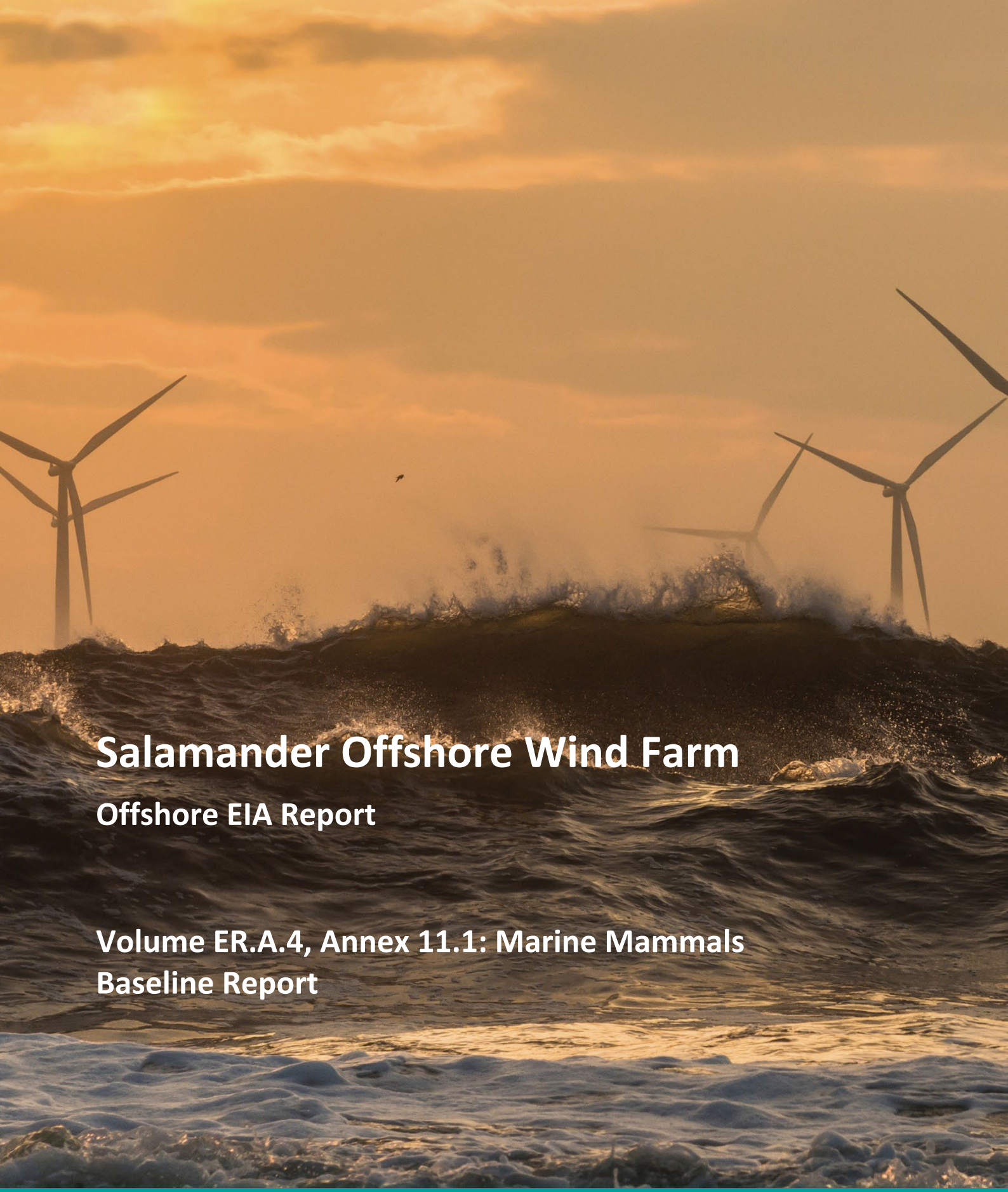

Salamander Offshore Wind Farm

Offshore EIA Report

Volume ER.A.4, Annex 11.1: Marine Mammals Baseline Report

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Salamander Offshore Wind Farm: Marine Mammal Baseline Characterisation

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1 Introduction

Salamander Offshore Wind Farm (hereafter referred to as 'Salamander Project') is located in the North Sea, approximately 35 kilometres east of Peterhead, Scotland, making landfall at north of Peterhead (Figure 1). Salamander Project is a floating wind farm with an installed capacity of up to 100 Megawatts (MW).

The purpose of this document is to provide a characterisation of the baseline environment to understand the range of species and the abundance and density of marine mammals that could be potentially impacted by the Salamander Project. The baseline data have been compiled through a combination of literature review and data obtained from site-specific surveys between March 2021 and February 2023. The best density and abundance estimates will be then used in the quantitative impact assessment.

1.1 Study Area

The Salamander Project marine mammal study area varies depending on the species, considering individual species ecology and behaviour. For all species, the study area covers the Salamander Project Offshore Array Area and Offshore Export Cable Corridor (together referred to as the 'Offshore Development') and is extended over an appriapriate area considdering the scale of movement and population structure for each species. For each species, the area considered in the assessment is largely defined by the appropriate Management Unit (MU) (Figure 1). This approach was agreed in the Scoping Opinion. The study area for marine mammals has been defined at two spacial scales:

- Management Unit scale for species-specific population units:
    - North Sea MU: harbour porpoise;
    - Celtic and Greater North Sea MU: white-beaked dolphin, minke whale and white-sided dolphin;
    - Greater North Sea MU: offshore bottlenose dolphins;
    - Coastal East Scotland MU: coastal bottlenose dolphins;
    - East Scotland Seal MU: harbour seal; and
    - Combined East Scotland, Moray Firth and North Coast and Orkney MU: grey seals.
- Marine mammal site-specific survey area for more local scale information (Figure 1).

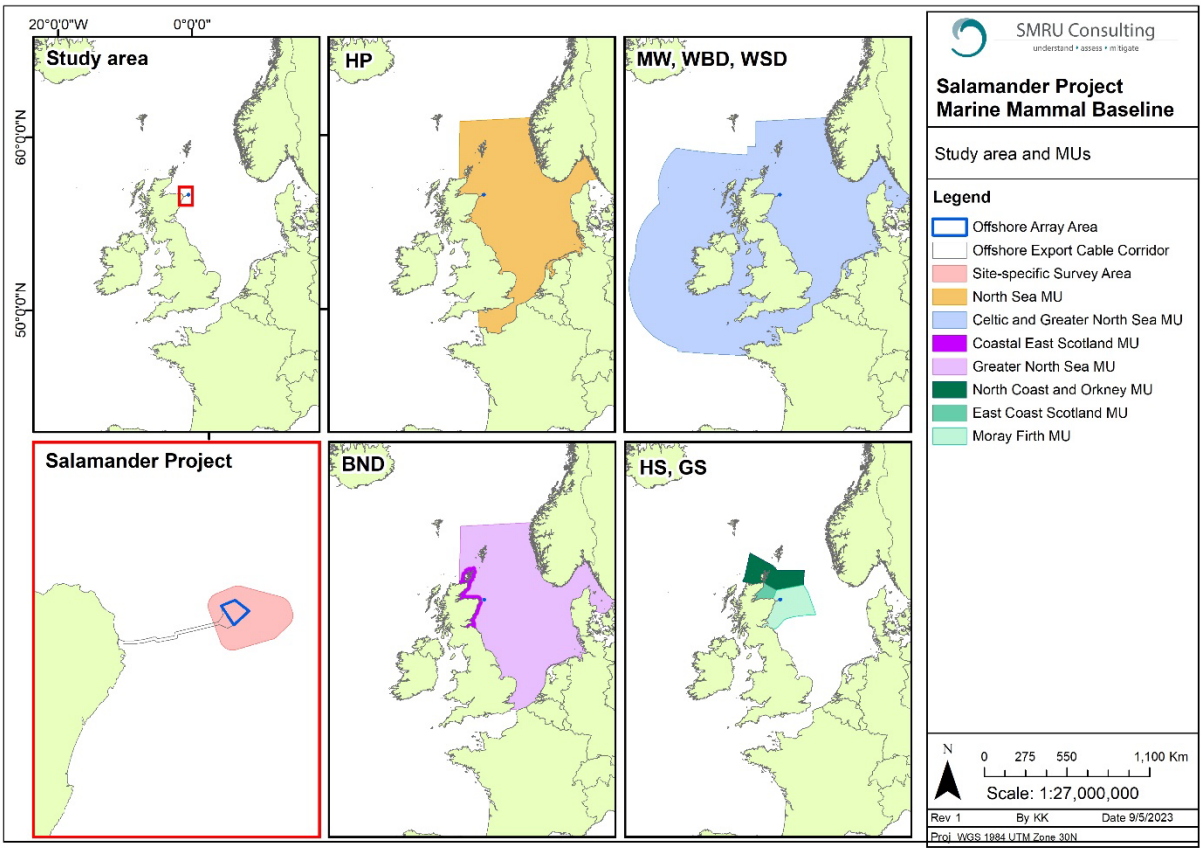

Figure 1 Study area and the Managements Units.

1.2 Species

The key marine mammal species that are common in the study area, and therefore, considered in detail in this report are harbour porpoise (*Phocoena phocoena*), bottlenose dolphin (*Tursiops truncatus*), white beaked dolphin (*Lagenorhynchus albirostris*), minke whale (*Balaenoptera acutorostrata*), harbour seal (*Phoca vitulina*) and grey seal (*Halichoerus grypus*). Other species that are less commonly found around east Scotland are white sided dolphin (*Lagenorhynchus acutus*), killer whale (*Orcinus orca*) and humpback whale (*Megaptera noveangliae*). These species were identified through literature and harbour porpoise, minke whales and seals were further confirmed in site-specific surveys.

2 Data sources

2.1 Overview

Table 1 and the following section provides detail on the key data sources used to characterise the baseline study area for marine mammals in relation to Salamander Project. These were agreed in the Scoping Opinion and references amended as requested. This section details the survey and analysis methodology implemented in each study and the potential limitations associated with these. The actual results of the surveys in terms of the species presence are detailed in subsequent species-specific sections.

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

SOURCE	DESCRIPTION
Salamander Project site-specific aerial surveys (HiDef Aerial Surveying Limited, 2022)	Site-specific baseline characterisation digital video aerial surveys conducted by HiDef between March 2021 and February 2023. The survey area consists of the originally proposed Salamander Project Offshore Array Area plus 4 km buffer.
Atlas of cetacean distribution in north-west European waters (Reid *et al.*, 2003)	Data of cetacean distribution and abundance. Combination of 3 major data sources between 1979 – 1997.
Regional baselines for marine mammal knowledge across the North Sea and Atlantic areas of Scottish waters (Hague *et al.*, 2020)	Collation of up-to-date information on the distribution and abundance of marine mammal species in the Scottish Northern North Sea region and Scottish Atlantic waters. This report covers the whole of Scotland, inclusive of the Salamander Project marine mammal study area.
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.
SCANS IV (Gilles *et al.*, 2023)	Combination of vessel and aerial surveys of the North Sea and European Atlantic continental shelf waters conducted in summer 2022.
ECOMMAS	The East Coast Marine Mammal Acoustic Study (ECOMMAS) began in 2013 and is inclusive of 30 Passive Acoustic Monitoring (PAM) sites along the East coast of Scotland. Each site consists of a CPOD (Chelonia Ltd) capable of detecting porpoise and delphinid clicks. CPOD data are presented in detection-positive days and detection-positive hours. Two sites are in proximity to the Salamander Project site, inclusive of Cruden Bay and Fraserburgh.
JCP Phase III (Paxton *et al.*, 2016)	38 data sources between 1994-2010. Species abundance estimates provided for each season for various areas of commercial interest for offshore development.
MERP (Waggitt *et al.*, 2020)	Predicted distribution maps available at monthly and 10 km^2 density scale for multiple cetacean species.
Bottlenose dolphin surveys (Cheney *et al.*, 2012, Cheney *et al.*, 2013, Cheney *et al.*, 2014a, Cheney *et al.*, 2014b, Quick *et al.*, 2014, Graham *et al.*, 2015, Graham *et al.*, 2016, Graham *et al.*, 2017, Cheney *et al.*, 2018, Arso	NatureScot report on the condition of 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

SOURCE	DESCRIPTION
Civil *et al.*, 2019, Arso Civil *et al.*, 2021)	is reported yearly 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.
Telemetry data (SMRU Seal Telemetry Database, 2019)	A total of 86 harbour seals have been tagged in the Southeast England MU since 2003. A total of 33 grey seals have been tagged in the Southeast England MU since 1988 and a further 31 have been tagged in the Northeast England MU.
Seal August haul-out data (SMRU Seal Count Database, 2020)	August haul-out surveys of harbour and grey seals.
Grey seal pup production database (SMRU)	Grey seal pup production estimates at various breeding colonies around the UK. Includes data collated between 1989 and 2022 (depending on site).
Seal habitat preference maps (Carter *et al.*, 2020, Carter *et al.*, 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.

2.2 Site-specific surveys

The site-specific baseline characterisation surveys for Salamander Project consisted of monthly digital video aerial surveys conducted by HiDef Aerial Surveying Limited (HiDef) from March 2021 to February 2023. The aim of the surveys was to collect data on the abundance and distribution of marine mammals to characterise the baseline environment to inform Environmental Impact Assessment Report (EIAR). Full details of the site-specific surveys can be found in the two-year survey report: HiDef Aerial Surveying Limited (2023).

The Digital Aerial Survey (DAS) design consisted of 2 km-spaced transects across the historical Salamander Refined Area of Search, from which the selected Offshore Array Area and INTOG lease exclusivity area was selected. This Area of Search (133.38 km²) and a 4 km buffer, together referred to as the 'DAS Area', has a total area of 371.93 km² (Figure 2). Aircraft were flown at a height of 550 m along transects of variable length with 2 km spacing. The survey design consisted of 13 strip transects providing a coverage of approximately 12.5% of the survey area (Table 2). Data collected were 2 cm Ground Sampling Distance (GSD) digital video with a combined sampled width of 500 m within a 575 m overall strip width. In order to calculate density estimates, relative density estimates were reported for most marine mammal species sighted, excluding harbour porpoises. For harbour porpoises, absolute density estimates were reported on, as this species was corrected for availability bias, as outlined in Teilmann *et al.* (2013).

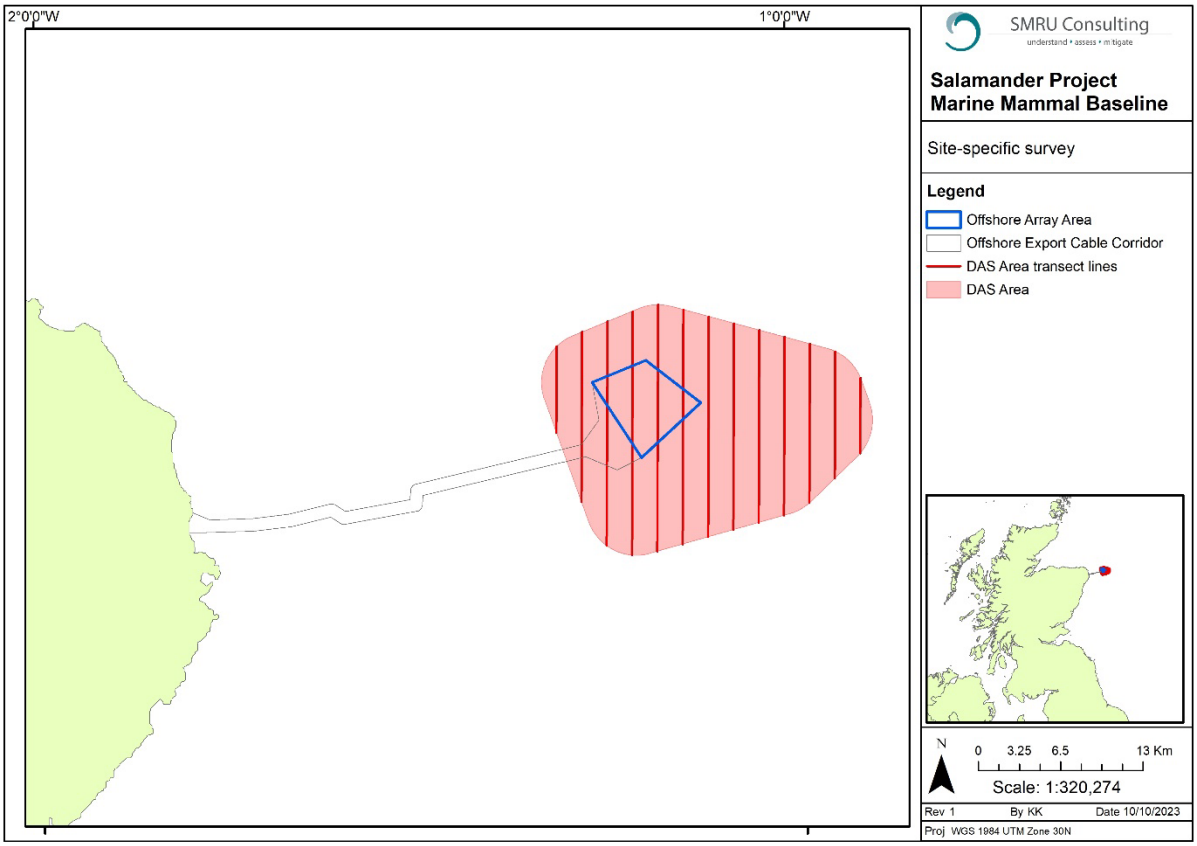

Figure 2 Salamander Project site-specific DAS Area and transect lines.

Table 2 Survey effort across the 12 surveys of Salamander Project site from March 2021 to February 2023 (HiDef Aerial Surveying Limited (2023).

Survey date	Total length of transects analysed (km)	Area covered (km^2)	% covered
13 March 2021	185.98	46.49	12.50
15 April 2021	185.92	46.48	12.49
23 May 2021	186.44	46.77	12.57
09 June 2021	186.40	46.60	12.52
15 July 2021	184.24	46.10	12.38
19 August 2021	186.30	46.57	12.52
07 September 2021	186.70	46.68	12.54
06 October 2021	185.46	46.36	12.46
10 November 2021	185.98	46.49	12.49
09 December 2021	186.67	46.67	12.54
07 January 2022	186.03	46.51	12.50
08 February 2022	185.41	46.35	12.46
10 March 2022	186.63	46.63	12.55

Survey date	Total length of transects analysed (km)	Area covered (km²)	% covered
12 April 2022	186.87	46.72	12.56
14 May 2022	186.15	46.54	12.51
12 June 2022	186.61	46.65	12.54
08 July 2022	186.33	46.58	12.52
17 August 2022	186.48	46.62	12.53
20 September 2022	186.10	46.53	12.51
07 October 2022	185.46	46.36	12.46
02 November 2022	185.98	46.49	12.50
20 December 2022	186.67	46.67	12.55
04 January 2023	186.03	46.51	12.50
23 February 2023	187.33	46.83	12.59

2.3 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 with data collated between 1979 – 1997. European Seabirds at Sea data provided data mostly from at-sea surveys using moving platforms 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, which is outdated, 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 and will not be providing quantitative input for this baseline characterisation.

2.4 Small Cetaceans in European Atlantic waters and the North Sea III (SCANS III)

The main objective of the SCANS III survey was to estimate small cetacean abundance and density in the North Sea and European Atlantic continental shelf waters. The survey was completed in July 2016,

and 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). The aerial surveys involved a single aircraft method using circle-backs (or race-track) methods whereas the boat-based surveys involved a double platform 'primary' and 'secondary' tracker methodology. Each of the surveys provides equal coverage probability within survey blocks such that each point within a block has the same probability of being surveyed. As a result, an unbiased abundance estimation is generated when extrapolating sample densities to block-wide density estimates (Hammond *et al.*, 2021).

While the SCANS III survey provides sightings, density and abundance estimates at a wide spatial scale, the survey was conducted during a single summer month (between 27 June and 31 July 2016), 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 III density estimates alone.

Salamander Project is located in the SCANS III survey block R (Figure 3) 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 Offshore Array Area (Figure 3). 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 Salamander Project to the boundary of the survey blocks, information will be provided for both survey blocks in this baseline characterisation.

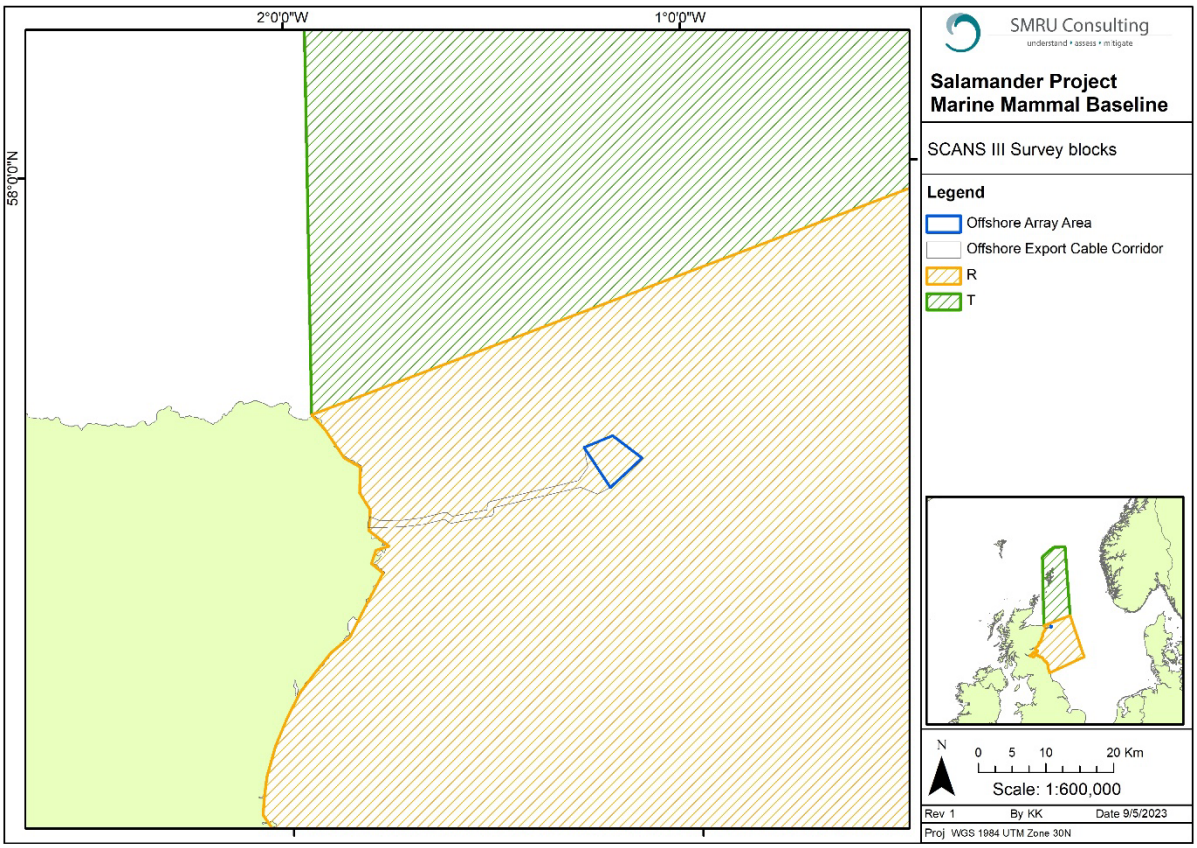

Figure 3 SCANS III R and T survey blocks in relation to Salamander Project (Hammond *et al.*, 2017).

Lacey *et al.* (2022) used the SCANS III data for species with sufficient coverage to perform density surface modelling for harbour porpoise, bottlenose, white-sided, white-beaked, common and striped dolphins, long-finned pilot whale, all beaked whale species, minke and fin whales. Latitude, longitude and spatially referenced data on the following environmental variables were used as covariates for the modelling: seabed depth and its corresponding standard deviation, slope, aspect of the slope, absolute distance from coast, absolute distance from 50, 200 and 2000 m isobaths (distance at shortest point), distance from 50 and 200 m isobath (distance at shortest point, negative on deeper side), absolute dynamic topography, sea level anomaly and sea surface temperature. The resulting surfaces show cetacean distribution on a 10x10 km scale (Lacey *et al.*, 2022).

2.5 Small Cetaceans in European Atlantic waters and the North Sea IV (SCANS IV)

The SCANS IV surveys were conducted from June to October 2022, and comprised a combination of vessel and aerial surveys. The main objective of the SCANS IV survey was to estimate small cetacean abundance and density in the North Sea and European Atlantic waters. The surveyed area included the offshore waters of Portugal which were not previously surveyed as part of SCANS, but excluded coastal Norwegian waters north to Vestfjorden that were included in SCANS III and waters to the south and west of Ireland that were included in the ObSERVE 2021/2022 project. Species abundance was estimated using the same methodology as for SCANS III (see Hammond *et al.*, 2021).

The surveyed blocks used during SCANS IV are presented in Figure 4. Salamander Project is located in SCANS IV block NS-D which was surveyed by 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 Salamander Project to the boundary of the survey blocks, information will be provided for both survey blocks in this baseline characterisation.

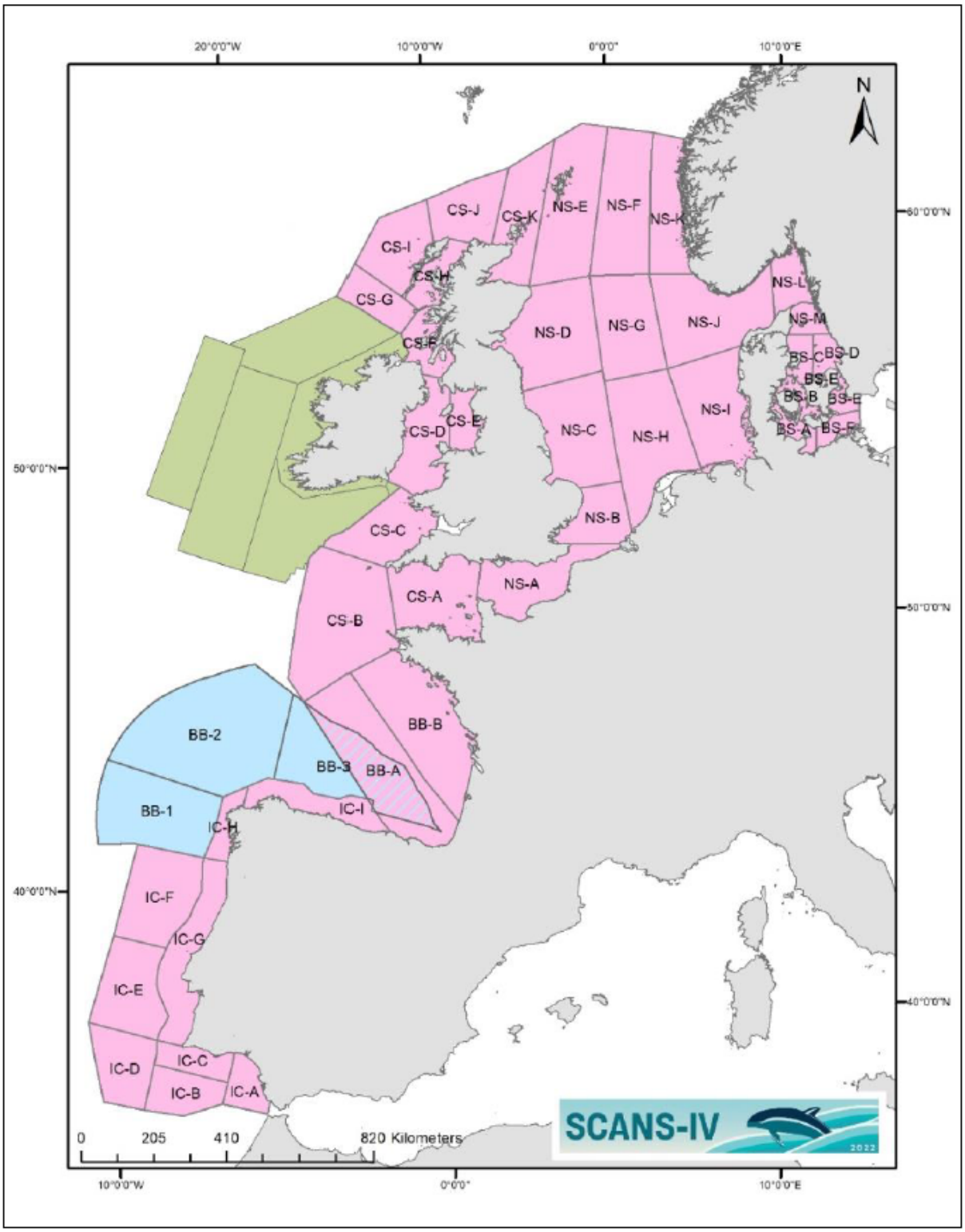

Figure 4 Area covered by SCANS IV survey blocks. Pink blocks were surveyed by aircraft and blue blocks by ship (Gilles *et al.*, 2023).

2.6 The East Coast Marine Mammal Acoustic Study (ECOMMAS)

ECOMMAS began in 2013 and consists of 30 Passive Acoustic Monitoring (PAM) sites along the east coast of Scotland to collect data on the relative abundance of dolphins and porpoise. Each site consists of an automatic click detector (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 Salamander Project Offshore Development, two ECOMMAS sites have been included in this report from 2013 – 2022. These sites are inclusive of Cruden Bay and Fraserburgh (Figure 5). 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 4 months), with data covering April to November usually. CPOD data are presented in detection-positive days (DPD) and detection-positive hours (DPH) in this report. See Section 4.6 for porpoise data, and Section 5.6 for dolphin data.

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.

