DOGGER BANK D WIND FARM

Preliminary Environmental Information Report

Volume 2
Appendix 12.2 Marine Mammals Technical Report

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Prepared By:	**Royal HaskoningDHV**
Prepared For:	**Dogger Bank D Offshore Wind Farm**

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Table of Contents

Glossary

Term	Definition
Design	All of the decisions that shape a development throughout its design and pre-construction, construction / commissioning, operation and, where relevant, decommissioning phases.
Effect	An effect is the consequence of an impact when considered in combination with the receptor's sensitivity/value/importance, defined in terms of significance.
Expert Topic Group (ETG)	A forum for targeted technical engagement with relevant stakeholders through the EPP.
Impact	A change resulting from an activity associated with the Project, defined in terms of magnitude.
Mitigation	Any action or process designed to avoid, prevent, reduce or, if possible, offset potentially significant adverse effects of a development.
Study Areas	A geographical area and / or temporal limit defined for each EIA topic to identify sensitive receptors and assess the relevant likely significant effects.
The Project	Dogger Bank D Offshore Wind Farm Project, also referred to as DBD in this PEIR.

12.2 Marine Mammals Technical Report

12.2.1 Introduction

1. This appendix to the Dogger Bank D (DBD) Offshore Wind Farm (hereafter referred to as the 'Project' or 'DBD') Preliminary Environmental Information Report (PEIR) supports **Volume 1, Chapter 12 Marine Mammals and Underwater Noise**.

2. This appendix provides further supporting marine mammal background information and survey data to define the baseline for the assessments in **Volume 1, Chapter 12 Marine Mammals and Underwater Noise** of the PEIR.

3. The following marine mammal species are scoped into the assessment:

   - Harbour porpoise *Phocoena Phocoena*;
   - Bottlenose dolphin *Tursiops truncates*;
   - Common dolphin *Delphinus delphis*;
   - White-beaked dolphin *Lagenorhynchus albirostris*;
   - Minke whale *Balaenoptera acutorostrata*;
   - Grey seal *Halichoerus grypus*; and
   - Harbour seal *Phoca vitulina*.

4. These species were determined from the site-specific aerial surveys (**Section 12.2.2**) and other data sources and have also been agreed through the marine mammal ecology Expert Topic Group (ETG 3). The latest meeting of ETG 3 was on 17th October 2024, at the time of writing.

12.2.1.1 Study Area

5. The Study Area for the marine mammal assessment has been defined on the basis that marine mammals are highly mobile and transitory in nature. Therefore, it is necessary to examine species occurrence, not only within the offshore development area, but also throughout the wider environment. Further details of defining the Study Areas for the species of interest are provided in the sections below.

12.2.1.1.1 Cetaceans

6. Management Units (MUs) provide an indication of the spatial scales at which effects of plans and projects alone, and in-combination, need to be assessed for the key cetacean species in United Kingdom (UK) waters, with consistency across the UK (Inter-Agency Marine Mammal Working Group (IAMMWG), 2023). The Study Areas, MUs and reference populations have been determined based on the most relevant information and scale at which potential effects from the Project alone and together with other plans and projects could occur.

7. The MUs are defined geographical areas in which individuals of a particular species are found and management of human activity is applied (IAMMWG, 2023). For this reason, delineation of cetacean MUs is, as far as is practical, aligned with the International Council for the Exploration of the Sea (ICES) Subarea and / or Divisions that are used for implementation of fisheries management measures as recommended by the ICES Working Group of Marine Mammal Ecology.

8. For each cetacean species, the Study Areas have been defined based on the relevant MUs as outlined in **Table 12.2-1** which provide relevant spatial scale for assessment of environmental impacts (IAMMWG, 2023).

Table 12.2-1 Relevant Management Unit for Cetaceans

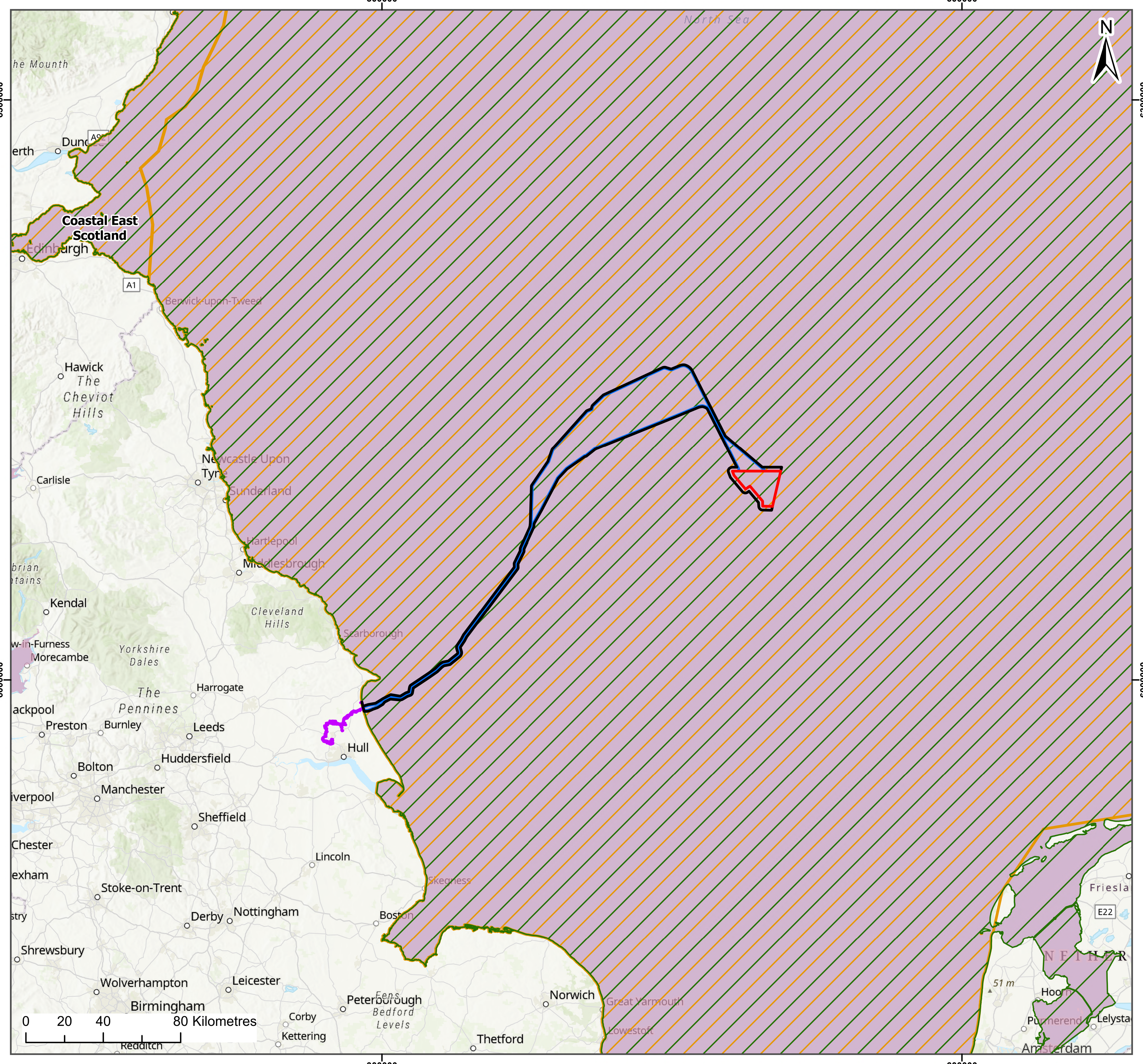
Species	Management unit/s relevant for the Project	Source	Plate reference
Harbour porpoise	North Sea (NS) MU	IAMMWG, 2023	**Figure 12.2-1**
Bottlenose dolphin	Coastal East Scotland (CES) and Greater North Sea (GNS) MU	Cheney *et al.* 2024; IAMMWG, 2023	
Common dolphin	Celtic and Greater North Seas (CGNS) MU	IAMMWG, 2023	
White-beaked dolphin	CGNS MU	IAMMWG, 2023	
Minke whale	CGNS MU	IAMMWG, 2023	

12.2.1.1.2 Pinnipeds

9. Both UK seal species, grey seal and harbour seal, are present in the North Sea in relatively high number, due to nearby key breeding areas for both species (Scottish Committee on Seals (SCOS), 2022).

10. Based on the movements of grey and harbour seal, and potential connectivity with the Project, the relevant MUs (**Figure 12.2-2**) are:

- North-east (NE) England MU; and
- South-east (SE) England MU



Legend:

- Dogger Bank D Array Area
- Offshore Development Area
- Offshore PEIR Corridors
- Onshore Development Area
- Bottlenose dolphin MU -Coastal East Scotland and Greater North Sea
- Harbour porpoise MU -North Sea
- Common dolphin, White-beaked dolphin, and Minke Whale Management Unit - Celtic and Greater North Seas (CGNS)

Source: IAMMWG, 2023; © Haskoning DHV UK Ltd, 2024; © JNCC, 2023; © OpenStreetMap (and) contributors, CC-BY-SA

Project: Dogger Bank D Offshore Wind Farm

DOGGER BANK WIND FARM

Title: Management Units for Cetaceans (based on *IAMMWG, 2023*)

Figure: 12.2-1 | Drawing No: PC6250-RHD-XX-OF-DR-GS-0049

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Co-ordinate system: WGS 1984 UTM Zone 31N

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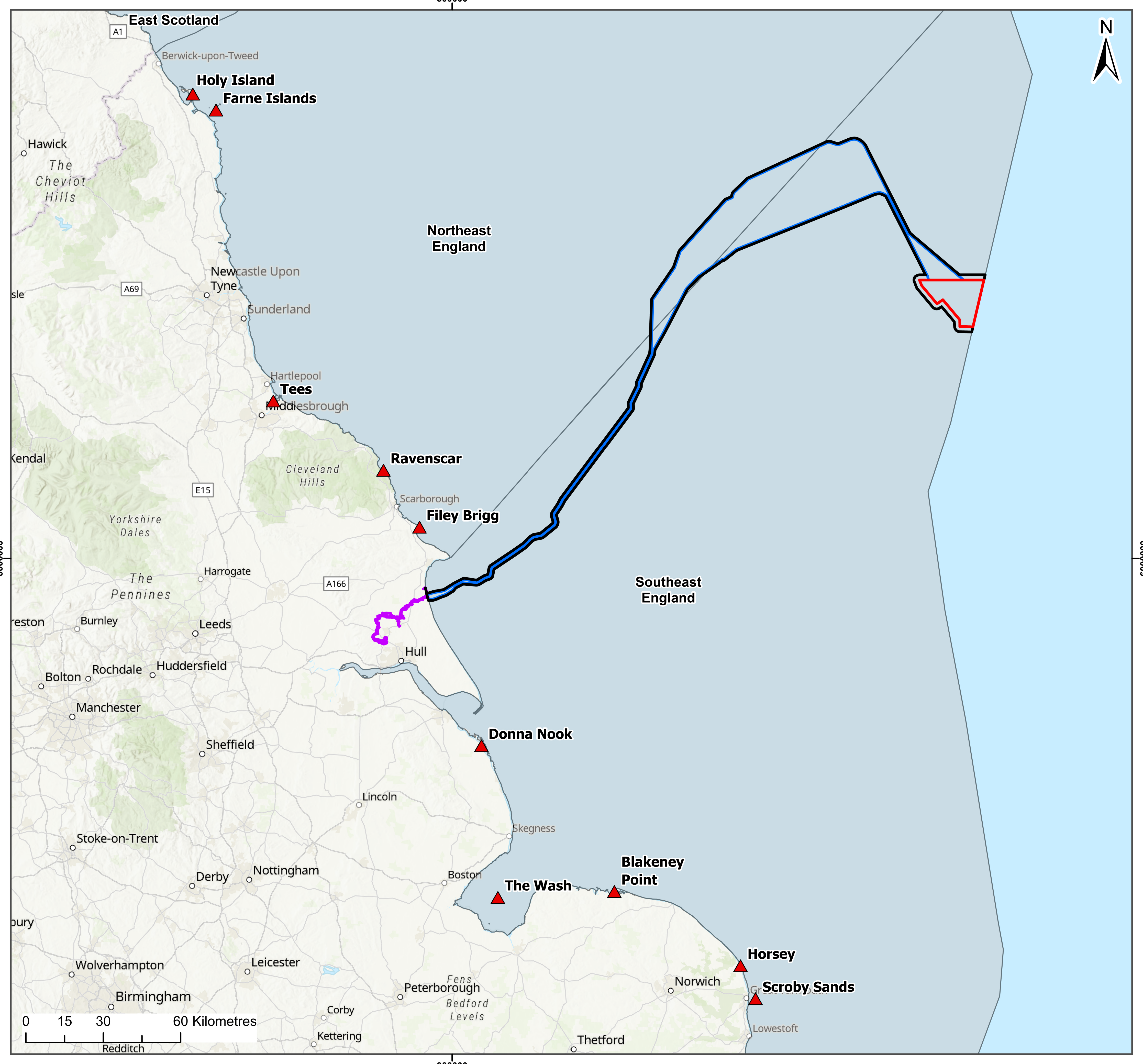

Legend:

- Dogger Bank D Array Area
- Offshore Development Area
- Offshore PEIR Corridors
- Onshore Development Area
- Seal Management Unit
- Seal Haul Out Sites

Source: IAMMWG, 2023; © Haskoning DHV UK Ltd, 2024; © JNCC, 2023; © OpenStreetMap (and) contributors, CC-BY-SA

Project: Dogger Bank D Offshore Wind Farm

DOGGER BANK WIND FARM

Title: Management Units for Seals (based on *SCOS, 2022*)

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12.2.2 Data Sources

12.2.2.1 Site Specific Surveys

12.2.2.1.1 Survey Overview

11. In order to provide site specific and up to date information on which to base the impact assessment, a site-specific digital aerial survey campaign was conducted for both marine mammals and seabirds. APEM Limited ('APEM') collected high resolution digital aerial still imagery for marine megafauna (combined with ornithology surveys) over the area of DBD Offshore Wind Farm (OWF), including a 4km buffer (hereafter referred to as the Survey Area) (see **Figure 12.2-3**).

12. Three standard APEM cameras with sensors set to a resolution of 1.5cm Ground Sample Distance were used.

13. The digital aerial survey was a grid-based design conducted along a series of strip transects (at approximately 3.3km spacing), flown on a monthly basis from October 2021 to September 2023, in which the camera system captured abutting still imagery along survey transit lines (see **Figure 12.2-3**).

14. The aircraft collected the data at an altitude of approximately 395m and a speed of approximately 120 knots. Images were collected continuously along the survey lines and an average of 20.35% coverage was captured.

15. Imagery was captured in raw format and post-processed to ensure optimal quality for the subsequent stage of image analysis, to extract information on marine fauna or other notable occurrences.

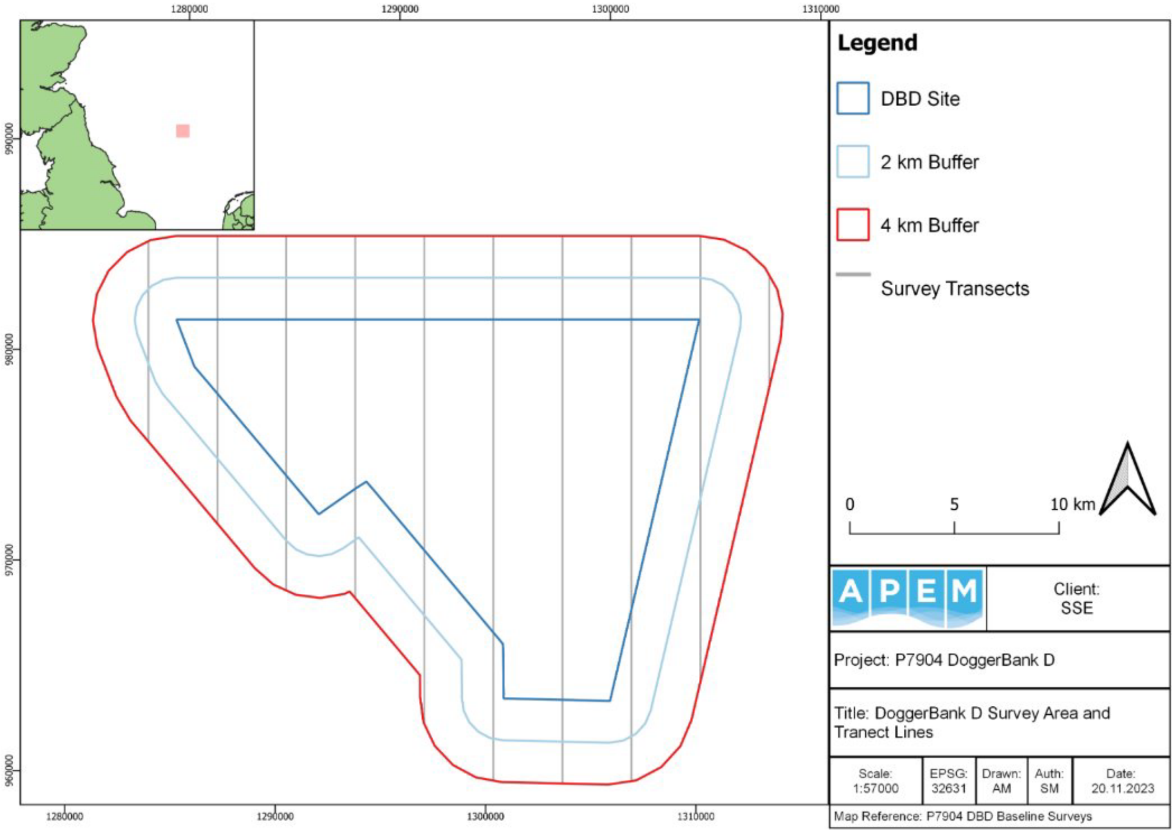


Figure 12.2-3 Dogger Bank D Site and 4km Buffer, Plus Aerial Digital Survey Transects

16. Data analysis followed a two-stage process in which images are reviewed (10%) then the detected objects were identified to species or species group level. Detections were attributed to a species level if 100% confident. The images underwent quality control inhouse.

