# Muir Mhòr Offshore Wind Farm

## Environmental Impact Assessment Report

### Volume 3, Appendix 12.1: Marine Mammal Baseline Technical Report

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SMRU Consulting

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# MUIR MHÒR OFFSHORE WIND FARM MARINE MAMMAL BASELINE CHARACTERISATION



| | |
|---|---|
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| Report Code: | SMRUC-GOB-2023-017 |
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# 1 Executive summary

The Muir Mhòr site-specific surveys alongside the literature review of other data sources confirmed the presence of six marine mammal species regularly present within the area of the Proposed Development (Table 1-1). Whilst not expected to be present in high densities, there was evidence that killer whales and humpback whales could be present and, therefore, they will be assessed qualitatively within the impact assessment. The most robust and relevant density estimates have been outlined in Table 1-1 and have been selected to take forward to the quantitative impact assessment.

**Table 1-1: Species, MU size and density estimate recommended for use in the quantitative impact assessment for the Proposed Development.**

| Species | MU | MU size | UK MU Size | MU Ref | Density | Density Ref |
|---|---|---|---|---|---|---|
| Harbour porpoise | North Sea | 346,601 | 159,632 | IAMMWG (2023) | Grid cell specific | Lacey *et al.* (2022) |
| | | | | | 0.5985 NS-D[1])<br>0.5156 (NS-E) | Gilles *et al.* (2023) |
| Bottlenose dolphin | Coastal East Scotland | 224 | | IAMMWG (2023) | 0.120 within 2 km of the coast and 0.003 beyond | Calculated |
| | Greater North Sea | 2,022 | 1,885 | IAMMWG (2023) | | |
| White beaked dolphin | Celtic and Greater North Seas | 43,951 | 34,025 | IAMMWG (2023) | Grid cell specific | Lacey *et al.* (2022) |
| | | | | | 0.0799 (NS D)<br>0.1775 (NS E) | Gilles *et al.* (2023) |
| Risso's dolphin | Celtic and Greater North Seas | 12,262 | 8,687 | IAMMWG (2023) | 0.000 (NS-D)<br>0.0702 (NS-E) | Gilles *et al.* (2023) |
| Minke whale | Celtic and Greater North Seas | 20,118 | 10,288 | IAMMWG (2023) | Grid cell specific | Lacey *et al.* (2022) |
| | | | | | 0.0419 (NS-D)<br>0.0100 (NS-E) | Gilles *et al.* (2023) |
| Harbour seal | East Scotland | 364 | | Scaled SCOS (2023) counts | Grid cell specific | Carter *et al.* (2020), Carter *et al.* (2022) |
| Grey seal | East Scotland<br>Moray Firth<br>N Coast & Orkney | 10,783<br>7,380<br>34,191 | | | | |

# 2 Introduction

Muir Mhòr Offshore Wind Farm Limited (hereafter referred to as 'the Developer') is proposing to develop the Muir Mhòr Offshore Wind Farm (hereafter 'the Project'). The Project is made up of both offshore and onshore components. The subject of this offshore Environmental Impact Assessment

[1] SCANS IV survey blocks: the Proposed Development is in block NS-D and is adjacent to block NS-E (Gilles *et al.*, 2023).

Report (EIAR) is the offshore infrastructure of the Project seaward of Mean High-Water Springs (MHWS) which is hereafter referred to as 'the Proposed Development'.

The Array Area covers an area of approximately 200 km$^2$ and is located approximately 63 km east of Peterhead on the east coast of Scotland. The offshore infrastructure of the Proposed Development includes Wind Turbine Generators (WTGs) and associated floating foundations, the Offshore Electrical Platforms (OEP(s)) and associated foundations, the inter-array cables, interconnector cable, offshore export cables and landfall.

The purpose of this document is to provide a characterisation of the baseline environment to understand the range of species, the abundance and the density of marine mammals that could potentially be impacted by the Proposed Development). The baseline data have been compiled through a review of the most recent literature providing relevant density estimates for marine mammal species expected to be in the vicinity of the Proposed Development, and data obtained from site-specific surveys conducted between April 2021 and March 2023 and during SSE regional surveys conducted between April 2022 and August 2023. The abundance and density estimates identified in this baseline characterisation form the basis of the quantitative impact assessment presented in the EIAR.

# 3 Study Area

The marine mammal study area varies depending on the species, considering individual species ecology and behaviour. For all species, the study area covers the Proposed Development (Array Area and offshore Export Cable Corridor (ECC)) 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:

1. The local study area including the site-specific survey area and SSE regional survey area and
2. A wider study area using species Management Units (MUs) defined by the Inter Agency Marine Mammal Working Group (IAMMWG, 2023), and the seal Management Units (SMUs) defined by the Special Committee on Seals (SCOS, 2023).

The local scale study area is the survey area for the Muir Mhòr site-specific surveys (covering the Scotwind E2 Plan Option (PO) site plus 4 km buffer) and the survey area for the SSE regional surveys (covering the Scotwind E1 and E2 POs plus a 12 km buffer). Surveys to inform the site-specific survey area were carried out between April 2021 and March 2023, and to inform the regional surveys between April 2022 and August 2023, both by HiDef Aerial Surveying Limited (HiDef). The local scale study area provides an indication of the local densities of each species. The survey areas are presented in Figure 3-1.

The wider study area encompasses the species MU to provide a larger geographic context in terms of species presence and their estimated densities and abundance. This scale defines the appropriate reference populations for the assessment. The wider study area for each species is as follows (Figure 3-2):

- 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;
- Risso's dolphin (*Grampus griseus*): CGNS MU;

- Minke whale (*Balaenoptera acutorostrata*): CGNS MU;
- Harbour seal (*Phoca vitulina*): the East Scotland SMU; and
- Grey seal (*Halichoerus grypus*): the East Scotland, Moray Firth and North Coast & Orkney SMUs.

In addition to the seven marine mammal species listed above, recognition is also given to the less common species including Atlantic white-sided dolphin (*Lagenorhynchus acutus*), killer whale (*Orcinus orca*) and humpback whale (*Megaptera novaeangliae*) within this baseline characterisation.

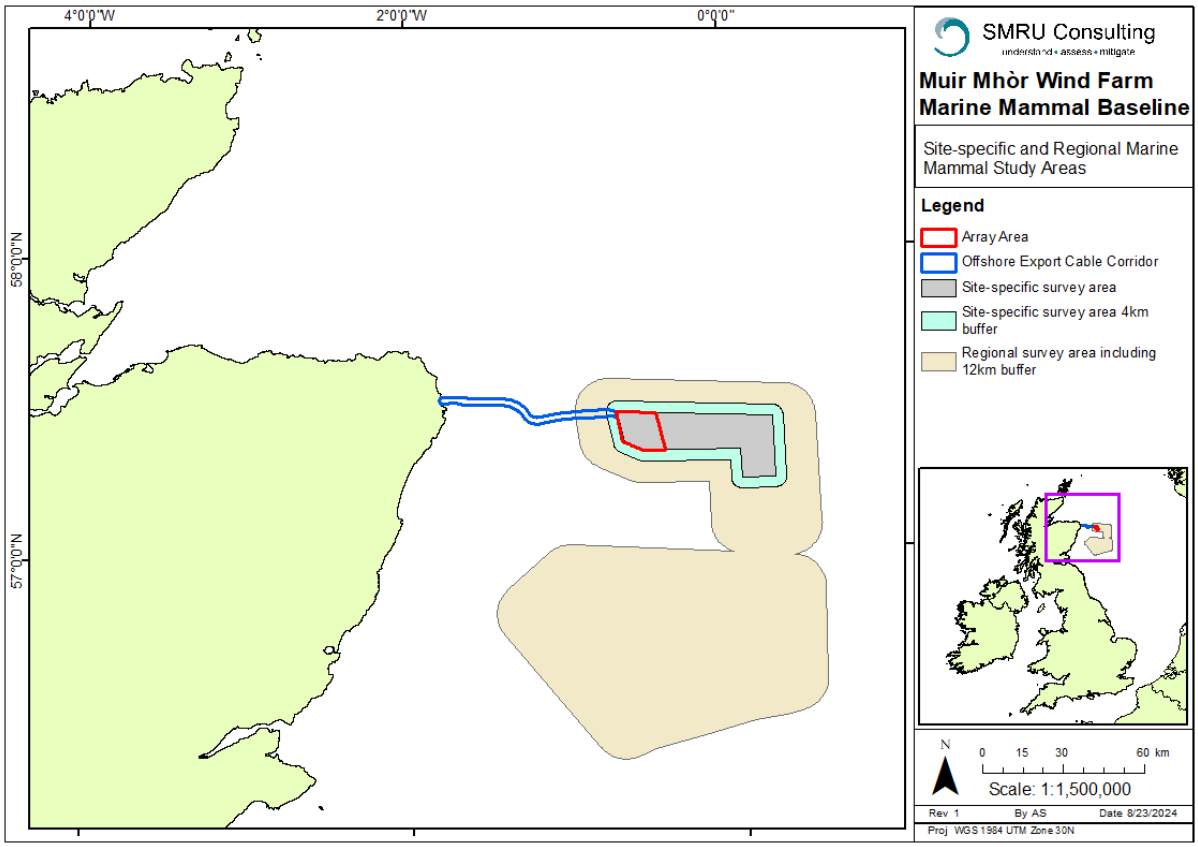


**Figure 3-1:** **Local scale marine mammal study area. This comprises the site-specific survey area (Scotwind E2 PO site plus 4 km buffer) and the regional study area (Scotwind E1 and E2 PO site plus 12 km buffer).**

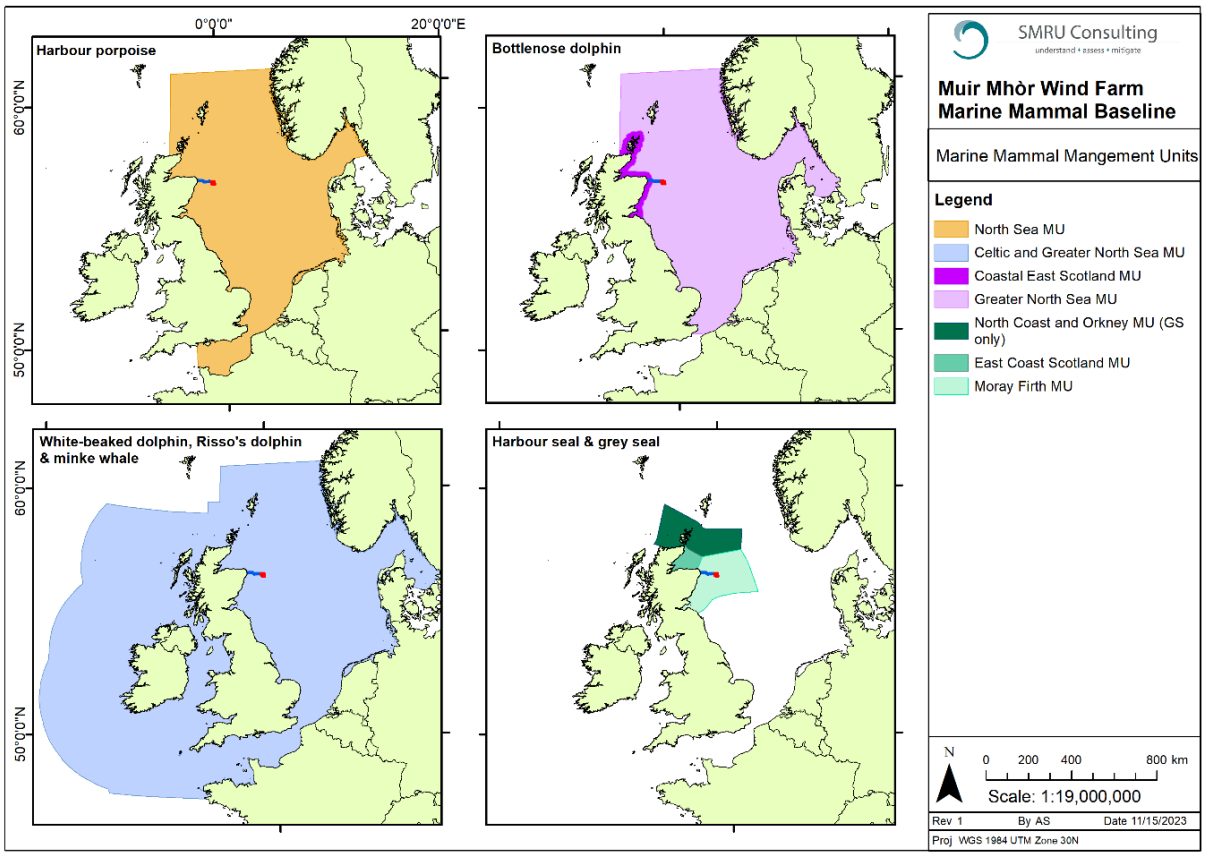


**Figure 3-2:** **The wider scale study area including the marine mammal MUs.**

# 4 Protected Areas

There are several protected areas for marine mammals within their respective MUs (Figure 4-1 and Table 4-1). The Array Area is not located within any protected areas, but the offshore ECC overlaps with the Southern Trench Nature Conservation Marine Protected Area (NCMPA) designated for minke whale.

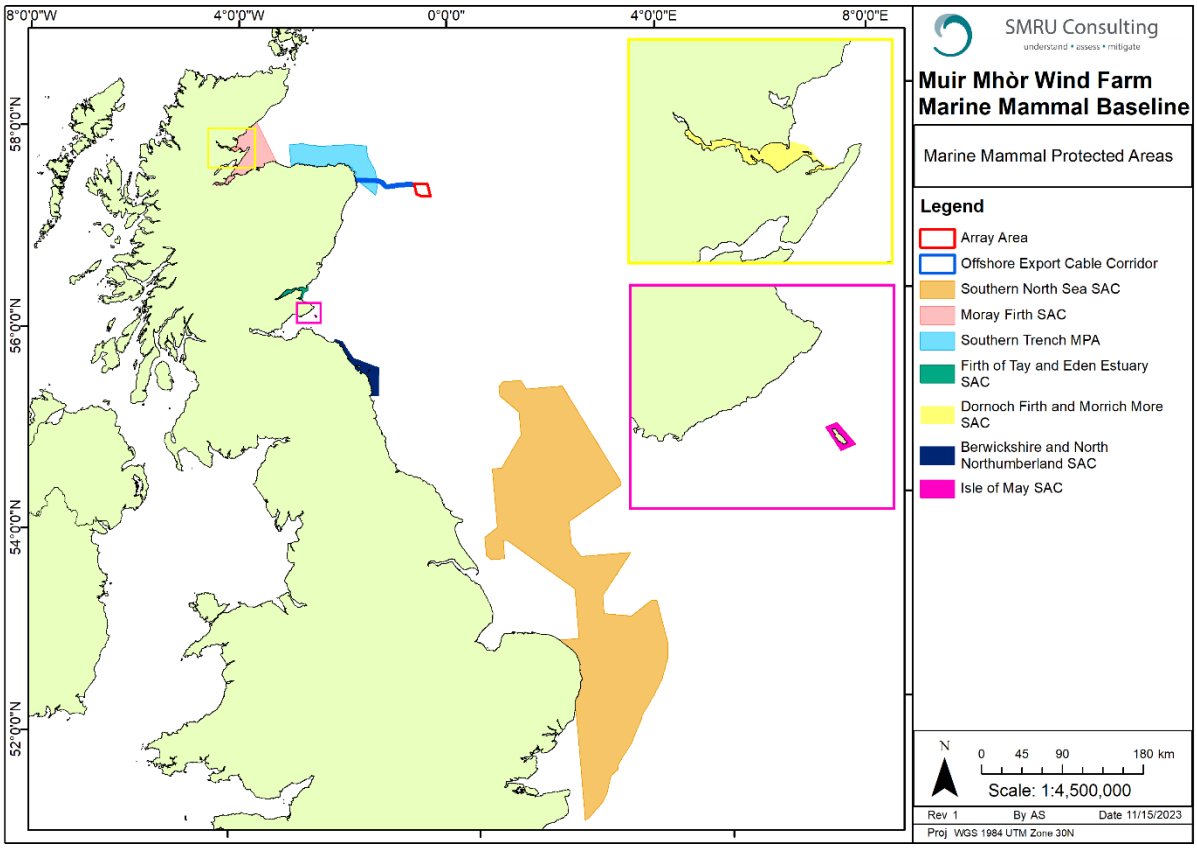


**Figure 4-1: Marine mammal protected areas within the MUs of the marine mammal species assessed.**

**Table 4-1: Designated protected areas for marine mammals located within their respective MUs.**

| Species | Designated site | Distance from proposed development | Site description |
|---|---|---|---|
| Harbour porpoise | Southern North Sea Special Area of Conservation (SAC) | Approximately 220.5 km south of the Array Area and 239 km from the offshore ECC. | The Southern North Sea SAC (UK0030395) was designated in 2019, listing harbour porpoise as a primary reason for the selection of the site. The SAC lies along the east coast of England, predominantly in the offshore waters of the central and southern North Sea, from north of Dogger Bank to the Straits of Dover in the south. It covers an area of 36,951 km$^2$. |
| Bottlenose dolphin | Moray Firth SAC | Approximately 157 km west of the Array Area and 102 km from the offshore ECC. | The Moray Firth SAC (UK0019808) was designated in 2005, listing bottlenose dolphins as a primary reason for selection of the site. This site supports the only known resident population of bottlenose dolphins in the North Sea. |
| Minke whale | Southern Trench NCMPA | Approximately 40 km west of the Array Area (by sea). The offshore ECC will overlap with the site. | The Southern Trench NCMPA (555703756) was designated in 2020, listing minke whales as one of the primary justifications for the selection of the site. This area persistently supports higher than average densities of minke whales compared to the rest of Scotland (NatureScot 2020). |
| Harbour seal | Firth of Tay and Eden Estuary SAC | Approximately 157.5 km southwest of the Array Area and 139 km from the offshore ECC. | The Firth of Tay and Eden Estuary SAC (UK0030311) was designated in 2005, listing harbour seals as a primary reason for the selection of the site. At the time of designation, the site supported a nationally important breeding colony of harbour seals, where around 600 adult seals hauled-out to rest, pup and moult. The SAC's August haul-out counts have declined by 94% since 1998, and the latest count was 41 animals in August 2021 (SCOS, 2023). |
| | Dornoch Firth and Morrich More SAC | Approximately 200 km west-northwest of Array Area and 147.5 km from the offshore ECC. | The Dornoch Firth and Morrich More SAC (UK0019806) was initially designated for harbour seals as numbers represented almost 2% of the UK population – counts are now in decline but could be attributed to redistribution of individuals within the SMU. |
| Grey seal | Berwickshire and North Northumberland Coast SAC | Approximately 182.5 km south-southwest of the Array Area and 177 km from the offshore ECC. | The Berwickshire and North Northumberland Coast SAC (UK0017072) was designated as an SAC in 2005, due to its importance to the grey seal breeding colonies in this area. The Berwickshire and North Northumberland SAC population is one of the largest breeding colonies on the North Sea coast. |
| | Isle of May SAC | Approximately 175 km | The Isle of May SAC (UK0030172) was designated |

| Species | Designated site | Distance from proposed development | Site description |
|---|---|---|---|
| | | southwest of the Array Area and 161 km from the offshore ECC. | in 2005, listing grey seals as a primary reason for the selection of the site. The site supports a large breeding colony of grey seals. The site used to be the main breeding colony in the East Scotland SMU and is currently described as potentially declining. By contrast, the breeding colony at Fast Castle in the Berwickshire & North Northumberland Coast SAC is showing a rapid increase pup production. The latest pup production estimate at the Isle of May SAC in 2019 was 1,885, resulting in a current trend estimate of a 1.94% decline per annum, and an overall decline of 20% since 2004 (SCOS, 2023). |

# 5 Data Sources

## 5.1 Overview

The following sections provide detail on the key data sources used to characterise the local study area (Table 5-1) and the regional study area (Table 5-2) or marine mammals in relation to the Proposed Development. These sections detail 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.

**Table 5-1: Marine mammal baseline datasets – local study area.**

| Data source | Description | Spatial coverage |
|---|---|---|
| Muir Mhòr site-specific aerial surveys (HiDef Aerial Surveying Limited, 2023b) | Site-specific baseline characterisation Digital Aerial Surveys (DAS) conducted by HiDef between April 2021 and March 2023. | Scotwind E2 PO site plus 4 km buffer. |
| SSE regional DAS surveys | Regional baseline characterisation DAS conducted by HiDef between April 2022 and August 2023 (HiDef Aerial Surveying Limited, 2023c). | Scotwind E1 and E2 PO sites plus 12 km buffer. |
| Preliminary Geophysical and Environmental Survey 2023 report (EGS (International) Limited, 2023) | Preliminary marine mammal survey results from Marine Mammal Observer (MMO) observations and Passive Acoustic Monitoring (PAM) detections during a geophysical site survey from March 2023 to July 2023. | The Array Area and offshore ECC. |

**Table 5-2: Marine mammal baseline datasets – wider study area.**

| Data source | Description | Spatial coverage |
|---|---|---|
| Atlas of cetacean distribution in north-west European waters (Reid *et al.*, 2003) | Data of cetacean distribution and abundance. Combination of three major data sources (European Seabirds at Sea, Sea Watch and SCANS I) between 1979 – 1997. | North-west European waters. |
| Regional baselines for marine mammal knowledge across the North Sea and Atlantic areas of Scottish waters (Hague *et al.*, 2020) | Collation of information on the distribution and abundance of marine mammal species in the Scottish Northern North Sea region and Scottish Atlantic waters. | All Scottish waters. |
| SCANS III (Hammond *et al.*, 2021) | Combination of vessel and aerial surveys of the North Sea and European Atlantic continental shelf waters conducted in July 2016. | North Sea and European Atlantic continental shelf waters.<br>The Proposed Development is located within SCANS III block R. |
| SCANS III density surfaces (Lacey *et al.*, 2022) | Modelled density surfaces of cetaceans in European Atlantic waters in summer 2016 using the SCANS III data. | North Sea and European Atlantic continental shelf waters.<br>The Proposed Development is located within SCANS III block R. |
| SCANS IV (Gilles *et al.*, | Combination of vessel and aerial surveys of | North Sea and European Atlantic |

| Data source | Description | Spatial coverage |
|---|---|---|
| 2023) | the North Sea and European Atlantic waters conducted from June to October 2022. | continental shelf waters.<br>The Proposed Development is in SCANS IV survey block NS-D. |
| Revised Phase III Data Analysis of Joint Cetacean Protocol (JCP) Data Resources (Paxton *et al.*, 2016) | Effort-linked sightings data contained within the JCP data resource (38 data sources between 1994-2010) 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. | European continental shelf. |
| 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. | European continental shelf.<br>User specified area for data extraction. |
| The Identification of Discrete and Persistent Areas of Relatively High Harbour Porpoise Density in the Wider UK Marine Area (Heinänen and Skov, 2015) | This report provides the results of detailed analyses of 18 years of survey data in the JCP undertaken to inform the identification of discrete and persistent areas of relatively high harbour porpoise density in the UK marine area within the UK Exclusive Economic Zone (EEZ). | Wider UK. |
| Distribution Maps of Cetacean and Seabird Populations in the North-East Atlantic, Marine Ecosystems Research Programme (MERP) (Waggitt *et al.*, 2019) | This study provides the largest ever collation and standardisation of diverse survey data for cetaceans and seabirds, and the most comprehensive distribution maps of these taxa in the North-East Atlantic. Aerial and vessel survey data were collated between 1980 and 2018. Distributional maps for 12 cetacean species were produced at 10 km resolution. | North-East Atlantic. |
| East Coast Scotland Marine Mammal Acoustic Array Surveys (ECOMMAS) (Palmer *et al.*, 2019) | ECOMMAS began in 2013 and is inclusive of 30 PAM sites along the East coast of Scotland. Each site consists of a Continuous Porpoise Monitoring Detector (CPOD) (Chelonia Ltd) capable of detecting porpoise and delphinid clicks. CPOD data are presented in Detection-Positive Days (DPDs) and Detection-Positive Hours (DPHs). | Two sites are in proximity to the proposed development, inclusive of Cruden Bay and Fraserburgh. |
| Integrating multiple data | NatureScot report on the condition of | Covers the CES MU for bottlenose |

| Data source | Description | Spatial coverage |
|---|---|---|
| sources to assess the distribution and abundance of bottlenose dolphins in Scottish waters (Cheney *et al.*, 2012, 2013, 2014a, 2014b, Quick *et al.*, 2014, Graham *et al.*, 2015, 2016, 2017, Cheney *et al.*, 2018, Arso Civil *et al.*, 2019, 2021) | bottlenose dolphins within the Moray Firth Special Area of Conservation (SAC) in six-year intervals. These are inclusive of reports from photo-ID surveys and PAM surveys. A Marine Mammal Monitoring Programme (MMMP) was developed for the Moray Firth in 2014. This includes yearly reports on the results of studies of reproduction, survival rates, assessments of trends in abundance and patterns of distribution. Further information is reported on the wider east coast of Scotland population inclusive of photo-ID data in the Firth of Forth and Firth of Tay, to provide the most up to date estimates on the proportion of the Moray Firth population which utilise areas further South. | dolphins, and the Moray Firth SAC. |
| Statistical approaches to aid the identification of MPAs for minke whale, Risso's dolphin, white-beaked dolphin and basking shark (Paxton *et al.*, 2014) | Effort-linked sightings data contained within the JCP plus additional data sourced by Scottish Natural Heritage were used to generate estimated densities per area surveyed (corrected for detection/availability) for minke whale (2000 – 2012), Risso's dolphin (1994 – 2012) and white-beaked dolphin (1994 – 2012). A further relative density per area surveyed index was obtained for basking shark (2000 – 2012). There were up to 23 distinct data sources used for each analysis (25 used in total) with data from at least 172 distinct survey platforms (ships and aircraft) representing up to 180,300 km of effort depending on the species considered. | Scottish coastal waters. |
| Site-specific survey information from nearby Offshore Wind Farms (OWFs) | DAS data from nearby OWFs. | Site-specific survey information from Berwick Bank (~110 km southwest), Caledonia (~120 km northeast), Green Volt (~40 km north), Seagreen (~100 km southwest) and Salamander (~30 km northwest) OWFs. |
| Existing OWF data (Multiple Sources, Multiple Years) | Strategic Marine Mammal Monitoring Programme (completed on behalf of Moray East OWF and Beatrice OWF) (Graham *et al.*, 2015, 2016, 2020, 2021); Various North Sea OWF project Environmental Impact Assessments (EIAs) and supplementary data (BOWL, 2012, Bailey, 2017, Moray Offshore | Various surveys in the North Sea. |

| Data source | Description | Spatial coverage |
|---|---|---|
| | Windfarm (West) Limited, 2018, Seagreen, 2018a, b). | |
| Special Committee on Seal (SCOS) report (SCOS, 2023) | Scientific Advice on Matters Related to the Management of Seal Populations. This outlines the current status of both harbour and grey seals in the UK. | British Isles. |
| Seal telemetry data (Seal Mammal Research Unit; SMRU.) data provided in 2019. | 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. | British Isles. |
| Seal August haul-out data (SMRU). Data provided in 2023. | August haul-out surveys of harbour and grey seals. | British Isles. |
| Designated haul-out sites for grey and harbour seals (Protection of Seals Orders) (Marine Scotland, 2017) | Seal haul-out sites are designated under section 117 of Marine (Scotland) Act 2010. Seal haul-outs are locations on land where seals come ashore to rest, moult, or breed. There are a total of 194 seal haul-out sites across Scotland which have been mapped on the National Marine Plan interactive (NMPi) system. | Scotland wide.<br>The closest seal haul-out site to the Proposed Development is the Ythan River Mouth, located approximately 60 km west-south-west of the Array Area and approximately 15 km south of the offshore ECC at its closest point. |
| Grey seal pup production database (SMRU). Data provided in 2023. | Grey seal pup production estimates at various breeding colonies around the UK. Includes data collated between 1989 and 2022 (depending on site). | British Isles. |
| Seal habitat preference maps (Carter *et al.*, 2020, 2022) | Habitat modelling was used, matching seal telemetry data to habitat variables, to understand the species-environment relationships that drive seal distribution. Haul-out count data were then used to generate predictions of seal distribution at sea from all known haul-out sites. This resulted in predicted distribution maps on a 5x5 km grid. The estimated density surface gives the percentage of the British Isles at sea population (excluding hauled-out animals) estimated to be present in each grid cell at any one time during the main foraging season. | British Isles. |

## 5.2 Site-specific surveys

The Muir Mhòr site-specific baseline characterisation surveys consisted of monthly DAS conducted by HiDef from April 2021 to March 2023. The site-specific survey area was designed to cover the Scotwind E2 PO site plus a 4 km buffer (Figure 5-1). The aim of the surveys was to collect data on the abundance and distribution of marine mammals to characterise the baseline environment to inform the EIAR. Specifically, one objective was to obtain species specific density estimates for the site which can be used during the impact assessment to quantitatively predict the potential for impacts on each marine mammal species from construction, operation, and decommissioning. Full details of the site-specific surveys can be found in the two-year survey report (HiDef Aerial Surveying Limited, 2023b).

The site-specific survey design consisted of 26 transects spaced 2.5 km apart running approximately northeast to southwest perpendicular to the depth contours along the coast to reduce the variation in abundance between transects by ensuring each transect was sampling a similar range of habitats. The surveys covered an area of approximately 1,541 km$^2$ (Figure 5-1).

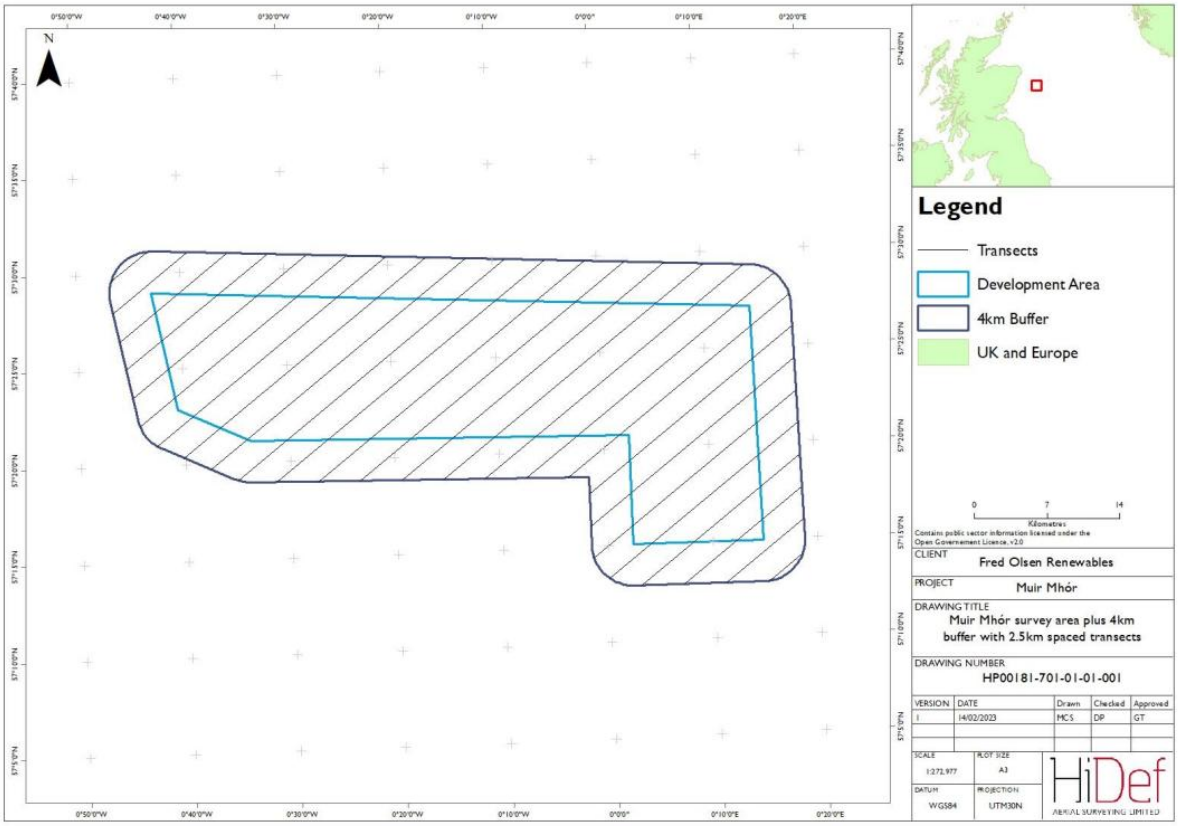


**Figure 5-1:** **Site-specific digital aerial survey area (Scotwind E2 PO site plus 4 km buffer) and transect lines (HiDef Aerial Surveying Limited, 2023b).**

Surveys were conducted using a specialist survey aircraft flown at approximately 550 m. The aircraft was equipped with four HiDef Gen II cameras with a resolution of 2 cm Ground Sample Distance (GSD) which each sampled a strip of 125 m width. A separation between cameras of approximately 25 m resulted in a combined sampled width of 500 m within a 575 m strip. The same transect lines were flown during each survey but slight variations in effort occurred due to variable start and stop times and minor deviations in the flight path (Table 5-3). The survey aimed to achieve a minimum

target of 10% coverage of the site-specific survey area, and a coverage of 9.93-10.02% was achieved. The average monthly Beaufort sea state during the surveys ranged from 1-4.99 (Table 5-3).

Data analysis for these surveys involved a two-stage process including a review of video footage with a 20% random sample used for audit, and then detected individuals were identified to species and/or species group level, also with 20% selected at random for auditing. Both stages in this audit process require 90% agreement to be achieved. Using non-parametric, bootstrap methods, species specific density estimates for the site were calculated including the corresponding standard deviation, 95% confidence intervals and coefficient of variance.

For harbour porpoise, the availability bias was then accounted for using data on the proportion of time tagged harbour porpoise spend at the surface (Teilmann *et al.*, 2013). Due to variations in sea state and turbidity, the depth to which porpoise are visible for detection will differ both within and between surveys. Therefore, all porpoise detections were categorised as either "snapshot surfacing" (dorsal fin was clear of the water surface) or not, to determine the proportion of encounters where the animal was at the surface. The relative density estimate was then multiplied by the proportion of encounters at the surface and divided by the estimated time spent at the surface from Teilmann *et al.* (2013) to derive the adjusted estimates of density and abundance. This process was not conducted for the other marine mammal species. Therefore, the data presented for other marine mammal species are relative abundance and density estimates only.

**Table 5-3: Survey effort across the 24 surveys of site-specific surveys (Scotwind E2 PO site plus 4 km buffer) from April 2021 to March 2023.**

| Survey date | Total length of transects analysed (km) | Area covered ($km^2$) | % covered | Beaufort sea state (average) |
|---|---|---|---|---|
| 15 April 2021 | 615.00 | 153.75 | 9.97 | 1.00 |
| 05 June 2021 | 615.08 | 153.77 | 9.97 | 1.76 |
| 12 June 2021 | 615.10 | 153.77 | 9.97 | 2.66 |
| 17 July 2021 | 611.31 | 152.82 | 9.91 | 3.54 |
| 04 August 2021 | 615.76 | 153.94 | 9.98 | 2.04 |
| 06 September 2021 | 616.01 | 154.00 | 9.98 | 2.27 |
| 08 October 2021 | 614.82 | 153.71 | 9.96 | 3.02 |
| 11 November 2021 | 616.46 | 154.12 | 9.99 | 1.86 |
| 12 December 2021 | 617.51 | 154.38 | 10.01 | 2.59 |
| 09 January 2022 | 614.99 | 153.75 | 9.97 | 3.00 |
| 26 February 2022 | 618.51 | 154.63 | 10.02 | 3.62 |
| 07 March 2022 | 615.54 | 153.88 | 9.98 | 3.99 |
| 02 April 2022 | 617.05 | 154.26 | 10.00 | 4.00 |
| 07 May 2022 | 617.27 | 154.32 | 10.00 | 2.04 |
| 14 June 2022 | 216.90 | 153.72 | 9.96 | 1.05 |

| Survey date | Total length of transects analysed (km) | Area covered ($km^2$) | % covered | Beaufort sea state (average) |
|---|---|---|---|---|
| 07 July 2022 | 614.92 | 153.73 | 9.97 | 1.08 |
| 03 August 2022 | 615.71 | 153.93 | 9.98 | 2.92 |
| 21 September 2022 | 617.44 | 154.36 | 10.00 | 3.62 |
| 13 October 2022 | 612.76 | 153.19 | 9.93 | 3.90 |
| 24 November 2022 | 618.13 | 154.53 | 10.02 | 4.99 |
| 20 January 2023 | 615.81 | 153.95 | 9.98 | 2.08 |
| 07 February 2023 | 613.91 | 153.48 | 9.95 | 3.10 |
| 23 February 2023 | 616.65 | 154.16 | 9.99 | 4.00 |
| 25 March 2023 | 615.31 | 153.83 | 9.97 | 4.54 |

### 5.3 Regional surveys

In addition to the site-specific surveys, in April 2022 SSE commissioned HiDef to undertake DAS for marine mammals over the proposed Regional Offshore Wind Farm Project area, located approximately 45 km off the northeast coast of Scotland. The survey area consisted of 30 5 km spaced transects within the regional development area (Scotwind E1 and E2 PO sites) plus a 12 km buffer, covering an area of 11,553 $km^2$ (Figure 5-2).

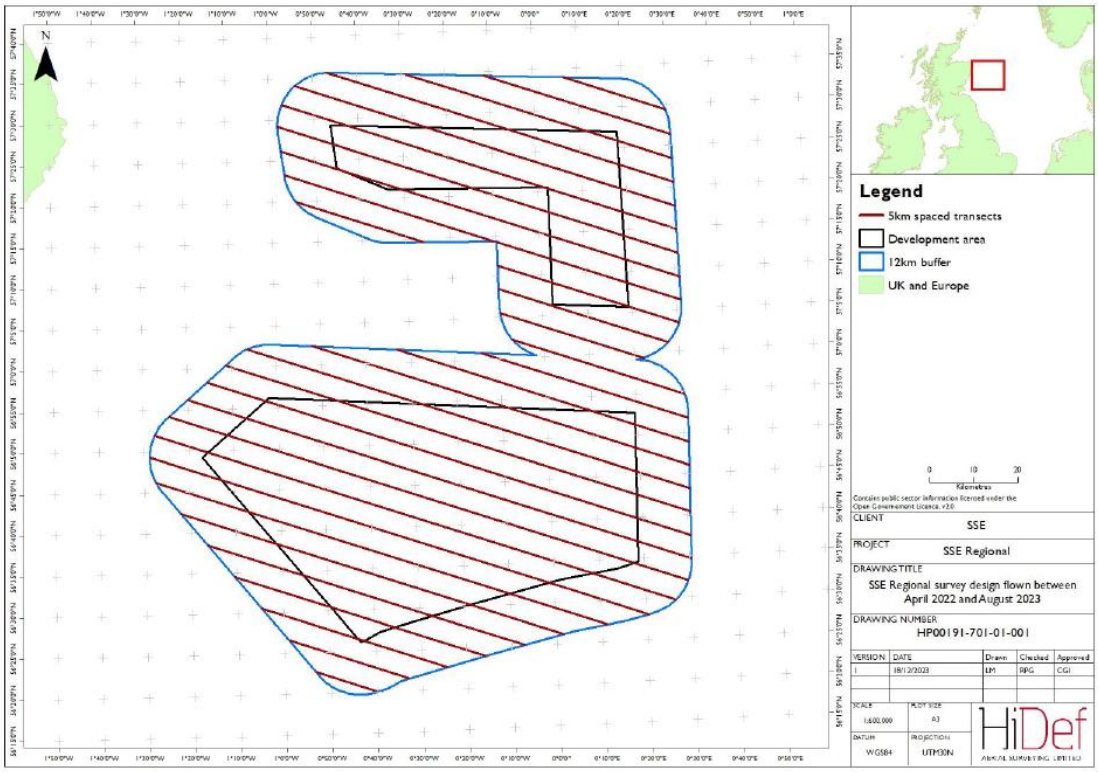

**Figure 5-2:** **Regional baseline digital aerial survey area (Scotwind E1 and E2 PO sites plus 12 km buffer) and transect lines (HiDef Aerial Surveying Limited, 2023c).**

The same survey methodology and data processing was used as presented for the site-specific surveys. A minimum of 5% site coverage was targeted, and 4.99-5% was achieved on all surveys (Table 5-4).

For harbour porpoise, the availability bias was then accounted for using data on the proportion of time tagged harbour porpoise spend at the surface (Teilmann *et al.*, 2013). This process was not conducted for the other marine mammal species. Therefore, the data presented for other marine mammal species are relative abundance and density estimates only.

**Table 5-4: Survey effort across the 18 regional surveys between April 2022 and February 2023 inclusive.**

| Survey date | Total length of transects analysed (km) | Area covered (km$^2$) | % covered |
|---|---|---|---|
| 10 April 2022 | 2308.11 | 577.03 | 4.99 |
| 23 April 2022 | 2308.49 | 577.12 | 4.99 |
| 20 May 2022 | 2310.70 | 577.67 | 5.00 |
| 23 June 2022 | 2310.14 | 577.54 | 5.00 |
| 18 July 2022 | 2310.24 | 577.56 | 5.00 |
| 19 August 2022 | 2308.32 | 577.08 | 4.99 |
| 14 September 2022 | 2306.10 | 576.52 | 4.98 |
| 02 October 2022 | 2304.52 | 576.13 | 4.99 |
| 04 November 2022 | 2309.64 | 577.41 | 5.00 |
| 09 January 2023 | 2309.56 | 577.39 | 5.00 |
| 06 February 2023 | 2309.09 | 577.27 | 5.00 |
| 21 February 2023 | 2308.79 | 577.20 | 4.99 |
| 04 April 2023 | 2309.09 | 577.27 | 5.00 |
| 21 April 2023 | 2308.19 | 577.05 | 4.99 |
| 16 May 2023 | 2308.40 | 577.10 | 4.99 |
| 15 June 2023 | 2306.33 | 576.58 | 4.99 |
| 08 July 2023 | 2304.45 | 576.11 | 4.99 |
| 05 August 2023 | 2306.70 | 576.67 | 4.99 |

## 5.4 Geophysical survey MMO report

A survey was conducted to acquire geophysical and environmental data to characterise the Array Area and offshore ECC for EIA. The geophysical survey included vessel-mounted Multibeam Echosounder (MBES) to acquire bathymetry data, towed side scan sonar (SSS), shallow sub-bottom profiler (pinger), magnetometer, and high-resolution single-channel seismic equipment (sparker) (EGS (International) Limited, 2023).

The report summarises the MMO and PAM operations conducted onboard the *EGS Ventus* to fulfil the geophysical survey requirements. Operations were conducted between 30$^{th}$ March 2023 to 14$^{th}$ July 2023. The mitigation team undertook mitigation for the pinger and sparker in accordance with the Joint Nature Conservation Committee guidelines for minimising the risk of injury to marine mammal from geophysical surveys (JNCC, 2017). In addition, the MBES and SSS were mitigated for in accordance with Scottish regulations (Marine Scotland, 2020) and to fulfil the European Protected Species (EPS) Licence requirements (EGS (International) Limited, 2023). The MMOs undertook a total

of 1,073 hours 49 minutes of visual monitoring and PAM was undertaken over 480 hours 52 minutes. This resulted in 28 marine mammal sightings and no acoustic detections (EGS (International) Limited, 2023).

### 5.5 Atlas of cetacean distribution

The Atlas of cetacean distribution (Reid *et al.*, 2003) presented data on distribution and abundance in the north-west European Waters of 25 cetacean species. It consisted of combination of three major data sources (European Seabirds at Sea, Sea Watch and SCANS I) with data collated between 1979 – 1997. European Seabirds at Sea data provided data mostly from at-sea surveys using moving platform and a small number of aerial surveys, collated across European countries. Although the surveys were designed for seabirds, cetacean data was collected as well, resulting in a database which contains over 13,000 cetacean records. Sea Watch data were mostly opportunistic effort-related sightings conducted from both on- and offshore. The Sea Watch has been collecting data from 1973 and the resulting database contains over 53,000 sighting records, including opportunistic and quantified survey efforts. The SCANS I survey was conducted in summer 1994 and was comprised of boat and aircraft platforms. The encounter rate data from both platforms was used by Reid *et al.* (2003). Due to the differences in datasets, the data was standardised into animal sightings per time unit and the sighting rates were modelled using correction factors and environmental variables. The observations were assigned into ¼ International Council for the Exploration of the Sea (ICES) rectangles (15' latitude x 30' longitude). The sighting rates were then corrected for the effort within each cell to obtain the resulting distribution surfaces (Reid *et al.*, 2003).

