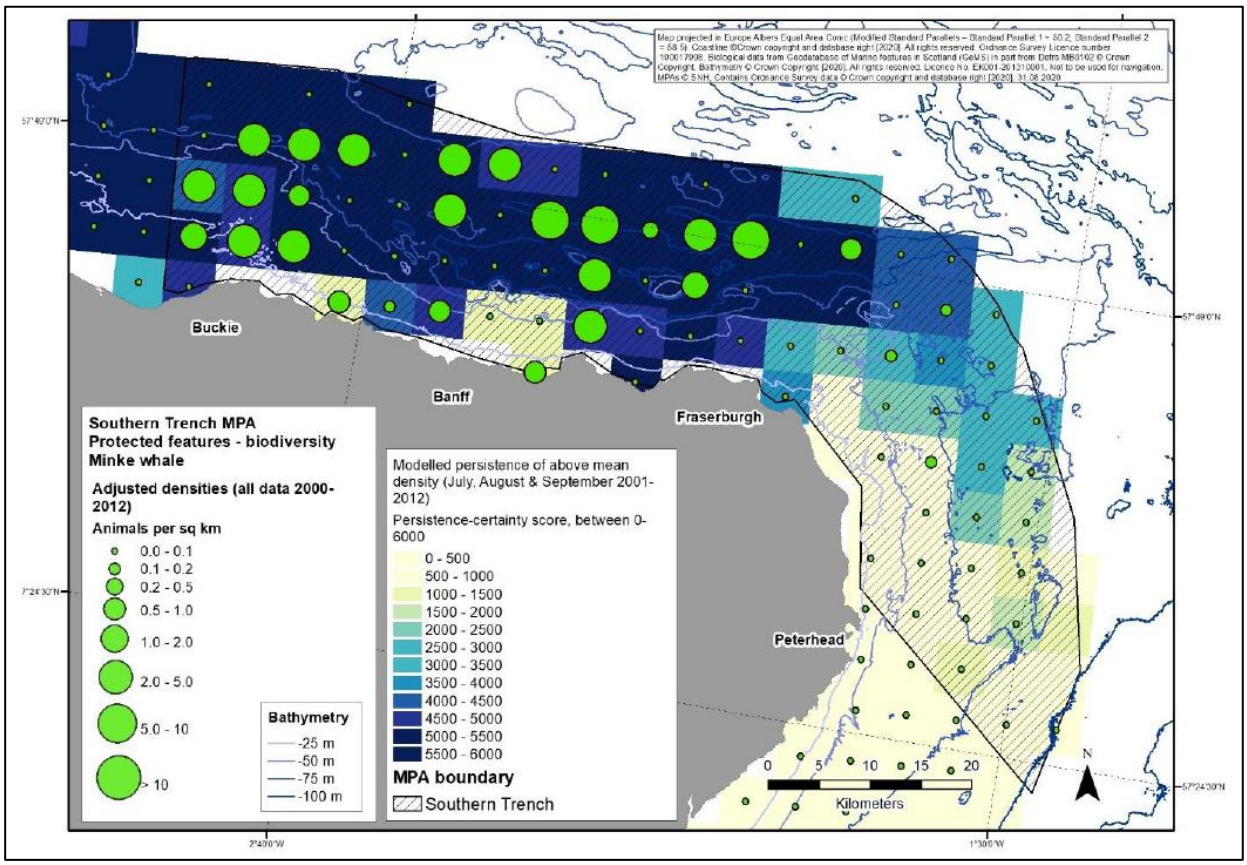


Figure 10-1 Minke whale densities and predicted persistence of above mean densities in Southern Trench MPA (NatureScot, 2020).

10.5 SCANS III

10.5.1.1 The Proposed Development (Offshore) is located within the SCANS III survey block S, where there was an estimated block-wide abundance of 383 minke whales (95% CI: 0 – 1,364) and an estimated density of 0.0095 (CV: 0.749) minke whales/km^2 in July 2016 (Hammond *et al.*, 2021[19]). The SCANS III block-wide density estimates have not been taken forward to be used in the quantitative impact assessment as the data have been superseded by the more recent SCANS IV surveys. Lacey *et al.* (2022[2]) used the SCANS III data and spatially referenced environmental features to predict density estimates for minke whales (Figure 10-2). The resulting predicted density map shows higher values in the eastern North Sea, around the north of Scotland and the northern Irish Sea. The density range for grid cells within the Proposed Development (Offshore) is presented in Table 10–2.

Table 10–2: Minke whale density estimates using the SCANS III density surface (Lacey *et al.*, 2022[2]).

Area Selected	Density Range (#/km^2)
Caledonia OWF	0.030 - 0.039
Caledonia North Site	0.030 - 0.039
Caledonia South Site	0.030 - 0.039
Caledonia OECC	0.030 - 0.037
Caledonia South OECC	0.030 - 0.037
Caledonia North OECC	0.030 – 0.039

10.6 SCANS IV

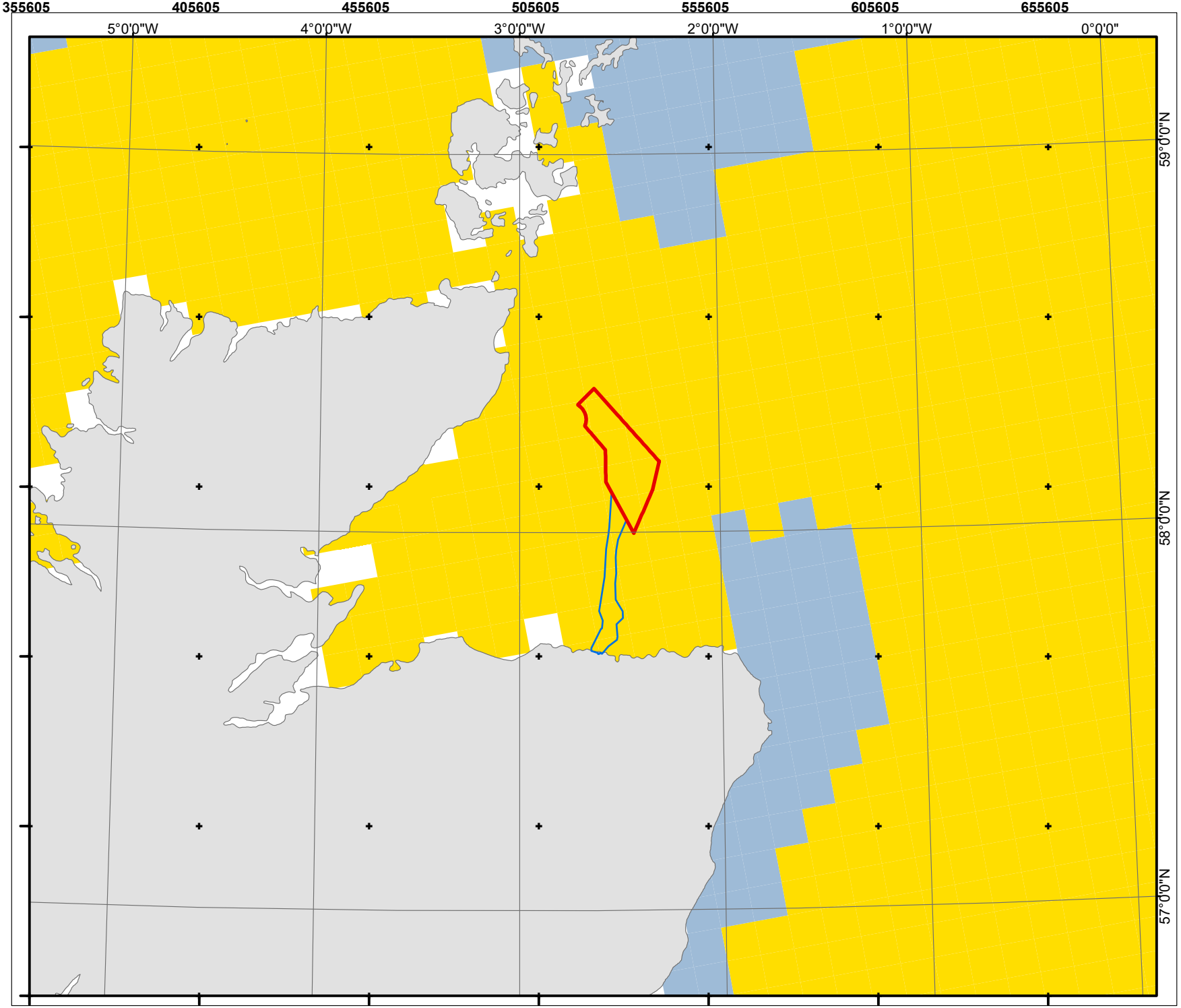
10.6.1.1 The Proposed Development (Offshore) is located within the SCANS IV survey block CS-K, where there was an estimated block-wide abundance of 467 minke whales (95% CI: 2 – 1,655) and an estimated density of 0.0116 minke whales/km^2 (CV = 0.794) (Gilles *et al.*, 2023[3]).

10.6.1.2 Larger scale impacts such as disturbance from pile driving may extend beyond block CS-K and into the adjacent block NS-E (where contours extend into the adjacent SCANS IV blocks, then the portion of the impact contour within respective block will be assigned to the block-specific density value). Abundance (795, 95% CI: 3 – 1,735) was higher in the neighbouring block NS-E and density (0.0100 minke whales/km^2, CV = 0.0.632) was slightly lower than in block CS-K.

10.7 Minke Whale Summary

10.7.1.1 It is recommended that two density estimates are taken forward to the quantitative assessment:

- The SCANS IV block estimates will be used as this represents the most recent and robust absolute density estimate.
- The SCANS III modelled density surface for minke whales (Lacey *et al.*, 2022[2]) (grid cell specific density estimates) will be used as this represents the most robust spatially explicit density surface.

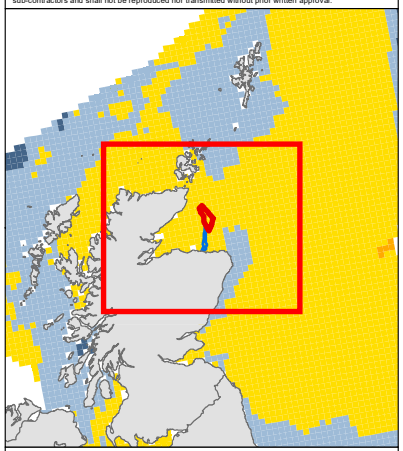


Legend

- Caledonia OWF
- OECC

Minke whale predicted density surface (#/km²)

- 0.01 - 0.02
- 0.02 - 0.05



0 5 10 15 20 km

REV	DATE	DOC STATUS	ORIGIN	REVIEW	APP
01	31/05/2024	For Review	AS	XX	XX

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SMRUC-011	01

GEODETIC PARAMETERS: GCS_WGS_1984 / World Geodetic System (WGS84)

DRAWING TITLE

Figure 10-2: Predicted surface of estimated density for minke whale in SCANS III (Lacey et al., 2022)

STATUS	SCALE	
Approved	1:1,500,000	
DRAWING NUMBER	SHEET NO	REV
N/A	01 of 01	N/A

11 Harbour Seal

11.1 Overview

11.1.1.1 Harbour seals are widely distributed around the UK, largely concentrated on the west coast of Scotland and throughout the Hebrides and Northern Isles. At a UK level, harbour seals have been assessed as having an Unfavourable – Inadequate Conservation Status, driven by an Unfavourable – Inadequate assessment of both population size and future prospects (JNCC, 2019f[65]).

11.1.1.2 The most recent estimate of the UK harbour seal population is 42,900 seals in 2021 (95% CI: 35,100 – 57,100) (SCOS, 2023[7]). This estimate is based on a composite August-haul out count of 30,900 seals in the UK (surveys between 2016 and 2021) and scaled by the proportion of the population hauled-out at the time of the count (0.72) (Lonergan *et al.*, 2013[45]). The most recent estimate of the Scottish harbour seal population is 36,600 seals in 2021 (95% CI: 30,000 – 48,800) (SCOS, 2023[7]), which means that 85% of the UK harbour seals are located in Scotland.