17. Density and abundance estimates were calculated using the raw counts divided by the number of images collected to give the mean number of animals per image. Population estimates for each survey month were subsequently generated by multiplying the mean number of animals per image by the total number of images required to cover the Survey Area.

18. Non-parametric bootstrap methods were used for variance estimation. A variability statistic was generated by re-sampling 999 times with replacement from the raw count data. The statistic was evaluated from each of these 999 bootstrap samples and upper and lower 95% confidence intervals (CI) of these 999 values were taken as the variability of the statistic over the population (Tibshirani & Efron, 1993).

19. A measure of precision was calculated using a Poisson estimator, suitable for a pseudo-Poisson over-dispersed distribution. This produced a coefficient of variation (CV) based on the relationship of the standard error to the mean.

20. The weather conditions were recorded for the digital aerial surveys and are presented in **Appendix A** in this document and shows the effort for all 24 surveys at DBD, as survey conditions can impact the ability to detect marine mammals. Most survey days were in favourable weather conditions, apart from November 2022 when clouds were very low and flight altitude was lowered. The imagery was unaffected by the cloud cover. Due to poor conditions in March 2023, the survey was moved to 3rd of April. Further to note were camera failures in June 2022 and July 2023, resulting in a loss of data capture points.

12.2.2.1.2 Survey Findings

21. **Table 12.2-2** shows the raw counts of marine mammals recorded during the digital aerial surveys in DBD, from October 2021 to September 2023. The raw count only presents a relative abundance and not total abundances.

22. The results indicate that four species have been identified to species level. Harbour porpoise is present in the highest numbers, with sightings recorded every month. Grey seal and other unidentified seal species were also noted, though less consistently. Numbers of common dolphin and minke whale were spotted only frequently, with a few months showing no sightings. The survey data also included dolphin / porpoise species, which have been attributed and apportioned to harbour porpoise using the method outlined in **Appendix B** in this document.

23. From the sightings numbers (**Table 12.2-2**) of each marine mammal species, or marine mammal species group, abundance and density estimates were calculated. Upper and lower CI as well as CV were also calculated for these density and abundance estimates. The density of animals at the sites (and hence the population size), the standard deviation, 95% CI and CV are then estimated using a non-parametric bootstrap method with replacement (Canty & Ripley, 2010).

24. For species, such as marine mammals, that dive and therefore spend a considerable amount of time underwater, an availability bias, or correction factor, must be applied in order to account for those individuals that it is not possible to survey as they are underwater.

25. Without these availability biases, or correction factors, being corrected for, any abundance or density estimate would be relative only, rather than being an absolute estimate. As correction factors are only applicable at the species level, harbour porpoise was the only species to which this was applied. The abundance estimates for dolphin species and seal species were not corrected for availability bias.

Table 12.2-2 Summary of Marine Mammal Species Counted in the APEM Digital Aerial Surveys Between October 2021 and September 2023 for the DBD Array Area and 4km Buffer

Survey year	Survey month	Harbour porpoise	Grey seal	Seal species	Common dolphin	Dolphin / porpoise species	Minke whale	Marine mammal species
2021	Oct	31	-	-	-	-	-	-
	Nov	92	2	1	-	-	-	2
	Dec	20	-	3	3	3	-	-
2022	Jan	6	-	-	-	2	-	-
	Feb	11	-	-	-	1	-	-
	Mar	31	-	1	-	2	-	-
	April	85	-	2	-	3	1	8
	May	23	1	1	1	-	-	1
	June	49	-	-	-	7	-	-
	July	5	1	-	-	-	-	-
	Aug	8	-	-	-	-	-	-
	Sept	10	-	-	-	-	-	-
	Oct	6	1	1	-	-	-	-
	Nov	6	-	-	-	-	-	-

	Dec	3	1	-	-	-	-	-
2023	Jan	12	-	5	-	-	-	1
	Feb	53	3	-	-	-	-	8
	Mar	74	1	1	-	-	-	1
	April	29	3	-	-	-	-	-
	May	98	5	-	-	-	-	4
	June	85	-	-	-	-	1	2
	July	2	-	-	-	-	-	-
	Aug	29	-	-	-	-	-	-
	Sept	27	1	-	-	-	-	-
Total		**795**	**19**	**15**	**4**	**18**	**2**	**27**

12.2.2.1.2.1. Abundance and Density Estimates

26. In order to provide a precise or appropriate abundance and density estimate, a sufficiently large sample size of raw counts needs to be available (Hammond *et al*. 2021a). As per **Table 12.2-2**, harbour porpoise was the only species with sufficiently large raw counts over a two year period, for which such estimations would be appropriate. For all other species, a lack of sufficient sightings data over the two-year monthly surveys did not allow for a representative or appropriate density and abundance to be estimated. For these species, other available density data has been discussed in **Section 12.2.3**.

12.2.2.1.2.1.1. Harbour Porpoise Density Estimates

27. A total of 795 harbour porpoises were counted during the 24-month surveys (**Table 12.2-2**) providing enough data to estimate the density of animals/km^2 for the survey area plus 4km buffer. A correction factor has been used to account for seasonal differences (**Table 12.2-3**; Voet *et al*. 2017) and to consider the probability of harbour porpoise being within the upper 2m of the water column (**Table 12.2-4**; Teilmann *et al*. 2013).

Table 12.2-3 Correction Factors Used for Harbour Porpoise (Voet et al. 2017)

Season	Correction Factor
Spring (Mar – May)	0.571
Summer (Jun – Aug)	0.547
Autumn (Sep – Nov)	0.455
Winter (Dec – Feb)	0.472

28. The depth above which harbour porpoise are available for detection has been estimated to be 2m by Teilmann *et al*. (2013) when correcting for availability bias during visual aerial surveys of harbour porpoise. The correction factors applied for harbour porpoise are dependent on the month and time of day (**Table 12.2-4**).

Table 12.2-4 Correction Factors Used to Account for the Availability Bias for Harbour Porpoise for Different Months and Times of Day (Taken from Teilmann et al. 2013)

Month	Behaviour			
	Surface		0 – 2m	
	09:00-15:00	15:00-21:00	09:00-15:00	15:00-21:00
January	0.0490	0.0476	0.4381	0.418614
February	0.0398	0.0384	0.3748	0.355348
March	0.0543	0.0529	0.4637	0.444271
April	0.0646	0.0632	0.5708	0.551331
May	0.0563	0.0549	0.5262	0.506735
June	0.0518	0.0503	0.5093	0.489809
July	0.0493	0.0479	0.5116	0.492099
August	0.0530	0.0516	0.4508	0.431293
September	0.0420	0.0406	0.4468	0.427348
October	0.0413	0.0399	0.4422	0.42276
November	0.0406	0.0392	0.4439	0.424431
December	0.0429	0.0415	0.4790	0.459555

29. The monthly absolute density estimates for harbour porpoise for the whole Project survey area, including buffer, are presented in **Table 12.2-5**. The number of unidentified individuals in a group (dolphin / porpoise, or marine mammal species) have been apportioned to the specific species that are contained within that group based on the relative abundance of the positively identified species in that month's survey (see **Appendix B** in document). For harbour porpoise only, this data has then been apportioned as outlined in **Paragraph 27**.

30. To present the most precautionary annual and seasonal averages, the maximum density from each survey month has been used for the estimations (**Table 12.2-5**). The highest density was estimated for the summer, which has been determined based on the average of the maximum monthly estimates for April to September. The lowest density was estimated for the winter, which has been determined based on the average of the maximum monthly estimates for October to March. The average annual density estimate has been determined based on the full 24 survey months aerial surveys.

31. The first winter in 2021 had an overall higher average maximum density (0.57 animals/km^2) than the following summer in 2022 (0.49 animals/km^2), possibly due to a spike in densities in November 2021 with 1.66 animals/km^2. On the contrary, the second winter surveys had a much lower density in harbour porpoise (0.44 animals/km^2) than the following summer in 2023 (0.68 animals/km^2), possibly due to a spike in densities in May 2023 with 1.44 animals/km^2. Overall, the average maximum densities for the summer or winter seasons over the two years are quite similar (**Table 12.2-5**).

Table 12.2-5 Apportioned Harbour Porpoise Absolute Density Estimates for Each Month, Corrected for Availability Bias, With Summer, Winter and Annual Density Estimates for the Survey Area and 4km buffer

Month	Absolute density estimate (corrected & apportioned) for whole survey area + 4km buffer
October 2021	0.57
November 2021	1.66
December 2021	0.39
January 2022	0.14
February 2022	0.21
March 2022	0.47
April 2022	1.35
May 2022	0.34
June 2022	0.90
July 2022	0.07
August 2022	0.11
September 2022	0.18

October 2022	0.11
November 2022	0.12
December 2022	0.05
January 2023	0.23
February 2023	1.04
March 2023	1.06
April 2023	0.41
May 2023	1.44
June 2023	1.29
July 2023	0.03
August 2023	0.42
September 2023	0.48
Average maximum for summer period (April-Sept)	**0.842**
Average maximum for winter period (Oct-Mar)	**0.825**
Annual maximum average	**0.833**

12.2.2.1.2.1.2. Harbour Porpoise Abundance Estimates

32. The abundance estimates for harbour porpoise (**Table 12.2-6**) have been corrected in the same way as the density estimates as outlined above. As for the densities, to present the most precautionary annual and seasonal averages, the maximum abundance and confident limit from each survey month has been used for the estimations.

Table 12.2-6 Apportioned Absolute Abundance Estimates of Harbour Porpoise Within Whole Survey Area Including 4km Buffer, Corrected for Availability Bias

Month	Abundance estimate (corrected) for number of harbour porpoise in survey area + 4km buffer	Lower and upper 95% confidence limits for abundance estimates

October 2021	347	144 - 575
November 2021	1,019	627 – 1,406
December 2021	236	112 - 355
January 2022	84	31 - 157
February 2022	126	53 - 200
March 2022	285	155 - 431
April 2022	825	345 – 1,604
May 2022	208	79 - 340
June 2022	550	402 - 696
July 2022	45	5 - 90
August 2022	70	9 - 162
September 2022	110	44 - 198
October 2022	65	22 - 109
November 2022	71	35 - 106
December 2022	31	3 - 63
January 2023	139	52 - 262
February 2023	638	449 - 848
March 2023	647	303 - 995
April 2023	251	114 - 394
May 2023	882	511 – 1,264
June 2023	790	326 – 1,513
July 2023	17	2 - 55
August 2023	260	126 - 415
September 2023	293	119 - 488
Annual average maximum (rounded)	**510**	**260 - 818**

12.2.2.2 Other Surveys Within the Dogger Bank Area

12.2.2.2.1 Dogger Bank South Surveys

33. APEM conducted the surveys for Dogger Bank South (DBS) East and West between March 2021 and February 2023. The results from both areas including a 4km buffer indicate that harbour porpoise was present in the highest number (n=1,473), followed by grey seal (n=150), common dolphin (n=4), white-beaked dolphin (n=27) and minke whale (n=9). Similar to findings at DBD, the number of unidentified seal species (n=112) was close to those of grey seal, and number of dolphin or porpoise species sightings were relatively common (n=96) (RWE, 2024).

12.2.2.2.2 Round 3 Dogger Bank Zone Survey

34. HiDef Aerial Surveying Limited (HiDef) carried out digital aerial video surveys over the Round 3 Dogger Bank zone. The transect surveys were used to generate species density and distribution maps for the area with a 4km buffer. Surveys took place from April 2010 until May 2012 (HiDef, 2012).

35. Harbour porpoise was the most numerous marine mammal recorded (n=6,244), recorded (see **Figure 12.2-4**), observed in every month of the year. Other marine mammals are presented on **Figure 12.2-5**, highlighting the year-round presence of white-beaked dolphin and grey seal. Minke whale were sighted only in six months, while the rarer species were seen only on one occasion throughout the survey year, e.g. a killer whale.

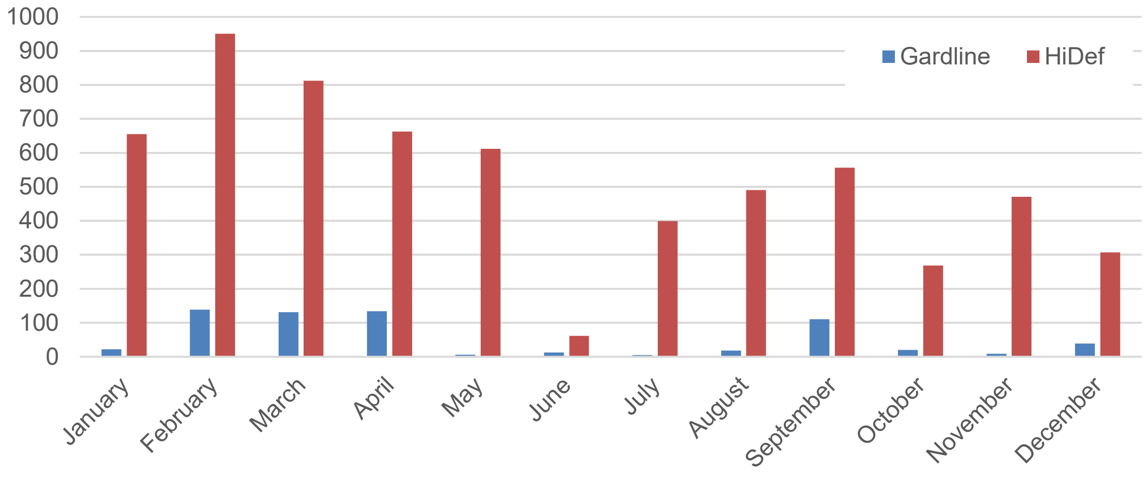


Figure 12.2-4 Sum of Harbour Porpoise Sightings by Month in the Dogger Bank Area by Gardline (during September 2010 to April 2012) and HiDef (April 2010 to December 2011) [Datasource: HiDef, 2012; Gardline, 2012].

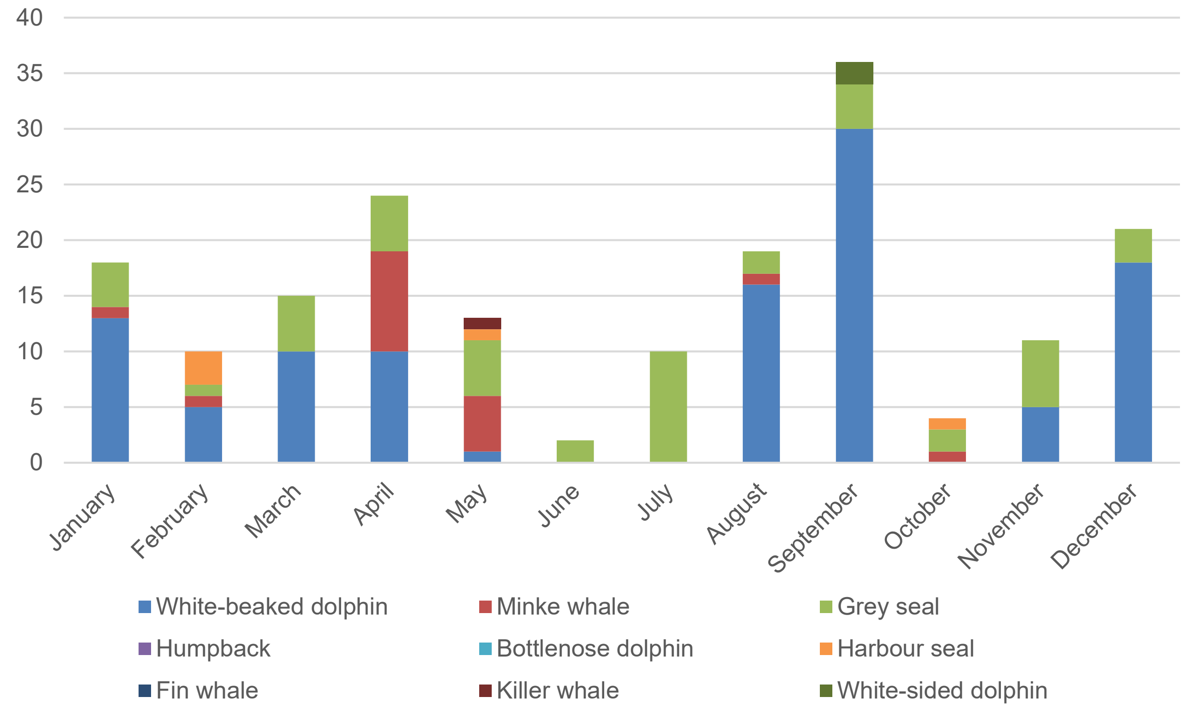


Figure 12.2-5 Sum of Marine Mammal Sightings by Month in the Dogger Bank Area by HiDef (during April 2010 and May [Datasource: HiDef, 2012].