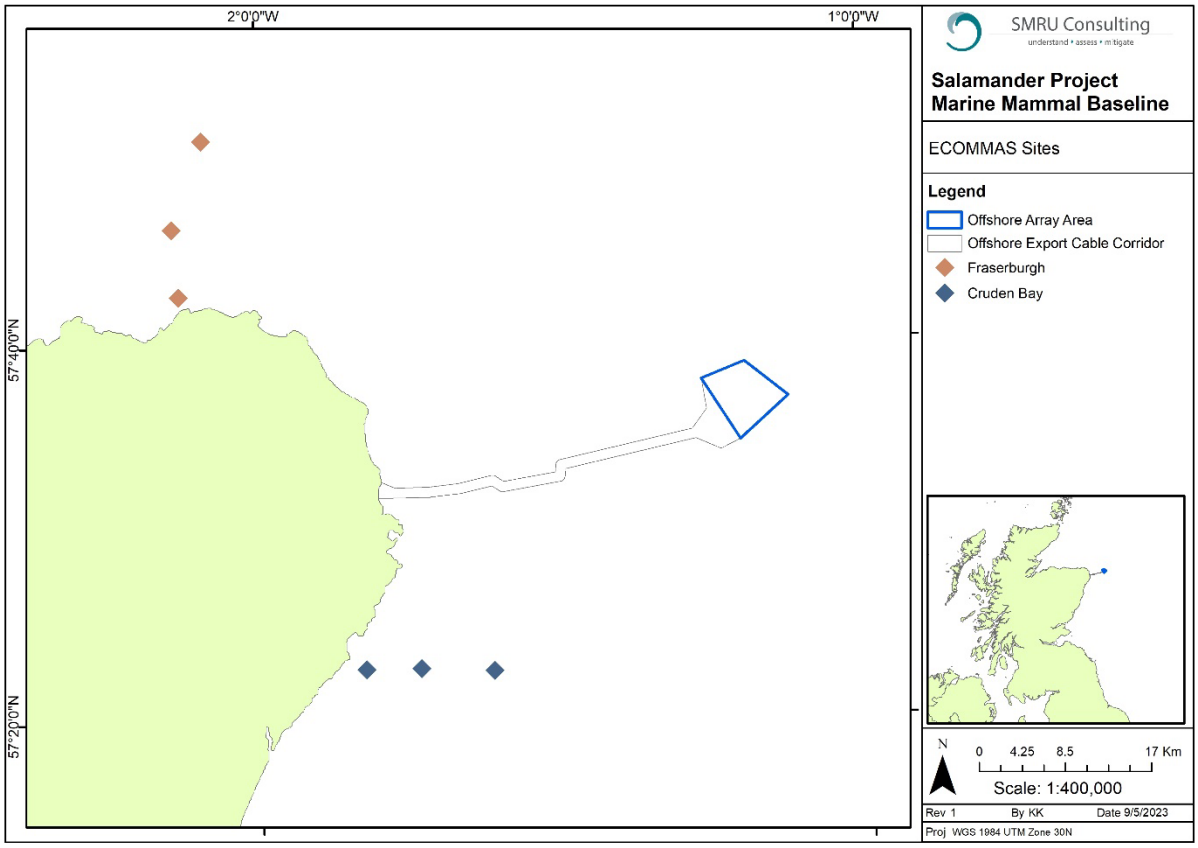

Figure 5 Locations of the Cruden Bay and Fraserburgh ECOMMAS PAM stations, in relation to the Salamander Project offshore array.

2.7 Joint Cetacean Protocol (JCP) Phase III Analysis

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 Offshore 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 6).

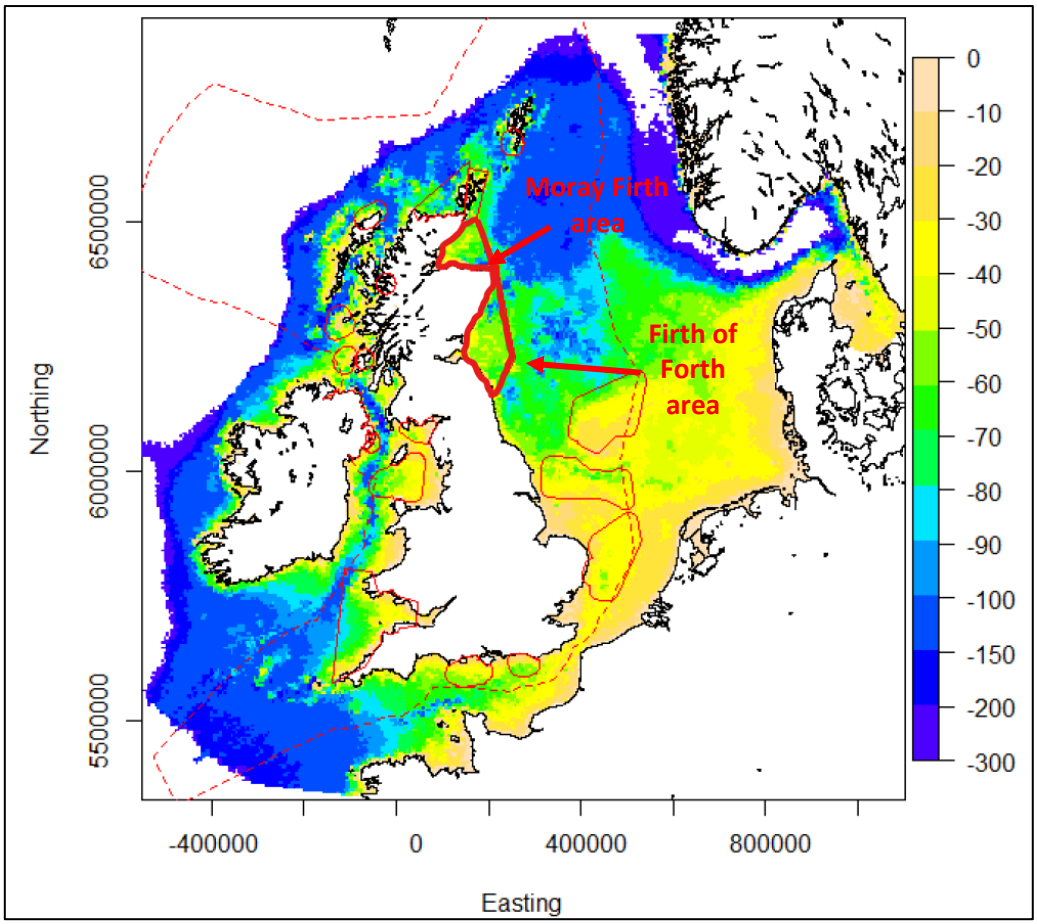

Figure 6 The JCP Phase III region showing (red) areas of interest for the Offshore Development Area where estimates of abundance are of special commercial interest (red dashed line = British exclusive economic zone, colour = depth in m) (Paxton *et al.*, 2016).

In 2017, JNCC released R code that can be used to extract cetacean abundance estimates for summer 2007-2010 (average) for a user specified area. This code was originally created by Charles Paxton at CREEM and was modified by JNCC to include abundance estimates that are scaled to the SCANS III results. The user specified area used to extract these abundance estimates is shown in Figure 7 and consists of total area of 11,496.3 km^2.

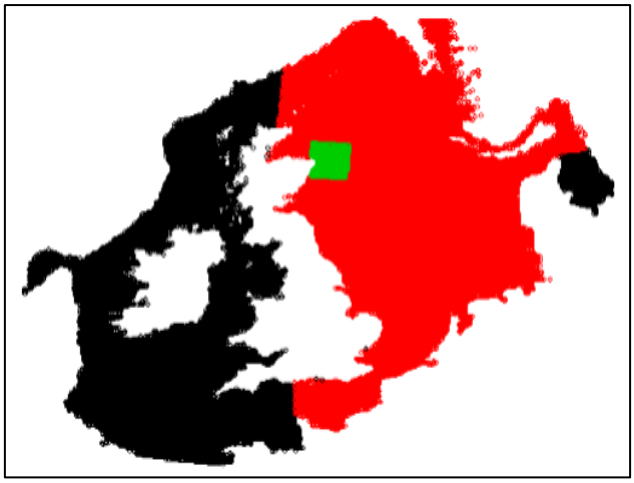

Figure 7 The user specified area used to extract cetacean abundance and density estimates from the JCP III R code. The map shows the whole area under consideration (black + red + green), the harbour porpoise North Sea MU (red) and the specific area of interest (green).

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 standardising the data (such as corrections for undetected animals and potential biases) from so many different platforms/methodologies and the strong assumptions that had to be made when calculating detection probability. In addition, the density estimate obtained from the Data Analysis Tool is an averaged density estimate for the summer 2007-2010 and is therefore not representative of densities at other times of the year.

2.8 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 Joint Cetacean Protocol (JCP) database. The goal of this analysis was to try and identify "discrete and persistent areas of high density" that might be considered important for harbour porpoise with the ultimate goal of determining Special Areas of Conservation (SACs) for the species. The 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*". It is worth highlighting that the analysis presented in Heinänen and Skov (2015) relies on extensive extrapolation of survey data over space and time. Any such extrapolation is sensitive to the covariates used in the models; and assumes that these relationships hold outside of the surveyed areas. Subjective decisions in the retention of covariates in Heinänen and Skov (2015) could limit the wider validity of such extrapolation.

2.9 Marine Ecosystem Research Project (MERP) distribution maps

The aim of the MERP project (Marine Ecosystems Research Programme) 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 standardised. 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.* (2020) 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.* (2020) 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. 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 (Hammond *et al.*, 2006, Hammond *et al.*, 2021). Therefore, while the density estimates obtained from these maps for harbour porpoise may be 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.

2.10 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 (Cheney *et al.*, 2012, Cheney *et al.*, 2014b, Cheney *et al.*, 2018). In 1989, the University of Aberdeen, in collaboration with the Sea Mammal Research Unit (SMRU) at the University of St. Andrews began an intensive research programme to report on the condition of the site through the use of photo-identification surveys and passive acoustic monitoring (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 (MMMP) 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.

2.11 Seal surveys

2.11.1 Sea Mammal Research Unit (SMRU) Surveys

The Sea Mammal Research Unit (SMRU) carries out surveys of harbour (or common) and grey seals in Scotland and on the east coast of England to contribute to the Natural Environment Research Council's (NERC's) statutory obligation under the Conservation of Seals Act 1970 '*to provide the (UK government) with scientific advice on matters related to the management of seal populations*'. These SMRU surveys, as well as surveys by other organisations (including NatureScot, Natural England, the Natural Resources Wales, the National Trust and the Lincolnshire Wildlife Trust) form the routine monitoring of seal populations around the UK. The annually submitted 'Advice', which includes information on recent changes in grey and harbour seal numbers, can be found in the Special Committee on Seals (SCOS) reports on SMRU's website[1]. Grey seal pup surveys have been conducted since 1984 and most August haulout surveys have been conducted since 1996.

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

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

2.11.1.1 Harbour Seals

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

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

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

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

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

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

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

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

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

2.11.1.2 Grey seals

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

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.

2.11.2 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).

2.12 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 is a combination of the SMRU and University of Aberdeen tag deployments.

2.13 Seal at-sea distribution

BEIS funded a large-scale deployment of high-resolution GPS telemetry tags on grey seals around the UKto 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 8). 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 9) 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.

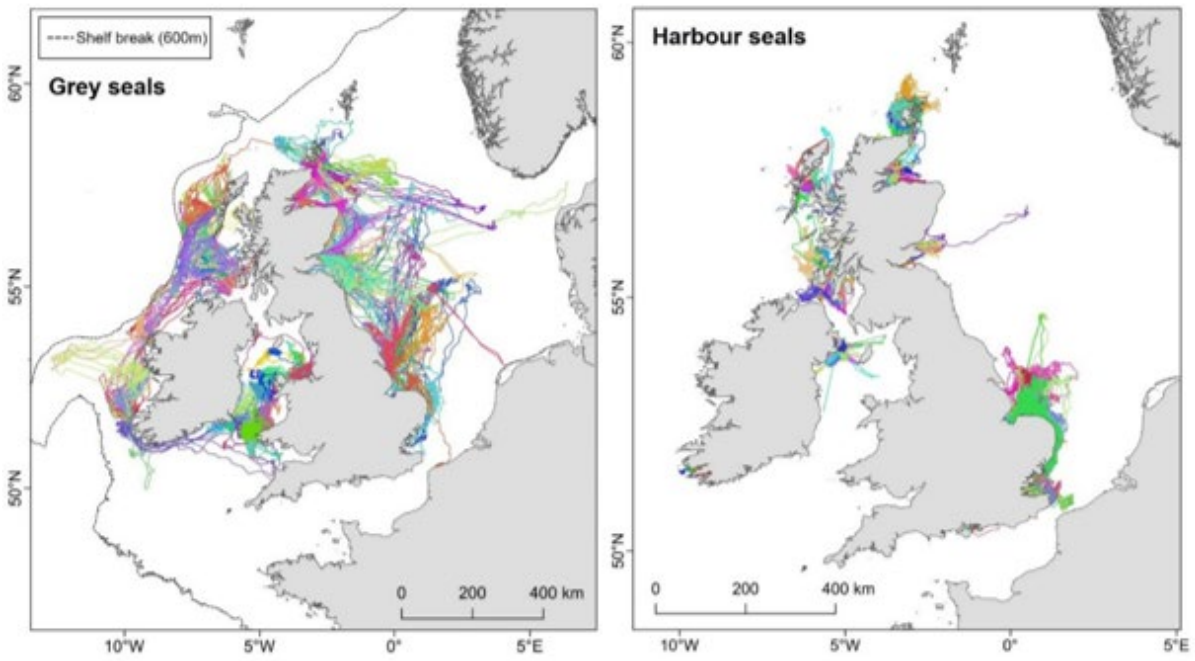

Figure 8 GPS tracking data for grey and harbour seals available for habitat preference models (Carter *et al.*, 2020).

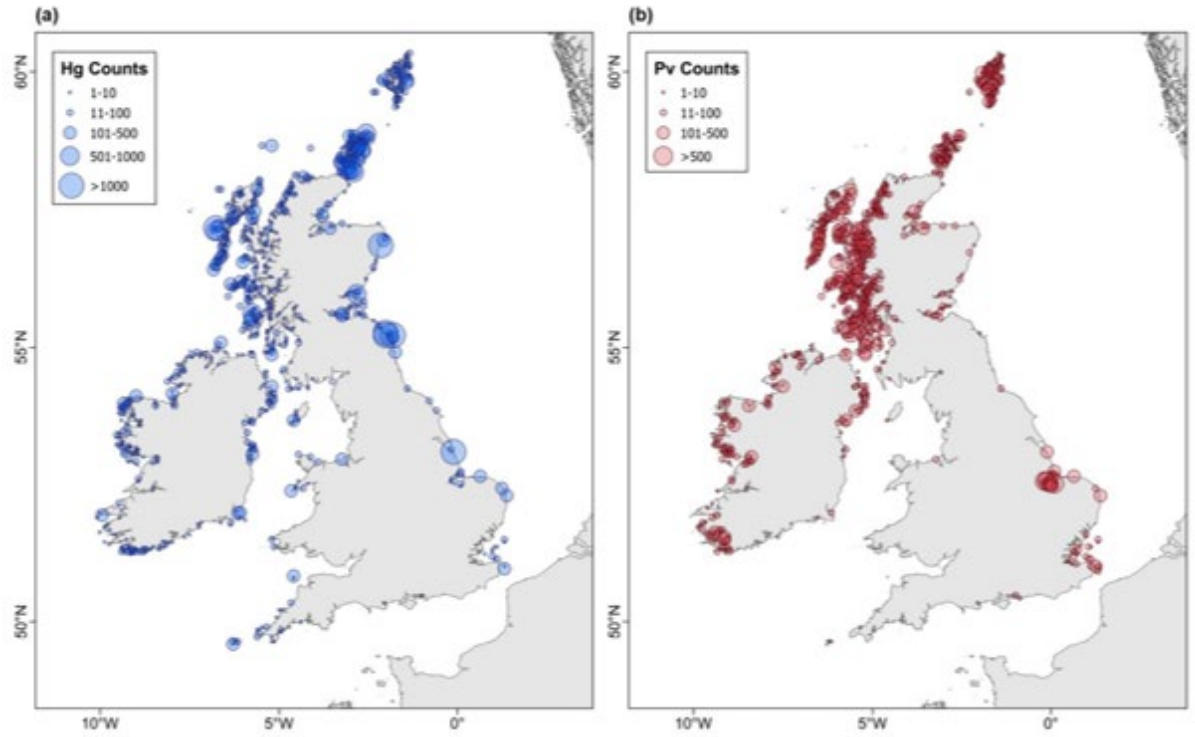

Figure 9 Most recent available August count data for (a) grey and (b) harbour seals per 5x5 km haul-out cell used in the distribution analysis (Carter *et al.* 2020).

2.14 Other Offshore Wind Farms

2.14.1 Berwick Bank Offshore Wind Farm

The Berwick Bank Offshore Wind Farm is located in the outer Firth of Forth. The EIA for the project includes a marine mammal baseline technical report which details the site-specific surveys (RPS, 2022). Digital aerial surveys were conducted by HiDef Aerial Surveying Limited between March 2019

and April 2021 resulting in 25 individual days of survey effort. The survey design consisted of 37 transects spaced 2 km apart across the Offshore Array Area plus ~16 km buffer (Figure 10). 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).

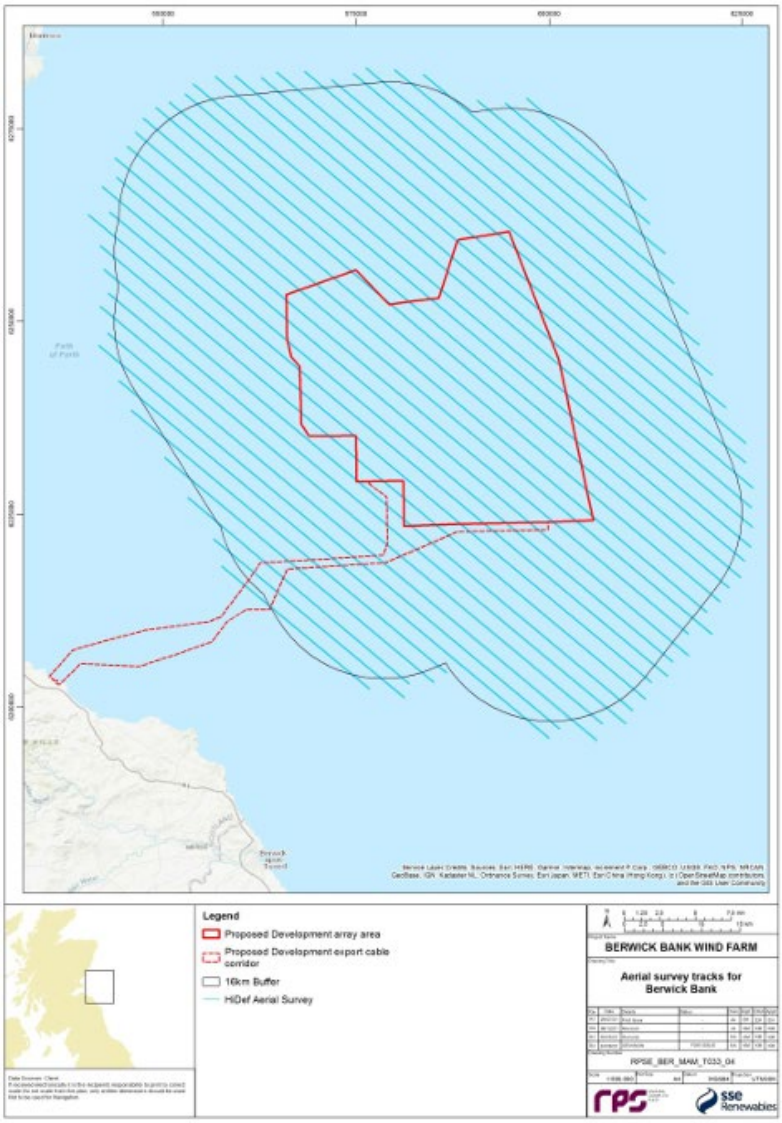

Figure 10 Berwick Bank Offshore Wind Farm site-specific survey area undertaken between March 2019 and April 2021. Figure taken from (RPS, 2022).

2.14.2 Caledonia Offshore Wind Farm

The Caledonia Offshore Wind Farm is located in the Moray Firth, immediately adject to the Moray East 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.

2.14.3 Green Volt Offshore Wind Farm

The Green Volt Offshore Wind Farm is a floating development in the Outer Moray Firth located 33 km from Salamander Project. 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.

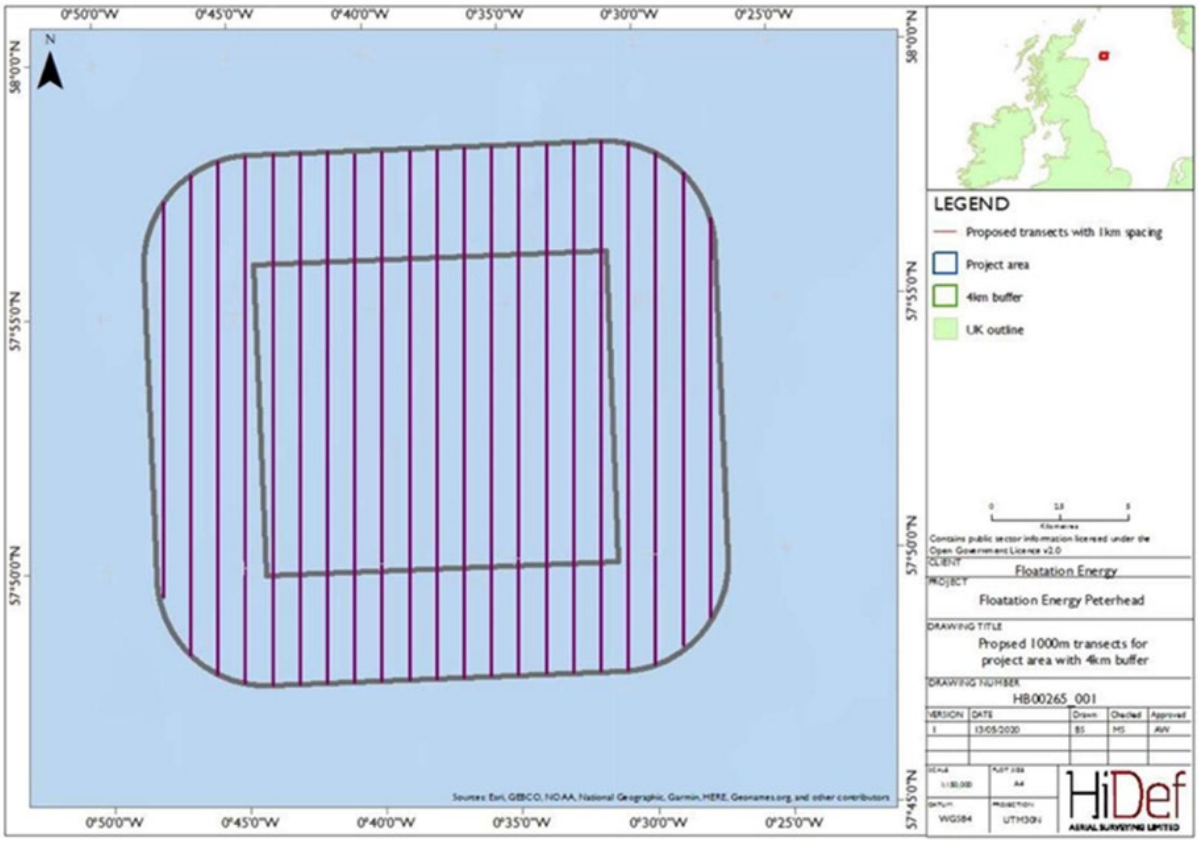

Figure 11 Green Volt Offshore Wind Farm site-specific survey area (Royal HaskoningDHV, 2021)

2.14.4 Muir Mhór Offshore Wind Farm

Muir Mhór Offshore Wind Farm is a floating development located on the East coast of Scotland, approximately 63 km East of Peterhead, and 28 km from the Salamander Project. Information is available for this site from the Scoping Report (Muir Mhor, 2023). Digital area surveys were carried out by Aerial Surveying Limited between April 2021 and March 2023. The survey area encompassed the Offshore Array Area and a portion of the Scotwind E2 Plan Option Area, including a 4 km survey buffer (Figure 11). Seven species of marine mammals were sighted including minke whales, bottlenose dolphins, harbour porpoises, white-beaked dolphins, Risso's dolphins, grey seals, and harbour seals. Monthly density estimates were provided for harbour porpoise which were corrected for availability bias using the Teilmann *et al.* (2013) tag data. Density estimates for Risso's dolphins could not be produced due to the limiting total of four sightings made of this species during the surveys.

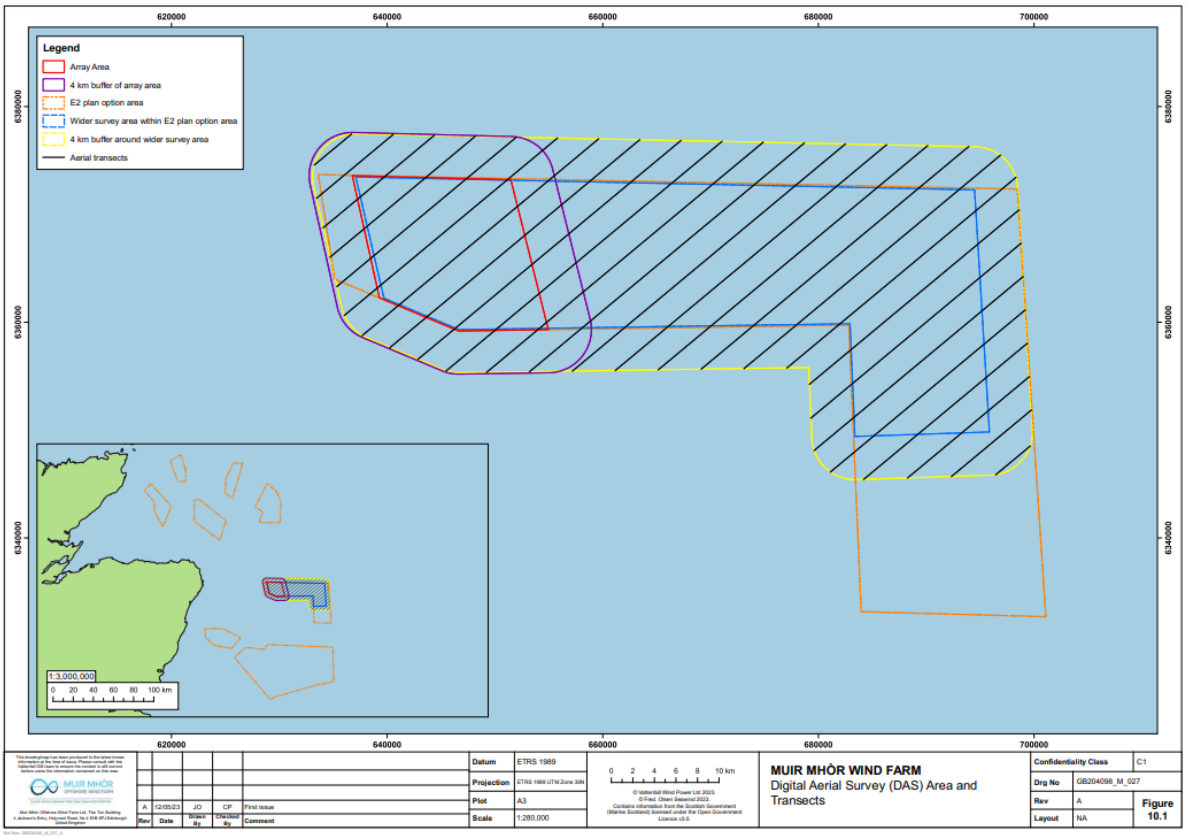

Figure 12 Muir Mhór Offshore Wind Farm site-specific survey area (Muir Mhor, 2023).

2.14.5 Seagreen Offshore Wind Farm

The Seagreen Offshore Wind Farm is currently under construction approximately 27 km from the coast of Angus in the North Sea. As part of their Project Environmental Monitoring Programme (PEMP) and Marine Mammal Monitoring Programme (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. Unfortunately, the PAM data from this PEMP were not available to be presented here.

3 Protected Areas

3.1 Moray Firth Special Area of Conservation

The Moray Firth Special Area of Conservation (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. Moray Firth SAC is located approximately 120 km from the Salamander Project Offshore Array Area.

3.2 Southern North Sea Special Area of Conservation

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,

predominately in the offshore waters of the central and southern North Sea, from North of Dogger Bank to the Straits of Dover in the South; covering an area of 36,951 km^2. It is considered one of the best areas for harbour porpoise in the UK and is mostly located in offshore waters (Figure 13). The Southern North Sea SAC is located just over 270 km from the Salamander Project Offshore Array Area.

3.3 Southern Trench Marine Protected Area

The Southern Trench Marine Protected Area (MPA) (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). Part of the Salamander Project Offshore Export Cable Corridor crosses through the southern part of this MPA (Figure 13) and the Offshore Array Area is located approximately 10 km from the MPA.

3.4 Firth of Tay and Eden Estuary Special Area of Conservation

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). Forth of Tay and Eden Estuary SAC is located approximately 155 km from the Salamander Project Offshore Array Area.

3.5 Isle of May Special Area of Conservation

The Isle of May SAC (UK0030172) was designated 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 Seal Management Unit (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). Isle of May SAC is located approximately 175 km from the Salamander Project Offshore Array Area.

3.6 Berwickshire and North Northumberland Special Area of Conservation

Berwickshire and North Northumberland SAC is located approximately 190 km from the Salamander Project Offshore Array Area. This site 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.

3.7 Farray and Holm of Farray Special Area of Conservation

Farray and Holm of Farray SAC (UK0017096) is located approximately 200 km from the Salamander Project Offshore Array Area. This site was designated as an SAC in 2005 and consists of two uninhabited islands in the northern part of Orkney. These two uninhabited islands support a well-established grey seal breeding colony.

3.8 Designated seal haul-out sites

The closest designated seal haul-out site is ES-003 Ythan River Mouth (55 km away from the Salamander Project Offshore Array Area) which is a year-round designated site. This haul-out site is protected under The Protection of Seals (Designation of Haul-out Sites) (Scotland) Amendment Order 2017 and protects seals while they are on land within the site.