11.2 Seal Management Unit

11.2.1.1 The Proposed Development (Offshore) is located within the Moray Firth SMU for harbour seals. The Moray Firth SMU population is considered to be stable but at a depleted level. Population models for this SMU estimate that counts decreased at a rate of 5.6% (95% CIs: 2.5-8.5%) per year between 1994 and 2000, then decreased more rapidly between 2000 and 2003, with a 28% reduction in population. No significant population trends have been observed since then (Thompson *et al.*, 2019[66]). Current population levels are still at least 40% below the pre-2002 level, the year of the second phocine distemper virus (SCOS, 2023[7]).

11.2.1.2 Since data collection began during the 1996-1997 period, harbour seal counts have declined from 1,409 to 690 in the latest 2021 counts. This results in the latest population estimate for the entire Moray Firth SMU (scaled to account for those at-sea at the time of the count) of 958 harbour seals (Table 11–1) (SCOS, 2023[7]).

11.2.1.3 The adjacent SMUs (East Scotland and North Coast & Orkney) are both considered to be depleted and still declining (Figure 11-1) (SCOS, 2023[7]). In the East Scotland SMU, the Firth of Tay and Eden Estuary SAC contributes a large proportion of the population, meaning regional and SAC trends are very similar and so trends were fitted to counts within the SAC. The counts within the SAC were previously considered stable (1990 to 2002), but declined rapidly and monotonically over a 15 year period at a rate of approximately 18.6% per year (95% CIs: 17.1-20% per year),

resulting in an overall 95% decline (Thompson *et al.*, 2019[66], SCOS, 2023[7]).

11.2.1.4 In the North Coast and Orkney SMU a similar pattern has been observed, but at a slightly different rate. Counts were stable until 2001, and between 2001 and 2006 there was a population decline of 46%, and then continued to decline at a rate of 10.4% per year (95% CIs: 9.3-11.5%). Overall since data collection begin in the 1996-1997 period, harbour seal counts have declined by approximately 85% (Thompson *et al.*, 2019[66], SCOS, 2023[7]).

Table 11–1: Harbour seal August haul-out counts in the SMUs. Source: SCOS (2023[7]).

SMU		1996-1997	2000-2006	2007-2009	2011-2015	2016-2019	2021
Moray Firth	Count	1,409	1,028	776	745	1,077	690
	Population estimate	1,957	1,428	1,078	1,035	1,496	958
East Scotland	Count	764	667	283	224	343	262
	Population estimate	1,061	926	393	311	476	364
North Coast & Orkney	Count	8,787	4,388	2,979	1,938	1,405	-
	Population estimate	12,204	6,094	4,138	2,692	1,951	-

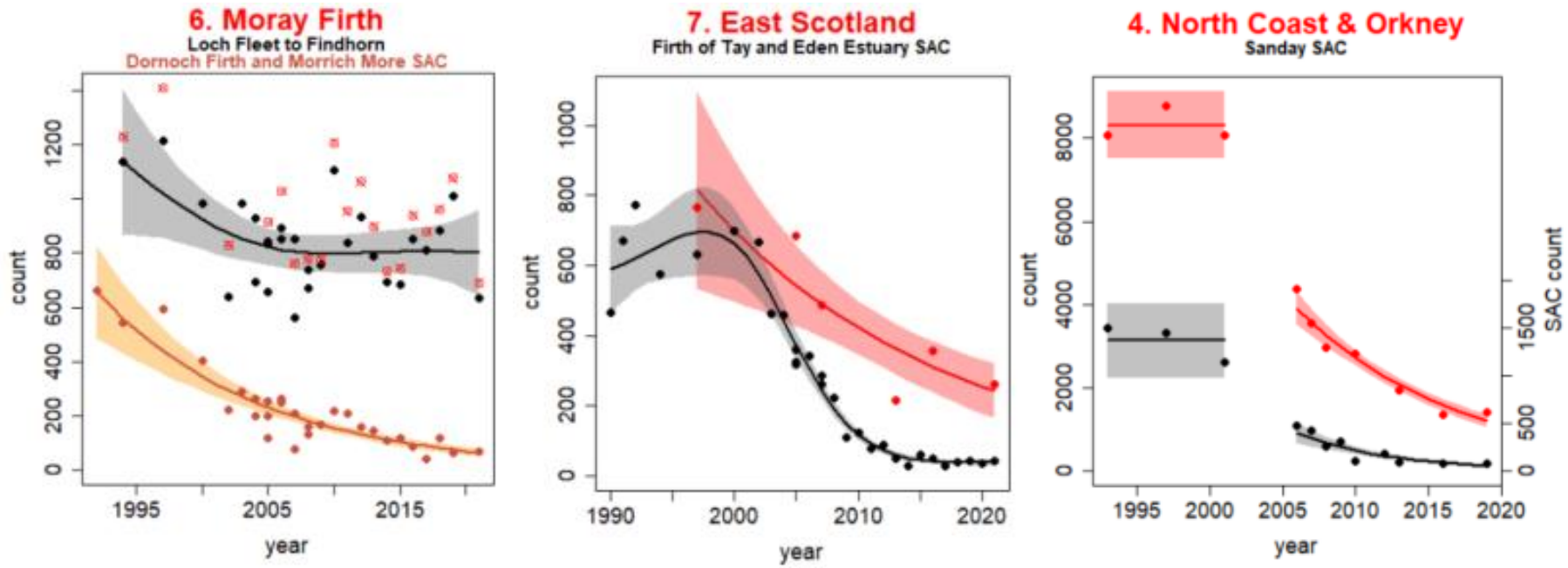


Figure 11-1: The predicted trend and associated 95% confidence intervals for harbour seal August counts in each SMU and encompassed SACs (SCOS, 2023[7]) (BP22/02).

11.3 Digital Aerial Surveys

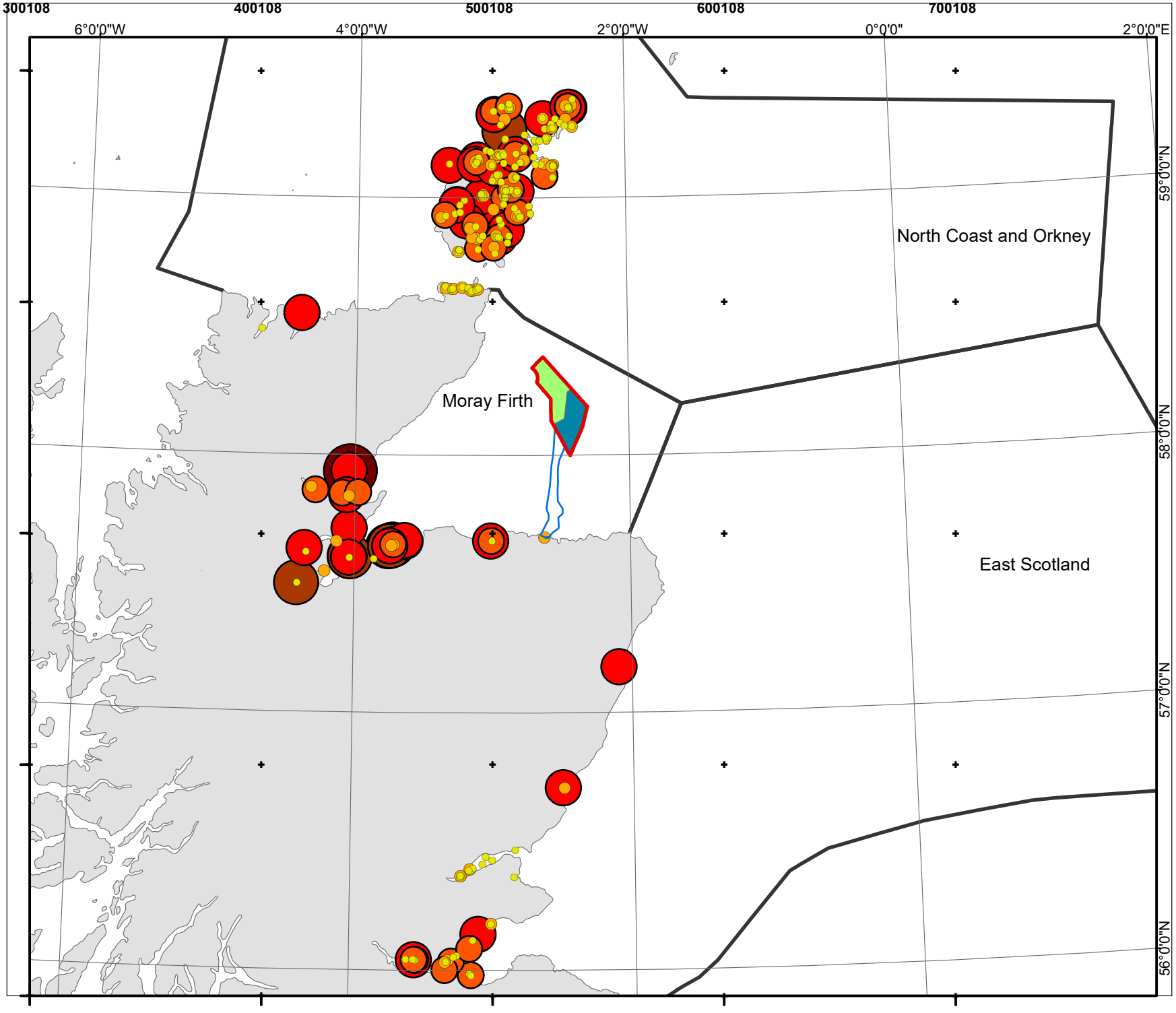
11.3.1.1 During the DAS, there were no sightings of harbour seals, though there were 13 sightings of unidentified seals over 10 months of the site-specific survey period (see Volume 7, Appendix 19: Caledonia OWF Digital Aerial Surveys)

11.4 August Haul-out Counts

11.4.1.1 Around the east coast of Scotland, the distribution of harbour seals is concentrated around the major estuaries, specifically the Moray Firth, the Firth of Forth and the Firth of Tay. The latest haul-out counts for the East Scotland SMU and the Moray Firth SMU are from 2021, the latest counts for Orkney are from 2019 and for the North Coast are from 2016 (Figure 11-2).

11.4.1.2 The closest haul-out to Caledonia North was recorded in the North Coast & Orkney SMU at the Ness of Huna where one seal was observed, approximately 40km away from the northernmost point of the array area. The closest haul-out in the Moray Firth SMU was at Wick where one harbour seal was counted, but this was in 2008.

11.4.1.3 The closest haul-out to Caledonia South in the Moray Firth SMU was at Boyne Bay (7 in 2021), which has also had seals recorded in previous years (11 in 2011, 12 in 2013). This haul-out is located within the OECC (and Landfall Site) boundary.

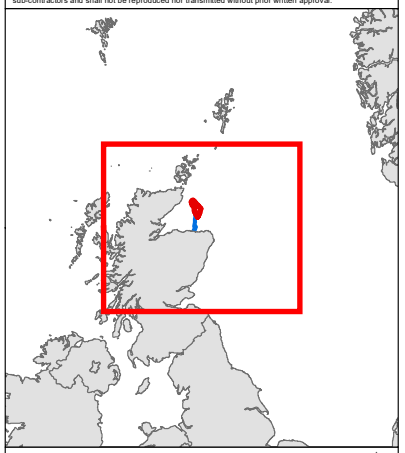


Legend

- Caledonia OWF
- OECC
- Caledonia North Site
- Caledonia South Site
- Seal Managament Units

count

- 1 - 5
- 6 - 10
- 11 - 15
- 16 - 50
- 51 - 100
- >100



0 20 40 60 80 km

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01	31/05/2024	For Review	AS	XX	XX

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SMRUC-012	01

GEODETIC PARAMETERS: GCS_WGS_1984 / World Geodetic System (WGS84)

DRAWING TITLE

Figure 11-2: Harbour seal August haul-out counts in the Moray Firth SMU (2021), East Scotland SMU (2021) and North Coast & Orkney SMU (2016)

STATUS	SCALE	
Approved	1:2,200,000	
DRAWING NUMBER	SHEET NO	REV
N/A	01 of 01	N/A

11.5 Telemetry

11.5.1.1 Harbour seal telemetry data have been used here to demonstrate the connectivity between seal MUs and the Proposed Development (Offshore).