The Atlas of cetacean distribution provides very outdated distribution information, the abundance information is not provided for all species presented in the Atlas and neither of those that had the abundance information are the species of interest for this baseline characterisation. The final resulting surfaces also varied in the correction and modelling that was included for each of the 25 species, due to data deficiencies (Reid *et al.*, 2003). The results of the analysis provide an overview of the 18-year long dataset, hence not allowing for detecting changes in distribution and abundance over the years. The results of the work done by Reid *et al.* (2003) are presented for informative purposes but will not be providing quantitative input for this baseline characterisation.

### 5.6 Regional baseline data for marine mammals

The report from Hague *et al.* (2020) aims to provide 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 Draft Plan Option (DPO) sites (Figure 5-3) within the Draft Sectoral Marine Plan for Offshore Wind Energy (Scottish Government, 2019). The DPOs consisted of 17 sites located within five regions. Since the publication of this report, the information has been consolidated in an adopted plan, which now includes 15 POs.

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 highlights areas where knowledge of species abundance and distribution is lacking (Hague *et al.*, 2020).

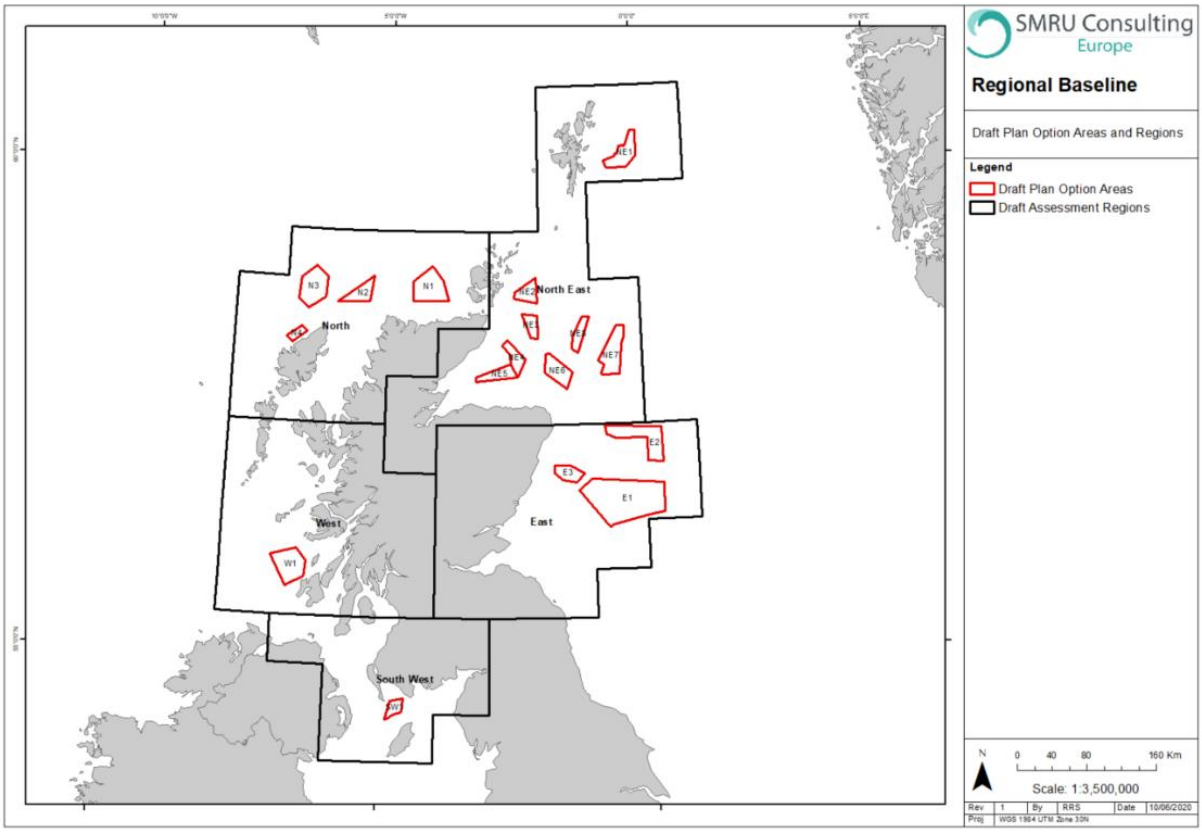


**Figure 5-3:** **The DPO sites and regions within Scottish waters presented in the Draft Sectoral Marine Plan for Offshore Wind Energy (Scottish Government, 2019). Figure from Hague *et al.* (2020).**

## 5.7 Small Cetaceans in European Atlantic waters and the North Sea (SCANS) surveys

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), SCANS II during summer 2005, SCANS III during summer 2016 (Hammond *et al.*, 2017, Hammond *et al.*, 2021) and SCANS IV during summer 2022 (Gilles *et al.*, 2023).

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).

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.

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.

### 5.7.1 SCANS III

The Proposed Development is located in the SCANS III survey block R (Figure 5-4) which was surveyed using aircraft. Block R has a surface area of 64,464 km$^2$ and only 2,179 km was surveyed under primary effort and 40.5 km under trailing search effort. During these surveys, the most common cetacean sightings in block R included harbour porpoise, bottlenose, white-sided and white-beaked dolphins, and minke whales (Hammond *et al.*, 2021). The closest neighbouring SCANS III survey block is T, which is approximately 18 km from the proposed development (Figure 5-4). Block T has a surface area of 65,417 km$^2$ and only 2,259 km was surveyed under primary effort and 24.0 km under trailing search effort. Given the proximity of the Proposed Development to the boundary of the survey blocks, information will be provided for both survey blocks in this baseline characterisation.

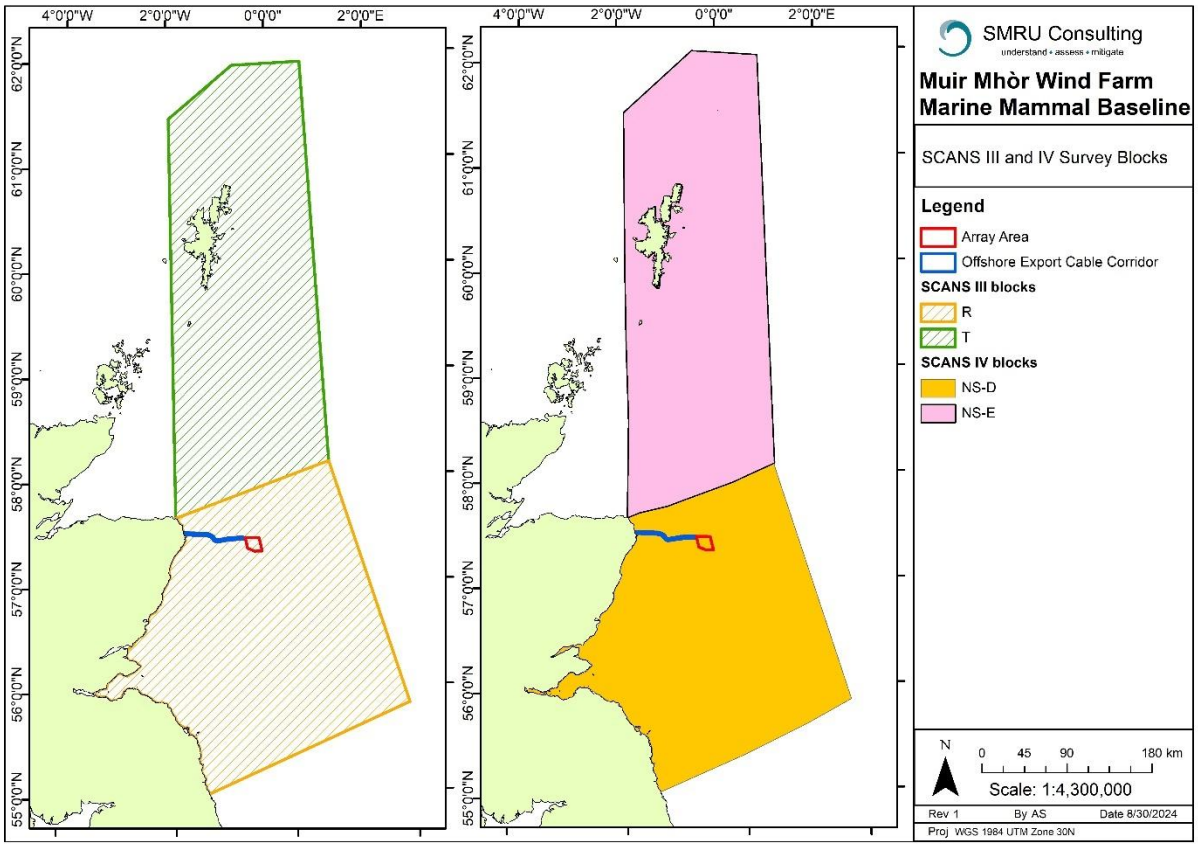


**Figure 5-4:** **Relevant SCANS III and IV survey blocks in relation to the Proposed Development (blocks presented in Hammond *et al.*, 2021, Gilles *et al.*, 2023)**

#### 5.7.1.1 SCANS III density surfaces

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). The cetacean data used in the models were the same as those obtained in 2016 that were used to provide block specific abundance estimates in Hammond *et al.* (2021). The environmental covariates used in the density surface modelling were selected due to their potential to explain the additional variability in the cetacean density estimates (for example, depth of the seabed, sea surface temperature (see

Lacey *et al.* (2022) for the full list of environmental covariates). The models were fitted using a spatial resolution of 10 km and predicted onto a 10 x 10 km spatial grid. Using the predicted density estimates from the surface models, density and abundance estimates can be generated for an entire survey area or a defined area within it, such as the Proposed Development.

### 5.7.2 SCANS IV

The survey blocks used during SCANS IV are presented in Figure 5-4. The Proposed Development is located in SCANS IV block NS-D which was surveyed using aircraft. Block NS-D has a surface area of 64,455 km$^2$ and only 1,703.8 km was surveyed under primary effort and 15.7 km under trailing search effort. The closest neighbouring survey block is NS-E which has a surface area of 65,423 km$^2$ and only 1,603.9 km was surveyed under primary effort and 11.7 km under trailing search effort. Given the proximity of the Proposed Development to the boundary of the survey blocks, information will be provided for both survey blocks in this baseline characterisation.

### 5.7.3 JCP Phase III

The JCP Phase III analysis included datasets from 38 sources, totalling over 1.05 million km of survey effort between 1994 and 2010 from a variety of platforms (Paxton *et al.*, 2016). The JCP Phase III analysis was conducted to combine 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 25 km$^2$ resolution for one day in each season in each survey year. The data are divided into regions for which seasonal estimates of abundance for winter (January-March), spring (April-June), summer (July-September) and autumn (October-December). The Proposed Development is situated within the 'Firth of Forth area of commercial interest', which is 14,241 km$^2$. It is also very close to the 'Moray Firth area of commercial interest', which is 7,899 km$^2$, which is also considered in this report (Figure 5-5).

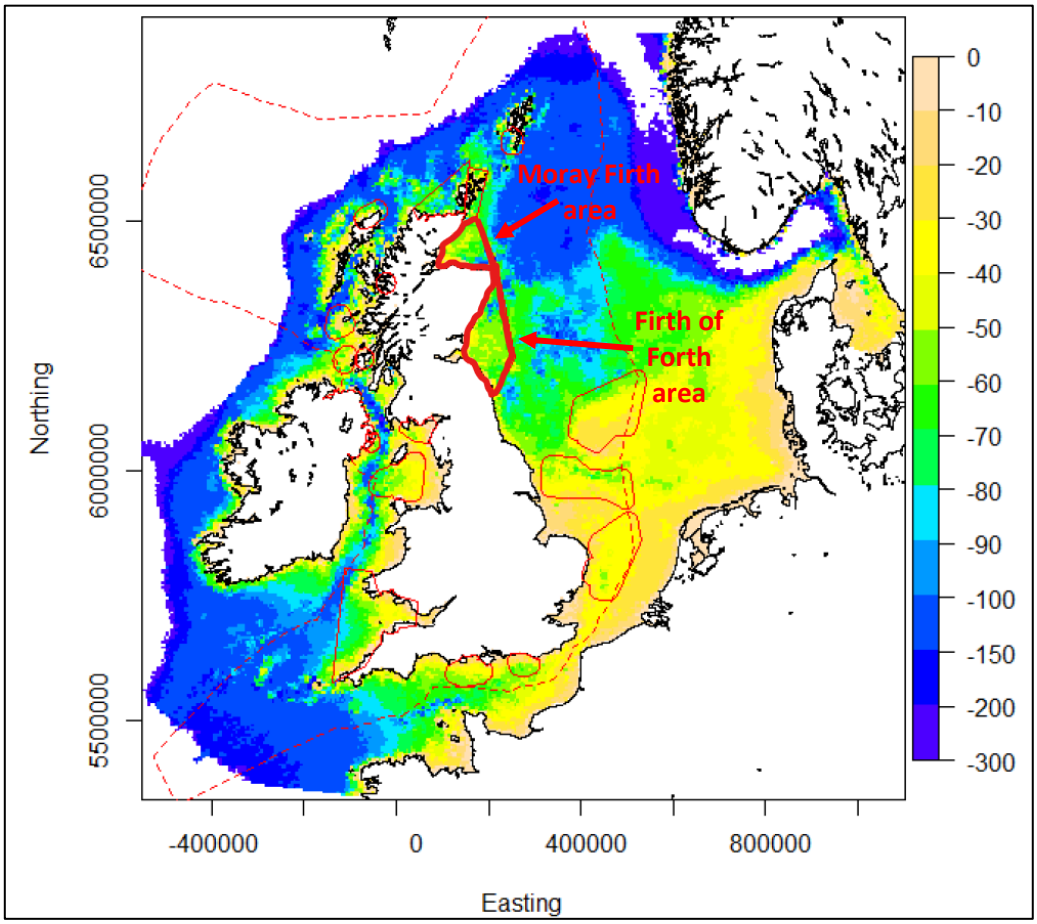


**Figure 5-5:** **The JCP Phase III region showing (red) areas of interest for the Offshore Development Area where estimates of abundance are of special commercial interest (red dashed line = British exclusive economic zone, colour = depth in m) (Paxton *et al.*, 2016).**

### 5.7.4 JCP data analysis tool

In 2017, JNCC released the JCP Phase III Data Analysis Product[2] that can be used to extract the cetacean abundance estimates for summer 2007-2010 (average) for a user specified area (containing the Muir Mhòr Array Area, plus a 50 km buffer) (Figure 5-6). This code was originally created by Charles Paxton at the Centre for Research into Ecological and Environmental Modelling (CREEM) at the University of St Andrews and was modified by JNCC to include abundance estimates that are scaled to the SCANS III results.

It should be noted that 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 1,000 km$^2$ because of issues relating to standardizing the data

[2] https://hub.jncc.gov.uk/assets/01adfabd-e75f-48ba-9643-2d594983201e

(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. In addition, the density estimates obtained from the Data Analysis Tool is an averaged density estimate for the summer 2007-2010 and are therefore not representative of densities at other times of the year.

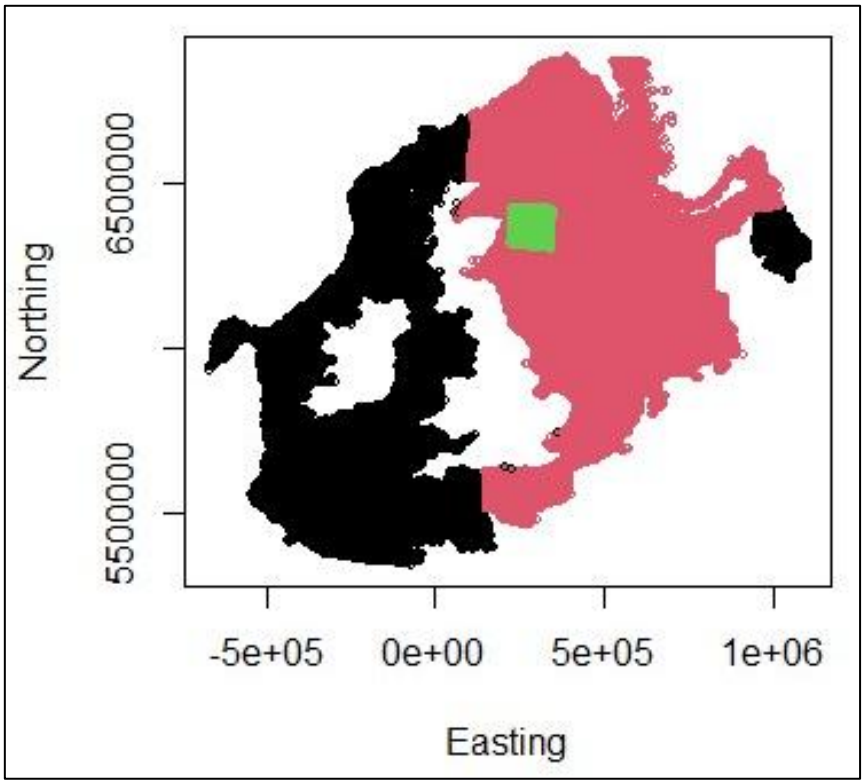


**Figure 5-6:** **The user specified area used to extract cetacean abundance and density estimates from the JCP III R code. The map shows the whole area under consideration (black + pink + green), the harbour porpoise North Sea MU (pink), the specific area of interest (the Muir Mhòr Array Area, plus a 50 km buffer, green) and the extent of all the IAMMWG MUs (black).**

### 5.7.5 Porpoise high density areas

Heinänen and Skov (2015) conducted a detailed analysis of 18 years of survey data on harbour porpoise around the UK between 1994 and 2011 held in the JCP database. The goal of this analysis was to try to identify *"discrete and persistent areas of high density"* that might be considered important for harbour porpoise with the ultimate goal of determining SACs for the species. The 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. 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 the draft SACs so that only areas with high confidence were retained (IAMMWG, 2015b).

### 5.7.6 MERP distribution maps

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

Waggitt *et al.* (2019) predicted monthly and 10 $km^2$ densities for each species (animals/$km^2$) and estimated the probability of encountering animals using a binomial model (presence-absence model) and estimated the density of animals if encountered using a Poisson model (count model). The product of these two components were used to present final density estimations (Barry and Welsh, 2002). The outputs of this modelling were monthly predicted density surfaces for 12 cetacean species at a 10 km resolution. There is no indication of whether the more recent sightings data are weighted more heavily than older data, which limits interpretation of how predictive the maps are to current distribution patterns. Therefore, while the density estimates obtained from these maps for harbour porpoise 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 and are provided in this baseline characterisation for illustrative purposes only. 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.

### 5.7.7 Spatially indexed adjusted densities

Marine Directorate (formerly Marine Scotland) have established the Scottish MPA project in response to the Marine (Scotland) Act 2010 to select MPAs and develop their network across Scotland. The focus is to identify areas that support significant aggregations and area persistently used by four key megafauna species: Risso's dolphin, white-beaked dolphin, minke whale and basking shark (*Cetorhinus maximus*) (Paxton *et al.*, 2014).

Paxton *et al.* (2014) 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 to support the advice on MPA designation (Figure 5-7). The values presented by Paxton *et al.* (2014) represent absolute density estimates and are presented seasonally and averaged over all seasons.

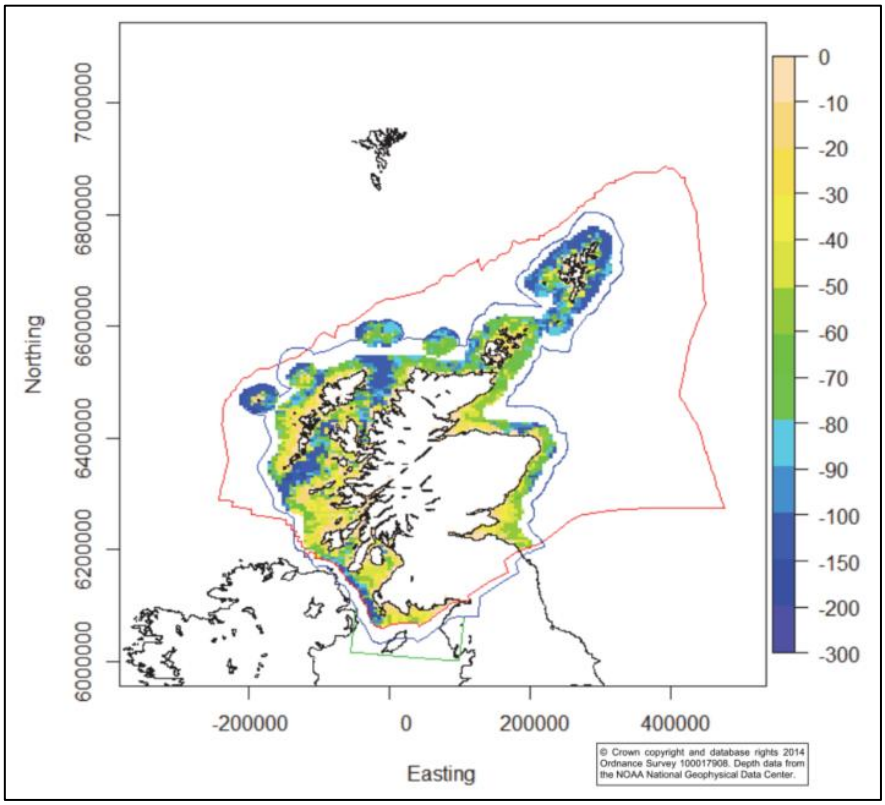


**Figure 5-7:** **The area of interest for the analysis including species specific input data. The coloured area (with depth shaded in m) indicates the 12 nm Scottish territorial limit. The red line shows the input area for white-beaked dolphin data (Scottish waters limited in the west and north by the 300 m contour). The blue line shows the input area for minke whale (12 nm limit with an additional approximate 10 nm buffer). The green line shows an extension of the blue area to include additional data for Risso's dolphin and basking shark from Manx waters (Paxton *et al.*, 2014).**

## 5.8 The East Coast Marine Mammal Acoustic Study (ECOMMAS)

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) 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. CPODs are logging devices which automatically detect odontocete echolocation clicks, of which the accompanying analysis software distinguishes between "porpoise" and "delphinid". To characterise porpoise and dolphin presence in proximity to the proposed development, two ECOMMAS sites have been included in this report from 2013-2022. These sites are inclusive of Cruden Bay and Fraserburgh (Figure 5-8). There are no data available for 2020 due to Covid-19 restrictions, preventing fieldwork from occurring.

Since 2015, two deployments have been undertaken per year (a duration of approximately four months), with data covering April to November usually. CPOD data are presented in DPDs and DPHs in this report. It is important to note that the software does not distinguish between delphinid species. As such, the data presented here is to be used qualitatively for dolphin species.

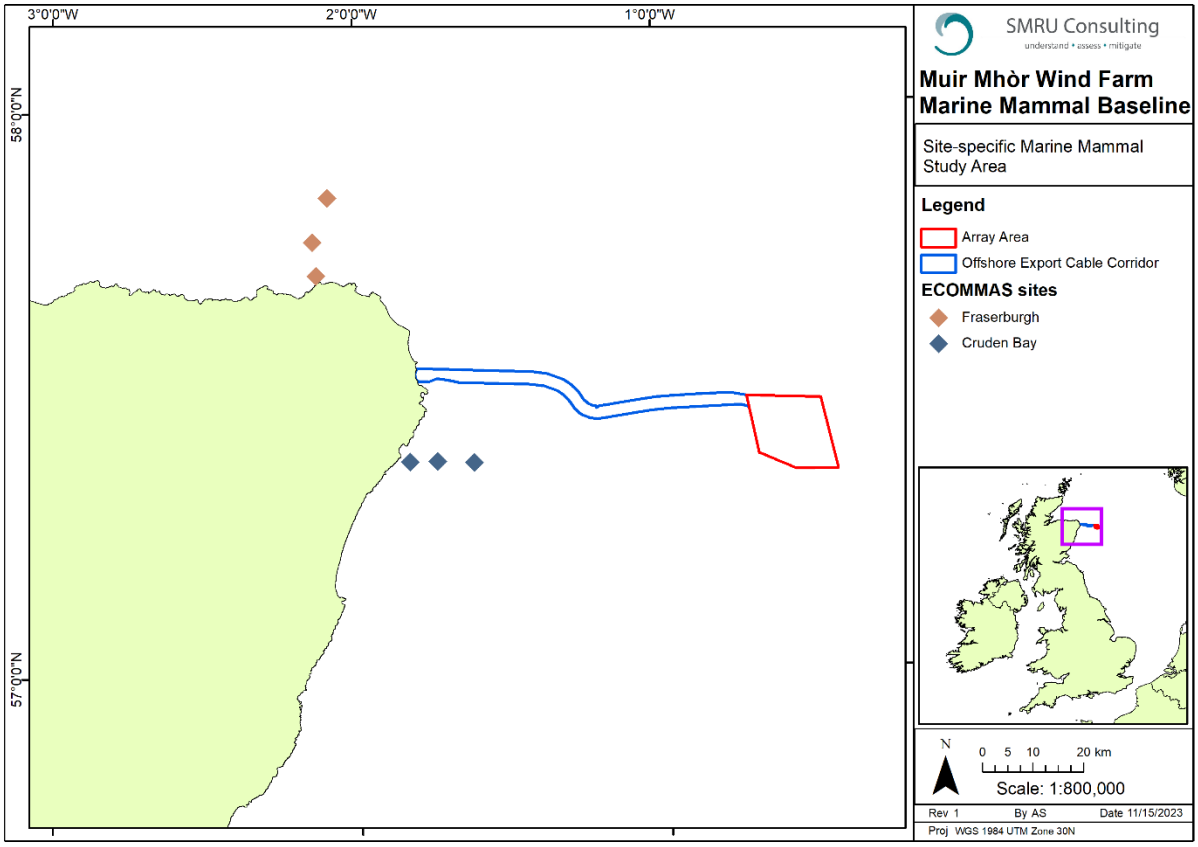


**Figure 5-8:** **Locations of the Cruden Bay and Fraserburgh ECOMMAS PAM stations in relation to the Proposed Development.**

## 5.9 Bottlenose dolphin surveys

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 are 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, Cheney *et al.*, 2014b, Cheney *et al.*, 2018, Cheney *et al.*, 2024). In 1989, the University of Aberdeen, in collaboration with 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. This research effort was further supported by NatureScot from 2004 onwards. It was determined that the main objective of this research programme was to estimate the number of bottlenose dolphins utilising the SAC, with mark-recapture and PAM analyses.

A Marine Mammal Monitoring Programme was developed for the Moray Firth in May 2014. The aims of this programme are to address strategic research and monitoring questions relating to the potential impacts of offshore wind farm construction and operations on key marine mammal species such as bottlenose dolphins. This is carried out using work packages for each species, including individual based studies of reproduction, survival rates, assessment of trends in abundance, and the collection of data on patterns of distribution. These are typically reported on annually, providing key

results from each of the studies mentioned previously (Graham *et al.*, 2015, Graham *et al.*, 2016, Graham *et al.*, 2017).

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). 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), with Arso Civil *et al.* (2021) 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.

It is important to note that the purpose of these surveys has generally 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 to known individual dolphins. These surveys differ significantly to those that would be required to estimate dolphin density within the survey area.

## 5.10 Existing OWF data

### 5.10.1 Berwick Bank OWF

The Berwick Bank OWF is located in the outer Firth of Forth approximately 110 km southwest of the Proposed Development. The EIA for the project includes a marine mammal baseline technical report which details the site-specific surveys (RPS, 2022a). Digital aerial surveys were conducted by HiDef Aerial Surveying Limited between March 2019 and April 2021 resulting in 25 surveys. The survey design consisted of 37 transects spaced 2 km apart across the Offshore Array Area plus ~16 km buffer. The total survey area was 4,980 km$^2$, of which ~620 km$^2$ was surveyed each month (12.5%). Six species of marine mammal were identified during the surveys: harbour porpoise, minke whale, white-beaked dolphin, bottlenose dolphin, grey seal and harbour seal. Monthly density estimates were provided for each species which were corrected for availability bias using the following correction factors: 0.425 for harbour porpoise (Teilmann *et al.*, 2013), 0.156 for grey seals (Orsted Hornsea Project Three (UK) Ltd, 2018), 0.443 for minke whales (McGarry *et al.*, 2017)and 0.180 for white-beaked dolphins (Rasmussen *et al.*, 2013).

### 5.10.2 Caledonia OWF

The Caledonia OWF is located in the Moray Firth, immediately adject to the Moray East development and approximately 120 km northeast of the Proposed Development. To date, the only information available for this site are from the Scoping Report (Caledonia Offshore Wind Farm Limited, 2022). Site-specific digital aerial surveys for Caledonia were conducted between May 2021 and April 2023, however the data have yet to be processed and so are not available to include here.

### 5.10.3 Green Volt OWF

The Green Volt OWF is a floating development in the Outer Moray Firth located approximately 37 km from the Proposed Development. Site-specific digital aerial surveys were conducted by HiDef Aerial Surveying Limited between May 2020 and April 2022. The surveys consisted of 1 km spaced transects over the Offshore Array Area plus 4 km buffer, resulting in a total survey area of 391 km$^2$ (Royal HaskoningDHV, 2023). Five species of marine mammal were identified during the surveys:

harbour porpoise, bottlenose dolphin, white-beaked dolphin, Risso's dolphin and grey seal. Monthly density estimates were provided for harbour porpoise which were corrected for availability bias using the Teilmann *et al.* (2013) tag data.

### 5.10.4 Ossian OWF

Ossian OWF is located off the Aberdeenshire coast and is approximately 50 km to the south of the Proposed Development. Site-specific digital aerial surveys were conducted by HiDef Aerial Surveying Limited between March 2021 and February 2023 (RPS, 2024). There were five marine mammal species of relevance for the Proposed Development identified during the surveys: harbour porpoise, white-beaked dolphin, minke whale, harbour seal and grey seal. Density estimates for harbour porpoise, white-beaked dolphins and grey seals were corrected for availability bias to provide absolute estimates (RPS, 2024).

### 5.10.5 Seagreen OWF

The Seagreen OWF is currently under construction approximately 27 km from the coast of Angus in the North Sea and approximately 100 km southwest of the Proposed Development. As part of their Project Environmental Monitoring Programme (PEMP) and MMMP, Seagreen are required to undertake pre-, during and post-construction monitoring efforts, within the development site. These surveys are inclusive of aerial survey efforts and PAM efforts. The PAM effort undertaken is inclusive of an additional five extra PAM monitoring stations between the Stonehaven and Arbroath ECOMMAS locations, in a transect from the coast to the Seagreen site. This design includes a monitoring station in the shallow, coastal area known to be frequented by bottlenose dolphins, as well as a gradient survey design extending to the wind farm site, to determine any possible changes in detections of other cetaceans in relation to construction activities. At the time of writing, the PAM data from this PEMP were not available to include here.

### 5.10.6 Salamander Floating OWF

The Salamander OWF is a floating development located approximately 28.5 km from the Proposed Development. Site-specific digital aerial surveys for Salamander were conducted by HiDef Aerial Surveying Limited from March 2021 to February 2023 (HiDef Aerial Surveying Limited, 2023a). Two marine mammal species were identified during surveys: harbour porpoise and minke whales. Monthly density estimates were provided for harbour porpoise which were corrected for availability bias using the Teilmann *et al.* (2013) tag data.

## 5.11 Special Committee on Seals

Under the Conservation of Seals Act 1970 (in England) and the Marine (Scotland) Act 2010, the Natural Environment Research Council (NERC) (now part of UK Research and Innovation) provides scientific advice to government on matters related to the management of UK seal populations through the advice provided by SCOS. SMRU provides this advice to SCOS on an annual basis through meetings and an annual report. The report includes advice on matters related to the management of seal populations, including general information on British seals, information on their current status and addresses specific questions raised by regulators and stakeholders.

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

### 5.11.1 August haul-out counts

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). 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.

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) (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.

#### 5.11.1.1 Grey seal pup counts

Grey seals are surveyed during their breeding season (Aug – Dec). Most breeding colonies are surveyed by SMRU by fixed wing aerial vertical photography (Hebrides, Orkney, North Scotland the Northeast Scotland, and most of the Firth of Forth) while others are surveyed by ground count by other organisations (Shetland and Incholm in the Firth of Forth). The grey seal pup production database contains data from 1989 to 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).

## 5.12 Seal telemetry

SMRU has developed telemetry tags on grey seals and harbour seals in the UK since 1988 and 2001, respectively. Tags are glued to the fur on the back of the seal's neck and fall off with the fur during the annual moult, if not before. These tags transmit data on seal locations with the tag duration (number of days) varying between individual deployments. It is worth noting that the timing of the tag deployment can be important, especially for grey seals, since movement patterns can differ between the breeding and non-breeding seasons (Russell *et al.*, 2013).

There are data from two types of telemetry tag which differ by their data transmission methods. Data transmission can be through the Argos satellite system (Argos tags) or Global Positioning System (GPS) phone tags which combine GPS quality locations with transmission of data using the Global System for Mobile communication (GSM) phone network. Both types of transmission result in location estimates, but the spatial and temporal resolution of the locational data varies with deployment. Argos location tags can have an error of >2.5 km (Vincent *et al.*, 2002) while GPS location tags have a better location accuracy, with a typical error of <50 m (Patterson *et al.*, 2010). Data from GPS phone tags also provide more frequent locations by incorporating the Fastloc GPS system (Wildtrack Telemetry Systems, UK) which obtains locational data within a fraction of a

second and therefore can collect data even when the animal surfaces for a short period. The GPS tags attempt to collect location data every 5-20 minutes (depending on the parametrisation at set-up). Data are stored on board the tags and then relayed to SMRU by a satellite (Argos tags) or by quad-band GSM mobile phone module when the animal is within range of the GSM mobile phone network. The data are then stored in databases, and cleaned according to methods described in Russell *et al.* (2011).

The data presented in this baseline characterisation report are a combination of the SMRU and University of Aberdeen tag deployments.

### 5.13 Seal at-sea distribution

The Department for Business, Energy & Industrial Strategy (BEIS, now Department for Energy Security and Net Zero, DESNZ) funded a large-scale deployment of high-resolution GPS telemetry tags on grey seals around the UK to create up-to-date estimates of the at-sea distribution for both seal species (Carter *et al.*, 2020, Carter *et al.*, 2022). Telemetry data from 114 grey seals and 239 harbour seals were included in the analysis (Figure 5-9). To estimate the at-sea distribution, a habitat modelling approach was used, matching seal telemetry data to habitat variables (such as water depth, seabed topography, sea surface temperature) to understand the species-environment relationships that drive seal distribution. Haul-out-count data (Figure 5-10) 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 5x5 km grid. The estimated density surface gives the percentage of the British Isles at-sea population (excluding hauled-out animals) estimated to be present in each grid cell at any one time during the main foraging season.

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). 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 out with the breeding season.

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) to estimate the number of animals present within the 5x5 km cell. This value can then be divided by 25 to obtain the density of seals per $km^2$.

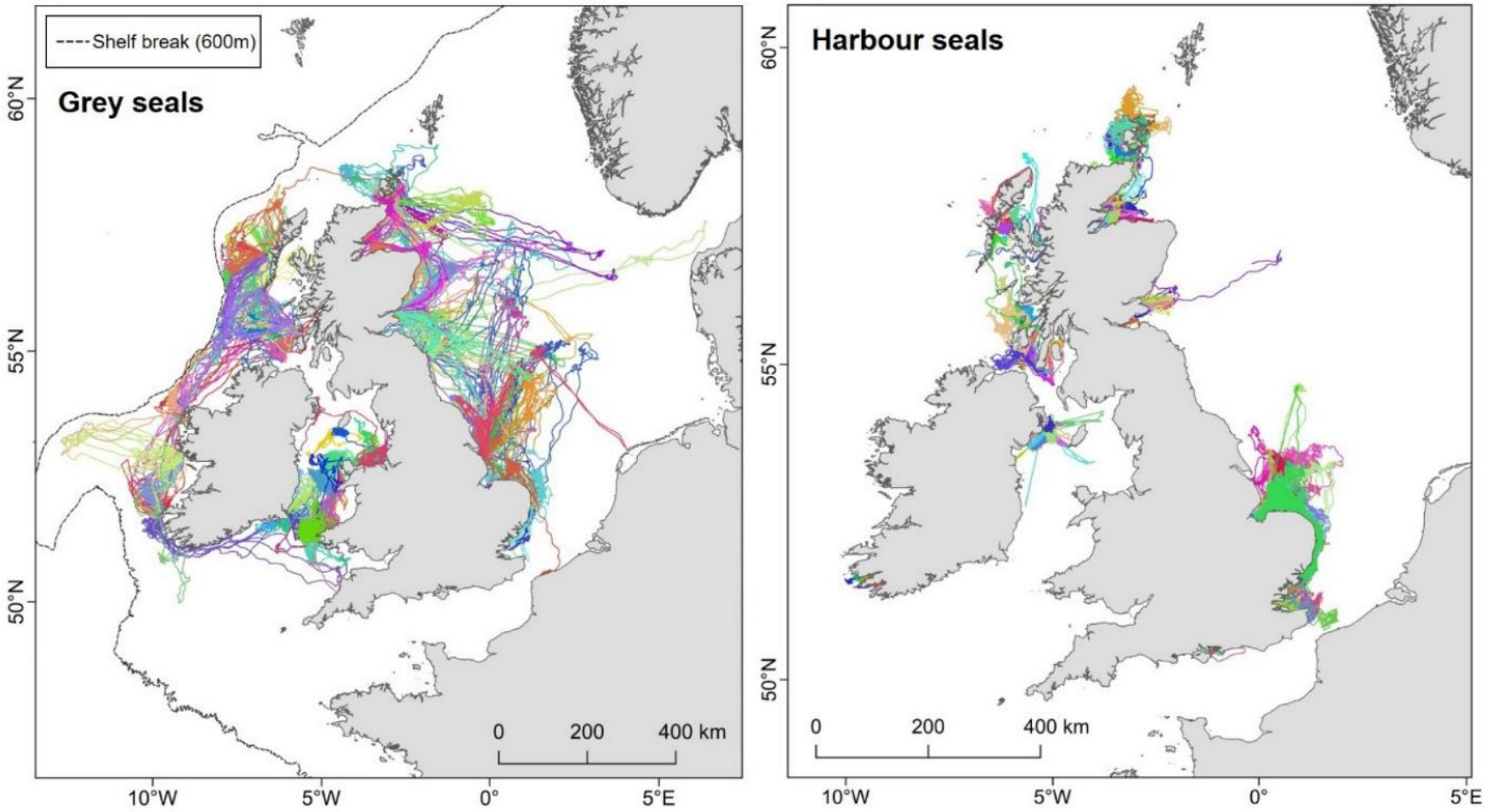


**Figure 5-9:** **GPS tracking data for grey and harbour seals available for habitat preference models (Carter *et al.*, 2020).**

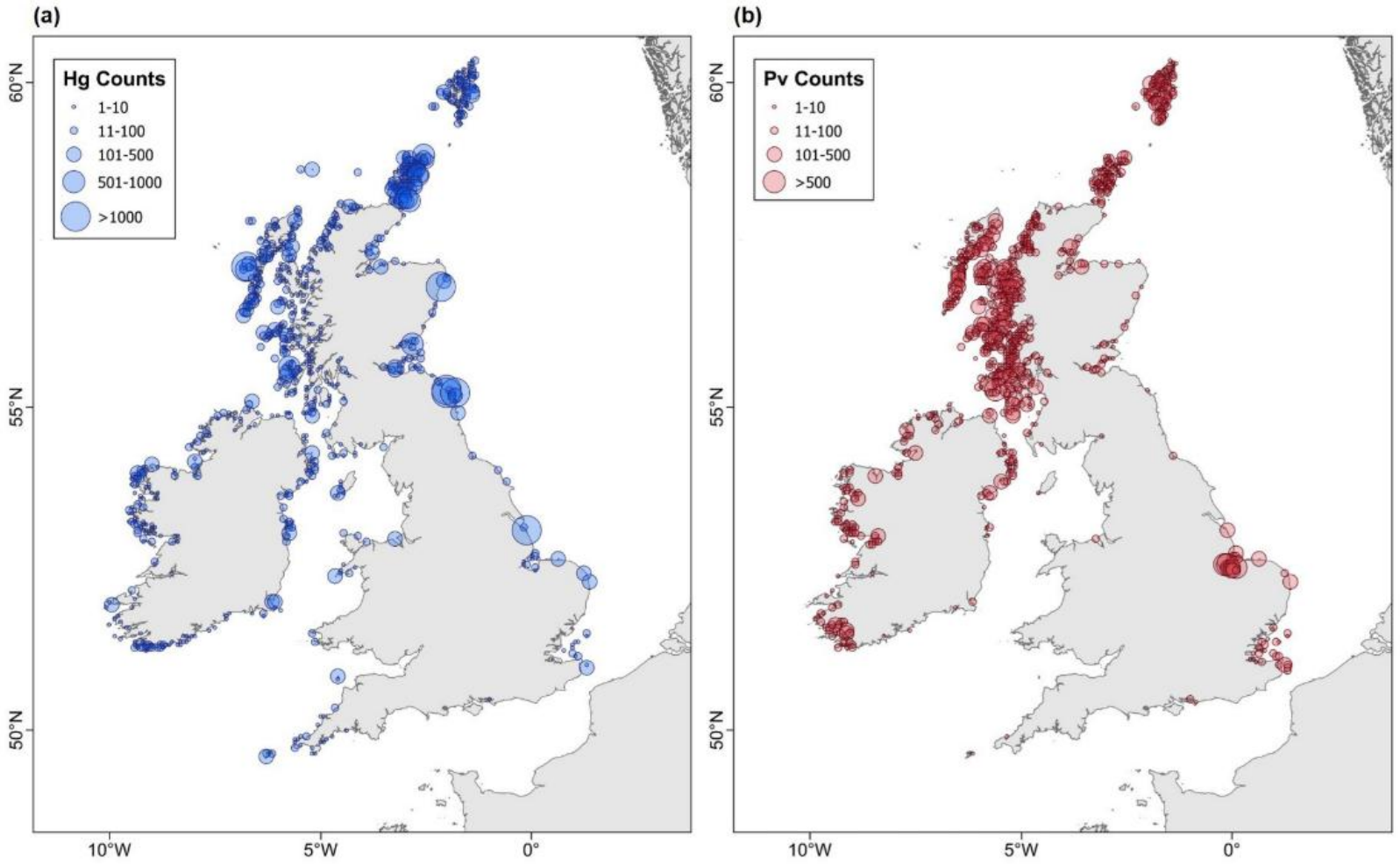


**Figure 5-10:** **Most recent available August count data for (a) grey and (b) harbour seals per 5x5 km haul-out cell used in the distribution analysis (Carter *et al.*, 2020).**

# 6 Harbour porpoise

Harbour porpoise are distributed globally and can be found throughout UK in shallow waters (<200 m). The distribution map produced by Reid *et al.* (2003) shows high sighting rates of harbour porpoise around north of the UK, including Scottish waters (Figure 6-1). They are the smallest and most abundant cetacean species in UK waters (Reid *et al.*, 2003), typically encountered in small groups between one and three individuals. Animals are frequently sighted throughout coastal habitats with studies suggesting they are highly mobile and cover large distances (Nabe-Nielsen *et al.*, 2011).

Harbour porpoise are present in Scottish waters year-round and are the most frequently sighted species, with their distribution overlapping with all PO regions and sites (Hague *et al.*, 2020). The series of SCANS surveys showed the southward change in distribution of harbour porpoises over the years (Hague *et al.*, 2020) and the most recent of the surveys suggest density range of 0.058 – 0.599 harbour porpoise/km$^2$ in Scottish waters (Hammond *et al.*, 2021). There is one SAC designated for harbour porpoise within the NS MU, the Southern North Sea SAC (Figure 4-1).