12.2.2.2.3 Forewind Round 3 Dogger Bank Zone Surveys

36. Gardline Environmental Ltd. (Gardline) carried out boat-based ornithology surveys for the Forewind Round 3 Dogger Bank zone (Gardline, 2012), where incidental marine mammal sightings were recorded between September 2010 and April 2012.

37. Harbour porpoise (n=646) was seen almost throughout the entire year (see **Figure 12.2-4**), and together with white-beaked dolphin (n=558) were the most numerous marine mammal recorded (**Figure 12.2-6**). Minke whale were sighted on six separate occasions and rarer baleen whale visitors were humpback whale (n=4) and fin whale (n=2).

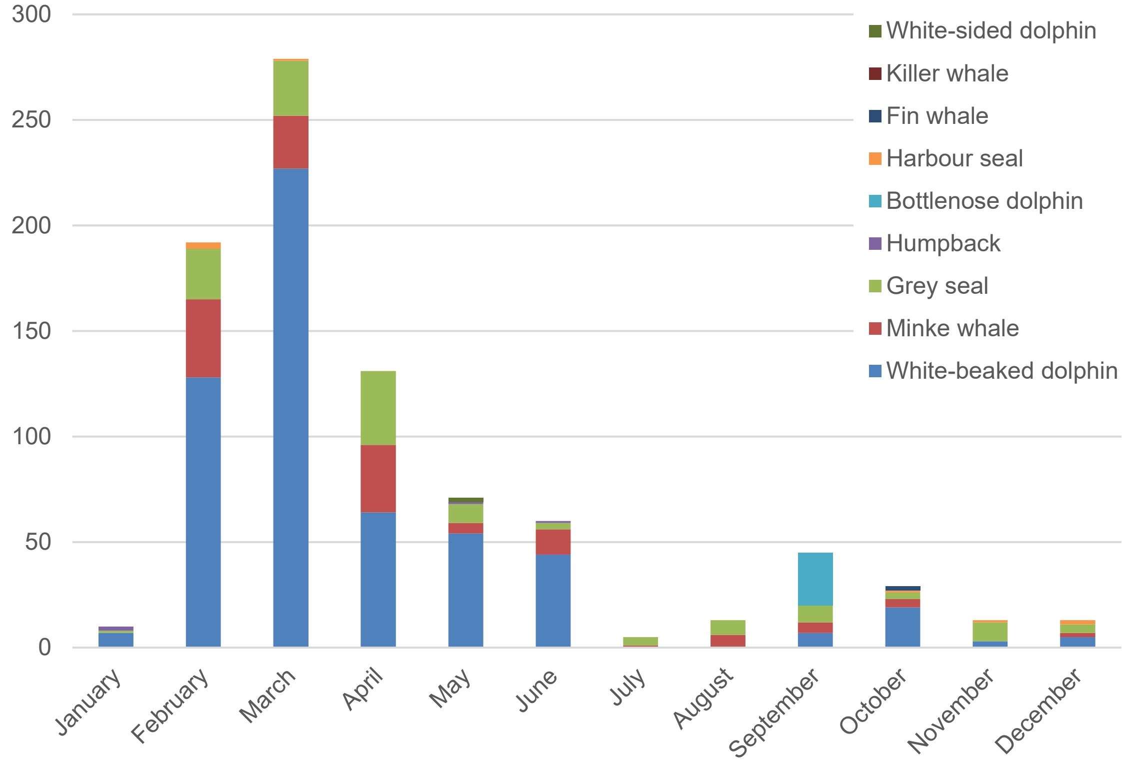


Figure 12.2-6 Sum of Marine Mammal Sightings by Month in the Dogger Bank Area by Gardline (during September 2010 to April 2012) and HiDef (April 2010 to December 2011) [Datasource: Gardline, 2012]

12.2.2.3 Key Desk Based Data Sources

12.2.2.3.1 SCANS surveys

38. A series of large-scale surveys for Small Cetaceans in European Atlantic waters and the North Sea (SCANS) was initiated in summer 1994 in the North Sea and adjacent waters (SCANS 1995; Hammond *et al*. 2002).

39. SCANS-II was undertaken in summer 2005 in all shelf waters (SCANS-II 2008; Hammond *et al*. 2013) and 2007 in offshore waters (Cetacean Offshore Distribution and Abundance in the European Atlantic (CODA), 2009).

40. SCANS-III was conducted in summer 2016 with the aim to survey all European Atlantic waters, however the final surveyed area excluded offshore waters of Portugal and also excluded waters to the south and west of Ireland which were surveyed by the Irish ObSERVE 2[1] project (Hammond *et al*. 2021). The Project lies within the boundaries of block N.

41. In October 2023, the SCANS-IV report was released with data collected during the summer 2022 (Gilles *et al*. 2023), with the aim to inform the upcoming MSFD in European Atlantic Waters in 2024. This survey included the offshore waters of Portugal which had not been previously surveyed as part of SCANS, but excluded waters south and west of Ireland, which were surveyed by the ObSERVE 2, and coastal Norwegian waters north of Vestfjorden. Some of the block boundaries have changed since SCANS-III but have not affected the block in which the Project lies (block NS-H).

42. With reference to **Figure 12.2-7** for SCANS-III and **Figure 12.2-8** for SCANS-IV, pink lettered blocks were surveyed by air and blue numbered blocks were surveyed by ship. Blocks coloured green to the south, west and north of Ireland were surveyed by the Irish ObSERVE project. SCANS-III blocks FC and FW coloured yellow were surveyed by the Faroe Islands as part of the North Atlantic Sightings Survey in 2015. The cross-hatched area is where SCANS-IV blocks BB-3 and BB-A overlapped.

[1] A survey of marine megafauna in Irish offshore waters between 2021 and 2025; see https://www.marei.ie/project/observe-ii/ for more details

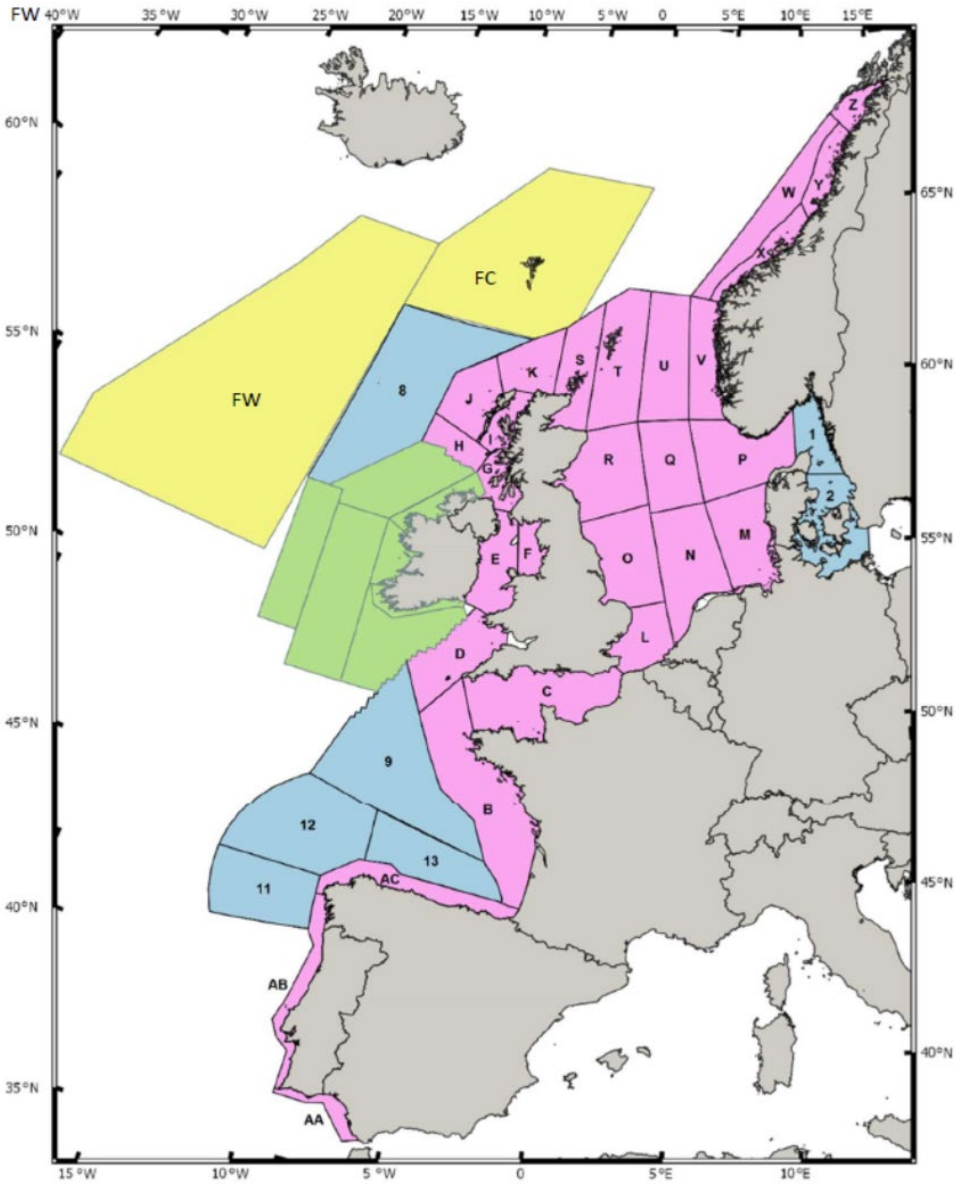


Figure 12.2-7 Area covered by SCANS-III and Adjacent Surveys (Hammond et al. 2021)

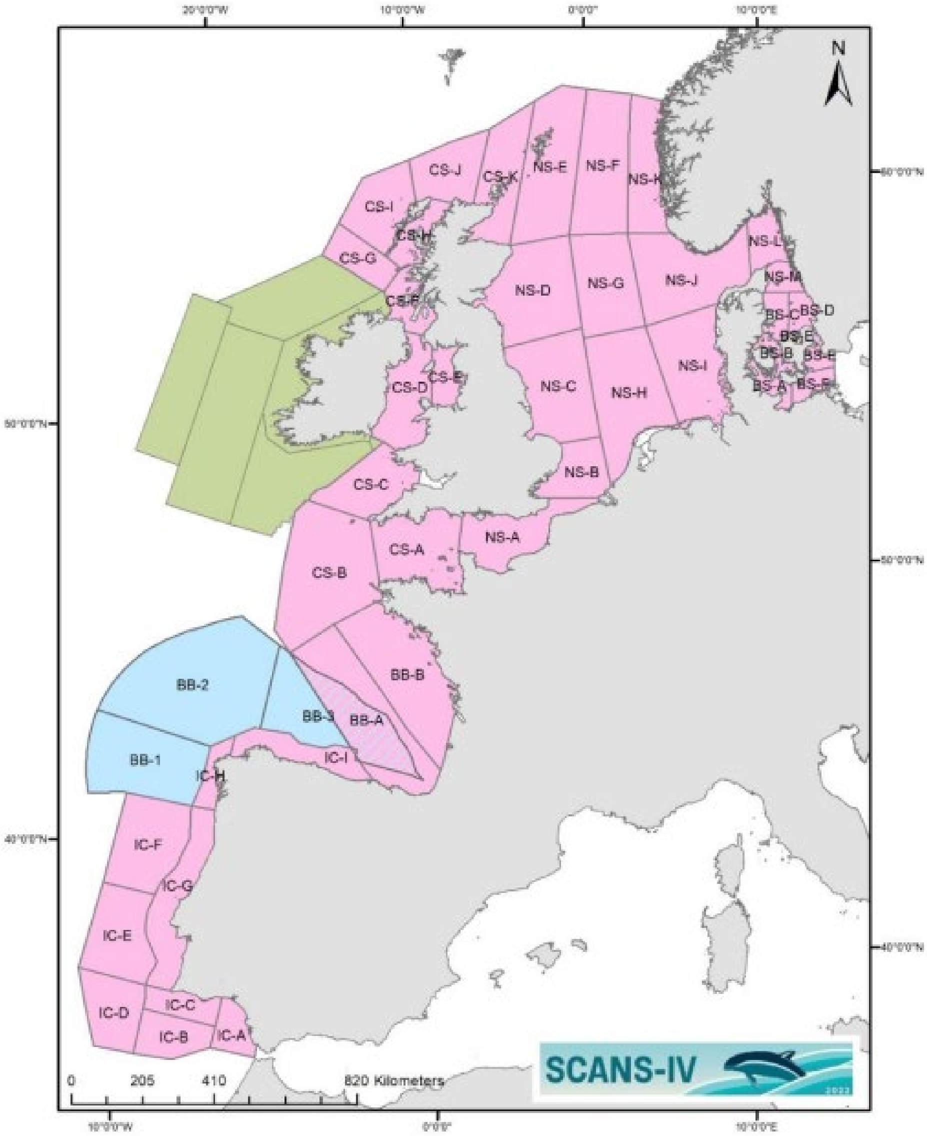


Figure 12.2-8 Area covered by SCANS-IV and Adjacent Surveys (Gilles et al. 2023)

12.2.2.3.2 Other Surveys and Data Sources

43. The following **Table 12.2-7** outlines additional available survey data that informs the baseline for marine mammals.

Table 12.2-7 Data Sources and Surveys Relevant to the Project Area

Data Source	Date	Data Contents
Creyke Beck Zone 3 Dogger Bank (Forewind, 2013)	Surveys undertaken from 2009 to 2011	Statistical analyses of high-definition aerial survey marine mammal observation survey data for the Dogger Bank development zone.
Revised Phase III data analysis of Joint Cetacean Protocol (JCP) data resources (Paxton *et al*. 2016)	Data from a range of sources, analysed and reported on in 2015 and 2016.	Density mapping for the most common cetacean species in UK waters.
Joint Cetacean Data Protocol (online data resource)	Various	Sightings and survey data from a large number of surveys within UK waters.
Distribution maps of cetacean and seabird populations in the North-East Atlantic (Waggitt *et al*. 2019)	Data from a range of sources, analysed and reported on in 2019.	Density mapping for the most common cetacean species in European and North-East Atlantic waters for each month.
Scientific Advice on Matters Related to the Management of Seal Populations (SCOS, 2021 and 2022)	August surveys undertaken in years 2021 and 2022.	Updated data and information on grey seal and harbour in the UK. Includes the most recent haul-out counts and population estimates for each seal MU in the UK.
Seal telemetry data (e.g. Sharples *et al*. 2008 & 2012; Carter *et al*. 2017 & 2022; Jones *et al*. 2017; Russel & McConnel, 2014; Vincent *et al*. 2017; Russel *et al*. 2016; Matthiopoulos *et al*. 2004	Various	Provides the results of seal tagging studies in the UK and Europe, to provide an indication of seal movements.
Updated Seal Usage Maps: The Estimated at-sea Distribution of Grey and Harbour Seals (Carter *et al*. 2022)	Data from a range of sources, analysed and reported on in 2022.	Provides grey seal and harbour seal density estimates for UK waters, and for each seal designated Special Area of Conservation (SAC).
Sea Watch Foundation (SWF) volunteer sightings off eastern England (SWF, 2024)	Public sightings database (currently available data from October 2023 until October 2024).	Public sightings database, records of marine mammals at locations around the UK.

Data Source	Date	Data Contents
MU for cetaceans in UK waters (IAMMWG, 2023)	Data from a range of sources, analysed and reported on in 2022.	MU areas and abundance estimates for the most comment cetacean species in the UK.

12.2.3 Baseline Environment

44. The Study Area for marine mammals has been defined on the basis that marine mammals are highly mobile and transitory in nature. It is, therefore, necessary to examine species occurrence not only within the wind farm site, but also over the wider area. Baseline data from developments and research projects in the wider North-east have been evaluated to determine species in the wider area of the Project.

12.2.3.1 Harbour Porpoise

12.2.3.1.1 Abundance

45. Harbour porpoise within the eastern North Atlantic are generally considered to be part of a continuous biological population that extends from the French coastline of the Bay of Biscay to northern Norway and Iceland (Tolley & Rosel, 2006; Fontaine *et al.* 2007, 2014; IAMMWG, 2023). However, for conservation and management purposes, it is necessary to consider this population within smaller MUs. MUs provide an indication of the spatial scales at which effects of plans and projects alone, and in-combination, need to be assessed for the key cetacean species in UK waters, with consistency across the UK (IAMMWG, 2023).

46. IAMMWG defined three MUs for harbour porpoise: NS MU; West Scotland (WS) MU; and the Celtic and Irish Sea (CIS) MU. As outlined in **Section 12.2.1.1** of this Appendix, the Project is located within the NS MU (**Figure 12.2-1**) with an estimated population of 346,601 (CV = 0.09) individuals. A more recent abundance estimate has been published in the SCANS-IV survey, indicating that there are 338,918 harbour porpoise in the North Sea Assessment Unit (AU) (Gilles *et al.* 2023).

47. As outlined in **Section 12.2.2.1.2.1**, harbour porpoise was the most commonly sighted marine mammal species during the site-specific surveys, with a total of 795 individuals recorded for the 24-month survey period. Harbour porpoise were recorded in all 24 months and across the entire survey area.