11.5.1.2 A total of 41 harbour seals have been tagged by SMRU in the Moray Firth SMU between 2004 and 2018 (24 at Ardersier, 15 at Dornoch Firth and 2 at Loch Fleet) (Figure 11-3) as well as another 57 harbour seals tagged at Loch Fleet between 2014 and 2017 by the University of Aberdeen (as part of the Moray Firth Marine Mammal Monitoring Plan) (Figure 11-4).

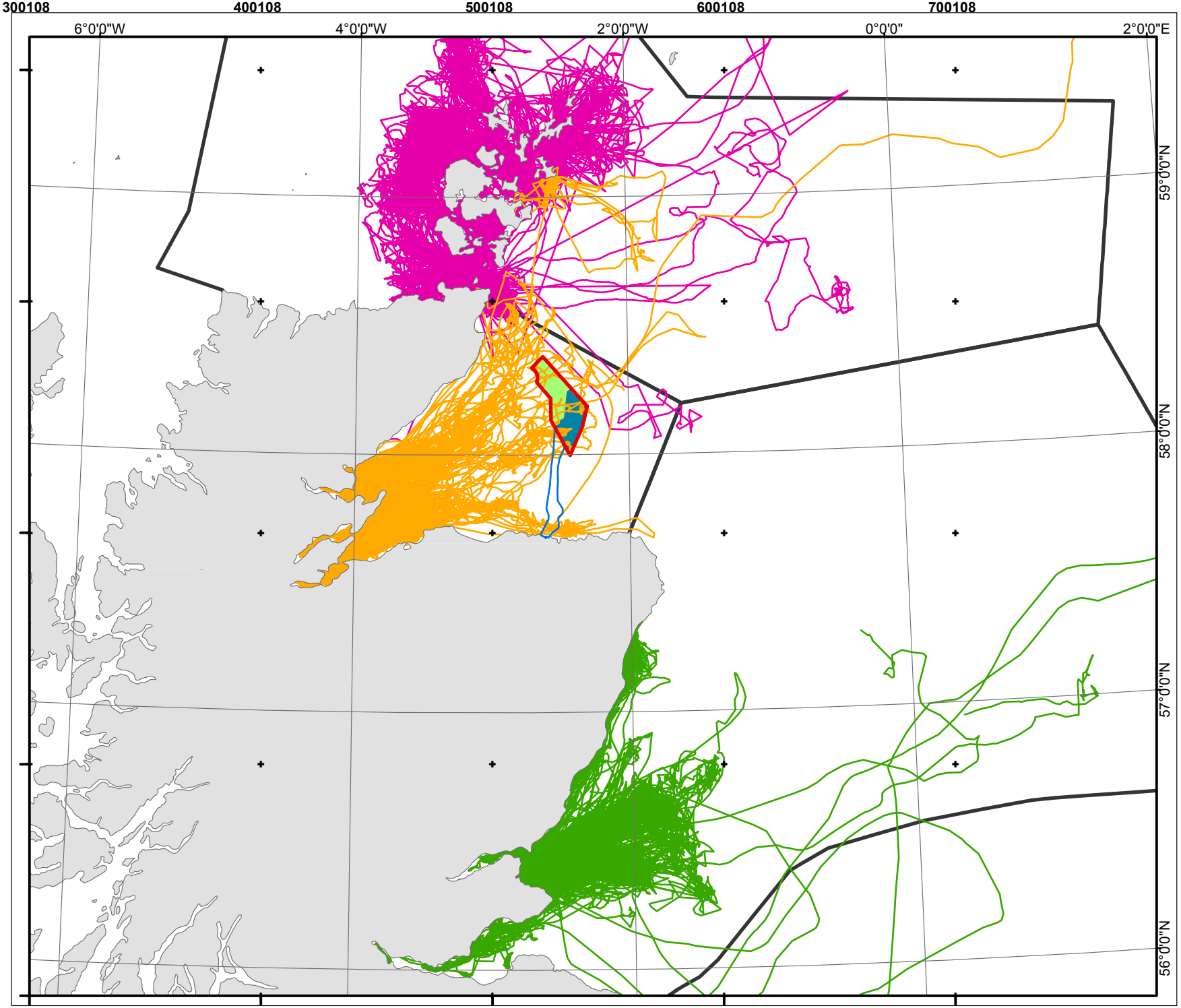
11.5.1.3 Additionally, a total of 50 harbour seals have been tagged by SMRU in the East Scotland SMU between 1993 and 2017 (4 at Abertay, 38 at Eden, 4 at Kirkaldy and 4 at the River Don) (Figure 11-3). A total of 105 have been tagged by SMRU in the North Coast & Orkney SMU between 2003 and 2018 at 11 different sites, primarily at Pentland Firth (47) (Figure 11-3).

11.5.1.4 The telemetry data from the seals tagged in the relevant SMUs show movement of harbour seals between the Moray Firth and North Coast & Orkney SMUs. There were 5 of the 41 seals tagged in the Moray Firth SMU which were tracked within the North Coast & Orkney SMU, and 15 of the 105 harbour seals tagged in the North Coast & Orkney SMU which were tracked within the Moray Firth SMU.

11.5.1.5 None of the harbour seals tagged in the East Scotland SMU recorded telemetry data within the Moray Firth or North Coast & Orkney SMUs. Only 2 of the 41 seals tagged in the Moray Firth SMU had telemetry data within the East Scotland MU, but only a very small portion of telemetry data for those two seals crossed the boundary and didn't go far into the East Scotland SMU. Only 1 of the 105 seals tagged in the North Coast & Orkney SMU had telemetry data within the East Scotland MU, and, similarly, only a very small portion of telemetry data crossed the boundary and didn't go far into the East Scotland SMU.

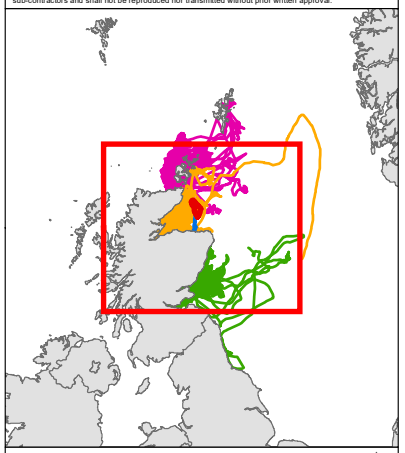
11.5.1.6 Based on these telemetry data there is limited evidence of harbour seal connectivity between the East Scotland and the Moray Firth and North Coast & Orkney SMUs. However, given the limited number of harbour seals and tagging locations within this telemetry dataset, it is not possible to conclude no connectivity for the wider populations between these SMUs.

11.5.1.7 There was one seal tagged in the Moray Firth SMU that showed connectivity with Caledonia North, one that showed connectivity with Caledonia South and three that showed connectivity with the Caledonia OWF (i.e., Caledonia North and South). This resulted in a total of five harbour seals tracked within the Caledonia OWF.



Legend

- Caledonia OWF
- OECC
- Caledonia North Site
- Caledonia South Site
- Seal Management Unit
- Tagged in the Moray Firth SMU (n=41)
- Tagged in the East Scotland SMU (n=50)
- Tagged in the North Coast & Orkney SMU (n=105)



0 20 40 60 80 km

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SMRUC-013	01

GEODETIC PARAMETERS: GCS_WGS_1984 / World Geodetic System (WGS84)

DRAWING TITLE: Figure 11-3: Telemetry data for harbour seals tagged in the Moray Firth SMU (n=41), East Scotland SMU (n=50) and North Coast & Orkney (n=105)

STATUS	SCALE	
Approved	1:2,200,000	
DRAWING NUMBER	SHEET NO	REV
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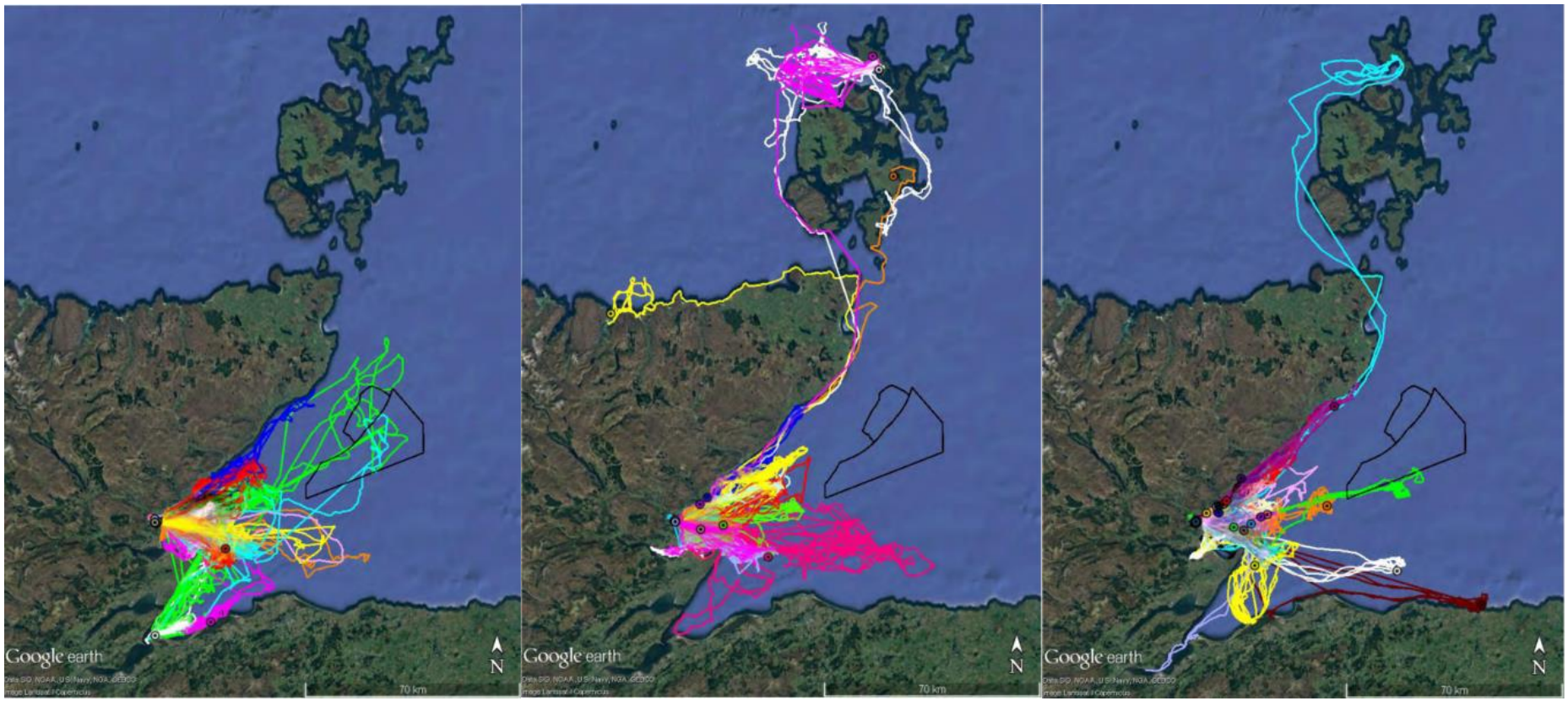