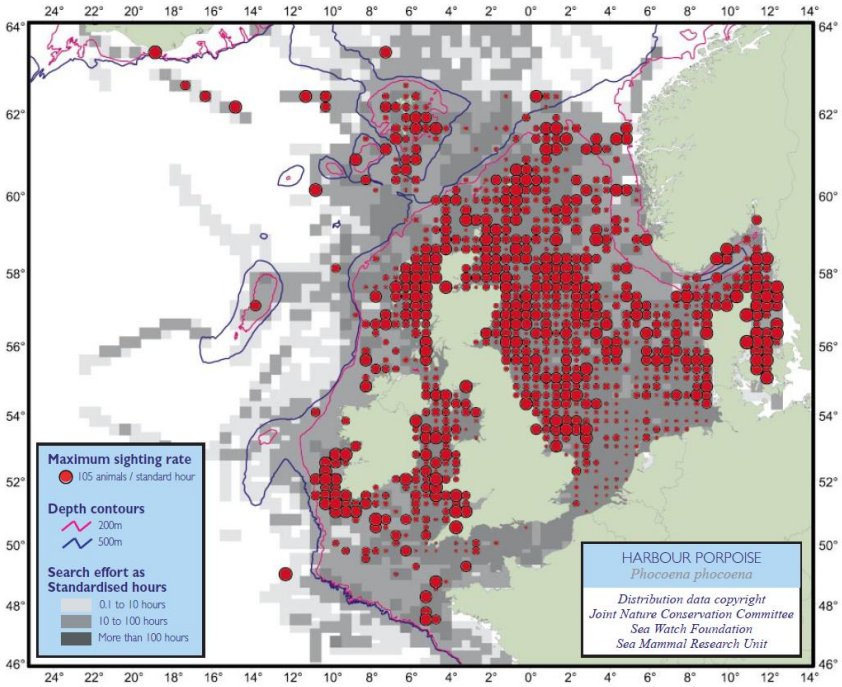


**Figure 6-1: Harbour porpoise distribution map of effort-related sightings (Reid *et al.*, 2003).**

## 6.1 Management Unit

The population estimate for the NS MU is 346,601 harbour porpoise (95% CI: 289,498- 419,967, CV: 0.09) (IAMMWG, 2023). The UK portion of this MU is 159,632 harbour porpoise (95% CI: 127,442-199,954, CV: 0.12) (IAMMWG, 2023). The conservation status of harbour porpoise in UK waters was updated in JNCC (2019c) 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". 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 (Figure 6-2),

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).

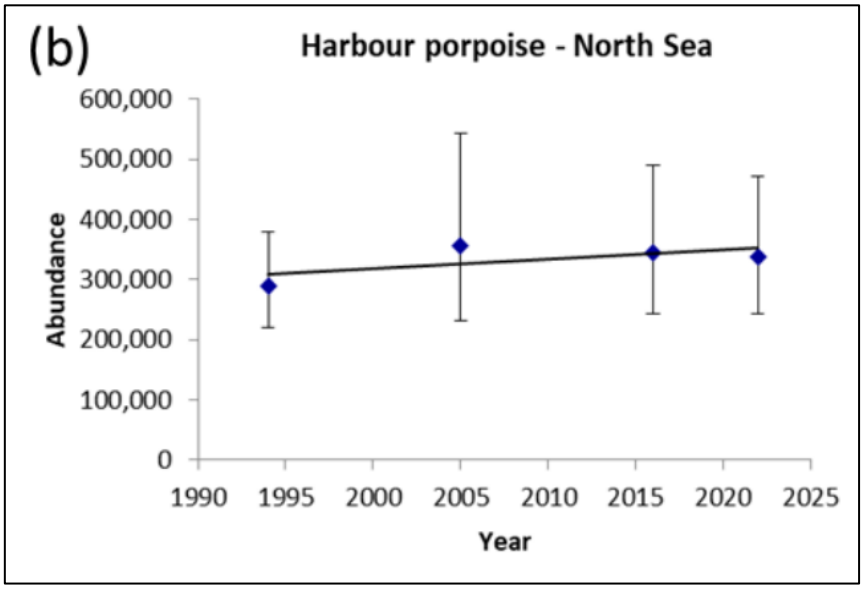


**Figure 6-2:** **North Sea harbour porpoise trend in abundance over the four SCANS surveys (Gilles *et al.*, 2023).**

## 6.2 Site-specific surveys

The two years of site-specific surveys conducted from April 2021 to March 2023 found that harbour porpoise were the most abundant non-avian species present, with peaks observed in May 2022 (130 harbour porpoise; Figure 6-3). Absolute density estimates ranged from 0 porpoise/km$^2$ (February and March 2022) to 2.55 porpoise/km$^2$ (95% CI 1.52 – 3.77) in May 2022 (Figure 6-4 and Table 6-1). Harbour porpoises appeared to show some degree of seasonality within the survey area (Scotwind E2 PO site), with a maximum estimated absolute density of 2.55 porpoise/km$^2$ occurring in late spring and remaining higher during the summer months, compared to a maximum estimated absolute density of 0.69 porpoise/km$^2$ during winter months. The average density estimate over the two years of site-specific surveys was 0.47 porpoise/km$^2$ (Table 6-1). There was clear seasonal variation in harbour porpoise density across the seasons; the average density was highest during spring (March, April and May) at 0.79 harbour porpoise/km$^2$ and lowest in winter (December, January and February) at 0.19 harbour porpoise/km$^2$.

The spatial distribution of these species is also presented (Figure 6-5, Figure 6-6, Figure 6-7 and Figure 6-8). There was no clear spatial pattern of site usage as spatial variation in the harbour porpoise sightings was observed throughout the two-year survey period, with all areas of the survey area (Scotwind E2 PO site) showing some evidence of usage.

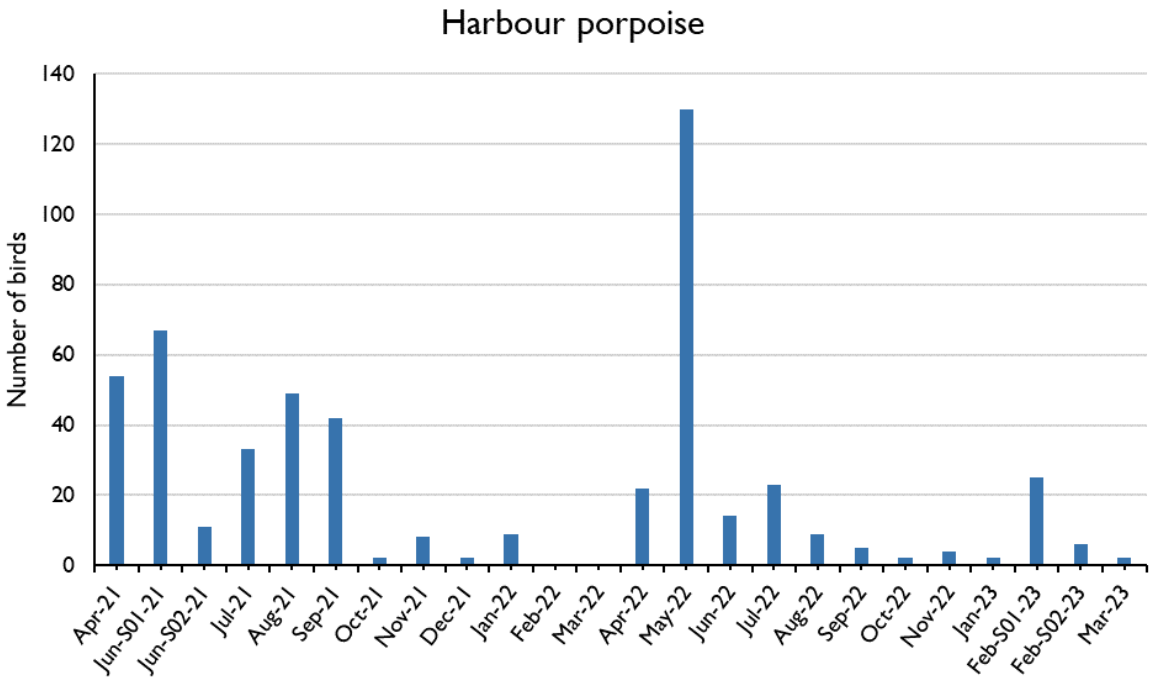


**Figure 6-3:** **The number of harbour porpoise recorded between April 2021 and March 2023 in the survey area (Scotwind E2 PO site plus 4 km buffer) (HiDef Aerial Surveying Limited, 2023b).**

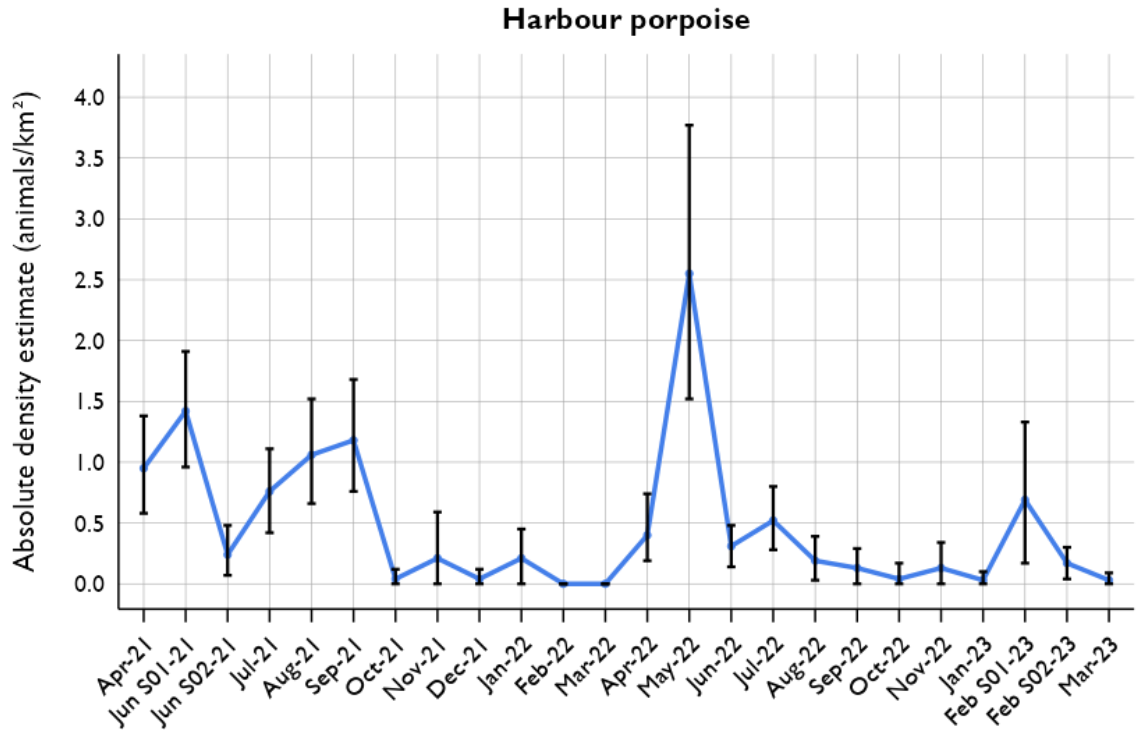


**Figure 6-4:** **Harbour porpoise absolute density estimates, with 95% lower and upper confidence limits, in the survey area (Scotwind E2 PO site plus 4 km buffer), between April 2021 and March 2023 (HiDef Aerial Surveying Limited, 2023b).**

**Table 6-1:** **Relative and absolute apportioned monthly density and population estimates for harbour porpoise in the survey area (Scotwind E2 PO site plus 4 km buffer) between April 2021 and March 2023 (corrected for availability bias). Data from HiDef Aerial Surveying Limited (2023b).**

| Date | # observed | Relative estimates | | | | Absolute estimates | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Density estimate (#/km²) | Abundance estimate | Confidence Intervals (CIs) | | Density estimate (#/km²) | Abundance estimate | Confidence Intervals (CIs) | |
| 15 Ap 2021 | 54 | 0.36 | 549 | 345 | 791 | 0.95 | 1,453 | 913 | 2,094 |
| 05 Jun 2021 | 67 | 0.43 | 661 | 443 | 885 | 1.42 | 2,182 | 1462 | 2,922 |
| 12 Jun 2021 | 11 | 0.07 | 109 | 30 | 209 | 0.24 | 3,71 | 102 | 711 |
| 17 Jul 2021 | 33 | 0.22 | 331 | 190 | 487 | 0.76 | 11,48 | 659 | 1,689 |
| 04 Aug 2021 | 49 | 0.32 | 492 | 309 | 705 | 1.06 | 1,630 | 1024 | 2,336 |
| 06 Sep 2021 | 42 | 0.28 | 427 | 273 | 618 | 1.18 | 1,798 | 1,150 | 2,603 |
| 08 Oct 2021 | 2 | 0.01 | 21 | 0 | 49 | 0.04 | 87 | 0 | 203 |
| 11 Nov 2021 | 8 | 0.05 | 80 | 0 | 208 | 0.21 | 337 | 0 | 876 |
| 12 Dec 2021 | 2 | 0.01 | 20 | 0 | 49 | 0.04 | 80 | 0 | 195 |
| 09 Jan 2022 | 9 | 0.06 | 89 | 0 | 199 | 0.21 | 311 | 0 | 694 |
| 26 Feb 2022 | 0 | 0.00 | 0 | 0 | 0 | 0.00 | 0 | 0 | 0 |
| 07 Mar 2022 | 0 | 0.00 | 0 | 0 | 0 | 0.00 | 0 | 0 | 0 |
| 02 Apr 2022 | 22 | 0.15 | 227 | 107 | 427 | 0.40 | 601 | 283 | 1,130 |
| 07 May 2022 | 130 | 0.84 | 1,292 | 767 | 1907 | 2.55 | 3,924 | 2,330 | 5,792 |
| 14 Jun 2022 | 14 | 0.09 | 140 | 68 | 219 | 0.31 | 476 | 231 | 745 |
| 07 Jul 2022 | 23 | 0.15 | 230 | 117 | 351 | 0.52 | 798 | 406 | 1,217 |
| 03 Aug 2022 | 9 | 0.06 | 90 | 20 | 184 | 0.19 | 290 | 65 | 594 |
| 21 Sep 2022 | 5 | 0.03 | 49 | 0 | 109 | 0.13 | 206 | 0 | 459 |
| 13 Oct 2022 | 2 | 0.01 | 21 | 0 | 61 | 0.04 | 87 | 0 | 253 |
| 24 Nov 2022 | 4 | 0.03 | 39 | 0 | 120 | 0.13 | 164 | 0 | 505 |
| 20 Jan 2023 | 2 | 0.01 | 20 | 0 | 49 | 0.03 | 70 | 0 | 171 |
| 07 Feb 2023 | 25 | 0.16 | 248 | 69 | 476 | 0.69 | 1,066 | 296 | 2,045 |
| 23 Feb 2023 | 6 | 0.04 | 61 | 20 | 108 | 0.17 | 262 | 86 | 464 |
| 25 Mar 2023 | 2 | 0.01 | 22 | 0 | 50 | 0.03 | 69 | 0 | 157 |
| **Two-year mean** | **22** | **0.14** | **217** | - | - | **0.47** | **725** | - | - |
| **Spring average (Mar Apr May)** | | | | | | **0.79** | - | - | - |
| **Summer average (Jun Jul Aug)** | | | | | | **0.64** | - | - | - |
| **Autumn average (Sep Oct Nov)** | | | | | | **0.29** | - | - | - |
| **Winter average (Dec Jan Feb)** | | | | | | **0.19** | - | - | - |

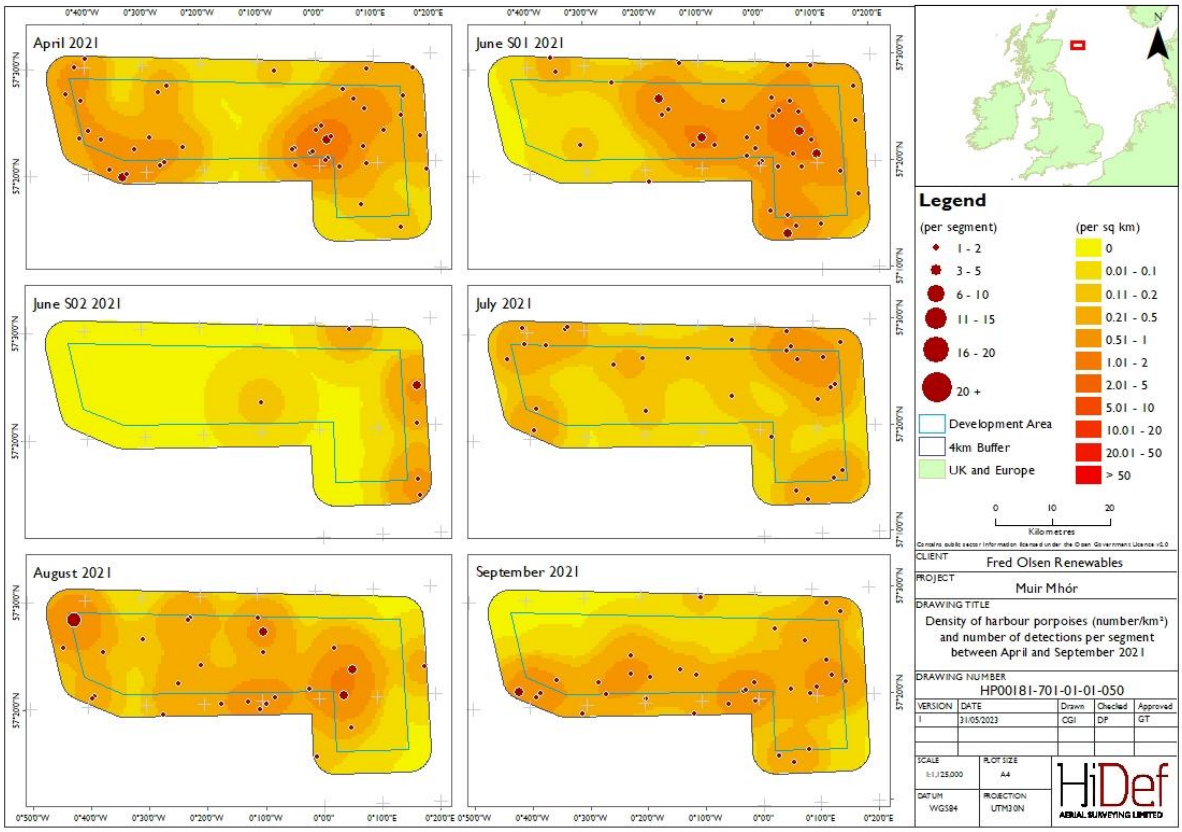


**Figure 6-5:** **Density of harbour porpoises (number/km²) and number of detections per segment in the survey area (Scotwind E2 PO site plus 4 km buffer) between April and September 2021 (HiDef Aerial Surveying Limited, 2023b).**

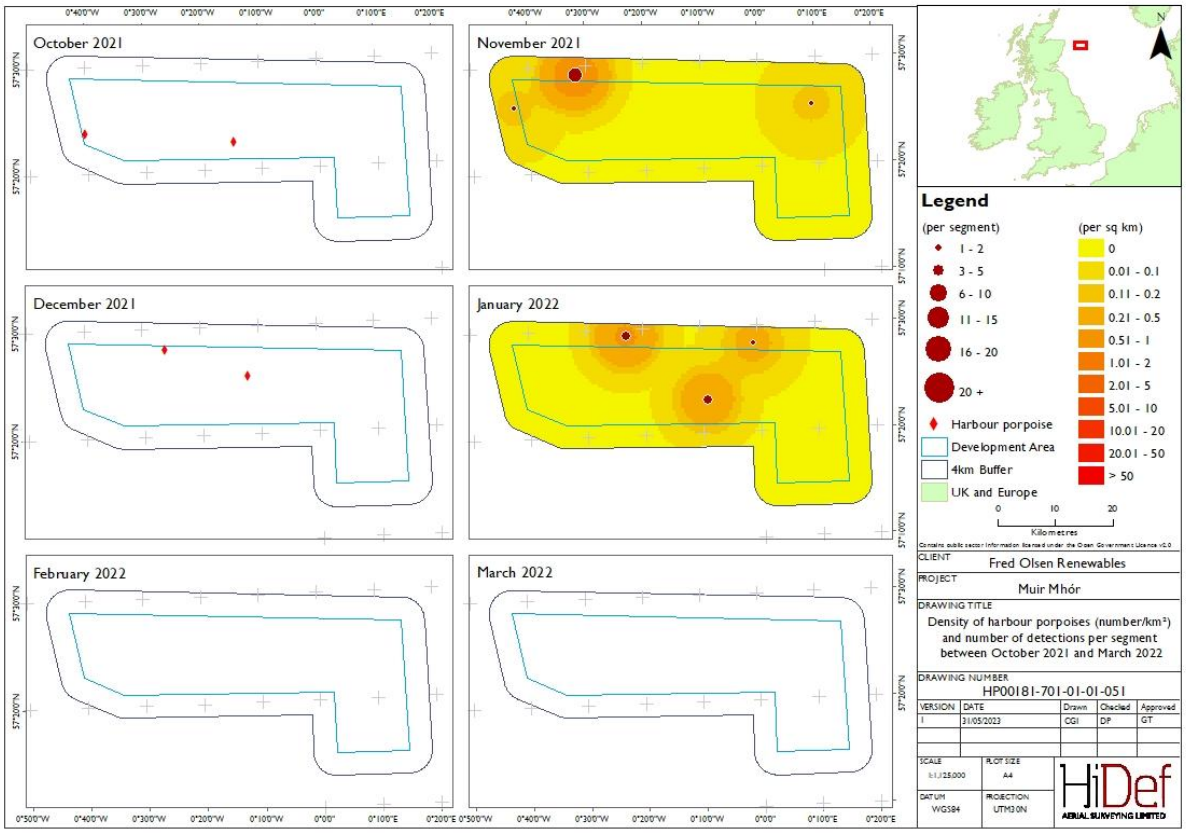


**Figure 6-6:** **Density of harbour porpoises (number/km²) and number of detections per segment in the survey area (Scotwind E2 PO site plus 4 km buffer) between October 2021 and March 2022 (HiDef Aerial Surveying Limited, 2023b).**

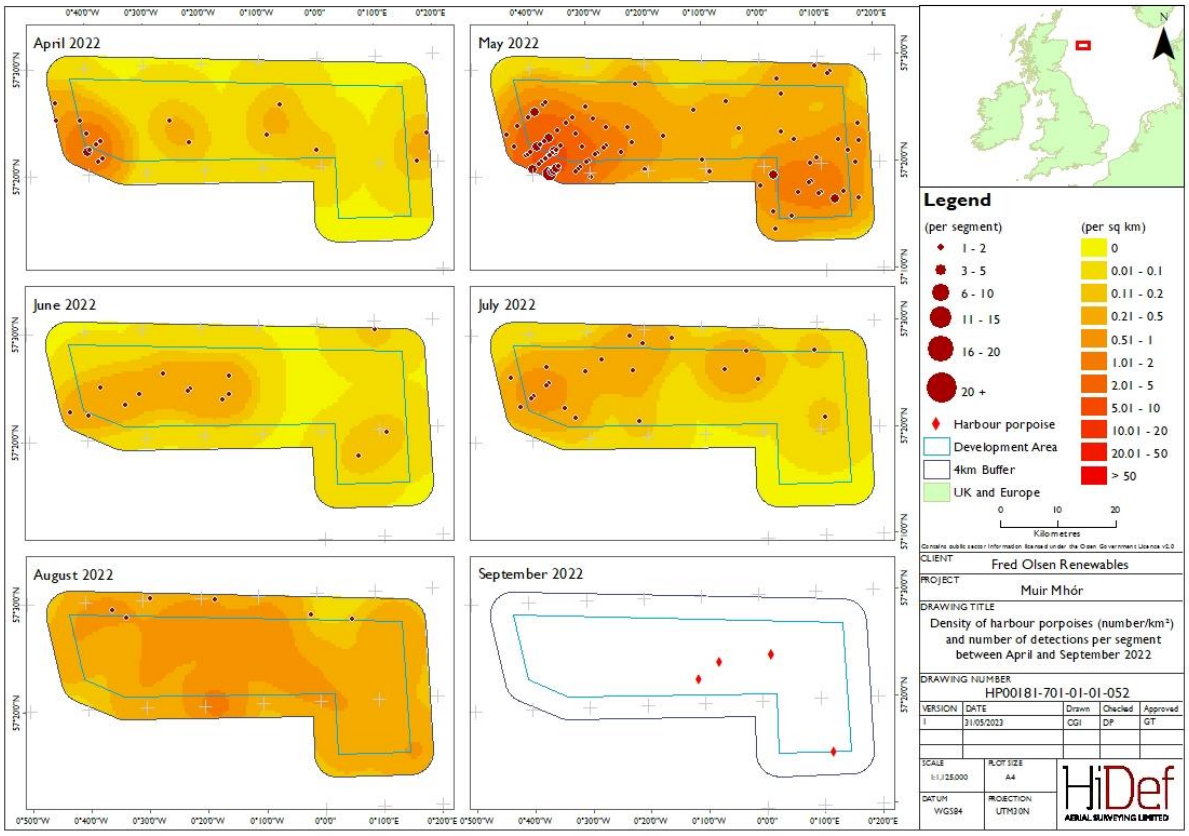


**Figure 6-7:** **Density of harbour porpoises (number/km²) and number of detections per segment in the survey area (Scotwind E2 PO site plus 4 km buffer) between April and September 2022 (HiDef Aerial Surveying Limited, 2023b).**

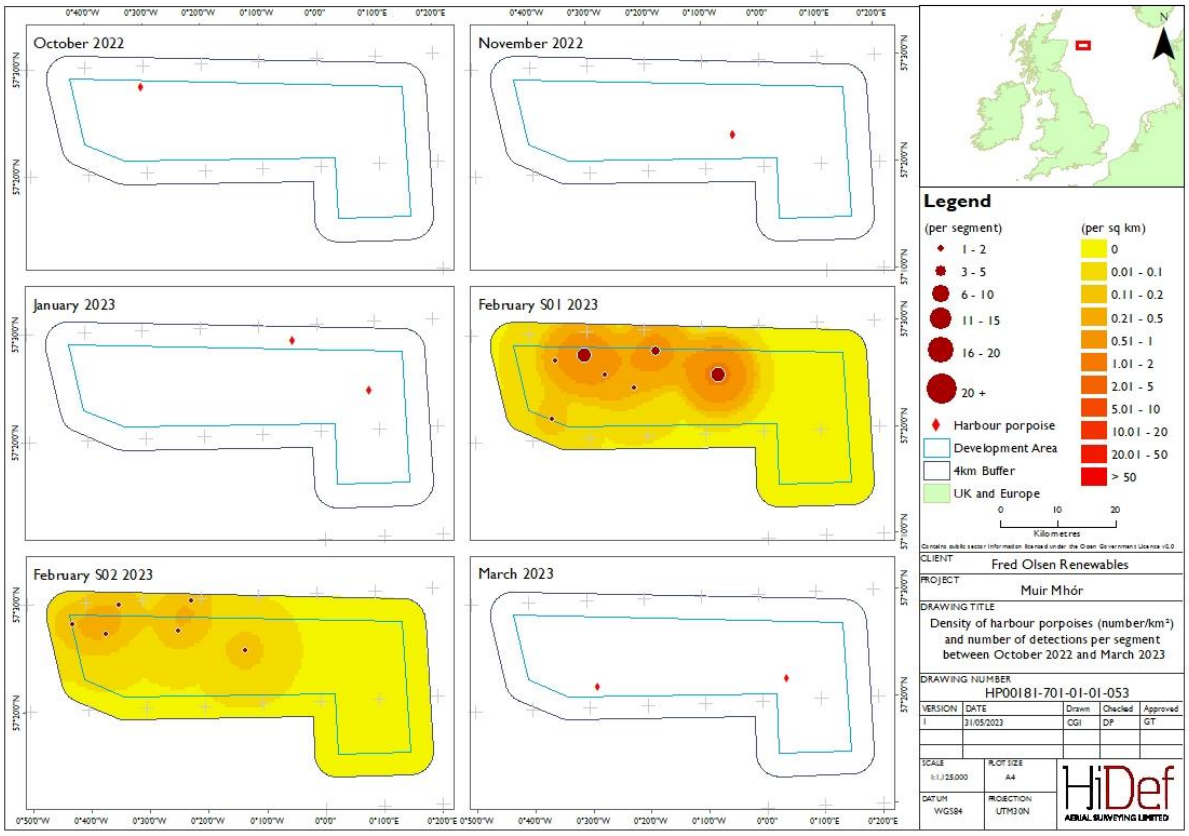


**Figure 6-8:** **Density of harbour porpoises (number/km²) and number of detections per segment in the survey area (Scotwind E2 PO site plus 4 km buffer) between October 2022 and March 2023 (HiDef Aerial Surveying Limited, 2023b).**

## 6.3 Regional surveys

The two years of regional surveys conducted from April 2022 to August 2023 found that harbour porpoise were the most abundant non-avian species present, with peaks observed in July 2022 (234 harbour porpoise; Figure 6-9). Absolute density estimates ranged from 0 porpoise/km$^2$ (95% CI 0 – 0.05) to 1.68 porpoise/km$^2$ (95% CI 1.52 – 3.77) in July 2022 (Figure 6-10 and Table 6-2). The average density estimate over the 18 months of regional surveys was 0.33 porpoise/km$^2$ (Table 6-2). The report states that harbour porpoise presence varied on a monthly basis with no strong seasonal pattern observed (HiDef Aerial Surveying Limited, 2023c).

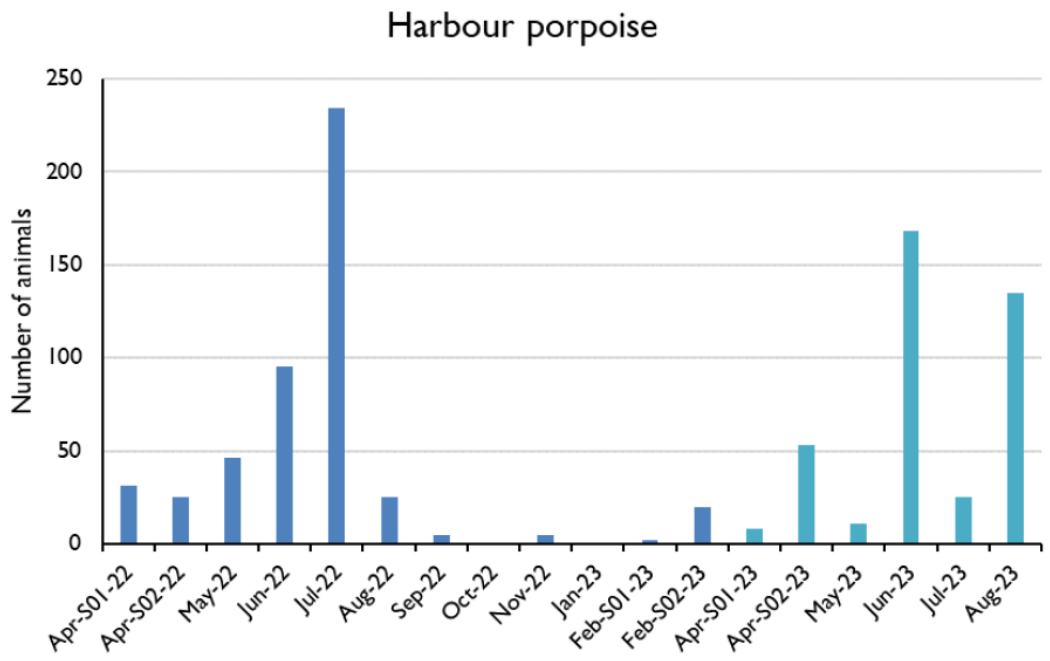


**Figure 6-9 Number of harbour porpoise recorded between April 2022 and August 2023 in the survey area (HiDef Aerial Surveying Limited, 2023c).**

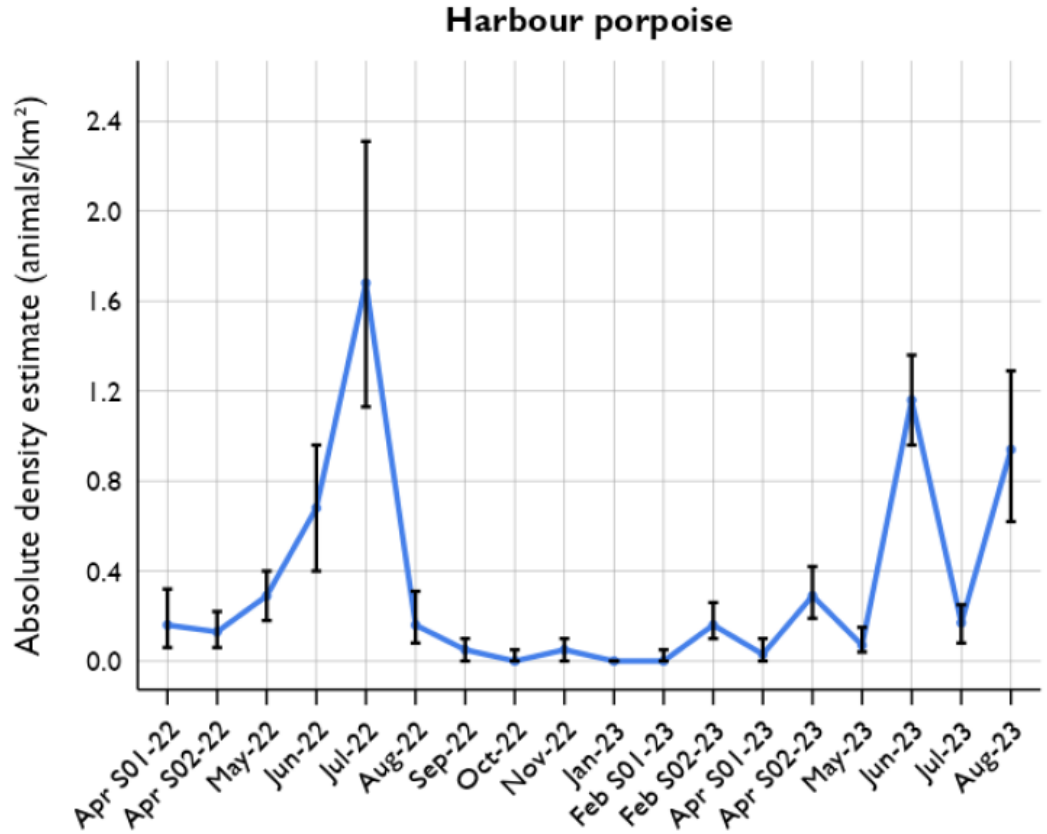


**Figure 6-10 Harbour porpoise absolute density estimates, with 95% lower and upper confidence limits, in the regional survey area, between April 2022 and August 2023 (HiDef Aerial Surveying Limited, 2023c).**

**Table 6-2:** **Relative and absolute apportioned monthly density and population estimates for harbour porpoise in the regional survey area (Scotwind E1 and E2 PO site plus 12 km buffer) between April 2022 and August 2023 (corrected for availability bias). Data from HiDef Aerial Surveying Limited (2023c) .**

| Date | # observed | Relative estimates | | | | Absolute estimates | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Density estimate (#/km²) | Abundance estimate | Confidence Intervals (CIs) | | Density estimate (#/km²) | Abundance estimate | Confidence Intervals (CIs) | |
| 10 Apr 2022 | 32 | 0.05 | 624 | 274 | 1,112 | 0.16 | 2,000 | 878 | 3,563 |
| 23 Apr 2022 | 25 | 0.04 | 505 | 251 | 798 | 0.13 | 1,618 | 804 | 2,557 |
| 20 May 2022 | 47 | 0.08 | 937 | 608 | 1,290 | 0.29 | 3,445 | 2,235 | 4,743 |
| 23 Jun 2022 | 98 | 0.17 | 1934 | 1,197 | 2,774 | 0.68 | 7,729 | 4,783 | 11,085 |
| 18 Jul 2022 | 259 | 0.40 | 4654 | 3,111 | 6,401 | 1.68 | 19,541 | 13,062 | 26,876 |
| 19 Aug 2022 | 25 | 0.04 | 500 | 179 | 874 | 0.16 | 1,953 | 699 | 3,414 |
| 14 Sep2022 | 5 | 0.01 | 118 | 21 | 221 | 0.05 | 582 | 103 | 1,089 |
| 02 Oct 2022 | 1 | 0.00 | 20 | 0 | 60 | 0.00 | 100 | 0 | 301 |
| 04 Nov 2022 | 5 | 0.01 | 97 | 20 | 195 | 0.05 | 495 | 102 | 994 |
| 09 Jan 2023 | 0 | 0.00 | 0 | 0 | 0 | 0.00 | 0 | 0 | 0 |
| 06 Feb 2023 | 2 | 0.00 | 38 | 0 | 99 | 0.00 | 198 | 0 | 515 |
| 21 Feb 2023 | 20 | 0.03 | 402 | 219 | 617 | 0.16 | 2,091 | 1,139 | 3,209 |
| 04 Apr 2023 | 8 | 0.01 | 160 | 39 | 345 | 0.03 | 513 | 125 | 1,105 |
| 21 Apr 2023 | 56 | 0.09 | 1065 | 675 | 1,553 | 0.29 | 3,413 | 2,163 | 4,976 |
| 16 May 2023 | 14 | 0.02 | 220 | 60 | 436 | 0.07 | 809 | 221 | 1,603 |
| 15 Jun 2023 | 170 | 0.29 | 3,395 | 2,767 | 3,980 | 1.16 | 13,567 | 11,057 | 15,905 |
| 08 Jul 2023 | 26 | 0.04 | 494 | 256 | 741 | 0.17 | 2,074 | 1,075 | 3,111 |
| 05 Aug 2023 | 140 | 0.24 | 2,753 | 1,835 | 3,820 | 0.94 | 10,752 | 7,167 | 14,920 |
| **18 month mean** | **52** | **0.08** | **995** | **640** | **1,406** | **0.33** | **3,738** | **2,534** | **5,554** |

## 6.4 Geophysical survey MMO report

During the geophysical surveys, there were two sightings of single harbour porpoise: one in April and the other in June 2023 (EGS (International) Limited, 2023). No density estimate was calculated.

## 6.5 SCANS surveys

### 6.5.1 SCANS III

The Proposed Development is located within the SCANS III survey block R, where there was an estimated block-wide abundance of 38,646 harbour porpoise (95% CI: 20,584 – 66,524) and an

estimated density of 0.599 harbour porpoise/km$^2$ in July 2016 (CV = 0.287) (Hammond *et al.*, 2021). Abundance (26,309, 95% CI: 14,219 – 45,280) and density (0.402 harbour porpoise/km$^2$, CV = 0.295) in the neighbouring block T was lower than in the block R (Hammond *et al.*, 2021). The SCANS III 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.

#### 6.5.1.1 SCANS III density surface

Lacey *et al.* (2022) used the SCANS III data and spatially referenced environmental features to predict density estimates for harbour porpoises (Figure 6-11). The highest densities are predicted in the central and southern North Sea. Around Scotland, high densities were located around east and southeast Scotland, which are still considerably lower compared to the central and southern North Sea values (Figure 6-11). The density range for grid cells within the Array Area is 0.607-0.708 porpoise/km$^2$.

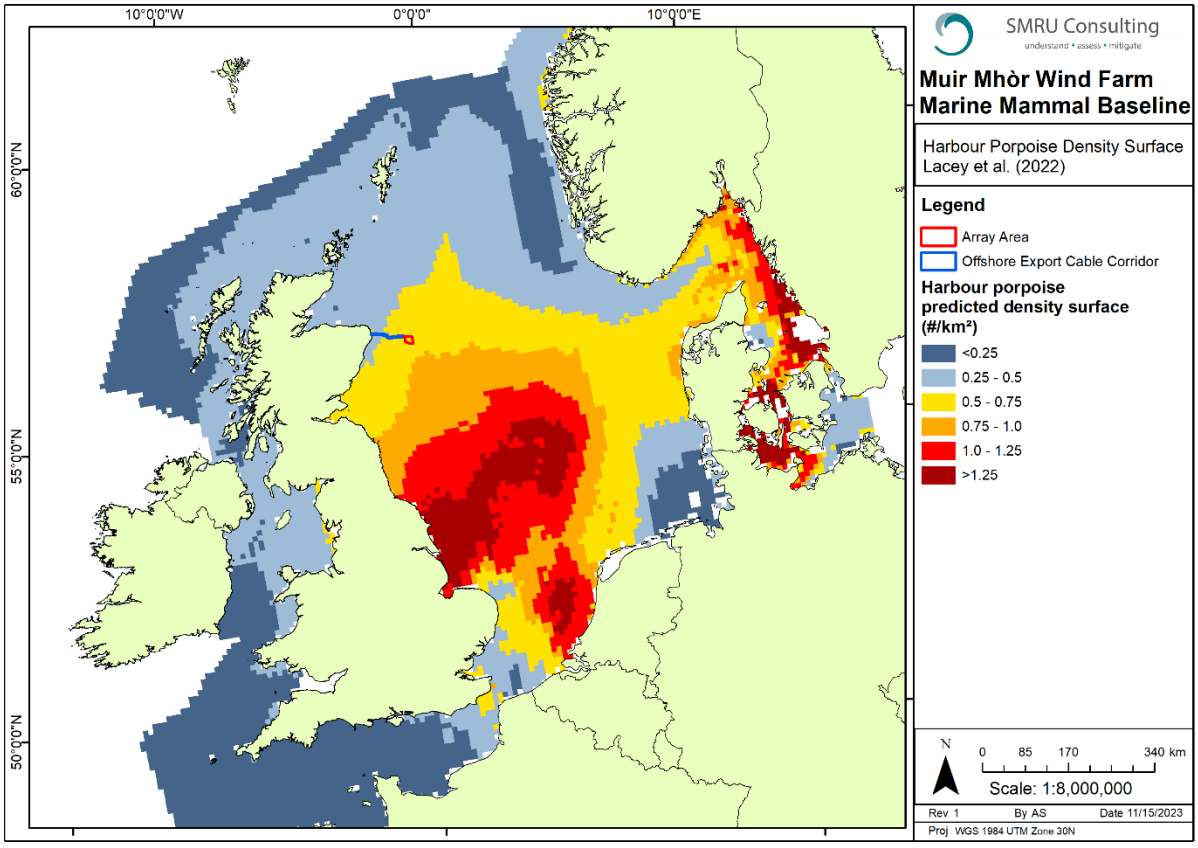


**Figure 6-11: Predicted surface of estimated density for harbour porpoise in SCANS III. Data from Lacey *et al.* (2022).**

### 6.5.2 SCANS IV

The Proposed Development is located within the SCANS IV survey block NS-D, where there was an estimated block-wide abundance of 38,577 harbour porpoise (95% CI: 18,017 – 76,361) and an estimated density of 0.5985 harbour porpoise/km$^2$ (CV = 0.367) (Gilles *et al.*, 2023). 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 slightly lower than in the block NS-D. 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.

## 6.6 JCP data

### 6.6.1 JCP Phase III

Paxton *et al.* (2016) used the JCP dataset to provide estimates of the density of harbour porpoise (Figure 6-12 and Figure 6-13). The highest predicted densities in the point surface are shown in southern North Sea, around west, north, and northeast of Scotland, and southeast Celtic Sea. Harbour porpoise densities are generally much lower further offshore. Density estimates for Firth of Forth, a 14,241 km$^2$ region to the east of Scotland where the proposed development is located, showed that harbour porpoise density was higher in winter months compared to the rest of the year and reached a maximum of 0.49 porpoise/km$^2$ and an average of 0.31 porpoise/km$^2$ over the year. The density estimate trend was similar in the Moray Firth, a 7,899 km$^2$ region just north of Firth of Forth, with higher winter density of 1.71 porpoise/km$^2$ and an average of 1.14 porpoise/km$^2$ over the year (Table 6-3).