48. Heinänen and Skov (2015) identified one area of high harbour porpoise density in the summer period, from the western slopes of Dogger Bank south along a 30m depth contour towards an area off the Norfolk coast. High densities in winter were also identified in the southern North Sea, within an area between Flamborough Head and the outer Thames Estuary. In the area of the offshore export cable corridor (ECC) and DBD Array Area, densities of harbour porpoise were predicted to be high.

12.2.3.1.2 Density

49. The JCP Phase III Report (Paxton *et al*. 2016) identified high harbour porpoise density distributions during summer in the southern North Sea in the vicinity of the Project area. Similar observations were made by Gilles *et al*. (2016), where modelled habitat- prediction maps indicated that in spring there were higher density areas in the southern and south-eastern part of the North Sea. During the summer season, the predicted density distribution of harbour porpoise dispersed east over the central North Sea. Compared to summer, during autumn, densities overall decreased, likely due to survey efforts, or a shift of harbour porpoise distribution. There are growing suggestions that the distribution of harbour porpoise within their range in the North Sea is shifting southwards (International Fund for Animal Welfare (IFAW) and Marine Conservation Research International (MCRI), 2012; Hammond *et al*. 2013, 2021; Isseldijk *et al*. 2020).

50. For cetacean species around Europe within the North-East Atlantic, Waggitt *et al*. (2019) developed distribution and abundance maps. For harbour porpoise, the distribution maps show a clear pattern of high harbour porpoise density in the southern North Sea, and the coasts of south-east England, for both January and July (**Figure 12.2-9**). The distribution maps are limited in that they should only be used to show general, broad-scale distributions of species. According to Waggitt *et al*. (2019), these densities should not be used for fine-scale distributions.

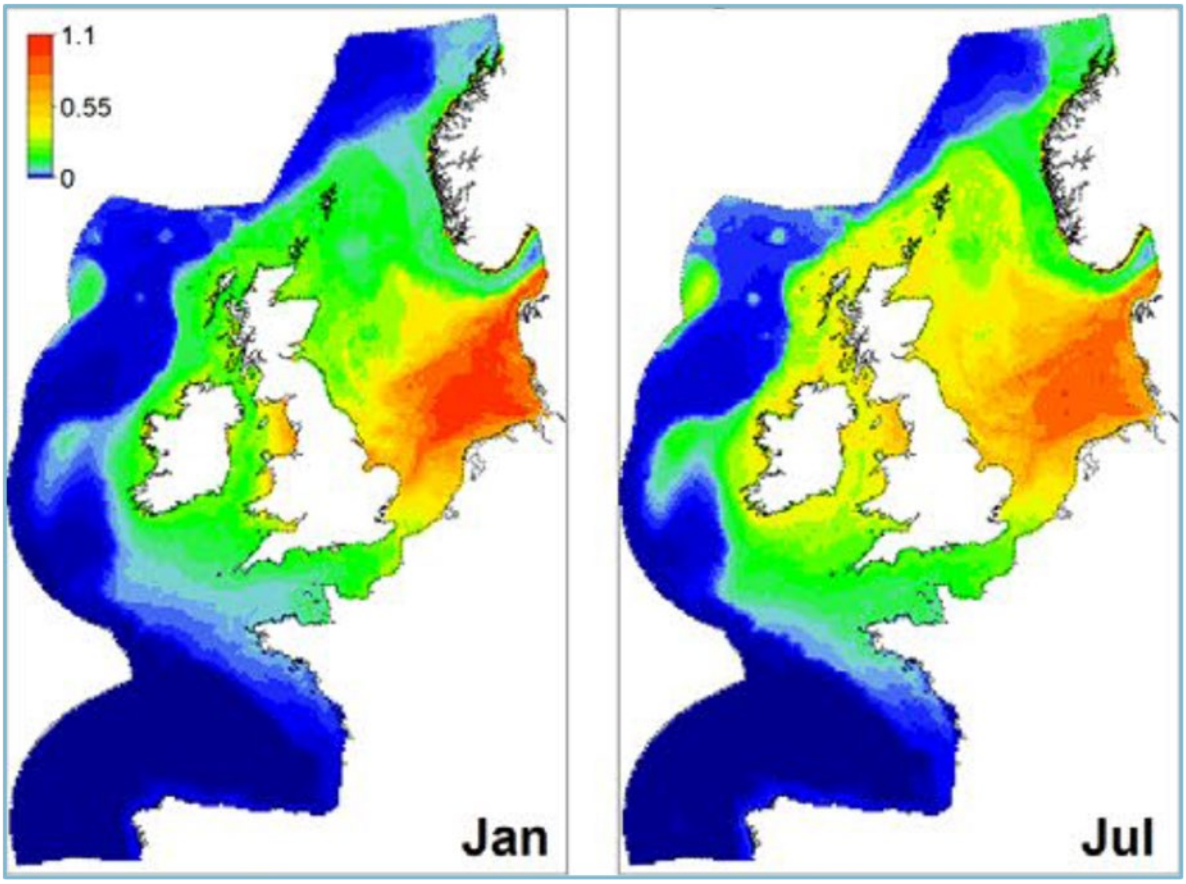


Figure 12.2-9 Spatial Variation in Predicted Densities (Individuals per km of Harbour Porpoise in January and July in The North-East Atlantic). Values are Provided at 10km Resolution (Waggitt et al. 2019)

51. Similarly to previous findings, the distribution of estimated density over the SCANS-III (Hammond *et al.* 2021) and SCANS-IV (Gilles *et al.* 2023) survey area indicate that the occurrence of harbour porpoise is greater in southern areas of the North Sea when compared to northern areas of the North Sea (**Figure 12.2-10** and **Figure 12.2-11**).

52. Since SCANS-III, the density of harbour porpoises in SCANS-IV has remained nearly the same with 0.837 animals/km^2 (in block N) and 0.8034 animals/km^2 (CV = 0.241) (in block NS-H), although the estimated abundance changed slightly between the 2017 and 2022 survey, in which numbers decreased from 58,066 (95% Confidence Limit (CL) = 32,372 - 91,372) to 55,691 individuals (95% CL = 33,836 – 87,685; block NS-H). These findings contribute to the existing suggestion of a southward shift mentioned above.

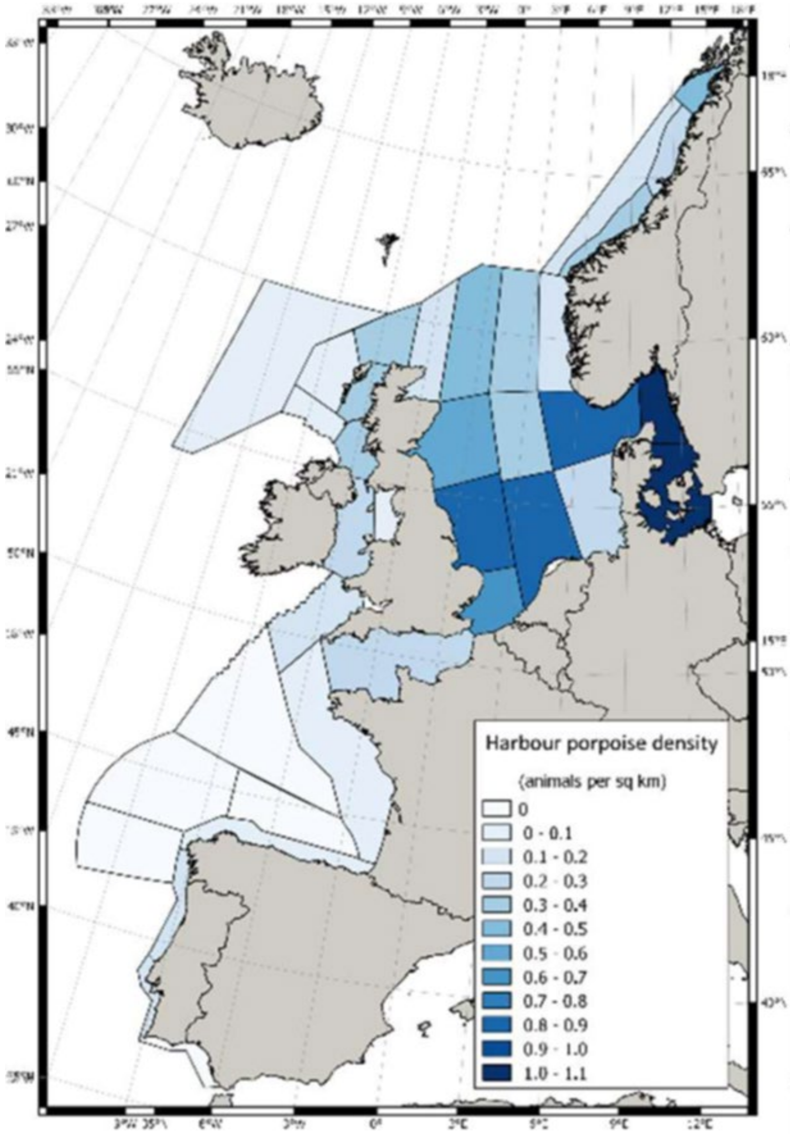


Figure 12.2-10 Estimated Density in Each Survey Block for Harbour Porpoise From SCANS-III (Hammond et al. 2021)

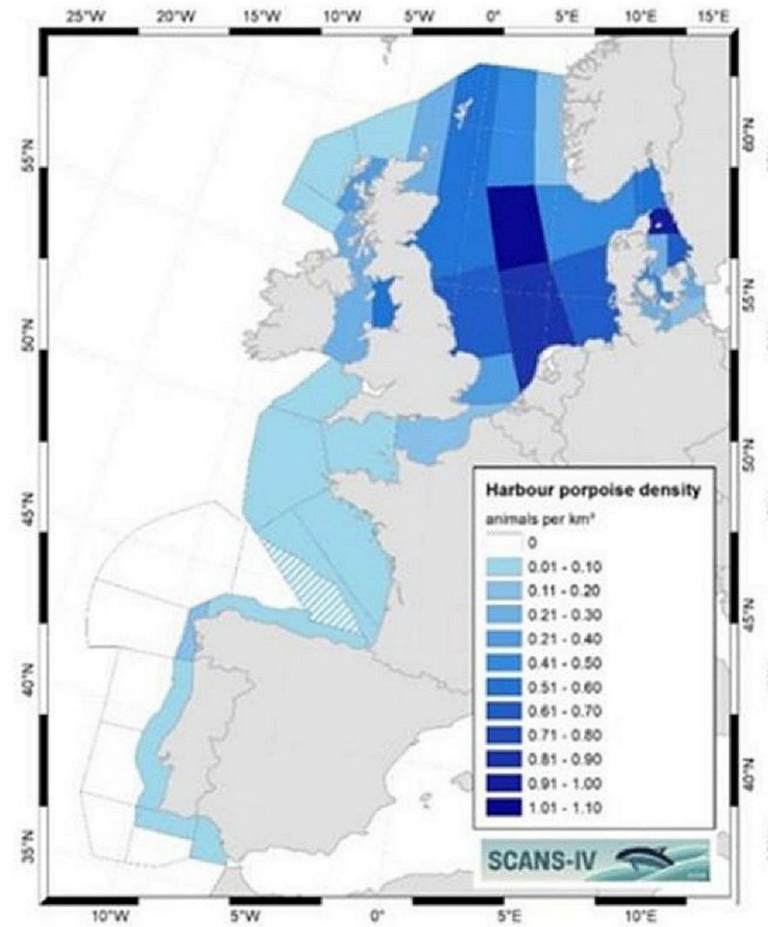


Figure 12.2-11 Estimated Density in Each Survey Block for Harbour Porpoise from SCANS-IV (Gilles et al. 2023)

53. The offshore ECC lies within SCANS-IV block NS-C, where the density (0.6027 animals/km^2; CV=0.228) and population abundance (36,286; 95% CL = 23,346 – 56,118) is lower than in the DBD Array Area block NS-H.

54. The Waggitt *et al*. (2019) dataset has its limitations with regard to fine-scale use. To allow for a more accurate comparison of the species densities across the different data sets, the average for seasonal and annual periods across the area of the SCANS block where the Project is located have been calculated using the Waggitt *et al*. (2019) dataset.

55. Therefore, the Waggitt *et al.* (2019) data was applied across the SCANS-IV block NS-H in which the DBD Array Area lies, as well as over block NS-C in which the offshore ECC is situated. This method allowed to identify another possible density estimate for the species for the relevant offshore components for DBD (**Table 12.2-8**).

Table 12.2-8 Density Overview for Harbour Porpoise using Waggitt et al. (2019) Data over SCANS-IV Block NS-H and NS-C

Scenario	Season	Density (animals/km^2)	Source
Waggitt *et al.* (2019) over SCANS-IV block NS-H for DBD Array Area	Summer	0.800	Waggitt *et al.* 2019
	Winter	**0.836**	
	Annual	0.818	
Waggitt *et al.* (2019) over SCANS-IV block NS-C for offshore ECC	**Summer**	**0.574**	
	Winter	0.545	
	Annual	0.559	

56. Having compared all possible densities for harbour porpoise, the following worst-case densities were taken forward for the impact assessment (see overview in **Table 12.2-17**):

- **0.842** harbour porpoise/km^2 for DBD Array Area (site-specific +4km buffer APEM survey); and
- **0.6027** harbour porpoise/km^2 for offshore ECC (SCANS-IV block NS-C).

12.2.3.1.3 Diet

57. The distribution and occurrence of harbour porpoise, as well as other marine mammal species, is most likely to be related to the availability and distribution of their prey species. They tend to concentrate their movements in small focal regions (Johnston *et al.* 2005), which often approximate to particular topographic (Isojunno *et al.* 2012; Brookes *et al.* 2013, Stalder *et al.* 2020) and oceanographic features (Weir and O'Brien 2000, Johnston *et al.* 2005, Embling *et al.* 2009, Marubini *et al.* 2009, Waggitt *et al.* 2018, Bouveroux *et al.* 2020) that are associated with prey aggregations (Sveegaard *et al.* 2012). Consequently, habitat use is highly correlated with prey density rather than any particular habitat type (e.g. Sveegaard *et al.* 2012).

58. Harbour porpoise are generalist feeders, and their diet reflects available prey in an area. Therefore, their diet varies geographically, seasonally, and annually, reflecting changes in available food resources and differences in diet between sexes or age classes may also exist. The diet of the harbour porpoise consists of a wide variety of fish, including pelagic schooling fish, as well as demersal and benthic species, especially Gadoids, Clupeids and sandeels (Börjesson *et al.* 2003; Santos and Pierce 2003; Santos *et al.* 2004; Sveegaard *et al.* 2012).

59. Harbour porpoise have relatively high daily energy demands and need to capture enough prey to meet its daily energy requirements. They must be near abundant food sources and are driven by the need to feed constantly (Read & Hohn 1995, Johnston *et al*. 2005, Wisniewska *et al*. 2016). However, it has been estimated that, depending on the conditions, harbour porpoise can rely on stored energy (primarily blubber) for three to five days, depending on body condition (Kastelein *et al*. 1997).

12.2.3.2 Bottlenose Dolphin

12.2.3.2.1 Abundance

60. Throughout its range, the bottlenose dolphin occurs in a diverse range of habitats, from shallow estuaries and bays, coastal waters, continental shelf edge and deep open offshore ocean waters. However, it is primarily an inshore species, with most sightings within 10km of land, but they can also occur offshore, often in association with other cetaceans.

61. It has been determined that there are two ‘eco-types’ of bottlenose dolphin present in Europe, the coastal type and the pelagic type, and that these types are genetically and ecologically different from each other (Louis *et al*. 2014; Oudejans *et al*. 2015; Department of Business, Energy and Industrial Strategy (BEIS), 2022).

62. In coastal waters, bottlenose dolphin are often associated with river estuaries (Ingram & Roger, 2002), steep benthic slopes (Wilson *et al*. 1997, Ingram & Rogan, 2002), headlands or sandbanks, where there is uneven bottom relief and / or strong tidal currents (e.g. Lewis and Evans 1993; Wilson *et al*.1997; Liret *et al*. 1998; Liret, 2001; Ingram & Rogan 2002; Reid *et al*. 2003, Moreno & Mathews, 2018).

63. A resident population of bottlenose dolphin is present in the Moray Firth, with an estimated 226 individuals (95% CI: 214 – 239; Cheney *et al.* 2024). Historically, very few sightings of bottlenose dolphin were recorded further south on the east coast of the UK. In recent years an increase in bottlenose dolphins along the coastline of north-east England have been reported (Aynsley, 2017; Hacket, 2022). They have been recorded approximately 480km outside of what would be considered their ‘normal’ home range (Cheney *et al*. 2018), with one individual from the Moray Firth population being recorded as far south and east as The Netherlands (Hoekendijk *et al*. 2021). Whilst bottlenose dolphin presence has been increasing in north-east England in recent years, they appear to be a coastal population at present (Hacket, 2022).

64. Further evidence that bottlenose dolphin are indeed utilising the coastal area of Northumberland, was confirmed in most recent research by Sharpe & Berggren (2024) in which dolphin click detection was recorded year-round at three nearshore locations (Drurdige Bay, Newbiggin, St. Mary's) with peaks in May and September. Other locations with numerous sightings were Scarborough, Hartlepool, Seahouses, and Berwick-upon-Tweed (Hackett, 2022).