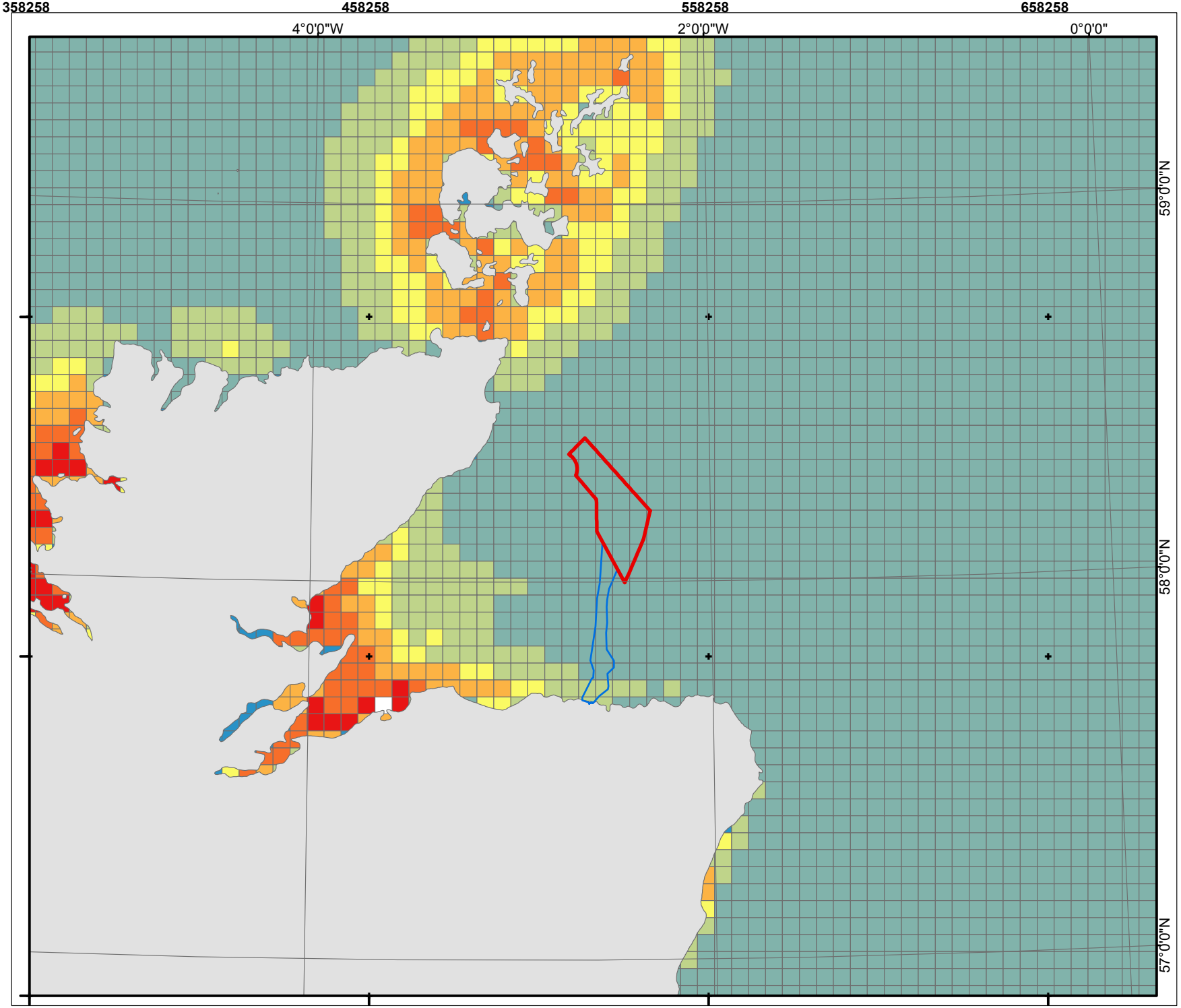
Figure 11-4: Telemetry data for harbour seals tagged at Loch Fleet by Aberdeen University as part of the Moray Firth Marine Mammal Monitoring Programme. Different colours represent different individual seals. Left 2014 (n=12), middle: 2015 (n=13), right: 2017 (n=32). Source: Graham *et al.* (2017[29]).

11.6 At-sea Distribution

11.6.1.1 The most up-to-date and comprehensive at-sea density and distribution data for seals hauling out in the UK and Ireland is the latest seal habitat preference map (Carter *et al.*, 2020[8]; 2022[9]). This habitat preference map clearly shows that in Scotland, harbour seals at-sea are distributed mainly off the west coast, around the Orkney Islands and in the Moray Firth (Figure 11-5). Within the Moray Firth SMU, harbour seal at-sea distribution is highly coastal, with highest at-sea usage in the inner Moray Firth and extending out of the Dornoch Firth. At-sea densities in the vicinity of the Caledonia OWF are very low in comparison to the high density estimates in the inner Moray Firth and around Orkney. There are slightly higher predicted densities towards the Landfall Site within the OECC, but these remain low compared to the inner Moray Firth. The density range for grid cells within the Proposed Development (Offshore) is presented in Table 11–2. The mean density across the Proposed Development (Offshore) was 0.005 harbour seals/km^2.

Table 11–2: Harbour seal density estimates extracted from the seal habitat preference map (Carter *et al.*, 2020[8]; 2022[9]).

Area Selected	Density Range (#/km^2)
Caledonia OWF	0.0003 – 0.0025
Caledonia North Site	0.0006 – 0.0018
Caledonia South Site	0.0003 – 0.0025
Caledonia OECC	0.0014 - 0.0584
Caledonia South OECC	0.0014 - 0.0584
Caledonia North OECC	0.0003 – 0.0584

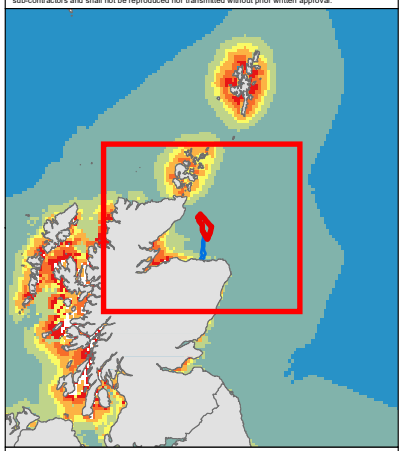


Legend

- Caledonia OWF
- OECC

% of the British Isles at-sea harbour seal population per cell

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



0 15 30 45 60 km

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SMRUC-014	01

GEODETIC PARAMETERS: GCS_WGS_1984 / World Geodetic System (WGS84)

DRAWING TITLE

Figure 11-5: Harbour seal at-sea habitat preference map.
Data from Carter et al. (2020), Carter et al. (2022).

STATUS	SCALE	
Approved	1:1,500,000	
DRAWING NUMBER	SHEET NO	REV
N/A	01 of 01	N/A

11.7 Harbour Seal Summary

11.7.1.1 The Proposed Development (Offshore) is located in the Moray Firth SMU which currently has a stable population but at a depleted level, still being at least 40% below the pre-2002 level (SCOS, 2023[7]).

11.7.1.2 For the quantitative impact assessment, the relevant population against which to assess impacts is the Moray Firth SMU population (958 harbour seals). Where impact contours extend into other SMUs then these will be considered separately (East Scotland (364) and North Coast and Orkney (1,951 harbour seals) SMUs). The density estimates used in the quantitative assessment will be grid-cell specific densities from the Carter *et al.* (2020[8]; 2022[9]) habitat preference maps.

12 Grey Seal

12.1 Overview

12.1.1.1 Grey seals are widely distributed around the UK, largely concentrated in the Outer Hebrides and Orkney, and the central and southern North Sea (SCOS, 2023[7]). At a UK level, grey seals have been assessed as having an Improving Conservation Status, driven by favourable assessments for population size, range and habitat and future prospects (JNCC, 2019e[67]).

12.1.1.2 The UK wide grey seal population is estimated using a population model that combines regional pup production estimates and August haul-out counts. 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) (SCOS, 2023[7]). Across the UK, pup production has increased since the 1960's, but the rate of increase across the whole UK has slowed to 1.4% per annum over the latest survey interval (2016-2019) (SCOS, 2023[7]). 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[7]).

12.2 Seal Management Unit

12.2.1.1 The Proposed Development (Offshore) is located within the Moray Firth SMU. However, telemetry data suggest connectivity between the Moray Firth SMU, the East Scotland SMU and the North Coast and Orkney SMU (see section 12.6 for further information). Therefore, data from all three SMUs are presented here.

12.2.1.2 The proportion of the grey seal population hauled out during the August survey window is 25.15% (95% CI: 21.45-29.07%) (SCOS, 2023[7]). Therefore, the August haul-out counts can be scaled to estimate the total SMU population size. The most recent population size for the East Scotland SMU is estimated to be 10,783 grey seals, for the Moray Firth SMU is estimated to be 7,380 grey seals and for the North Coast and Orkney SMU is estimated to be 34,191 grey seals (Table 12–1).

12.2.1.3 The three SMUs show differing trends. In the Moray Firth SMU, the August grey seal counts show an increasing trend (Figure 12-2) (SCOS, 2023[7]). Grey seal August counts in the East Scotland SMU are considered to be stable (Figure 12-2), though there are limited data to fit a robust trend for this SMU (SCOS, 2023[7]). The North Coast and Orkney SMU appears to have reached or be close to reaching its carrying capacity, as shown by both August counts (Figure 12-2) and pup production counts (SCOS, 2023[7]).

Table 12–1: Grey seal August haul-out counts in the SMUs. Source: SCOS (2023[7]).

SMU		1996-1997	2000-2006	2007-2009	2011-2015	2016-2019	2021
Moray Firth	Count	551	1,272	1,113	1,917	1,657	1,856
	Population estimate	2,191	5,058	4,425	7,622	6,588	7,380
East Scotland	Count	2,328	1,898	1,238	2,296	3,683	2,712
	Population estimate	9,256	7,547	4,922	9129	14,644	10,783
North Coast & Orkney	Count	9,427	10,315	8,525	8,106	8,599	-
	Population estimate	37,483	41,014	33,897	32,231	34,191	-

12.3 Digital Aerial Surveys

12.3.1.1 Full results for the DAS are presented in Volume 7, Appendix 19: Caledonia OWF Digital Aerial Surveys and are summarised below for grey seals.

12.3.1.2 Grey seals were sighted in 16 of the 24 DAS, with a total of 26 grey seals recorded. The average density over the two-year survey period was 0.01 grey seals/km^2. There were also 13 sightings of unidentified seals over 10 months of the site-specific survey period.

12.4 August Haul-out Counts

12.4.1.1 The latest haul-out counts for the East Scotland SMU and the Moray Firth SMU are from 2021, the latest counts for Orkney are from 2019 and for the North Coast are from 2016. The closest haul-outs in the Moray Firth SMU recorded to the Caledonia North Site were around Wick (11 seals counted). The closest haul-out in the Moray Firth SMU recorded to Caledonia South Site in the most recent haul-out data were at Boyne Bay (25 seals counted), which has also had seals recorded in previous years (6 seals counted in 2011 and 25 seals counted in 2013) as well as nearby Port Soy (8 seals counted in 2005). The Boyne Bay haul-out site is located within the OECC, and in the vicinity of the Landfall Site.