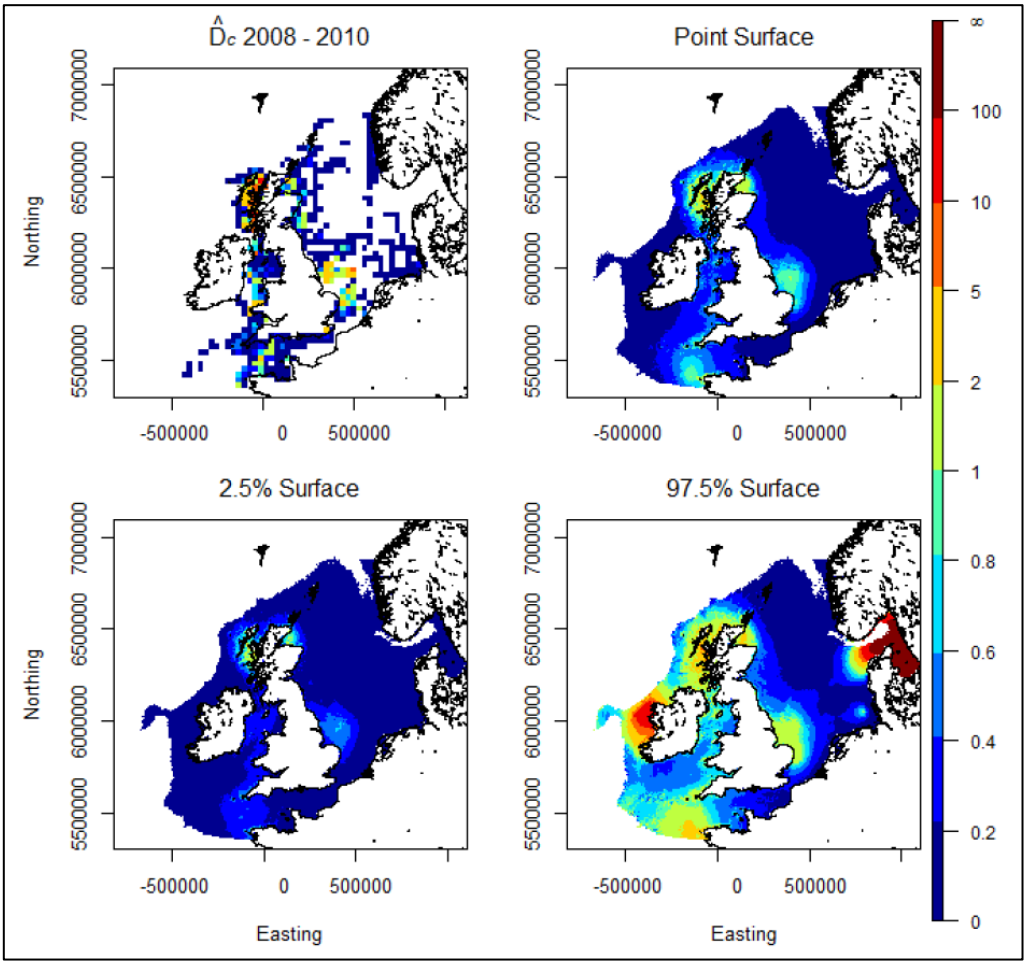


**Figure 6-12:** **Predicted harbour porpoise densities for summer 2010 (Paxton *et al.*, 2016). Top left; input densities (summer all years), top right; point estimate of cell densities, bottom left; lower (2.5%) confidence limit on cell densities, bottom right; upper (97.5%) confidence limit on cell densities (porpoise/km$^2$). Note that the top left plot exaggerates the spatial coverage of the relevant effort.**

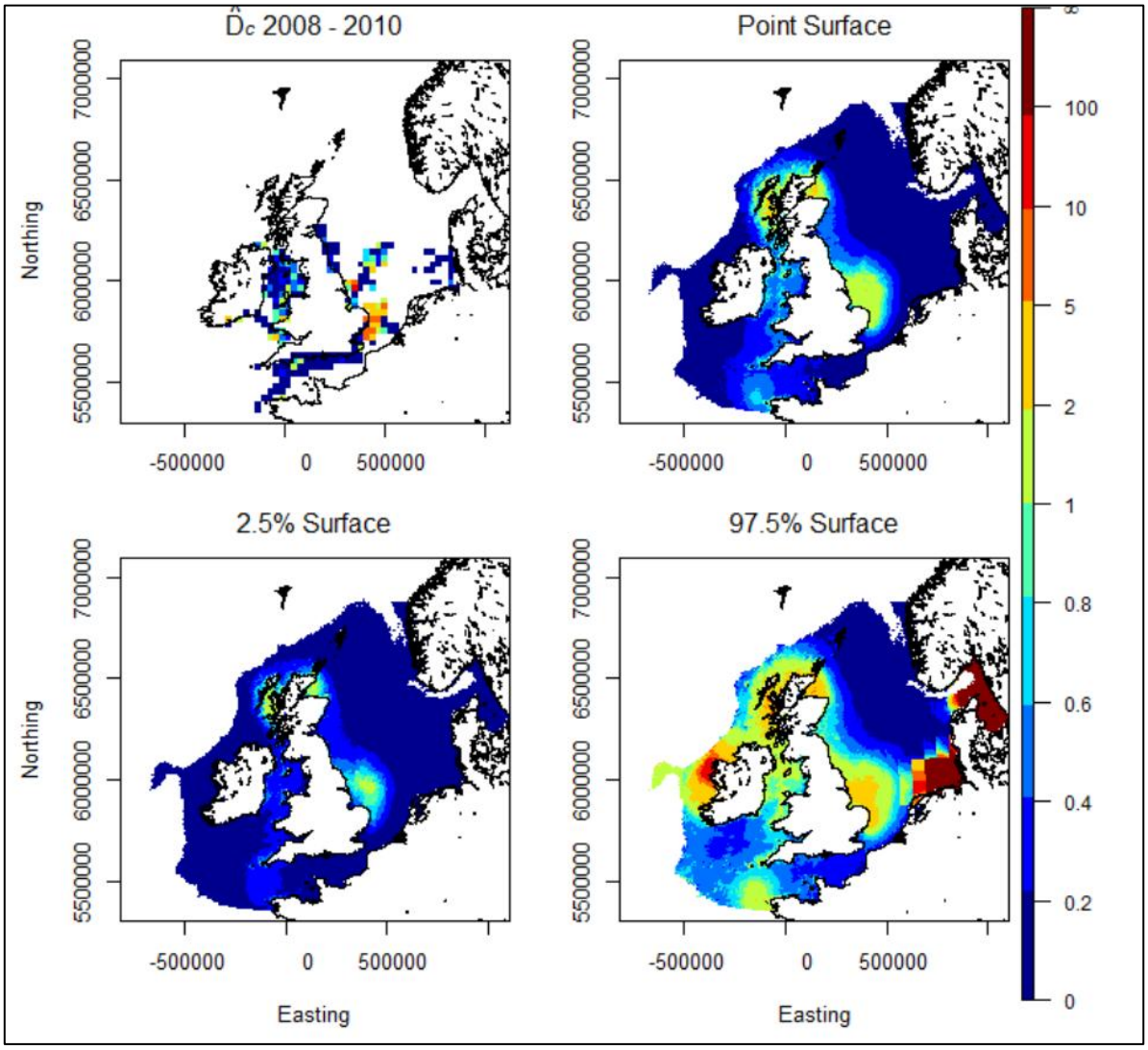


**Figure 6-13:** **Predicted harbour porpoise densities for winter 2010 (Paxton *et al.*, 2016). Top left; input densities (summer all years), top right; point estimate of cell densities, bottom left; lower (2.5%) confidence limit on cell densities, bottom right; upper (97.5%) confidence limit on cell densities (porpoise/km$^2$). Note that the top left plot exaggerates the spatial coverage of the relevant effort.**

**Table 6-3:** **JCP Phase III abundance and density estimates for harbour porpoise in 2010 for the Firth of Forth and Moray Firth commercial areas of interest (Paxton *et al.*, 2016).**

| Area | Season | Abundance point estimate | 95% CI | Density (#/km$^2$) |
|---|---|---|---|---|
| Firth of Forth | Winter | 7,000 | 5,200 – 11,800 | 0.49 |
| | Spring | 3,500 | 1,900 – 6,600 | 0.25 |
| | Summer | 4,400 | 2,90 – 6,800 | 0.31 |
| | Autumn | 2,500 | 1,600 – 3,600 | 0.18 |
| **Average** | | **4,350** | - | **0.31** |
| Moray Firth | Winter | 13,500 | 7,400 – 27,100 | 1.71 |
| | Spring | 8,100 | 5,200 – 16,200 | 1.03 |
| | Summer | 9,000 | 5,800 – 13,500 | 1.14 |
| | Autumn | 5,300 | 3,200 – 9,500 | 0.67 |
| **Average** | | **8,975** | - | **1.14** |

### 6.6.2 JCP data analysis tool

The JCP Phase III Data Analysis Product provided a density estimate of 0.296 harbour porpoise/km$^2$ (95% CI: 0.123-0.420) in the user specified area, averaged for the summer 2007-2010 (Table 6-4). It is important to note that this estimate is for the summer months only and is not representative of densities at other times of the year.

**Table 6-4:** **JCP Phase III Data Analysis Product scaled abundance and density estimates for harbour porpoise for the user specified area averaged for the summer 2007-2010.**

| | Scaled abundance | Density (#/km$^2$) |
|---|---|---|
| Point estimate | 4,006 | 0.296 |
| Lower confidence interval | 1,669 | 0.123 |
| Upper confidence interval | 5,675 | 0.420 |

### 6.6.3 Porpoise high density areas

Discrete and persistent areas of relatively high harbour porpoise densities in the wider UK marine area were identified by Heinänen and Skov (2015) through the use of detailed analyses of 18 year of survey data as part of the JCP. The analysis concluded that in the summer months, harbour porpoise presence in the North Sea MU was best predicted by season, water depth, surface salinity and eddy potential, while the density was best predicted by season, the water depth and the vertical temperature gradient. For the summer months the modelling showed a peak in densities at the inner shelf waters (30 to- 50 m depth) and that animals seemed to avoid well mixed areas and waters with high current speeds as well as avoiding areas with muddy or hard bottom substrates. In the winter months the presence of harbour porpoise was best predicted by the season, water depth, eddy potential and the surface sediments. For the winter months the modelling showed a peak in presence was observed at water depths of 30 to 40 m and that animals seemed to avoid waters with high current speeds as well as avoiding areas with muddy bottom substrates.

The analysis conducted by Heinänen and Skov (2015) showed that density estimates were low in the summer months in the vicinity of the proposed development (0.8-0.9 porpoise/km$^2$). During the winter months, porpoise densities were highly variable, with low densities of ≤0.3 porpoise/km$^2$ in 1997 and 2007, but high densities in winter 2004 when the density was ≥3 porpoise/km$^2$ (Figure 6-11).

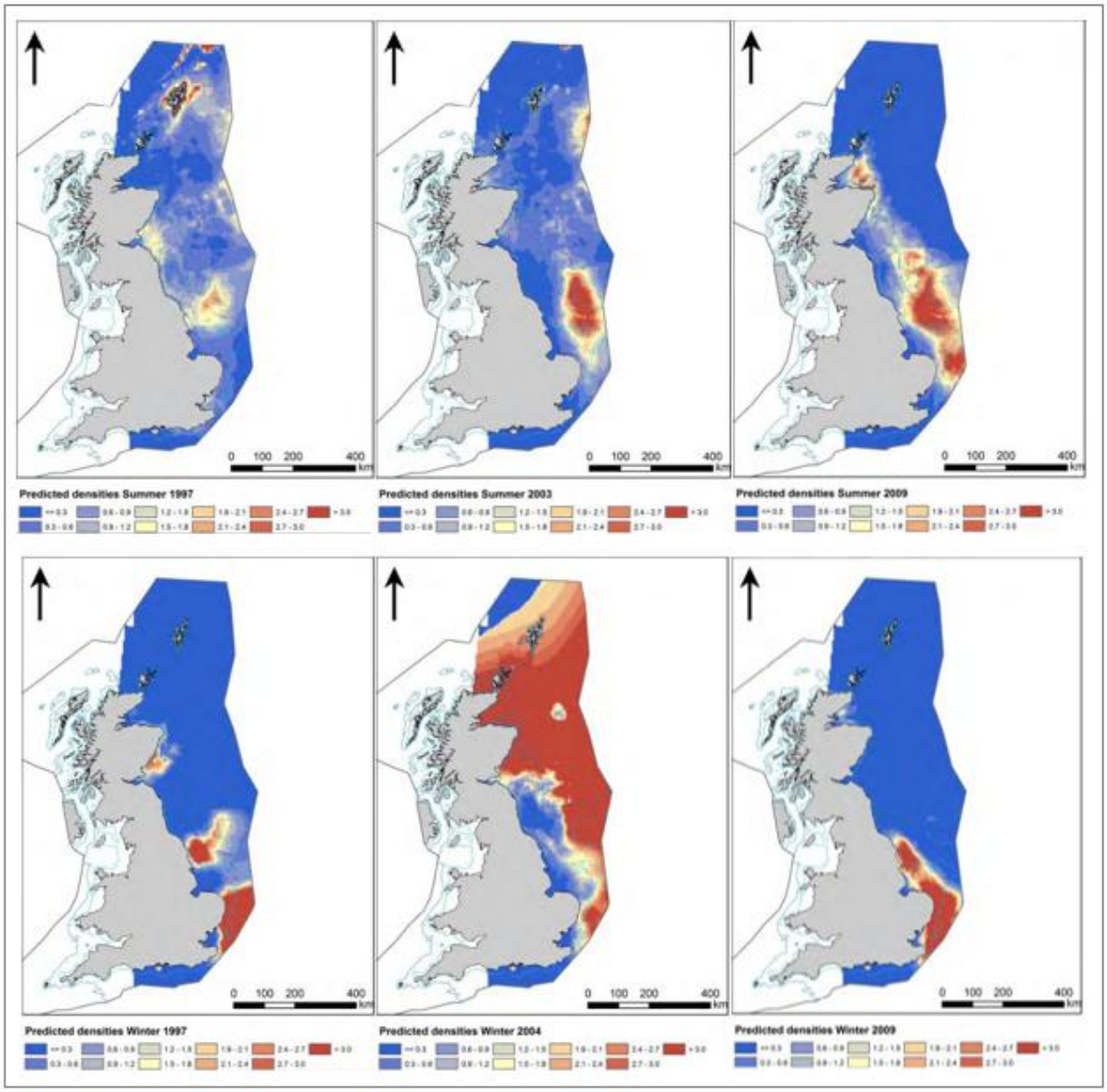


**Figure 6-14:** **Predicted densities (porpoise/km$^2$) during summer (top panel) and winter (bottom panel) in management unit 1 for three different years in each model period (Heinänen and Skov 2015).**

### 6.6.4 MERP

Density maps were produced by Waggitt *et al.* (2019) as part of the MERP project; however, these maps are not considered to be suitable for quantitative impact assessments and are provided in this baseline characterisation for illustrative purposes only. The highest densities were predicted for the southern North Sea and moderate densities has been demonstrated by the analyses presented in Waggitt *et al.* (2019). The maximum harbour porpoise density for grid cells within the Array Area is

0.252 harbour porpoise/km$^2$ for January and 0.448 harbour porpoise/km$^2$ for July. The minimum density for grid cells within the Array Area is 0.206 harbour porpoise/km$^2$ for January and 0.397 harbour porpoise/km$^2$ for July (Figure 6-15).

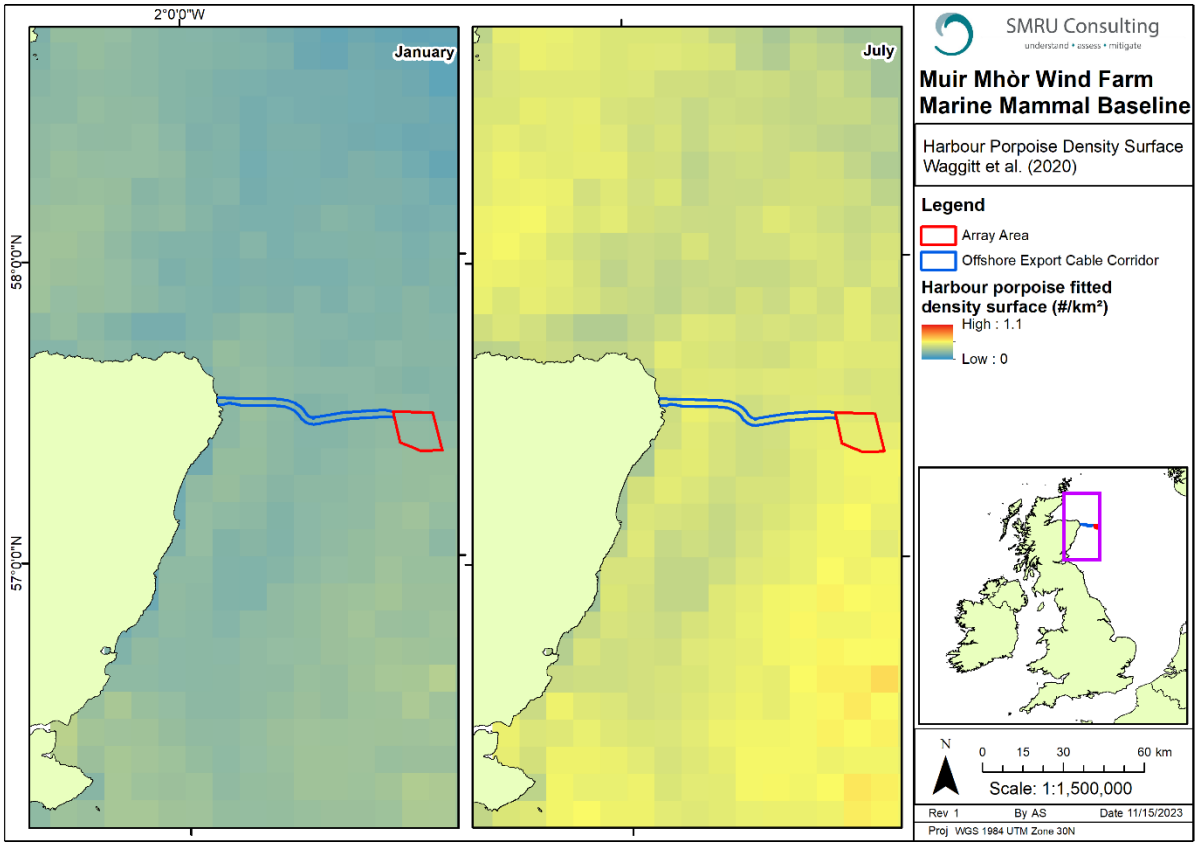


**Figure 6-15: Harbour porpoise density surface (porpoise/km$^2$) (January and July). Data from Waggitt *et al.* (2019).**

## 6.7 ECOMMAS

The ECOMMAS data presented below consists of CPOD data collected from 2013 – 2022 (note: data for 2020 are absent due to Covid-19 restrictions, preventing field work from occurring).

The data presented are inclusive of two ECOMMAS sites, Cruden Bay and Fraserburgh. Each of these sites have three PAM stations which are located approximately 5, 10 and 15 km from the coast. Porpoise were identified across all sites, with calculations of DPDs per year (Table 6-5) and average DPHs per year (Table 6-6) presented below. Data have also been visualised for DPH across each of the stations at the Cruden Bay (Figure 6-16) and Fraserburgh (Figure 6-17) sites.

These data conclude that harbour porpoises were consistently found in the coastal areas monitored by ECOMMAS. There is clear evidence from both Cruden Bay (Figure 6-16) and Fraserburgh (Figure 6-17) of seasonal variation present for harbour porpoise detection positive hours throughout the years. There was no obvious pattern in porpoise detection positive hours, or detection positive days, in relation to distance from the shore, for either the Cruden Bay or Fraserburgh sites. The Fraserburgh site would appear to have a slight increase in mean detection positive hours, compared to Cruden Bay (Table 6-6).

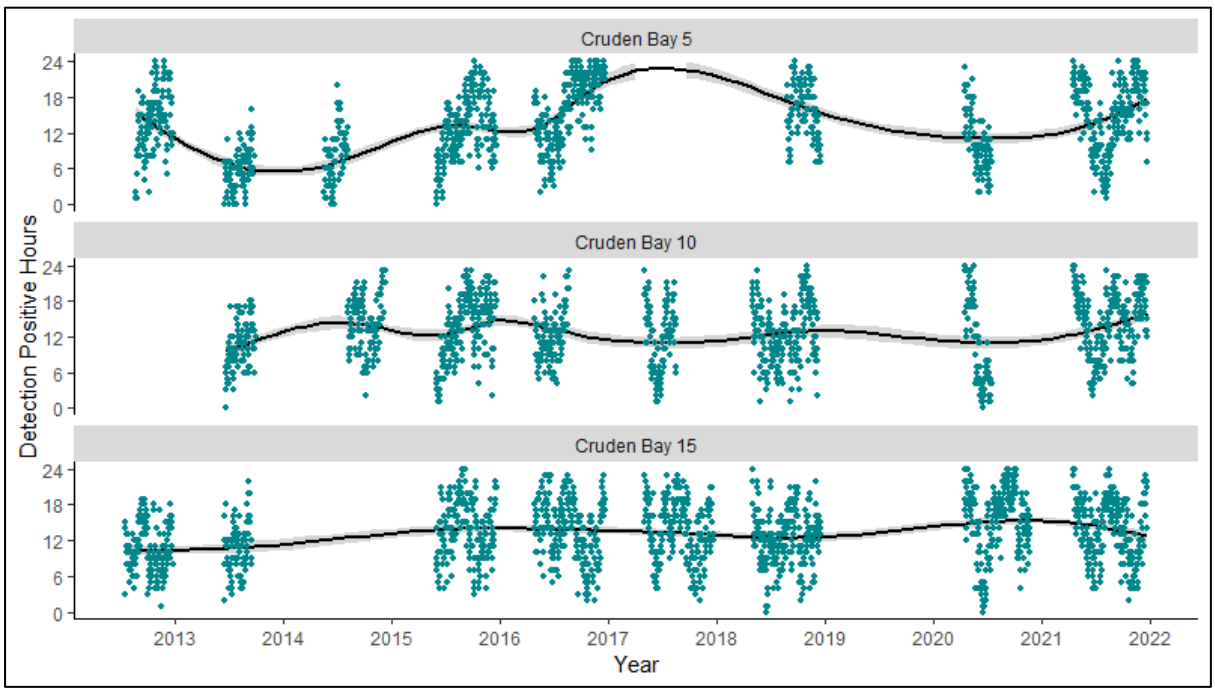


**Figure 6-16:** **Porpoise detection positive hours (DPH) at the Cruden Bay ECOMMAS stations from 2013 – 2022. CPOD data provided by Marine Directorate.**

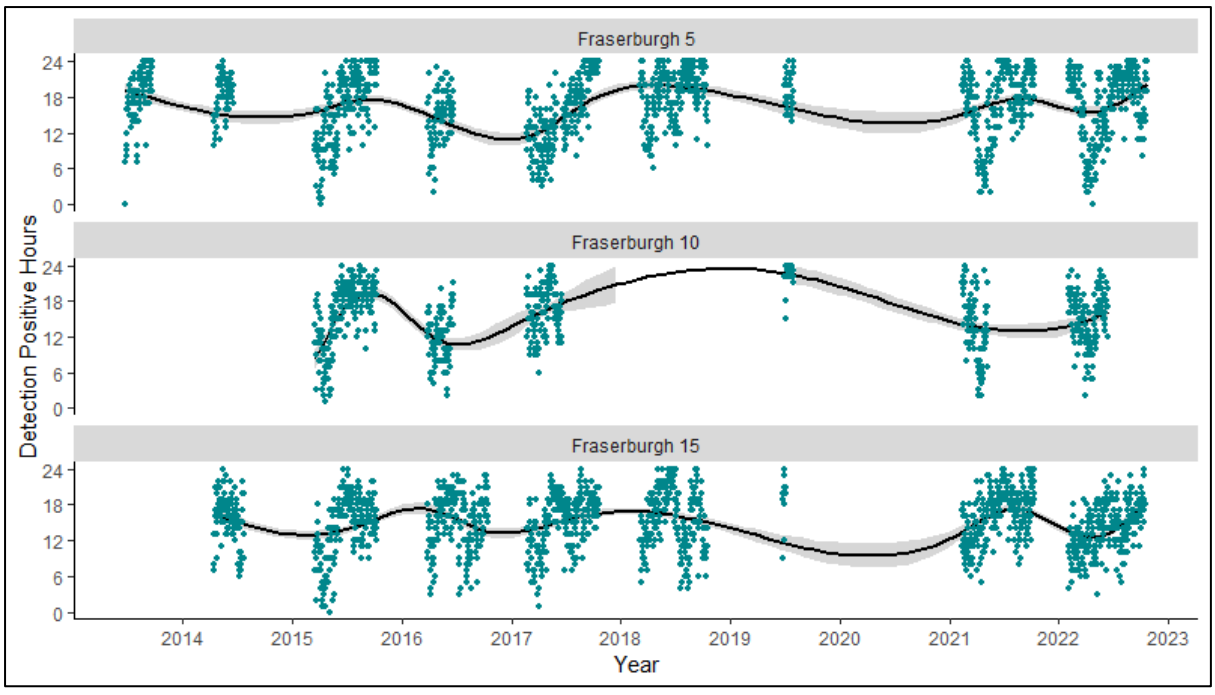


**Figure 6-17:** **Porpoise detection positive hours (DPH) at the Fraserburgh ECOMMAS stations from 2013 – 2022. CPOD data provided by Marine Directorate.**

**Table 6-5:** **Percentage of porpoise detection positive days at each ECOMMAS PAM site ('-' denotes no data). CPOD data provided by Marine Directorate.**

| PAM site | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Cruden Bay 5 | 100 | 93 | 97 | 99 | 100 | - | 100 | - | 100 | 100 | **98.6** |
| Cruden Bay 10 | - | 99 | 100 | 100 | 100 | 100 | 100 | - | 96 | 100 | **99.4** |
| Cruden Bay 15 | 100 | 100 | - | 100 | 100 | 100 | 99 | - | 99 | 100 | **99.8** |
| Fraserburgh 5 | 99 | 100 | 99 | 100 | 100 | 100 | 100 | - | 100 | 99 | **99.7** |
| Fraserburgh 10 | - | - | 100 | 100 | 100 | - | 100 | - | 100 | 100 | **100** |
| Fraserburgh 15 | - | 100 | 99 | 100 | 100 | 100 | 100 | - | 100 | 100 | **99.9** |

**Table 6-6:** **Mean detection positive hours of porpoise at each ECOMMAS PAM site ('-' denotes no data). CPOD data provided by Marine Directorate.**

| PAM site | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Cruden Bay 5 | 14 | 5 | 8 | 13 | 16 | - | 16 | - | 11 | 15 | **12.3** |
| Cruden Bay 10 | - | 11 | 14 | 14 | 12 | 12 | 12 | - | 10 | 14 | **12.4** |
| Cruden Bay 15 | 10 | 11 | - | 14 | 14 | 14 | 12 | - | 15 | 14 | **13** |
| Fraserburgh 5 | 18 | 18 | 16 | 14 | 15 | 19 | 19 | - | 17 | 17 | **17** |
| Fraserburgh 10 | - | - | 16 | 11 | 16 | - | 22 | - | 14 | 15 | **15.7** |
| Fraserburgh 15 | - | 16 | 14 | 15 | 15 | 16 | 19 | - | 16 | 14 | **15.6** |

## 6.8 Other OWFs

### 6.8.1 Berwick Bank OWF

Harbour porpoise were sighted on every one of the monthly surveys, resulting in a total of 2,034 harbour porpoise sightings (RPS, 2022a). The mean corrected density of porpoise across all surveys at the site was 0.229 porpoise/km$^2$, with much higher densities estimated in spring (0.826 porpoise/km$^2$) compared to other seasons (0.092 porpoise/km$^2$ in winter, 0.179 porpoise/km$^2$ in summer and 0.096 porpoise/km$^2$ in autumn).

### 6.8.2 Green Volt OWF

Harbour porpoise were sighted across the Green Volt site-specific survey area, with highest densities in the southeast of the survey area in the summer months (July and August). In year 1, the monthly absolute density estimates ranged between 0.09 animals/km$^2$ in December 2020 and 8.89 animals/km$^2$ in July 2020. In year 2 the monthly absolute density estimates ranged between 0.09 animals/km$^2$ in December 2021 and 0.61 animals/km$^2$ in August 2021. The average absolute density

estimate over the 24 months of surveys was estimated to be 0.76 animals/km$^2$ (Royal HaskoningDHV, 2023).

### 6.8.3 Ossian OWF

Harbour porpoise were the most abundant marine mammal species present at Ossian, observed in all but three of the 24 months of survey. Peak harbour porpoise counts occurred in July 2021 where 140 porpoise were observed. Absolute densities were highest in the summer bio-season (April to September) at 0.651 animals/km2 (95% CI: 0.365-0.931) and lower in the winter bio-season (October to March) 0.062 animals/km$^2$ (95% CI: 0.035-0.089). The average annual density estimate was 0.357 animals/km$^2$ (95% CI: 0.200-0.510) (RPS, 2024).

### 6.8.4 Seagreen OWF

No site-specific data are currently available from the post-consent surveys for Seagreen.

### 6.8.5 Salamander OWF

Harbour porpoise were the most abundant marine mammal species present, with peaks found in July and August 2022 of 18 and 19 sightings (HiDef Aerial Surveying Limited, 2023a). Absolute density estimates ranged from 0.00-3.00 animals/km$^2$ and the average density estimates within the DAS Area for the two years of HiDef surveys was 0.710 animals/km$^2$. Harbour porpoise present at the site did not appear to show any distinct spatial patterns within the site (HiDef Aerial Surveying Limited, 2023a).

## 6.9 Harbour porpoise summary

Density estimates obtained for harbour porpoise from the grey and published literature varies from 0.206 harbour porpoise/km$^2$ to 0.76 harbour porpoise/km$^2$ (Table 6-7). The highest density reported is from Paxton *et al.* (2016) and is taken from the Moray Firth and so is not considered representative of the densities likely to be present at the Proposed Development given the distance of the Proposed Development from the Moray Firth location, as well as the differences in site specifications (Moray Firth is more coastal). Therefore, despite being the highest, this density estimate is not considered the most representative of harbour porpoise densities in the Proposed Development and will not be used in the quantitative impact assessment.

The site-specific surveys and regional surveys concluded an average absolute density of 0.47 porpoise/km$^2$ and 0.33 porpoise/km$^2$ respectively. The site-specific and regional survey density estimates are lower than the SCANS IV density estimates, and are only relevant only to their respective survey areas and should not be extrapolated beyond this. Therefore, it is recommended that the SCANS III modelled density surface for harbour porpoise (Lacey *et al.*, 2022) is brought forward to the quantitative impact assessment (0.607-0.708 harbour porpoises/km$^2$). The impact contours will be overlain on the density surface to obtain the number of animals impacted in each grid cell in each impact contour. In addition to this, the SCANS IV block-wide unform density estimates will also be presented in the quantitative impact assessment as they provide a more recent estimate (though not a spatially explicit density surface).

**Table 6-7: Summary table of the available density estimates for harbour porpoise.**

| Source | Details | Density estimate (#/km²) |
|---|---|---|
| Site-specific surveys | Scotwind E2 DPO site plus 4 km buffer. Average absolute density (min – max) | 0.47 (0.00 – 2.55) |
| Regional surveys | Scotwind E1 & E2 DPO site plus 12 km buffer. Average absolute density (min – max) | 0.33 (0.00 -1.68) |
| SCANS III (Hammond *et al.*, 2021) | Block R | 0.599 |
| SCANS III (Hammond *et al.*, 2021) | Block T (adjacent) | 0.402 |
| **Lacey *et al.* (2022)** | **Grid cell specific densities** | **Grid cell specific**<br>**Array Area range 0.607 – 0.708** |
| **SCANS IV (Gilles *et al.*, 2023)** | **Block NS-D** | **0.5985** |
| **SCANS IV (Gilles *et al.*, 2023)** | **Block NS-E (adjacent)** | **0.5156** |
| Paxton *et al.* (2016) | Average in Firth of Forth in 2010 | 0.31 |
| Paxton *et al.* (2016) | Average in Moray Firth in 2010 | 1.14 |
| JCP Data Tool | User specified area average for summer 2007-2010 | 0.296 (0.123-0.420) |
| Heinänen and Skov (2015) | Predicted density range for summer 2009 around the Array Area | 0.9 – 1.2 |
| Heinänen and Skov (2015) | Predicted density range for winter 2009 around the Array Area | <0.3 |
| MERP | Array Area range in January | 0.206 – 0.252 |
| MERP | Array Area range in July | 0.397 – 0.448 |
| Berwick Bank OWF | Berwick Bank Array Area + 16 km buffer (average) | 0.299 |
| Green Volt OWF | Green Volt Array Area + 4 km buffer (average) | 0.76 |
| Ossian OWF | Ossian Array Area + 8 km buffer (average) | 0.357 |
| Salamander OWF | Salamander Array Area + 4 km buffer (average) | 0.710 |

# 7 Bottlenose dolphin

Bottlenose dolphins are a worldwide marine mammal species that occurs in tropical and temperate seas (Reid *et al.*, 2003). The distribution map shows high sightings rate of bottlenose dolphins around the east coast of Scotland as well as in the coastal waters of Wales and west Ireland (Figure

7-1). They typically form groups of 5-25 animals (Reid *et al.*, 2003). There are two ecotypes of bottlenose dolphins within Scottish waters: the coastal and the offshore ecotype (Hague *et al.*, 2020). In Scottish waters, bottlenose dolphins were sighted in the east Scotland, northern Ireland and southern Inner Hebrides, and in the Atlantic west of Scotland during the latest SCANS III surveys and the density ranged from 0-0.121 bottlenose dolphins/km$^2$ (Hammond *et al.*, 2021). These sightings include both ecotypes (Hague *et al.*, 2020).

This species is classified as a priority species under the UK Post- 2010 Biodiversity Framework, as well as listed as Least Concern on the International Union for Conservation of Nature (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 4-1).

The conservation status in UK waters was updated in JNCC (2019b). 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". Note that the conservation status of the species does not impact the EIA and will be considered as part of the Habitat Regulations Appraisal (HRA) Screening Report (Muir Mhòr Offshore Wind Farm Limited, 2023).

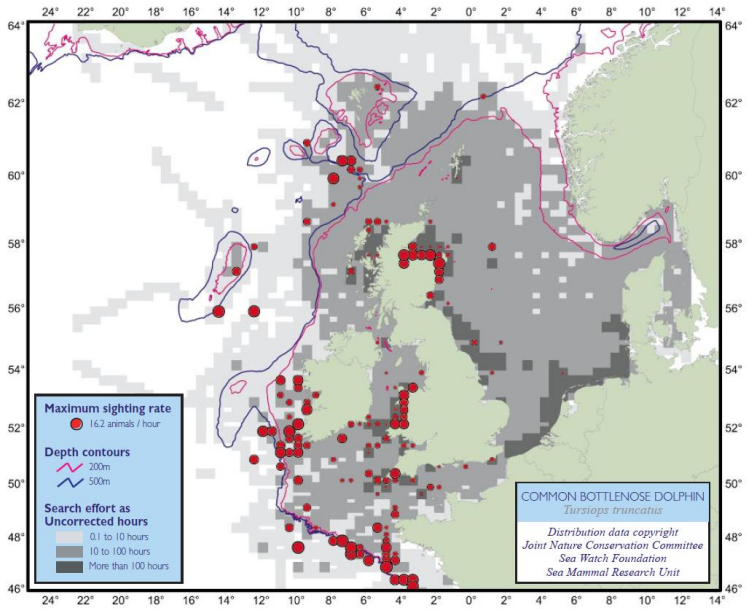


**Figure 7-1: Bottlenose dolphin distribution map of effort-related sightings (Reid *et al.*, 2003).**

## 7.1 Management Unit

The Proposed Development is located within two bottlenose dolphin MUs: the Array Area and part of the ECC is in the GNS MU, while the coastal part of the ECC is in the CES MU. 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). The population estimate for the CES MU is 224 dolphins (95% CI: 214 – 234, CV: 0.02) (Arso Civil *et al.*, 2021, IAMMWG, 2023).

### 7.2 Site-specific surveys

No bottlenose dolphins were observed during the site-specific surveys

### 7.3 Regional surveys

No bottlenose dolphins were observed during the regional surveys.

### 7.4 Geophysical survey MMO report

During the geophysical surveys, there was one bottlenose dolphin sighting in June 2023 (EGS (International) Limited, 2023). No density estimates were calculated.

### 7.5 SCANS surveys

#### 7.5.1 SCANS III

The Proposed Development is located within the SCANS III survey block R, where there was an estimated block-wide abundance of 147 bottlenose dolphins (95% CI: 0-488) and an estimated density of 0.0023 (CV = 0.995) bottlenose dolphins/km$^2$ in July 2016 (Hammond *et al.*, 2021). There were no bottlenose dolphins sighted in the neighbouring block T. The SCANS III 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, Lacey *et al.*, 2022). Mark-recapture analyses are better suited to obtain density information for smaller population, such as photo-identification studies by Arso Civil *et al.* (2019) or Cheney *et al.* (2018). These sources are further explored in Section 7.8.

##### 7.5.1.1 SCANS III density surface

Lacey *et al.* (2022) used the SCANS III data and spatially referenced environmental features to predict density estimates for bottlenose dolphins (Figure 7-2). South and west of Ireland were surveyed as part of the ObSERVE project (Rogan *et al.*, 2018), and are, therefore, not included in the modelling efforts. The modelled surface shows the highest densities in the Celtic Sea and Bay of Biscay. The density range for grid cells within the Array Area is 0.001-0.003 bottlenose dolphins/km$^2$.

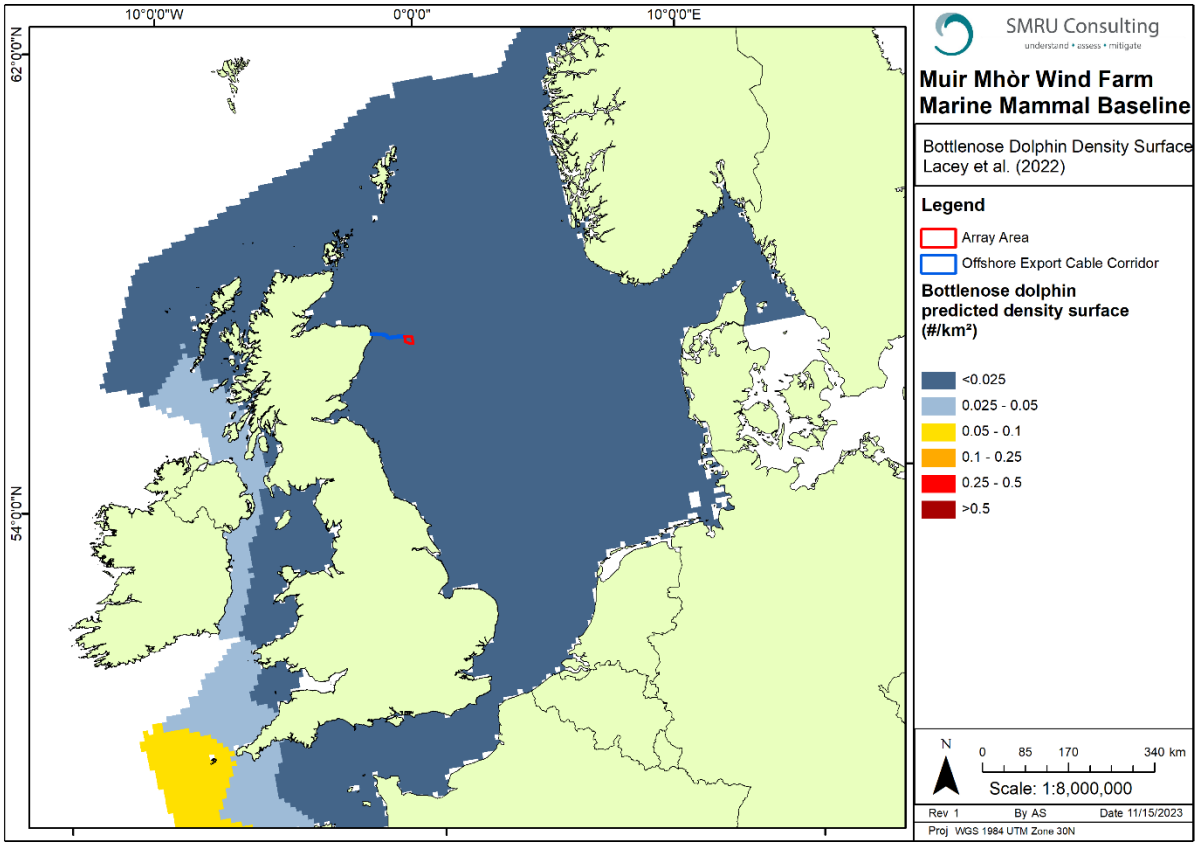


**Figure 7-2:** **Predicted surface of estimated density for bottlenose dolphin in SCANS III. Data from Lacey *et al.* (2022).**

### 7.5.2 SCANS IV

The Proposed Development is located within the SCANS IV survey block NS-D and in close proximity to block NS-E. There were no bottlenose dolphin sightings in either block (Gilles *et al.*, 2023).

## 7.6 JCP data

### 7.6.1 JCP Phase III

Paxton *et al.* (2016) produced predicted bottlenose dolphin densities for summer 2010 (Figure 7-3). The point surface shows generally low densities, with somewhat higher density areas around the coast of east Scotland and northwest of Northern Ireland. Density estimates for Firth of Forth, in which the proposed development is located, showed that bottlenose dolphin density was higher in spring months compared to the rest of the year and reached a maximum of 0.032 and an average of 0.023 bottlenose dolphin/km$^2$ over the year. The density estimate trend was similar in the Moray Firth, neighbouring region just north of Firth of Forth, with higher spring density of 0.032 bottlenose dolphin/km$^2$ and an average of 0.027 bottlenose dolphin/km$^2$ over the year (Figure 7-3).

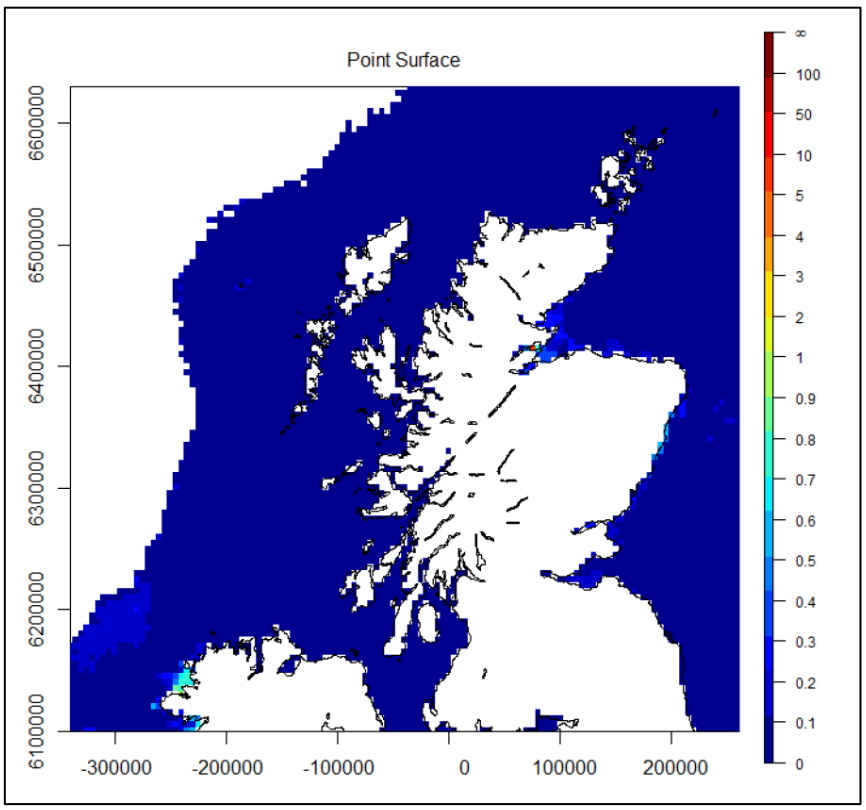


**Figure 7-3:** **Predicted bottlenose dolphin densities for the northern British Isles for summer 2010 (Paxton *et al.*, 2016). Point estimate of cell densities (bottlenose dolphins/km²), x-axis represents easting and the y-axis represents northing.**

**Table 7-1:** **JCP Phase III abundance and density estimates for bottlenose dolphin in 2010 for the Firth of Forth and Moray Firth regions (Paxton *et al.*, 2016).**

| Area | Season | Abundance point estimate | 95% CI | Density (#/km$^2$) |
|---|---|---|---|---|
| Firth of Forth | Winter | 230 | 90 – 450 | 0.016 |
| | Spring | 460 | 130 – 1,340 | 0.032 |
| | Summer | 430 | 190 – 780 | 0.030 |
| | Autumn | 190 | 80 – 290 | 0.013 |
| **Average** | | **328** | - | **0.023** |
| Moray Firth | Winter | 170 | 60 – 330 | 0.022 |
| | Spring | 250 | 60 – 780 | 0.032 |
| | Summer | 230 | 80 – 450 | 0.029 |
| | Autumn | 190 | 80 – 290 | 0.024 |
| **Average** | | **210** | - | **0.027** |

### 7.6.2 JCP data analysis tool

The JCP Phase III Data Analysis Product provided a density estimate of 0.026 bottlenose dolphin/km$^2$ (95% CI: 0.017-0.032) from the GNS MU in the user specified area, averaged for the summer 2007-2010 (Table 7-2). It is important to note that this estimate is for the summer months only and is not representative of densities at other times of the year.