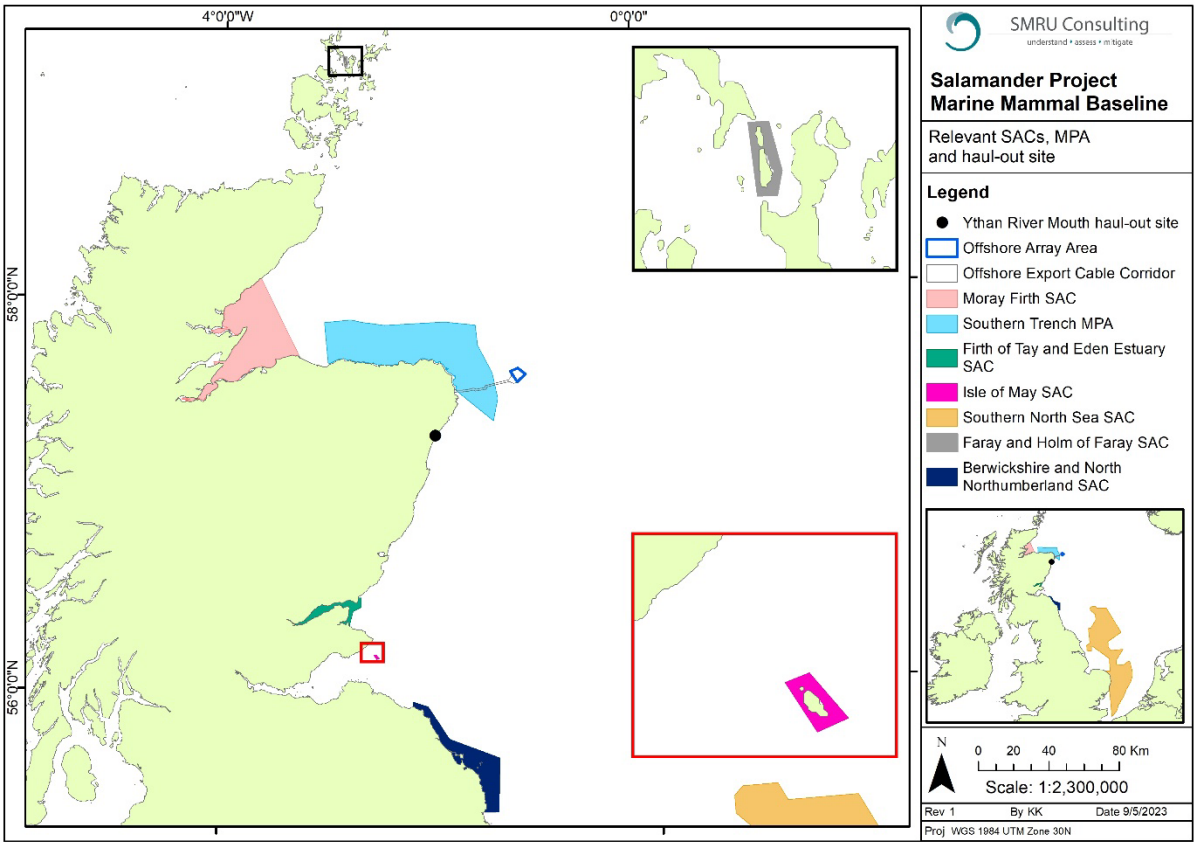

Figure 13 Special Areas of Conservation, and Marine Protected Area for marine mammals and protected haul-out site relevant to Salamander Project.

4 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 rate of harbour porpoise around north of the UK, including Scottish waters (Figure 14). 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 water year-round and are the most frequently sighted species (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 North Sea MU, Southern North Sea SAC (Figure 13).

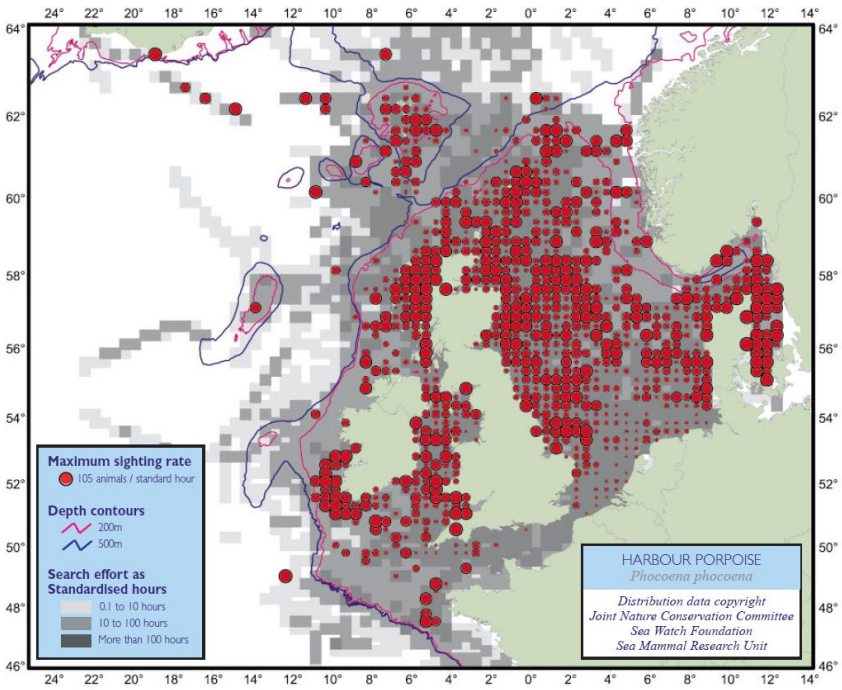

Figure 14 Harbour porpoise distribution map of effort-related sightings (Reid *et al.*, 2003).

4.1 Management Unit

The population estimate for the North Sea 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 15) (Gilles *et al.*, 2023).

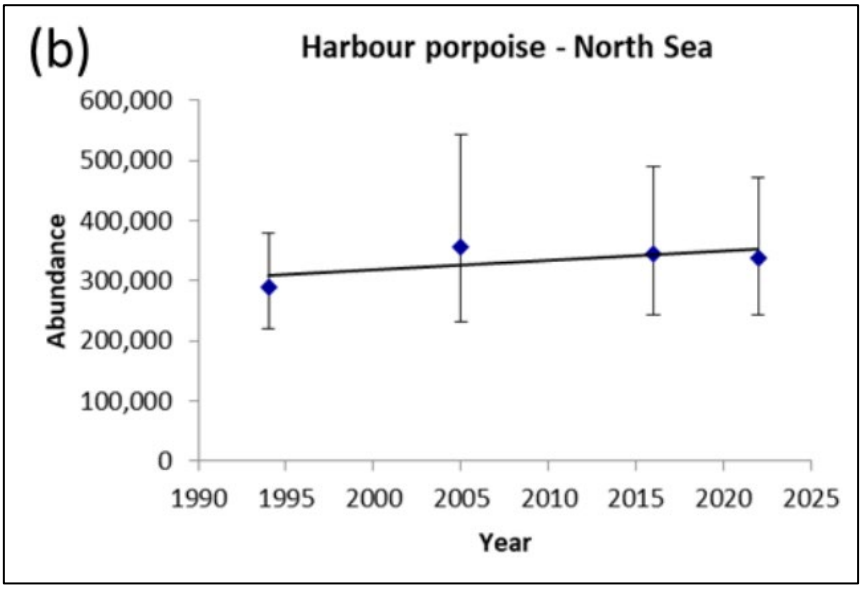

Figure 15 North Sea harbour porpoise trend in abundance over the four SCANS surveys (Gilles *et al.*, 2023).

4.2 Site-specific surveys

The two years of site-specific surveys conducted monthly from March 2021 to February 2023 concluded that harbour porpoise were the most abundant non-avian species present, with peaks found in July and August 2022 at 18 and 19 sightings, respectively and an absolute density of 3.00 animals/km^2 (95% CI 1.46 – 4.92) within the DAS Area in July 2022 (Table 3). Lower estimates of 0.19 animals/km^2 (CI 0.00 – 0.56) within the DAS Area were found in November 2022. For each of the 24 surveys conducted, relative and absolute density estimates (animals/km^2) were provided for harbour porpoises (Table 3, Figure 10). The spatial distribution of this species was also visualised (Figure 17 - Figure 20). The average density estimates within the DAS Area for the two years of HiDef surveys were reported to be an absolute density of 0.710 animals/km^2.

Harbour porpoises appeared to show some patterns of seasonality at the site, with a maximum estimated absolute density of 3.00 animals/km^2 within the DAS Area during the summer months, compared to a maximum estimated absolute density of 1.33 animals/km^2 within the DAS Area during winter months. This is also reflected in Figure 16 - Figure 20. Harbour porpoise present at the site did not appear to show any distinct spatial patterns within the site (Figure 17 - Figure 20).

Table 3 Number of harbour porpoise sighted per survey, relative density estimates and absolute density estimates (corrected for availability bias) for the DAS Area and the Salamander Refined Area of Search. Data from HiDef Aerial Surveying Limited (2023).

Survey	Date	Raw count	DAS Area				Salamander Refined Area of Search			
			Density estimate (#/km^2)	Abundance estimate	Lower CI	Upper CI	Density estimate (#/km^2)	Abundance estimate	Lower CI	Upper CI
1	Mar-21	0	0.00	0	0	0	0	0	0	0
2	Apr-21	3	0.35	147	0	305	1.19	41	0	103
3	May-21	0	0.00	0	0	0	0	0	0	0
4	Jun-21	4	0.59	234	59	446	0	0	0	0
5	Jul-21	15	2.54	946	308	1776	0	0	0	0
6	Aug-21	14	2.15	808	329	1423	4.78	163	0	346
7	Sep-21	5	0.99	370	72	776	0	0	0	0
8	Oct-21	0	0.00	0	0	0	0	0	0	0
9	Nov-21	0	0.00	0	0	0	0	0	0	0
10	Dec-21	7	1.33	495	71	1104	0	0	0	0
11	Jan-22	5	0.85	317	62	642	0	0	0	0
12	Feb-22	0	0.00	0	0	0	0	0	0	0
13	Mar-22	0	0.00	0	0	0	0	0	0	0
14	Apr-22	0	0.00	0	0	0	0	0	0	0
15	May-22	4	0.61	222	0	464	0	0	0	0
16	Jun-22	3	0.51	183	0	519	0	0	0	0
17	Jul-22	18	3.00	1115	530	1814	5	169	61	277
18	Aug-22	19	2.93	1101	579	1723	0	0	0	0
19	Sep-22	5	0.99	379	0	893	0	0	0	0
20	Oct-22	0	0.00	0	0	0	0	0	0	0
21	Nov-22	1	0.19	84	0	224	0	0	0	0
22	Dec-22	0	0.00	0	0	0	0	0	0	0
23	Jan-23	0	0.00	0	0	0	0	0	0	0
24	Feb-23	0	0.00	0	0	0	0	0	0	0
Two-year average			**0.710**	**267**	**-**	**-**	**0.457**	**16**	**-**	**-**

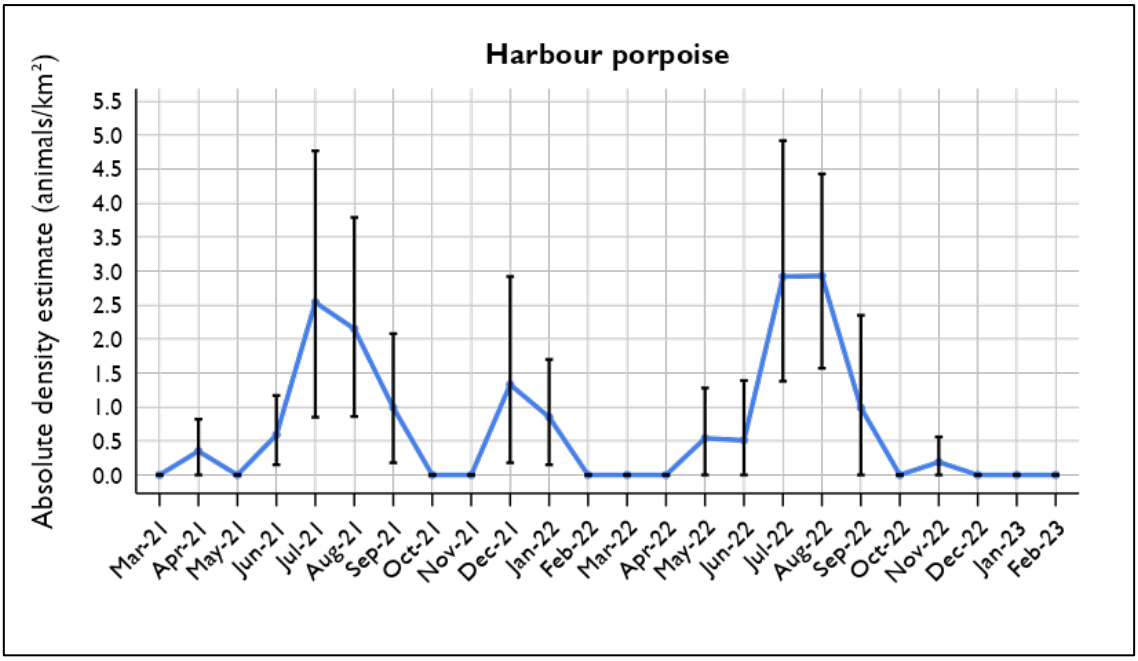

Figure 16 Harbour porpoise absolute density estimates, with lower and upper confidence intervals for the DAS Area between March 2021 and February 2023. Figure from HiDef Aerial Surveying Limited (2023).

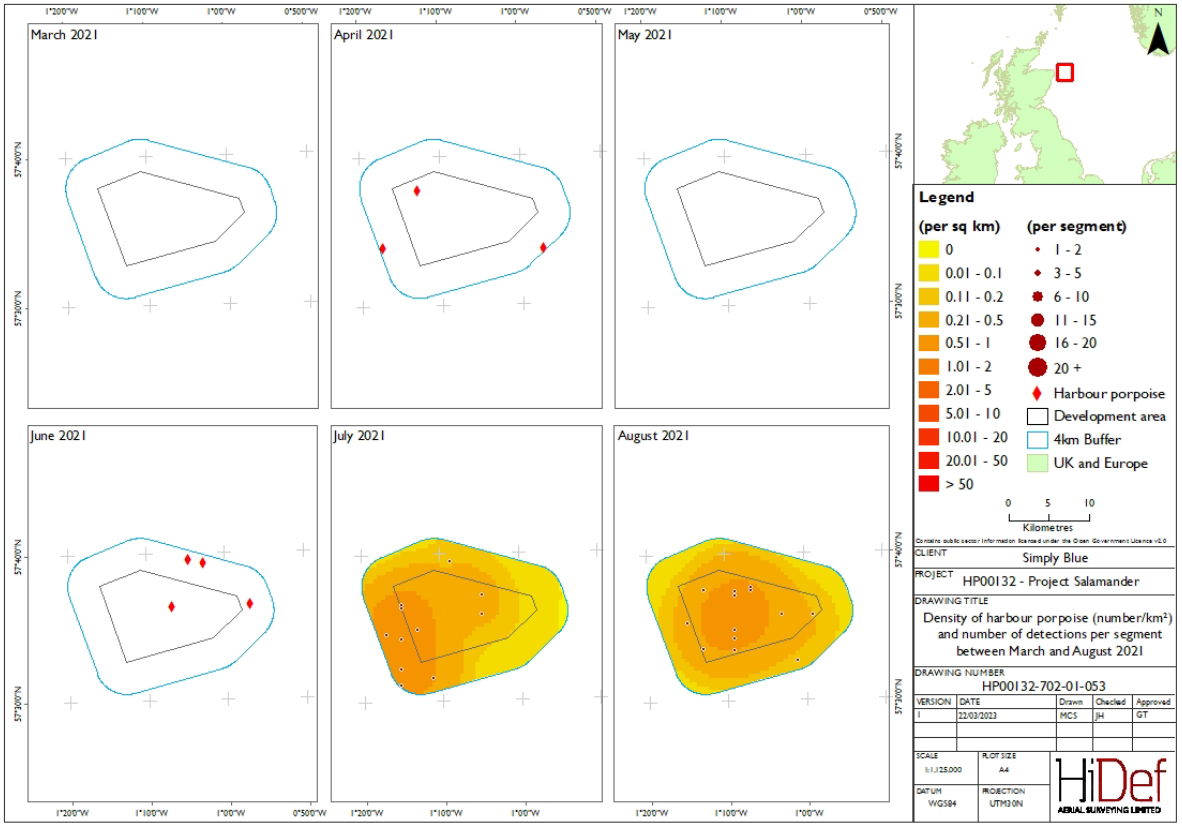

Figure 17 Density of harbour porpoises (number/km²) and number of detections across the DAS Area between March 2021 and August 2021. Figure from HiDef Aerial Surveying Limited (2022).

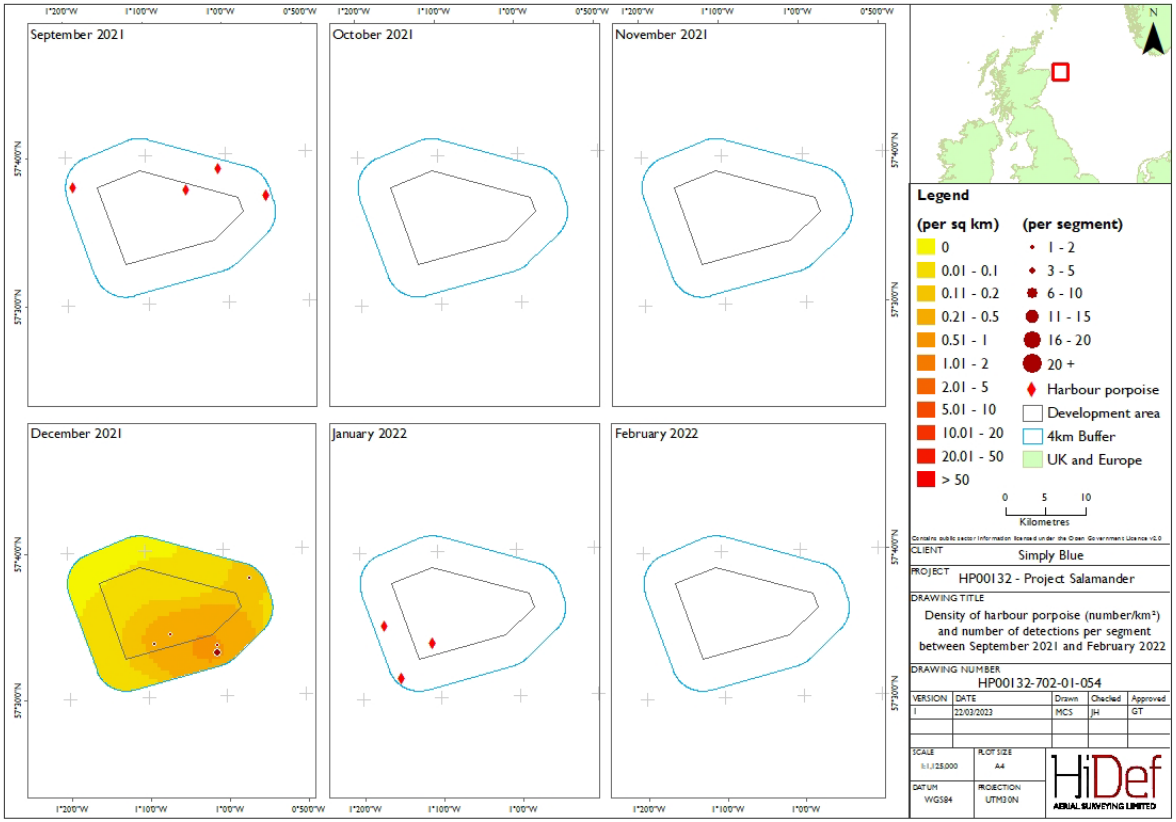

Figure 18 Density of harbour porpoises (number/km²) and number of detections across the DAS Area between September 2021 and February 2022. Figure from HiDef Aerial Surveying Limited (2022).

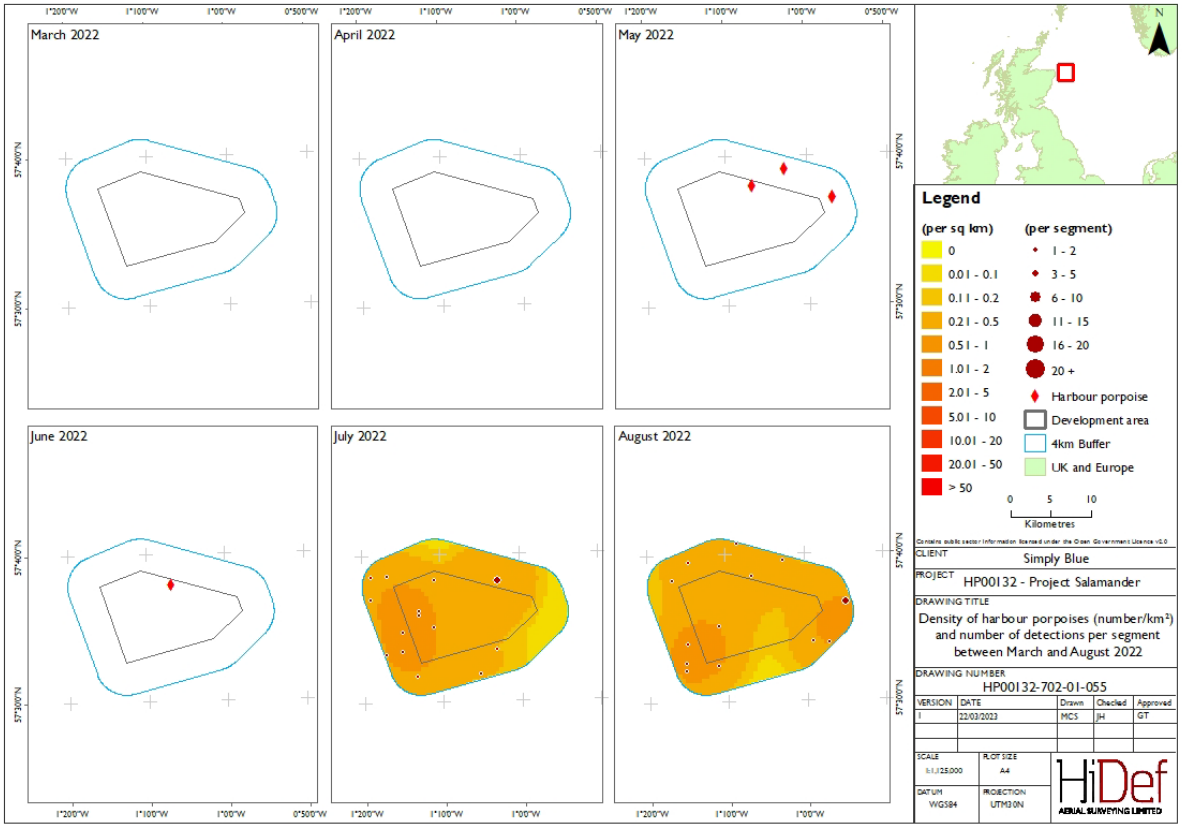

Figure 19 Density of harbour porpoises (number/km²) and number of detections across the DAS Area between March 2021 and August 2022. Figure from HiDef Aerial Surveying Limited (2023).

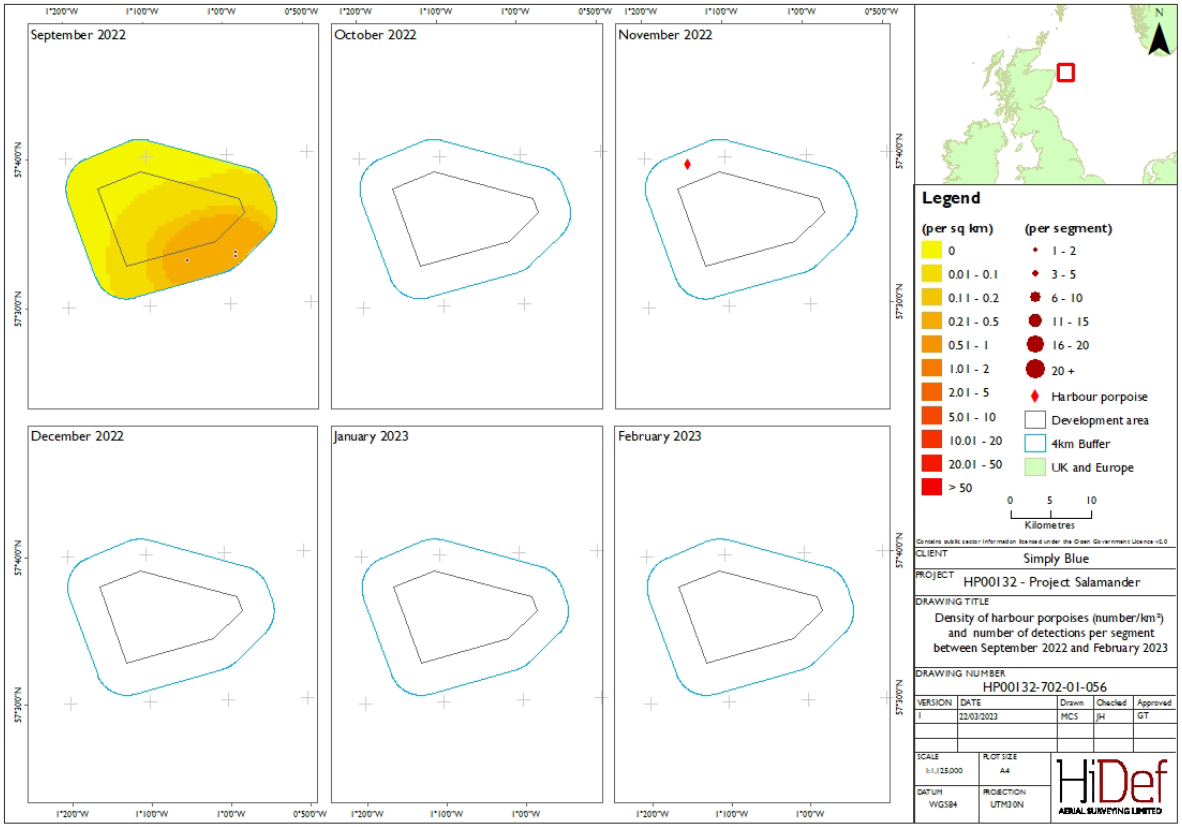

Figure 20 Density of harbour porpoises (number/km²) and number of detections across the DAS Area between September 2022 and February 2023. Figure from HiDef Aerial Surveying Limited (2023).

4.3 Small Cetaceans in European Atlantic waters and the North Sea III and IV

Salamander Project 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.

Salamander Project is located within the SCANS IV survey block NS-D with 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 in summer 2022 (CV = 0.367) (Gilles *et al.*, 2023). Abundance (33,735, 95% CI: 21,757 – 50,324) and density (0.5156 harbour porpoise/km^2, CV = 0.208) in the neighbouring block NS-E were lower than in the block NS-D, same as in SCANS III.

Lacey *et al.* (2022) used the SCANS III data and spatially referenced environmental features to predict density estimates for harbour porpoises (Figure 21). 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 21). The density range for grid cells within the Offshore Array Area is 0.482 – 0.526 porpoise/km^2.

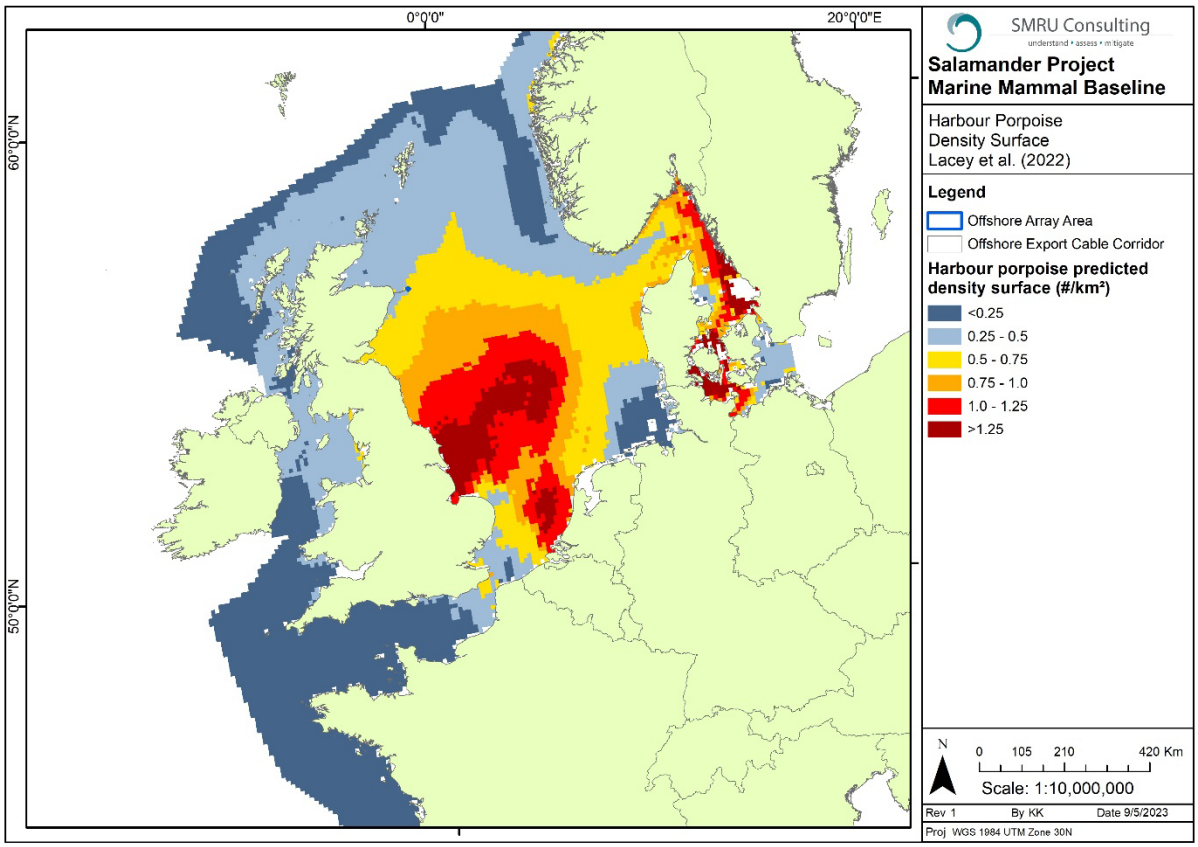

Figure 21 Predicted surface of estimated density for harbour porpoise in SCANS III. Figure from Lacey *et al.* (2022).

4.4 Joint Cetacean Protocol Phase III Analysis

4.4.1 Paxton *et al.* (2016)

Paxton *et al.* (2016) produced predicted harbour porpoise densities for summer 2010 (Figure 22). 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 in which Salamander Project 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 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 and an average of 1.14 porpoise/km^2 over the year (Table 4).