65. Bottlenose dolphin presence was not recorded in survey block N (in which the DBD Array Area is located) during the SCANS-III surveys, however, during SCANS-IV an estimated population of up to 96 (CL: 1 - 344) bottlenose dolphin were recorded in block NS-H (within which the DBD Array Area is located). This block and block NS-C were the only two blocks in the central North Sea in which bottlenose dolphin were sighted, although the SCANS-IV surveys included both the coastal and the offshore ecotype of bottlenose dolphin in their counts.

66. As outlined in **Section 12.2.1.1** of this Appendix, the Project is located within the GNS MU (**Figure 12.2-1**), with an estimated reference population of is 2,022 (CV = 0.75) individuals (IAMMWG, 2023).

67. As mentioned above observations were made that bottlenose dolphin from the Moray Firth are traveling as far south as Flamborough Head. As such, there is the possibility that individuals from this resident population, which is part of the Coast East Scotland (CES) MU, may be affected from DBD. PEIR will also consider the population of 226 (95% CI: 214 – 239; Cheney *et al*. 2024) in all relevant assessments.

12.2.3.2.2 Density

68. The results of the JCP Phase III Report (Paxton *et al*. 2016) identified that for bottlenose dolphins, densities are low across much of UK waters. The animals are considered a coastal species, with higher densities off the west coast of Wales, and within the Moray Firth on the east coast of England.

69. The seasonal distribution of the offshore ecotype of bottlenose dolphin were captured by Waggitt *et al*. (2019) showing a clear pattern of higher density to the western coastal areas of the UK, extending southwards to the Bay of Biscay (**Figure 12.2-12**). The distribution maps indicate a 'corridor' of increased bottlenose dolphin density travelling from west of Scotland, southwards around the west coast of Northern Ireland and the Republic of Ireland, and through the centre of the Bay of Biscay. The distribution maps are limited in that they should only be used to show general, broad-scale distributions of species. According to Waggitt *et al*. (2019), these densities should not be used for fine-scale distributions.

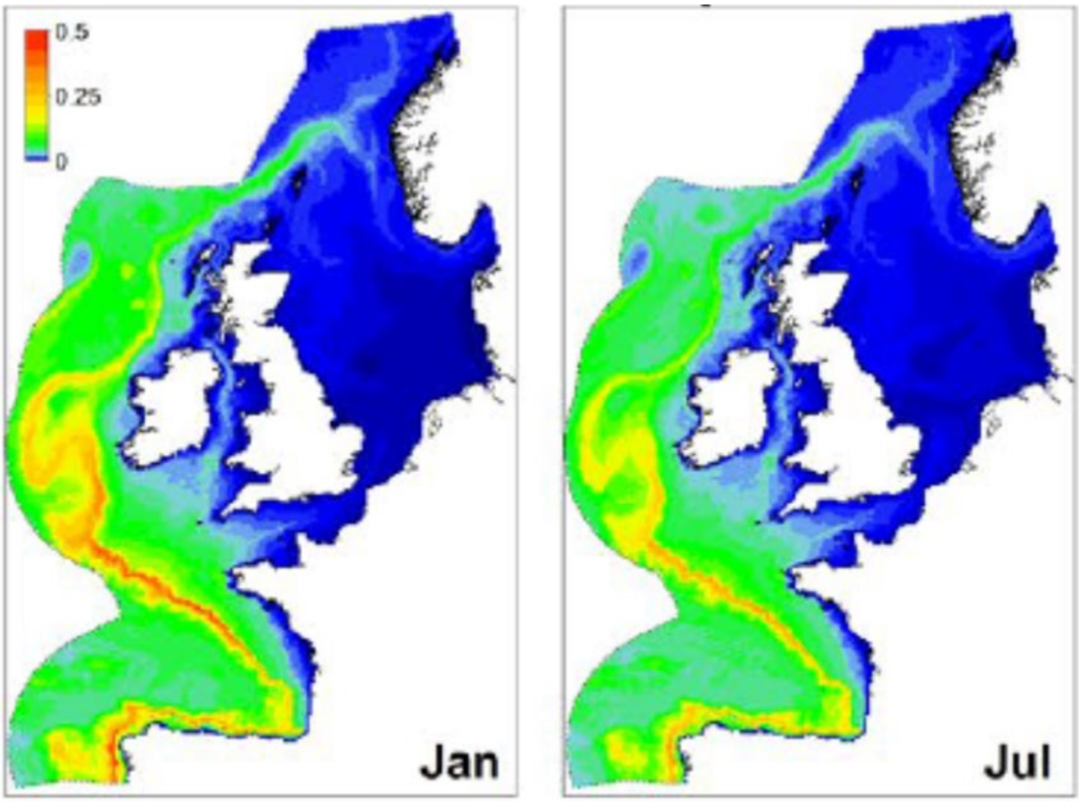


Figure 12.2-12 Spatial Variation in Predicted Densities (Individuals Per km of the Offshore Ecotype Bottlenose Dolphin in January and July in the North-East Atlantic). Values are Provided at 10km Resolution (Waggitt et al. 2019)

70. Distribution of estimated density over the SCANS-III and IV survey area indicate that the occurrence of bottlenose dolphin is much greater in the Celtic and Irish Sea compared to the North Sea (**Figure 12.2-13** and **Figure 12.2-14**).

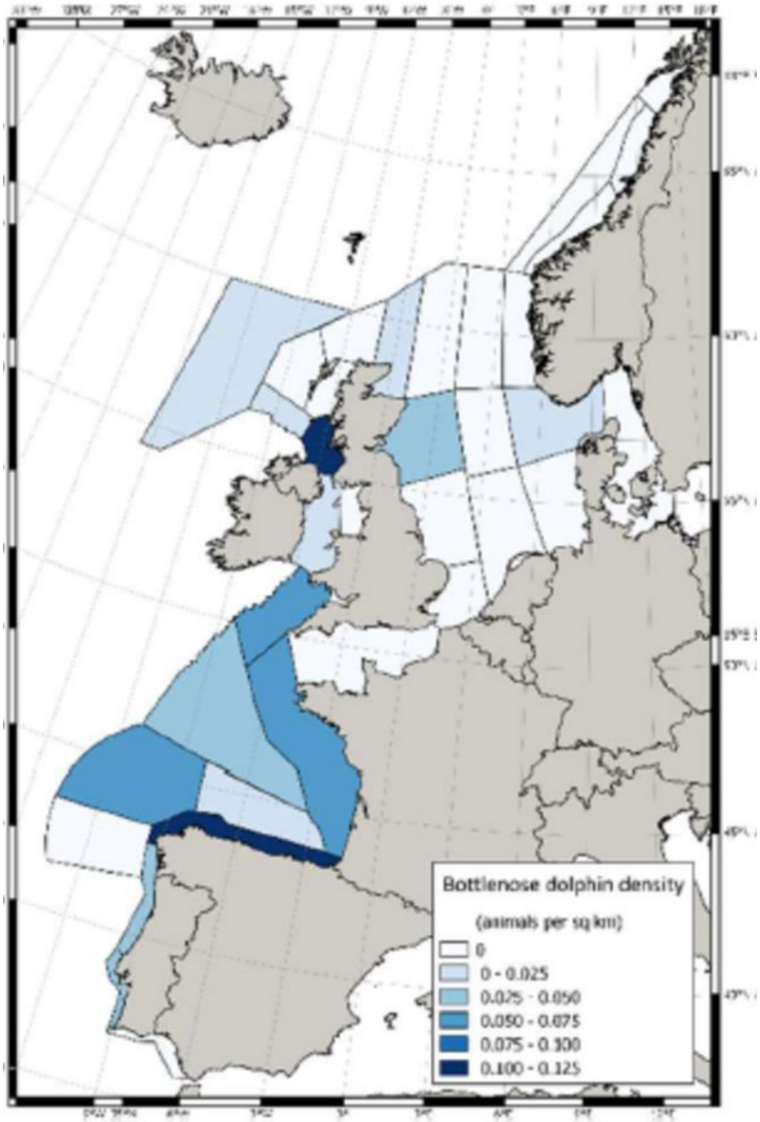


Figure 12.2-13 Estimated Density in Each Survey Block for Bottlenose Dolphin From SCANS-III (Hammond et al. 2021)

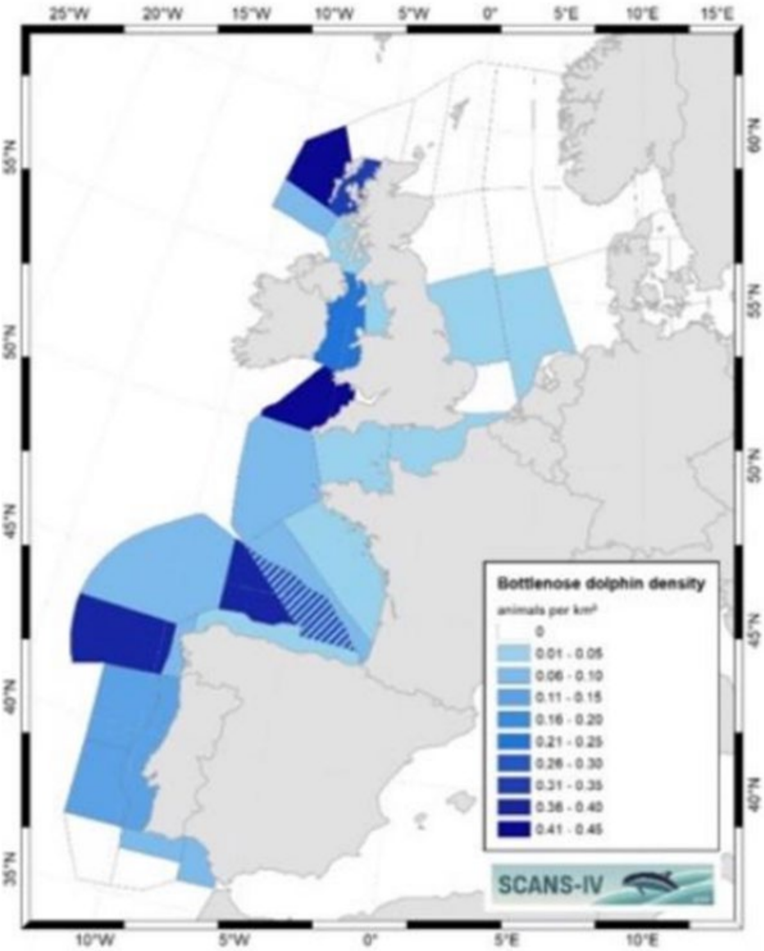


Figure 12.2-14 Estimated Density in Each Survey Block for Bottlenose from SCANS-IV (Gilles et al. 2023)

71. No bottlenose dolphins were recorded during SCANS-III (block N; Hammond *et al.* 2021). During SCANS-IV in block NS-H in which the DBD Array Area is located, an estimated abundance of 96 (95% CL: 1- 344) bottlenose dolphin were made, with a density of 0.0014 animals/km^2 (CV=0.994). However, in block NS-C (location of the offshore ECC) has a density of 0.0419 animals/km^2 (CV=0.683) with an estimated abundance of 2,520 (95% CL: 57 – 6,616) (Gilles *et al.* 2023).

72. In comparison to the density in the DBD Array Area, the block in which the offshore ECC is situated (NS-C) has a much higher density (0.0213 animals/km^2) and abundance (2,520; 95% CL: 57 – 6,616). As bottlenose dolphin in the UK are more likely to be from the inshore ecotype, the difference in abundance between the offshore block NS-H and block NS-C featuring much of the coastline underlines this observation.

73. The Waggitt *et al*. (2019) dataset has its limitations with regard to fine-scale use. To allow for a more accurate comparison of the species densities across the different data sets, the average for seasonal and annual periods across the area of the SCANS block where the Project is located have been calculated using the Waggitt *et al*. (2019) dataset

74. Therefore, the Waggitt *et al.* (2019) data was applied across the SCANS-IV block NS-H in which the DBD Array Area lies, as well as over block NS-C in which the offshore ECC is situated. This method allowed to identify another possible density estimate for the species for the relevant offshore components for DBD (**Table 12.2-9**).

Table 12.2-9 Density Overview for Bottlenose Dolphin using Waggitt et al. (2019) Data over SCANS-IV Block NS-H and NS-C (Highest Densities in Bold)

Scenario	Season	Density (animals/km^2)	Source
Waggitt *et al*. (2019) over SCANS-IV block NS-H for DBD Array Area	Summer	**0.00050**	Waggitt *et al*. 2019
	Winter	0.00030	
	Annual	0.00040	
Waggitt *et al*. (2019) over SCANS-IV block NS-C for offshore ECC	Summer	**0.0009**	
	Winter	0.0007	
	Annual	0.0008	

75. Having compared all possible densities for bottlenose dolphin, the following worst-case densities were taken forward for the impact assessment (see overview in **Table 12.2-17**):

- **0.0014** bottlenose dolphin /km^2 for DBD Array Area (SCANS-IV block NS-H); and
- **0.0213** bottlenose dolphin /km^2 for offshore ECC (SCANS-IV; block NS-C).

12.2.3.2.3 Diet

76. Bottlenose dolphin are opportunistic feeders and take a wide variety of fish and invertebrate species. Benthic and pelagic fish (both solitary and schooling species), including:

- Haddock Melanogrammus aeglefinus;
- Saithe Pollachius virens;

- Pollock Pollachius pollachius;
- Cod Gadus morhua;
- Whiting Merlangius merlangus;
- Hake Merluccius merluccius;
- Bass Dicentrarchus labrax;
- Mullet Mugilidae;
- Mackerel Scombridae;
- Salmon Salmo salar;
- Sea trout Salmo trutta trutta;;
- Flounder Platichthys flesus
- Sprat Sprattus sprattus;
- Sandeels Ammodytidae; and
- Blue whiting Micromesistius poutassou.

77. Octopus and other cephalopods have also all been recorded in the diet of bottlenose dolphin (Santos *et al.* 2001; Santos *et al.* 2004; Reid *et al.* 2003).

78. Diet analysis suggests that bottlenose dolphin are selective opportunists and although they may have preference for a type of prey, their diet seems to be determined largely by prey availability. Research in Australia has shown that when presented with a choice, they will preferentially feed on certain types of prey, particularly those with a high fat content (Corkeron *et al.* 1990).

79. Analysis of the stomach contents of ten bottlenose dolphin in Scottish waters, from 1990 to 1999, reveals that the main prey are cod (29.6% by weight), saithe (23.6% by weight), and whiting (23.4% by weight), although other species including salmon (5.8% by weight), haddock (5.4% by weight) and cephalopods (2.5% by weight) were also identified in lower number (Santos *et al.* 2001).

80. In Irish waters, haddock, saithe and pollock are the dominant prey species ingested, followed by whiting, blue whiting, Atlantic mackerel and horse mackerel; cephalopods are also important (Hernandez-Milian *et al.* 2015).

12.2.3.3 Common Dolphin

12.2.3.3.1 Abundance

81. As reviewed in BEIS (2022), during summer common dolphin are widely distributed throughout the north-east Atlantic, from coastal waters to the mid-Atlantic ridge, from the Azores and the Strait of Gibraltar to Norway, with the majority of sightings having been reported in waters south of 60°C (Murphy *et al.* 2013). Analysis of summer sightings on shelf waters around the UK and adjacent waters showed the vast majority of common dolphins to occur in waters above 14°C in temperature (MacLeod *et al*. 2008; Cañadas *et al*. 2009). Strong seasonal shifts in their distribution have been noted, with winter inshore movements onto the Celtic Shelf and into the western English Channel and St. George's Channel resulting in pronounced concentrations (Northridge *et al.* 2004).

82. Information on dispersal patterns and site fidelity is scarce, thus the reference population for common dolphin are based on that of the CGNS MU, as outlined in **Section 12.2.1.1** (**Table 12.2-1**) and are estimated to be 102,656 (CV = 0.29) animals (IAMMWG, 2023).

83. There is very little literature on common dolphins in the North Sea, however it is documented that they have a seasonal occurrence in the North Sea in the summer months (Waggitt *et al*. 2019).

84. Results from ORCA (Organisation Cetacea) surveys carried out yearly have recorded 20 sightings of common dolphins with 52 individuals from 2006 to 2017 in the summer months in the North Sea (ORCA, 2024).

12.2.3.3.2 Density

85. The results of the JCP Phase III Report (Paxton *et al*. 2016) identified that for common dolphin, densities are high across much of UK waters, but were very low in the Dogger Bank area.

86. Distribution maps developed by Waggitt *et al*. (2019) show a clear pattern of higher density to the western coastal areas of the UK, extending south to the Bay of Biscay (**Figure 12.2-15**). Densities of common dolphin in the North Sea are very low in comparison. There are indications of a 'corridor' of increased common dolphin density travelling from west of Scotland, southwards around the west coast of the Northern Ireland and the Republic of Ireland, and through the centre of the Bay of Biscay, with little occurrence in the North Sea. The distribution maps are limited in that they should only be used to show general, broad-scale distributions of species. According to Waggitt et al. (2019), these densities should not be used for fine-scale distributions.