**Table 7-2:** **JCP Phase III Data Analysis Product abundance and density estimates for bottlenose dolphin for the user specified area averaged for the summer 2007-2010.**

| | Scaled abundance | Density (#/km$^2$) |
|---|---|---|
| Point estimate | 357 | 0.026 |
| Lower confidence interval | 229 | 0.017 |
| Upper confidence interval | 430 | 0.032 |

### 7.6.3 MERP

Density maps were produced by Waggitt *et al.* (2019) for the bottlenose dolphin offshore ecotype only. The east coast of UK was predicted to have very low densities. The maximum bottlenose dolphin density for grid cells within the Array Area is 0.003 bottlenose dolphins/km$^2$ for January and July and the minimum density for grid cells within the Array Area is 0.002 bottlenose dolphins/km$^2$ for January and July (Figure 7-4).

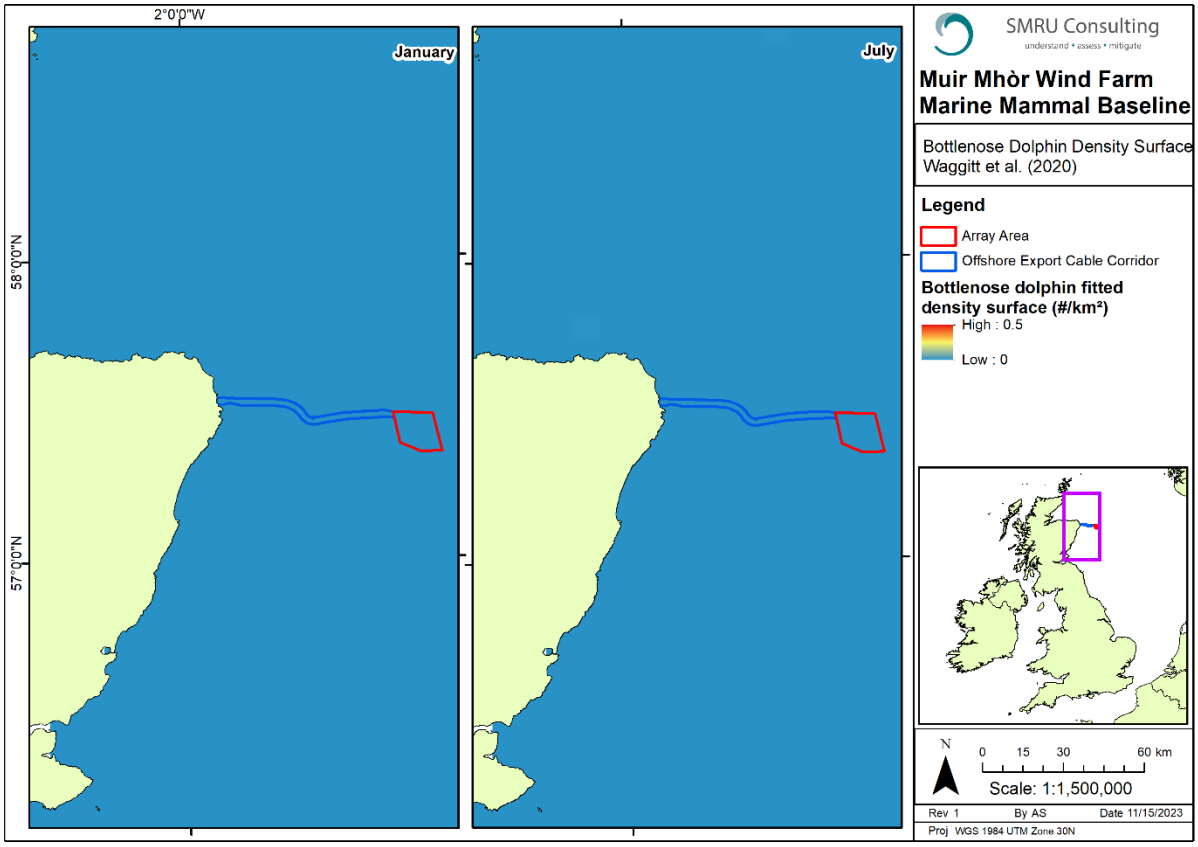


**Figure 7-4:** **Bottlenose dolphin density surface (dolphins/km²) for January and July. Data from Waggitt *et al.* (2019).**

## 7.7 ECOMMAS

The ECOMMAS data presented below consists of CPOD data collected from 2013 – 2022 (data for 2020 absent due to Covid-19 restrictions, preventing field work from occurring).

The data presented are inclusive of two ECOMMAS sites, Cruden Bay and Fraserburgh. Each of these sites have three PAM stations which are located approximately 5, 10 and 15 km from the coast. Delphinid species were identified across most sites, with calculations of DPDs per year (Table 7-3) and average DPHs per year (Table 7-4) presented below. Data have also been visualised for DPH across each of the stations at the Cruden Bay (Figure 7-5) and Fraserburgh (Figure 7-6) sites. These data conclude that dolphins were found in low numbers (with the exception of 2022), in the coastal areas monitored by ECOMMAS. There is no evidence from either the Cruden Bay (Figure 7-5) and Fraserburgh (Figure 7-6) sites of seasonal variation in detections, most likely due to the low detections. There was no obvious pattern in dolphin detection rate in relation to distance from the shore for the Cruden Bay site. However, there is evidence to suggest that dolphins frequent the more coastal areas of the Fraserburgh site, with higher averages present at Fraserburgh 5 (Table 7-3 and Table 7-4).

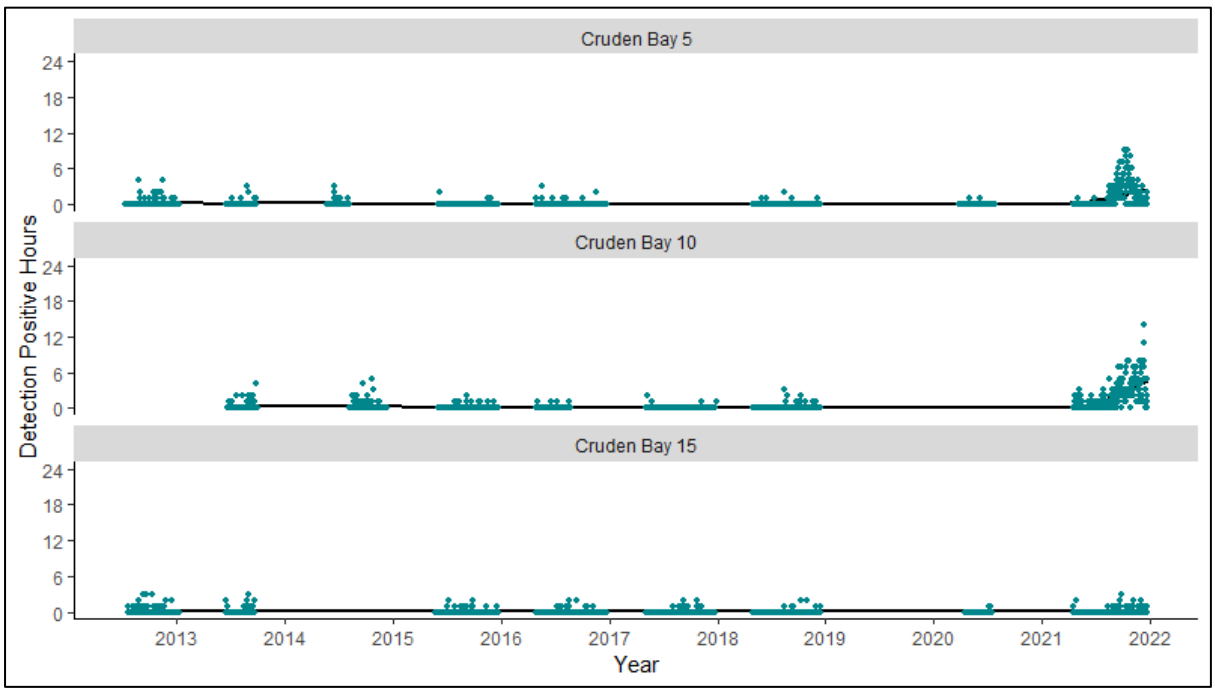


**Figure 7-5:** **Dolphin detection positive hours (DPH) at the Cruden Bay ECOMMAS stations from 2013-2022. CPOD data provided by Marine Directorate.**

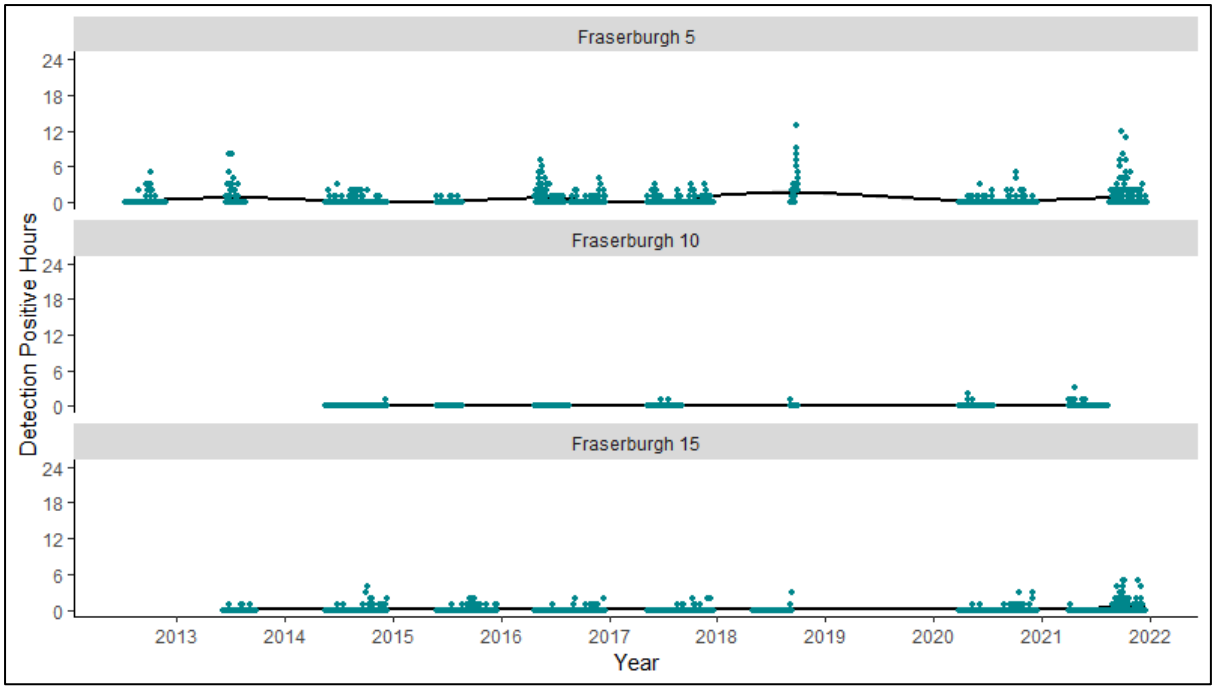


**Figure 7-6:** **Dolphin detection positive hours (DPH) at the Fraserburgh ECOMMAS stations from 2013-2022. CPOD data provided by Marine Directorate.**

**Table 7-3:** **Percentage (%) of dolphin detection positive days at the Cruden Bay and Fraserburgh ECOMMAS sites per year. ('-' denotes no data). CPOD data provided by Marine Directorate.**

| PAM site | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Cruden Bay 5 | 13 | 6 | 13 | 1 | 5 | - | 3 | - | 2 | 39 | **10.3** |
| Cruden Bay 10 | - | 15 | 20 | 7 | 3 | 2 | 6 | - | - | 59 | **16** |
| Cruden Bay 15 | 14 | 16 | - | 7 | 6 | 6 | 3 | - | 2 | 12 | **8.3** |
| Fraserburgh 5 | 9 | 31 | 11 | 6 | 28 | 16 | 65 | - | 11 | 40 | **24.1** |
| Fraserburgh 10 | - | - | 0 | 0 | 0 | 2 | 3 | - | 3 | 6 | **2** |
| Fraserburgh 15 | - | 4 | 8 | 10 | 4 | 4 | 2 | - | 7 | 18 | **7.1** |

**Table 7-4:** **Mean dolphin detection positive hours at the Cruden Bay and Fraserburgh ECOMMAS sites per year. ('-' denotes no data). CPOD data provided by Marine Directorate.**

| PAM site | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Cruden Bay 5 | 0.21 | 0.09 | 0.16 | 0.02 | 0.06 | - | 0.03 | - | 0.02 | 1.21 | **0.2** |
| Cruden Bay 10 | - | 0.24 | 0.30 | 0.07 | 0.03 | 0.02 | 0.07 | - | - | 1.85 | **0.4** |
| Cruden Bay 15 | 0.20 | 0.21 | - | 0.08 | 0.07 | 0.07 | 0.04 | - | 0.02 | 0.14 | **0.1** |
| Fraserburgh 5 | 0.19 | 0.84 | 0.15 | 0.06 | 0.52 | 0.25 | 2.55 | - | 0.16 | 1.13 | **0.7** |
| Fraserburgh 10 | - | - | 0 | 0 | 0 | 0.02 | 0.03 | - | 0.04 | 0.07 | **0.02** |
| Fraserburgh 15 | - | 0.04 | 0.12 | 0.12 | 0.05 | 0.06 | 0.03 | - | 0.08 | 0.34 | **0.1** |

## 7.8 Bottlenose dolphin surveys

Quick *et al.* (2014) estimated the abundance of bottlenose dolphins from 2012-2013 the Firth of Forth to Aberdeen utilising photo-identification data collected. All encounters of individually marked bottlenose dolphin in each month from May to September were collated to prepare individual capture histories. The capture histories of 49 (2012) and 52 (2013) individuals over five capture occasions were analysed in CAPTURE. The results of this analysis were consistent for 2012 and 2013, estimating an abundance 118 (95% CI: 98 – 143) and 119 bottlenose dolphins (95% CI: 101 – 140) for 2012 and 2013 respectively. The previous abundance estimates from Cheney *et al.* (2013) of 88 individuals for 2006, and 93 for 2007 were lower, suggesting an increase in bottlenose dolphin abundance in this area.

Arso Civil *et al.* (2021) conducted intensive sampling of the Tay Estuary and adjacent waters in the summers of 2017, 2018 and 2019, conducting photo-identification surveys of bottlenose dolphins. This data was combined with a pre-existing time-series of data collected since 1989 through collaboration with the Lighthouse Field Station at the University of Aberdeen and SMRU at the

University of St. Andrews. Abundance estimates for bottlenose dolphins were calculated using the Tay Estuary and adjacent waters based on photo-identification data collected between May and September 2009-2019 to provide a population estimate of 224 individuals (95% CI of 214-234) for the CES MU (IAMMWG, 2023).

This estimate has recently been updated based on data presented in most recent site condition monitoring report, which provides an estimate of 245 dolphins (95% CI: 224-268) within the CES population based on data from 2022 (Cheney *et al.*, 2024). 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), despite the recent large scale offshore developments around the Scottish coast (e.g. Moray East OWF).

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 (Wilson *et al*. 2004, Arso Civil *et al*. 2019, Arso Civil *et al*. 2021), 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.

## 7.9 Other OWFs

### 7.9.1 Berwick Bank OWF

Bottlenose dolphins were sighted on two of the monthly surveys, resulting in a total of seven bottlenose dolphin sightings (RPS, 2022b). The monthly encounter rate ranged between 0.0005 dolphins/km in October 2019 and 0.0024 dolphins/km in April 2021. No density estimate was calculated.

### 7.9.2 Caledonia OWF

No site-specific data are currently available for this project.

### 7.9.3 Green Volt OWF

Only one bottlenose dolphin was sighted in the 24 months of site-specific surveys at Green Volt. No density estimate was calculated (Royal HaskoningDHV, 2023).

### 7.9.4 Ossian OWF

No bottlenose dolphins were observed during Ossian site-specific surveys (RPS, 2024).

### 7.9.5 Seagreen OWF

No site-specific data are currently available from the post-consent surveys at Seagreen.

### 7.9.6 Salamander OWF

No bottlenose dolphins were observed during Salamander site-specific surveys (HiDef Aerial Surveying Limited, 2023a).

### 7.10 Assumed density estimates

Given the fact that no reliable density estimate is available for bottlenose dolphins in the vicinity of the Proposed Development, this baseline characterisation presents three approaches to obtaining an assumed density estimate for coastal bottlenose dolphins in relation to the Proposed Development:

1) Assume a uniform density across the GNS MU;
2) Assume a uniform density across the CES MU; and
3) Assume a uniform density within 2 km of the mainland coast in the CES MU;

#### 7.10.1 GNS MU

The majority of the Proposed Development is located within the GNS MU for bottlenose dolphins. According to IAMMWG (2023), 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.

#### 7.10.2 CES MU

Unfortunately, density estimates for bottlenose dolphins within the CES MU are also lacking, since the primary surveys for this species are photo-ID surveys which, while they allow for the estimation of the population size, are not suitable to provide a density estimate within the areas surveyed. 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).

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 20 m deep and within 2 km of the coast (Quick *et al.*, 2014). Therefore, a 2 km buffer from the coast was created for the mainland Scotland part of the CES MU and it was assumed that bottlenose dolphins were uniformly spread within this area. This results in a uniform density estimate of 0.120 bottlenose dolphins/km$^2$ within 2 km from the mainland coast in the CES MU.

#### 7.10.3 Assumption of uniform density

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). 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, because there are currently no density surfaces available which reflect the differences in the coastal and offshore distribution of bottlenose dolphins in this area, it is currently considered the best way to estimate potential densities in the vicinity of the Proposed Development in the absence of any other reliable density data.

### 7.11 Bottlenose dolphin summary

Bottlenose dolphin density estimates are relatively low around the east of Scotland (Table 7-5). 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) 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, two density estimates are recommended to be used in the quantitative impact assessment: 0.120 bottlenose dolphins/km$^2$ within 2 km of the coast and 0.003 bottlenose dolphins/km$^2$ beyond that. This approach allows the quantitative assessment to differentiate between higher densities 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.

**Table 7-5: Summary table of the available density estimates for bottlenose dolphin.**

| Source | Details | Density estimate (#/km$^2$) |
|---|---|---|
| Site-specific surveys | Scotwind E2 PO site plus 4 km buffer | No bottlenose dolphins sighted |
| Regional surveys | Scotwind E1 and E2 PO sites plus 12 km buffer | No bottlenose dolphins sighted |
| SCANS III (Hammond *et al.*, 2021) | Block R | 0.0023 |
| SCANS III (Hammond *et al.*, 2021) | Block T (adjacent) | 0 |
| Lacey *et al.* (2022) | Array Area range (min – max) | 0.001-0.003 |
| SCANS IV (Gilles *et al.*, 2023) | Block NS-D | 0 |
| SCANS IV (Gilles *et al.*, 2023) | Block NS-E (adjacent) | 0 |
| Paxton *et al.* (2016) | Average in Firth of Forth in 2010 | 0.023 |
| Paxton *et al.* (2016) | Average in Moray Firth in 2010 | 0.027 |
| JCP Data Tool | User specified area average for summer 2007-2010 for GNS MU | 0.026 |
| MERP | Array Area range in Jan and Jul | 0.002 – 0.003 |
| **GNS MU** | **Uniform density across GNS MU** | **0.003** |
| **CES MU – 2 km** | **Uniform density within 2 km from the coast in the CES MU** | **0.110** |

# 8 White-beaked dolphin

White-beaked dolphin are wide-spread across the northern European continental shelf. The species is the most abundant cetacean after the harbour porpoise in the North Sea (Banhuera-Hinestroza *et al.*, 2009), and the waters off the coast of Scotland and north east England are one of the four global centres of peak abundance. The species occurs mainly in waters of 50-100 m in depth (Reid *et al.*, 2003). They are abundant on the continental shelf around west and north Scotland and in the northern North Sea and are less common in the southern North Sea, the English Channel and Irish Sea (Figure 8-1). Evidence supports the assumption that white-beaked dolphin from around the British Isles and North Sea represent one population, with movement between Scottish waters and

the Danish North Sea and Skagerrak (Banhuera-Hinestroza *et al.*, 2009). They are a resident species in Scottish waters, present mostly across central and northern North Sea and northwest Scotland (Hague *et al.*, 2020), and data suggests that white-beaked dolphin distribution is shifting northwards (Evans *et al.*, 2011). During the most recent SCANS survey they were sighted offshore west Scotland, north of the Hebrides and north coast and at east coast of Scotland (Hague *et al.*, 2020), and their density estimates ranged from 0-0.316 white-beaked dolphin/km$^2$ in Scottish waters (Hammond *et al.*, 2021).

The conservation status of white-beaked dolphin in UK waters was updated in JNCC (2019f) 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".

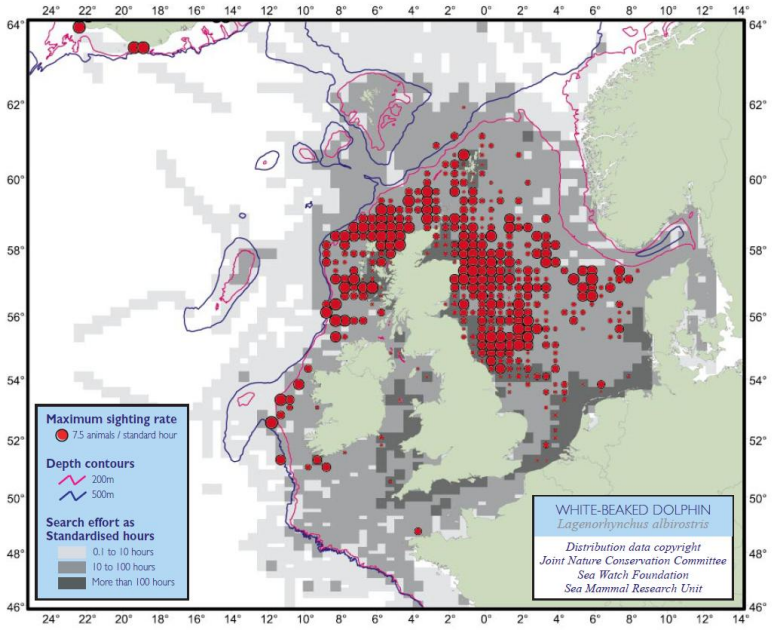


**Figure 8-1: White-beaked dolphin distribution map of effort-related sightings (Reid *et al.*, 2003).**

## 8.1 Management Unit

The relevant MU for white-beaked dolphins is the Celtic and Greater North Seas MU which has an estimated population size of 43,951 animals (95% CI 28,439 – 67,924) (IAMMWG, 2023) of which 34,025 (95% CI: 20,026 – 57,807) are estimated within the UK EEZ.

## 8.2 Site-specific surveys

The two years of site-specific surveys conducted from April 2021 to March 2023 found that white-beaked dolphins were present on eight of the 24 surveys, with a maximum of 14 individuals observed in July 2022 (Table 8-1). The maximum relative density was in July 2022 (0.09 white-beaked dolphin/km$^2$) with an average relative density estimate over the survey period of 0.01 white-beaked dolphin/km$^2$.

**Table 8-1:** **Number of white-beaked dolphins observed in the survey area (Scotwind E2 PO site plus 4 km buffer) between April 2021 and March 2023. Data from HiDef Aerial Surveying Limited (2023b).**

| | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Jan | Feb | | Mar |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Year 1** | 0 | 2 | 6 | 0 | 0 | 4 | 4 | 0 | 0 | 5 | 0 | | 0 |
| **Year 2** | 0 | 0 | 0 | 14 | 2 | 0 | 0 | 0 | - | 2 | 0 | 0 | 0 |

## 8.3 Regional surveys

White-beaked dolphins were the second most abundant marine mammal species observed during regional surveys, with 143 white-beaked dolphins recorded. The species was recorded during 10 of the 18 surveys, with the peak occurring in July 2022 where 52 white-beaked dolphins were recorded and a mean of 8 white-beaked dolphins recorded each month (Table 8-2). The maximum relative density was in July 2022 (0.09 white-beaked dolphin/km$^2$) with an average relative density estimate over the survey period of 0.01 white-beaked dolphin/km$^2$.

**Table 8-2:** **Number of white-beaked dolphins observed in the regional survey area (Scotwind E1 and E2 PO site plus 12 km buffer) between April 2022 and March 2023. Data from HiDef Aerial Surveying Limited (2023b).**

| Date | # observed |
|---|---|
| 10 Apr 2022 | 10 |
| 23 Apr 2022 | 0 |
| 20 May 2022 | 0 |
| 23 Jun 2022 | 9 |
| 18 Jul 2022 | 52 |
| 19 Aug 2022 | 7 |
| 14 Sep2022 | 0 |
| 02 Oct 2022 | 0 |
| 04 Nov 2022 | 2 |
| 09 Jan 2023 | 0 |
| 06 Feb 2023 | 5 |
| 21 Feb 2023 | 12 |
| 04 Apr 2023 | 0 |
| 21 Apr 2023 | 0 |
| 16 May 2023 | 0 |
| 15 Jun 2023 | 10 |
| 08 Jul 2023 | 7 |
| 05 Aug 2023 | 29 |
| **18 month mean** | **8** |

### 8.4 Geophysical survey MMO report

During the geophysical surveys there were no observations of white-beaked dolphins (EGS (International) Limited, 2023).

### 8.5 SCANS surveys

#### 8.5.1 SCANS III

The Proposed Development is located within the SCANS III survey block R, where there was an estimated block-wide abundance of 15,694 white-beaked dolphins (95% CI: 3,022-33,340) and an estimated density of 0.243 (CV = 0.484) white-beaked dolphins/km$^2$ in July 2016 (Hammond *et al.*, 2021). Abundance (2,417, 95% CI: 593-5,091) and density (0.037 white-beaked dolphins/km$^2$, CV = 0.463) in the neighbouring block T were considerably lower than in the block R (Hammond *et al.*, 2021).

##### 8.5.1.1 SCANS III density surface

Lacey *et al.* (2022) used the SCANS III data and spatially referenced environmental features to predict density estimates for white-beaked dolphins (Figure 8-2). 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. The density range for grid cells within the Array Area is 0.250-0.401 white-beaked dolphin/km$^2$.

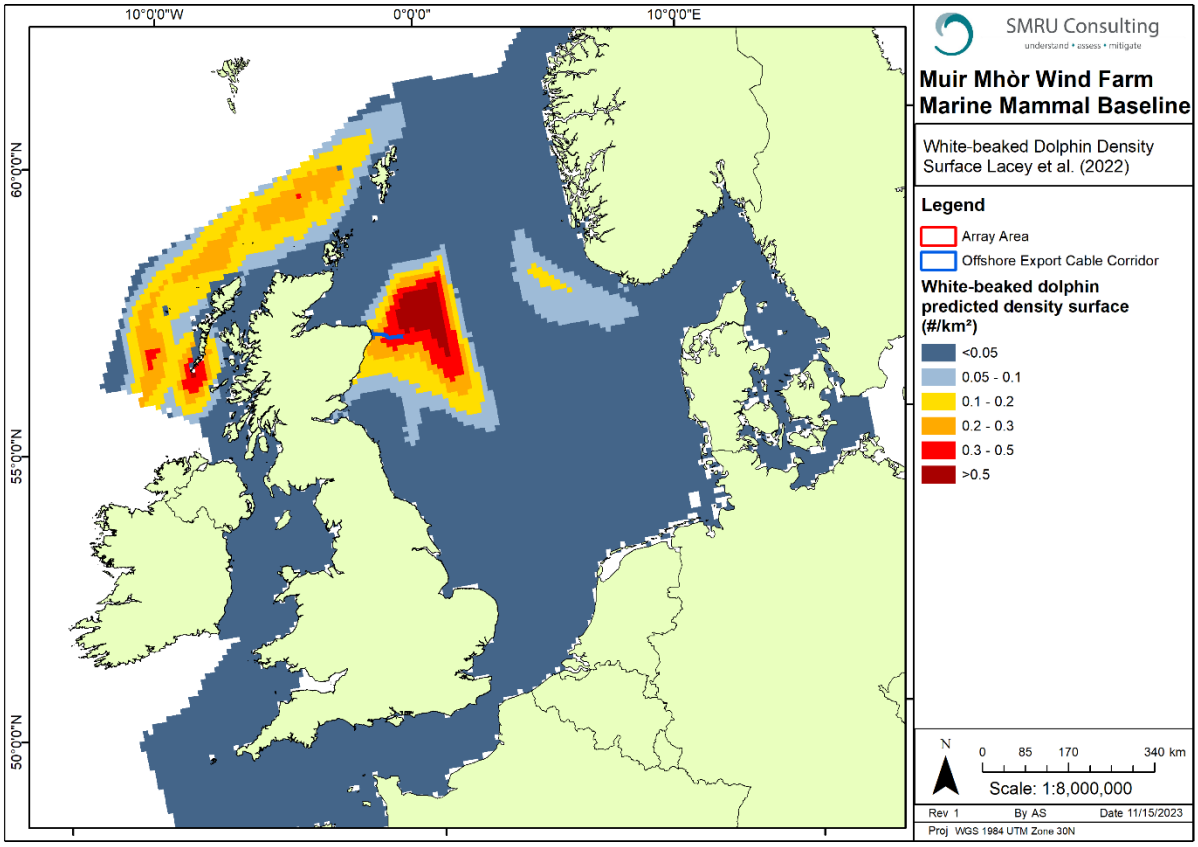


**Figure 8-2:** **Predicted surface of estimated density for white-beaked dolphin in SCANS III. Data from Lacey *et al.* (2022).**

### 8.5.2 SCANS IV

The Proposed Development is located within the SCANS IV survey block NS-D, where there was an estimated block-wide abundance of 5,149 white-beaked dolphins (95% CI: 961 – 10,586) and an estimated density of 0.0799 white-beaked dolphin/km$^2$ (CV = 0.481) (Gilles *et al.*, 2023). Abundance (11,611, 95% CI: 3,875 – 10,586) and density (0.1775 white-beaked dolphin/km$^2$, CV = 0.383) in the neighbouring block NS-E were significantly higher.

## 8.6 JCP data

### 8.6.1 JCP Phase III

Paxton *et al.* (2016) produced predicted white-beaked dolphin densities for summer 2010 (Figure 8-3). The point surface shows densities around UK are generally very low, with areas of slightly higher density off northwest and central east Scotland. Density estimates for Firth of Forth, in which the Proposed Development is located, showed that white-beaked dolphin density was considerably higher in spring months compared to the rest of the year and reached a maximum of 0.124 white-beaked dolphin/km$^2$ and an average of 0.060 white-beaked dolphin/km$^2$ over the year. The density estimate trend was similar in the Moray Firth, neighbouring region just north of Firth of Forth, with higher spring density of 0.023 white-beaked dolphin/km$^2$ and an average of 0.011 white-beaked dolphin/km$^2$ over the year (Table 8-3).

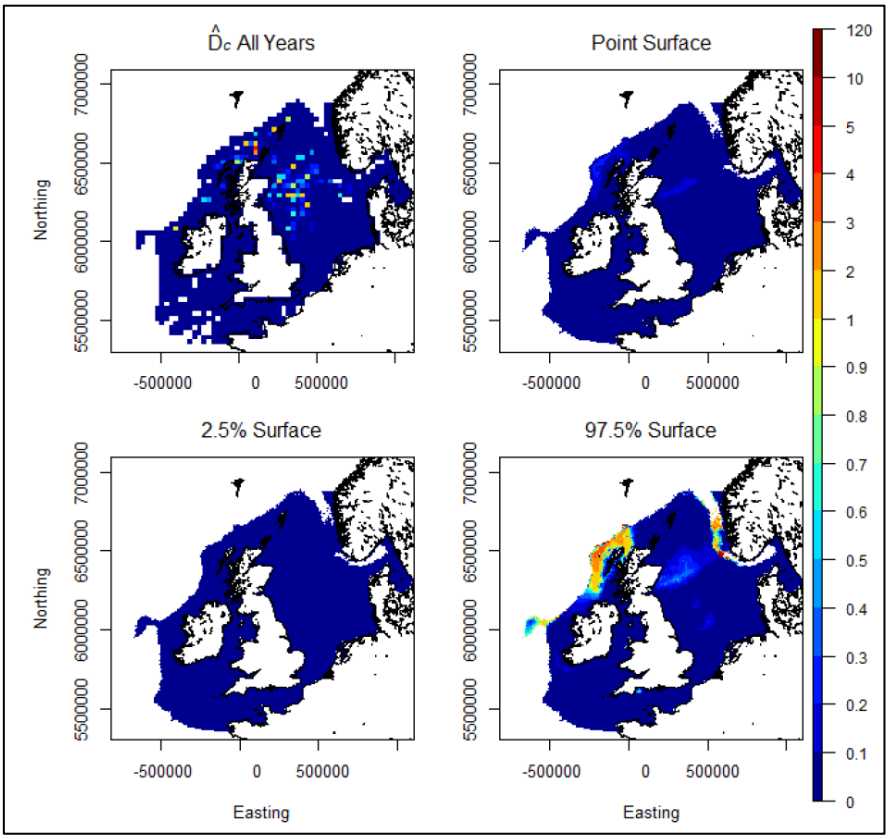


**Figure 8-3:** **Predicted white-beaked dolphin densities for summer 2010 (Paxton *et al.*, 2016). Top left; input densities (summer all years), top right; point estimate of cell densities, bottom left; lower (2.5%) confidence limit on cell densities, bottom right; upper (97.5%) confidence limit on cell densities (white-beaked dolphins/km$^2$). Note that the top left plot exaggerates the spatial coverage of the relevant effort.**

**Table 8-3:** **JCP Phase III abundance and density estimates for white-beaked dolphin in 2010 for the Firth of Forth and Moray Firth areas of commercial interest (Paxton *et al.*, 2016).**

| Area | Season | Abundance point estimate | 95% CI | Density (#/km$^2$) |
|---|---|---|---|---|
| Firth of Forth | Winter | 410 | 170 – 1,110 | 0.029 |
| | Spring | 1,760 | 620 – 4,530 | 0.124 |
| | Summer | 720 | 360 – 1,840 | 0.051 |
| | Autumn | 540 | 220 – 1,130 | 0.038 |
| **Average** | | **858** | - | **0.060** |
| Moray Firth | Winter | 40 | 200 – 10 | 0.005 |
| | Spring | 180 | 80 – 400 | 0.023 |
| | Summer | 70 | 40 – 200 | 0.009 |
| | Autumn | 60 | 20 - 120 | 0.008 |
| **Average** | | **88** | - | **0.011** |

### 8.6.2 JCP data analysis tool

The JCP Phase III Data Analysis Product provided a density estimate of 0.194 white-beaked dolphin/km$^2$ (95% CI: 0.005-0.228) in the user specified area, averaged for the summer 2007-2010 (Table 8-4). It is important to note that this estimate is for the summer months only and is not representative of densities at other times of the year.

**Table 8-4:** **JCP Phase III Data Analysis Product abundance and density estimates for white-beaked dolphin for the user specified area averaged for the summer 2007-2010.**

| | Scaled abundance | Density (#/km$^2$) |
|---|---|---|
| Point estimate | 2,621 | 0.194 |
| Lower confidence interval | 72 | 0.005 |
| Upper confidence interval | 3,088 | 0.228 |

### 8.6.3 MERP

Density maps of white-beaked dolphins produced by Waggitt *et al.* (2019) predicted the highest densities at north of UK. The densities around east Scotland vary seasonally but are moderately high year-round. The maximum density for grid cells within the Array Area is 0.055 white-beaked dolphin/km$^2$ for January and 0.130 white-beaked dolphin/km$^2$ for July. The minimum density for grid cells within the Array Area is 0.046 white-beaked dolphin/km$^2$ for January and 0.105 white-beaked dolphin/km$^2$ for July (Figure 8-4). White-beaked dolphin densities were significantly higher in the Array Area during July.

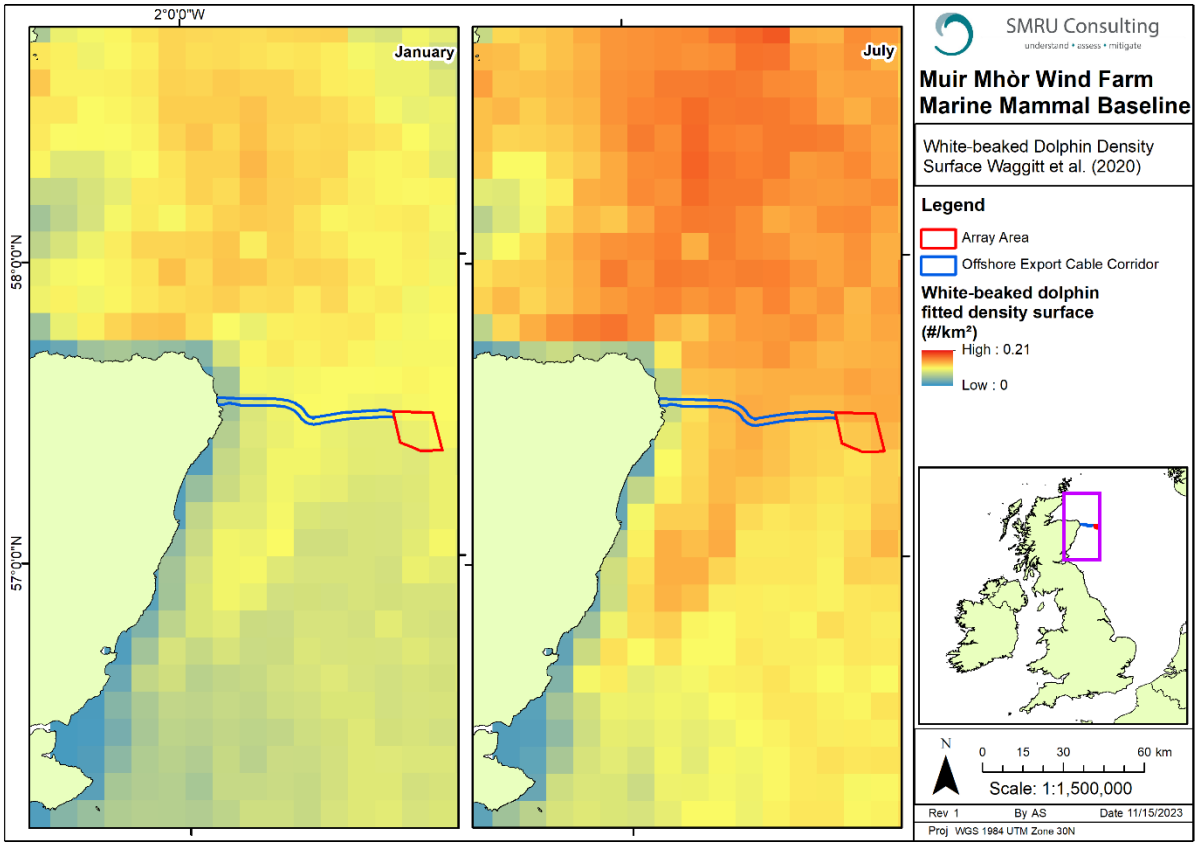


**Figure 8-4:** **White-beaked dolphin density surface (dolphins/km²) for January and July. Data from Waggitt *et al.* (2019).**

### 8.6.4 Spatially indexed adjusted densities

Paxton *et al.* (2014) presented point estimates for white-beaked dolphin density in spring, autumn and winter 2005 and summer 2001, 2005 and 2012. The location of the Proposed Development corresponds with an area of low density between 0-0.1 white-beaked dolphin/km$^2$ during winter, spring and autumn, and in summer the density ranges from 0-0.5 (Paxton *et al.*, 2014).

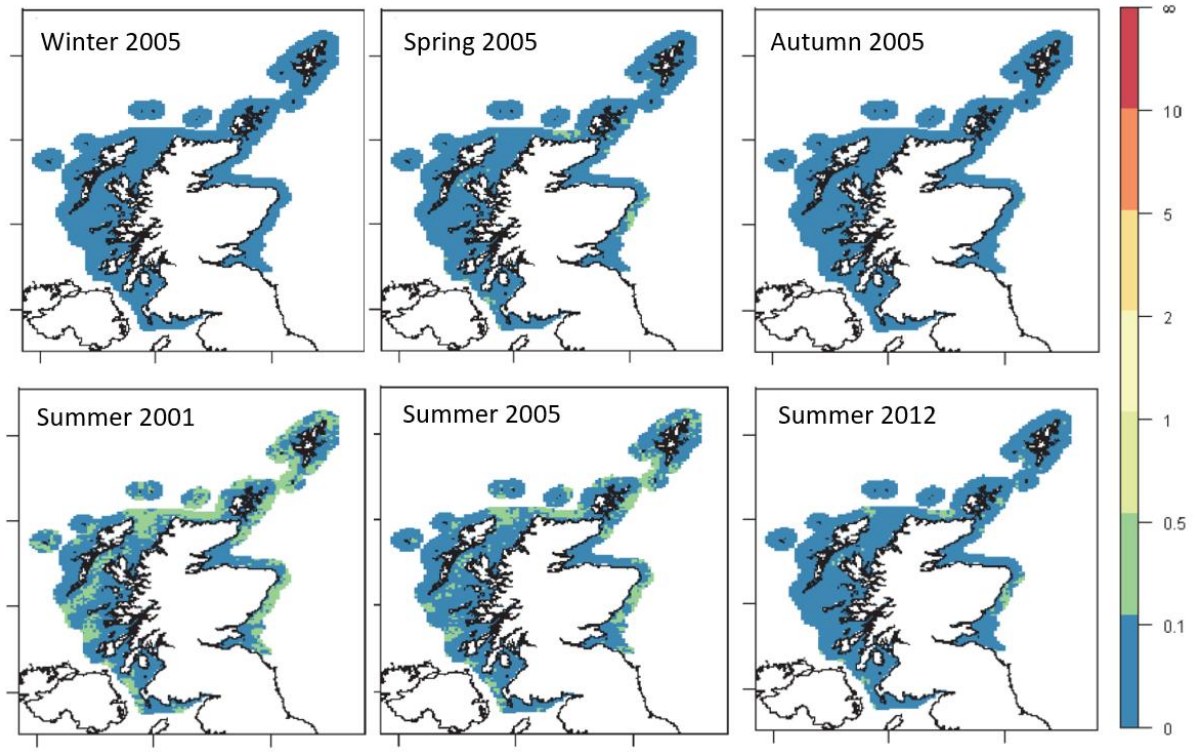


**Figure 8-5:** **White-beaked dolphin estimated density surfaces (Paxton *et al.*, 2014). Colours indicate animals per km². Each cell is 5 by 5 km.**

## 8.7 ECOMMAS

The ECOMMAS data presented in Section 7.7 can also be considered for white-beaked dolphins as the delphinid species cannot be differentiated in the calculation of DPD and DPH. As mentioned previously, these data concluded that dolphins were found in low numbers (with the exception of 2022), in the coastal areas monitored by ECOMMAS. There is no evidence from either the Cruden Bay and Fraserburgh sites of seasonal variation in detections, most likely due to the low detections. There was no obvious pattern in dolphin detection rate, in relation to distance from the shore for the Cruden Bay site. However, there is evidence to suggest that dolphins frequent the more coastal areas of the Fraserburgh site, with higher averages present at Fraserburgh 5.