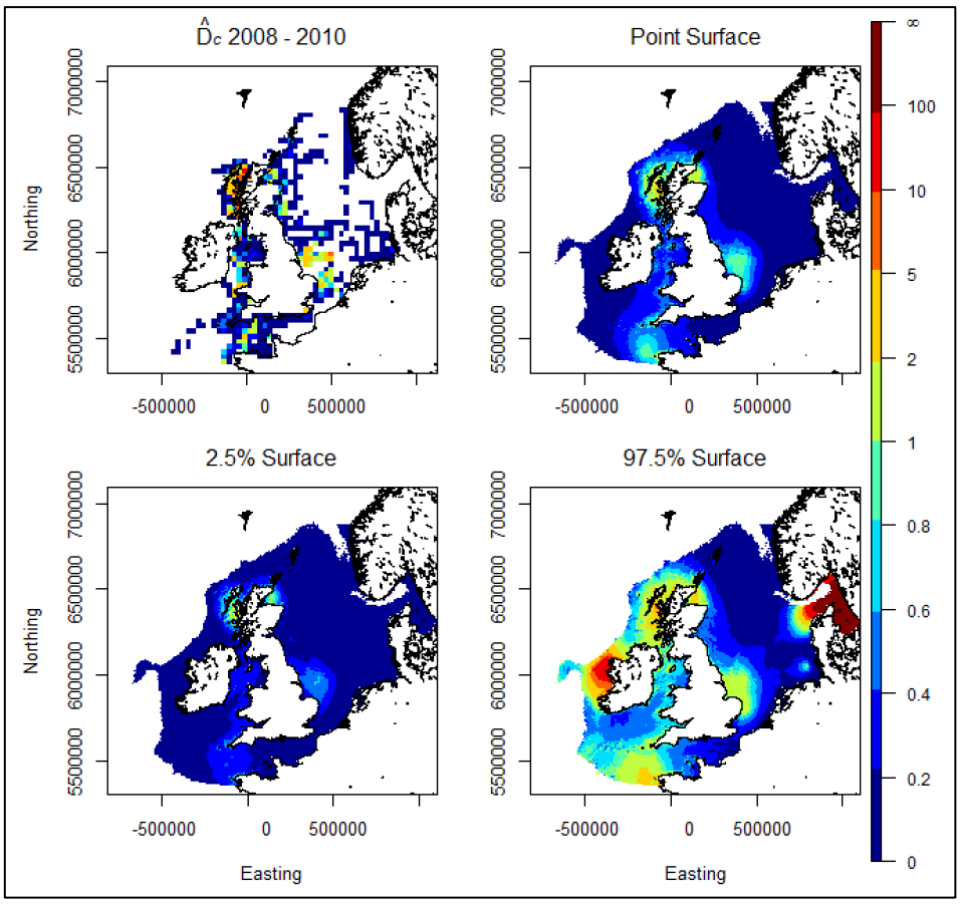

Figure 22 Predicted harbour porpoise densities for summer 2010 (Paxton *et al.*, 2016). Top left; input densities (summer all years), top right; point estimate of cell densities, bottom left; lower (2.5%) confidence limit on cell densities, bottom right; upper (97.5%) confidence limit on cell densities (porpoise/km^2). Note that the top left plot exaggerates the spatial coverage of the relevant effort.

Table 4 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**

4.4.2 Heinänen and Skov (2015)

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 years 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.

Overall, this analysis predicted varying densities in both the summer and winter months in the central part of the North Sea MU (Figure 23). The density estimates within the outer Forth and Tay region were predicted to be relatively low compared to other parts of the North Sea, between 0.9 – 1.2 porpoise/km^2 for summer 2009 and <0.3 porpoise/km^2 for winter 2009. It is also worth highlighting here that the analysis presented in Heinänen and Skov (2015) relies on extensive extrapolation of survey data over space and time. Any such extrapolation is sensitive to the covariates used in models, as opposed to predictions within the support of the data. Subjective decisions in the retention of covariates in Heinänen and Skov (2015) calls into question the validity of such extrapolation.

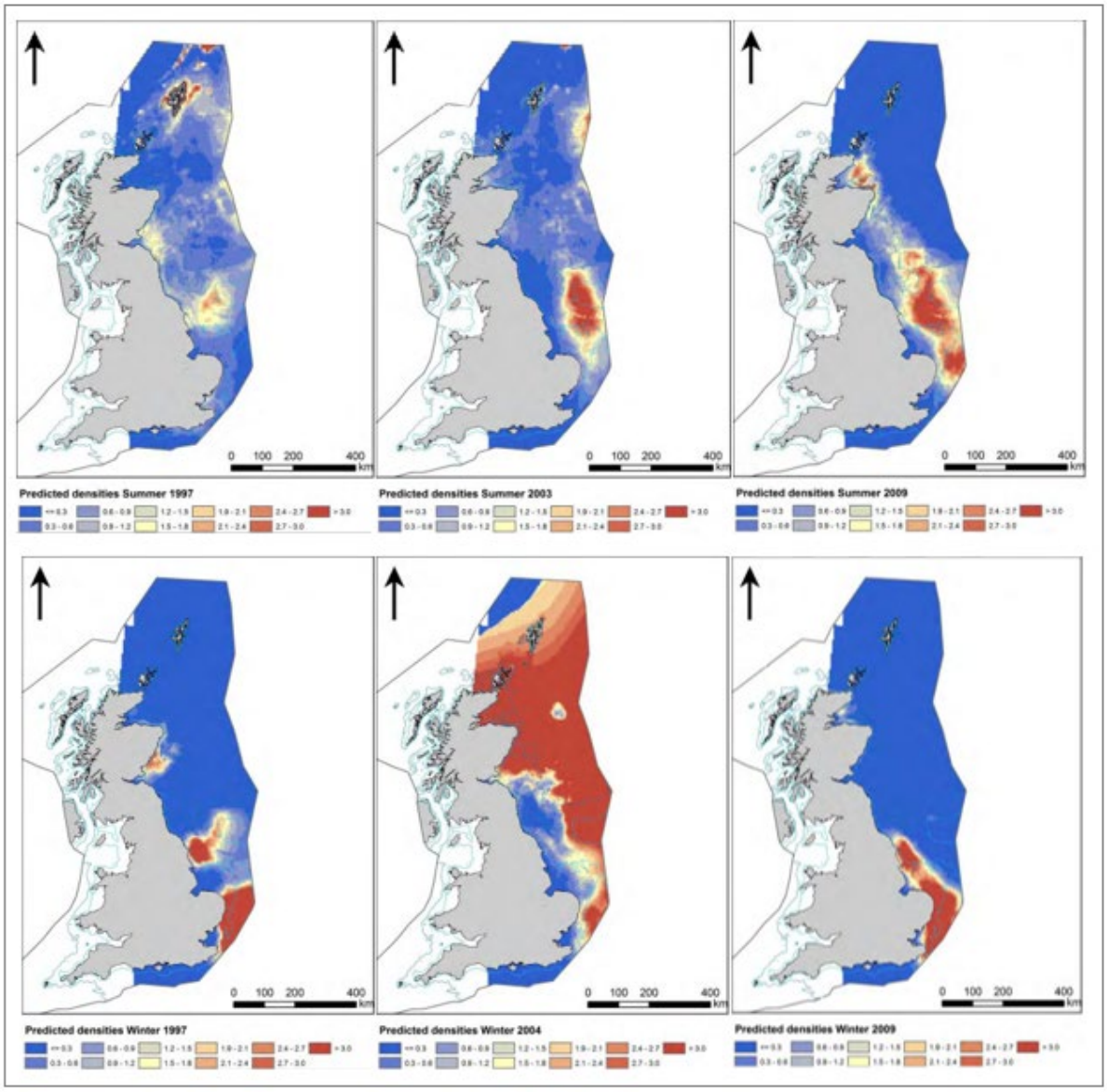

Figure 23 Predicted densities (porpoises/km^2) during summer (top) and winter (bottom) in the North Sea MU for three different years in each model (Heinänen and Skov, 2015).

4.4.3 Joint Cetacean Protocol Data Tool

In the user specified area, the averaged abundance estimate for harbour porpoise in summer 2007-2010 was 0.319 porpoise/km^2 (CI: 0.145 – 0.494).

4.5 Marine Ecosystem Research Project

Density maps were produced by Waggitt *et al.* (2020) 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 were demonstrated by the analyses presented in Waggitt *et al.* (2020). The maximum harbour porpoise density for grid cells within the Offshore Array Area is 0.255 porpoise/km^2 for January and 0.426 porpoise/km^2 for July. The minimum density for grid cells within the Offshore Array Area is 0.215 porpoise/km^2 for January and 0.355 porpoise/km^2 for July (Figure 24).

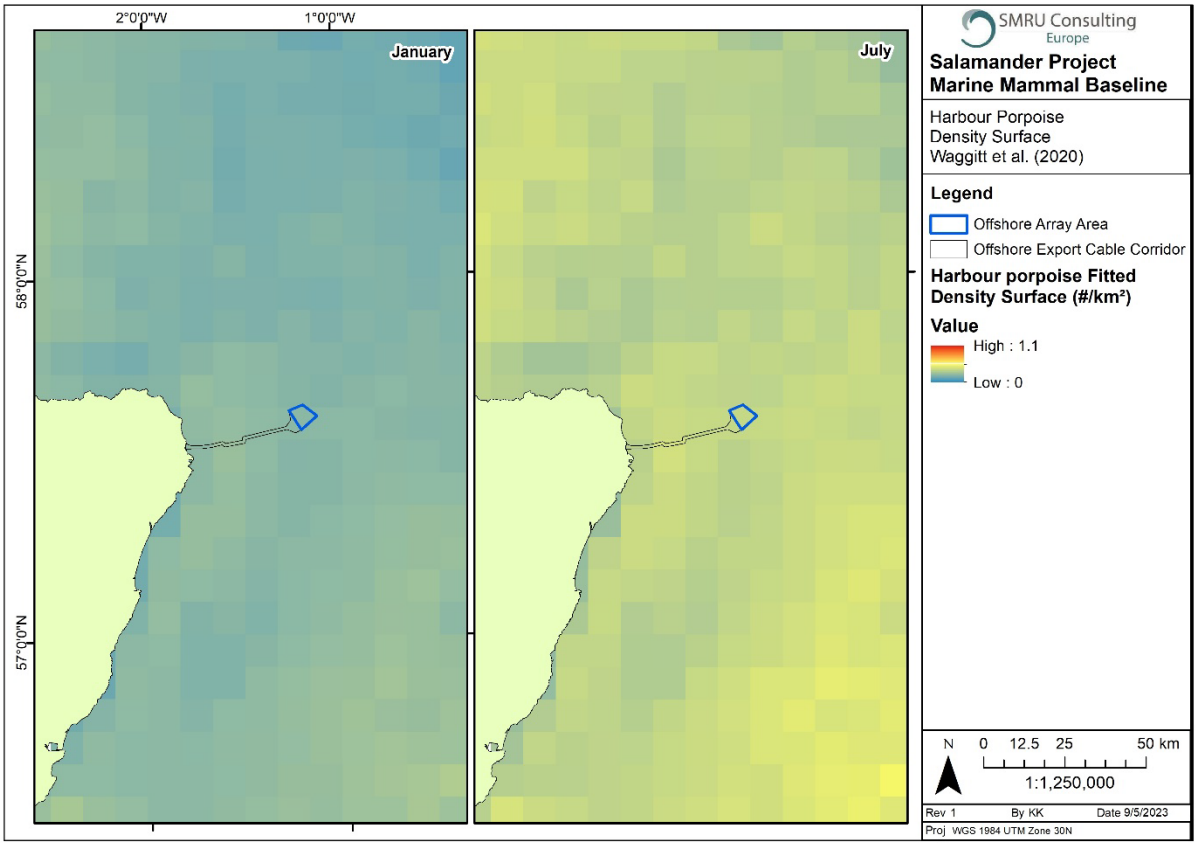

Figure 24 Harbour porpoise density surface (#/km^2) (January and July). Data from Waggitt *et al.* (2020).

4.6 The East Coast Marine Mammal Acoustic Study

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 detection positive days (DPD) per year (Table 5) and average detection positive hours (DPH) per year (Table 6) presented below. Data have also been visualised for DPH across each of the stations at the Cruden Bay (Figure 25) and Fraserburgh (Figure 26) 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 25) and Fraserburgh (Figure 26) 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).

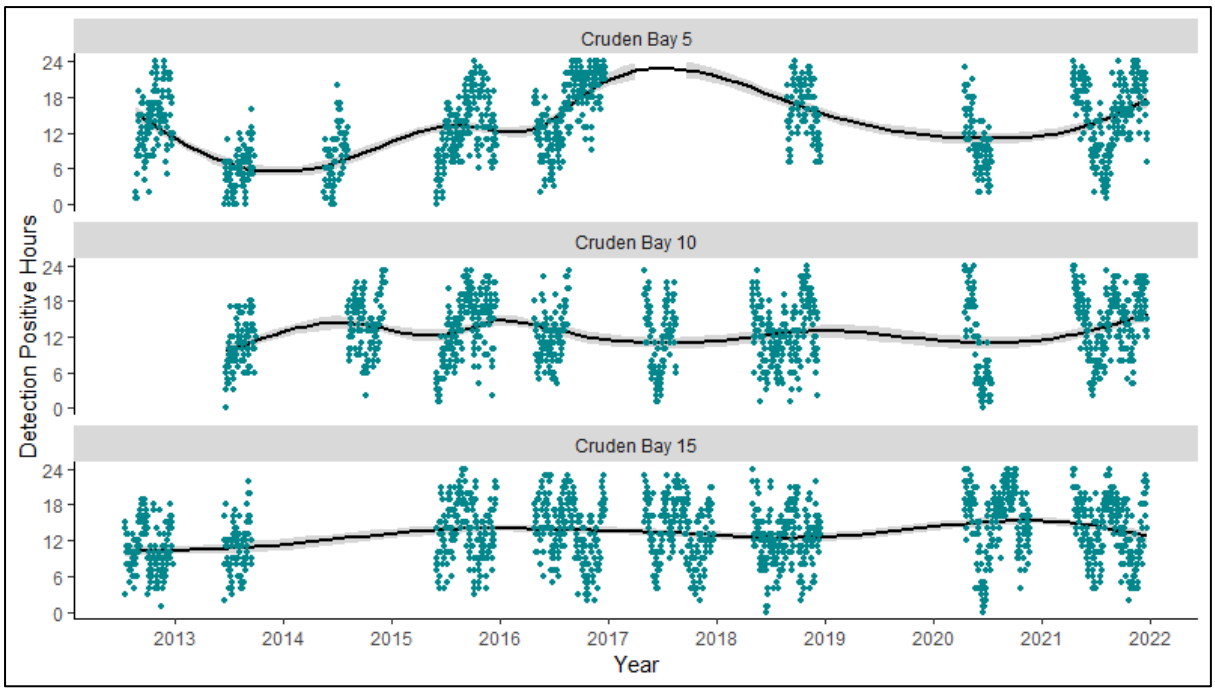

Figure 25 Porpoise detection positive hours (DPH) at the Cruden Bay ECOMMAS stations from 2013 – 2022. CPOD data provided by Marine Scotland.

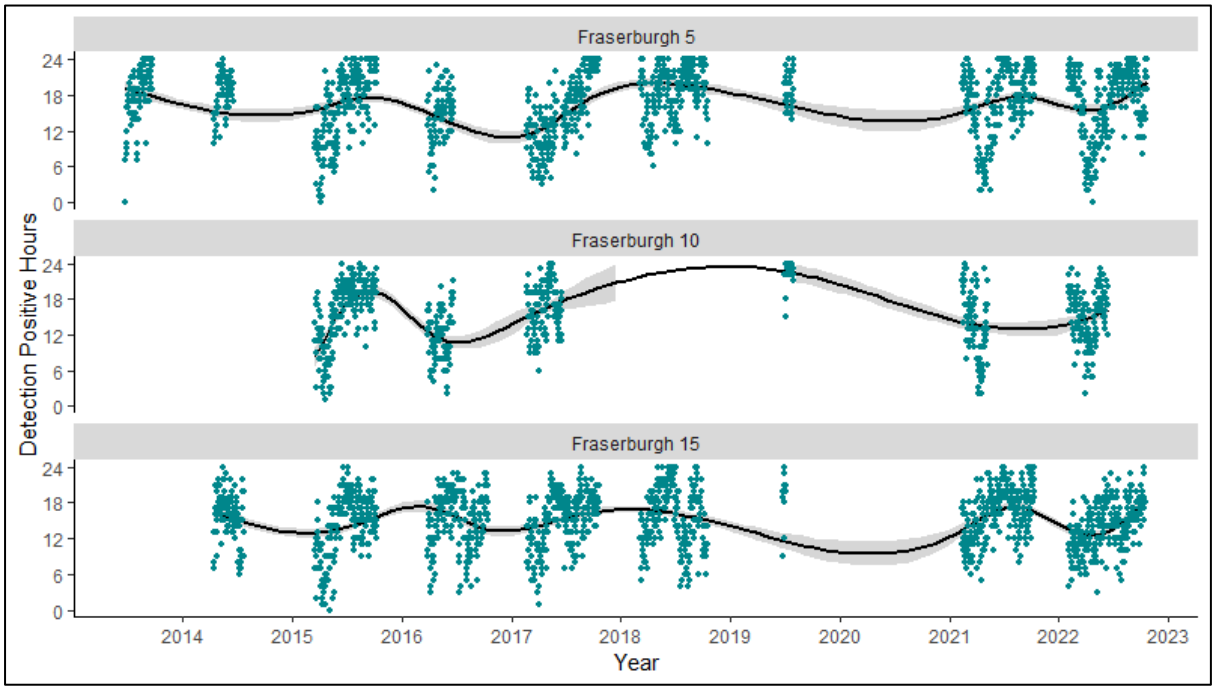

Figure 26 Porpoise detection positive hours (DPH) at the Fraserburgh ECOMMAS stations from 2013 – 2022. CPOD data provided by Marine Scotland.

Table 5 Percentage of porpoise detection positive days at each ECOMMAS PAM site ("-" denotes no data). CPOD data provided by Marine Scotland.

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 Mean detection positive hours of porpoise at each ECOMMAS PAM site ("-" denotes no data). CPOD data provided by Marine Scotland.

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**

4.7 Other Offshore Wind Farms

4.7.1 Berwick Bank

Harbour porpoise were sighted on every one of the monthly surveys, resulting in a total of 2,034 harbour porpoise sightings (RPS, 2022). 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).

4.7.2 Caledonia

No data are available for this project yet.

4.7.3 Green Volt

Harbour porpoise were the 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).

4.7.4 Muir Mhor

The site-specific surveys at Muir Mhor found that harbour porpoise were the most abundant marine mammal species sighted in the survey area (Muir Mhor, 2023). Monthly density estimates have not yet been reported.

4.7.5 Seagreen

No data are available from post-consent surveys for this project yet.

4.8 Harbour porpoise summary

Density estimates obtained for harbour porpoise from the grey and published literature varies from 0.215 porpoises/km^2 to 1.14 porpoises/km^2 (Table 7). The site-specific surveys for Salamander Project conclude an average absolute density of 0.457 porpoises/km^2 across the Refined Search Area. This value is very similar to the SCANS III Block R and SCANS IV Block NS-D density estimate (0.599 and 0.5985 porpoises/km^2, respectively), concluding that these datasets are aligned. The densities reported from Paxton *et al.* (2016) are taken from the Moray Firth and do not necessarily represent the densities likely to be present at the Salamander Project Offshore Array Area given the distance of the site from the survey locations, as well as the differences in site specifications (Moray Firth is more coastal than the Salamander Project site).

While the site-specific survey density estimates are very similar to the SCANS III density estimates, the site-specific data are relevant only to the survey area and should not be extrapolated beyond this. Therefore, it is recommended that the SCANS III modelled density surface for harbour porpoise 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. In addition to this, the new SCANS IV block-wide unform density estimates will also be presented in the quantitative impact assessment.

Table 7 Summary table of the available density estimates for harbour porpoise.

Source	Details	Density estimate (#/km^2)
Salamander Project site-specific surveys	DAS area: Average absolute density	0.710
Salamander Project site-specific surveys	Refined Search Area: Average absolute density	0.457
SCANS III	Block R	0.599
SCANS III	Block T (adjacent)	0.402
SCANS IV	Block NS-D	0.5985
SCANS IV	Block NS-E (adjacent)	0.5156
Lacey *et al.* (2022)	Offshore Array Area range (min – max)	0.482 – 0.526
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	0.319

Heinänen and Skov (2015)	Predicted density range for summer 2009 around Offshore Array Area	0.9 – 1.2
Heinänen and Skov (2015)	Predicted density range for winter 2009 around Offshore Array Area	<0.3
MERP	Offshore Array Area range in January	0.215 – 0.255
MERP	Offshore Array Area range in July	0.355 – 0.426
Berwick Bank Offshore Wind Farm	Offshore Array Area + 16 km buffer (average)	0.299
Green Volt Offshore Wind Farm	Offshore Array Area + 4 km buffer (average)	0.76

5 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 27). 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 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 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 13).

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”.

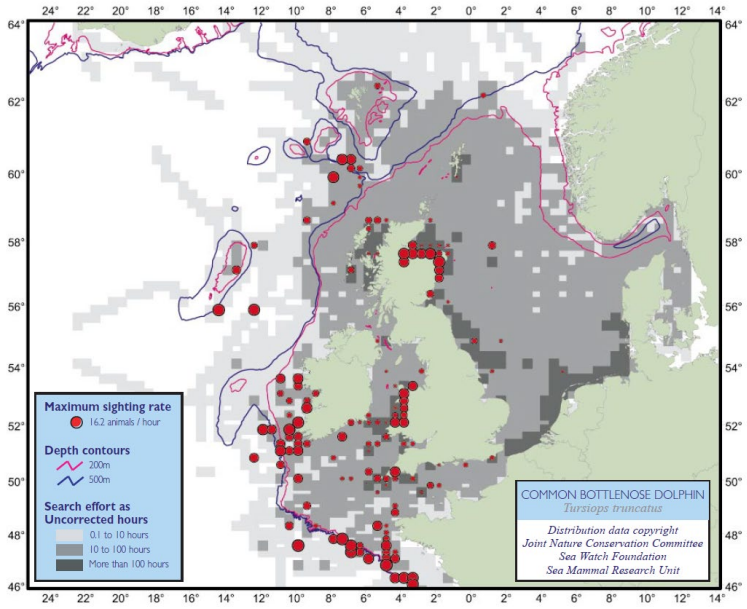

Figure 27 Bottlenose dolphin distribution map of effort-related sightings (Reid *et al.*, 2003).

5.1 Management Unit

The Project site boundary is located within two bottlenose dolphin MUs: the Offshore Array Area and most of the Offshore Export Cable Corridor is in the Greater North Sea MU, while the coastal part of the Offshore Export Cable Corridor is in the Coastal East Scotland MU (Figure 1). The Greater North Sea MU population are considered 'offshore bottlenose dolphins' and the Coastal East Scotland MU are considered the 'coastal protected east coast Scotland population'. The population estimate for the Greater North Sea 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 Coastal East Scotland MU is 224 dolphins (95% CI: 214 – 234, CV: 0.02) (Arso Civil *et al.*, 2021, IAMMWG, 2023).

5.2 Site-specific surveys

In both years of the Salamander Project site-specific surveys, no bottlenose dolphins were identified, and therefore, no density estimate is available from these data.

5.3 Small Cetaceans in European Atlantic waters and the North Sea III and IV

Salamander Project 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 Section5.7.

No bottlenose dolphins were sighted within the SCANS IV survey block NS-D, where Salamander Project is located or in the adjacent survey block NS-E (Gilles *et al.*, 2023).

Lacey *et al.* (2022) used the SCANS III data and spatially referenced environmental features to predict density estimates for bottlenose dolphins (Figure 28). 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 Salamander Project Offshore Array Area is 0.0038 – 0.0062 dolphins/km^2.

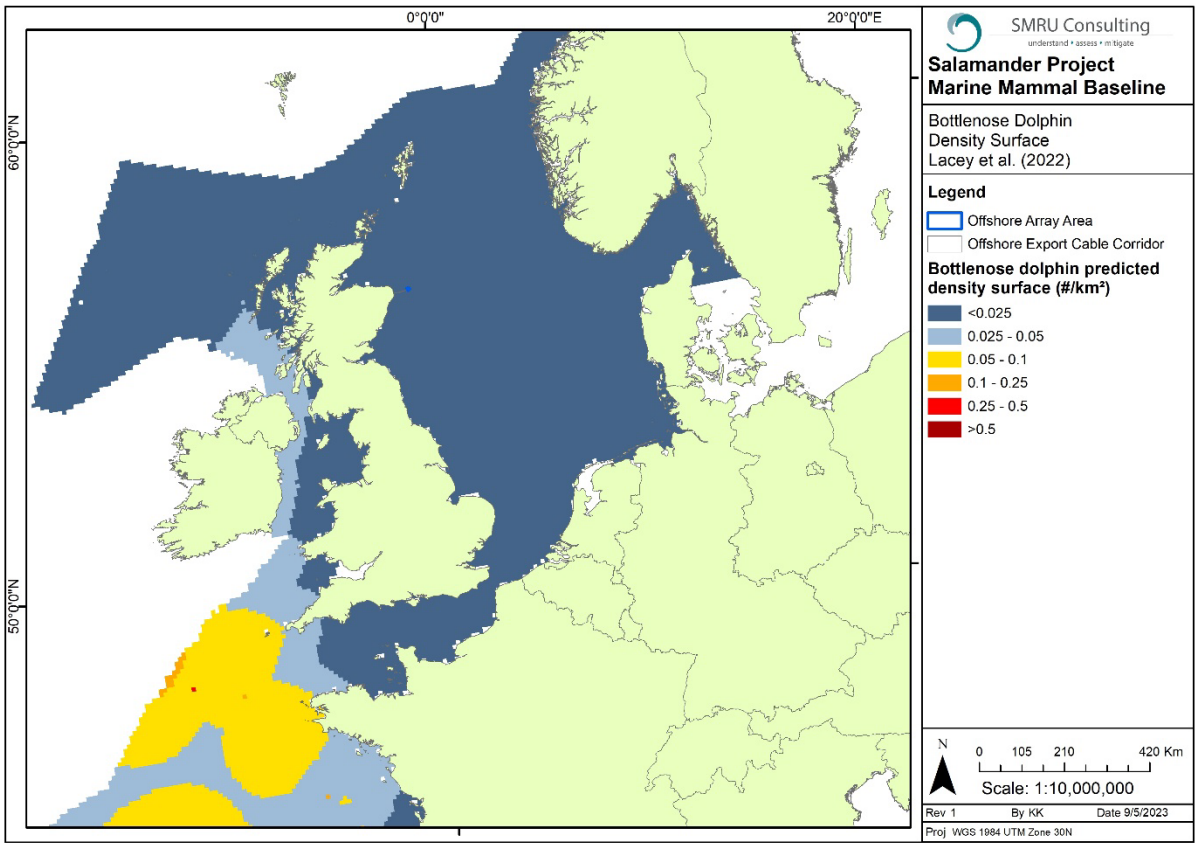

Figure 28 Predicted surface of estimated density for bottlenose dolphin in SCANS III. Figure from Lacey *et al.* (2022).

5.4 Joint Cetacean Protocol Phase III Analysis

Paxton *et al.* (2016) produced predicted bottlenose dolphin densities for summer 2010. The point surface (Figure 29) 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 Salamander Project 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 and an average of 0.027 bottlenose dolphin/km^2 over the year (Table 8).

In the user specified area, the JCP Data Tool estimated an average bottlenose dolphin density for summer 2007-2010 of 0.022 dolphins/km^2 (CI: 0.014 – 0.026).

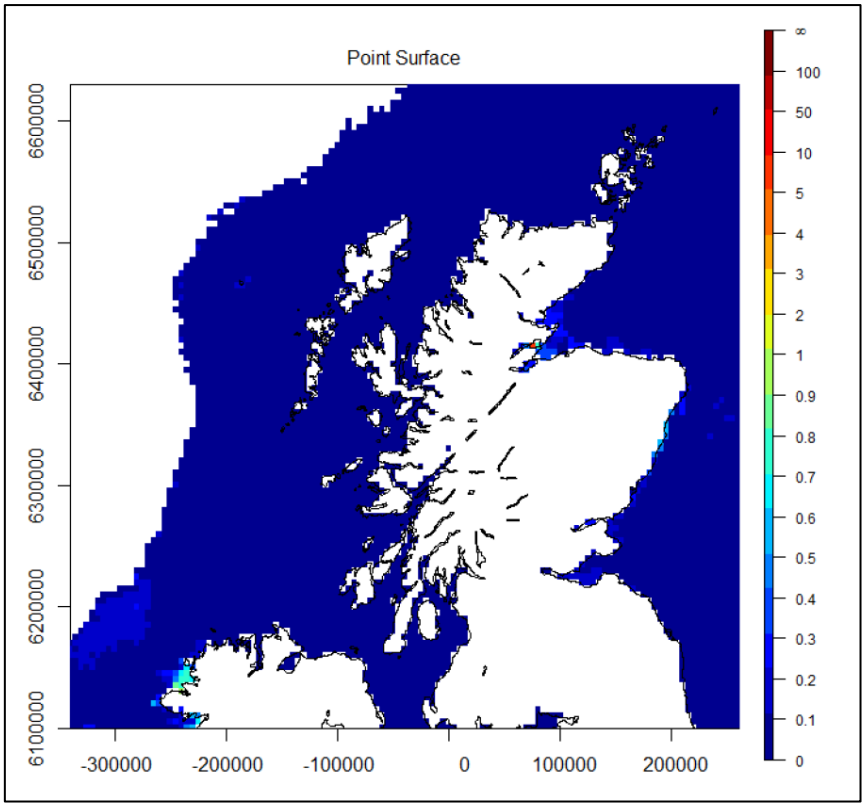

Figure 29 Predicted bottlenose dolphin densities for the northern British Isles for summer 2010 (Paxton *et al.*, 2016). Point estimate of cell densities (bottlenose dolphins/km^2), x-axis represents easting and the y-axis represents northing.

Table 8 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**

In the user specified area (Figure 7), the JCP Data Tool density, the averaged abundance estimate for summer 2007-2010 estimate for bottlenose dolphins was 0.022 dolphins/km^2 (CI: 0.014 – 0.026).

5.5 Marine Ecosystem Research Project

Density maps were produced by Waggitt *et al.* (2020) 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 Offshore Array Area is 0.003 dolphins/km^2 for January and July and the minimum density for grid cells within the Offshore Array Area is 0.001 dolphins/km^2 for January and July (Figure 30).