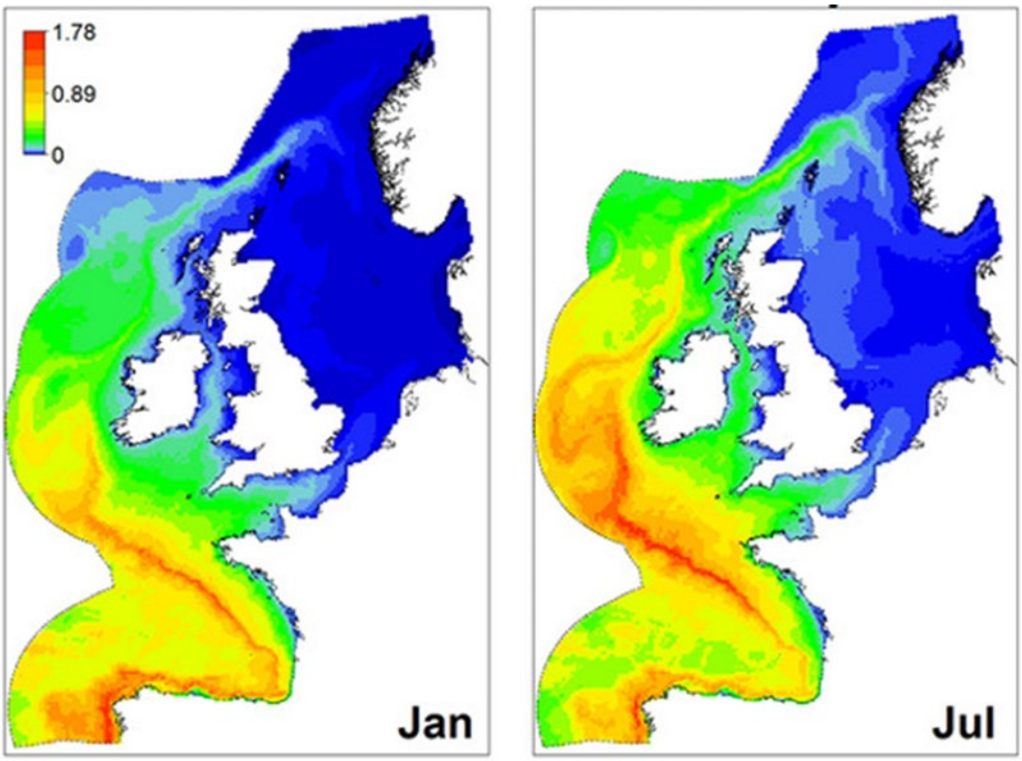


Figure 12.2-15 Spatial Variation in Predicted Densities Individuals per km of Common Dolphin in January and July in the North-East Atlantic). Values are Provided at 10km Resolution. Source: Waggitt et al. 2019.

87. No common dolphins were observed in block N (in which the Project is located), nor any other neighbouring blocks within the North Sea (blocks R, Q or L) during the SCANS-III surveys in July (**Figure 12.2-16**).

88. During SCANS-IV (Gilles *et al.* 2023), no common dolphin were sighted in block NS-H (in which DBD Array Area is located) (**Figure 12.2-17**), only in neighbouring blocks NS-C (location of offshore ECC) (density of 0.0032 animals/km^2 (CV = 0.966)) with an estimated abundance of 192 animals (95% CL: 6 - 724) and block NS-I (density of 0.0006 animals/km^2 (CV = 1.042)).

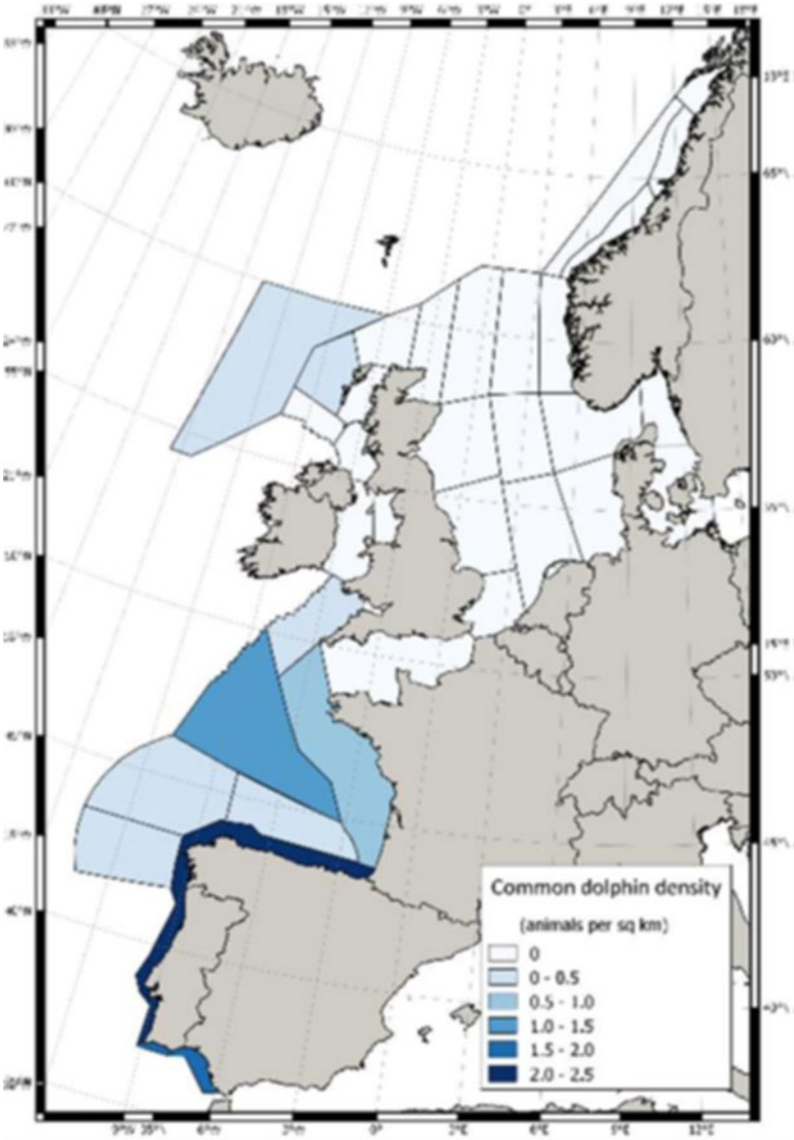


Figure 12.2-16 Estimated Density in Each Survey Block for Common Dolphin from SCANS-III (Hammond et al. 2021)

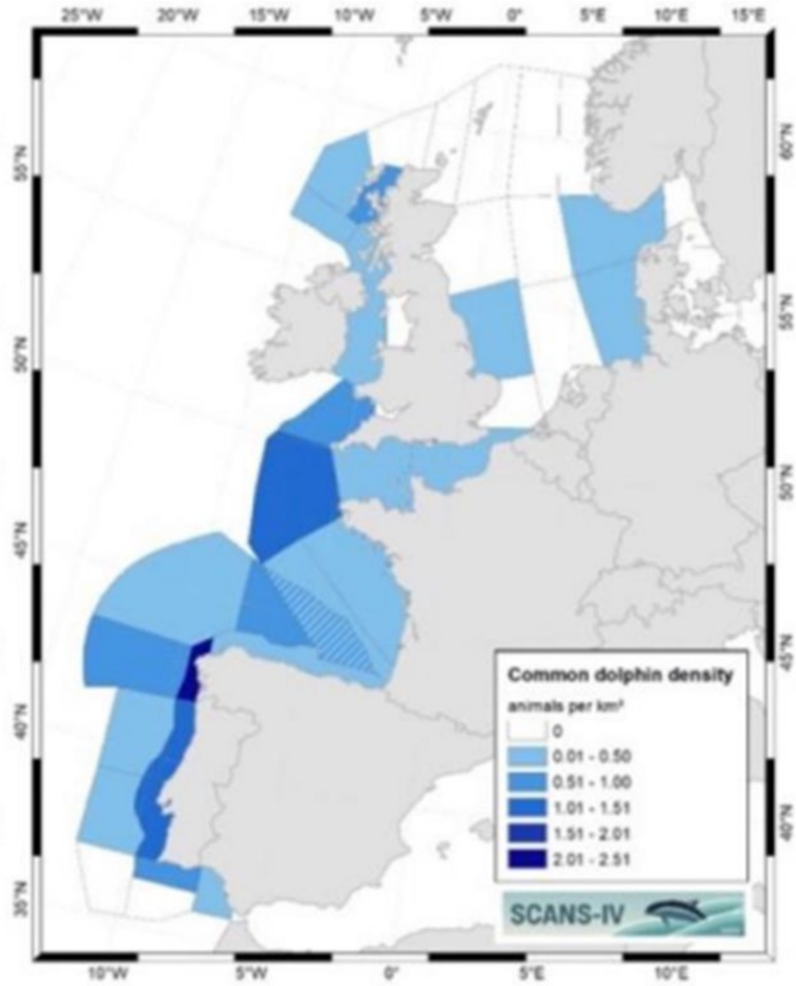


Figure 12.2-17 Estimated Common Dolphin Density in Each SCANS-IV Survey Block (Gilles et al. 2023)

89. The Waggitt *et al.* (2019) dataset has its limitations with regard to fine-scale use. To allow for a more accurate comparison of the species densities across the different data sets, the average for seasonal and annual periods across the area of the SCANS block where the Project is located have been calculated using the Waggitt *et al.* (2019) dataset.

90. Therefore, the Waggitt *et al*. (2019) data was applied across the SCANS-IV block NS-H in which the DBD Array Area lies, as well as over block NS-C in which the offshore ECC is situated. This method allowed to identify another possible density estimate for the species for the relevant offshore components for DBD (**Table 12.2-10**).

Table 12.2-10 Density overview for Common Dolphin using Waggitt et al. (2019) Data over SCANS-IV Block NS-H and NS-C (highest densities in bold)

Scenario	Season	Density (animals/km^2)	Source
Waggitt *et al*. (2019) over SCANS-IV block NS-H for DBD Array Area	Summer	**0.012**	Waggitt *et al*. 2019
	Winter	0.007	
	Annual	0.010	
Waggitt *et al*. (2019) over SCANS-IV block NS-C for offshore ECC	Summer	**0.017**	
	Winter	0.009	
	Annual	0.013	

91. Having compared all possible densities for common dolphin, the following worst-case densities were taken forward for the impact assessment (see overview in **Table 12.2-17**):

- **0.012** common dolphin/km^2 for DBD Array Area (Waggitt *et al*. (2019) over SCANS-IV block NS-H); and
- **0.017** common dolphin/km^2 for offshore ECC (Waggitt *et al*. (2019) over SCANS-IV block NS-C).

12.2.3.3.3 Diet

92. Common dolphin are cooperative feeders, working within a pod to capture prey. They have a varied diet of fish including haddock, mackerel *Scomber scombrus*, Atlantic horse mackerel *Trachurus trachurus*, blue whiting *Micromesistius poutassou*, anchovy Engraulida spp., and sardine *Sardina pilchardus* (Couperus 1997; Silva 1999; Meynier, 2004; Santos *et al.* 2013; Marçalo *et al.* 2018) which are also exploited by fisheries. Other prey items recorded in common dolphins include cephalopods and crustacean (Brophy *et al*. 2009).

93. Analysis of 63 common dolphin stomach contents from the Bay of Biscay found that the diet was dominated by fish with mackerel being the preferred fish and cephalopods were recorded as a prey of secondary importance (Pusineri *et al*. 2007). Stomach content of 71 stranded common dolphins along the French coast between 1999-2002 contained sardine, anchovy, sprat and horse mackerel (Meynier *et al*. 2008). This study also highlighted the temporal variations in diet composition, which was attributed to prey availability in the region. It further analysed that prey composition and size varied in relation to sex and maturity status of the individual animal. Statistically, common dolphins are more likely to select high energy prey, otherwise it is disregarded, even when highly abundant in the area (Spitz *et al*. 2010).

12.2.3.4 White-Beaked Dolphin

12.2.3.4.1 Abundance

94. White-beaked dolphin are found in temperate and sub-Arctic seas of the North Atlantic, usually over the continental shelf in waters of 50-100m depth (Reid *et al*. 2003). In UK waters, sightings occur throughout the year, but are slightly more frequent from July to October (Reid *et al*. 2003).

95. Their distribution is generally restricted to the northern half of UK waters, with greatest abundance in the central and northern North Sea, Orkney and Shetland and north-west Scotland (BEIS, 2022).

96. There is only one MU for white-beaked dolphins, the CGNS MU, and is estimated to hold a population of 43,951 individuals (CV = 0.22) (IAMMWG, 2023).

12.2.3.4.2 Density

97. The results of the JCP Phase III Report (Paxton *et al*. 2016) identified that white-beaked dolphin densities are low across much of UK waters, with higher densities shown to be in the Hebrides and the northern North Sea. The density of white-beaked dolphin within the southern North Sea in the vicinity of the Project area is relatively low. However, surveys within the Dogger Bank area highlighted that white-beaked dolphin were present year-round in relatively high numbers (see **Section 12.2.2.2**).

98. The seasonal distribution maps by Waggitt *et al*. (2019) indicate higher densities around the Project area in summer compared to observations made by Paxton *et al*. (2016). Overall, highest densities were in the northern North Sea and around the coasts of Scotland, with decreasing densities southwards of Scotland along the east coast of England. There is also a clear seasonal difference in the densities of white-beaked dolphin, with higher densities in July, particularly to the north of their range (**Figure 12.2-18**). The distribution maps are limited in that they should only be used to show general, broad-scale distributions of species. According to Waggitt *et al*. (2019), these densities should not be used for fine-scale distributions.

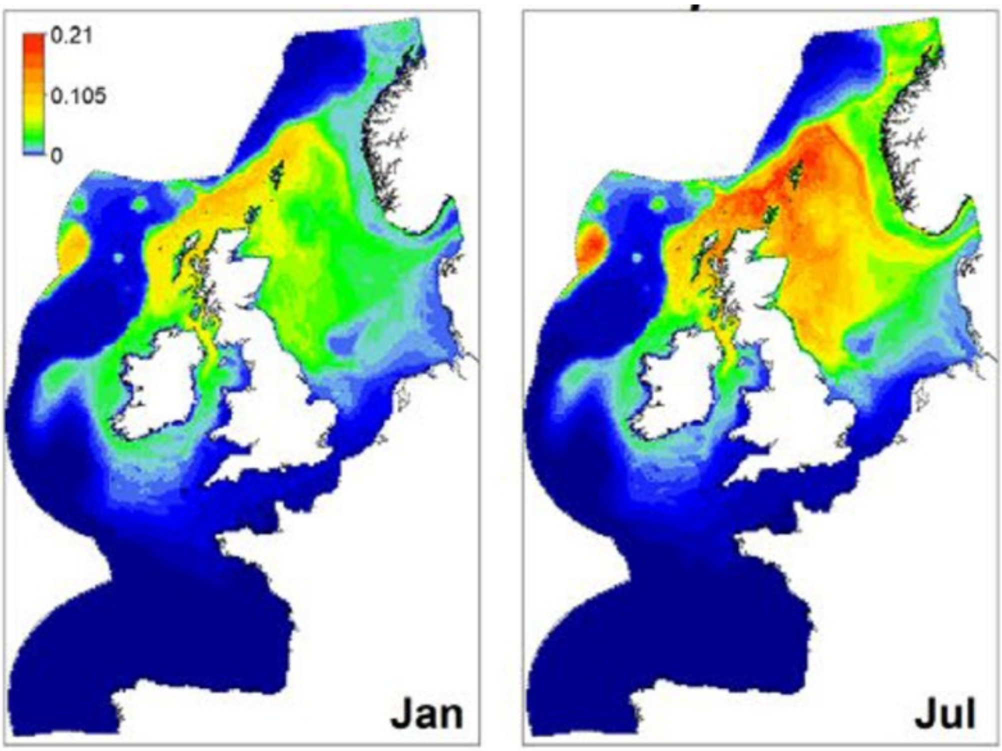


Figure 12.2-18 Spatial Variation in Predicted Densities (Individuals per km of White-beaked Dolphin in January and July in the North-East Atlantic). Values are Provided at 10km Resolution (Waggitt et al. 2019)

99. The SCANS-III recorded no white-beaked dolphin within the survey block N (in which the Project is located) (Hammond *et al*. 2021).

100. The SCANS-IV surveys (Gilles *et al.* 2023) recorded white-beaked dolphin in the survey block NS-H which shows their number have been increasing in the southern North Sea since SCANS-III. For survey block NS-H (in which the DBD Array Area is located), white-beaked dolphin abundance was estimated to be 157 (95% CL = 3 – 484), with an overall estimated density of 0.0023 animals/km^2 (CV = 0.992). Survey block NS-C (location of offshore ECC) had a density estimate of 0.0149 animals/km^2 (CV = 0.758) and an estimated abundance of 894 animals (95% CL: 12 -2,387).

101. The Waggitt et al. (2019) dataset has its limitations with regard to fine-scale use. To allow for a more accurate comparison of the species densities across the different data sets, the average for seasonal and annual periods across the area of the SCANS block where the Project is located have been calculated using the Waggitt et al. (2019) dataset.

102. Therefore, the Waggitt *et al*. (2019) data was applied across the SCANS-IV block NS-H in which the DBD Array Area lies, as well as over block NS-C in which the offshore ECC is situated. This method allowed to identify another possible density estimate for the species for the relevant offshore components for DBD (**Table 12.2-11**).