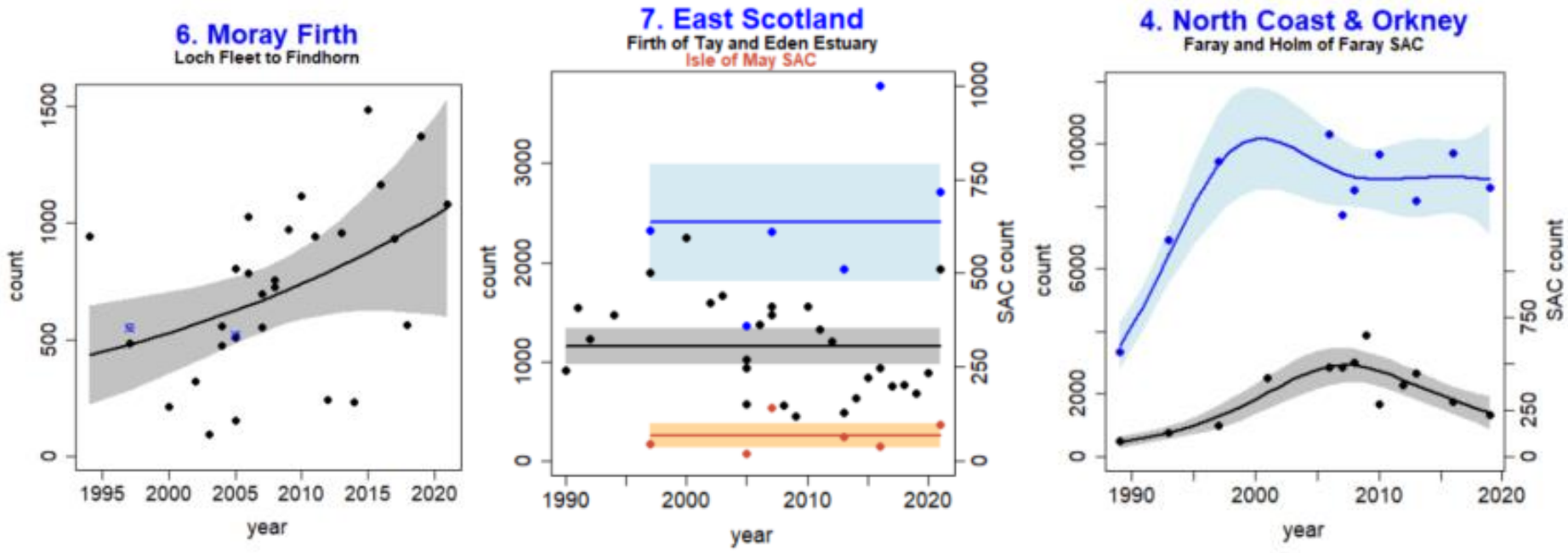
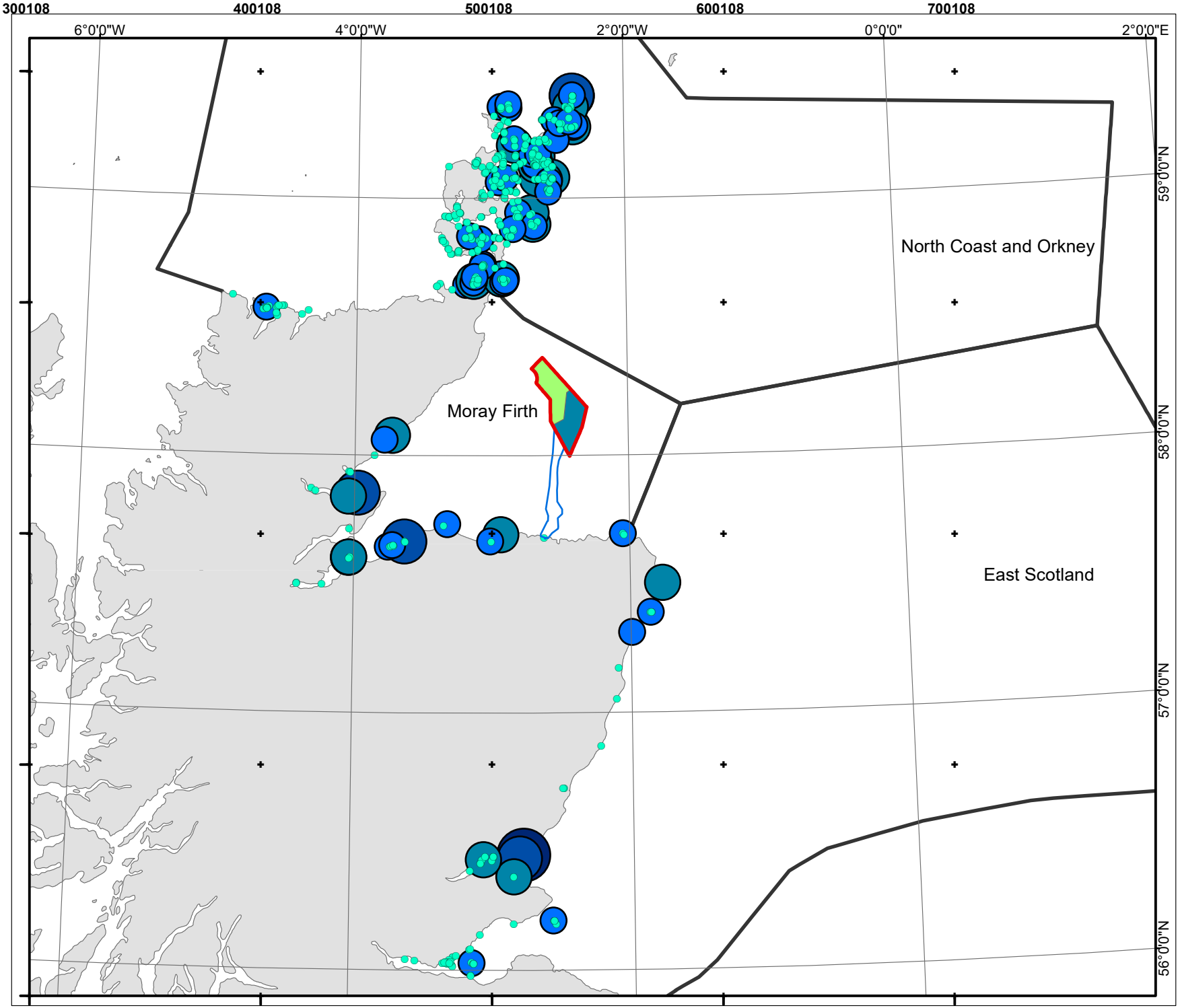


Figure 12-1: The predicted trend and associated 95% confidence intervals for grey seal August counts in each SMU and encompassed SACs (BP22/02). Source: SCOS (2023[7]).

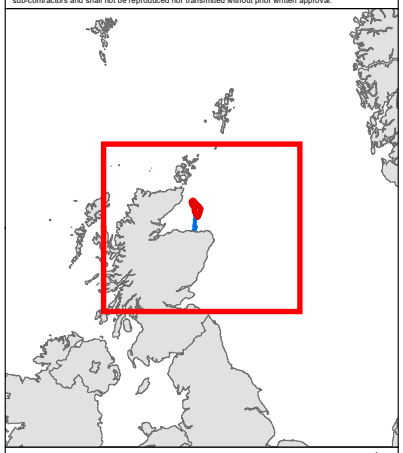


Legend

- Caledonia OWF
- OECC
- Caledonia North Site
- Caledonia South Site
- Seal Management Unit

Grey seal haul-out counts

- 1 - 50
- 51 - 100
- 101 - 200
- 201 - 500



0 20 40 60 80 km

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SMRUC-015	01

GEODETIC PARAMETERS: GCS_WGS_1984 / World Geodetic System (WGS84)

DRAWING TITLE

Figure 12-2: Grey seal August haul-out counts in the Moray Firth SMU (2021), East Scotland SMU (2021), Orkney (2019) and North Coast (2016).

STATUS	SCALE	
Approved	1:2,200,000	
DRAWING NUMBER	SHEET NO	REV
N/A	01 of 01	N/A

12.5 Pup Production Counts

12.5.1.1 Within the Moray Firth SMU, there are three grey seal breeding colonies: Helmsdale to Dunbeath, Dunbeath to Wick and Duncansby Head. Pup production in the Moray Firth in 2019 totalled 1,856 pups, with a current trend of a 3.12% increase per annum.

12.5.1.2 Within the neighbouring East Scotland SMU, there are five grey seal breeding colonies: Craigleith (west of Edinburgh), Fast Castle (Berwickshire) and the islands of Inchcolm, Inchkeith and May (all in the Firth of Forth). The latest total pup count across the East Scotland SMU was 7,268 pups in 2019.

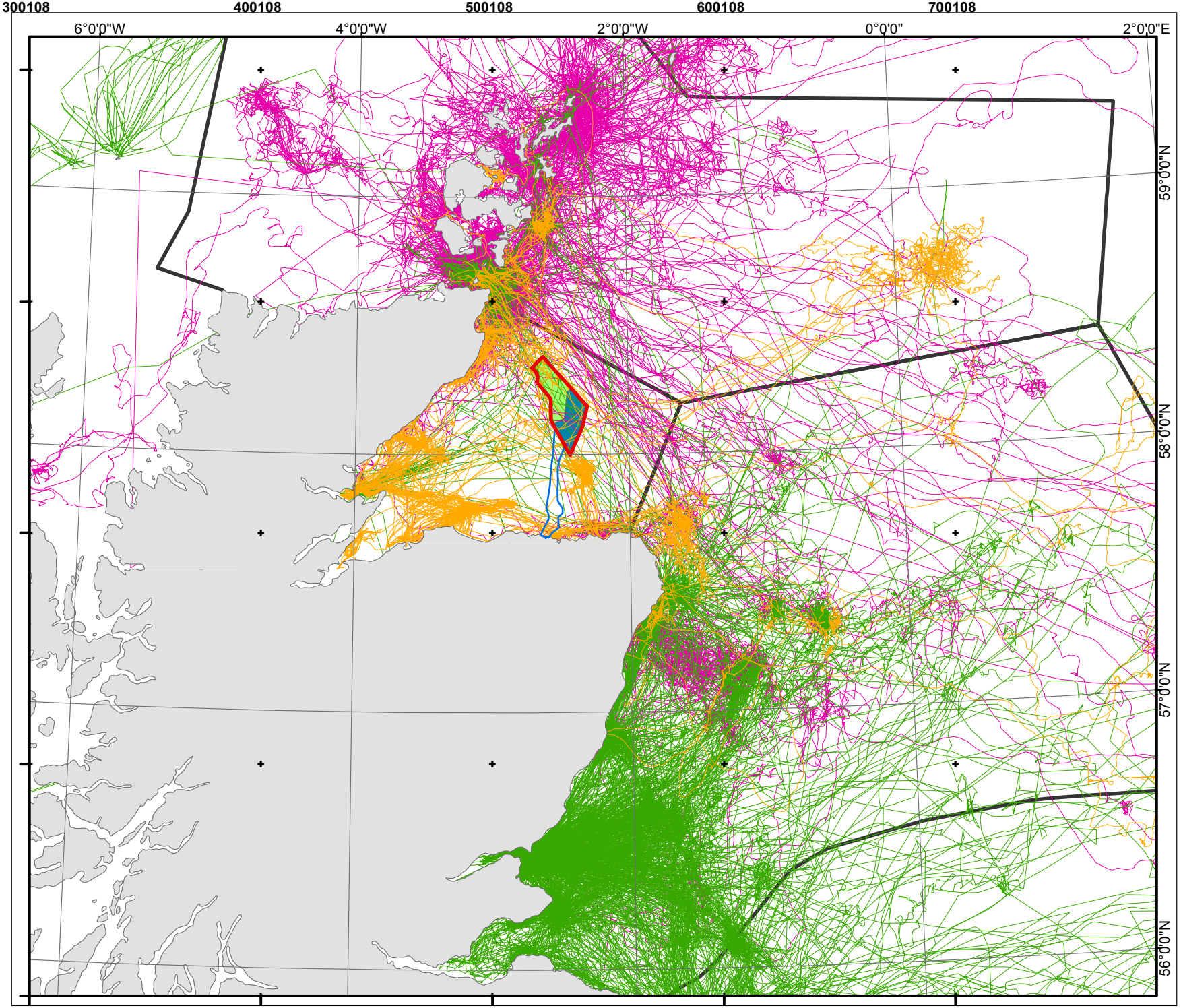
12.5.1.3 There are 28 grey seal breeding colonies in the North Coast and Orkney SMU. In total, pup counts across the SMU have increased from 7,439 in 1989 to 22,714 in 2019 with a current increasing trend of 0.65% per annum.

12.6 Telemetry

12.6.1.1 Grey seal telemetry data have been used here to demonstrate the connectivity between seal MUs and the Proposed Development (Offshore).

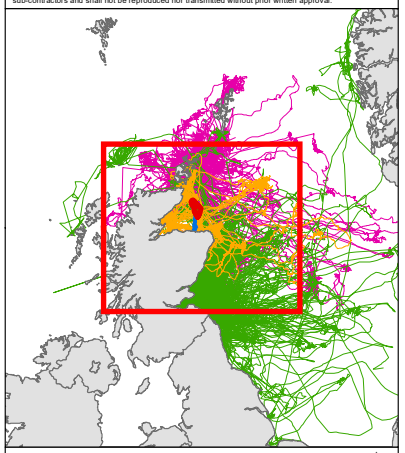
12.6.1.2 A total of 10 grey seals were tagged by SMRU in the Moray Firth SMU in 2018 (1 at Ardersier, 8 at Dornoch Firth and 1 at Findhorn) (Figure 12-3). All individuals tagged in the Moray Firth SMU were adults. Additionally, a total of 86 grey seals have been tagged in the East Scotland SMU between 1990 and 2016 (32 at Abertay, 40 at the Isle of May, 4 at St Andrews and 10 at Tentsmuir). Of these, 56 were adults (adults includes individuals classed as juveniles and of unknown age) (Figure 12-3) and 30 were pups (Figure 12-4). A total of 47 have been tagged by SMRU in the North Coast & Orkney SMU between 1993 and 2018 at 11 different sites, primarily at Stroma (n=14). This comprised 33 adults (Figure 12-3) and 14 pups (Figure 12-4).