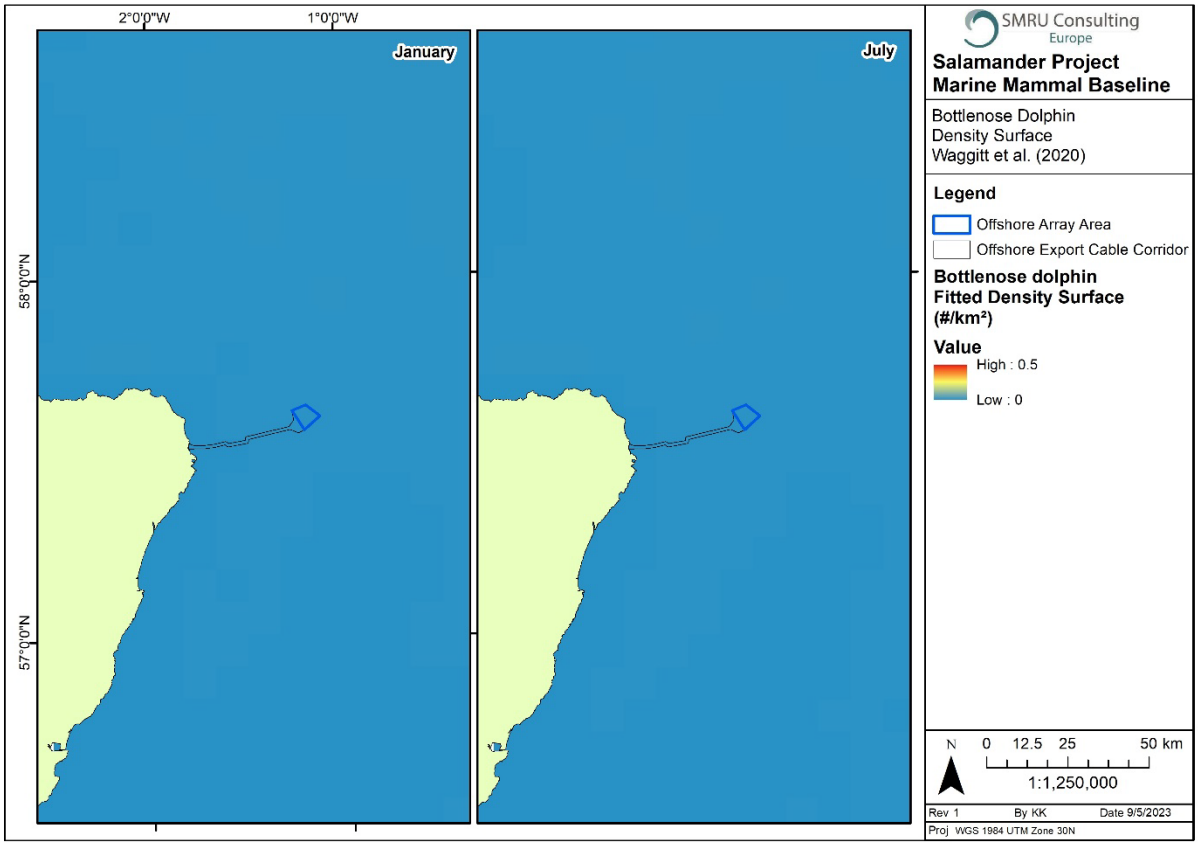

Figure 30 Bottlenose dolphin density surface (#/km^2) for January and July. Data from Waggitt *et al.* (2020).

5.6 The East Coast Marine Mammal Acoustic Study

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 detection positive days (DPD) per year (Table 9) and average detection positive hours (DPH) per year (Table 10) presented below. Data have also been visualised for DPH across each of the stations at the Cruden Bay (Figure 31) and Fraserburgh (Figure 32) 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 31) and Fraserburgh (Figure 32) 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 9, Table 10).

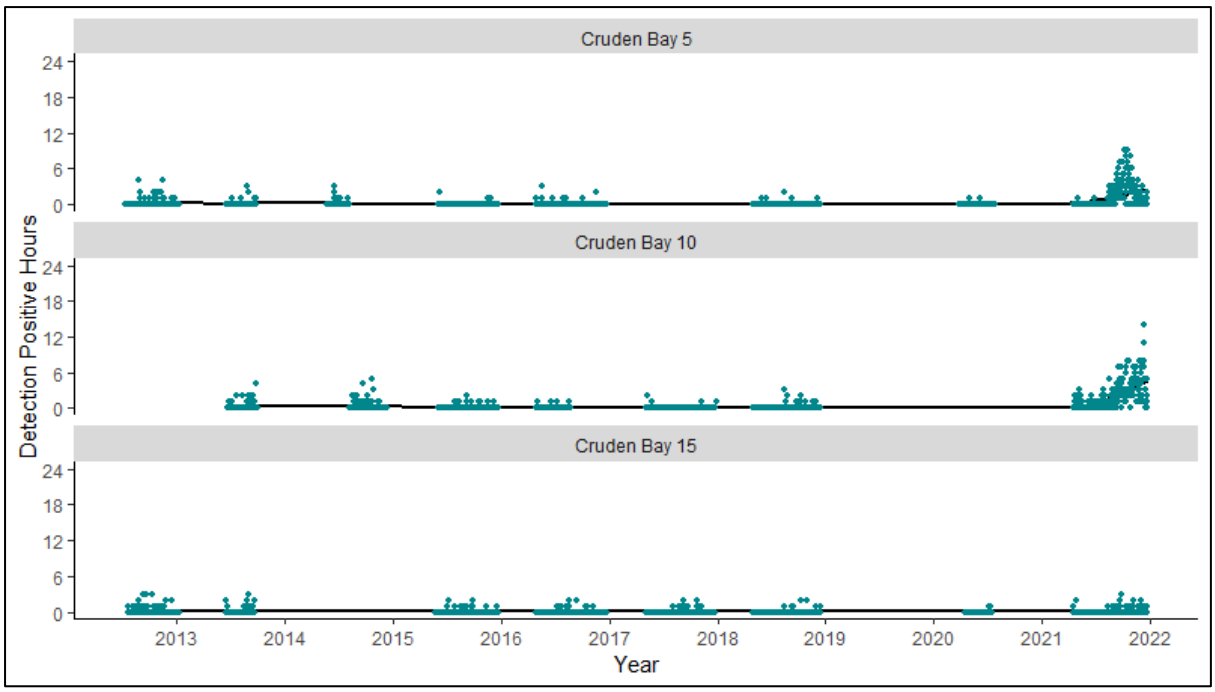

Figure 31 Dolphin detection positive hours (DPH) at the Cruden Bay ECOMMAS stations from 2013 – 2022. CPOD data provided by Marine Scotland.

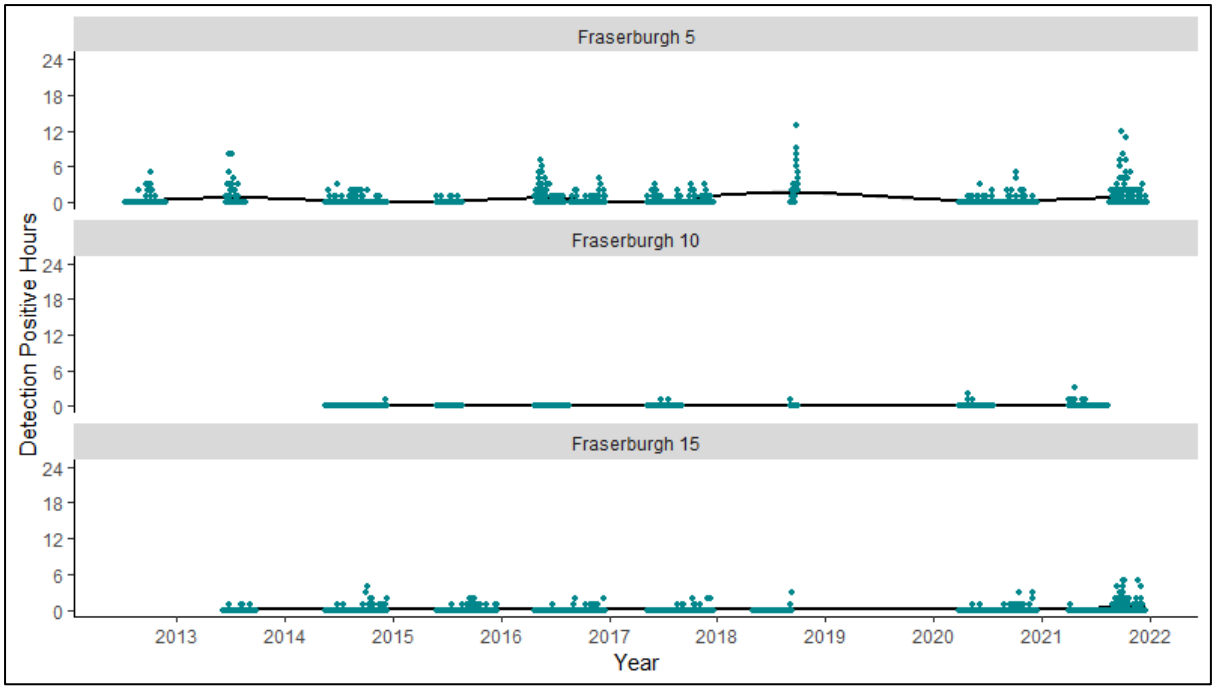

Figure 32 Dolphin detection positive hours (DPH) at the Fraserburgh ECOMMAS stations from 2013 – 2022. CPOD data provided by Marine Scotland.

Table 9 Percentage (%) of dolphin detection positive days at the Cruden Bay and Fraserburgh ECOMMAS sites per year. ("-" denotes no data). CPOD data provided by Marine Scotland.

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 10 Mean dolphin detection positive hours at the Cruden Bay and Fraserburgh ECOMMAS sites per year. ("-" denotes no data). CPOD data provided by Marine Scotland.

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**

5.7 Bottlenose dolphin surveys

Quick *et al.* (2014) estimated the abundance of bottlenose dolphins from 2012 – 2013 within an area spanning from the Firth of Forth to Aberdeen, utilising photo-identification data. All encounters of each 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, reporting 118 (95% CI: 98 – 143) and 119 (95% CI: 101 – 140) for 2012 and 2013 respectively. This estimate was more than 60% higher than that of 88 individuals estimated by Cheney *et al.* (2013) for 2006, and 93 for 2007 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. This study estimated the size of the overall Scottish East coast population for

the time-period 2009-2019. The current estimated population size of the overall Coastal East Scotland population is 224 individuals with a 95% confidence interval of 214-234.

In terms of the home ranges for bottlenose dolphins in this area, it has been found that individuals move outside of this area, mainly southwards from the Moray Firth SAC, to the Firth of Forth (Quick *et al.*, 2014, Arso Civil *et al.*, 2019, Arso Civil *et al.*, 2021). Therefore, it must be considered that a large proportion of the East coast of Scotland bottlenose dolphin population have a wide habitat range.

5.8 Other Offshore Wind Farms

5.8.1 Berwick Bank

Bottlenose dolphins were sighted on two of the monthly surveys, resulting in a total of seven bottlenose dolphin sightings (RPS, 2022). 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.

5.8.2 Caledonia

No data are available for this project yet.

5.8.3 Green Volt

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).

5.8.4 Muir Mhor

The site-specific surveys at Muir Mhor did not detect any bottlenose dolphins, although a total of 89 sightings of unidentified seal and/or cetacean species were made, some of which may have been bottlenose dolphins (Muir Mhor, 2023).

5.8.5 Seagreen

No data are available from post-consent surveys for this project yet.

5.9 Assumed density estimates

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

1) Assume a uniform density across the GNS MU;
2) Assume a uniform density across the CES MU;
3) Assume a uniform density within 2 km of the mainland coast in the CES MU;
4) Assume a uniform density within the 25 m depth contour from the mainland coast in the CES MU.

5.9.1 Greater North Sea (GNS) MU

The majority of the Salamander Project is located within the GNS MU for bottlenose dolphins. According to the 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. Thus, the only possible density estimate that can be assumed using these data is to assume that bottlenose dolphins are uniformly (evenly) distributed across the entire MU. This results in a uniform density estimate of 0.003 dolphins/km^2 across the GNS MU.

5.9.2 Coastal East Scotland (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. Assuming that bottlenose dolphins are uniformly distributed throughout the CES MU, the resulting density estimate is 0.010 dolphins/km^2.

5.9.3 2 km from the coast and within the 25 m depth contour

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 0.110 dolphins/km^2 within 2 km from the mainland coast in the CES MU.

Additionally, to be conservative, it was assumed that bottlenose dolphins are located within the 25 m depth contour of the Scottish mainland within the CES MU (slightly further than the reported 20 m depth contour). Assuming that bottlenose dolphins were uniformly distributed, this results in a density estimate of 0.104 dolphins/km^2 within the 25 m depth contour in the CES MU.

5.9.4 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, it is currently the only way to estimate potential densities in the vicinity of the Project in the absence of any other reliable density data.

5.10 Bottlenose dolphin summary

Bottlenose dolphin density estimates are relatively low in the East coast of Scotland (Table 11). An 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). 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: 0.110 dolphins/km^2 within 2 km of the coast and 0.003 dolphins/km^2 beyond that. This approach allows the quantitative assessment to differentiate between higher densities at the coast and lower densities further offshore.

Table 11 Summary table of the available density estimates for bottlenose dolphin.

Source	Details	Density estimate (#/km^2)
Salamander Project site-specific surveys	Average density	No bottlenose dolphins sighted
SCANS III	Block R	0.0023
SCANS III	Block T (adjacent)	No bottlenose dolphins sighted

SCANS IV	Block NS-D	No bottlenose dolphins sighted
SCANS IV	Block NS-E (adjacent)	No bottlenose dolphins sighted
Lacey *et al.* (2022)	Offshore Array Area range (min – max)	0.0038 – 0.0062
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	0.022
MERP	Offshore Array Area range in January and July	0.001 – 0.003
GNS MU	Uniform density across GNS MU	0.003
CES MU	Uniform density across CES MU	0.010
CES MU – 2 km	Uniform density within 2 km from the coast in the CES MU	0.110
CES MU – 25 m	Uniform density within 25 m depth contour in the CES MU	0.104

6 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 to 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 33). 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 to 0.316 in Scottish waters (Hammond *et al.*, 2021).

The conservation status of white-beaked dolphin 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".

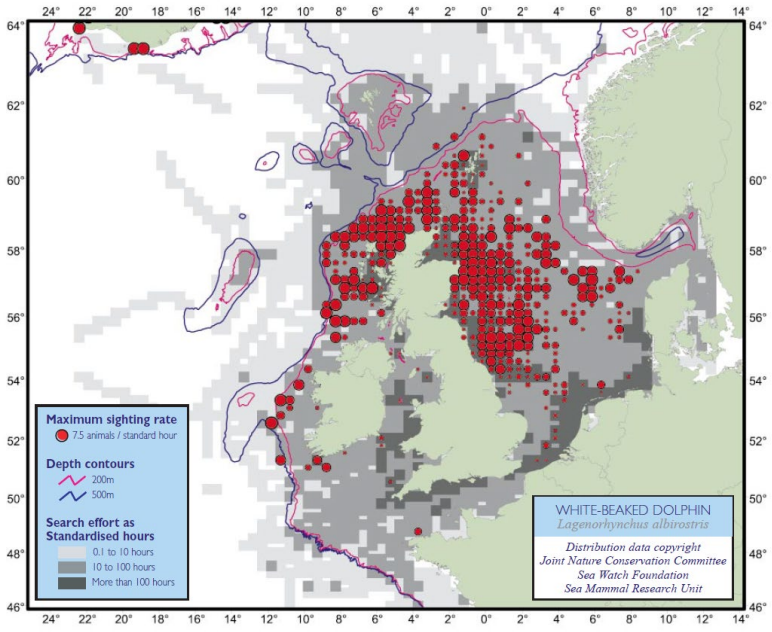

Figure 33 White-beaked dolphin distribution map of effort-related sightings (Reid *et al.*, 2003).

6.1 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.

6.2 Site-specific surveys

In both years of the site-specific surveys, no white-beaked dolphins were identified, and therefore, no density estimate is available from these data.

6.3 Small Cetaceans in European Atlantic waters and the North Sea III and IV

Salamander Project 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).

Salamander Project is located within the SCANS IV survey block NS-D with 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 dolphins/km^2 in summer 2022 (CV = 0.481) (Gilles *et al.*, 2023). Abundance (11,611, 95% CI: 3,875 – 21,601) and density (0.1775 white-beaked dolphins/km^2, CV = 0.383) in the neighbouring block NS-E was significantly higher than in the block NS-D, contrary to what was reported in SCANS III.

Lacey *et al.* (2022) used the SCANS III data and spatially referenced environmental features to predict density estimates for white-beaked dolphins (Figure 34). The highest densities were predicted further offshore off the east Scotland and off the north/northwest 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 Offshore Array Area is 0.208 – 0.385 dolphins/km^2.

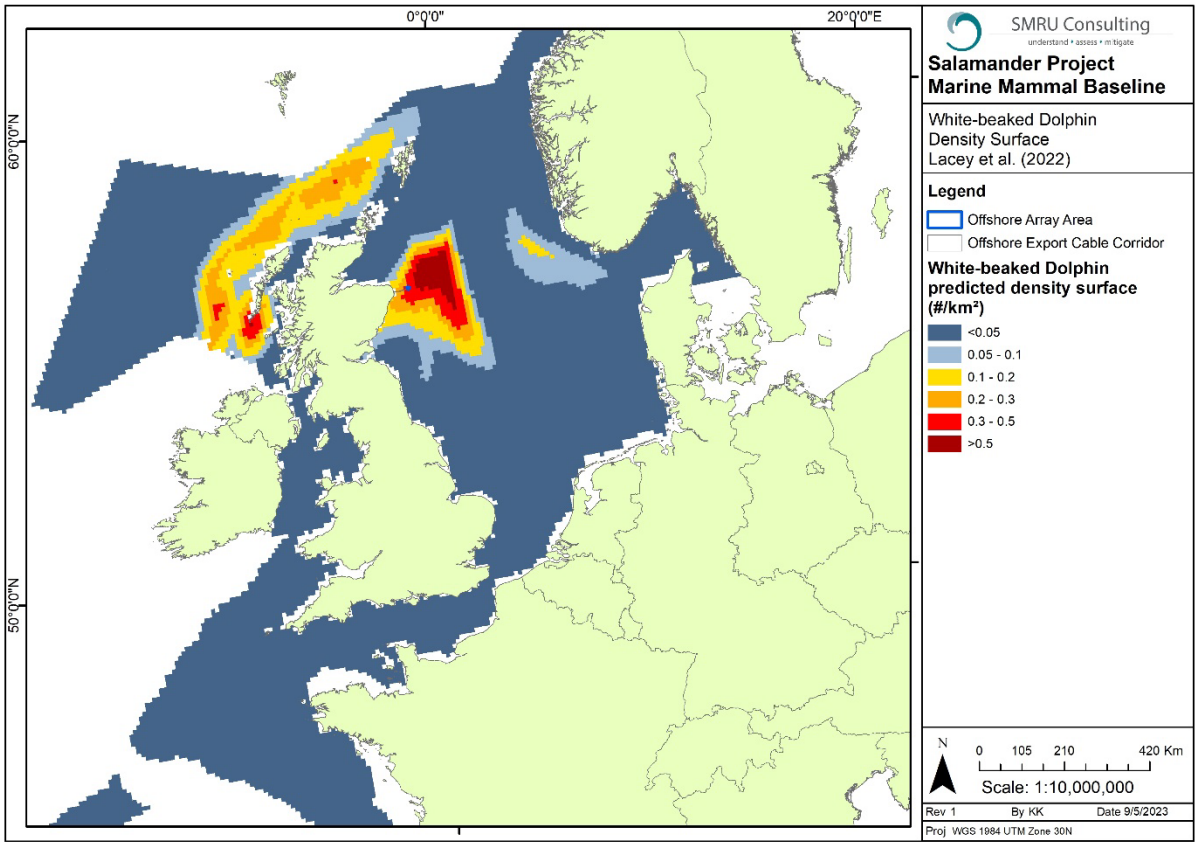

Figure 34 Predicted surface of estimated density for white-beaked dolphin in SCANS III. Figure from Lacey *et al.* (2022).

6.4 Joint Cetacean Protocol Phase III Analysis

Paxton *et al.* (2016) produced predicted white-beaked dolphin densities for summer 2010 (Figure 35). 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 Salamander Project 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 and an average of 0.060 white-beaked dolphins/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 and an average of 0.011 white-beaked dolphins/km^2 over the year (Table 12).

In the user specified area, the JCP Data Tool estimated an averaged white-beaked dolphin density for summer 2007-2010 of 0.116 dolphins/km^2 (CI: 0.003 – 0.137).

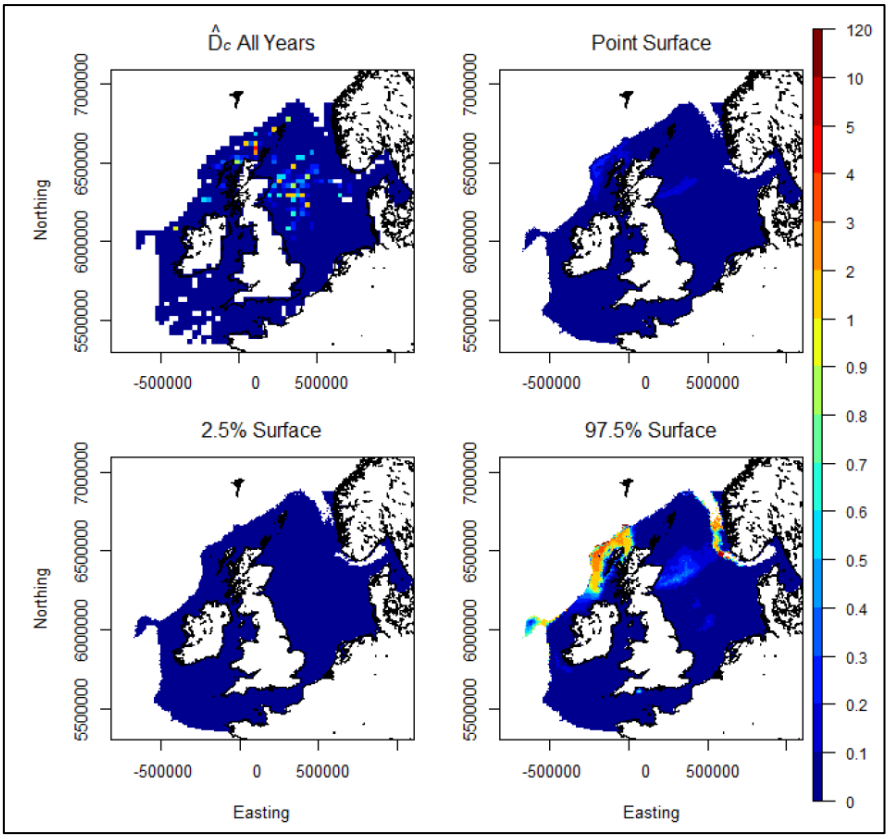

Figure 35 Predicted white-beaked dolphin densities for summer 2010 (Paxton *et al.*, 2016). Top left; input densities (summer all years), top right; point estimate of cell densities, bottom left; lower (2.5%) confidence limit on cell densities, bottom right; upper (97.5%) confidence limit on cell densities (white-beaked dolphins/km^2). Note that the top left plot exaggerates the spatial coverage of the relevant effort.

Table 12 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**

6.5 Marine Ecosystem Research Project

Density maps of white-beaked dolphins produced by Waggitt *et al.* (2020) predicted the highest densities in the north of the UK. The densities around east Scotland vary seasonally but are moderately high year-round. The maximum white-beaked dolphin density for grid cells within the Offshore Array

Area is 0.057/km^2 for January and 0.132/km^2 for July. The minimum density for grid cells within the Offshore Array Area is 0.030/km^2 for January and 0.070/km^2 for July (Figure 36).

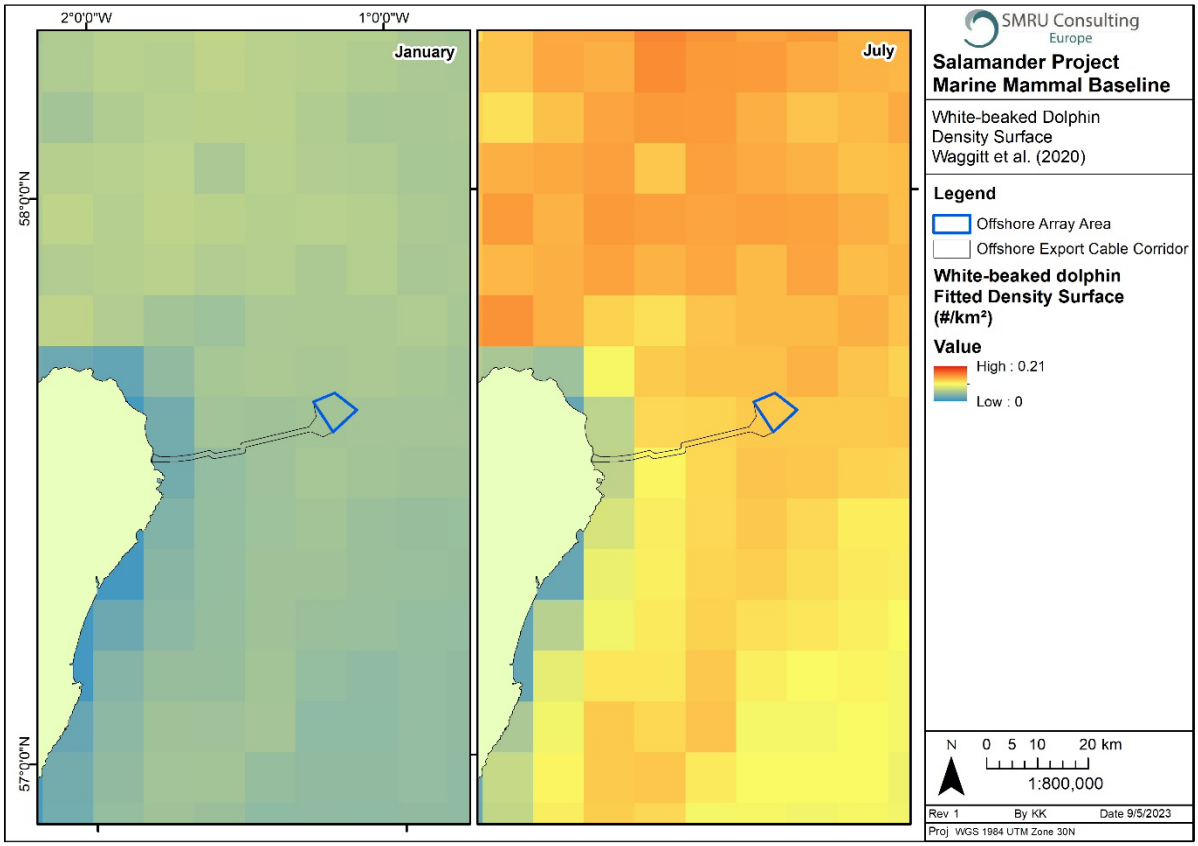

Figure 36 White-beaked dolphin density surface (#/km^2) for January and July. Data from Waggitt *et al.* (2020).

6.6 The East Coast Marine Mammal Acoustic Study

The ECOMMAS data presented consists of CPOD data collected from 2013 – 2022 (data for 2020 absent due to Covid-19 restrictions, preventing field work from occurring). Delphinid species were identified across most sites, with calculations of detection positive days (DPD) per year (Table 9) and average detection positive hours (DPH) per year (Table 10) presented below. Data have also been visualised for DPH across each of the stations at the Cruden Bay (Figure 31) and Fraserburgh (Figure 32) 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 31) and Fraserburgh (Figure 32) 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 9, Table 10).

6.7 Other Offshore Wind Farms

6.7.1 Berwick Bank

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, 2022). The mean corrected density of white-beaked dolphins across all surveys at the site was 0.050 dolphins/km^2.

6.7.2 Caledonia

No data are available for this project yet.

6.7.3 Green Volt

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).

6.7.4 Muir Mhor

The site-specific surveys at Muir Mhor recorded white-beaked dolphins during six of the surveys, resulting in a total of 37 sightings (Muir Mhor, 2023). No density estimate is available yet.

6.7.5 Seagreen

No data are available from post-consent surveys for this project yet.

6.8 White-beaked dolphin summary

Whilst white-beaked dolphins were not sighted during the Salamander Project site-specific surveys, it is the recommendation of SMRU Consulting that this species is scoped into the quantitative impact assessment. Previous surveys have concluded consistent densities of this species in the surrounding areas (Table 13), with increased densities during the summer months, demonstrating seasonal variation. It is recommended that the SCANS III modelled density surface 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 13 Summary table of the available density estimates for white-beaked dolphin.

Source	Details	Density estimate (#/km^2)
Salamander Project site-specific surveys	Average density	None sighted
SCANS III	Block R	0.243
SCANS III	Block T (adjacent)	0.037
SCANS IV	Block NS-D	0.0799
SCANS IV	Block NS-T (adjacent)	0.1775
Lacey *et al.* (2022)	Offshore Array Area range (min – max)	0.208 – 0.385
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	0.116
MERP	Offshore Array Area range in January	0.030 - 0.057
MERP	Offshore Array Area range in July	0.070 - 0.132
Berwick Bank Offshore Wind Farm	Offshore Array Area plus 16 km buffer	0.050

7 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 parts of the UK (Figure 37), including the east coast of Scotland (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 (2019h) 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 Marine Protected Area (MPA) in Scottish waters: Southern Trench MPA (Figure 13).

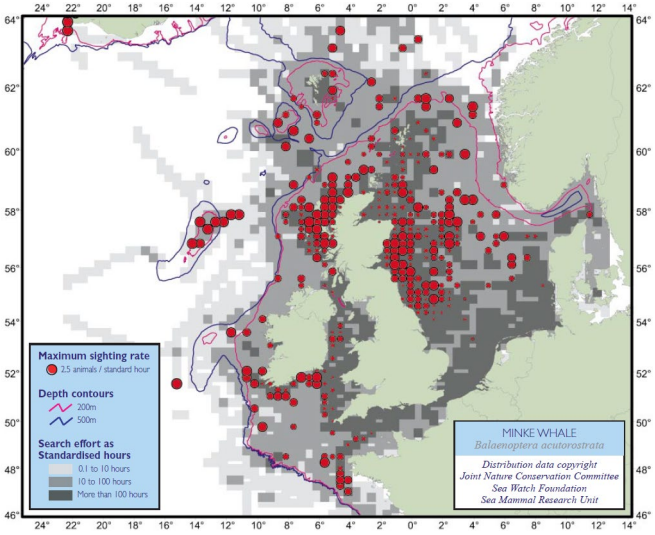

Figure 37 Minke whale distribution map of effort-related sightings (Reid *et al.*, 2003).

7.1 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).

7.2 Site-specific surveys

A total of three minke whales were recorded throughout the entire survey period in June, October and December 2021 (HiDef Aerial Surveying Limited, 2023). The maximum relative density estimate for minke whales in the survey area was 0.02 whales/km^2. The maximum relative density estimate for minke whales in the Salamander Refined Area of Search was 0.26 whales/km^2 in June 2021.

7.3 Small Cetaceans in European Atlantic waters and the North Sea III and IV

Salamander Project 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).

Salamander Project is located within the SCANS IV survey block NS-D with an estimated block-wide abundance of 2,702 minke whales (95% CI: 547 – 7,357) and an estimated density of 0.0419 minke whales/km^2 in summer 2022 (CV = 0.594) (Gilles *et al.*, 2023). Abundance (795, 95% CI: 3 – 2,673) and density (0.0121 minke whales/km^2, CV = 0.724) in the neighbouring block NS-E was lower than in the block NS-D.

Lacey *et al.* (2022) used the SCANS III data and spatially referenced environmental features to predict density estimates for minke whales (Figure 38). The resulting predicted density map shows higher values in the eastern part of the North Sea, around north of Scotland and northern Irish Sea. The density range for grid cells within the Offshore Array Area is 0.017 – 0.021 minke whale/km^2.