## 8.8 Other OWFs

### 8.8.1 Berwick Bank OWF

White-beaked dolphins were sighted on six of the monthly surveys in the summer months only (June-September), resulting in a total of 45 white-beaked dolphin sightings (RPS, 2022b). The mean corrected density of white-beaked dolphins across all surveys at the site was 0.050 white-beaked dolphin/km$^2$.

### 8.8.2 Caledonia OWF

No site-specific data are currently available for this project.

### 8.8.3 Green Volt OWF

Only five white-beaked dolphins were sighted in the 24 months of site-specific surveys at Green Volt (all on one survey). No density estimate was calculated (Royal HaskoningDHV, 2023).

### 8.8.4 Ossian OWF

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

### 8.8.5 Seagreen OWF

No site-specific data are currently available for this project.

### 8.8.6 Salamander OWF

No white-beaked dolphins were observed during Salamander site-specific surveys (HiDef Aerial Surveying Limited, 2023a).

## 8.9 White-beaked dolphin summary

Whilst white-beaked dolphins were observed during the site-specific surveys, the average density was quite low (0.01 white-beaked dolphin/km$^2$). Other surveys have concluded consistent densities of this species in the surrounding areas (Table 8-5), with increased densities during the summer months, demonstrating seasonal variation. It is recommended that the SCANS III modelled density surface (Lacey *et al.*, 2022) for white-beaked dolphins is brought forward to the quantitative impact assessment. The impact contours will be overlain on the density surface to obtain the number of animals impacted in each grid cell in each impact contour. This is conservative since this density surface is derived from summer data, when dolphin sightings are higher compared to other seasons. In addition to this, the new SCANS IV block-wide unform density estimates will also be presented in the quantitative impact assessment.

**Table 8-5: Summary table of the available density estimates for white-beaked dolphin.**

| Source | Details | Density estimate (#/km$^2$) |
|---|---|---|
| Site-specific surveys | Scotwind E2 PO site plus 4 km buffer. Average relative density | 0.01 |
| Regional surveys | Scotwind E1 & E2 PO site plus 12 km buffer. Average relative density (min – max) | 0.01 |
| SCANS III (Hammond *et al.*, 2021) | Block R | 0.243 |
| SCANS III (Hammond *et al.*, 2021) | Block T (adjacent) | 0.037 |
| **Lacey *et al.* (2022)** | **Grid cell specific densities** | **Grid cell specific**<br>**Array Area range 0.250 - 0.401** |

| Source | Details | Density estimate (#/km$^2$) |
|---|---|---|
| **SCANS IV (Gilles *et al.*, 2023)** | **Block NS-D** | **0.0799** |
| **SCANS IV (Gilles *et al.*, 2023)** | **Block NS-E (adjacent)** | **0.1775** |
| Paxton *et al.* (2016) | Average in Firth of Forth in 2010 | 0.060 |
| Paxton *et al.* (2016) | Average in Moray Firth in 2010 | 0.011 |
| JCP Data Tool | User specified area average for summer 2007-2010 | 0.194 |
| MERP | Array Area range in Jan | 0.046 – 0.055 |
| MERP | Array Area range in Jul | 0.105 – 0.130 |
| Paxton *et al.* (2014) | Adjusted density estimates in spring, autumn and winter 2005 and summer 2001, 2005 and 2012 | 0 – 0.5 |
| Berwick Bank OWF | Berwick Bank Array Area + 16 km buffer (average) | 0.050 |
| Ossian OWF | Ossian Array Area + 8 km buffer (average) | 0.031 |

# 9 Risso's dolphin

Risso's dolphins are found to be 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 Management Unit

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, CV: 0.46) (estimated using data from SCANS III and ObSERVE) (IAMMWG, 2023). Prior to the estimate initially provided in IAMMWG (2021), there was no abundance estimates for this species in the Celtic and Greater North Seas MU due to the low numbers of Risso's sightings (IAMMWG, 2015a).

## 9.2 Site-specific surveys

During the two years of site-specific surveys, Risso's dolphins were only sighted on three occasions (Table 9-1). The maximum relative density was in March 2022 and February 2023 (0.02 Risso's dolphin/km$^2$) with an average relative density estimates over the survey period was 0.002 Risso's dolphin/km$^2$ (HiDef Aerial Surveying Limited, 2023b).

**Table 9-1: Number of Risso's dolphins observed in the survey area (Scotwind E2 PO site plus 4 km buffer) between April 2021 and March 2023. Data from HiDef Aerial Surveying Limited (2023b).**

| | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Jan | Feb | | Mar |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Year 1** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 3 |
| **Year 2** | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | - | 0 | 3 | 0 | 0 |

## 9.3 Regional surveys

No Risso's dolphins were observed during regional surveys (HiDef Aerial Surveying Limited, 2023c).

## 9.4 Geophysical survey MMO report

During the geophysical surveys there were no observations of white-beaked dolphins (EGS (International) Limited, 2023).

## 9.5 SCANS surveys

### 9.5.1 SCANS III

The Proposed Development is located within the SCANS III survey block R, where there were no Risso's dolphins recorded in July 2016 (Hammond *et al.*, 2021). There were also none observed in the neighbouring block T (Hammond *et al.*, 2021).

#### 9.5.1.1 SCANS III density surfaces

Lacey *et al.* (2022) did not provide a modelled density surface for Risso's dolphins.

### 9.5.2 SCANS IV

There were no Risso's dolphins observed in block NS-D in which the Proposed Development is located. However, in neighbouring block NS-E, the estimate abundance of Risso's dolphins was 4,589 (95% CI: 31 – 16,458), with a density of 0.0702 (CV: 0.974) (Gilles *et al.*, 2023).

## 9.6 JCP data

### 9.6.1 JCP Phase III

Paxton *et al.* (2016) produced predicted Risso's dolphin densities for summer 2010 (Figure 9-1). The point surface shows densities around UK are generally very low, with areas of slightly higher density around the Hebrides, Anglesey, the Isle of Man and country Wexford and the western English Channel. Density estimates for Firth of Forth, in which the proposed development is located, showed that Risso's dolphin density was consistently low throughout the year. Risso's dolphins were only present in the Firth of Forth in spring (<0.001 Risso's dolphin/km$^2$) and were not observed in the Moray Firth (Table 9-2).

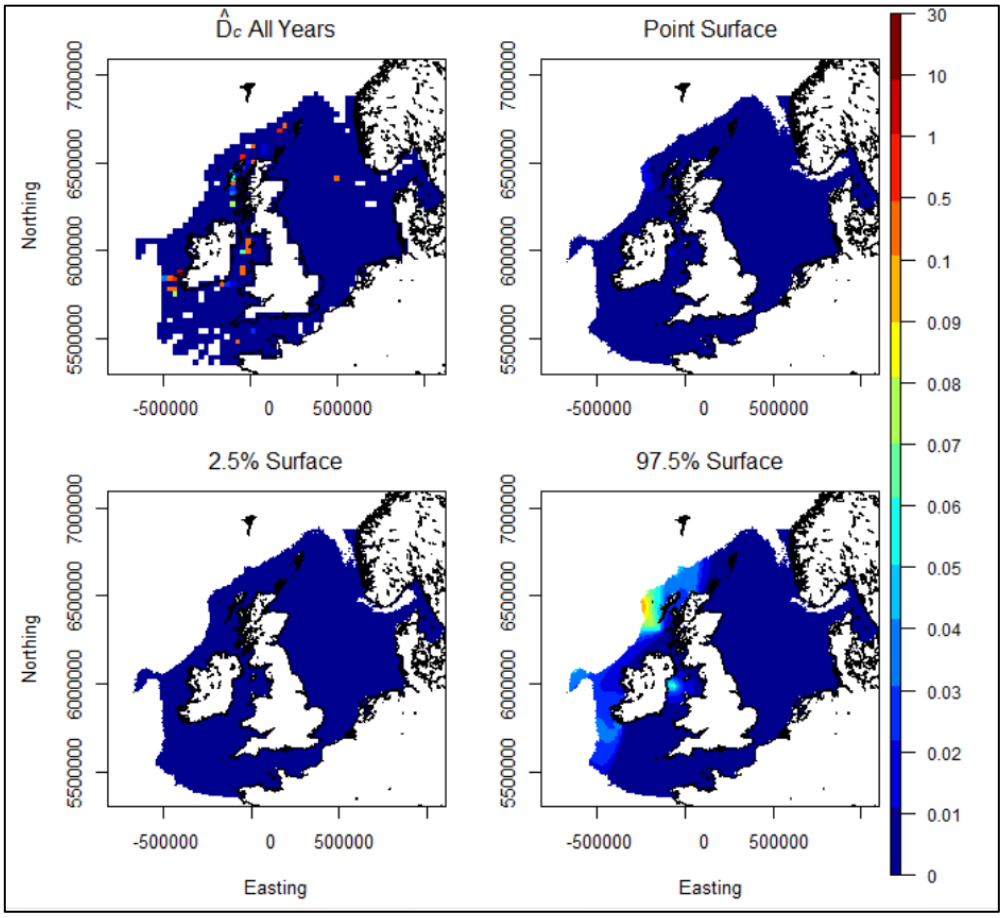


**Figure 9-1:** **Predicted Risso's dolphin densities for summer 2010 (Paxton *et al.*, 2016). Top left; input densities (summer all years), top right; point estimate of cell densities, bottom left; lower (2.5%) confidence limit on cell densities, bottom right; upper (97.5%) confidence limit on cell densities (Risso's dolphin/km$^2$). Note that the top left plot exaggerates the spatial coverage of the relevant effort.**

**Table 9-2:** **JCP Phase III abundance and density estimates for Risso's dolphin in 2010 for the Firth of Forth and Moray Firth areas of commercial interest (Paxton *et al.*, 2016).**

| Area | Season | Abundance point estimate | 95% CI | Density (#/km$^2$) |
|---|---|---|---|---|
| Firth of Forth | Winter | 0 | 0 | 0 |
| | Spring | 10 | 0-50 | <0.001 |
| | Summer | 0 | 0-20 | 0 |
| | Autumn | 0 | 0 | 0 |
| **Average** | | **2.5** | - | **<0.001** |
| Moray Firth | Winter | 0 | 0 | 0 |
| | Spring | 0 | 0-40 | 0 |
| | Summer | 0 | 0-10 | 0 |
| | Autumn | 0 | 0 | 0 |
| **Average** | | | - | **0** |

### 9.6.2 JCP data analysis tool

The JCP Phase III Data Analysis Product provided a density estimate of 0.002 Risso's dolphin/km$^2$ (95% CI: 0.001-0.003) in the user specified area, averaged for the summer 2007-2010 (Table 9-3). It is important to note that this estimate is for the summer months only and is not representative of densities at other times of the year.

**Table 9-3:** **JCP Phase III Data Analysis Product abundance and density estimates for Risso's dolphin for the user specified area averaged for the summer 2007-2010.**

| | Scaled abundance | Density (#/km$^2$) |
|---|---|---|
| Point estimate | 2,621 | 0.194 |
| Lower confidence interval | 72 | 0.005 |
| Upper confidence interval | 3,088 | 0.228 |

### 9.6.3 MERP

Density maps of white-beaked dolphins produced by Waggitt *et al.* (2019) predicted the highest densities at north of UK. The densities around east Scotland vary seasonally but are moderately high year-round. The density for all grid cells within the Array Area during January is <0.001 Risso's dolphin/km$^2$. The maximum density minimum density for grid cells within the Array Area during July is 0.003 Risso's dolphin/km$^2$ and the minimum is 0.002 Risso's dolphin/km$^2$ for July (Figure 9-2).

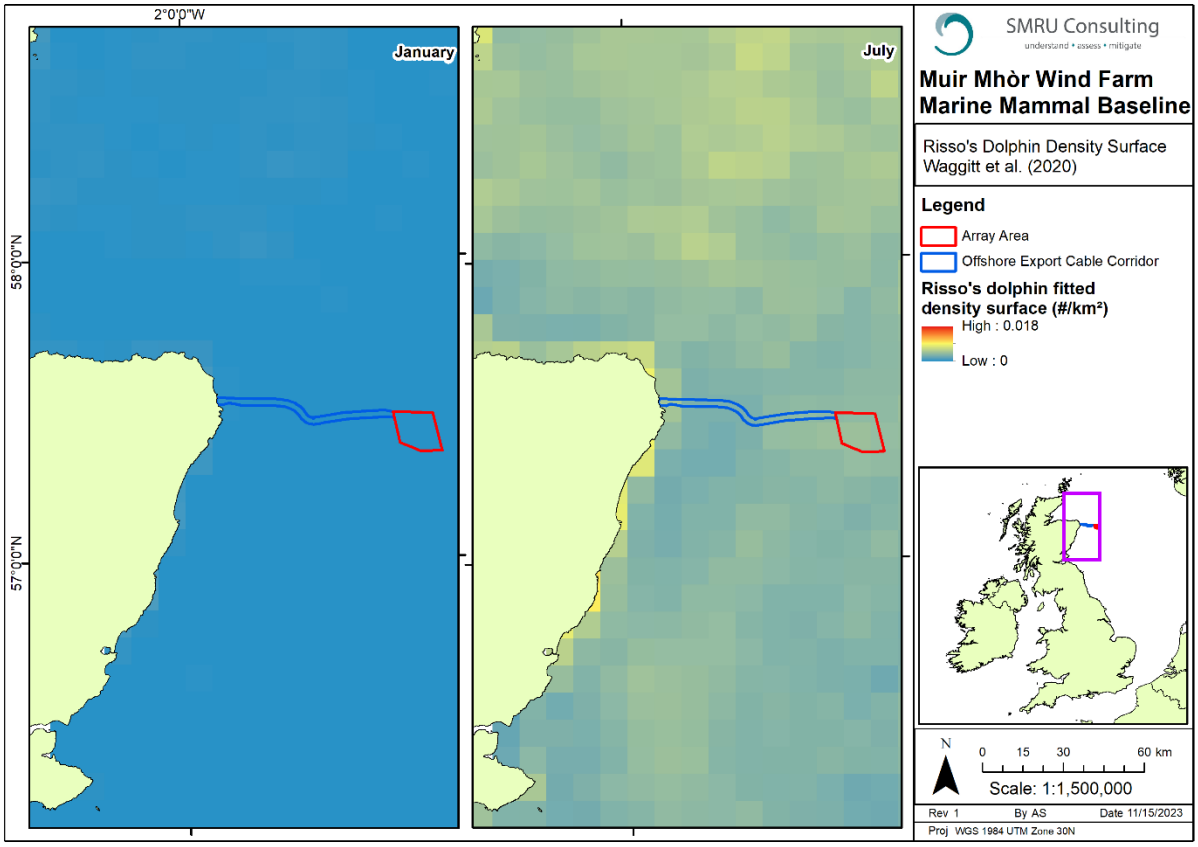


**Figure 9-2:** **Risso's dolphin density surface (dolphins/km²) for January and July. Data from Waggitt *et al.* (2019).**

### 9.6.4 Spatially indexed adjusted densities

Paxton *et al.* (2014) presented adjusted density estimates for Risso's dolphin in spring, autumn and winter 2005 and summer 2001, 2005 and 2012 (Figure 9-3). The location of the Proposed Development corresponds with an area of low density between 0-0.05 Risso's dolphin/km$^2$ in all seasons and years analysed (Paxton *et al.*, 2014).

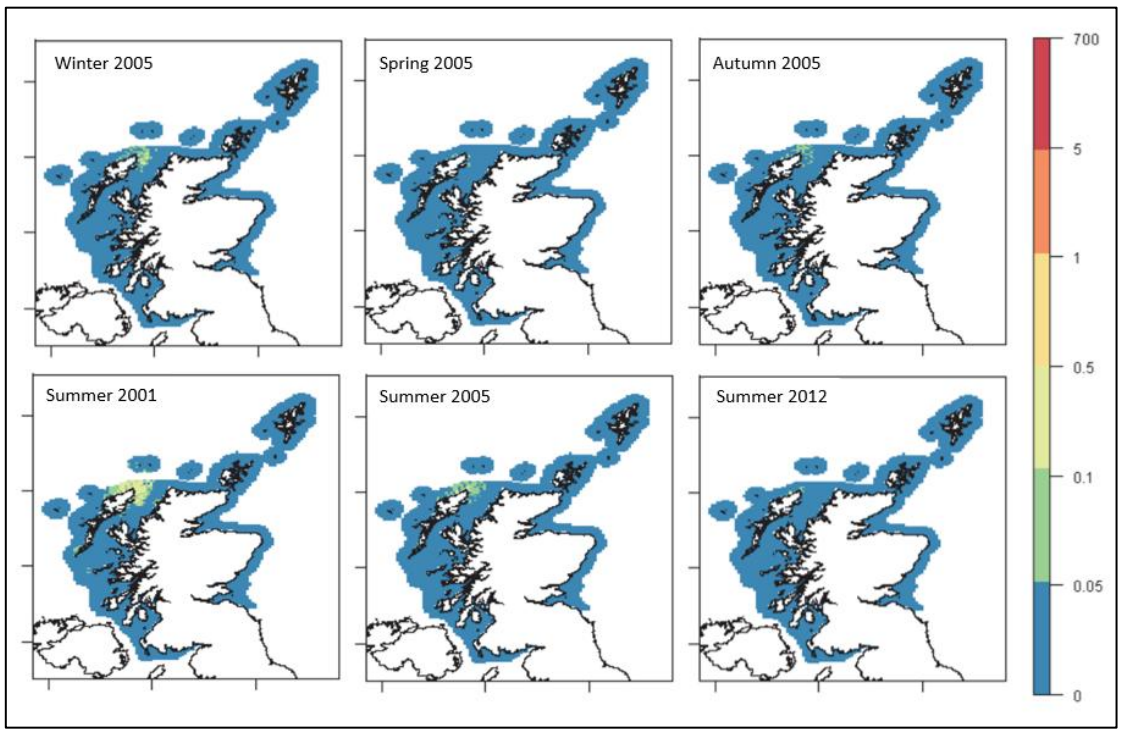


**Figure 9-3:** **Risso's dolphin estimated density surfaces (Paxton *et al.*, 2014). Colours indicate animals per km$^2$. Each cell is 5 by 5 km.**

## 9.7 ECOMMAS

The ECOMMAS data presented in Section 7.7 can also be considered for Risso's dolphins as the delphinid species cannot be differentiated in the calculation of DPD and DPH. As mentioned previously, these data concluded that dolphins were found in low numbers (with the exception of 2022), in the coastal areas monitored by ECOMMAS. There is no evidence from either the Cruden Bay or Fraserburgh sites of seasonal variation in detections, most likely due to the low detections. There was no obvious pattern in dolphin detection rate, in relation to distance from the shore for the Cruden Bay site. However, there is evidence to suggest that dolphins frequent the more coastal areas of the Fraserburgh site, with higher averages present at Fraserburgh 5.

## 9.8 Other OWFs

### 9.8.1 Berwick Bank OWF

Risso's dolphin were not sighted during the Berwick Bank site-specific surveys (RPS, 2022b).

### 9.8.2 Caledonia OWF

No site-specific data are currently available for this project.

### 9.8.3 Green Volt OWF

Only one Risso's dolphin was sighted in the 24 months of site-specific surveys at Green Volt. No density estimate was calculated (Royal HaskoningDHV, 2023).

### 9.8.4 Ossian OWF

No Risso's dolphins were observed during Ossian site-specific surveys (RPS, 2024).

### 9.8.5 Seagreen OWF

No post-consent site-specific data are currently available for this project.

### 9.8.6 Salamander OWF

No Risso's dolphins were observed during Salamander site-specific surveys (HiDef Aerial Surveying Limited, 2023a).

## 9.9 Risso's dolphin summary

Risso's dolphins were not observed in high densities during the site-specific surveys (0.002 Risso's dolphins/km$^2$) and were only observed in low densities during the majority of other survey data analysed (Table 9-4). It is recommended that the latest density estimate from the SCANS IV survey is the most appropriate to use in the quantitative assessment.

**Table 9-4: Summary table of the available density estimates for Risso's dolphin.**

| Source | Details | Density estimate (#/km$^2$) |
|---|---|---|
| Site-specific surveys | Scotwind E2 PO site plus 4 km buffer. Average relative density | 0.002 |
| Regional surveys | Scotwind E1 & E2 PO site plus 12 km buffer. | No Risso's dolphins observed |
| SCANS III (Hammond *et al.*, 2021) | Block R | 0 |
| SCANS III (Hammond *et al.*, 2021) | Block T (adjacent) | 0 |
| **SCANS IV (Gilles *et al.*, 2023)** | **Block NS-D** | **0** |
| **SCANS IV (Gilles *et al.*, 2023)** | **Block NS-E (adjacent)** | **0.0702** |
| Paxton *et al.* (2016) | Average in Firth of Forth in 2010 | <0.001 |
| Paxton *et al.* (2016) | Average in Moray Firth in 2010 | 0 |
| JCP Data Tool | User specified area average for summer 2007-2010 | 0.194 |
| MERP | Array Area range in Jan | <0.001 – 0.003 |
| MERP | Array Area range in Jul | <0.001 – 0.002 |
| Paxton *et al.* (2014) | Adjusted density estimates in spring, autumn and winter 2005 and summer 2001, 2005 and 2012 | 0 - 0.05 |

# 10 Minke whale

Minke whales are mainly observed in continental shelf waters around the UK, in waters depths <200 m. They are most commonly sighted in the summer months when they are located in more inshore waters to feed on herring and mackerel (Reid *et al.*, 2003). The distribution map shows high sighting rate of minke whale west of Scotland and central to northern part ok UK (Figure 10-1), including the east coast of Scotland area relevant to the proposed development location (Reid *et al.*, 2003). In Scottish waters, minke whales are sighted year-round with peak presence in summer months (Evans *et al.*, 2011, Hague *et al.*, 2020). They were sighted in northern Ireland and southern Inner Hebrides, Shetland and east coast of Scotland during the latest SCANS survey, with density estimates ranging from 0.008 – 0.039 in Scottish waters (Hammond *et al.*, 2021).

The conservation status of minke whales in UK waters was updated in JNCC (2019g) 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 NC MPA in Scottish waters: Southern Trench NCMPA (Figure 10-1).

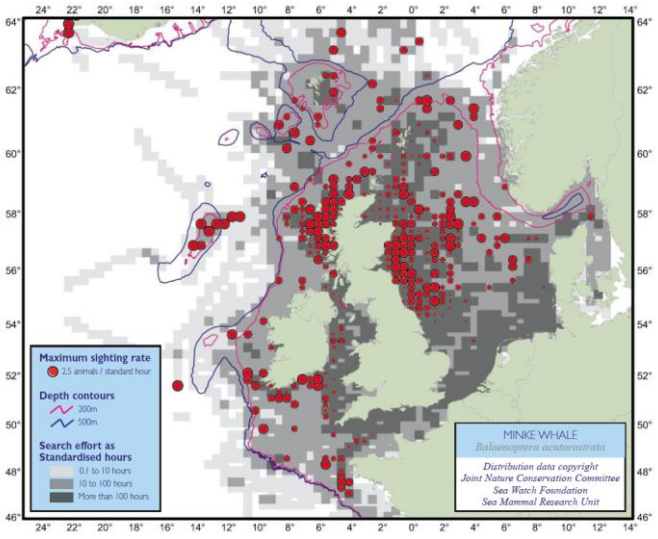


**Figure 10-1: Minke whale distribution map of effort-related sightings (Reid *et al.*, 2003).**

## 10.1 Management Unit

All minke whales in UK waters are considered to be part of the Celtic and Greater North Seas 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).

## 10.2 Site-specific surveys

During the two years of site-specific surveys, minke whales were sighted on seven occasions during the spring/summer/autumn months (April-Oct) (Table 10-1). No sightings occurred in the winter months (Nov-Mar). The maximum relative density was in April 2021 (0.03 minke whales/km$^2$) with an average relative density estimates over the survey period was 0.004 minke whales/km$^2$ (HiDef Aerial Surveying Limited, 2023b).

**Table 10-1: Number of Risso's dolphins observed in the Muir Mhòr survey area between April 2021 and March 2023. Data from HiDef Aerial Surveying Limited (2023b).**

| | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Jan | Feb | | Mar |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Year 1** | 4 | 1 | 0 | 0 | 0 | 3 | 1 | 0 | 0 | 0 | 0 | | 0 |
| **Year 2** | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | - | 0 | 0 | 0 | 0 |

## 10.3 Regional surveys

A total of 16 minke whales were observed across four months during regional surveys, seven of which occurred in July 2022. The relative density in July 2022 was 0.01 minke whales/km$^2$, and was 0 in all other months (HiDef Aerial Surveying Limited, 2023c).

## 10.4 Geophysical survey MMO report

During the geophysical surveys, minke whales were sighted in all months (April to July 2023). The greatest number of minke whales occurred in June 2023 (6) (EGS (International) Limited, 2023). No density estimate was calculated.

## 10.5 SCANS surveys

### 10.5.1 SCANS III

The Proposed Development is located within the SCANS III survey block R, where there was an estimated block-wide abundance of 2,498 minke whales (95% CI: 604 – 6,791) and an estimated density of 0.0387 (CV = 0.614) minke whales/km$^2$ in July 2016 (Hammond *et al.*, 2021). Abundance (2,068, 95% CI: 290 – 6,960) and density (0.0316 minke whales/km$^2$, CV = 0.805) in the neighbouring block T were lower than in the block R (Hammond *et al.*, 2021).

#### 10.5.1.1 SCANS III density surfaces

Lacey *et al.* (2022) 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 north of Scotland and northern Irish Sea. The density range for grid cells within the Array Area is 0.025-0.030 minke whale/km$^2$.

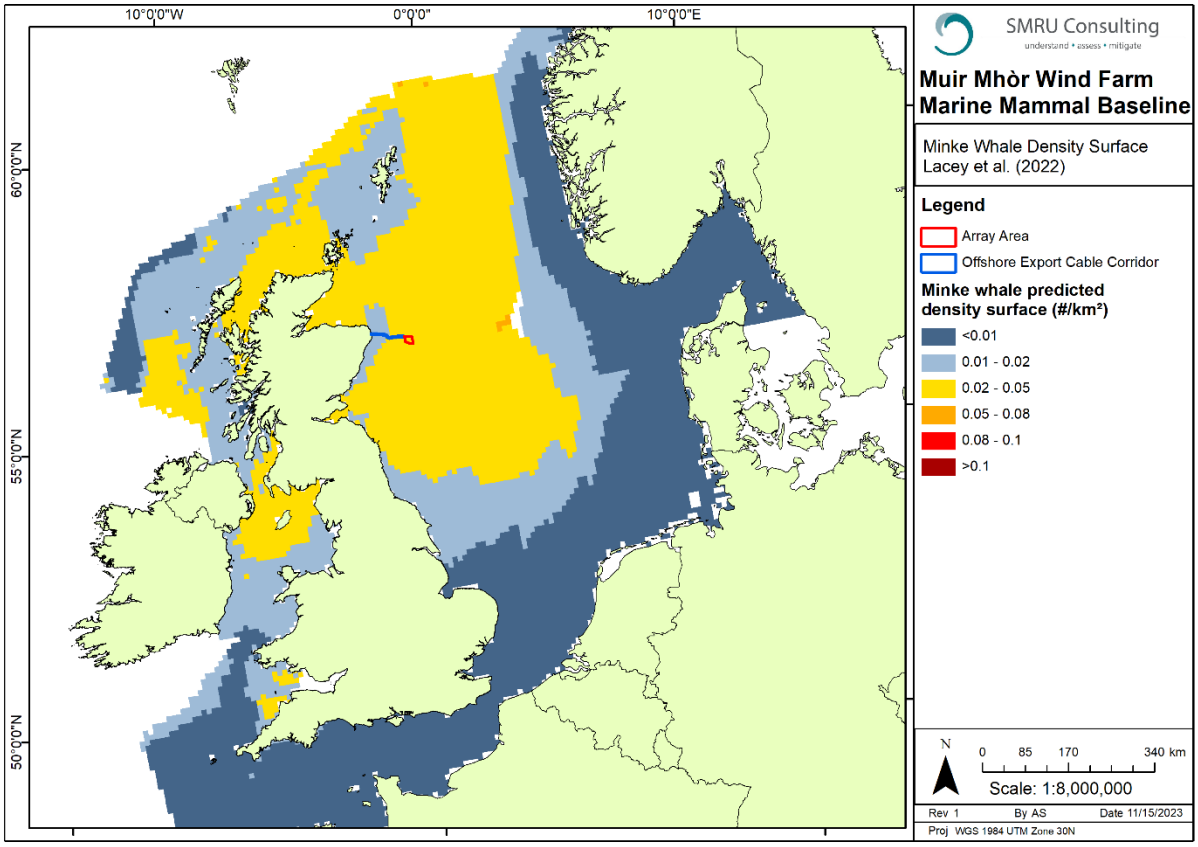


**Figure 10-2: Predicted surface of estimated density for minke whale in SCANS III. Data from Lacey *et al.* (2022).**

### 10.5.2 SCANS IV

The Proposed Development is located within the SCANS IV survey block NS-D, where there was an estimated block-wide abundance of 2,702 minke whales (95% CI: 547 – 7,357) and an estimated density of 0.0419 minke whale/km$^2$ (CV = 0.594) (Gilles *et al.*, 2023). Abundance (795, 95% CI: 3 – 1,735) and density (0.0100 minke whale/km$^2$, CV = 0.0.632) in the neighbouring block NS-E was significantly lower than in the block NS-D.

## 10.6 JCP data

### 10.6.1 JCP Phase III

Paxton *et al.* (2016) produced predicted minke whale densities for summer 2010 (Figure 10-3). The point surface shows the highest density area off the northwest of Scotland. Besides this area the density values are generally very low in the UK waters, with somewhat higher densities in the northern part of the UK waters. Density estimates for Firth of Forth, in which the proposed development is located, showed that minke whale density was considerably higher in summer months compared to the rest of the year and reached a maximum of 0.025 and an average of 0.008 minke whale/km$^2$ over the year. The density estimate trend was similar in the Moray Firth, neighbouring region just north of Firth of Forth, with higher summer density of 0.027 and an average of 0.009 minke whale/km$^2$ over the year (Table 10-2).

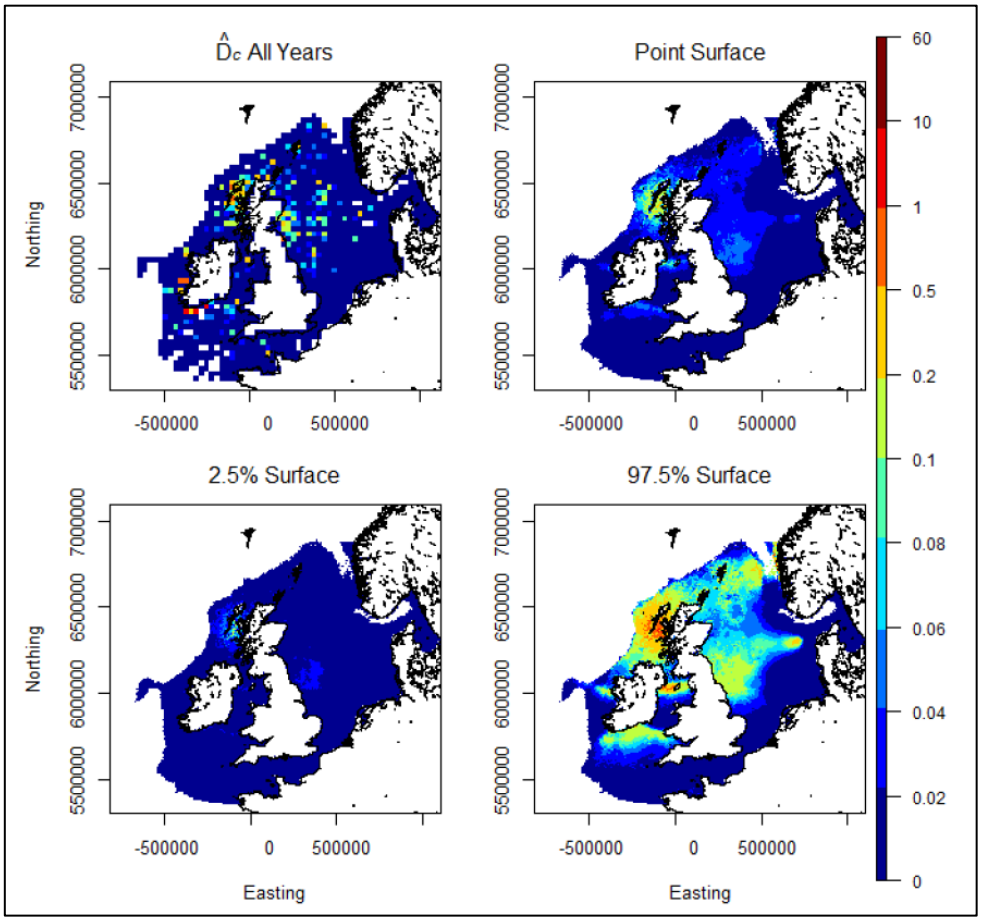


**Figure 10-3:** **Predicted minke whale densities for summer 2010 (Paxton *et al.*, 2016). Top left; input densities (summer all years), top right; point estimate of cell densities, bottom left; lower (2.5%) confidence limit on cell densities, bottom right; upper (97.5%) confidence limit on cell densities (minke whale/km²). Note that the top left plot exaggerates the spatial coverage of the relevant effort.**

**Table 10-2: JCP Phase III abundance and density estimates for minke whale in 2010 for the Firth of Forth and Moray Firth areas of commercial interest (Paxton *et al.*, 2016).**

| Area | Season | Abundance point estimate | 95% CI | Density (#/km$^2$) |
|---|---|---|---|---|
| Firth of Forth | Winter | 20 | 0 - 150 | 0.001 |
| | Spring | 60 | 0 – 480 | 0.004 |
| | Summer | 360 | 140 – 990 | 0.025 |
| | Autumn | 20 | 0 - 60 | 0.001 |
| **Average** | | **115** | - | **0.008** |
| Moray Firth | Winter | 20 | 0 – 130 | 0.003 |
| | Spring | 30 | 0 – 260 | 0.004 |
| | Summer | 210 | 80 - 540 | 0.027 |
| | Autumn | 20 | 0 - 60 | 0.003 |
| **Average** | | **70** | - | **0.009** |

### 10.6.2 JCP data analysis tool

The JCP Phase III Data Analysis Product provided a density estimate of 0.017 minke whale/km$^2$ (95% CI: 0.008-0.019) in the user specified area, averaged for the summer 2007-2010 (Table 10-3). It is important to note that this estimate is for the summer months only and is not representative of densities at other times of the year.

**Table 10-3: JCP Phase III Data Analysis Product abundance and density estimates for minke whale for the user specified area averaged for the summer 2007-2010.**

| | Scaled abundance | Density (#/km$^2$) |
|---|---|---|
| Point estimate | 236 | 0.017 |
| Lower confidence interval | 106 | 0.008 |
| Upper confidence interval | 260 | 0.019 |

### 10.6.3 MERP

Minke whale density maps produced by Waggitt *et al.* (2019) as part of the MERP project show moderate densities in Scottish waters. The offshore ECC of the Proposed Development intersects the Southern Trench NCMPA (Figure 4-1), which was established because of minke whales, however the maximum minke whale density for grid cells within the Array Area is 0.005 whales/km$^2$ for January and 0.012 whales/km$^2$ for July. The minimum density for grid cells within the Array Area is 0.003 whales/km$^2$ for January and 0.009 whales/km$^2$ for July (Figure 10-4). These maps are not considered to be suitable for quantitative impact assessments and are provided in this baseline characterisation for illustrative purposes only.

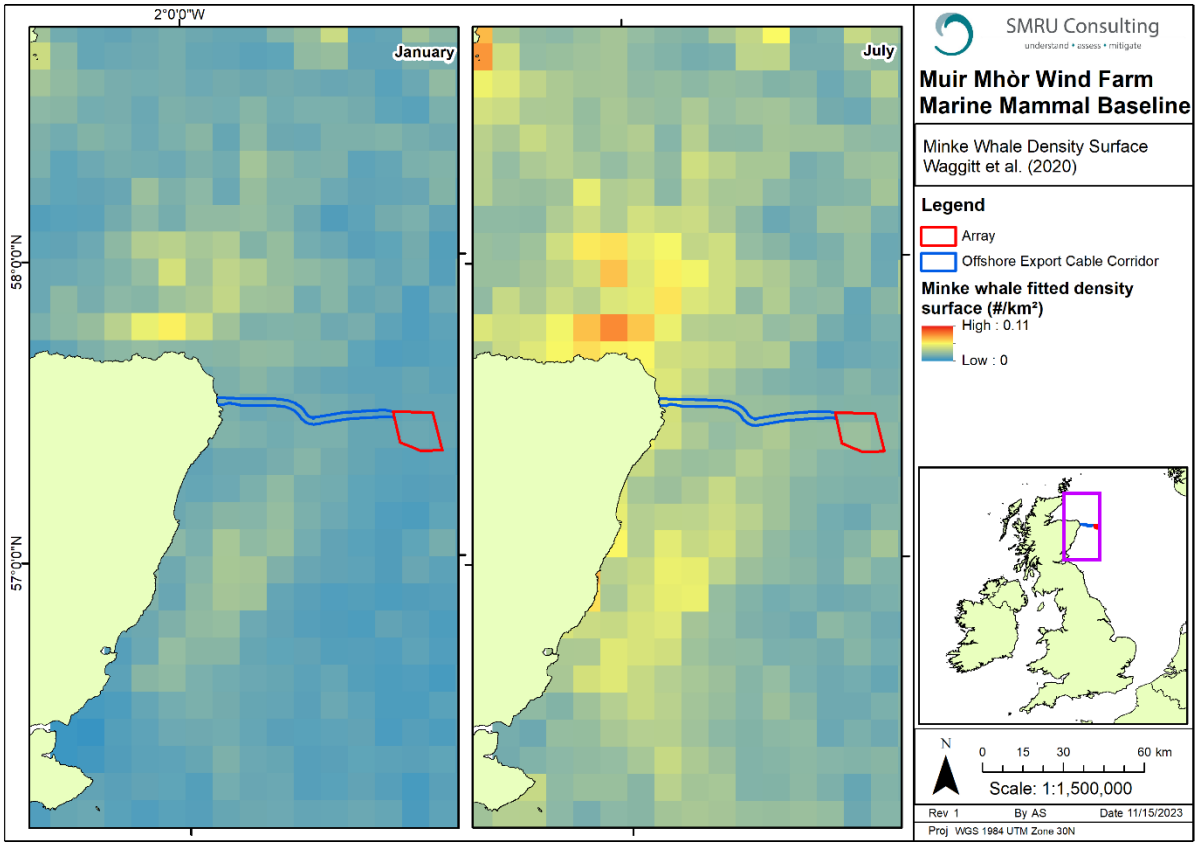


**Figure 10-4: Minke whale density surface (whales/km²) for January and July. Data from Waggitt *et al.* (2019).**

## 10.7 Spatially indexed adjusted densities

Paxton *et al.* (2014) presented adjusted density estimates for minke whales in spring and autumn 2005 and summer 2001, 2005 and 2012. The location of the Proposed Development corresponds with an area of low density between 0-0.1 minke whale/km$^2$ in all seasons in 2005. In summer 2001 and 2012, minke whale density ranged from 0.05-0.5 minke whale/km$^2$ (Paxton *et al.*, 2014).

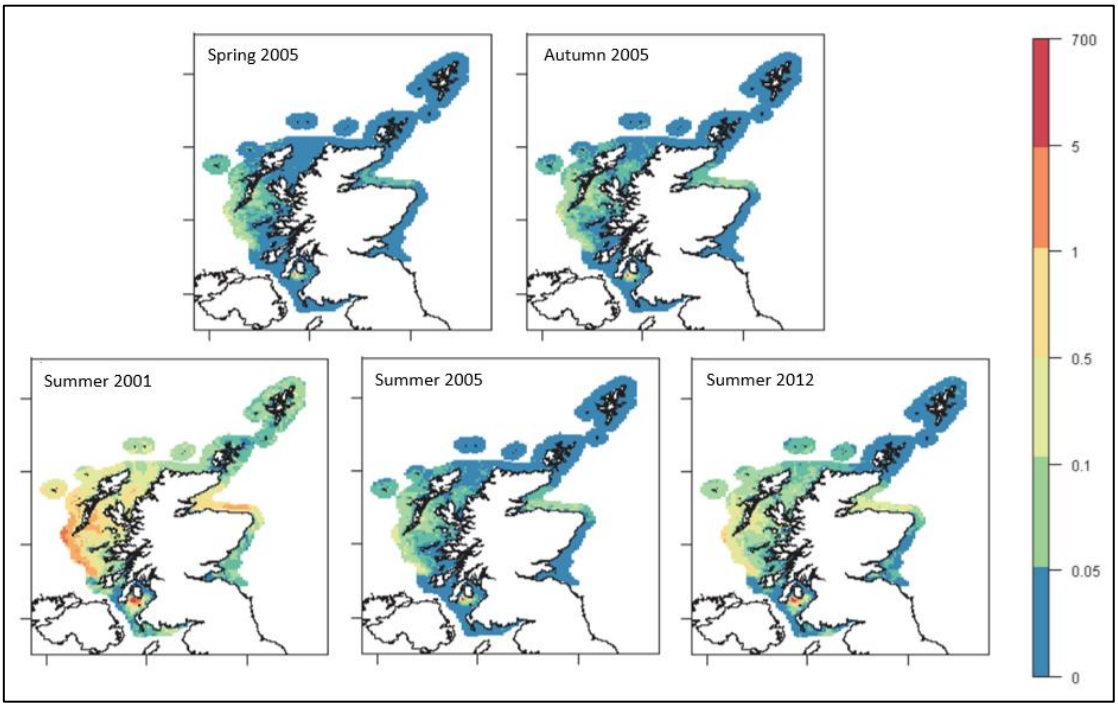


**Figure 10-5:** **Minke whale estimated density surfaces (Paxton *et al.*, 2014). Colours indicate animals per km$^2$. Each cell is 5 by 5 km.**

## 10.8 Southern Trench NCMPA

The Southern Trench NCMPA 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 10-6), providing feeding grounds for juveniles and adults (NatureScot, 2020). The NCMPA 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 NCMPA, just east of Fraserburgh and Peterhead (Figure 10-6). The same trend is shown for predicted persistence of above mean densities during summer months. This area of lower density is approximately where the offshore ECC for the Proposed Development intersects the Southern Trench NCMPA (Figure 4-1). The density range within the Southern Trench NCMPA produced by Lacey *et al.* (2022) using SCANS III data was 0-0.039 minke whales/km$^2$.