12.6.1.3 The telemetry data from the seals show movement of grey seals between the Moray Firth, East Scotland and North Coast & Orkney SMUs. There were 5 of the 10 seals tagged in the Moray Firth SMU which were tracked within the East Scotland SMU, and 16 of the 86 grey seals tagged in the East Scotland SMU which were tracked within the Moray Firth SMU. There were 5 of the 10 seals tagged in the Moray Firth SMU which were tracked within the North Coast & Orkney SMU, and 27 of the 47 grey seals tagged in the North Coast & Orkney SMU which were tracked within the Moray Firth SMU. Based on these telemetry data there is evidence of grey seal connectivity between the East Scotland and the Moray Firth and North Coast & Orkney SMUs.



Legend

- Caledonia OWF
- OECC
- Caledonia North Site
- Caledonia South Site
- Seal Management Unit
- Tagged in the Moray Firth SMU (n=10)
- Tagged in the East Scotland SMU (n=56)
- Tagged in the North Coast & Orkney SMU (n=33)



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SMRUC-016	01

GEODETIC PARAMETERS: GCS_WGS_1984 / World Geodetic System (WGS84)

DRAWING TITLE: Figure 12-3: Telemetry data for adult grey seals tagged in the Moray Firth SMU (n=10), East Scotland SMU (n=56), North Coast & Orkney (n=33) by SMRU

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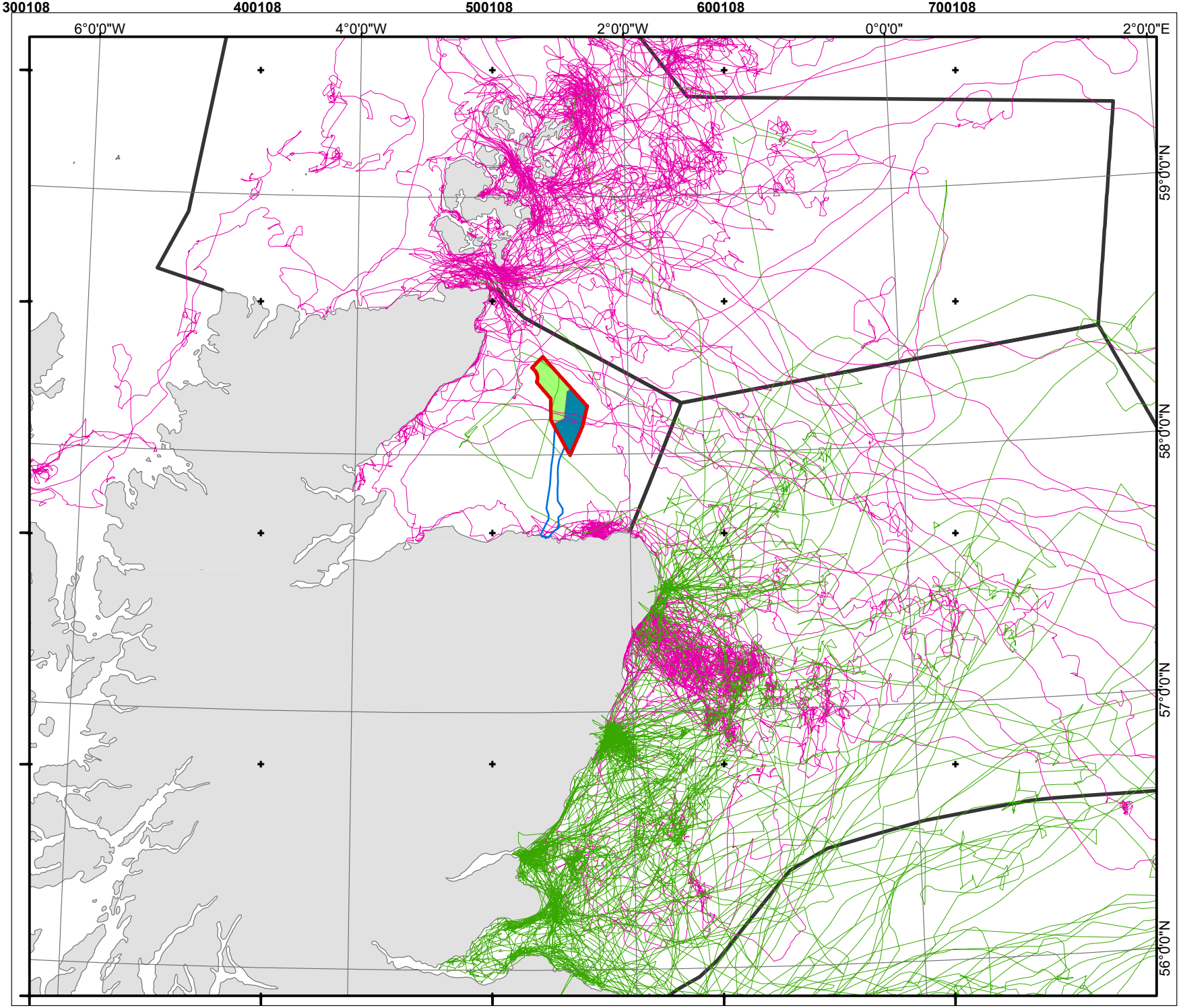
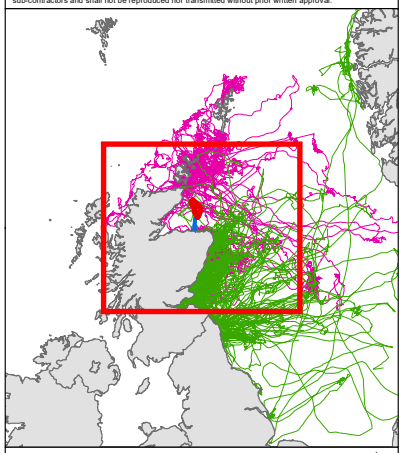


Legend

- Caledonia OWF
- OECC
- Caledonia North Site
- Caledonia South Site
- Seal Management Unit
- Tagged in the East Scotland SMU (n=30)
- Tagged in the North Coast & Orkney SMU (n=14)



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SMRUC-017	01

GEODETIC PARAMETERS
GCS_WGS_1984 / World Geodetic System (WGS84)

DRAWING TITLE
Figure 12-4: Telemetry data for grey seal pups tagged in the East Scotland SMU (n=30) and North Coast & Orkney (n=14) by SMRU

STATUS	SCALE	
Approved	1:2,200,000	
DRAWING NUMBER	SHEET NO	REV
N/A	01 of 01	N/A

12.7 At-sea Distribution

12.7.1.1 The most up-to-date and comprehensive at-sea density and distribution data for seals hauling out in the UK and Ireland is the latest seal habitat preference map (Carter *et al.*, 2020[8]; 2022[9]). This habitat preference map clearly shows that grey seals at-sea are distributed widely around all of Scotland, with high at-sea densities mainly around Orkney and the Firth of Forth, with smaller concentrations in parts of the Hebrides and the Moray Firth (Figure 12-5). Within the Moray Firth SMU, grey seal at-sea distribution is highest in the inner Moray Firth and along the southern Moray Firth coast. The density range for grid cells within the Proposed Development (Offshore) is presented in Table 12–2. The mean density across the Proposed Development (Offshore) was 0.364 grey seals/km^2.

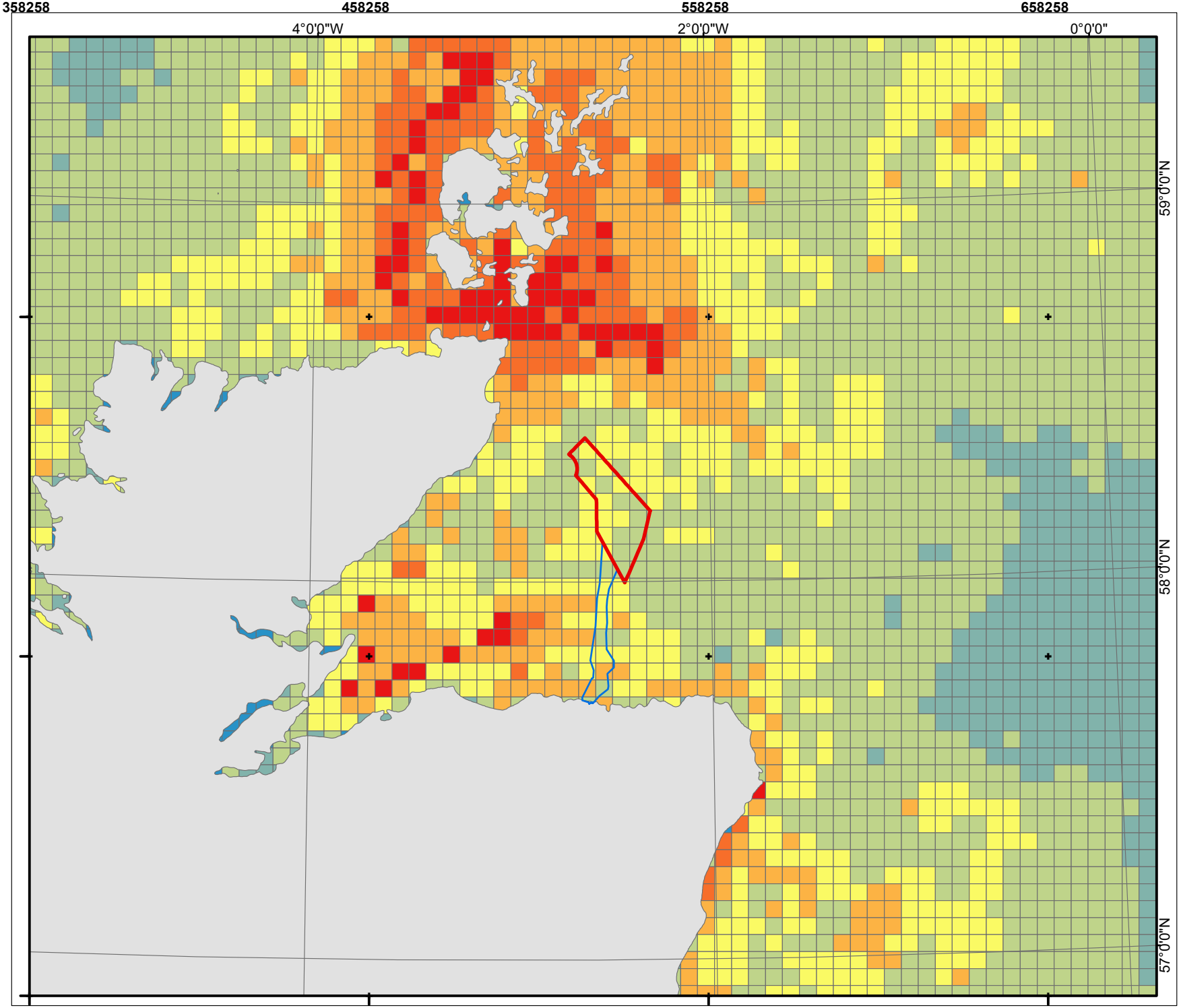
Table 12–2: Grey seal density estimates.

Area Selected	Density Range (#/km^2)
Caledonia OWF	0.141 - 0.577
Caledonia North Site	0.159 - 0.577
Caledonia South Site	0.141 - 0.465
Caledonia OECC	0.118 - 1.349
Caledonia South OECC	0.118 - 1.349
Caledonia North OECC	0.118 - 1.349

12.8 Grey Seal Summary

12.8.1.1 The Proposed Development (Offshore) is located in the Moray Firth SMU. However, given the wide-ranging behaviour of grey seals, it is considered appropriate to assess impacts to the Moray Firth, East Scotland, and North Coast and Orkney SMUs together as one reference population (each will be assessed individually in the impact assessment as well as collectively).