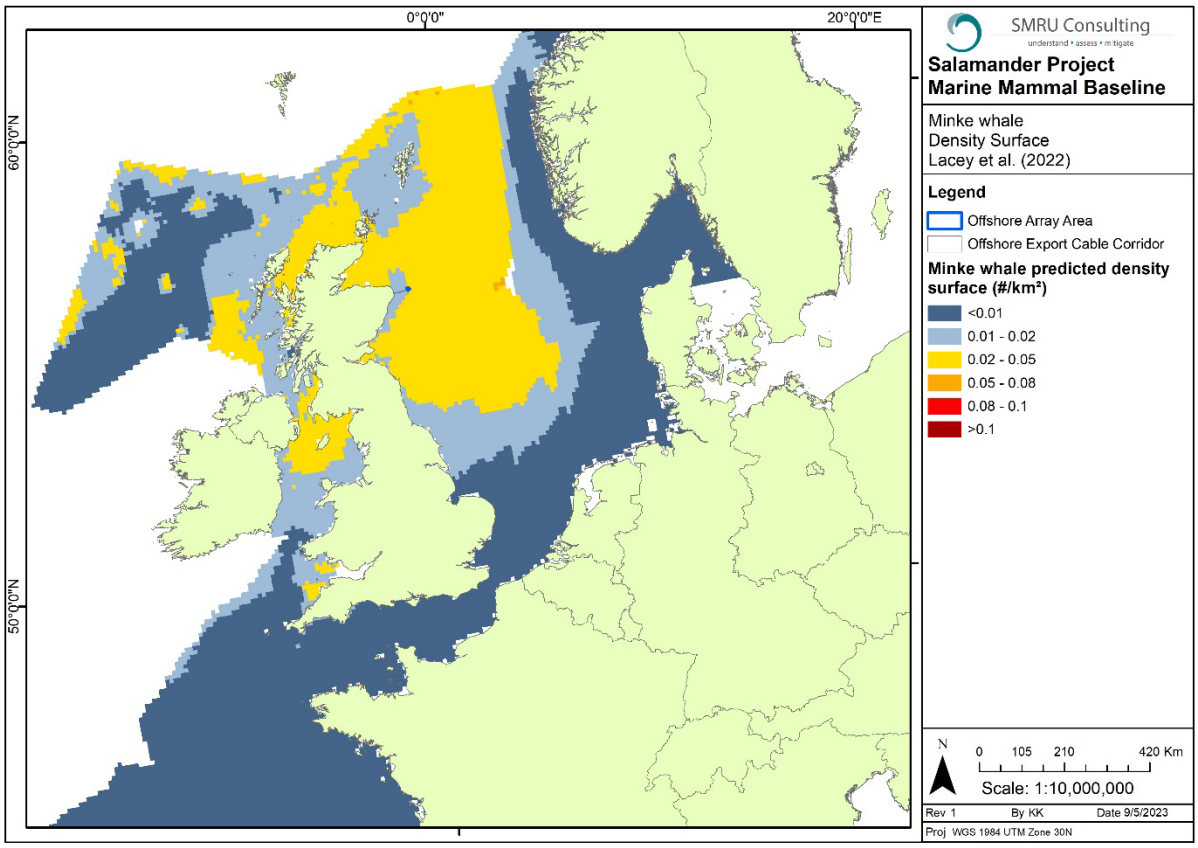

Figure 38 Predicted surface of estimated density for minke whale in SCANS III. Figure from Lacey *et al.* (2022).

7.4 Joint Cetacean Protocol Phase III Analysis

Paxton *et al.* (2016) produced predicted minke whale densities for summer 2010 (Figure 39). 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 Salamander Project 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 14).

In the user specified area, the JCP Data Tool estimated an averaged minke whale density for summer 2007-2010 of 0.016 whales/km^2 (CI: 0.007 – 0.019).

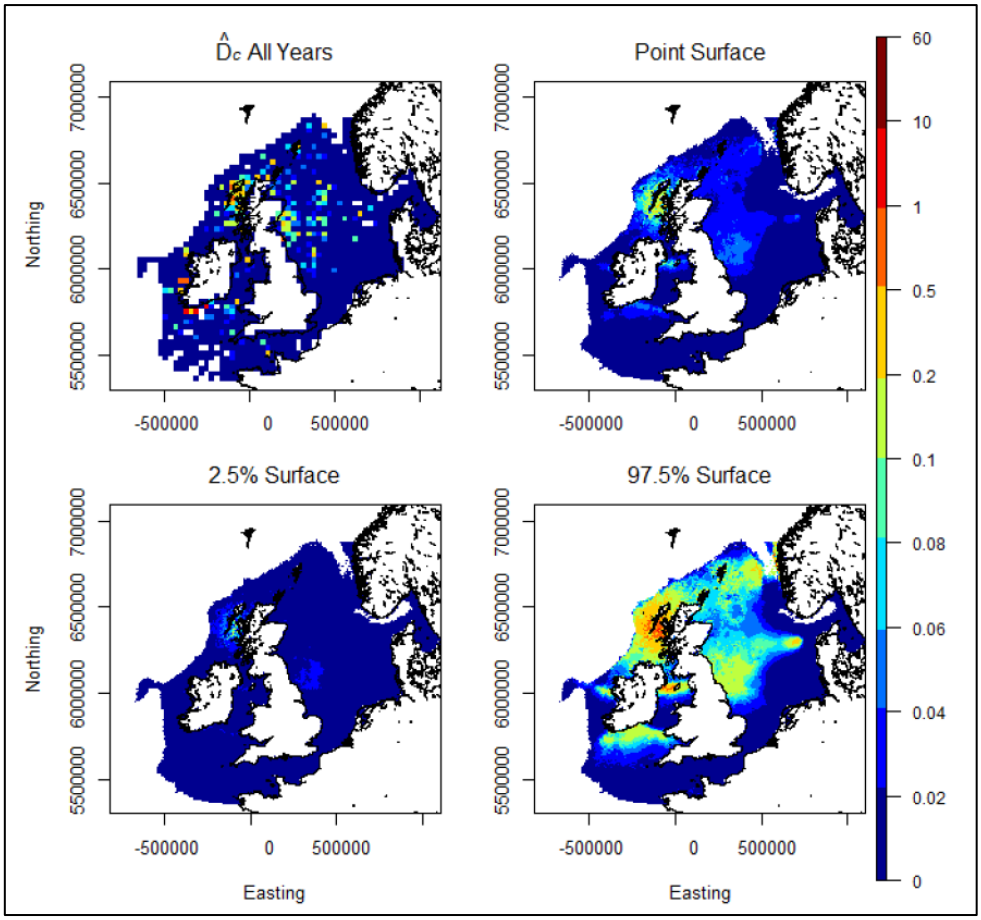

Figure 39 Predicted minke whale densities for summer 2010 (Paxton *et al.*, 2016). Top left; input densities (summer all years), top right; point estimate of cell densities, bottom left; lower (2.5%) confidence limit on cell densities, bottom right; upper (97.5%) confidence limit on cell densities (minke whale/km^2). Note that the top left plot exaggerates the spatial coverage of the relevant effort.

Table 14 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**

7.5 Marine Ecosystem Research Project

Minke whale density maps produced by Waggitt *et al.* (2020) as part of the MERP project show moderate densities in Scottish waters. Salamander Project Offshore Export Cable Corridor intersects the Southern Trench MPA (Figure 13), which was established because of minke whales, however the maximum minke whale density for grid cells within the Offshore Array Area is 0.007 whales/km^2 for January and 0.020 whales/km^2 for July. The minimum density for grid cells within the Offshore Array Area is 0.004 whales/km^2 for January and 0.009 whales/km^2 for July (Figure 40). These maps are not considered to be suitable for quantitative impact assessments and are provided in this baseline characterisation for illustrative purposes only.

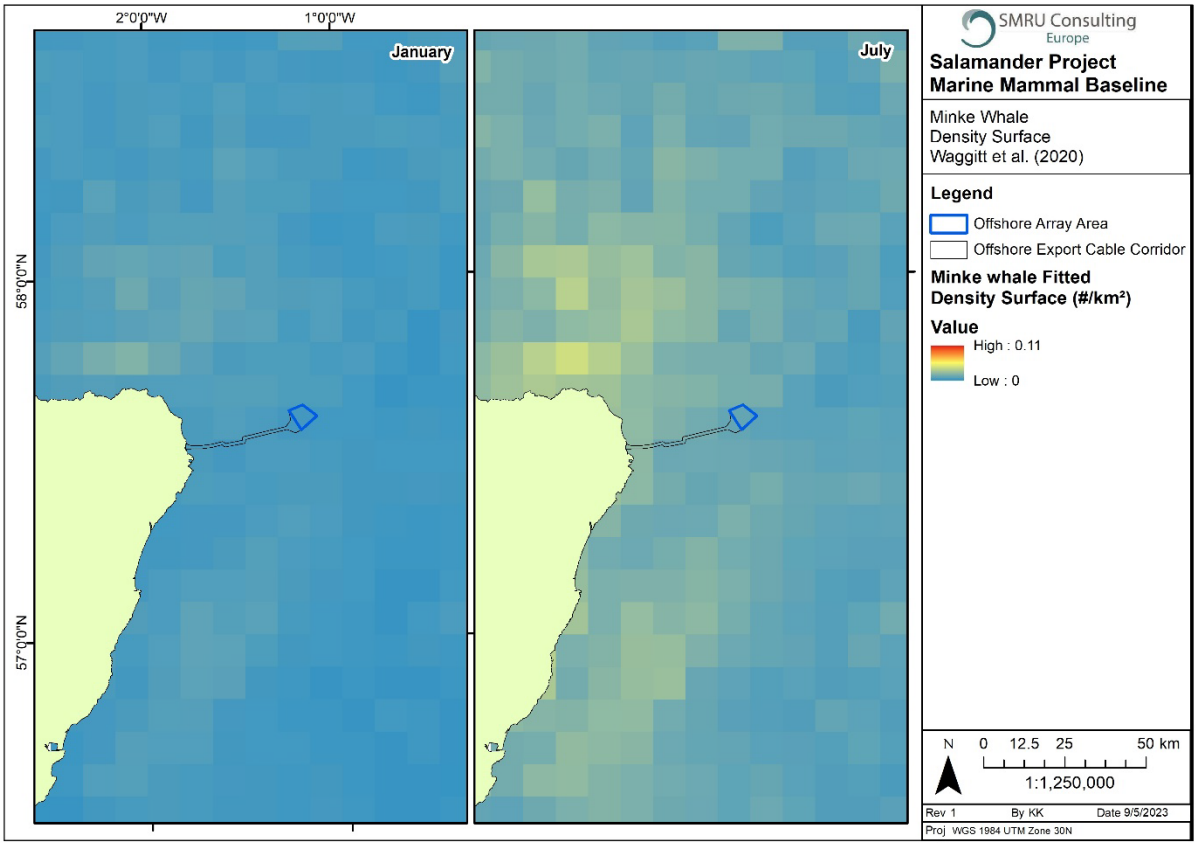

Figure 40 Minke whale density surface (#/km^2) for January and July. Data from Waggitt *et al.* (2020).

7.6 Southern Trench Marine Protected Area

The Southern Trench MPA was designated in December 2020 and one of the primary reasons for designation was minke whales. This site shows a continuous support of higher than average densities of minke whales compared to other UK sites (Figure 41), providing feeding grounds for juveniles and adults (NatureScot, 2020). The MPA supports the high densities of minke whales in the majority of the designated area, with the densities decreasing towards the more southern part of the MPA, just east of Fraserburgh and Peterhead (Figure 41). The same trend is shown for predicted persistence of above mean densities during summer months. This area of lower density is where the Salamander Project Offshore EEC intersects the Southern Trench MPA (Figure 13).

The density range within the Southern Trench MPA produced by Lacey *et al.* (2022) using SCANS III data was 0 – 0.039 minke whales/km^2. The density range for this area reported by Waggitt *et al.* (2020) 0.009 - 0.039 minke whales/km^2 for July.

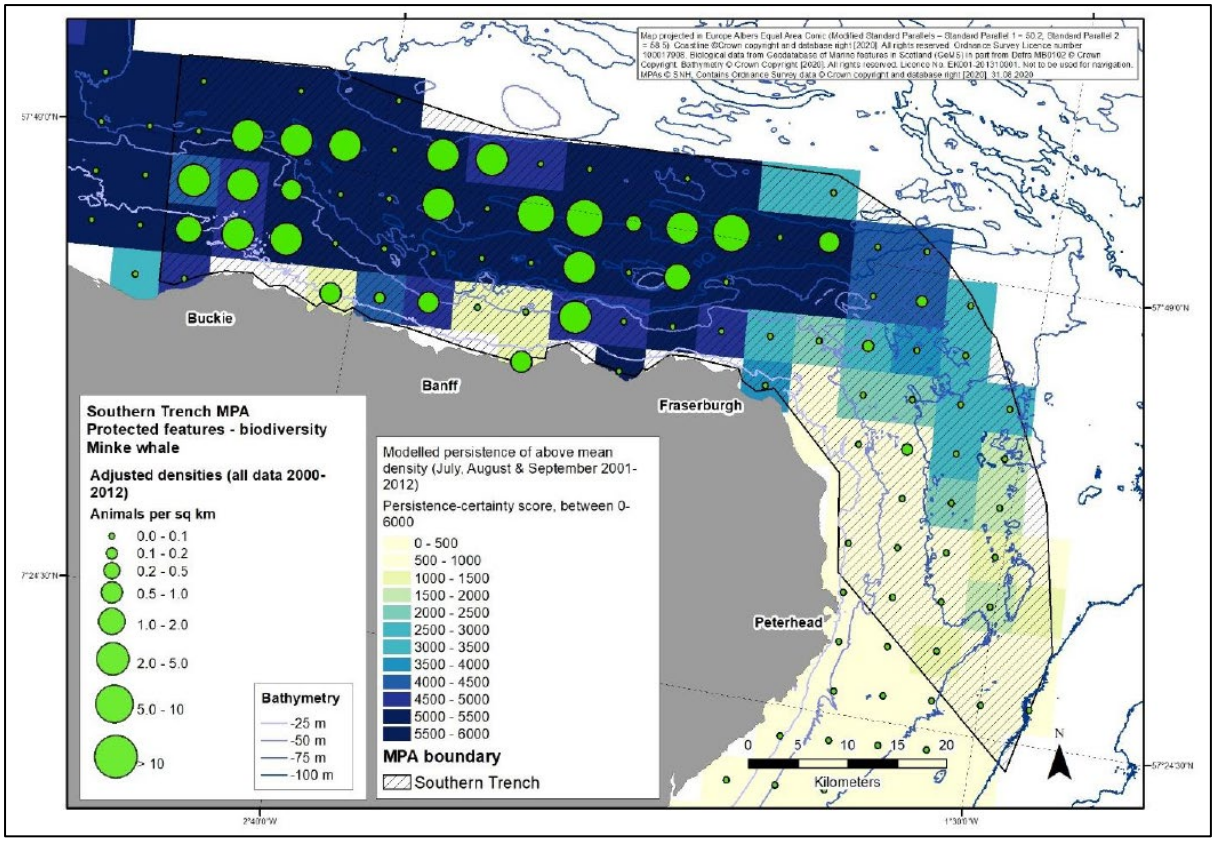

Figure 41 Minke whale densities and predicted persistence of above mean densities in Southern Trench MPA (NatureScot, 2020).

7.7 Other Offshore Wind Farms

7.7.1 Berwick Bank

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

7.7.2 Caledonia

No data are available for this project yet.

7.7.3 Green Volt

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

7.7.4 Muir Mhor

The site-specific surveys at Muir Mhor recorded minke whales during eight of the surveys, resulting in a total of 12 sightings made between April – August 2021 and April – September 2022 (Muir Mhor, 2023). No density estimate is available yet.

7.7.5 Seagreen

No data are available from post-consent surveys for this project yet.

7.8 Minke whale summary

As detailed in Table 15 below, all surveys found low abundances of minke whales, with reported densities ranging from 0.003 – 0.26 whales/km^2. Three minke whales were sighted during the Salamander Project site-specific surveys. 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 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 15 Summary table of the available density estimates for minke whale.

Source	Details	Density estimate (#/km^2)
Salamander Project site-specific surveys	DAS area: Maximum relative density	0.02
Salamander Project site-specific surveys	Refined Search Area: maximum relative density	0.26
SCANS III	Block R	0.0387
SCANS III	Block T (adjacent)	0.0316
SCANS IV	Block NS-D	0.0419
SCANS IV	Block NS-E (adjacent)	0.0121
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
Lacey *et al.* (2022)	Offshore Array Area range (min – max)	0.017 – 0.021
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	0.016
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	Offshore Array Area range in January	0.004 – 0.007
MERP	Offshore Array Area range in July	0.009 – 0.020
Berwick Bank Offshore Wind Farm	Offshore Array Area + 16 km buffer average	0.016

8 Harbour seal

Harbour seals are widely distributed around the UK, largely concentrated in the west coast of Scotland and throughout the Hebrides and Northern Isles. On the east coast of the UK, they are concentrated in major estuaries of the Thames, The Wash, the Firths of Forth and Tay, and the Moray Firth. At a UK

level, harbour seals have been assessed as having an Unfavourable – Inadequate Conservation Status, driven by an Unfavourable – Inadequate assessment of both population size and future prospects (JNCC, 2019e).

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

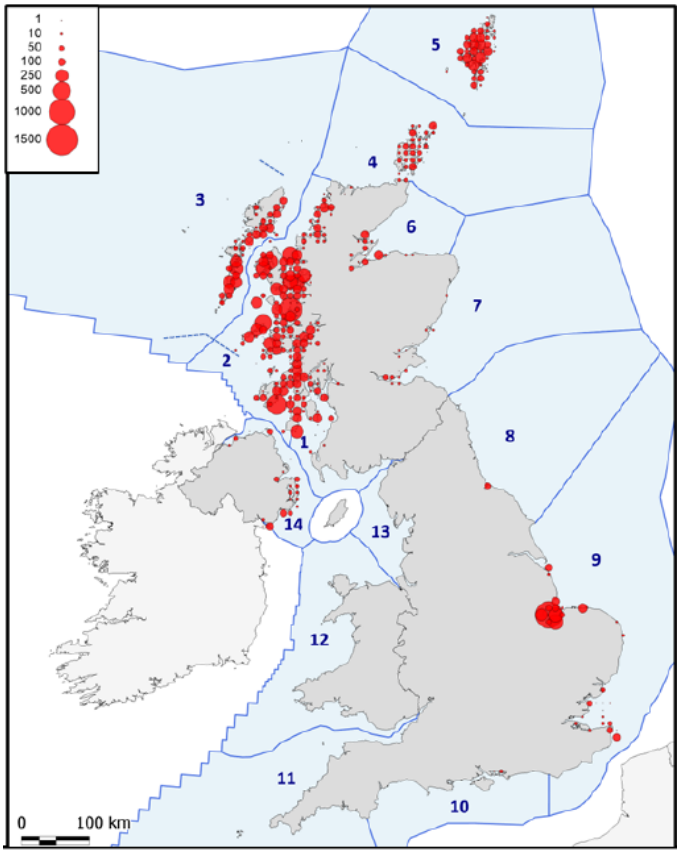

Figure 42 August distribution of harbour seals around the UK by 10km squares based on the most recent available haul-out count data collected up until 2022[2]. Figure taken from SCOS (2023).

8.1 Seal Management Unit

The Salamander Project is located within the East Scotland Seal Management Unit (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 16) 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 16) (SCOS, 2023).

[2] Numbers refer to Seal MUs: 1 Southwest Scotland, 2 West Scotland, 3 Western Isles, 4 North Coast and Orkney, 5 Shetland, 6 Moray Firth, 7 East Scotland, 8 Northeast England, 9 Southeast England, 10 South England, 11 Southwest England, 12 Wales, 13 Northwest England and 14 Northern Ireland.

Table 16 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

8.2 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 43).

The closest haul-out count recorded to the Salamander Project Offshore Export Cable Corridor is at Peterhead, where 11 harbour seals were counted in 2007 (Figure 43). Peterhead was surveyed in 2021 but no harbour seals were recorded. In 2021, the closest harbour seal haul-out site to the Offshore Export Cable Corridor was at the Bridge of Don, which is ~46 km south of the Salamander Project Offshore Export Cable Corridor (Figure 44).

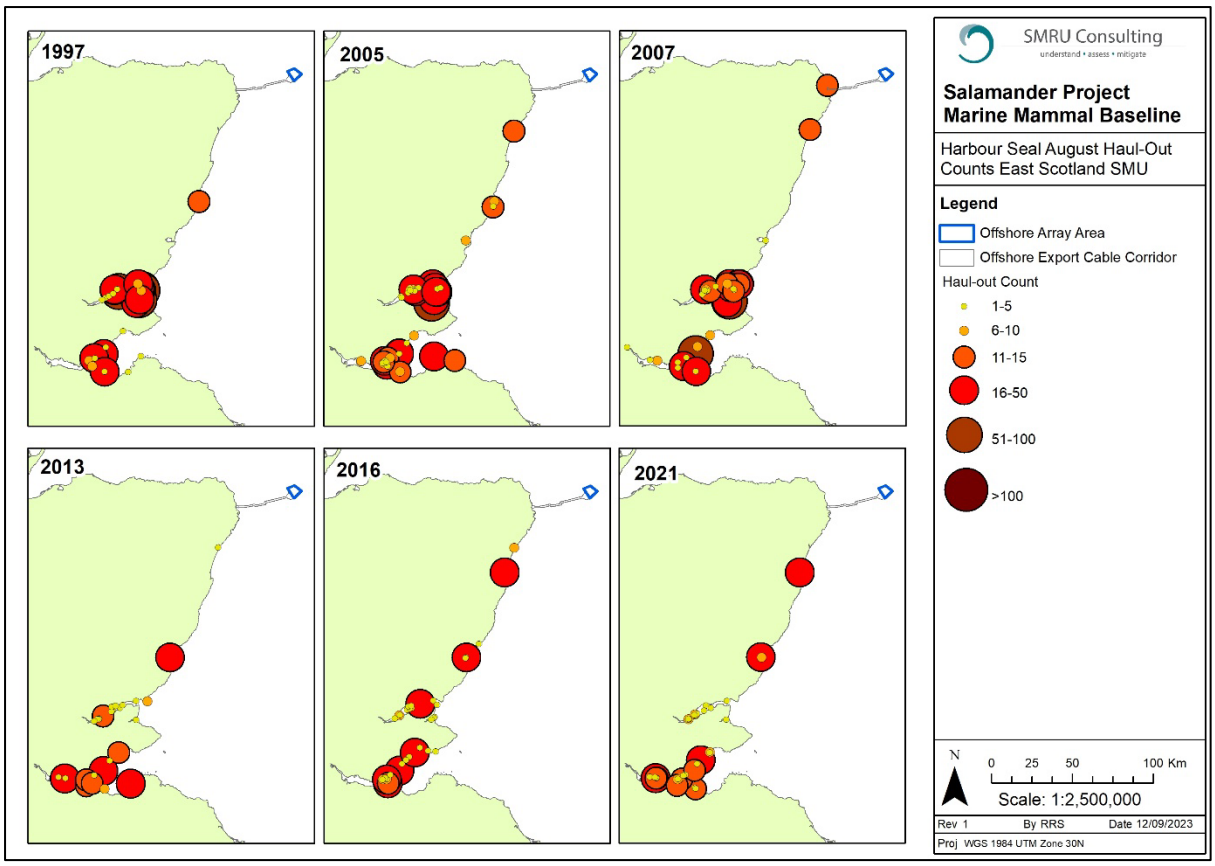

Figure 43 Harbour seal August haul-out counts in the East Scotland SMU between 1997 and 2021. Data provided by SMRU.

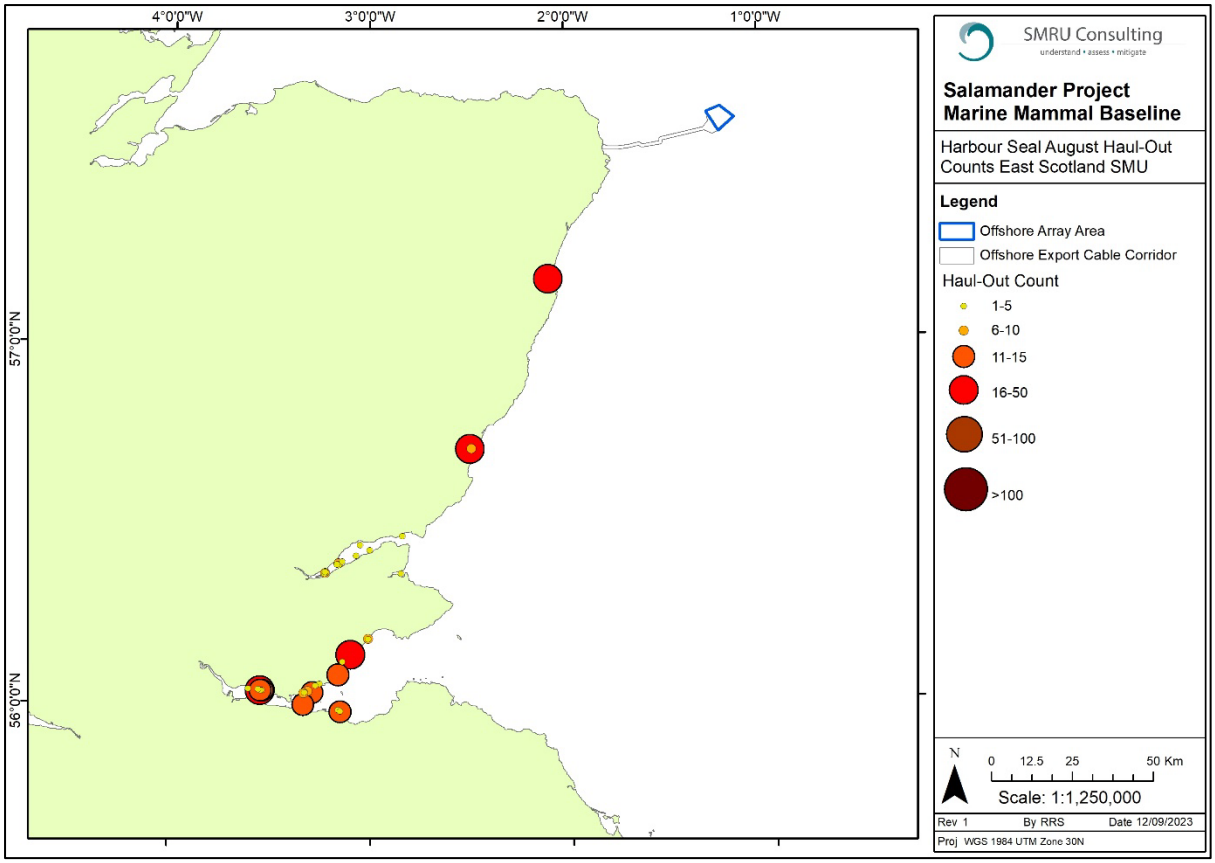

Figure 44 Harbour seal August haul-out counts in the East Scotland SMU in 2021. Data provided by SMRU.

8.3 Telemetry

A total of 50 harbour seals have been tagged by SMRU in the East Scotland SMU between 2001 and 2017 (4 at Abertay, 38 at Eden, 4 at Kirkaldy and 4 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 2 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. 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 Salamander Project area.

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 46). 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 SMUs. However, given the limited number of harbour seals and tagging locations within this telemetry dataset, it is not possible to conclude no connectivity for the wider populations between the two SMUs.

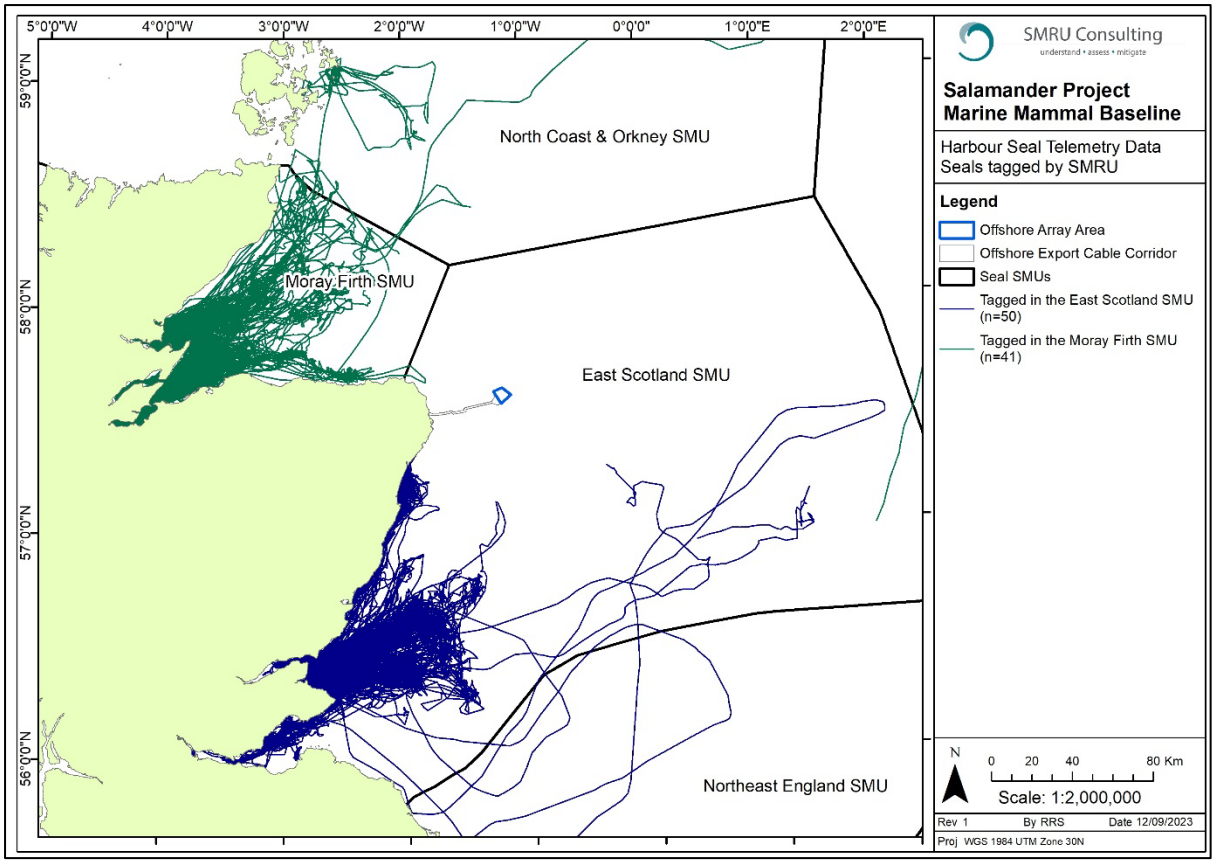

Figure 45 Telemetry data for harbour seals tagged in the East Scotland SMU (n=50) and the Moray Firth SMU (n=41) by SMRU between 2001 and 2015. Data provided by SMRU.