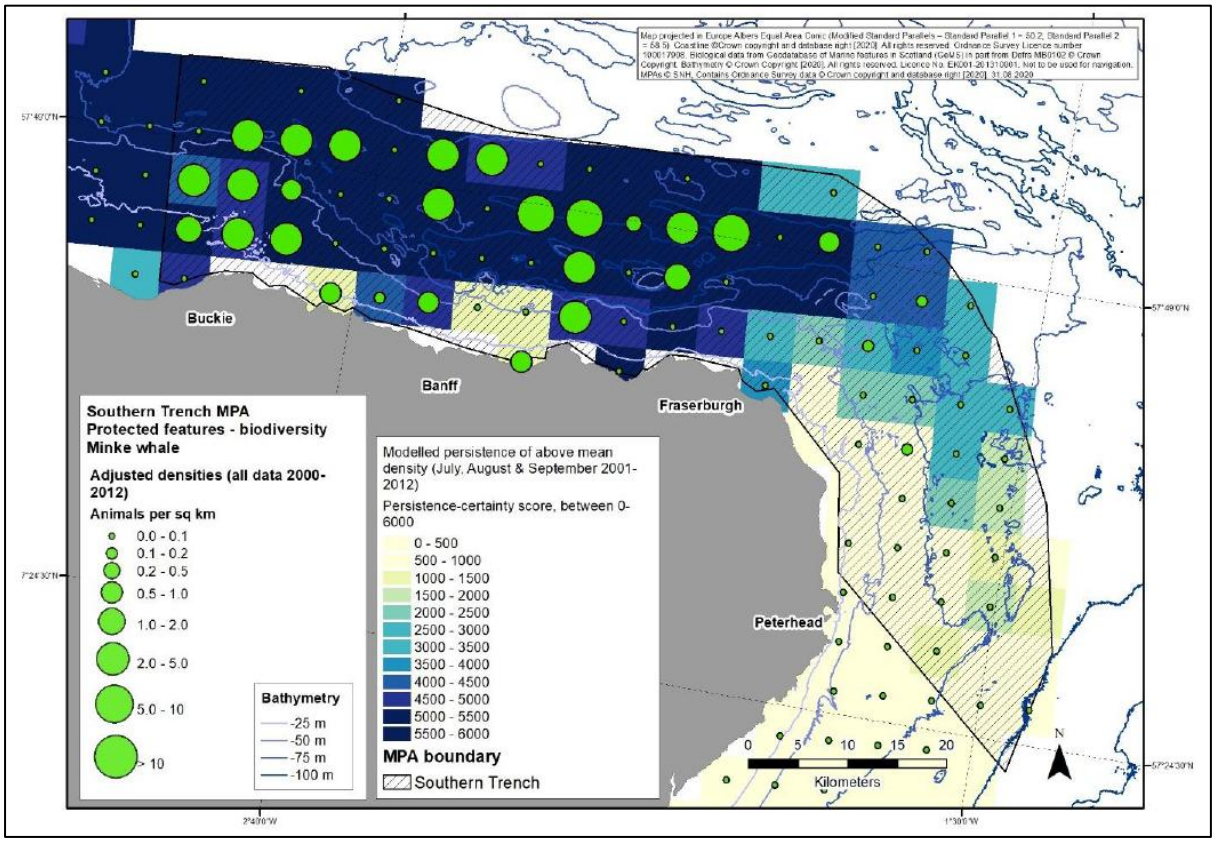


**Figure 10-6:** **Minke whale densities and predicted persistence of above mean densities in Southern Trench NCMPA (NatureScot, 2020).**

## 10.9 Other OWFs

### 10.9.1 Berwick Bank OWF

Minke whales were sighted on 11 of the monthly surveys (mainly April-September), resulting in a total of 57 minke whale sightings (RPS, 2022b). The mean corrected density of minke whales across all surveys at the site was 0.016 whales/km$^2$.

### 10.9.2 Caledonia OWF

No site-specific data are currently available for this project.

### 10.9.3 Green Volt OWF

No minke whales were sighted in the 24 months of site specific surveys at Green Volt (Royal HaskoningDHV, 2023).

### 10.9.4 Ossian OWF

There were 12 minke whales observed over four months of the site-specific surveys, with a peak in July 2022 of 5 whales. Insufficient data was available to calculate density estimates for minke whales (RPS, 2024).

### 10.9.5 Seagreen OWF

No post-consent site-specific data are currently available for this project.

### 10.9.6 Salamander OWF

A total of three minke whales were recorded over the 24 months of site-specific surveys, one in each of June, October and December 2021. The maximum relative density estimate in the site-specific survey area was 0.02 whales/km$^2$ (HiDef Aerial Surveying Limited, 2023a).

## 10.10 Minke whale summary

All surveys found low abundances of minke whales, with reported densities ranging from 0– 0.039 minke whales/km$^2$ (Table 10-2). Minke whales were sighted in low densities during the site-specific surveys (0.004 minke whales/km$^2$). However, as this species is known to be present year-round, with seasonal variability resulting in higher summer densities compared to winter densities, it is recommended that the higher SCANS III modelled density surface for minke whales is brought forward to the quantitative impact assessment. The impact contours will be overlain on the density surface to obtain the number of animals impacted in each grid cell in each impact contour. This is conservative since this density surface is derived from summer data, when minke whale sightings are higher compared to other seasons. In addition to this, the new SCANS IV block-wide unform density estimates will also be presented in the quantitative impact assessment.

**Table 10-4: Summary table of the available density estimates for minke whale.**

| Source | Details | Density estimate (#/km$^2$) |
|---|---|---|
| Site-specific surveys | Scotwind E2 PO site plus 4 km buffer. Average relative density | 0.004 |
| Regional surveys | Scotwind E1 & E2 PO site plus 12 km buffer. July 2022 relative density | 0.01 |
| SCANS III | Block R | 0.0387 |
| SCANS III | Block T (adjacent) | 0.0316 |
| **Lacey *et al.* (2022)** | **Array Area range (min – max)** | **0.025 - 0.030** |
| **SCANS IV (Gilles *et al.*, 2023)** | **Block NS-D** | **0.0419** |
| **SCANS IV (Gilles *et al.*, 2023)** | **Block NS-E (adjacent)** | **0.0100** |
| Paxton *et al.* (2016) | Average in Firth of Forth in 2010 | 0.008 |
| Paxton *et al.* (2016) | Summer in Firth of Forth in 2010 | 0.025 |
| JCP Data Tool | User specified area average for summer 2007-2010 | 0.017 |
| Paxton *et al.* (2016) | Average in Moray Firth in 2010 | 0.009 |
| Paxton *et al.* (2016) | Summer in Moray Firth in 2010 | 0.027 |
| MERP | Array Area range in Jan | 0.003 – 0.005 |
| MERP | Array Area range in Jul | 0.009 – 0.012 |

| | | |
|---|---|---|
| Paxton *et al.* (2014) | Adjusted density estimates in spring, and autumn 2005 and summer 2001, 2005 and 2012 | 0 – 0.5 |
| Southern Trench MPA | Lacey *et al*. 2020 (min – max) | 0 – 0.039 |
| Southern Trench MPA | Waggitt *et al*. 2020 January (min – max) | 0.003 – 0.018 |
| Southern Trench MPA | Waggitt *et al*. 2020 July (min – max) | 0.009 – 0.039 |
| Berwick Bank OWF | Berwick Bank Array Area + 16 km buffer (average) | 0.016 |
| Salamander OWF | Salamander Array Area + 4 km buffer (average) | 0.02 |

# 11 Harbour seal

## 11.1 Seal Management Unit

The Proposed Development is located within the East Scotland SMU. Harbour seal August counts in the East Scotland SMU have been in decline since 1997, with the latest trend assessment concluding a decrease of 4.93% per year (95% CI: 6.28 – 9.09) (SCOS, 2023). Since 1997, the population has declined by 70% (95% CI: 47 – 83) (Table 11-1) and the latest population estimate for the entire SMU (scaled to account for those at sea at the time of the count) is 364 harbour seals (Table 11-1) (SCOS, 2023).

**Table 11-1: Harbour seal August haul-out counts in the East Scotland SMU. Values taken from SCOS (2023).**

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

## 11.2 Site-specific surveys

In year one of the site-specific surveys, three harbour seals were sighted, alongside 66 sightings of unidentified seal species. In year two of the surveys, one harbour seal was sighted, alongside 25 sightings of unidentified seal species (HiDef Aerial Surveying Limited, 2023b). The maximum apportioned density estimate of harbour seals across the 24 surveys was 0.02 harbour seals/km$^2$.

## 11.3 Regional surveys

No harbour seals were observed during regional surveys (HiDef Aerial Surveying Limited, 2023c)

## 11.4 Geophysical survey MMO report

During the geophysical surveys, there were no sightings of harbour seal. However, there was one observation of an unidentified seal in May 2023 (EGS (International) Limited, 2023).

## 11.5 August haul-out counts

The distribution of harbour seals within the East Scotland SMU has varied significantly over time. The population used to be concentrated in the Firth of Tay and Eden Estuary area, leading to the

designation of the SAC in 2005 when approximately 600 adult harbour seals would haul-out to rest, pup and moult. However, the SAC August haul-out counts have declined by 94% since 1998, and the latest count was 41 animals in August 2021 (SCOS, 2023). In recent years, the majority of the East Scotland SMU now hauls-out within the Firth of Forth area (Figure 11-1).

The closest haul-out count recorded to the offshore ECC is at Peterhead, where 11 harbour seals were counted in 2007 (Figure 11-1). Peterhead was surveyed in 2021 but no harbour seals were recorded. In 2021, the closest harbour seal haul-out site to the ECC was at the Bridge of Don, which is ~30 km south and where 21 harbour seals were counted (Figure 11-2).

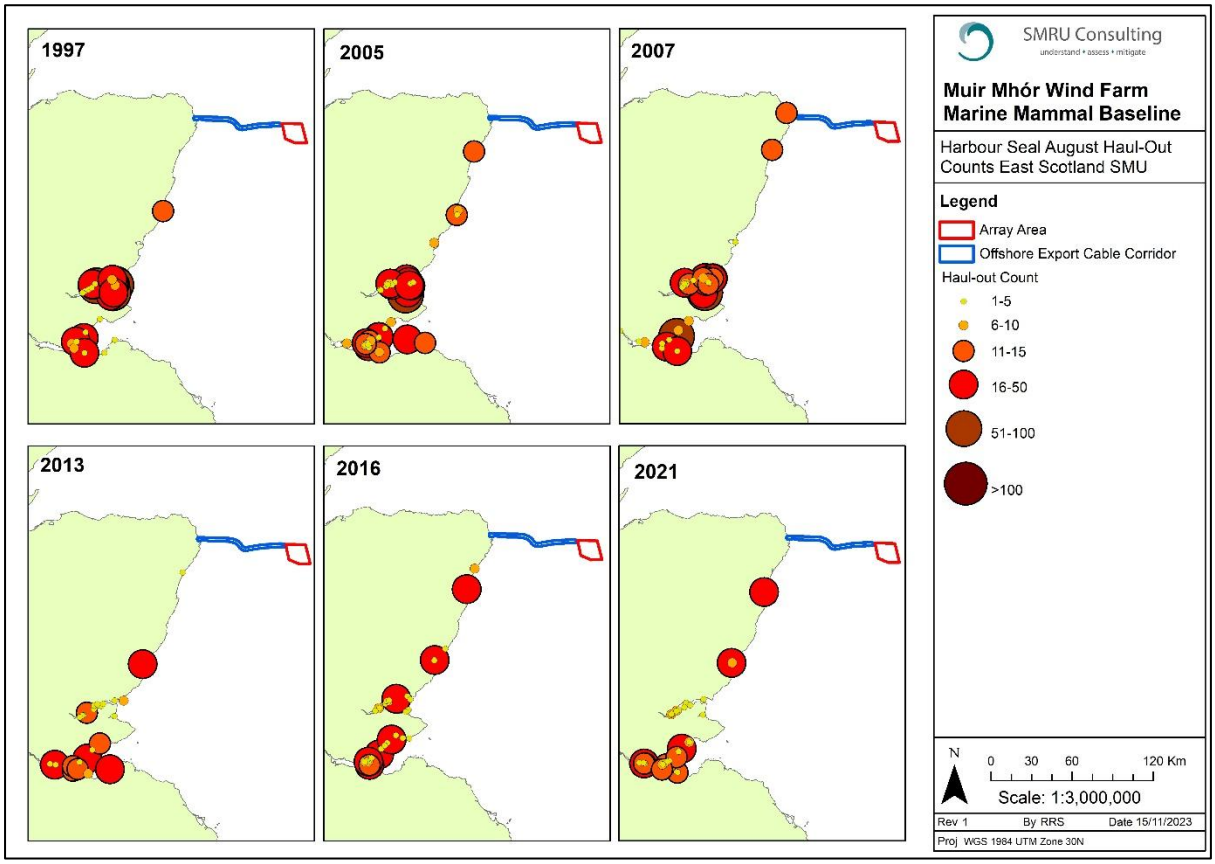


**Figure 11-1:** **Harbour seal August haul-out counts in the East Scotland SMU between 1997 and 2021. Data provided by SMRU.**

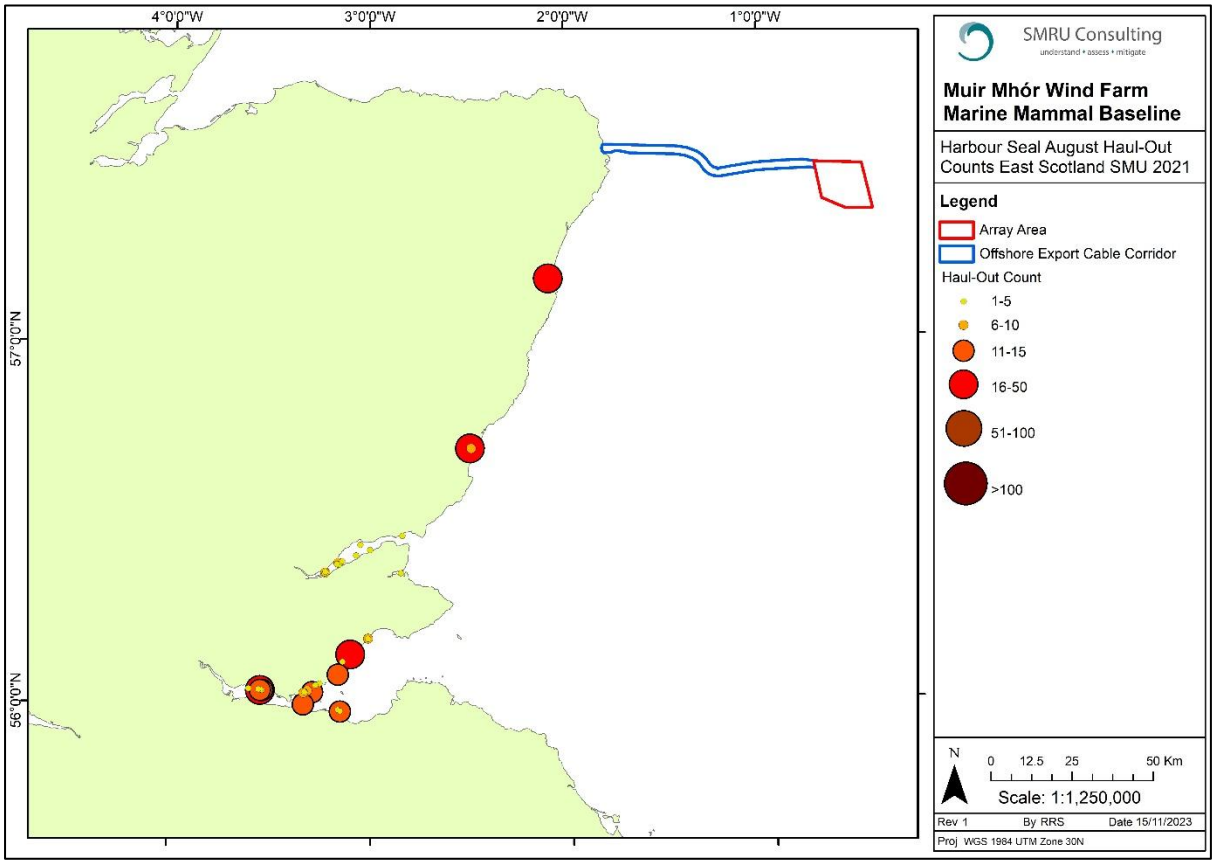


**Figure 11-2:** **Harbour seal August haul-out counts in the East Scotland SMU in 2021. Data provided by SMRU.**

## 11.6 Telemetry

A total of 50 harbour seals have been tagged by SMRU in the East Scotland SMU between 2001 and 2017 (four at Abertay, 38 at Eden, four at Kirkaldy and four at the River Don). Additionally, there have been a total of 41 harbour seals tagged by SMRU in the Moray Firth SMU between 2004 and 2015 (24 at Ardersier, 15 at Dornoch Firth and two at Loch Fleet) 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 Programme).

The telemetry data from the seals tagged in the East Scotland SMU show movement of harbour seals within the East Scotland SMU and the Northeast England SMU (Figure 11-3). None of the harbour seals tagged in the East Scotland SMU recorded telemetry data within the Moray Firth SMU. None of the harbour seals tagged in the East Scotland SMU showed any connectivity with the Proposed Development.

The telemetry data from the seals tagged in the Moray Firth SMU show movement of harbour seals within the Moray Firth SMU and the North Coast and Orkney SMU (Figure 11-4). Only two of the 98 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.

Based on these telemetry data there is no evidence of harbour seal connectivity between the East Scotland and the Moray Firth SMU. 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 the two SMUs.

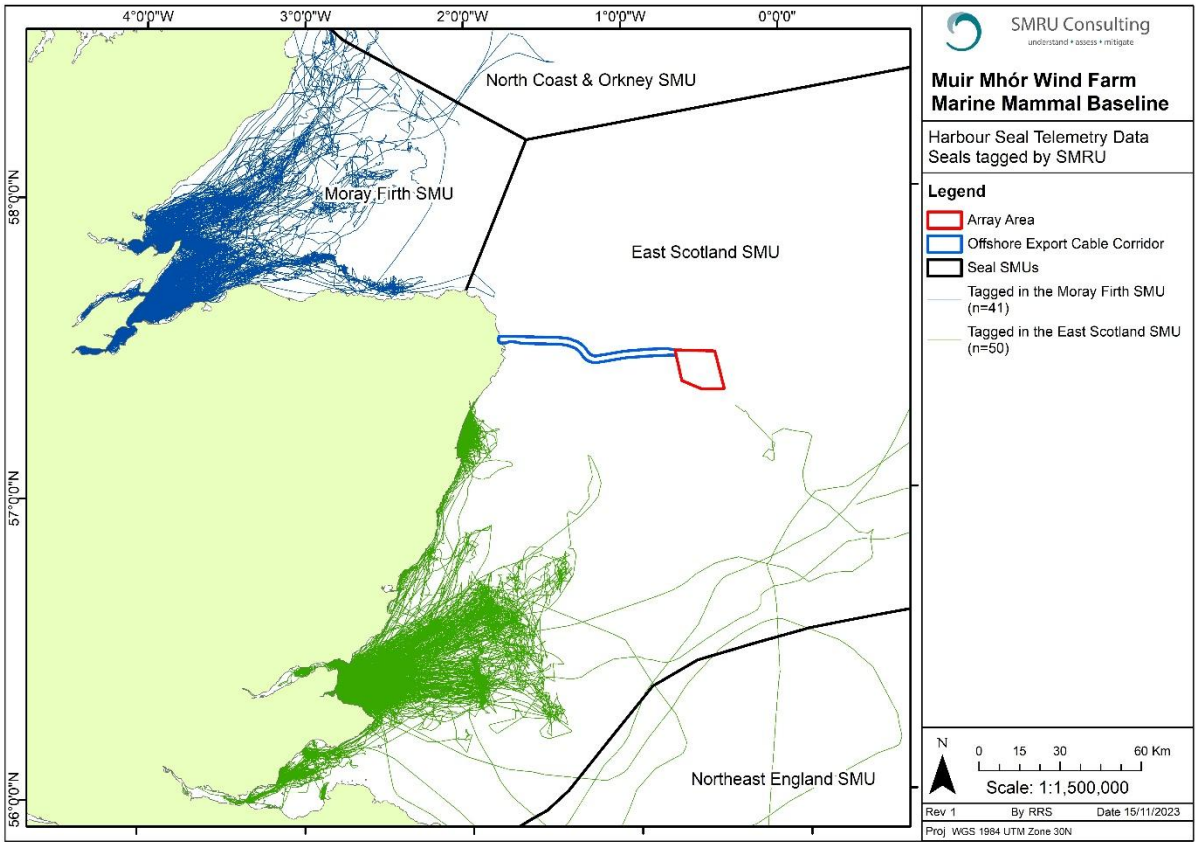


**Figure 11-3:** **Telemetry data for harbour seals tagged in the East Scotland SMU (n=50) and the Moray Firth SMU (n=41) by SMRU between 2001 and 2015. Data provided by SMRU.**

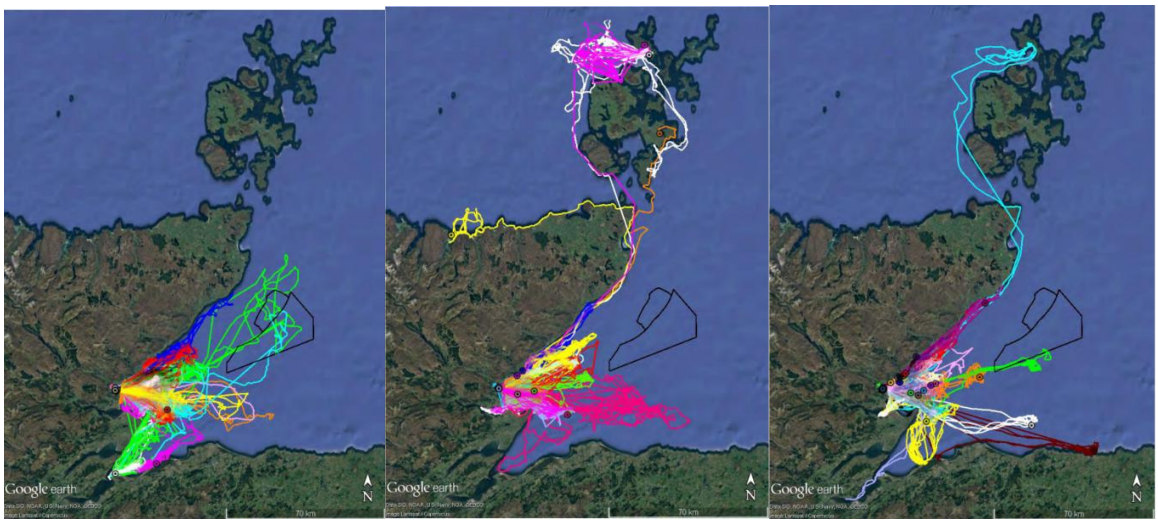


**Figure 11-4:** **Telemetry data for harbour seals tagged at Loch Fleet by Aberdeen University as part of the Moray Firth Marine Mammal Monitoring Programme. Left: 12 harbour seals tagged in 2014, middle: 13 harbour seals tagged in 2015, right: 32 harbour seals tagged in 2017. Figures taken from Graham *et al.* (2017).**

## 11.7 At-sea distribution

In Scotland, harbour seals at-sea are distributed mainly in the West of Scotland, in the Moray Firth and in the Firth of Forth (Figure 11-5). Within the East Scotland SMU, harbour seal at-sea distribution is highly coastal, with highest at-sea usage in the Firth of Forth. At-sea densities in the vicinity of the proposed development are very low. The maximum expected density of harbour seals within the ECC is 0.042 harbour seals/km$^2$.

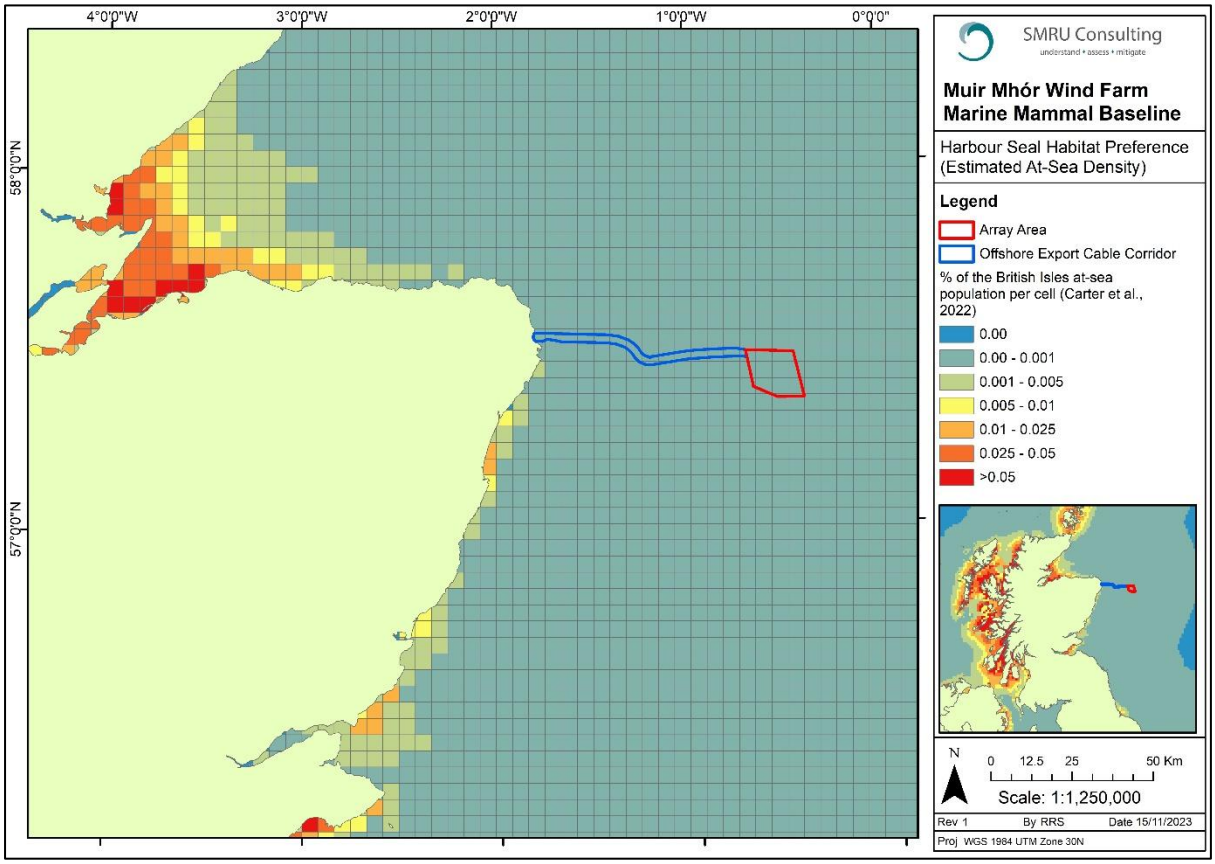


**Figure 11-5: Harbour seal at-sea habitat preference map. Data from Carter *et al.* (2020), Carter *et al.* (2022).**

## 11.8 Harbour seal summary

The Proposed Development is located in the East Scotland SMU, which has been in decline since 1997. While harbour seals have previously been recorded at Peterhead, adjacent to the offshore ECC and landfall area, none were recorded at Peterhead in the latest count in 2021. The at-sea distribution predicts very low densities of harbour seals in the vicinity of the Array Area and offshore ECC. The available telemetry data show very coastal movements of harbour seals in the East Scotland SMU.

For the quantitative impact assessment, the relevant population against which to assess impacts is the East Scotland SMU population (364 harbour seals), using the Carter *et al.* (2020), Carter *et al.* (2022) habitat preference maps to quantify the number of animals potentially impacted.

# 12 Grey seal

## 12.1 Seal Management Unit

The Proposed Development is located within the East Scotland SMU, however telemetry data suggest connectivity between the East Scotland SMU, the Moray Firth SMU and the North Coast and Orkney SMU (see section 12.7 for further information). Therefore, all three SMUs are presented here.

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). 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).

**Table 12-1: Grey seal August haul-out counts in the East Scotland SMU and the Moray Firth SMU. Values taken from SCOS (2023).**

| SMU | | 1996-1997 | 2000-2006 | 2007-2009 | 2011-2015 | 2016-2019 | 2021 |
|---|---|---|---|---|---|---|---|
| **East Scotland** | **Count** | 2,328 | 1,898 | 1,238 | 2,296 | 3,683 | 2,712 |
| | **Population estimate** | 9,256 | 7,547 | 4,922 | 9129 | 14,644 | 10,783 |
| **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 |
| **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 | - |

## 12.2 Site-specific surveys

Grey seals were the second most frequently sighted marine mammal species in the Muir Mhòr baseline surveys (HiDef Aerial Surveying Limited 2023). In year one of the site-specific surveys, 33 grey seals were sighted, alongside 66 sightings of unidentified seal species. In year two of the surveys, 13 grey seals were sighted, alongside 25 sightings of unidentified seal species (HiDef Aerial Surveying Limited, 2023b). The maximum apportioned density estimate of grey seals across the 24 surveys was 0.05 grey seals/km$^2$.

## 12.3 Regional surveys

Grey seals were observed during nine of the regional surveys, with the peak occurring in June 2023 where 13 grey seals were recorded, and a mean of 3 grey seals were recorded each month (Table 12-2). The maximum relative density was in July 2022 and June 2023 (0.04 grey seals/km$^2$) with an average relative density estimate over the survey period of 0.01 grey seals/km$^2$ (HiDef Aerial Surveying Limited, 2023c).

**Table 12-2: Number of grey seals observed in the regional survey area (Scotwind E1 and E2 PO site plus 12 km buffer) between April 2022 and March 2023. Data from HiDef Aerial Surveying Limited (2023b).**

| Date | # observed |
|---|---|
| 10 Apr 2022 | 0 |
| 23 Apr 2022 | 0 |
| 20 May 2022 | 1 |
| 23 Jun 2022 | 0 |
| 18 Jul 2022 | 8 |
| 19 Aug 2022 | 2 |
| 14 Sep2022 | 0 |
| 02 Oct 2022 | 0 |
| 04 Nov 2022 | 0 |
| 09 Jan 2023 | 0 |
| 06 Feb 2023 | 5 |
| 21 Feb 2023 | 3 |
| 04 Apr 2023 | 0 |
| 21 Apr 2023 | 1 |
| 16 May 2023 | 0 |
| 15 Jun 2023 | 13 |
| 08 Jul 2023 | 10 |
| 05 Aug 2023 | 3 |
| **18 month mean** | **3** |

## 12.4 Geophysical survey MMO report

During the geophysical surveys, there were grey seal sightings in May, June and July 2023: the largest number of seals was observed in May (three). In addition, there was one observation of an unidentified seal in May 2023 (EGS (International) Limited, 2023).

## 12.5 August-haul-out counts

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-out sites to the offshore ECC are at Cruden Bay (immediately south of the offshore ECC), where 114 grey seals were counted across 4 sites in 2021, and Peterhead (immediately north of the offshore ECC), where 140 grey seals were counted in 2021 (Figure 12-1).

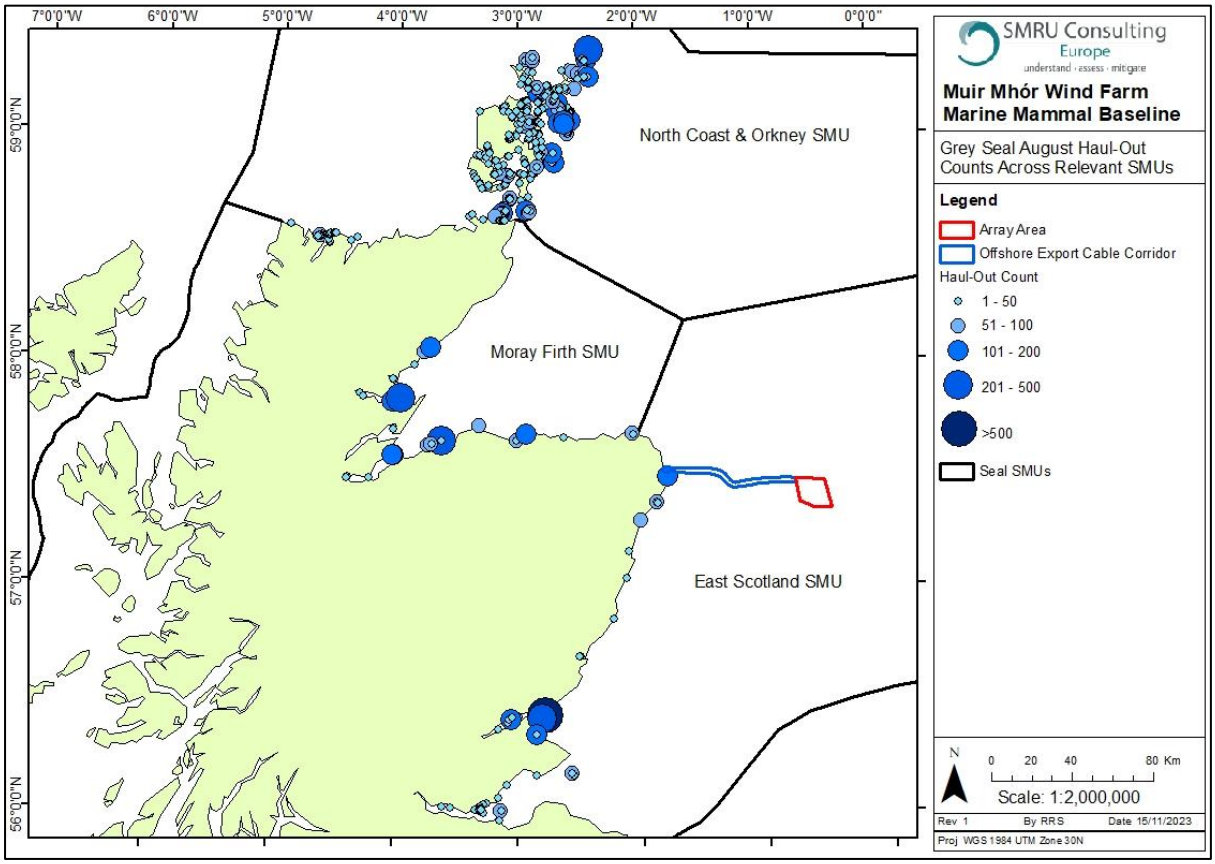


**Figure 12-1:** **Grey seal August haul-out counts in the East Scotland SMU (2021), Moray Firth SMU (2021), Orkney (2019) and North Coast (2016). Data provided by SMRU.**

## 12.6 Pup production counts

Within the 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) (Figure 12-2). The latest total pup count across the East Scotland SMU was 7,268 pups in 2019. The Isle of May used to be the primary breeding colony in east Scotland, with annual pup counts between 1989 and 2019 ranging between 936 (in 1989) to 2,355 (in 2012). The population in the Isle of May SAC is currently described as potentially declining, and the most recent pup count at the Isle of May was 1,885 pups in 2019 (26% SMU total count). In 1997, 236 grey seal pups were recorded at Fast Castle and the pup production has significantly increased since then to a maximum of 4,499 pups in 2019 (62% SMU total count), with an increasing trend of 8.31% per annum. Pup counts at Inch Keith have increased from 65 in 2003 to 8.3 in 2019 and counts at Craigleith and Inchcolm remain low (74 and seven in 2019 respectively).

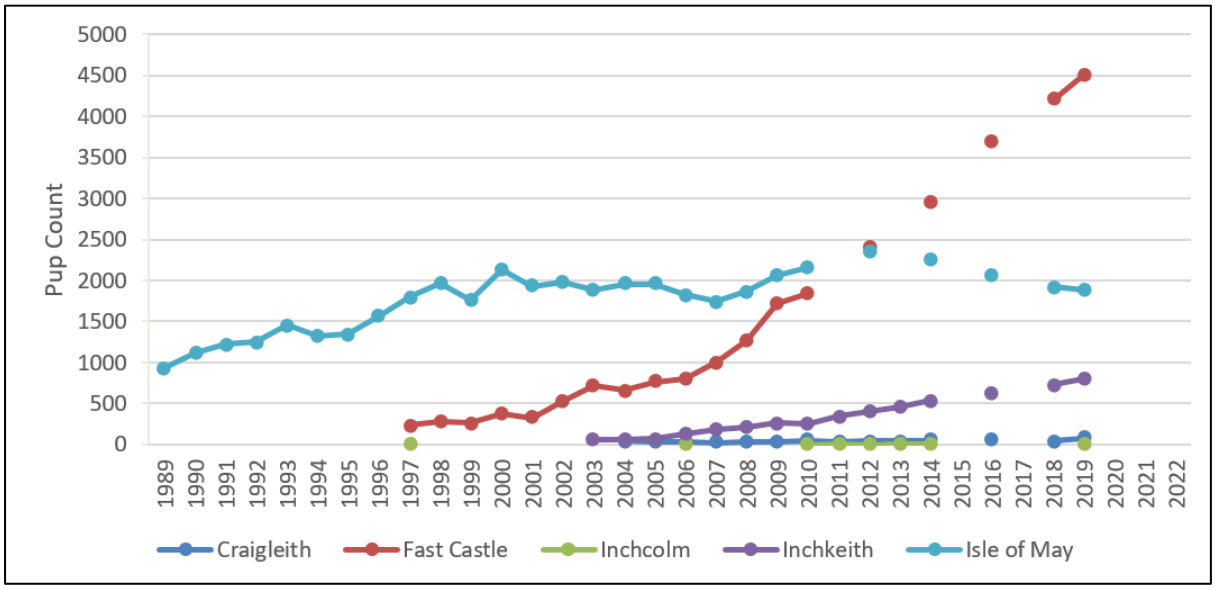


**Figure 12-2:** **Grey seal pup counts over time at the five breeding colonies in the East Scotland SMU. Data provided by SMRU.**

Within the Moray Firth SMU there are three grey seal breeding colonies: Helmsdale to Dunbeath, Dunbeath to Wick and Duncansby Head. The first count at Helmsdale to Dunbeath was in 1997 where 523 pups were counted, this has increased to 1,116 pups in 2019. Counts at Dunbeath to Wick and Duncansby Head are lower but have been increasing since 2003 (Figure 12-3). Pup production in the Moray Firth in 2019 totalled 1,856 pups, with a current trend of a 3.12% increase per annum.

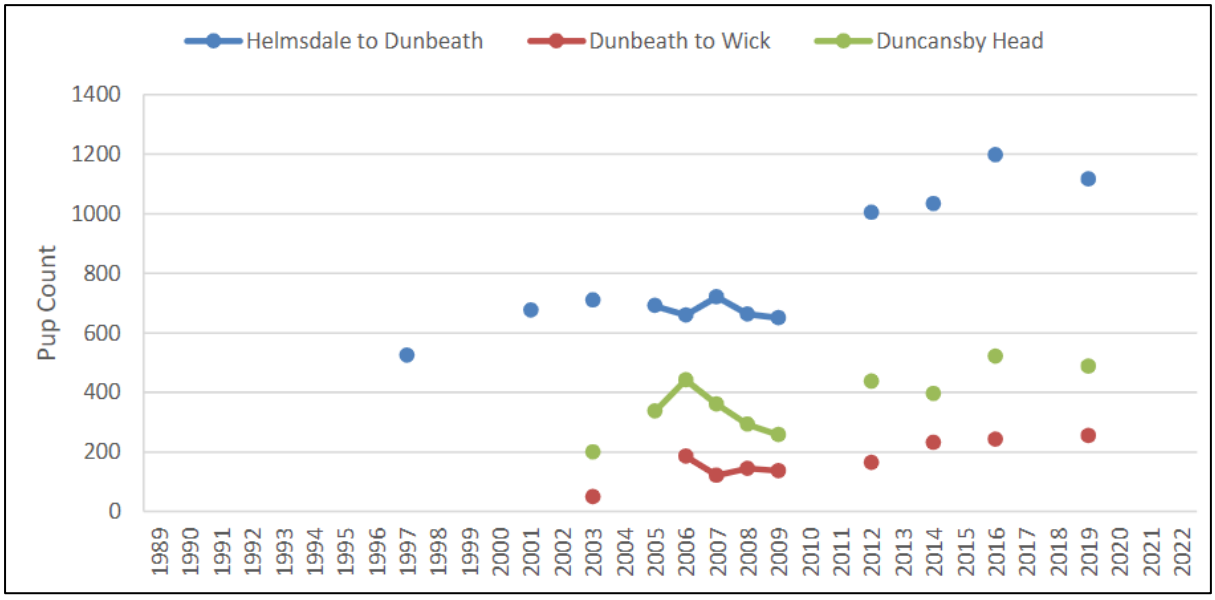


**Figure 12-3:** **Grey seal pup counts over time at the three breeding colonies in the Moray Firth SMU. Data provided by SMRU.**

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 (Figure 12-4). The largest of these breeding colonies is at Linga Holm (uninhabited island to the west of Stronsay) where 4,379 pups were counted in 2019.

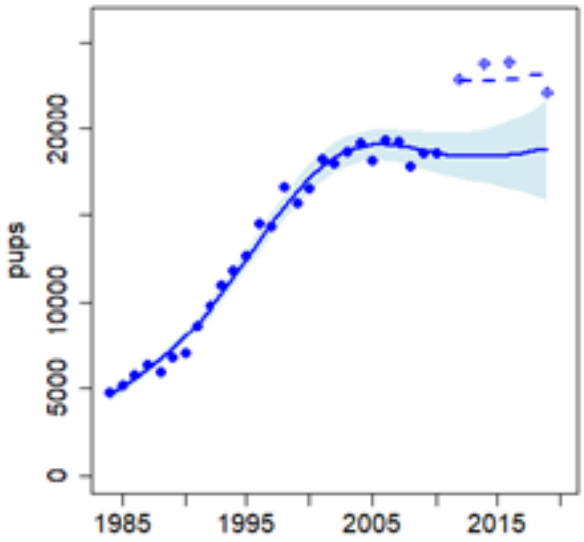


**Figure 12-4:** **Pup production estimates by year for the North Coast and Orkney SMU, and predicted trend and associated 95% confidence intervals. Figure taken from SCOS (2023).**

## 12.7 Seal telemetry

There have been 86 grey seals tagged in the East Scotland SMU between 1990 and 2016 (Figure 12-5). Of these:

- 46 were adults tagged at Abertay (n=32), the Isle of May (n=11), St Andrews (n=1) and Tentsmuir (n=2);
- 30 were pups tagged at the Isle of May (n=29) and Tentsumuir (n=1);
- Five were juveniles tagged in St Andrews (n=3) and Tentsmuir (n=2); and
- Five were listed as unknown age but marked as 1+, all tagged at Tentsmuir.

Additionally, there have been 10 grey seals tagged in the Moray Firth SMU by the University of Aberdeen, all tagged animals were adults and were tagged in 2018 at Ardersier (n=1), Dornoch Firth (n=8) and Findhorn (n=1) (Figure 12-5).

Grey seals are far more wide-ranging than harbour seals and are known to travel over 100 km between haul-out sites, with foraging trips generally within 100 km of a haul-out, though some individuals have been tracked foraging hundreds of kilometres offshore. As expected, telemetry tracks from animals tagged in the East Scotland SMU have shown that individual grey seals can travel very large distances, to west Scotland, Shetland, Norway, Denmark, the Netherlands and southern England (Figure 12-5).

Within a 50 km buffer of the Array Area, there are telemetry tracks from 52 grey seals (Figure 12-6), tagged in the East Scotland SMU (n=28), the North Coast and Orkney SMU (n=12), the Moray Firth SMU (n=4), the Northeast England SMU (n=6) and the Southeast England SMU (n=2).

The grey seals within the 50 km buffer or the Array Area show connectivity with the Isle of May SAC (Firth of Forth), the Berwickshire and North Northumberland Coast SAC, the Farray and Holm of Farray SAC (Orkney) and the Humber Estuary SAC (England). Given the connectivity of grey seals with

a 50 km buffer of Array Area and multiple SMUs, it is recommended that the relevant population against which to assess impacts is a combination of the East Scotland MU, the Moray Firth MU and the North Coast and Orkney SMU (each will be assessed individually in the impact assessment as well as collectively).