12.8.1.2 For the quantitative impact assessment, the relevant population against which to assess impacts is the Moray Firth (7,380 grey seals), East Scotland (10,783 grey seals), and North Coast and Orkney (34,191 grey seals) SMUs. The density estimates used in the quantitative assessment will be grid-cell specific densities from the Carter *et al.* (2020[8]; 2022[9]) habitat preference maps.

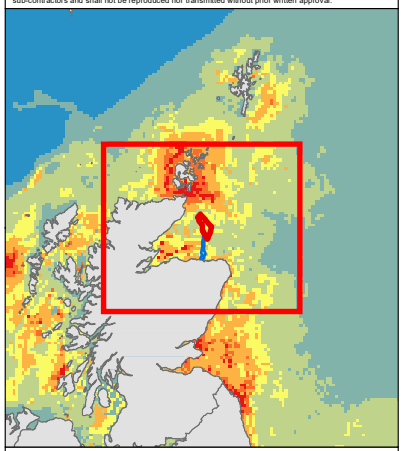


Legend

- Caledonia OWF
- OECC

% of the British Isles at-sea grey seal population per cell

- 0.00
- 0.00 - 0.001
- 0.001 - 0.005
- 0.005 - 0.010
- 0.010 - 0.025
- 0.025 - 0.050
- >0.05



0 15 30 45 60 km

REV	DATE	DOC STATUS	ORIGIN	REVIEW	APP
01	31/05/2024	For Review	AS	XX	XX

CALEDONIA Offshore Wind Farm

SMRU Consulting understand • assess • mitigate

CONTRACTOR DRAWING NO	CONTRACTOR REV
SMRUC-018	01

GEODETIC PARAMETERS: GCS_WGS_1984 / World Geodetic System (WGS84)

DRAWING TITLE

Figure 12-5: Grey seal at-sea habitat preference map. Data from Carter et al. (2020), Carter et al. (2022).

STATUS	SCALE	
Approved	1:1,500,000	
DRAWING NUMBER	SHEET NO	REV
N/A	01 of 01	N/A

13 Less Common Species

13.1 Overview

13.1.1.1 Less commonly recorded species in the vicinity of the Proposed Development (Offshore) include killer whales and humpback whales, which are discussed in the following sections.

13.2 Killer Whale

13.2.1.1 Killer whales are the largest delphinid species. Around the UK, they are most commonly observed around northern and western Scotland as well as the west and south of Ireland. They can be observed all year round, albeit in low densities (Hague *et al.*, 2020[15]). They are most frequently observed in near-shore areas between April and October and along the continental shelf north of Shetland in May and June (Reid *et al.*, 2003[68]).

13.2.1.2 The conservation status of killer whales in UK waters was not updated in JNCC (2019g[69]) due to lack of data. Future prospect parameters for range were considered 'Favourable', but population, habitat, and overall assessment of conservation status of the species were all classed as 'Unknown'. The overall trend in conservation status was not assessed.

13.2.1.3 No MU is defined for killer whales in IAMMWG (2023[1]). Within the northeast Atlantic, the most recent abundance estimate provided by the North Atlantic Marine Mammal Commission (NAMMCO) comes from the North Atlantic Sightings Survey which estimated there were 15,014 killer whales (95% CI: 6,637-33,964) (NAMMCO, 2021[70]). The minimum population size in the UK was estimated at 124 individuals in JNCC (2019g[69]).

13.2.1.4 For all but one of the data sources examined, no killer whales were recorded (Table 13–1).

13.2.1.5 The lack of a defined MU, infrequent sightings and lack of reliable density estimate means that this species is not considered to be present in high numbers in the vicinity of the Proposed Development (Offshore). Therefore, it is the recommendation of SMRU Consulting that this species is screened out of the quantitative impact assessment.

Table 13–1: Summary of data on killer whale sightings.

Data Source	Result
DAS	None sighted
Geophysical survey	1 sighted
SCANS III	No density estimate
SCANS IV	No density estimate
Moray Firth visual surveys	None sighted
Existing OWF	None sighted

13.3 Humpback Whale

13.3.1.1 Humpback whales are distributed globally, occurring in both hemispheres in waters ranging from tropical to polar (Reid *et al.*, 2003[68]). They are an annually migratory species that feeds in high-latitudes over winter and breeds in low-latitudes over summer. The conservation status of humpback whales in UK waters was not updated in JNCC (2019a[71]) due to a lack of data. Future prospect parameters for range, population and habitat of the species were all classed as 'Unknown', but no overall assessment of conservation status or trend was given for this species. Humpback whales rarely occur in UK waters and no MU is defined.

13.3.1.2 For all of the key data sources examined, no humpback whales were recorded (Table 13–2).

13.3.1.3 Despite this, in recent years, opportunistic humpback whale sightings off the east coast of Scotland have been increasing. In 2017 and 2018 humpback whales 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 whales on their southbound migration (O'Neil *et al.*, 2019[72]). Since then, public sightings of humpback whales in the Firth of Forth have become more numerous, and sightings (e.g., Edinburgh Evening News, 2023[73]) have occurred in the summers in 2021, 2022 and 2023 (Hague, 2023[74]). Occasional public sightings of humpback whales have also occurred in the Moray Firth over recent years.

13.3.1.5 Humpback whales are considered rare around the UK and were not sighted during the site-specific surveys; and density estimates have not been reported during the studies outlined in this section (Table 13–2). However, the number of humpback whales in the area has been increasing in recent years (O'Neil *et al.*, 2019[72]; Hague, 2023[74]) and their presence is known to occur within the Moray Firth, typically between May and September in deeper waters in excess of 200m (Reid *et al.*, 2003[68], Robinson *et al.*, 2007[75]). Therefore, humpback whale will be assessed within the impact assessment, but in a qualitative manner as there is not enough empirical data currently available to support the inclusion of a quantitative assessment of this species due to a lack of MU size or density estimate.

Table 13–2: Summary of data on humpback whale density.

Data Source	Result
DAS	None sighted
Geophysical survey	None sighted
SCANS III	None sighted
SCANS IV	None sighted
Moray Firth visual surveys	None sighted
Existing OWF	None sighted

14 Conclusion

14.1.1.1 The analysis of DAS alongside the literature review of other data sources confirmed the regular presence of eight marine mammal species in proximity to the Proposed Development (Offshore) (Table 1–1). These eight species will be taken forward to the quantitative impact assessment. Whilst not expected to be present in high densities, there was evidence that humpback whales could be present within the Proposed Development (Offshore) and, therefore, they will be assessed qualitatively within the impact assessment.

14.1.1.2 In addition to identifying the MU and density estimate(s) to take forward to quantitative impact assessment (Table 1–1), this baseline has also identified MMPAs that will be given further consideration:

- Moray Firth SAC (bottlenose dolphins)
- Southern Trench MPA (minke whale).

14.1.1.3 It is important to note that marine mammals present in the Moray Firth have already experienced impacts associated with the construction and operation of wind farms. The Beatrice Demonstrator Wind Farm (two WTGs) was constructed in 2007 and is due to be decommissioned between 2024 and 2029. The Beatrice OWF (84 WTGs) was installed between 2017 and 2018, the Moray East OWF (100 WTGs) was installed between 2019 and 2021 and the Moray West OWF is currently under construction. Therefore, the current baseline for marine mammals does not represent a pristine unimpacted population.

Table 14–1: Species, MU size and density estimates recommended for the use in the quantitative assessment of the Proposed Development (Offshore).

Species	MU	MU Size	UK MU Size	MU Ref	Density (#/km^2)	Density Reference
Harbour porpoise	North Sea	346,601	159,632	IAMMWG (2023[1])	Grid cell specific	Lacey *et al.* (2022[2])
					0.2813 (CS-K) 0.5156 (NS-E)	Gilles *et al.* (2023[3])
Bottlenose dolphin	Coastal East Scotland	245		Cheney *et al.* (2024[44])	Grid cell specific within the Moray Firth (max 0.0543)	Calculated (Quick *et al.*, 2014[5], Thompson *et al.*, 2015b[76], Cheney *et al.*, 2024[23])
					0.142 within 2km of the coast south of the Moray Firth	
	Greater North Sea	2,022	1,885	IAMMWG (2023[1])	0.003 - beyond Moray Firth and 2km buffer	Calculated (IAMMWG, 2023[1])
White-beaked dolphin	Celtic and Greater North Seas	43,951	34,025	IAMMWG (2023[1])	Grid cell specific	Lacey *et al.* (2022[2])
					0.1352 (CS-K) 0.1775 (NS-E)	Gilles *et al.* (2023[3])
Common dolphin	Celtic and Greater North Seas	102,656	57,417	IAMMWG (2023[1])	Grid cell specific	Lacey *et al.* (2022[2])
Risso's dolphin	Celtic and Greater North Seas	12,262	8,687	IAMMWG (2023[1])	0.0376 (CS-K) 0.0702 (NS-E)	Gilles *et al.* (2023[3])
Minke whale	Celtic and Greater North Seas	20,118	10,288	IAMMWG (2023[1])	Grid cell specific	Lacey *et al.* (2022[2])
					0.0116 (CS-K)	Gilles *et al.* (2023[3])

Species	MU	MU Size	UK MU Size	MU Ref	Density (#/km^2)	Density Reference
					0.0100 (NS-E)	
Harbour seal	Moray Firth	958		Scaled SCOS (2023[7]) counts	Grid cell specific	Carter *et al.* (2020[8]; 2022[9])
	East Scotland	364				
	North Coast & Orkney	1,951				
Grey seal	Moray Firth	7,380		Scaled SCOS (2023[7]) counts	Grid cell specific	Carter *et al.* (2020[8]; 2022[9])
	East Scotland	10,783				
	North Coast & Orkney	34,191				

15 Other Data Sources Examined

15.1 Overview

15.1.1.1 This section lists other data sources that were examined. These data sources were identified as not being suitable to take forward to detailed examination and are not suitable to inform the quantitative impact assessment in the EIAR.

15.2 Regional Baseline Data

15.2.1.1 The report from Hague *et al.* (2020[15]) provides up to date information regarding the abundance and distribution of marine mammals within Scottish waters (Northern North Sea and Atlantic) with a focus on the Regions and DPO sites within the Draft Sectoral Marine Plan for Offshore Wind Energy (Scottish Government, 2019[77]). The DPOs consisted of 17 sites located within five regions. Caledonia OWF is DPO site NE4 within Draft Assessment Region North East. A review of a variety of data sources containing marine mammal survey data in Scottish waters was conducted, regardless of the sampling methodology and survey type. The report also highlighted areas where knowledge of species abundance and distribution is lacking (Hague *et al.*, 2020[15]).

15.3 Geophysical Survey MMO Report

15.3.1.1 A geophysical reconnaissance survey was conducted of the Caledonia OWF plus a 2.5km buffer from 05 September to 21 November 2022. Further geophysical surveys were conducted between March and June 2023 covering the Caledonia OWF and Caledonia OECC. Species observed included: harbour porpoise, bottlenose dolphins, short-beaked common dolphin, Risso's dolphin, minke whale, killer whale, grey seal and harbour seal. No density estimates were provided so this data source is not considered further in this baseline characterisation report.

15.4 Production of Seabird and Marine Mammal Distribution Models for the East of Scotland

15.4.1.1 Paxton *et al.* (2022[78]) describes the results of aerial surveys undertaken in offshore east Scottish waters by APEM on behalf of Marine Scotland between February 2020 and March 2021. The aim of these surveys was to produce seabird and marine mammal distribution models to derive abundance estimates and density surfaces for the east of Scotland.

15.4.1.2 Aerial data was collected using two-centimetre ground sampling distance digital still images that were collected continuously along 10 transects with

a swathe of 960m, covering an area of 194km^2. Flights only occurred in sea states less than a Beaufort 4.

15.4.1.3 There were four cetacean species of particular interest considered within this study: harbour porpoise, white-beaked dolphin, common dolphin and minke whale. Other species including Risso's dolphins, killer whales and humpback whales were identified during the study, but were seen too few times for density distributions to be modelled.

15.4.1.4 Limited data availability has limited the robustness of the results presented. For example, for minke whales, there were only 35 datums out of 5,036 reduced data locations with minke whale presence. This meant that, instead of a number-based spatial model, a binomial presence-absence model was fitted instead which estimated the mean number observed per presence. Similarly, a binomial model was used for common dolphins which had fewer datums (n=18) of common dolphin presence due to the fact that they were only seen between March and July. In both instances, this was not considered an ideal modelling approach (Paxton *et al.*, 2022[78]).