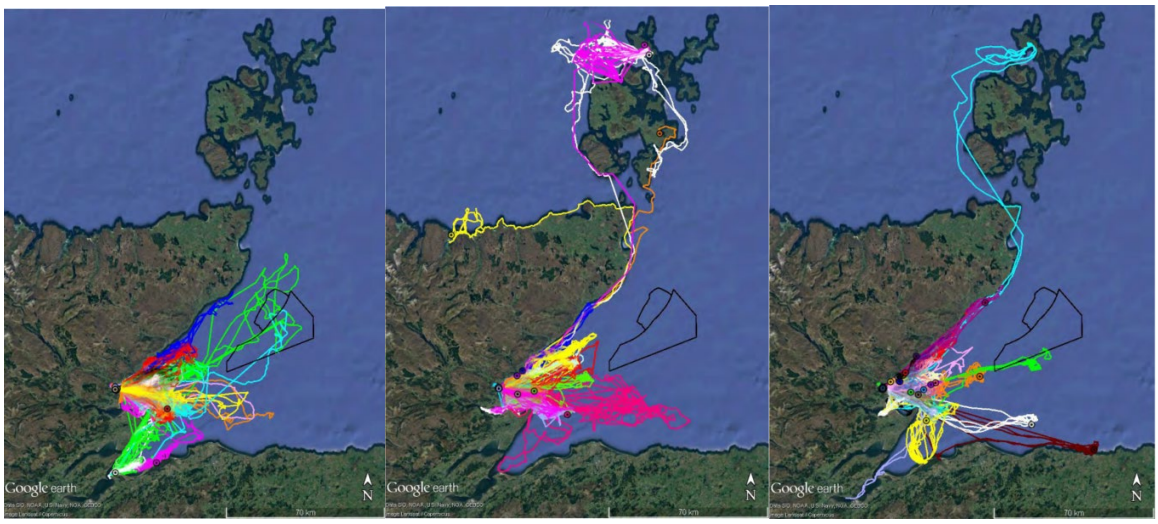

Figure 46 Telemetry data for harbour seals tagged at Loch Fleet by Aberdeen University as part of the Moray Firth Marine Mammal Monitoring Programme. Left: 12 harbour seals tagged in 2014, middle: 13 harbour seals tagged in 2015, right: 32 harbour seals tagged in 2017. Figures taken from Graham *et al.* (2017).

8.4 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 47). 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 Salamander Project are very low. The maximum expected density of harbour seals within the Offshore Array Area and Offshore Export Cable Corridor is 0.003 harbour seals/km^2.

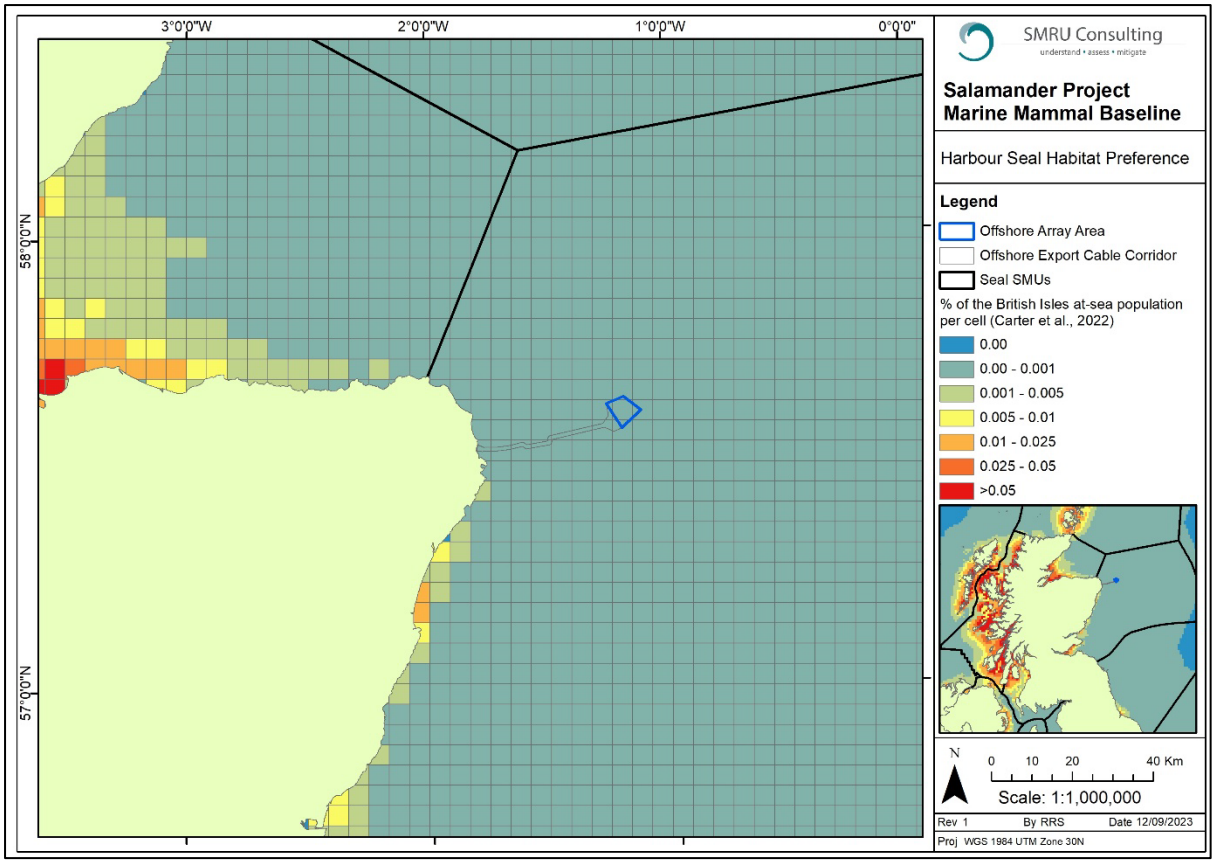

Figure 47 Harbour seal at-sea habitat preference map. Data from Carter *et al.* (2020), Carter *et al.* (2022).

8.5 Site-specific surveys

In both years of the Salamander Project site-specific surveys, no harbour seals were identified, though there were a total of three sightings of "unidentified seal species" across the 24 surveys in April and October 2021 (HiDef Aerial Surveying Limited, 2023). No density estimate is available for harbour seals from these data.

8.6 Harbour seal summary

The Salamander Project 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 Salamander Project Offshore Export Cable Corridor 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 Salamander Project Offshore Array Area and Export Cable Corridor. The available telemetry data show very coastal movements of harbour seals in the East Scotland SMU.

For the Salamander Project 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.

9 Grey seal

Grey seals are widely distributed around the UK, largely concentrated in the Outer Hebrides and in Orkney, central and southern North Sea (Figure 49 and Figure 48). At a UK level, grey seals have been assessed as having an Improving Conservation Status, driven by favourable assessments for population size, range and habitat and future prospects (JNCC, 2019d).

The UK wide grey seal population is estimated using a population model that combines regional pup production estimates (Figure 48) and August haul-out counts (Figure 49). The UK total grey seal population size at the start of the 2022 breeding season was estimated to be 162,000 grey seals (95% CI: 146,700-178,500) (SCOS, 2023). Across the UK, pup production has increased since the 1960's (Figure 48) but the rate of increase across the whole UK has slowed to 1.4% per annum over the latest survey interval (2016-2019) (SCOS, 2023). The most recent August haul-out count of grey seals in Scotland (across 2016 and 2021) is 24,640 grey seals, which is 9% higher than count from the surveys between 2011 and 2015 (SCOS, 2023).

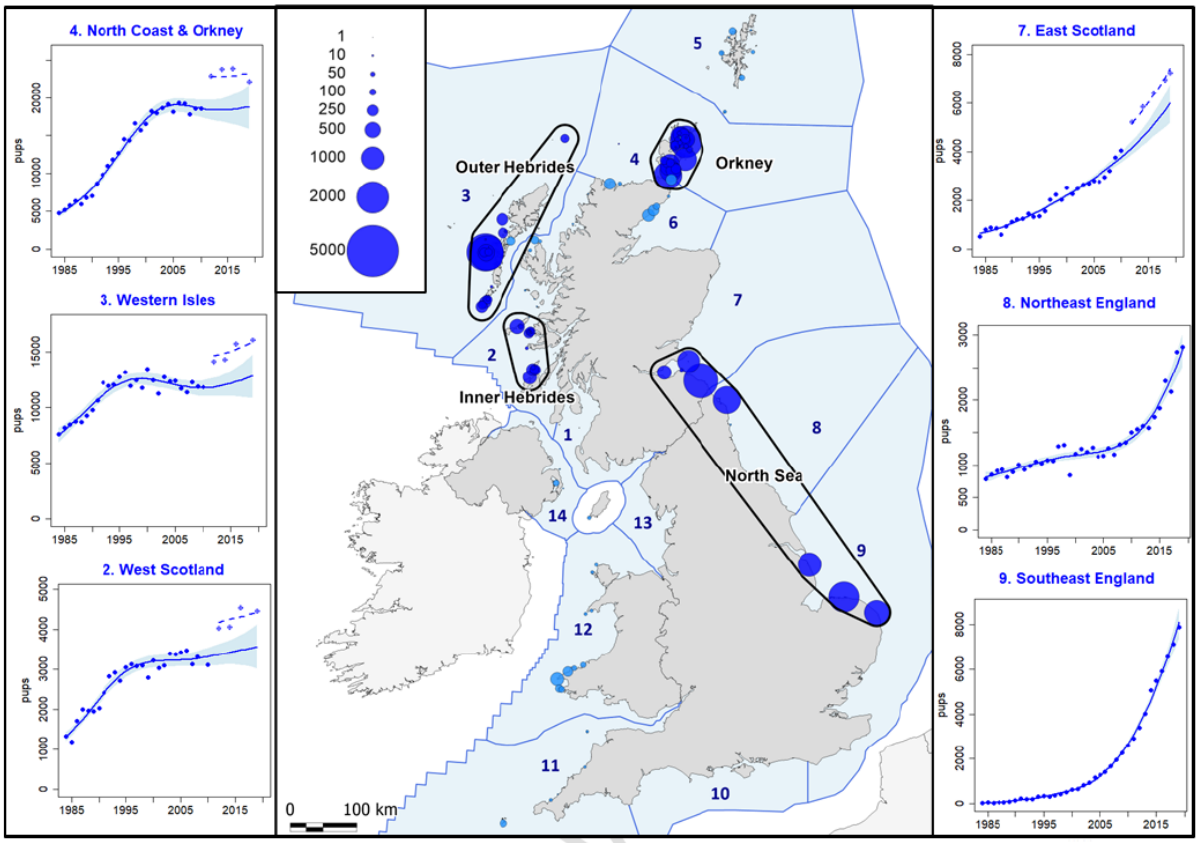

Figure 48 Distribution and estimated pup production of the main grey seal breeding colonies around the UK (dark blue circles-regularly monitored & light blue-sporadically monitored). Black polygons indicate regional groups of regularly monitored colonies and SMU boundaries are shown in blue. Figure taken from SCOS (2023).

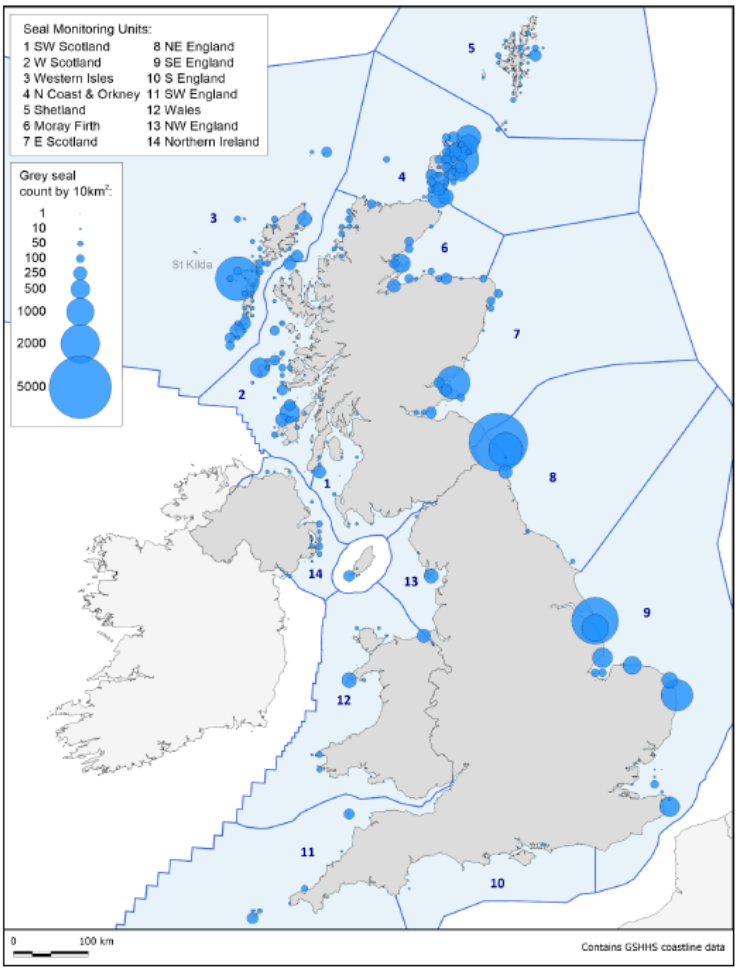

Figure 49 August distribution of grey seals around the British Isles by 10km squares based on the most recent available haul-out count data collected up until 2021. Figure taken from SCOS (2023).

9.1 August haul-out counts

The Salamander Project 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 9.4 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 17).

The latest haul-out counts for the East Scotland SMU and the Moray Firth SMU are from 2021, the latest counts for Orkney is from 2019 and for the North Coast is from 2016. The closest haul-out count recorded to the Salamander Project Offshore Export Cable Corridor is at Peterhead, where 140 grey seals were counted in 2021 (Figure 50).

Table 17 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	-

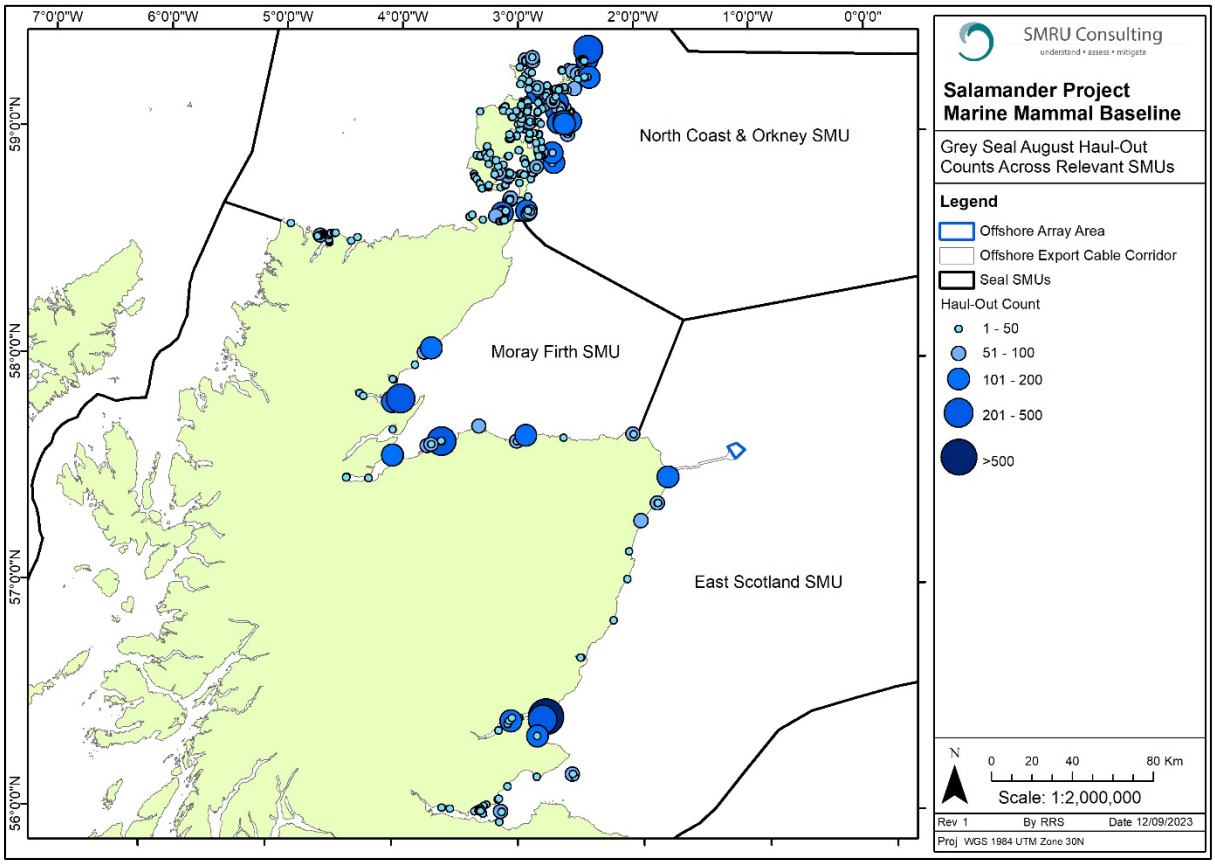

Figure 50 Grey seal August haul-out counts in the East Scotland SMU (2021), Moray Firth SMU (2021), Orkney (2019) and North Coast (2016). Data provided by SMRU.

9.2 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 51). 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 7 in 2019 respectively).

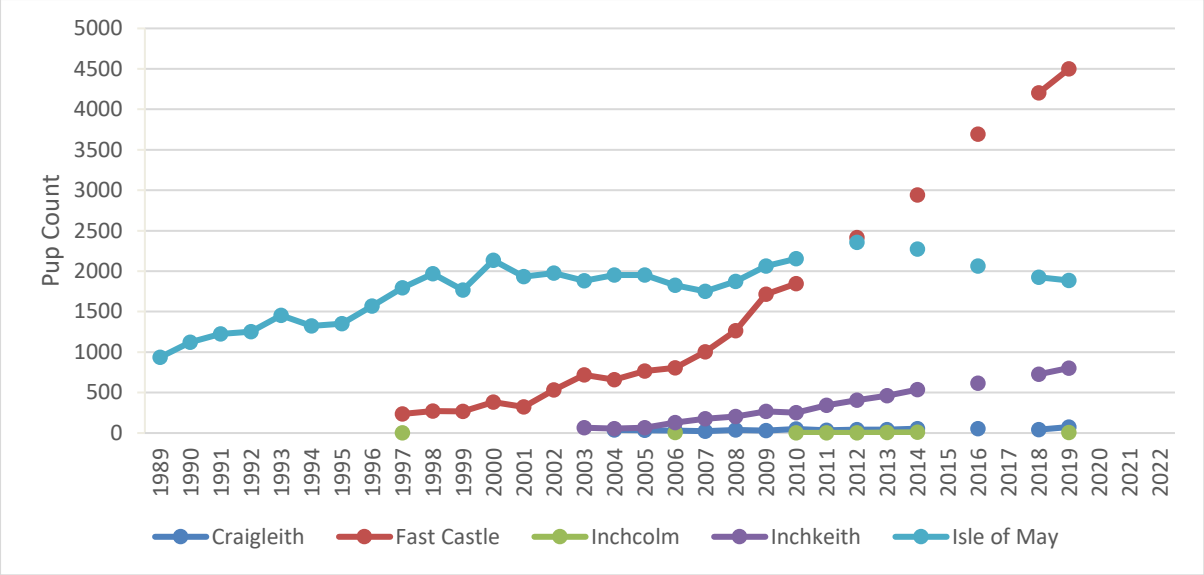

Figure 51 Grey seal pup counts over time at the five breeding colonies in the East Scotland SMU. Data provided by SMRU.

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 52). Pup production in the Moray Firth in 2019 totalled 1,856 pups, with a current trend of a 3.12% increase per annum.

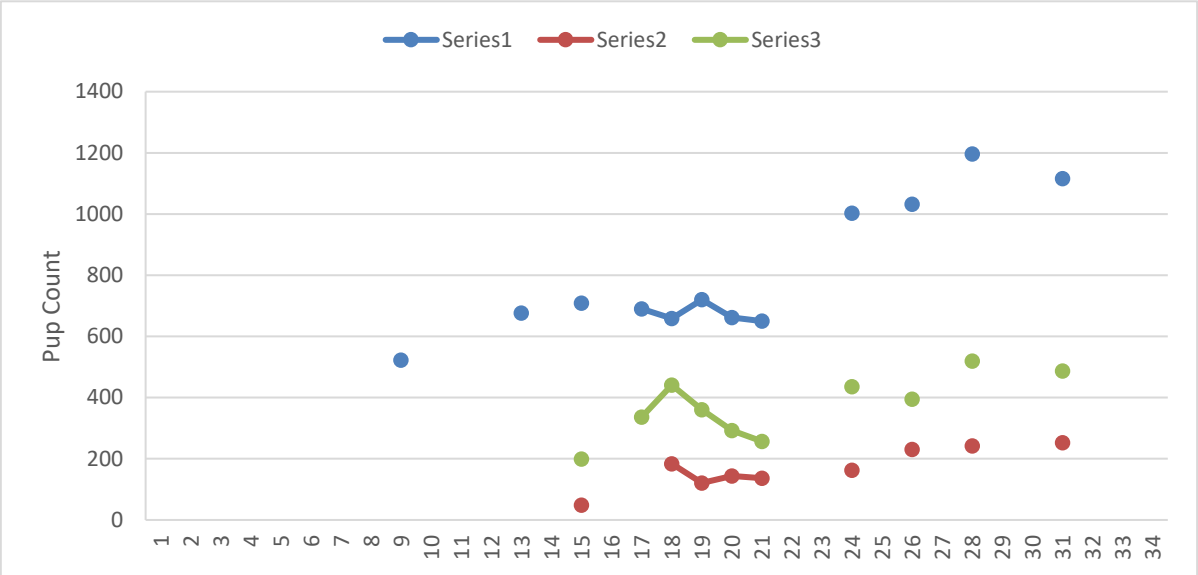

Figure 52 Grey seal pup counts over time at the three breeding colonies in the Moray Firth SMU. Data provided by SMRU.

There are 28 grey seal breeding colonies in the North Coast and Orkney SMU. These are shown combined in Figure 53 and separately in Figure 54. 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. 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.

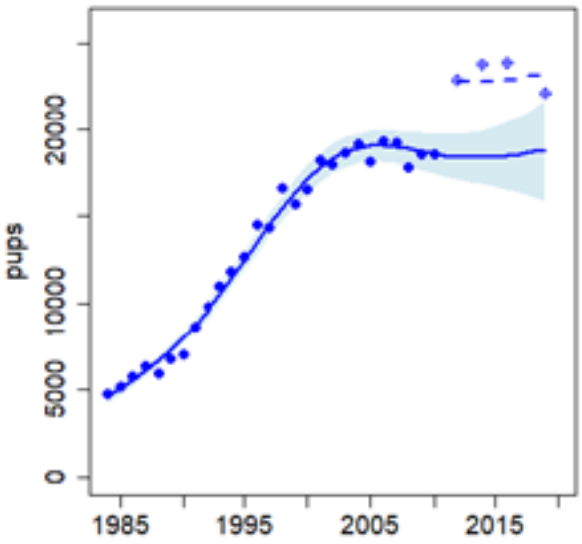

Figure 53 Pup production estimates by year for the North Coast and Orkney SMU, and predicted trend and associated 95% confidence intervals. Figure taken from SCOS (2023).

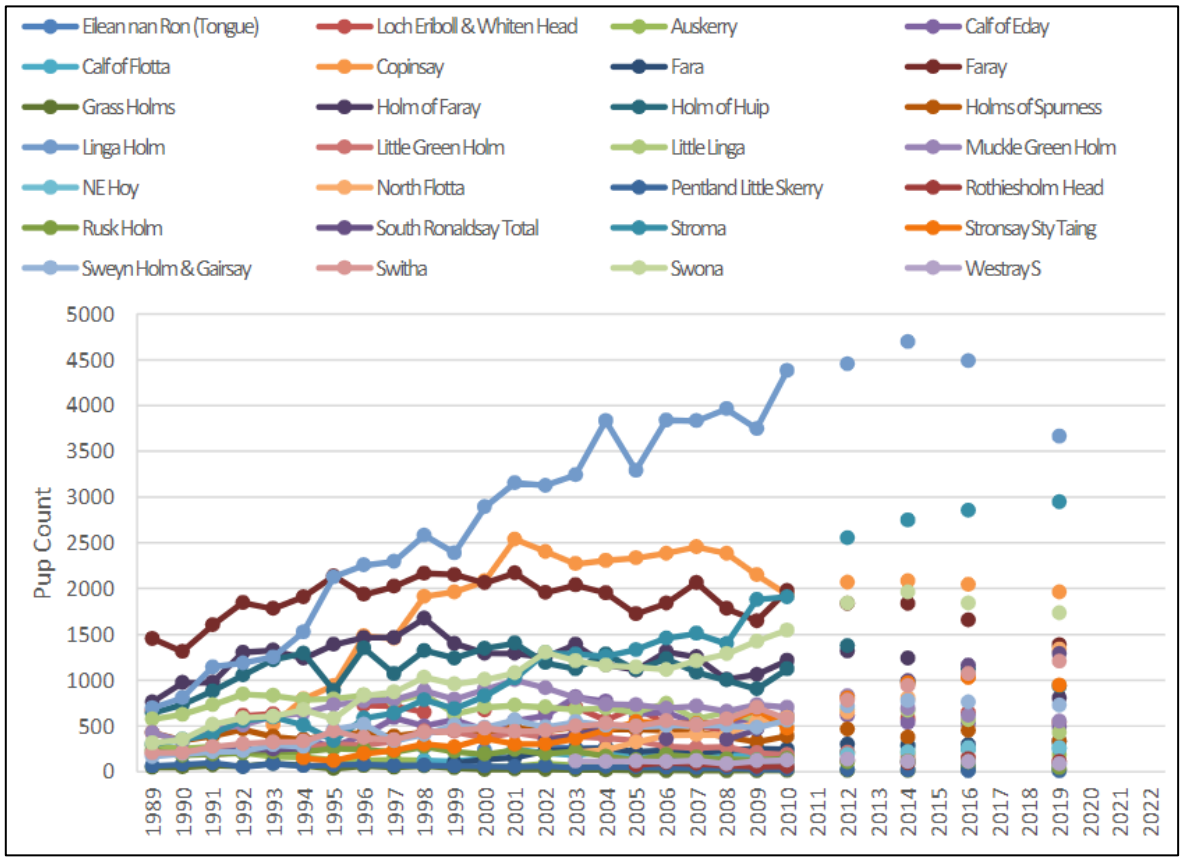

Figure 54 Grey seal pup counts over time at the breeding colonies in the North Coast and Orkney SMU. Data provided by SMRU.

9.3 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 55). Within the East Scotland SMU, grey seal at-sea distribution is highest in the Firth of Forth. The average density of grey seals at-sea within the 50 km buffer of the Salamander Project Offshore Array Area is 0.23 grey seals/km^2. The highest density of grey seals within the

Salamander Project Offshore Export Cable Corridor is 0.89 grey seals/km^2 at the grid cells at the coastline and within the Salamander Project Offshore Array Area boundary the highest density is 0.11 grey seals/km^2.

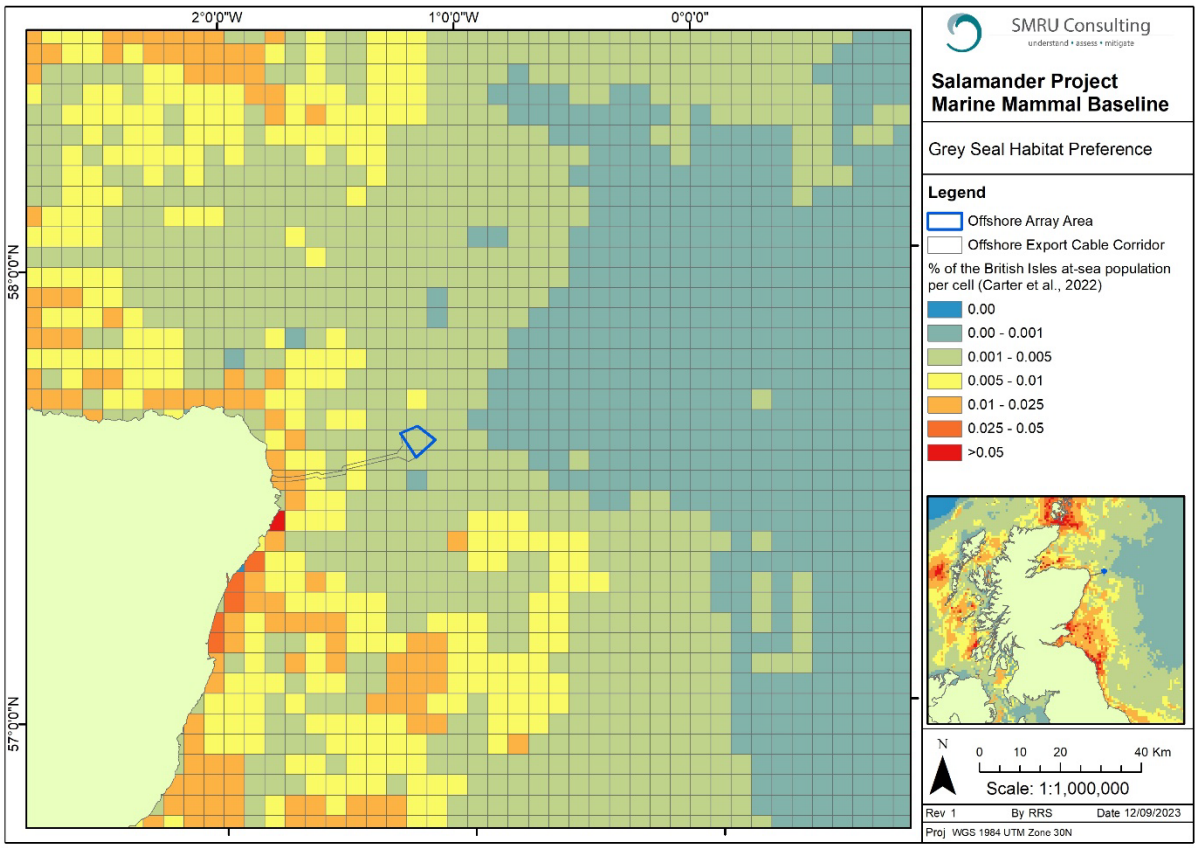

Figure 55 Grey seal at-sea habitat preference map. Data from Carter *et al.* (2020), Carter *et al.* (2022).

9.4 Telemetry

There have been 86 grey seals tagged in the East Scotland SMU between 1990 and 2016 (Figure 56). 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);
- 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, all adults tagged in 2018 at Ardersier (n=1), Dornoch Firth (n=8) and Findhorn (n=1) (Figure 56).