Table 12.2-11 Density Overview for White-beaked Dolphin Using Waggitt et al. (2019) Data Over SCANS-IV Block NS-H and NS-C (Highest Densities in Bold)

Scenario	Season	Density (animals/km^2)	Source
Waggitt *et al*. (2019) over SCANS-IV block NS-H for DBD Array Area	**Summer**	**0.0104**	Waggitt *et al*. 2019
	Winter	0.0088	
	Annual	0.0096	
Waggitt *et al*. (2019) over SCANS-IV block NS-C for offshore ECC	Summer	0.030	
	Winter	**0.034**	
	Annual	0.025	

103. Having compared all possible densities for white-beaked dolphin, the following worst-case densities were taken forward for the impact assessment (see overview in **Table 12.2-17)**:

- **0.0104** white-beaked dolphin/km^2 for DBD Array Area (Waggitt *et al.* (2019) over SCANS-IV block NS-H); and

- **0.034** white-beaked dolphin/km^2 for offshore ECC Waggitt *et al.* (2019) over SCANS-IV block NS-C).

12.2.3.4.3 Diet

104. Dietary analysis for white-beaked dolphin stranded between 1992 and 2003 around the UK (Canning *et al*. 2008) and between 1968 and 2005 along the Dutch coast (Jansen *et al*. 2010) found that while a wide variety of prey species were identified, the majority of prey were Gadidae (cod and whiting), haddock and gobies. Canning *et al*. (2008) further identified that herring Clupea harengus and mackerel Scomber scombrus were also found in the stomachs and is in line with more dated journals that observed that white-beaked dolphins are associated with herring and mackerel shoals (Harmer, 1927; Fraser, 1946; Evans, 1980). Anecdotal evidence from fisherman in Scotland suggests that individuals seen inshore may coincide with mackerel appearing in the same areas (Canning *et al*. 2008).

12.2.3.5 Minke Whale

12.2.3.5.1 Abundance

105. Within UK waters, minke whale are most frequently sighted in the western central-northern North Sea and west of Scotland around the Hebrides (BEIS, 2022). They are primarily a seasonal visitor to UK waters, with increased sightings from May to October, although some animals may remain in coastal waters year-round (BEIS, 2022; Reid *et al.* 2003).

106. Animals are present throughout the year, but most sightings are between May and September (Reid *et al*. 2003). DECC (2016) support this, stating that sightings rarely extend past Dogger Bank, but that occasional sightings of minke whale are made as far south as Flamborough Head and the north Humberside coastlines between July and October (DECC, 2016).

107. Higher densities of minke whale have been recorded along the margins of Dogger Bank and adjacent areas in spring and summer (de Boer, 2010; Gilles *et al*. 2012; Hammond *et al*. 2013). Few sightings of minke whale have been made further south of these areas and it is thought that they probably enter the North Sea from the north (DECC, 2016). Minke whales appear to move into the North Sea at the beginning of May and are present throughout the summer until October (Northridge *et al*. 1995).

108. Some genetic differentiation among individuals has been reported (e.g. Andersen *et al*. 2003), but this does not appear to be caused by geographic structuring within the north-east Atlantic (Anderwald *et al*. 2011). Minke whale of the North Atlantic are likely to be a single genetic population (Anderwald *et al*. 2012). Therefore, IAMMWG (2023) considers a single MU is appropriate for minke whale in UK waters which holds an estimated population of 20,118 individuals (CV = 0.18).

12.2.3.5.2 Density

109. The results of the JCP Phase III Report (Paxton *et al*. 2016) identified that for minke whale densities were highest around the northern coast of the UK, with hotspots in the Hebrides and moderate densities around the Dogger Bank area.

110. For minke whale, the distribution maps by Waggitt *et al*. (2019) indicate higher densities in the northern North Sea, around Scotland and Ireland, including the Celtic Sea area, with decreasing densities southwards of Scotland along the east coast of England (**Figure 12.2-19**). There is a clear seasonal difference in the densities of minke whale, with higher densities in July, particularly in evident in their northern range.

111. The maps indicate a ‘corridor’ of increased minke whale density from north of Orkney, around the north and west coasts of the UK to Northern Ireland (**Figure 12.2-19**). Whilst the density of minke whales in the Project area in January is nearly absent, it slightly increases in July, but the overall densities are relatively low *et al*. 2019 data. The distribution maps are limited in that they should only be used to show general, broad-scale distributions of species. According to Waggitt *et al*. (2019), these densities should not be used for fine-scale distributions.

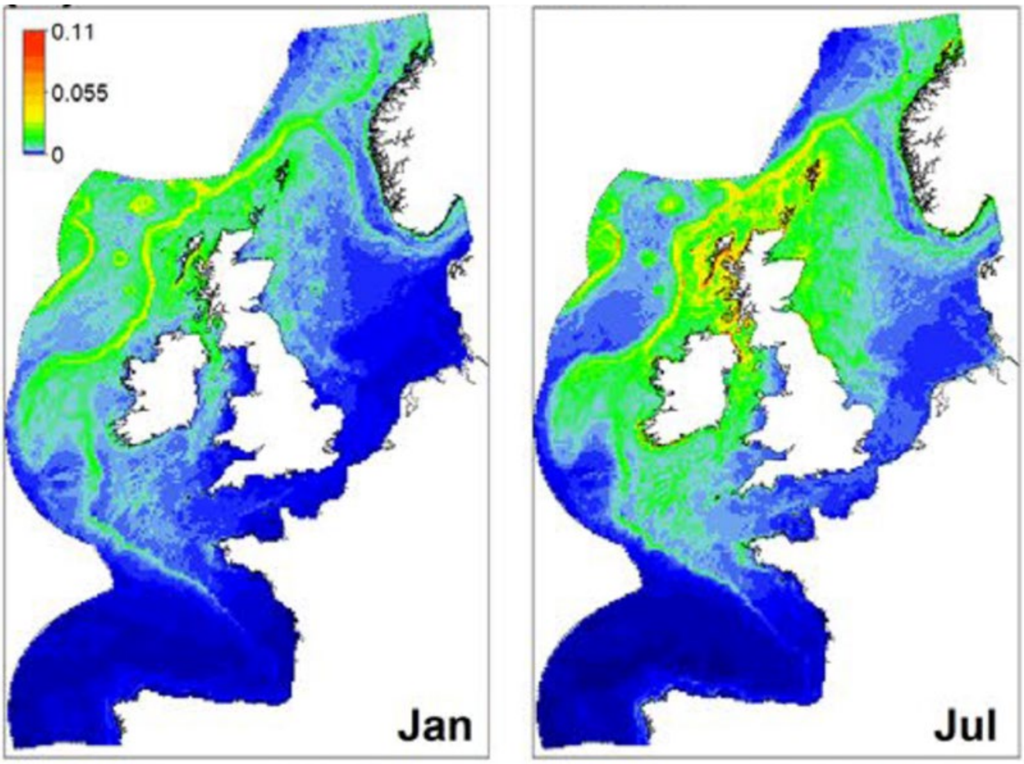


Figure 12.2-19 Spatial Variation in Predicted Densities (Individuals per km of Minke Whale in January and July in the North-East Atlantic). Values are provided at 10km resolution (Waggitt et al. 2020)

112. During the SCANS-III surveys, minke whales were recorded within block N (in which the Project is located) and an abundance was estimated to be 1,392 minke whales (95% CL = 450 –3,459). The density estimate is 0.0201 animals/km^2 (CV = 0.504; Hammond *et al.* 2021) (**Figure 12.2-20**).

113. Only few minke whale were sighted during SCANS-IV, resulting in a low density of 0.0153 animals/km^2 (CV = 0.552) and a population abundance of 1,061 minke whale (95% CL = 231 – 2,771) in block NS-H (Gilles *et al.* 2023) In block NS-C (location of the offshore ECC), the density was at 0.0068 animals/km^2 (CV = 0.881) and an estimated abundance of 412 (95% CL: 4 -1,392) (**Figure 12.2-21**).

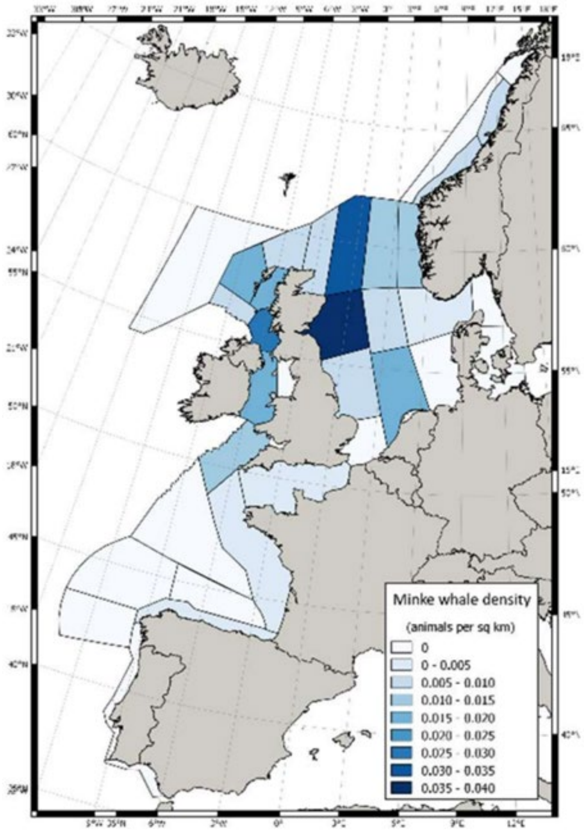


Figure 12.2-20 Estimated Density in Each Survey Block for Minke Whale from SCANS-III (Hammond et al. 2021)

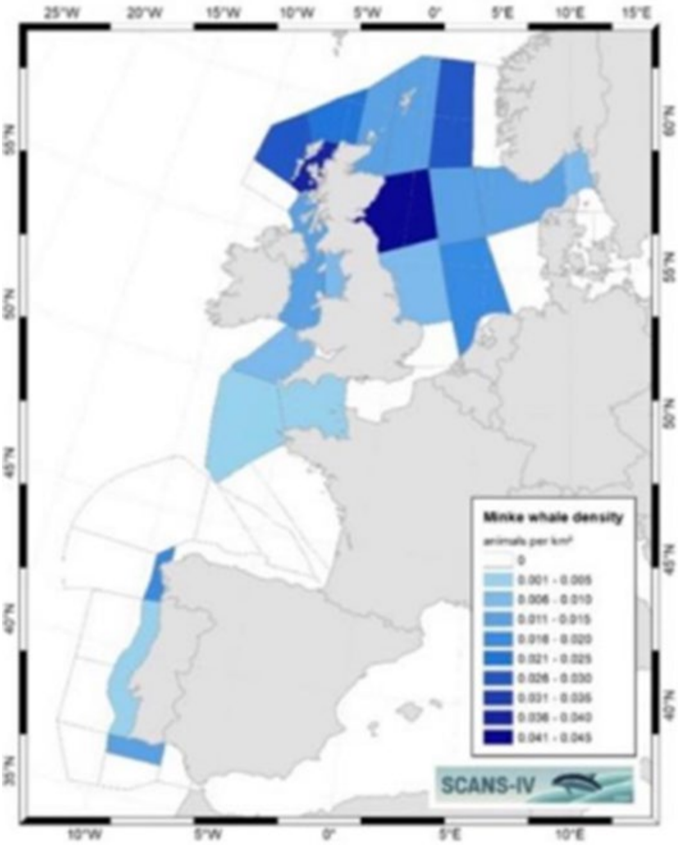


Figure 12.2-21 Estimated density in Each Survey Block for Minke Whale from SCANS-IV (Gilles et al. 2023)

114. The Waggitt *et al.* (2019) dataset has its limitations with regard to fine-scale use. To allow for a more accurate comparison of the species densities across the different data sets, the average for seasonal and annual periods across the area of the SCANS block where the Project is located have been calculated using the Waggitt *et al. (*2019) dataset.

115. Therefore, the Waggitt *et al*. (2019) data was applied across the SCANS-IV block NS-H in which the DBD Array Area lies, as well as over block NS-C in which the offshore ECC is situated. This method allowed to identify another possible density estimate for the species for the relevant offshore components for DBD (**Table 12.2-12**).

Table 12.2-12 Density Overview for Minke Whale using Waggitt et al. (2019) Data over SCANS-IV Block NS-H and NS-C (Highest Densities in Bold)

Scenario	Season	Density (animals/km^2)	Source
Waggitt *et al*. (2019) over SCANS-IV block NS-H for DBD Array Area	Summer	**0.0014**	Waggitt *et al*. 2019
	Winter	0.0007	
	Annual	0.0010	
Waggitt *et al*. (2019) over SCANS-IV block NS-C for offshore ECC	Summer	**0.0048**	
	Winter	0.0026	
	Annual	0.0037	

116. Having compared all possible densities for minke whale, the following worst-case densities were taken forward for the impact assessment (see overview in **Table 12.2-17**):

- **0.0153** minke whale /km^2 for DBD Array Area (SCANS-IV; block NS-H); and
- **0.0068** minke whale /km^2 for offshore ECC (SCANS-IV, block NS-C).

12.2.3.5.3 Diet

117. Minke whales feed on a variety of fish species, including herring, cod and haddock. Minke whale feed by engulfing large volumes of prey and water, which they then 'sieve' out through their baleen plates and swallow their prey whole.

118. A study into the diet of minke whale in the north-eastern Atlantic sampled a total of 210 minke whale forestomach contents from 2000 to 2004, with a total of 37 minke whale samples analysed within the northern North Sea. Within this area, minke whale were found to prey upon a number of different species at the population level, however, 84% of individuals were found to prey upon only one species. Sandeels (56% of total prey by biomass) and mackerel (30% of total prey by biomass) were found to be the most dominant prey species for minke whale in the northern North Sea (Windsland *et al*. 2007).

12.2.3.6 Grey Seal

12.2.3.6.1 Distribution

119. Grey seals only occur in the North Atlantic, Barents and Baltic Sea with their main concentrations on the east coast of Canada and United States of America and in north-west Europe (SCOS, 2022).

120. Approximately 35% of the world's grey seals breed in the UK. 80% of these breed at colonies in Scotland, with the main concentrations in the Outer Hebrides and in Orkney. There are also breeding colonies in Shetland, on the north and east coasts of mainland Britain and in south-west England and Wales (SCOS, 2022).

121. The Holderness coast lies north of the Humber Estuary, in which surveys were carried out for the Humber Gateway Offshore Wind Farm. Aerial and vessel-based surveys recorded 78 grey seals and eight harbour seals in their study area (RPS Planning Transport & Environment, 2005). Furthermore, the Humber provides an important area for grey seal pup production (Carter *et al*. 2022), particularly during August and breeding (SCOS, 2022). Additionally, the number of grey seals using Flamborough Head as a haul-out site have increased over the past few years. The Yorkshire Wildlife Trust (2023) recorded over 500 grey seals during their August surveys.

122. Grey seals are wide ranging and can breed and forage in different areas (Russell *et al*. 2013). They generally travel between known foraging areas and back to the same haul-out site but will also move to new sites (Russel, 2016).

123. **Figure 12.2-22** provides grey seal foraging movements (the tagging data was cleaned to remove data during the grey seal breeding season) by Carter *et al*. (2022), indicating that grey seals are extensively using the offshore areas around Dogger Bank and the North Sea from their initial tagging sites.

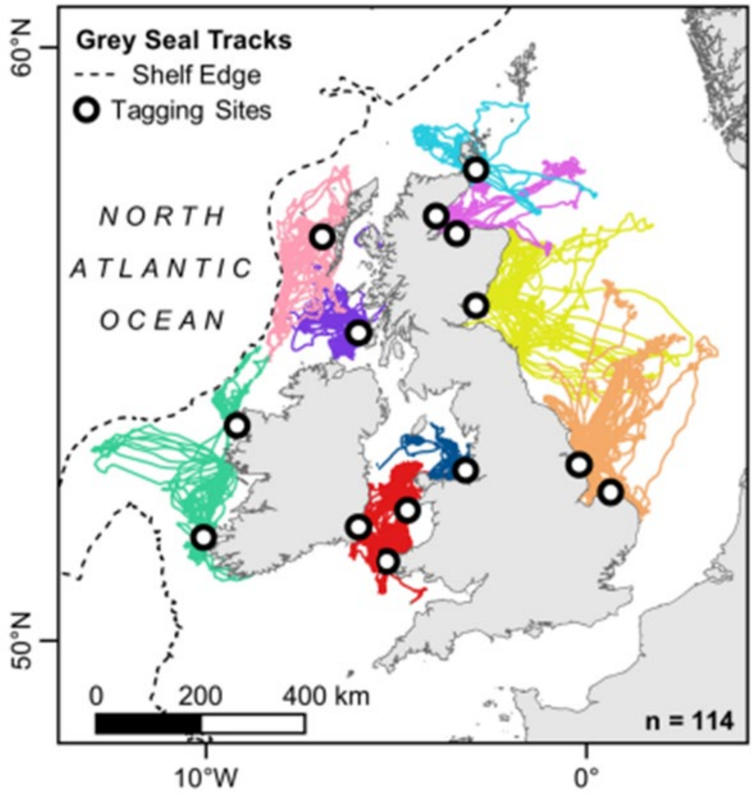


Figure 12.2-22 Grey Seal Tagging Data (n=114), Colour-Coded by Habitat Preference Region (Carter et al. 2022)

124. Grey seal forage in the open sea and they may range widely to forage and frequently travel over 100km between haul-out sites (SCOS, 2022). Foraging trips can last anywhere between one and 30 days. Tracking of individual grey seal has shown that most foraging probably occurs within 100km of a haul-out site, although they can feed up to several hundred kilometres offshore (SCOS, 2022). The grey seal maximum foraging range is estimated to be 448km based on tracking data (Carter *et al.* 2022).