15.4.1.5 Where density estimates were calculated, they were corrected for surface availability. However, it should be noted that uncertainty in surface availability was not incorporated into the analysis. Some of these availability biases have since been updated following more recent studies (Paxton *et al.*, 2022[78]).

15.4.1.6 The density estimates presented from this study are not considered within this baseline characterisation report due to the limitations of the data collected. For example, the sawtooth transects were focussed on offshore areas beyond 12 nm, and habitat within the 50m isobath was poorly sampled. Several species within this region have predominantly coastal distributions, and therefore, these species would not have been adequately sampled during these surveys. Furthermore, there are also gaps in the temporal data coverage, largely due to restrictions in place during the COVID-19 pandemic. Only eight surveys were conducted over 13 months, with no surveys during May, August and December and the east of Shetland not included in surveys between mid-April and the end of June, so the data only provide a snapshot of the occurrence of marine mammals, given that they are highly mobile species (Paxton *et al.*, 2022[78]).

15.4.1.7 Survey images were also low resolution due to the flight height of 2,000 ft which aimed to capture a wider survey area. This has the potential to impact species identification. Species identification can also differ by observer and varying levels of experience: during the first two surveys no identification occurred to species level with all images classified as porpoise/dolphin despite environmental conditions in which the images were taken being the same as in subsequent surveys (Paxton *et al.*, 2022[78]).

15.5 Joint Cetacean Protocol (JCP) Phase III Analysis

15.5.1 JCP Phase III

15.5.1.1 The JPC Phase III analysis included datasets from 38 sources (including SCANS I and SCANS II), totalling over 1.05 million km of survey effort between 1994 and 2010 from a variety of platforms (Paxton *et al.*, 2016[20]). The JCP Phase III analysis combined these data sources to estimate spatial and temporal patterns of abundance for seven species of cetaceans (harbour porpoise, minke whales, bottlenose dolphins, common dolphins, Risso's dolphins, white-beaked dolphins, and white-sided dolphins). The JCP Phase III analysis provided abundance estimates for specific areas of commercial interest for offshore developments. Density surface models were used to predict species density over a fine scale grid of 25km^2 resolution for one day in each season in each survey year. The data were divided into regions for seasonal estimates of abundance for winter (January-March), spring (April-June), summer (July-September) and autumn (October-December).

15.5.1.2 It is important to note that the authors state: "*Surveys specifically designed for large-scale abundance estimation, such as SCANS, should produce more reliable estimates of abundance over a wide area for a particular time than those given here, and should be used in preference where possible*". Therefore, in addition to the fact that the data in the Phase III analysis are considered to be out of date, the authors advise that SCANS data are more appropriate and reliable. For these reasons, this data source is not considered further in this baseline report.

15.5.2 JCP Data Analysis Tool

15.5.2.1 In 2017, JNCC released the JCP Phase III Data Analysis Product (JNCC, 2016[79]) that can be used to extract cetacean abundance estimates for summer 2007-2010 (average) for a user-specified area. This code was originally created by Charles Paxton at CREEM and was modified by JNCC to include abundance estimates that are scaled to the SCANS III results.

15.5.2.2 There are several limitations of this dataset. The data are between 10 and 26 years old and as such, do not provide a recent density estimate against which to assess impacts. The authors state that the JCP database provides relatively poor spatial and temporal coverage, that the results should be considered indicative rather than an accurate representation of species distribution, and that due to the patchy distribution of data, the estimates are less reliable than those obtained from SCANS surveys. In addition, the authors categorically state that the JCP Phase III outputs cannot be used to provide baseline data for impact monitoring of short-term change or to

infer abundance at a finer scale than 1,000km^2 because of issues relating to standardizing the data (such as corrections for undetected animals and potential biases) from so many different platforms/methodologies and the strong assumptions that had to be made when calculating detection probability. Finally, the density estimates obtained from the Data Analysis Tool is an averaged density estimate for the summer 2007-2010 and is, therefore, not representative of densities at other times of the year.

15.5.2.3 For these reasons, this data source is not considered further in this baseline report as other more recent and more reliable data sources are available.

15.5.3 Porpoise High Density Areas

15.5.3.1 Heinänen and Skov (2015[80]) conducted a detailed analysis of 18 years of survey data on harbour porpoise around the UK between 1994 and 2011 held in the JCP database. The goal of this analysis was to try to identify "*discrete and persistent areas of high density*" that might be considered important for harbour porpoise with the ultimate goal of determining SACs for the species. The analysis grouped data into three subsets: 1994-1999, 2000-2005 and 2006-2011 to account for patchy survey effort and analysed summer (April-September) and winter (October-March) data separately to explore whether distribution patterns were different between seasons and to examine the degree of persistence between the subsets.

15.5.3.2 The authors note that "*due to the uneven survey effort over the modelled period, the uncertainty in modelled distributions vary to a large extent*". In addition, the authors stated that "*model uncertainties are particularly high during winter*". The uncertainties in the modelled distributions were taken into account when designating draft SACs so that only areas with high confidence were retained (IAMMWG, 2015b[81]). However, as these uncertainties are particularly high, and more reliable and more recent data are available, this data source is not considered further in this baseline report.

15.5.4 Marine Ecosystem Research Project (MERP) Distribution Maps

15.5.4.1 The aim of the MERP project was to produce species distribution maps of cetaceans and seabirds at basin and monthly scales for conservation and marine management purposes. A total of 2.68 million km of survey data in the Northeast Atlantic between 1980 and 2018 were collated and standardized. Only aerial and vessel survey data were included where there were dedicated observers and where data on effort, survey area and transect design were available. The area covered by Waggitt *et al.* (2019[21]) comprised an area spanning Norway and Iberia on a north-south axis, and Rockall to the Skagerrak on an east-west axis.

15.5.4.2 Waggitt *et al.* (2019[21]) predicted monthly and 10km^2 densities for each species (animals/km^2), estimated the probability of encountering animals using a binomial model (presence-absence model), and estimated the density of animals if encountered using a Poisson model (count model). The product of these two components were used to present final density estimations (Barry and Welsh, 2002[82]). The outputs were monthly predicted density surfaces for 12 cetacean species at a 10km resolution. There is no indication if the more recent sightings data are weighted more heavily than older data, which limits interpretation of how predictive the maps are to current distribution patterns. Therefore, while the density estimates obtained from these maps are representative of relative density compared to other sites around the UK, they are not considered to be suitable density estimates for use in quantitative impact assessment. This is especially key when considering harbour porpoise since previous survey efforts (SCANS I, II and III) have shown a southwards movement of harbour porpoise in the Southern North Sea.

15.5.4.3 For these reasons, this data source is not considered further in this baseline report as other more recent and more reliable data sources are available.

15.5.5 Spatially Indexed Adjusted Densities

15.5.5.1 Marine Scotland, now referred to as Marine Directorate, established the Scottish MPA project in response to the 2010 Marine (Scotland) Act (Scottish Parliament, 2010[11]) to select MPAs and develop a network across Scotland. The focus was to identify areas that support significant aggregations and areas persistently used by four key megafauna species: Risso's dolphin, white-beaked dolphin, minke whale and basking shark (*Cetorhinus maximus*) (Paxton *et al.*, 2014[36]).

15.5.5.2 Paxton *et al.* (2014[36]) used a combination of survey data from 1994-2012 to create a spatially indexed set of adjusted densities. This dataset was then modelled to predict density surfaces to allow areas of persistent higher species density to be identified and support the advice on MPA designation. The values presented by Paxton *et al.* (2014[36]) represent absolute density estimates which are presented seasonally and averaged over all seasons.

15.5.5.3 The survey effort underlying these data is very uneven, with large areas of the region having limited to no effort. The survey effort was also restricted temporally, with effort being highly variable across seasons and years, and little spatio-temporal overlap between different surveys. The corrections used for availability bias were also determined based on limited data. For all species except harbour porpoise, the models produced were considered largely unrealistic as the models did not include an interaction term. It is, therefore, considered that more reliable spatio-temporal models are

available for the time period and region presented (Paxton *et al.*, 2014[36]) and so no further consideration is made of these data.

15.6 The East Coast Marine Mammal Acoustic Study (ECOMMAS)

15.6.1.1 ECOMMAS began in 2013 and consists of 30 PAM sites along the east coast of Scotland to collect data on the relative abundance of dolphins and porpoise. Each site consists of a CPOD (Chelonia Ltd, 2014[83]) capable of detecting dolphin and porpoise clicks and some sites also include a broadband recorder, capable of recording underwater noise and vocalisations of dolphin species. There are five ECOMMAS sites in the Moray Firth: Latheron, Helmsdale, Cromarty, Spey Bay and Fraserburgh.

15.6.1.2 The CPOD data can be analysed to determine the presence of porpoises and dolphins in proximity to the five sites. However, the data do not allow for calculation of density estimates and, therefore, is not considered further within this baseline characterisation report. It is also important to note that the software does not distinguish among delphinid species meaning this dataset is limited in utility for species level density estimates.

15.7 Cetacean Research and Rescue Unit (CRRU) Publications

15.7.1 Risso's Dolphins

15.7.1.1 The population size and distribution of Risso's dolphins in Scottish waters is not well understood. Sighting and photo-identification studies have been undertaken around northeast Scotland, Orkney and the Shetland Isles. Records show that sightings in these areas have increased in recent years, with a greater number occurring in the summer months, and photo-ID showing inter- and intra-annual site fidelity (Hodgins *et al.*, 2024[35]).

15.7.1.2 Data suggest that Risso's dolphins in this area travel long distances, with a photo-ID match made between two individuals at Caithness and in the Shetlands (Hodgins *et al.*, 2024[35]).

15.7.1.3 Whilst these data provide evidence of the presence of Risso's dolphins around northeast Scotland, no density estimates were derived from these data and, therefore, no further consideration is given within this baseline characterisation report.

15.7.2 Minke Whales

15.7.2.1 CRRU conducted a study to examine and compare the distribution and feeding behaviour of adult and juvenile minke whales. Dedicated boat

surveys were conducted in a 1,980km^2 area within the Moray Firth (overlapping with the Southern Trench NCMPA) between 2001 and 2022. During this time there were 784 encounters with 964 whales of confirmed age class (471 juveniles and 493 adults), resulting in 238 focal follows. Minke whales were predominantly observed to be feeding/foraging (Robinson *et al.*, 2023[34]). Foraging activity was particularly prevalent in July and August, coinciding with the presence of oceanic fronts (sea surface temperature standard deviation used as a proxy). Minke whales were also associated with area of high burrowed sandeel density in May and June (MacDougall and Robinson, 2024[84]). Data were also analysed to examine the spatial distribution of adult and juvenile minke whales within the survey area, with presence-absence modelling conducted for surveys undertaken from 2009 to 2022 (Robinson *et al.*, 2023[34]; MacDougall and Robinson, 2024[84]).

15.7.2.2 Whilst these surveys provide evidence of the presence of adult and juvenile minke whales within the Moray Firth, including within the Southern Trench NCMPA, and evidence that the area is important for foraging activity, no density estimates were derived from these data and, therefore, no further consideration is given within this baseline characterisation report.

15.7.3 Killer Whales

15.7.3.1 CRRU collated sightings of killer whales from serval sources for analysis. This included their sightings from dedicated surveys in the southern outer Moray Firth between May and October 2001 and 2015, incidental sightings from a public sightings scheme (including tour operators, fishermen etc.) and sightings provided by the Sea Watch Foundation (Robinson *et al.*, 2017[33]).

15.7.3.2 There were a total of 143 sightings confirmed within the Moray Firth or in proximity to the outer Moray Firth boundary, with the greatest concentration of sightings (approximately 75%) occurring between Helmsdale and Duncansby Head. Sightings occurred throughout the year but were highest between May and July.

15.7.3.3 Whilst these surveys provide evidence of the presence of killer whales year-round within the Moray Firth, no density estimates were derived from these data and, therefore, no further consideration is given within this baseline characterisation report.

16 References

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