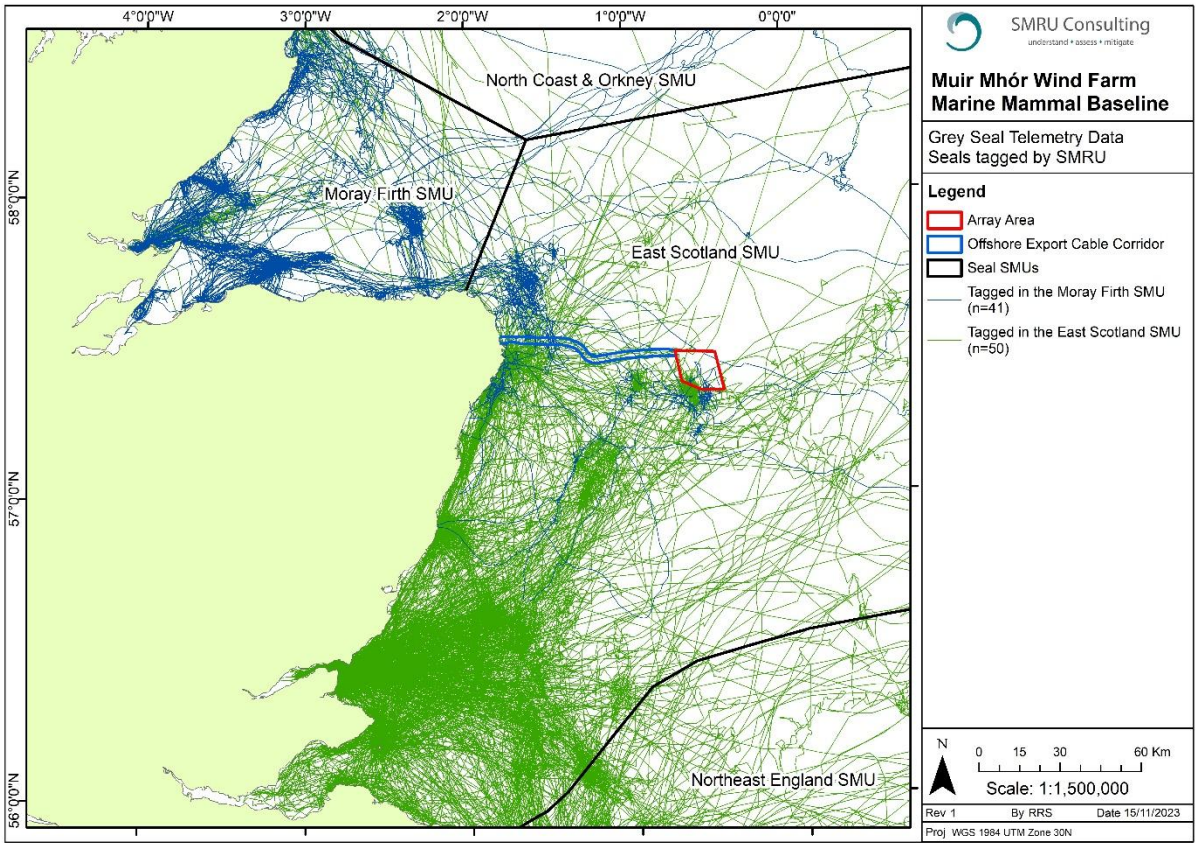


**Figure 12-5:** **Grey seal telemetry tracks for seals tagged in the East Scotland SMU (n=86) and the Moray Firth SMU (n=10). Data provided by SMRU.**

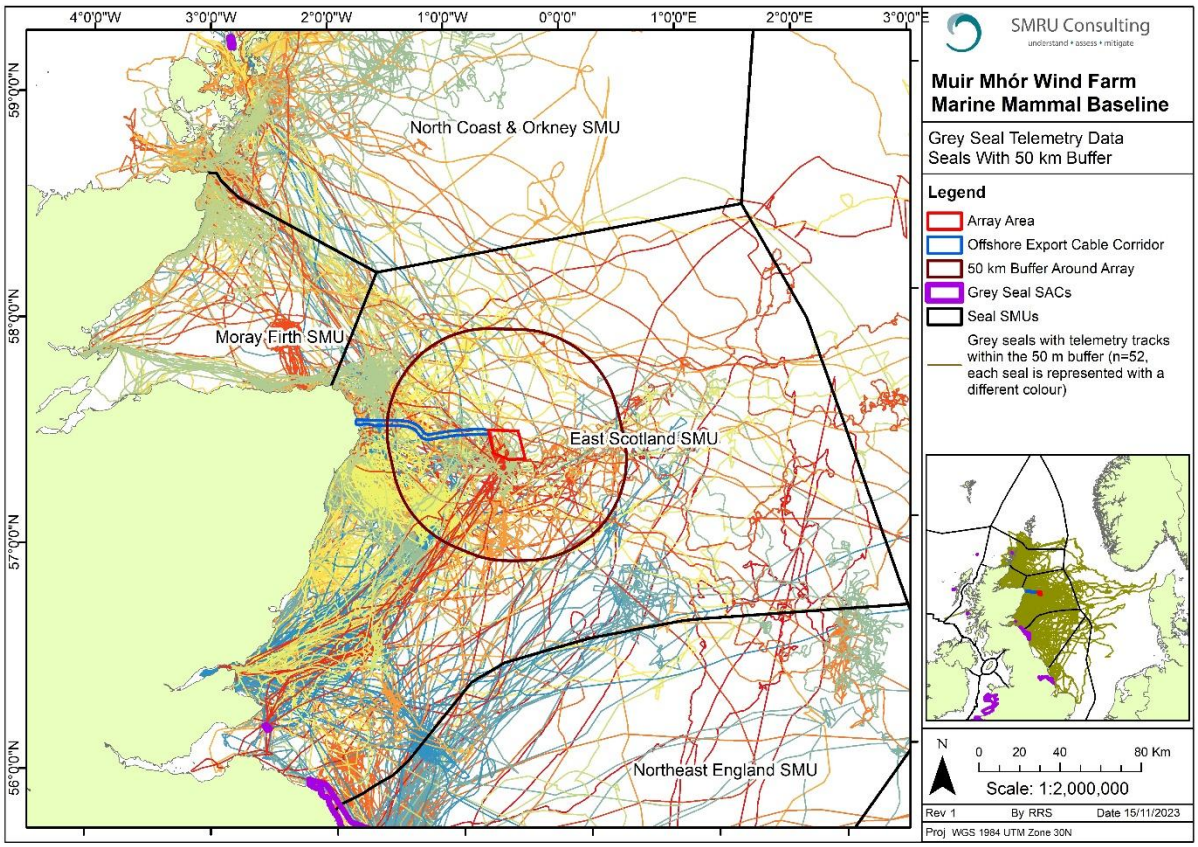


**Figure 12-6:** **Grey seal telemetry tracks for 52 grey seals with telemetry tracks within the 50 km buffer of the Array Area. Data provided by SMRU.**

## 12.8 Seal at-sea distribution

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 12-7). Within the East Scotland SMU, grey seal at-sea distribution is highest off the coast of Fife and in the Firth of Forth. The highest density of grey seals within the offshore ECC is 3.88 grey seals/km$^2$ at the grid cells at the coastline and within the Array Area the highest density is 0.48 grey seals/km$^2$.

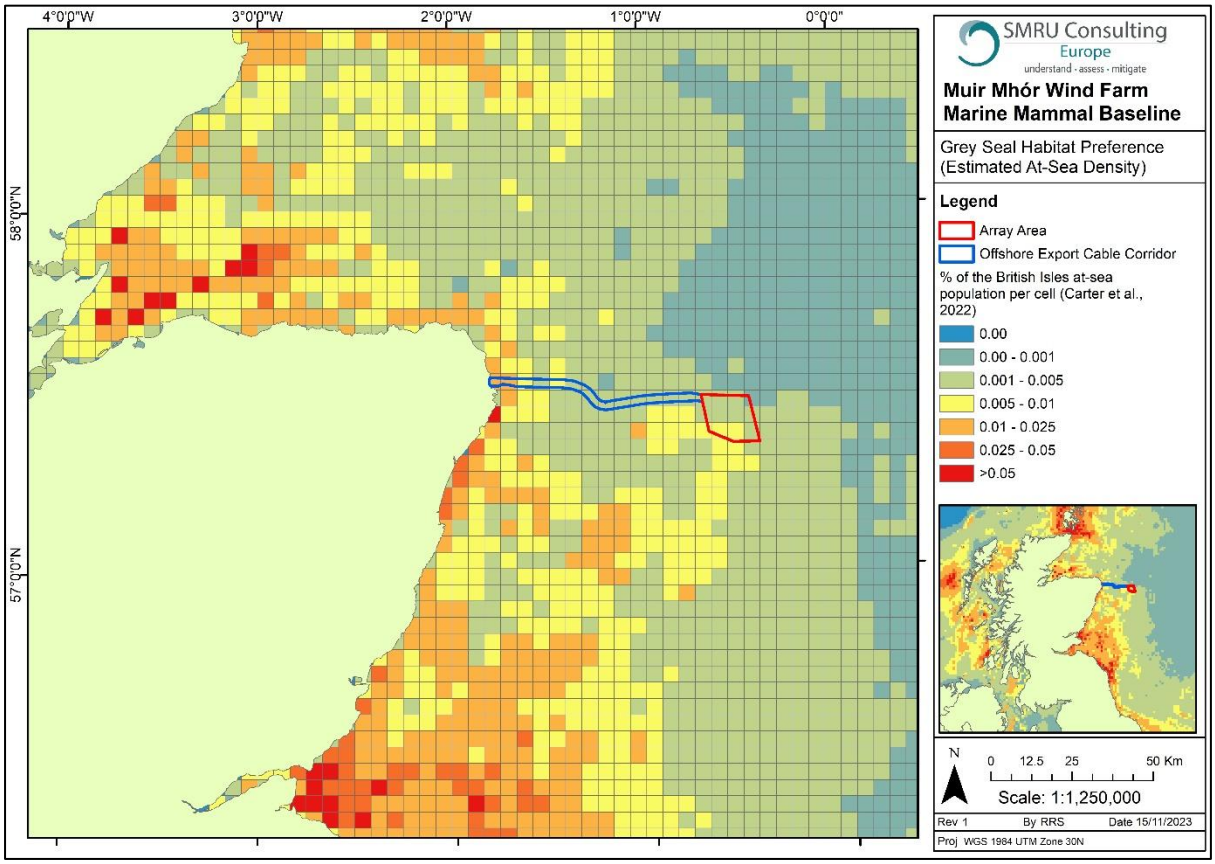


**Figure 12-7:** **Grey seal at-sea habitat preference map. Data from Carter *et al.* (2020), Carter *et al.* (2022).**

### 12.9 Grey seal summary

The Proposed Development is located in the East Scotland SMU, however given the wide-ranging behaviour of grey seals, it is considered appropriate to assess impacts to the East Scotland, Moray Firth and North Coast and Orkney SMUs together as one reference population (each will be assessed individually in the impact assessment as well as collectively). The at-sea distribution predicts moderately high densities of grey seals in the vicinity of the Array Area and offshore ECC. The available telemetry data show wide ranging movements of grey seals throughout the east coast of Scotland and England.

For the quantitative impact assessment, the relevant population against which to assess impacts is the combined East Scotland (10,783 grey seals), Moray Firth (7,380 grey seals) and North Coast and Orkney (34,191 grey seals) SMUs, using the Carter *et al.* (2020), Carter *et al.* (2022) habitat preference maps to quantify the number of animals potentially impacted.

# 13 Less common species

### 13.1 White sided dolphin

Atlantic white-sided dolphin can be a very gregarious species, forming groups up to 1,000 individuals in the offshore waters (Reid *et al.*, 2003). They can be found in temperate and sub-Arctic waters across North Atlantic, more offshore and along edges of continental shelves rather than over them (Reid *et al.*, 2003). The distribution map shows higher distribution of white-sided dolphin north and

northwest of Scotland, mostly further offshore (Figure 13-2) (Reid *et al.*, 2003). The distribution is much lower and less dense off the east coast of Scotland. In Scottish waters, they are present in low numbers, mostly encountered close to or beyond continental shelf edges around Shetlands, the Hebrides, the Northern Isles and offshore in the northern North Sea (Evans *et al.*, 2011). The latest SCANS survey also shows offshore distribution in Atlantic west Scotland with densities ranging from 0-0.083 dolphins/km$^2$ (Hammond *et al.*, 2021).

The conservation status of white-sided dolphin in UK waters was updated in JNCC (2019e) 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".

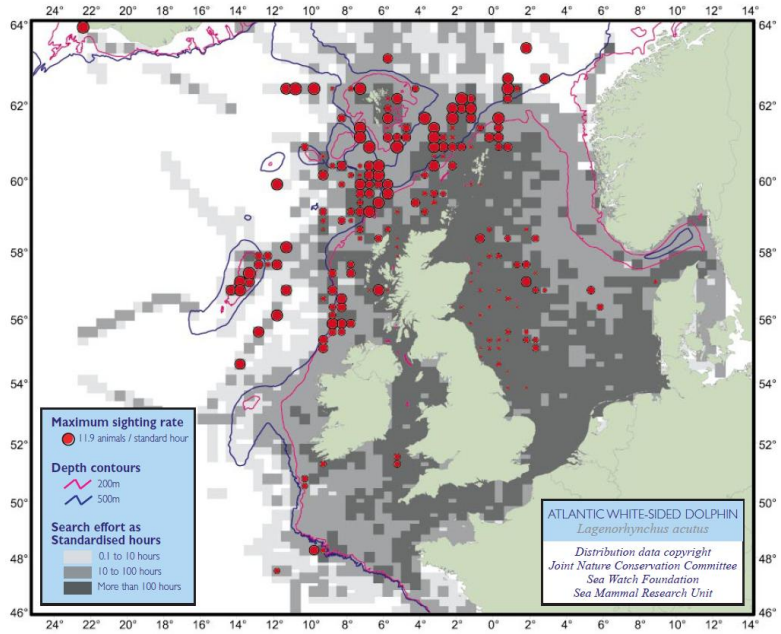


**Figure 13-1: White-sided dolphin distribution map of effort-related sightings (Reid *et al.*, 2003).**

### 13.1.1 Management Unit

The relevant MU for white-sided dolphins is the Celtic and Greater North Seas MU which has an estimated population size of 18,128 animals (95% CI 6,049-54,323) of which 12,293 (95% CI: 3,891-38,841) are estimated within the UK EEZ (IAMMWG, 2023).

### 13.1.2 Site-specific surveys

No white-sided dolphins were identified during the site-specific surveys.

### 13.1.3 Regional surveys

No white-sided dolphins were observed during regional surveys (HiDef Aerial Surveying Limited, 2023c).

### 13.1.4 Geophysical survey MMO report

During the geophysical surveys, there were no observations of white-beaked dolphin (EGS (International) Limited, 2023).

### 13.1.5 SCANS surveys

#### 13.1.5.1 SCANS III

The Proposed Development is located within the SCANS III survey block R, where there was an estimated block-wide abundance of 644 white-sided dolphins (95% CI: 0-2,069) and an estimated density of 0.0100 (CV = 0.994) white-sided dolphins/km$^2$ in July 2016 (Hammond *et al.*, 2021). Abundance (1,366 , 95% CI: 0-5,031) and density (0.0209 white-sided dolphins/km$^2$, CV = 0.984) in the neighbouring block T were much higher than in the block R (Hammond *et al.*, 2021).

#### 13.1.5.2 SCANS III density surfaces

Lacey *et al.* (2022) did not provide a modelled density surface for white-sided dolphins.

#### 13.1.5.3 SCANS IV

There were no white-sided dolphins observed in block NS-D within which the Proposed Development is located. However, in neighbouring block NS-E, the estimate abundance of white-beaked dolphins was 958 (95% CI: 5 – 3,583), with a density of 0.0146 (CV: 1.028) (Gilles *et al.*, 2023).

### 13.1.6 JCP data

#### 13.1.6.1 JCP Phase III

Paxton *et al.* (2016) produced predicted white-sided dolphin densities for summer 2010 (Figure 13-2). The point surface shows that the densities are predicted to be very low all-around UK. Density estimates for the Firth of Forth, in which the Proposed Development is located, as well as the Moray Firth region (close neighbouring region just north of Firth of Forth) showed predicted densities of ≤0.01 dolphins/km$^2$ for each season as well as average over the year.

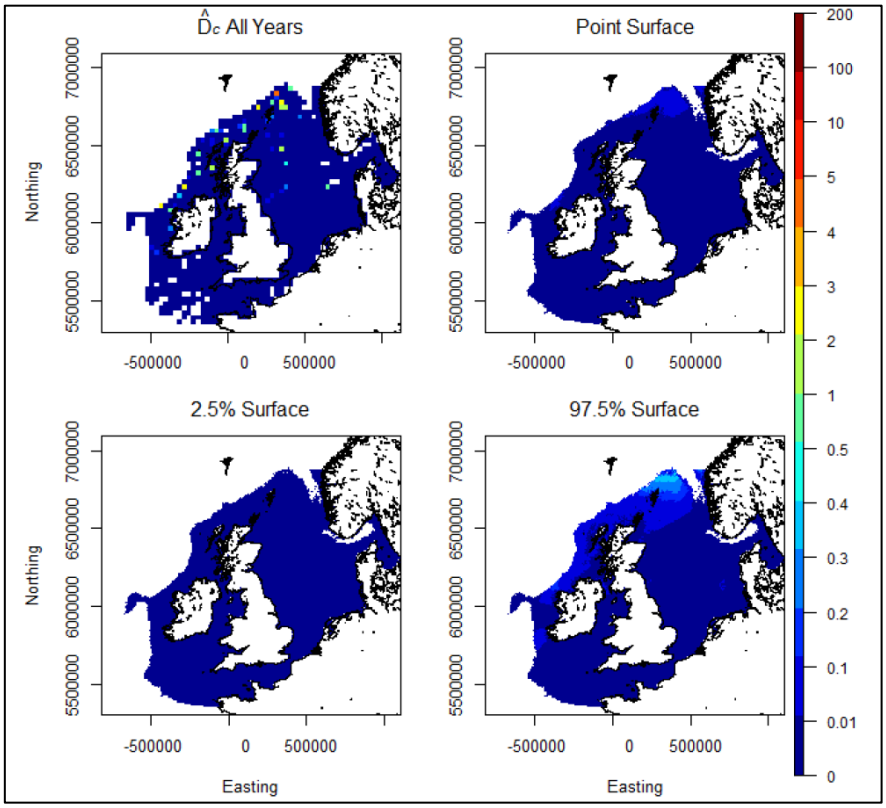


**Figure 13-2:** **Predicted white-sided dolphin densities for summer 2010 (Paxton *et al.*, 2016). Top left; input densities (summer all years), top right; point estimate of cell densities, bottom left; lower (2.5%) confidence limit on cell densities, bottom right; upper (97.5%) confidence limit on cell densities (white-sided dolphins/km$^2$). Note that the top left plot exaggerates the spatial coverage of the relevant effort.**

### 13.1.6.2 JCP data analysis tool

The JCP Phase III Data Analysis Product provided a density estimate of 0.00 white-sided dolphin/km$^2$ (95% CI: 0-0.001) in the user specified area, averaged for the summer 2007-2010 (Table 13-1). It is important to note that this estimate is for the summer months only and is not representative of densities at other times of the year.

**Table 13-1:** **JCP Phase III Data Analysis Product abundance and density estimates for white-sided dolphin for the user specified area averaged for the summer 2007-2010.**

| | Scaled abundance | Density (#/km$^2$) |
|---|---|---|
| Point estimate | 7 | 0.000 |
| Lower confidence interval | 2 | 0.000 |
| Upper confidence interval | 18 | 0.001 |

### 13.1.6.3 MERP

Atlantic white-sided dolphin density maps produced by Waggitt *et al.* (2019) predicted generally low densities around east Scotland. The maximum white-sided dolphin density for grid cells within the Array Area is 0.020/km$^2$ for January and 0.035/km$^2$ for July. The minimum density for grid cells within the Array Area is 0.011/km$^2$ for January and 0.019/km$^2$ for July (Figure 13-3).

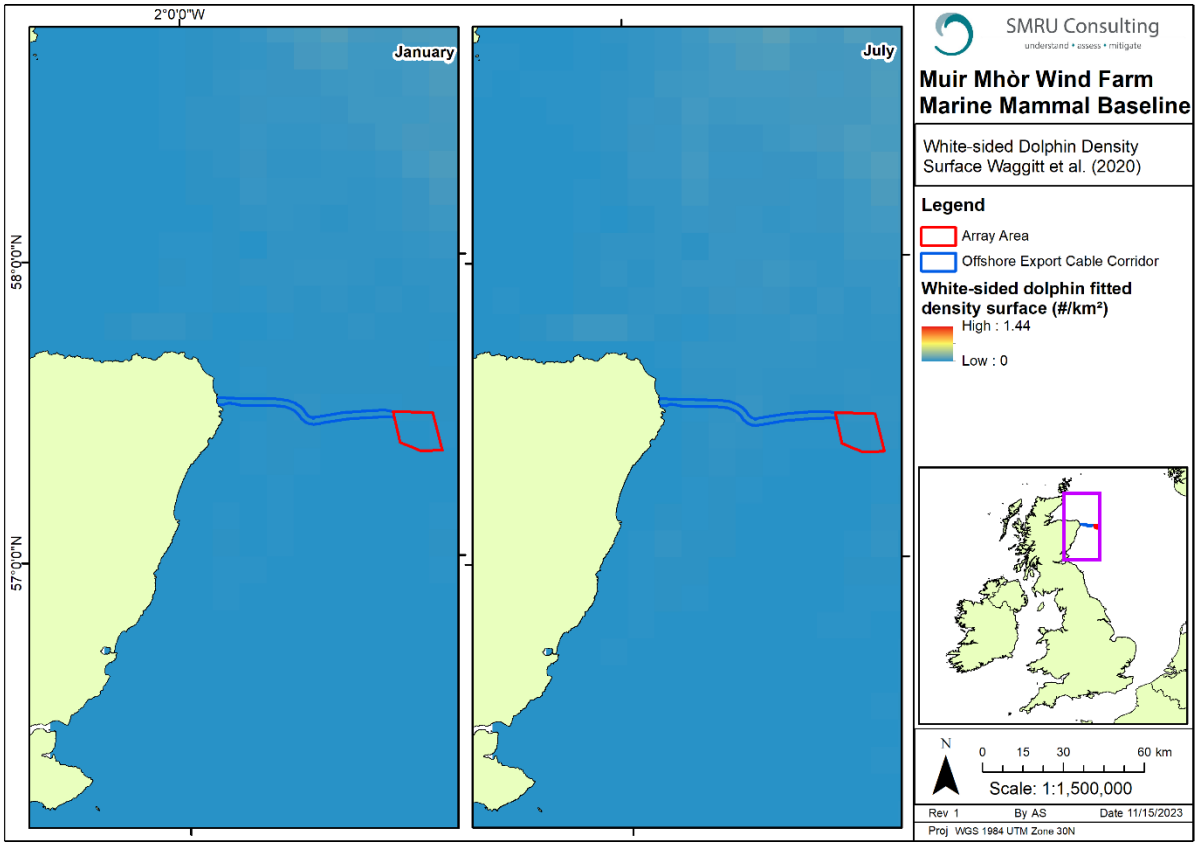


**Figure 13-3:** **White-sided dolphin density surface (dolphins/km²) for January and July. Data from Waggitt *et al.* (2019).**

### 13.1.7 ECOMMAS

The ECOMMAS data presented consists of CPOD data collected from 2013 – 2022 (data for 2020 is absent due to Covid-19 restrictions, preventing field work from occurring). Delphinid species were identified across most sites, with calculations of DPD per year (Table 7-3) and average DPH per year (Table 7-4) presented below. Data have also been visualised for DPH across each of the stations at the Cruden Bay (Figure 7-5) and Fraserburgh (Figure 7-6) sites.

These data conclude that dolphins were found in low numbers (with the exception of 2022), in the coastal areas monitored by ECOMMAS. There is no evidence from either the Cruden Bay (Figure 7-5) and Fraserburgh (Figure 7-6) sites of seasonal variation in detections, most likely due to the low detections. There was no obvious pattern in dolphin detection rate, in relation to distance from the shore for the Cruden Bay site. However, there is evidence to suggest that dolphins frequent the more coastal areas of the Fraserburgh site, with higher averages present at Fraserburgh 5 (Table 7-3, Table 7-4).

### 13.1.8 White-sided dolphin summary

White-sided dolphin density estimates are low on the east coast of Scotland (Table 13-2), with density estimates ranging from 0 to 0.035 dolphins/km$^2$. This species was not sighted during the HiDef site-specific surveys, nor was it expected to be present in either the Firth of Forth or Moray Firth commercial areas of interest or the JCP data tool user specified area. Therefore, it is the

recommendation of SMRU Consulting that this species is scoped out of the quantitative impact assessment.

**Table 13-2: Summary table of the available density estimates for white-sided dolphin.**

| Source | Details | Density estimate (#/km$^2$) |
|---|---|---|
| Site-specific surveys | Scotwind E2 PO site plus 4 km buffer | None sighted |
| SCANS III | Block R | 0.01 |
| SCANS III | Block T (adjacent) | 0.021 |
| SCANS IV (Gilles *et al.*, 2023) | Block NS-D | 0 |
| SCANS IV (Gilles *et al.*, 2023) | Block NS-E (adjacent) | 0.0146 |
| Paxton *et al.* (2016) | Average in Firth of Forth in 2010 | 0 |
| Paxton *et al.* (2016) | Average in Moray Firth in 2010 | 0 |
| JCP Data Tool | User specified area average summer 2007-10 | 0 |
| MERP | Array Area range in January | 0.011 – 0.020 |
| MERP | Array Area range in July | 0.019 – 0.035 |

## 13.2 Killer whale

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 (Figure 13-4). They can be observed all year round, albeit in low densities (Hague *et al.*, 2020). They are most frequently observed in near-shore area between April and October and along the continental shelf north of Shetland in May and June (Reid *et al.*, 2003).

The conservation status of killer whales in UK waters was not updated in JNCC (2019d) 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.

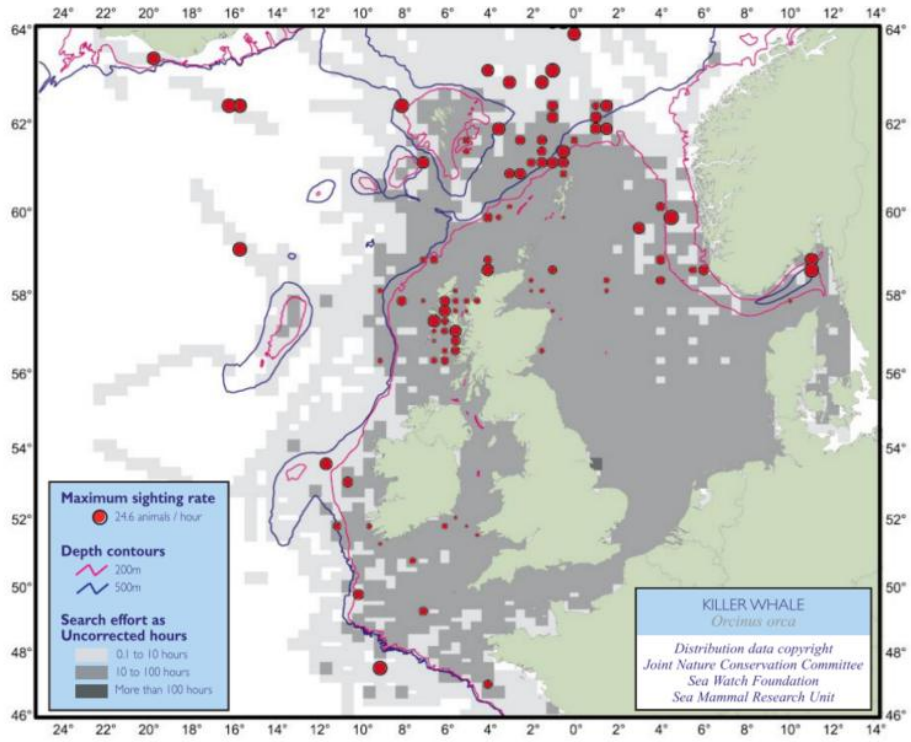


**Figure 13-4: Killer whale distribution map of effort-related sightings (Reid *et al.*, 2003).**

No management unit is defined for killer whales in IAMMWG (2023). 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 (NASS) which estimated there were 15,014 killer whales (95% CI: 6,637-33,964) (NAMMCO, 2021). The minimum population size in the UK was estimated at 124 individuals in JNCC (2019d).

### 13.2.1 Site-specific surveys

During the site-specific surveys no killer whales were identified.

### 13.2.2 Regional surveys

No killer whales were observed during regional surveys (HiDef Aerial Surveying Limited, 2023c).

### 13.2.3 Geophysical survey MMO report

During the geophysical surveys, there were five sightings of killer whales from April to June 2023. The greatest number of killer whales occurred in June 2023 (10) (EGS (International) Limited, 2023).

### 13.2.4 SCANS surveys

#### 13.2.4.1 SCANS III

No abundance or density estimates of killer whales are presented in SCANS III (Hammond *et al.*, 2021).

#### 13.2.4.2 SCANS III density surfaces

Lacey *et al.* (2022) did not provide a modelled density surface for killer whales.

#### 13.2.4.3 SCANS IV

No abundance or density estimates of killer whales are presented in SCANS IV (Gilles *et al.*, 2023)

### 13.2.5 JCP data

Killer whales were not included in the analysis of the JCP data (Paxton *et al.*, 2016).

#### 13.2.5.1 MERP

Killer whale dolphin density maps produced by Waggitt *et al.* (2019) predicted generally low densities around east Scotland. The maximum killer whale density for grid cells within the Array Area is 0.002/km$^2$ for January and July. The minimum density for grid cells within the Array Area is 0.001/km$^2$ for January and July (Figure 13-5).

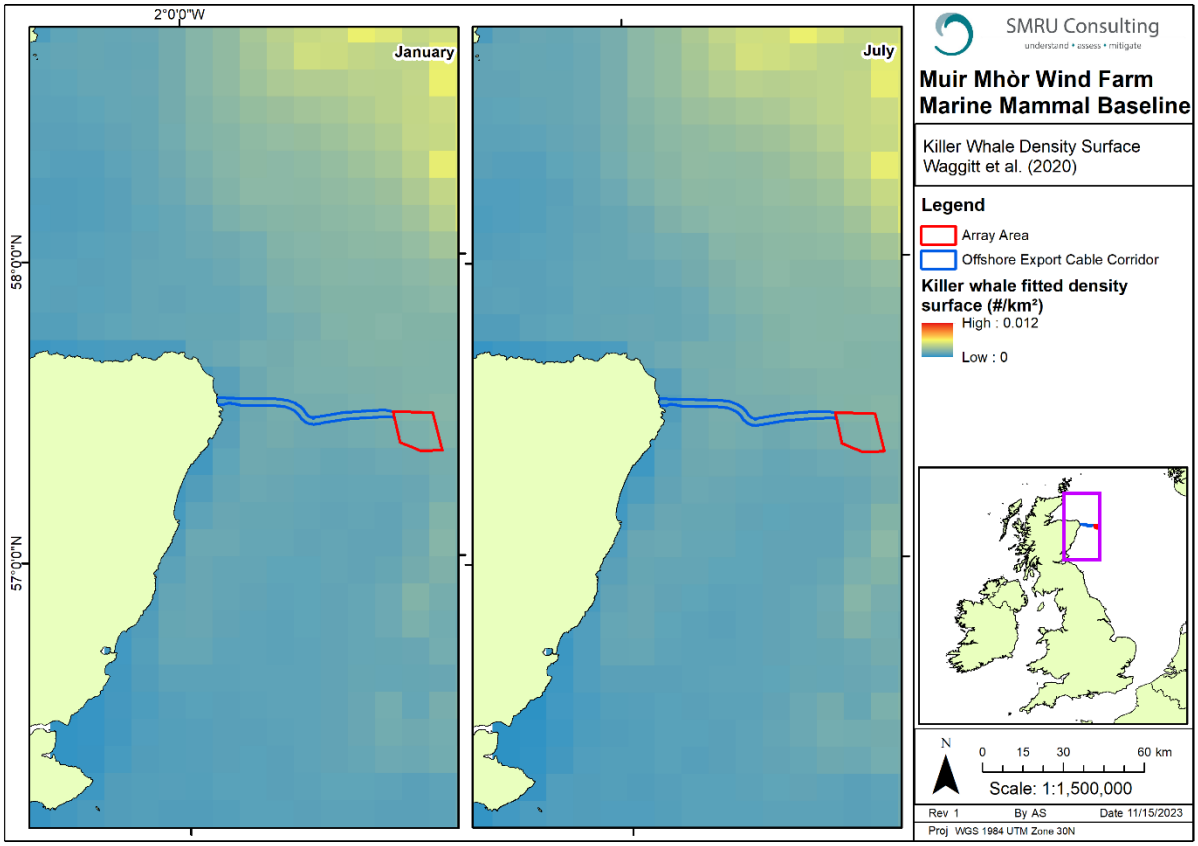


**Figure 13-5: Killer whale density surface (whales/km$^2$) for January and July. Data from Waggitt *et al.* (2019).**

### 13.2.6 Killer whale summary

Density estimates for killer whales were only available using the MERP data available where they were estimated to be present in low densities (Table 13-3). Killer whales were observed on multiple occasions by the MMOs during geophysical surveys, therefore this species needs to be considered in the impact assessment. The lack of defined MU and lack of reliable density estimate means that this species can only be assessed qualitatively within the impact assessment.

**Table 13-3: Summary table of the available density estimates for killer whales.**

| Source | Details | Density estimate (#/km$^2$) |
|---|---|---|
| Site-specific surveys | Scotwind E2 PO site plus 4 km buffer. | Not sighted |
| SCANS III | Block R | Not presented |
| SCANS III | Block T (adjacent) | Not presented |
| SCANS IV (Gilles *et al.*, 2023) | Block NS-D | Not presented |
| SCANS IV (Gilles *et al.*, 2023) | Block NS-E (adjacent) | Not presented |
| Paxton *et al.* (2016) | Average in Firth of Forth in 2010 | Not included |
| Paxton *et al.* (2016) | Average in Moray Firth in 2010 | Not included |
| JCP Data Tool | User specified area average summer 2007-10 | Not included |
| MERP | Array Area - range in January and July | 0.001 – 0.002 |

## 13.3 Humpback whale

Humpback whales are often found solitary or in pairs and they aggregate for feeding and breeding events (Reid *et al.*, 2003). They occur in range of tropical to polar waters in both hemispheres (Reid *et al.*, 2003). Generally, very few humpback whales were shown on the distribution map of effort-related sightings produced by Reid *et al.* (2003) around UK (Figure 13-6). The distribution, although year-round, is scarce in Scottish waters with very low estimates off east Scotland, where the proposed development is located.

The conservation status of humpback whales in UK waters was not updated in JNCC (2019a) due to 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.

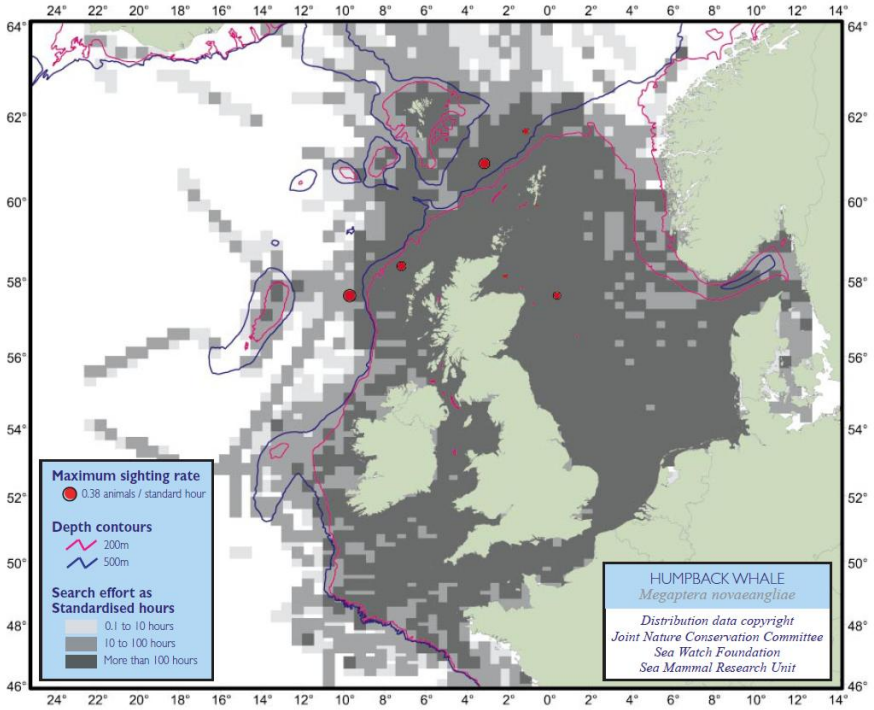


**Figure 13-6: Humpback whale distribution map of effort-related sightings (Reid *et al.*, 2003).**

### 13.3.1 Management Unit

Humpback whale is a global species that occurs in both hemispheres in waters ranging from tropical to polar (Reid *et al.*, 2003). They are annual migratory species that feed in high-latitudes over winter and breed in low-latitudes over summer. Humpback whales rarely occurs in UK waters and no MU is defined for it, although there has been an increase in sightings over the recent years (e.g. two recent sightings of a couple of humpback whales off the northeast coast of Scotland in March 2023[3]).

### 13.3.2 Site-specific surveys

During the site-specific surveys no humpback whales were identified.

### 13.3.3 Regional surveys

No humpback whales were observed during regional surveys (HiDef Aerial Surveying Limited, 2023c).

### 13.3.4 Geophysical survey MMO report

During the geophysical surveys, there were no observations of humpback whales (EGS (International) Limited, 2023).

[3] Sightings data taken from https://www.seawatchfoundation.org.uk/recentsightings/ 19/06/2023.

### 13.3.5 SCANS surveys

#### 13.3.5.1 SCANS III

There were no sightings of humpback whales in block R. There was a single sighting of humpback whale during SCANS III survey (northern end of block T), but that did not provide enough data for further analysis.

#### 13.3.5.2 SCANS III density surfaces

Lacey *et al.* (2022) did not provide a modelled density surface for humpback whales.

#### 13.3.5.3 SCANS IV

No humpback whale sightings occurred during SCANS IV (Gilles *et al.*, 2023).

### 13.3.6 JCP data

Humpback whales were not included in the analysis of JCP (Paxton *et al.*, 2016).

#### 13.3.6.1 MERP

Waggitt *et al.* (2019) did not produce a density map for humpback whale.

### 13.3.7 Opportunistic sightings

In recent years, humpback whale sightings in the east 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). Since then, public sightings of humpback whales in the Firth of Forth have become more numerous, and sightings have occurred in the summers in 2021, 2022 and 2023[4] (Hague, 2023). Occasional public sightings of humpback whales have also occurred in the Moray Firth over recent years.

### 13.3.8 Humpback whale summary

Humpback whales were not sighted during the site-specific surveys; and have not been reported during from the density estimate studies outlined above. Whilst opportunistic sightings have suggested an increase of sightings of humpback whales in the Firth of Forth during winter months; 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. However, the number of humpback whales in the area has been increasing in recent years (O'Neil *et al.*, 2019, Hague, 2023) and, therefore, they will be assessed qualitatively within the impact assessment.

[4] e.g. https://www.edinburghnews.scotsman.com/news/environment/rare-humpback-whale-spotted-in-the-firth-of-forth-near-fife-fishing-village-4138901

**Table 13-4: Summary table of the available density estimates for humpback whale.**

| Source | Details | Density estimate (#/km$^2$) |
|---|---|---|
| Site-specific surveys | Scotwind E2 PO site plus 4 km buffer | None sighted |
| SCANS III | Block R | 0 |
| SCANS III | Block T (adjacent) | Single sighting |
| SCANS IV (Gilles *et al.*, 2023) | Block NS-D | Not presented |
| SCANS IV (Gilles *et al.*, 2023) | Block NS-E (adjacent) | Not presented |
| Paxton *et al.* (2016) | Average in Firth of Forth in 2010 | Not included |
| Paxton *et al.* (2016) | Average in Moray Firth in 2010 | Not included |
| JCP Data Tool | User specified area average summer 2007-10 | Not included |
| MERP | Array Area range in January and July | Not included |

# 14 Conclusion

The Muir Mhòr site-specific surveys alongside the literature review of other data sources confirmed the presence of six marine mammal species regularly present within the area of the Proposed Development (Table 14-1) and, therefore, should be considered within the quantitative impact assessment. There was little evidence of white-sided dolphins in the vicinity of the Proposed Development. As such, it is recommended that this species be scoped out of quantitative impact assessment. Whilst not expected to be present in high densities, there was evidence that killer whales and humpback whales could be present within the Proposed Development and, therefore, they will be assessed qualitatively within the impact assessment. There are a range of density estimates available from various surveys and data sources, as outlined above for each species. The most robust and relevant density estimates have been outlined in Table 14-1 and are recommended by SMRU Consulting to take forward to the quantitative impact assessment.

**Table 14-1:** **Species, MU size and density estimate recommended for use in the quantitative impact assessment for the Proposed Development.**

| Species | MU | MU size | UK MU Size | MU Ref | Density | Density Ref |
|---|---|---|---|---|---|---|
| Harbour porpoise | North Sea | 346,601 | 159,632 | IAMMWG (2023) | Grid cell specific<br>0.5985 NS-D[5])<br>0.5156 (NS-E) | Lacey *et al.* (2022)<br>Gilles *et al.* (2023) |
| Bottlenose dolphin | Coastal East Scotland | 224 | | IAMMWG (2023) | 0.120 within 2 km of the coast and 0.003 beyond | Calculated |
| | Greater North Sea | 2,022 | 1,885 | IAMMWG (2023) | | |
| White beaked dolphin | Celtic and Greater North Seas | 43,951 | 34,025 | IAMMWG (2023) | Grid cell specific<br>0.0799 (NS D)<br>0.1775 (NS E) | Lacey *et al.* (2022)<br>Gilles *et al.* (2023) |
| Risso's dolphin | Celtic and Greater North Seas | 12,262 | 8,687 | IAMMWG (2023) | 0.000 (NS-D)<br>0.0702 (NS-E) | Gilles *et al.* (2023) |
| Minke whale | Celtic and Greater North Seas | 20,118 | 10,288 | IAMMWG (2023) | Grid cell specific<br>0.0419 (NS-D)<br>0.0100 (NS-E) | Lacey *et al.* (2022)<br>Gilles *et al.* (2023) |
| Harbour seal | East Scotland | 364 | | Scaled SCOS (2023) counts | Grid cell specific | Carter *et al.* (2020), Carter *et al.* (2022) |
| Grey seal | East Scotland<br>Moray Firth<br>N Coast & Orkney | 10,783<br>7,380<br>34,191 | | Scaled SCOS (2023) counts | Grid cell specific | Carter *et al.* (2020), Carter *et al.* (2022) |
| White-sided dolphin | Scoped out | | | | | |
| Killer whale | Qualitative assessment only | | | | | |
| Humpback whale | Qualitative assessment only | | | | | |

[5] SCANS IV survey blocks: the Proposed Development is in block NS-D and is adjacent to block NS-E (Gilles *et al.*, 2023).

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# 16 Acronyms

| Term | Description |
|---|---|
| BEIS | The Department for Business, Energy and Industrial Strategy |
| CES | Coastal East Scotland |
| CGNS | Celtic and Greater North Sea |
| CI | Confidence Interval |
| CPOD | Continuous Porpoise Monitoring Detector |

| Term | Description |
|---|---|
| CREEM | Centre for Research into Ecological and Environmental Modelling |
| DAS | Digital Aerial Survey |
| DESNZ | Department for Energy Security and Net-Zero |
| DPD | Detection-Positive Days |
| DPH | Detection-Positive Hours |
| DPO | Draft Plan Option |
| ECC | Export Cable Corridor |
| ECOMMAS | East Coast Scotland Marine Mammal Acoustic Array Surveys |
| EEZ | Exclusive Economic Zone |
| EIAR | Environmental Impact Assessment Report |
| EOWDC | European Offshore Wind Deployment Centre |
| EPS | European Protected Species |
| GNS | Greater North Sea |
| GPS | Global Positioning System |
| GSD | Ground Sample Distance |
| GSM | Global System for Mobile |
| HRA | Habitat Regulations Appraisal |
| IAMMWG | Inter-Agency Marine Mammal Working Group |
| ICES | International Council for the Exploration of the Sea |
| JCP | Joint Cetacean Protocol |
| MBES | Multibeam Echosounder |
| MERP | Marine Ecosystems Research Programme |
| MMMP | Marine Mammal Monitoring Programme |
| MMO | Marine Mammal Observer |
| MMOWF | Muir Mhòr Offshore Wind Farm |

| Term | Description |
|---|---|
| MPA | Marine Protected Area |
| MU | Management Unit |
| NAMMCO | North Atlantic Marine Mammal Commission |
| NASS | North Atlantic Sightings Survey |
| NERC | Natural Environment Research Council |
| NMPi | National Marine Plan interactive |
| NCMPA | Nature Conservation Marine Protected Area |
| NS | North Sea |
| OEP(s) | Offshore Electrical Platform(s) |
| OWF | Offshore Wind Farm |
| PAM | Passive Acoustic Monitoring |
| PEMP | Project Environmental Monitoring Programme |
| PO | Plan Option |
| SAC | Special Area of Conservation |
| SCANS | Small Cetaceans in European Atlantic waters and the North Sea |
| SCOS | Special Committee on Seals |
| SMP | Sectoral Marine Plan |
| SMRU | Sea Mammal Research Unit |
| SMU | Seal Management Unit |
| SSS | Side Scan Sonar |