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 56).

Within a 50 km buffer of the Salamander Project Offshore Array Area, there are telemetry tracks from 52 grey seals (Figure 57), tagged in the East Scotland SMU (n=27), the North Coast and Orkney SMU

(n=14), the Moray Firth SMU (n=5), the Northeast England SMU (n=5) and the Southeast England SMU (n=1).

The grey seals within the 50 km buffer or the Salamander Project Offshore 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 Salamander Project 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.

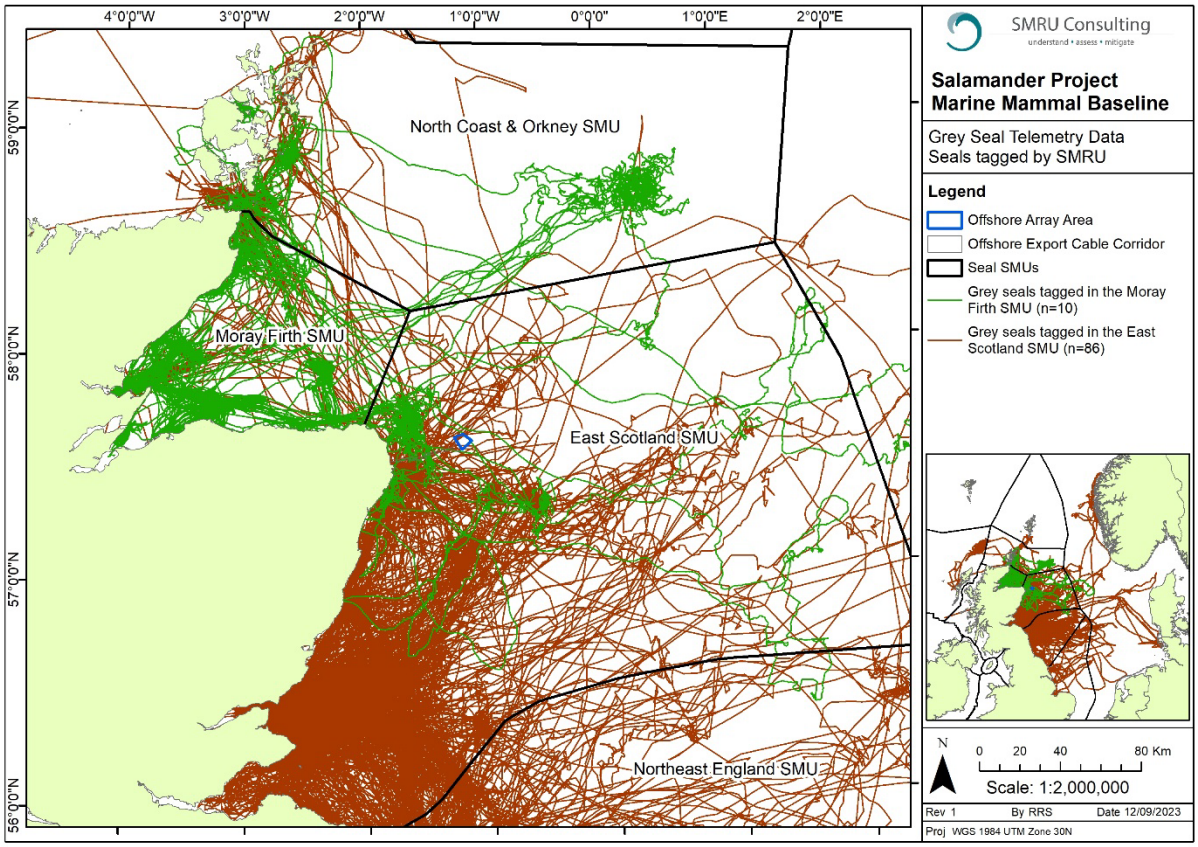

Figure 56 Grey seal telemetry tracks for seals tagged in the East Scotland SMU (n=86) and the Moray Firth SMU (n=10). Data provided by SMRU.

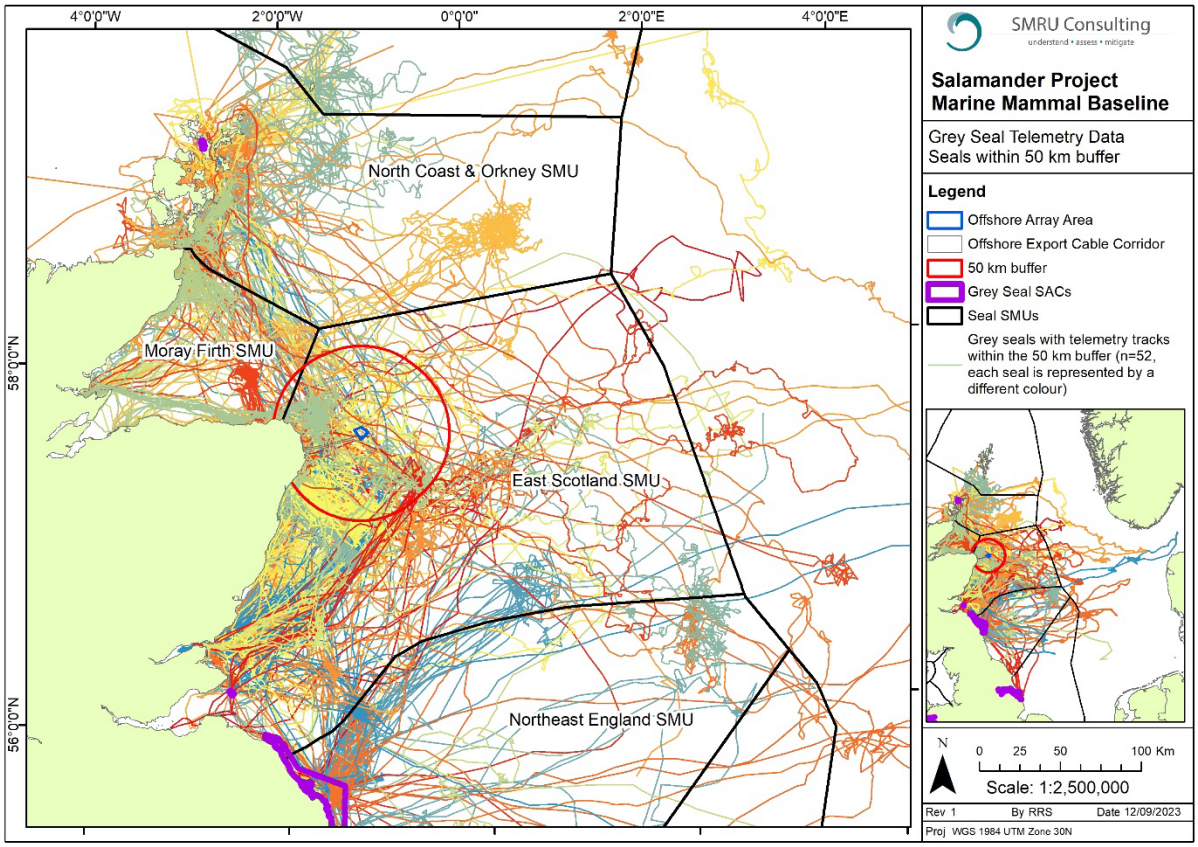

Figure 57 Grey seal telemetry tracks for 52 grey seals with telemetry tracks within the 50 km buffer of the Salamander Project array area. Data provided by SMRU.

9.5 Site-specific surveys

In both years of the Salamander Project site-specific surveys, no harbour seals were identified, though there were a total of 3 sightings of "unidentified seal species" across the 24 surveys in April and October 2021 (HiDef Aerial Surveying Limited, 2023). No density estimate is available for grey seals from these data.

9.6 Grey seal summary

The Salamander Project 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. The at-sea distribution predicts moderately high densities of grey seals in the vicinity of the Offshore Array Area and Offshore Export Cable Corridor. The available telemetry data show wide ranging movements of grey seals throughout the east coast of Scotland and England.

For the Salamander Project 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.

10 Less common species

10.1 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 58) (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 (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".

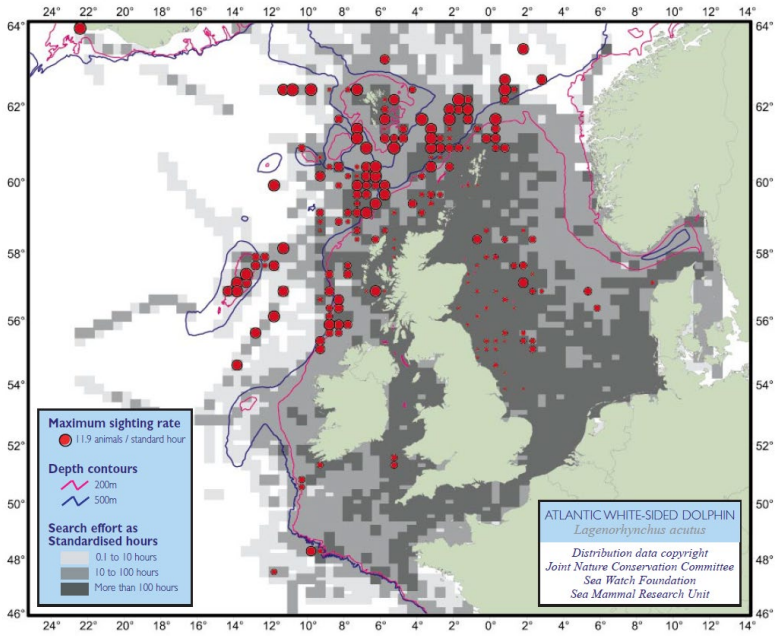

Figure 58 White-sided dolphin distribution map of effort-related sightings (Reid *et al.*, 2003).

10.1.1 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.

10.1.2 Site-specific surveys

In year one of the Salamander Project site-specific surveys, no white-sided dolphins were identified, and therefore, no density estimate is available from these data.

10.1.3 Small Cetaceans in European Atlantic waters and the North Sea III and IV

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

No white-sided dolphins were sighted in the SCANS IV survey block NS-D where Salamander Project is located, but they were sighted in the adjacent survey block NS-E (Gilles *et al.*, 2023). The estimated abundance of white-sided dolphins in the block NS-E was 958, (95% CI: 5 – 3,583) and the density was 0.0146 white-sided dolphins/km^2 (CV = 1.028).

10.1.4 Joint Cetacean Protocol Phase III Analysis

Paxton *et al.* (2016) produced predicted white-sided dolphin densities for summer 2010 (Figure 59). 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 Salamander Project 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.

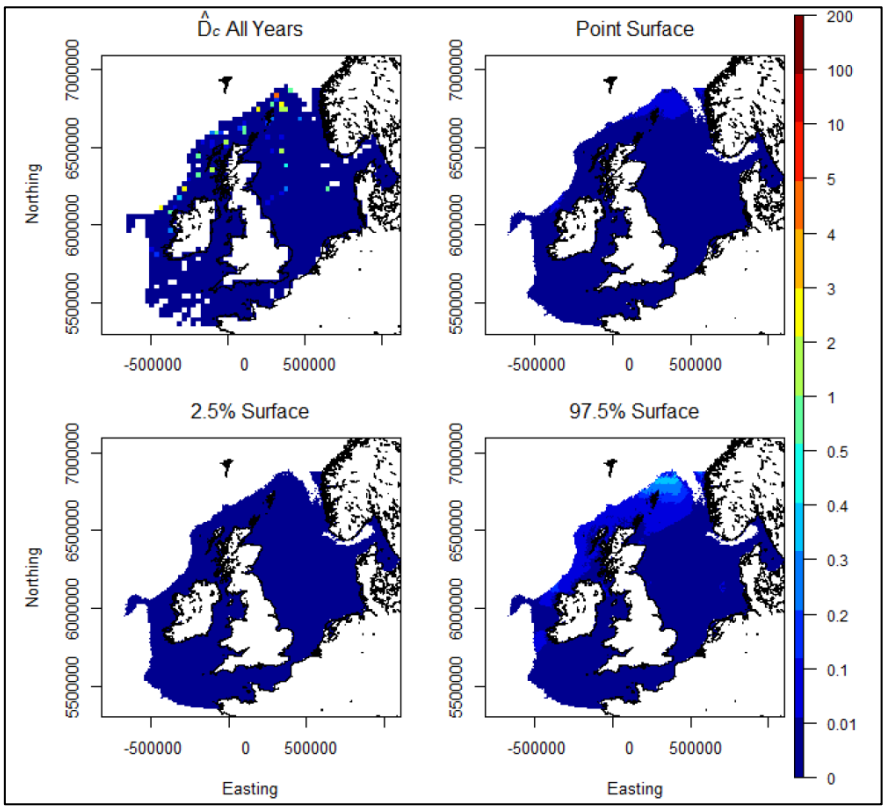

Figure 59 Predicted white-sided dolphin densities for summer 2010 (Paxton *et al.*, 2016). Top left; input densities (summer all years), top right; point estimate of cell densities, bottom left; lower (2.5%) confidence limit on cell densities, bottom right; upper (97.5%) confidence limit on cell densities (white-sided dolphins/km^2). Note that the top left plot exaggerates the spatial coverage of the relevant effort.

10.1.5 Marine Ecosystem Research Project

Atlantic white-sided dolphin density maps produced by Waggitt *et al.* (2020) predicted generally low densities around east Scotland. The maximum white-sided dolphin density for grid cells within the Offshore Array Area is 0.020/km^2 for January and 0.035/km^2 for July. The minimum density for grid cells within the Offshore Array Area is 0.006/km^2 for January and 0.009/km^2 for July (Figure 60).

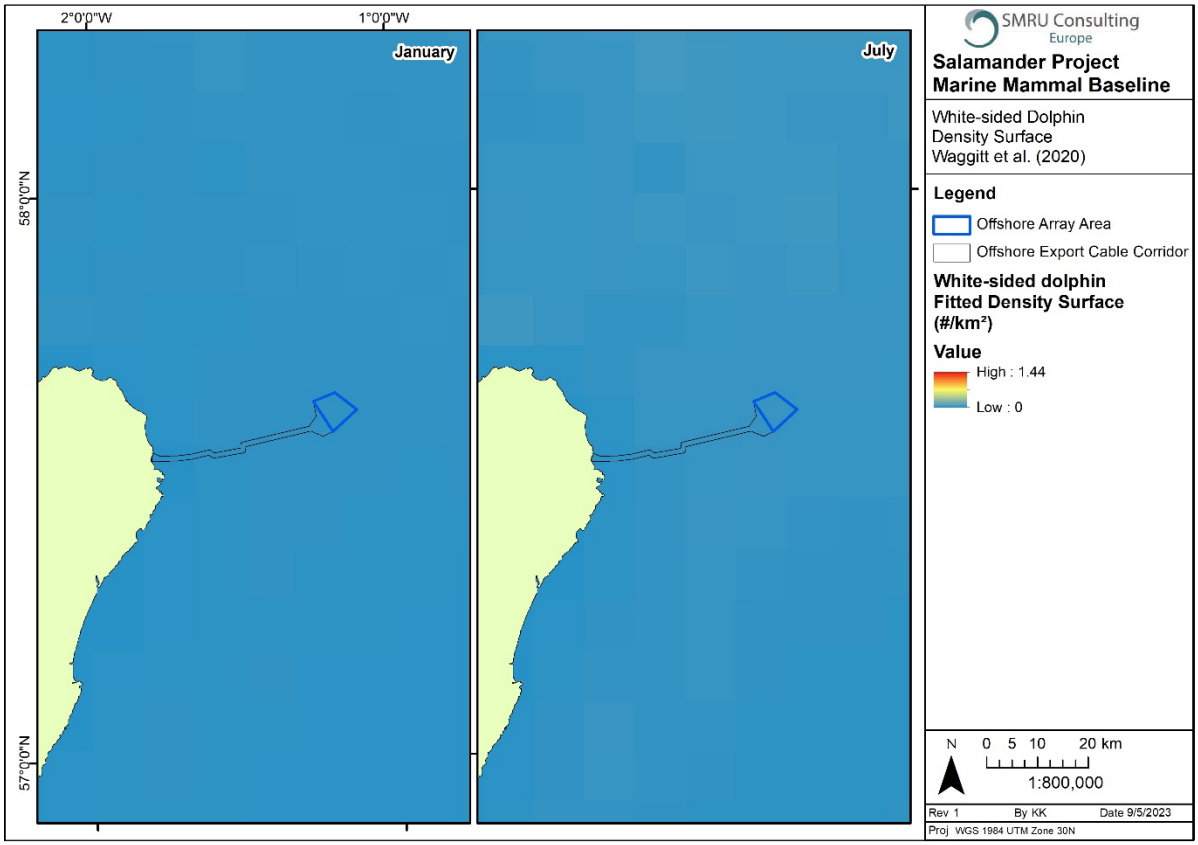

Figure 60 White-sided dolphin density surface (#/km^2) for January and July. Data from Waggitt *et al.* (2020).

10.1.6 The East Coast Marine Mammal Acoustic Study

The ECOMMAS data presented consists of CPOD data collected from 2013 – 2022 (data for 2020 absent due to Covid-19 restrictions, preventing field work from occurring). Delphinid species were identified across most sites, with calculations of detection positive days (DPD) per year (Table 9) and average detection positive hours (DPH) per year (Table 10) presented below. Data have also been visualised for DPH across each of the stations at the Cruden Bay (Figure 31) and Fraserburgh (Figure 32) 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 31) and Fraserburgh (Figure 32Figure 26) 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 9, Table 10).

10.1.7 White-sided dolphin summary

White-sided dolphin density estimates are low on the east coast of Scotland (Table 18), with density estimates ranging from 0 to 0.035 dolphins/km^2. This species was not sighted during the HiDef Salamander Project 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 species be scoped out of the quantitative impact assessment.

Table 18 Summary table of the available density estimates for white-sided dolphin.

Source	Details	Density estimate (#/km^2)
Salamander Project site-specific surveys	Average density	None sighted
SCANS III	Block R	0.01
SCANS III	Block T (adjacent)	0.021
SCANS IV	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	Offshore Array Area range in January and July	0.02 - 0.035

10.2 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 61). 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 (2019i) 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.

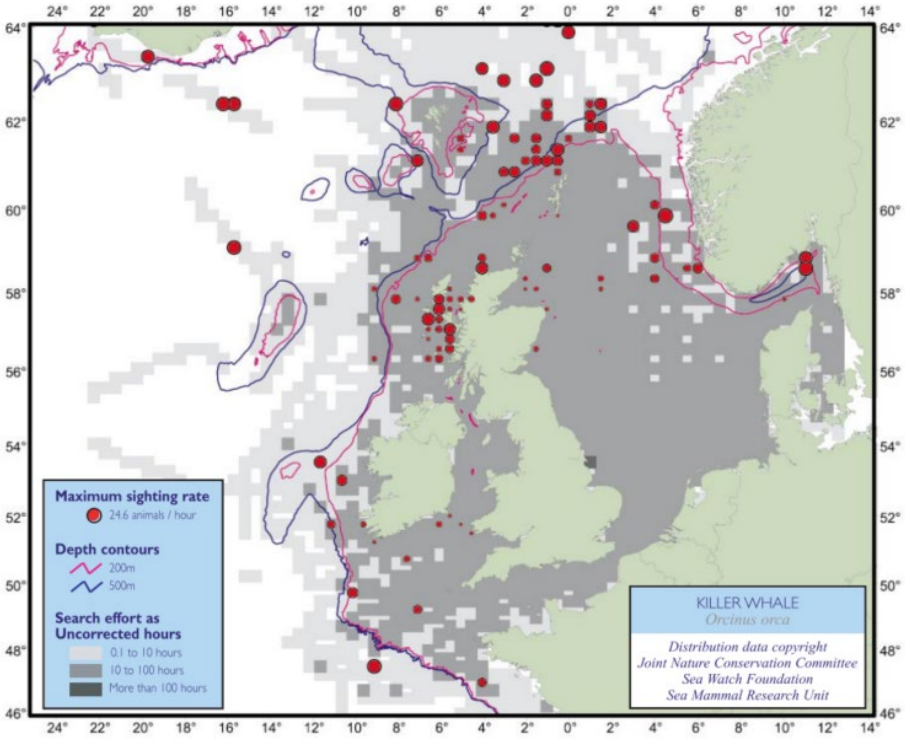

Figure 61 Killer whale distribution map of effort-related sightings (Reid *et al.*, 2003).

10.2.1 Management unit

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 (2019i).

10.2.2 Site-specific surveys

In both years of the Salamander Project site-specific surveys, no killer whales were identified. However, a Project specific terrestrial ecology survey did opportunistically sight killer whales during a site visit in February 2023. This opportunistic sighting recorded 2 (or 3) killer whales pursuing a seal approximately 100-200 m offshore.

10.2.3 Small Cetaceans in European Atlantic waters and the North Sea III and IV

No killer whale sightings were reported during SCANS III or IV surveys, and therefore, no abundance or density estimates were provided (Hammond *et al.*, 2021, Gilles *et al.*, 2023). Lacey *et al.* (2022) did not provide a modelled density surface for killer whales.

10.2.4 Joint Cetacean Protocol Phase III Analysis

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

10.2.5 Marine Ecosystems Research Project

Killer whale dolphin density maps produced by Waggitt *et al.* (2020) predicted generally low densities around east Scotland. The maximum killer whale density for grid cells within the array area is 0.0013 killer whale/km^2 for January and 0.0014 /km^2 July. The minimum density for grid cells within the array area is 0.0006/km^2 for January and 0.0007/km^2 for July (Figure 62).

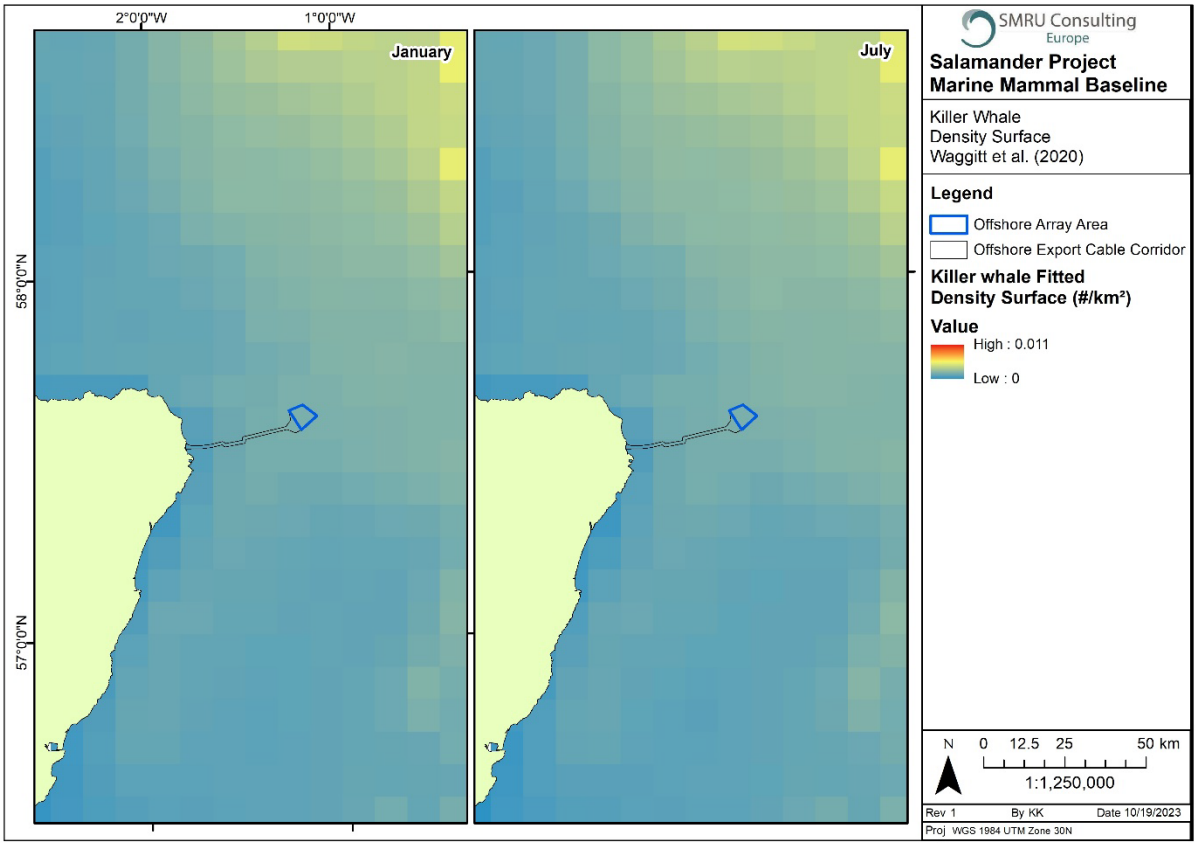

Figure 62 Killer whale density surface (#/km2) for January and July. Data from Waggitt *et al.* (2020).

10.2.6 Killer whale summary

Killer whales were not sighted during the HiDef Salamander Project site-specific surveys; and density estimates were only available using the MERP data, where they were estimated to be present in low densities (Figure 62). There is not enough empirical data currently available to support the inclusion of this species in the quantitative impact assessment. Therefore, SMRU Consulting recommends killer whales are included qualitatively only in the assessment.

Table 19 Summary table of the available density estimates for killer whale.

Source	Details	Density estimate (#/km²)
Salamander Project site-specific surveys	Average density	None sighted
SCANS III	Block R	None sighted
SCANS III	Block T (adjacent)	None sighted
SCANS IV	Block NS-D	None sighted
SCANS IV	Block NS-E (adjacent)	None sighted
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	Offshore Array Area range in January	0.0006-0.0013
MERP	Offshore Array Area range in July	0.0007-0.0014

10.3 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 63). The distribution, although year-round, is scarce in Scottish waters with very low estimates off east Scotland, where Salamander Project 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.

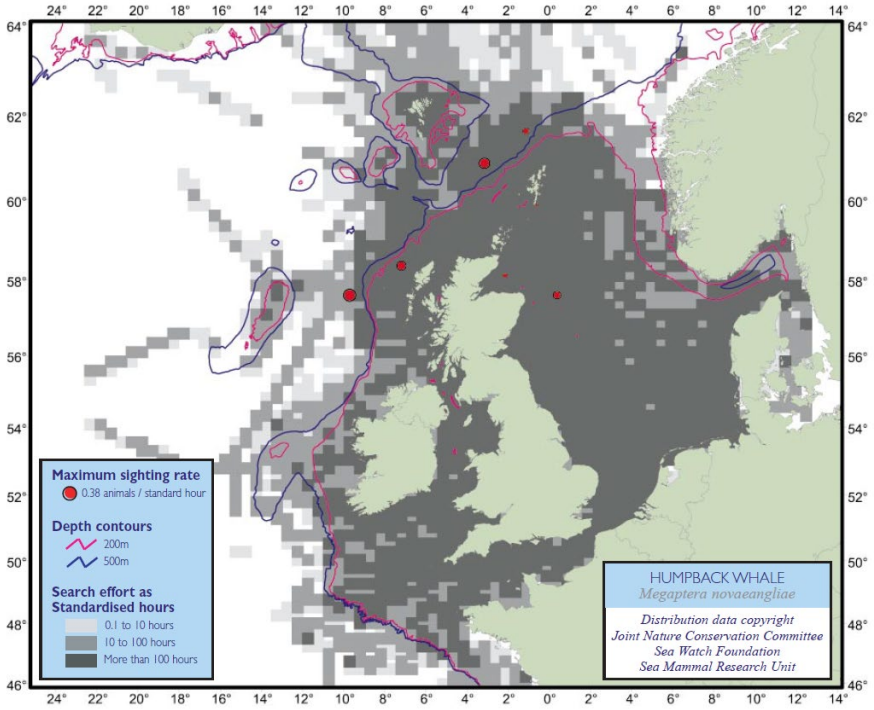

Figure 63 Humpback whale distribution map of effort-related sightings (Reid *et al.*, 2003)

10.3.1 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]).

10.3.2 Site-specific surveys

In both years of the Salamander Project site-specific surveys, no humpback whales were identified, and therefore, no density estimate is available from these data.

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

10.3.3 Small Cetaceans in European Atlantic waters and the North Sea III and IV

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. Lacey *et al.* (2022) did not provide a modelled density surface for humpback whales. No humpback whale sightings were reported during SCANS IV survey (Gilles *et al.*, 2023).

10.3.4 Joint Cetacean Protocol Phase III Analysis

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

10.3.5 Marine Ecosystem Research Project

Waggitt *et al.* (2020) did not produce a density map for humpback whale.

10.3.6 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.

10.3.7 Humpback whale summary

Humpback whales were not sighted during the HiDef Salamander Project site-specific surveys; and have not been reported on 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 this species in the quantitative impact assessment. Therefore, SMRU Consulting recommends humpback whales are included qualitatively only in the assessment.

Table 20 Summary table of the available density estimates for humpback whale.

Source	Details	Density estimate (#/km^2)
Salamander Project site-specific surveys	Average density	None sighted
SCANS III	Block R	0
SCANS III	Block T (adjacent)	Single sighting
SCANS IV	Block NS-D	None sighted
SCANS IV	Block NS-T (adjacent)	None sighted
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	Offshore Array Area range in January and July	Not included

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

11 Conclusion

The data available for this baseline characterisation have confirmed that bottlenose dolphins, harbour porpoise, white beaked dolphin, minke whale, grey seals, and harbour seals are likely to be present in the vicinity of the Salamander Project site and should be considered within the quantitative impact assessment.

There was little evidence of humpback whale and killer whale presence in proximity to the Salamander Project site. Given a lack of information on population size or density, it is recommended that these two species are scoped out of quantitative impact assessment, however, given that there is a chance that both species may be present rarely in the area, they will be considered briefly and qualitatively in the impact assessment (as recommended in the Scoping Opinion). Given the lack of information on white-sided dolphins in the area, they are scoped out of assessment completely.

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 21, and are the ones recommended by SMRU Consulting to take forward to the quantitative impact assessment.

Table 21 Species, MU size and density estimate recommended for use in the Project quantitative impact assessment.

Species	MU	MU Size	UK MU	MU Ref	Density (#/km^2)	Density Ref
Harbour porpoise	North Sea	346,601	159,632	IAMMWG (2023)	Grid cell specific	Lacey *et al.* (2022)
					0.5985*	Gilles *et al.* (2023)
Bottlenose dolphin	Coastal East Scotland	224		IAMMWG (2023)	0.110 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*	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*	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 Moray Firth N Coast & Orkney	10,783 7,380 34,191		Scaled SCOS (2023) counts	Grid cell specific	(Carter *et al.*, 2020, Carter *et al.*, 2022)

White-sided dolphin	Scoped out
Killer whale	Qualitatively assessed only
Humpback whale	Qualitatively assessed only

* Where impact contours cross multiple SCANS IV blocks, block-specific density estimates will be used for the corresponding portion of the impact contour.

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