12.2.3.6.2 Haul-Out Sites

125. Compared with other times of the year, grey seals in the UK spend longer hauled out during their annual moult (between December and April) and during their breeding season (between August and December) (SCOS, 2020).

126. In the north and west Scotland, pupping occurs mainly between September and late November, whereas (SCOS, 2020). Pups are typically weaned 17 to 23 days after birth, when they moult their white natal coat, and then remain on the breeding colony for up to two or three weeks before going to sea. Mating occurs at the end of lactation and then adult females depart to sea and provide no further parental care (SCOS, 2020).

127. **Table 12.2-13** below presents main haul-out sites in northeast England, of which some are shared with harbour seals. Distances are measured in a straight line using QGIS v.3.38.0.

Table 12.2-13 Grey Seal Haul-Out Sites (from North to South), Population Numbers and Distance to the Project Area

Haul-out site	Approx. Distance (km)		Population
	Landfall	DBD Array Area	
Holy Island	209	310	4,251 (2020 mean grey seal count; SCOS, 2020)
Farne Islands	199	300	
Tees	91	265	30 (2021 mean grey seal count; SCOS, 2022)
Ravenscar	45	235	Both Ravenscar and Filey Brigg are transient sites.
Filey Brigg	20	230	15 grey seal (grey seal count, Yorkshire seal org, 2023).
Flamborough Head	18	212	500 (August surveys by The Yorkshire Wildlife Trust (2023)
Donna Nook	60	247	3,897 grey seal (2021 mean grey seal count; SCOS, 2022).
The Wash	117	285	799 grey seal (2021 mean grey seal count; SCOS, 2022).
Blakeney Point	135	257	493 grey seal (2021 mean grey seal count; SCOS, 2022).
Horsey	182	260	380 (mean 2021 grey seal count; SCOS, 2022).
Scroby Sands	195	263	1,377 (mean 2021 grey seal count; SCOS, 2022).

12.2.3.6.3 Abundance and Density Estimates for Grey Seal

12.2.3.6.3.1. Seal Density Maps

128. The following sections provide the grey seal at-sea density estimates from a grey seal mapping dataset (Carter *et al.* 2022). **Figure 12.2-23** shows the relative abundance of grey seals in the wider Project area as a percentage of the total UK population.

129. The relative seals at-sea abundance maps have been used to calculate grey seal density estimates for the wind farm site. The Carter *et al*. (2022) density maps are an update to the Russell *et al*. (2017) mapping and include updated tagging studies. These density maps only include tagging studies from the UK.

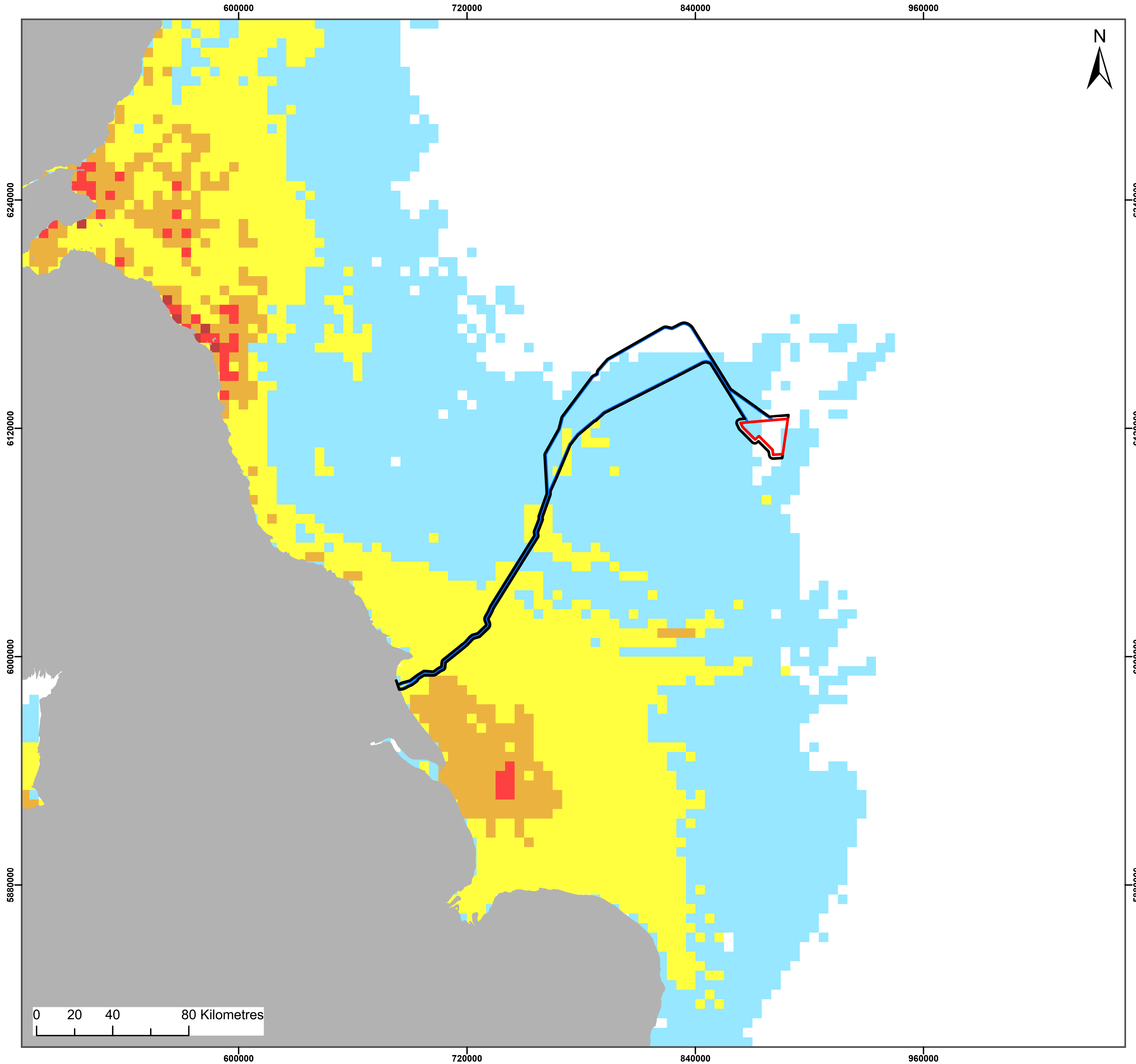
130. The resultant density of seals at-sea maps (Carter *et al*. 2022) differs from the Russell *et al*. (2017) maps, in that they show the relative density of seals in each 5-by-5km grid cell. Each grid cell shows the percentage of the overall seal population within the British Isles, which can then be related to the current best population estimate for each species. This ensures that the relative densities can be updated based on overall population level changes.

131. To calculate a density estimate based on the Carter *et al*. (2022) data, the current at-sea population of each species must be used. A correction factor is also applied to the overall population level to take account of those individuals that are estimated to be on land. **Figure 12.2-23** shows the mean percentage of at-sea population estimated to be present in each 5 x 5km grid square at any one time.

132. The total grey seal population in the British Isles, at-sea, is approximately 162,000 individuals. This at-sea estimate is based on the latest (SCOS, 2022) grey seal August counts of 44,833 for the UK and Republic of Ireland (RoI), which has been corrected for both those individuals that were not available to count (0.2515; SCOS-BP 21/02 in SCOS, 2021), and for those individuals that would be at-sea at any one time (0.8616; Russel *et al*. 2015). This is the population estimate used with the Carter *et al*. (2022) data to calculate density estimates for the wind farm site. The grey seal density estimates for the wind farm site have been calculated from the latest seal at sea maps produced by Sea Mammal Research Unit (SMRU) (Carter *et al*. 2022), based on the 5 x 5km grids that overlap with the Project area.

133. The mean at-sea density estimate been calculated based on Carter *et al*. (2022) and taken forward in the assessment:

- **0.080** grey seal /km^2 for DBD Array Area; and
- **0.274** grey seal /km^2 offshore ECC.



Legend:

- Dogger Bank D Array Area
- Offshore Development Area
- Offshore PEIR Corridors

Proportion of the population per 25km² (as a %)

- ≤ 0.001 (Transparent)
- 0.001 - 0.005
- 0.005 - 0.02
- 0.02 - 0.05
- 0.05 - 0.1
- 0.1 - 0.275

Project:
Dogger Bank D Offshore Wind Farm

DOGGER BANK WIND FARM

Title:
Grey Seal at-sea distribution. Maps show mean percentage of at-sea population estimated to be present in each 5km x 5km grid square at any one time (Carter *et al.*, 2022)

Figure:	12.2-23	Drawing No:	PC6250-RHD-XX-OF-DR-GS-0051		
Revision:	Date:	Drawn:	Checked:	Size:	Scale:
01	19/12/2024	JH	AB	A3	1:2,000,000

Co-ordinate system: WGS 1984 UTM Zone 30N

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12.2.3.6.3.2. Grey Seal Population Counts

134. Grey seal population trends are assessed from the counts of pups born during the autumn breeding season, when females congregate on land to give birth (SCOS, 2022). The pup production estimates are converted to estimates of total population size (1+ aged population) using a mathematical model and projected forward (SCOS, 2022).

135. The most recent surveys of the principal grey seal breeding sites Scotland, Wales, Northern Ireland and England, resulted in an estimate of 67,850 pups (in 2019; 95% CL = 60,500 – 75,200; SCOS, 2022).

136. The estimated adult UK grey seal population size in regularly monitored colonies in 2022 was 162,000 (approximate 95% CL = 146,700-178,500; SCOS, 2022) based on 2019 pup production, representing the total population alive on the first day of 2022 breeding season.

137. The most recent counts of grey seal in the August surveys 2016-2021, estimated that the minimum count of grey seals in the UK was 41,135 (SCOS, 2022).

138. These have also been corrected to take account of the number of seals not available to count during the surveys. Approximately 0.2515 grey seals are available to count within the August surveys (i.e. are hauled out), and therefore this has been used as a correction factor (SCOS-BP 21/02 in SCOS, 2021), to derive total grey seal numbers within each MU, rather than the number counted within each MU. The reference population for grey seal is therefore currently based on the most recent estimates as shown in **Table 12.2-14**.

Table 12.2-14 Grey Seal Counts and Population Estimates

Population area	Grey seal haul-out count	Source of haul-out count data	Correction factor for seals not available to count	Grey seal total population
SE England MU	7,694	SCOS (2022)	0.2515	30,592
NE England MU	6,517	SCOS (2022)	0.2515	25,913
Total wider reference population	**14,211**	-	**0.2515**	**56,505**

12.2.3.6.4 Diet and Foraging

139. Grey seals will typically forage in the open sea and return regularly to land to haul-out, although they may frequently travel up to 100km between haul-out sites. Foraging trips generally occur within 100km of their haul-out sites, although grey seal can travel up to several hundred kilometres offshore to forage (SCOS, 2020). Grey seal generally travel between known foraging areas and back to the same haul-out site but will occasionally move to a new site. For example, movements have been recorded between haul-out sites on the east coast of England and the Outer Hebrides (SCOS, 2020).

140. Individual grey seals based at a specific haul-out site often make repeated trips to the same region offshore but will occasionally move to a new haul-out site and begin foraging in a new region (SCOS, 2020). Telemetry studies of grey seal in the UK have identified a highly heterogeneous spatial distribution with a small number of offshore ‘hot spots’ continually utilised (Matthiopoulos *et al.*2004; Russell *et al.* 2017).

141. Grey seals are generalist feeders, feeding on a wide variety of prey species (SCOS, 2020; Hammond & Grellier, 2006). Diet varies seasonally and from region to region (SCOS, 2020).

142. Principal prey items are sandeel, whitefish (such as cod, haddock, whiting and ling *Molva molva)* and flatfish (plaice *Pleuronectes platessa*, sole *Solea solea*, flounder, and dab *Limanda limanda*) (Hammond & Grellier, 2006). Amongst these, sandeels are typically the predominant prey species.

143. Food requirements depend on the size of the seal and fat content (oiliness) of the prey, but an average consumption estimate for an adult is 4-7kg per seal per day depending on the prey species (SCOS, 2020).

12.2.3.7 Harbour Seal

12.2.3.7.1 Distribution

144. Harbour seals have a circumpolar distribution in the Northern Hemisphere and are divided into five sub-species. The population in European waters represents one sub-species *Phoca vitulina vitulina* and approximately 32% of European harbour seals are found in the UK, of which 12% are found in England (SCOS, 2022). On the east coast of Britain harbour seal distribution is generally restricted, with concentrations in the major estuaries of the Thames, The Wash and the Moray Firth (SCOS, 2022).

145. Counts of harbour seals in east Scotland, Moray Firth, and south-east England in 2021 were substantially lower than in recent years (SCOS, 2022). Potential causal factors include grey seal competition for prey, grey seal predation, disease, and some aspect of anthropogenic activity. It is likely that more than one factor is contributing to the decrease.

146. The Holderness coast lies just north of the Humber Estuary, in which surveys were carried out for the Humber Gateway Offshore Wind Farm. Aerial and vessel-based surveys recorded 78 grey seals and eight harbour seals in their study area (RPS Planning Transport & Environment, 2005).

147. SMRU, in collaboration with others, has deployed around 344 telemetry tags on harbour seals around the UK between 2001 and 2012. The spatial distributions indicate harbour seals persist in discrete regional populations, display heterogeneous usage, and generally stay within 50km of the coast (Russell & McConnell, 2014). Tagged harbour seals were observed to have a more coastal distribution than grey seals and do not travel as far from haul-outs (Russell and McConnell, 2014).

148. Harbour seal tags, deployed between 2006 and 2017, were cleaned and analysed, and maps of tracks for all individuals included in a habitat preference analysis (n= 239) are shown in **Figure12.2-24** (Carter *et al*. 2020).

149. Harbour seals generally make smaller foraging trips than grey seals, typically travelling 40-50km from their haul-out sites to foraging areas (SCOS, 2020). Tracking studies have shown that harbour seals travel 50-100km offshore and can travel 200km between haul-out sites (Lowry *et al*. 2001; Sharples *et al*. 2012). The range of these trips varies depending on the location and surrounding marine habitat. The typical and average foraging range for harbour seal is 50-80km (SCOS, 2021). Tracking data analysed in Carter *et al*. (2022) produced a radius based on the maximum geodesic distance of 273km for harbour seals representing the species' maximum foraging range.

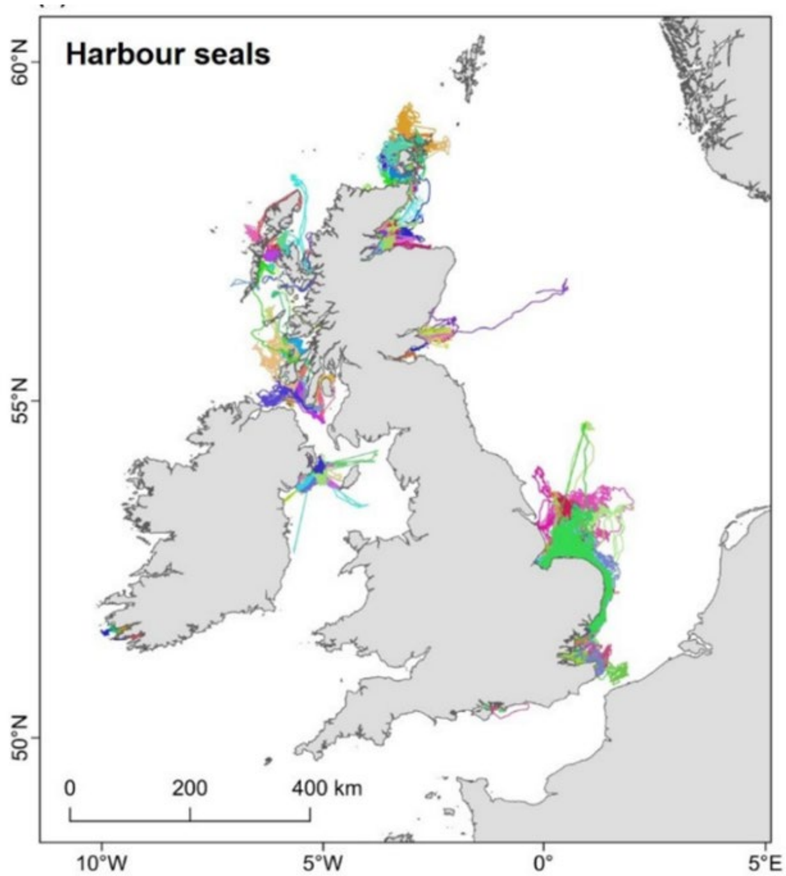


Figure12.2-24 GPS tracking Data for Harbour Seals Available for Habitat Preference Models (Carter et al. 2020)

12.2.3.7.2 Haul-Out Sites

150. Harbour seal come ashore in sheltered waters, typically on sandbanks and in estuaries, but also in rocky areas. They regularly haul-out on land in a pattern that is often related to the tidal cycle. Harbour seals give birth to their pups in June and July and pups can swim almost immediately after birth. In August, when moulting occurs they spend a higher proportion of their time on land than at other times (SCOS, 2020). **Table 12.2-15** presents haul-out sites on the east coast of England.

Table 12.2-15 Harbour Seal Haul-Out Sites (from North to South), Population Numbers and Distance to the Project Area

Haul-out site	Approx. Distance (km)		Population
	Landfall	DBD Array Area	
Tees	91	265	86 (2021 harbour seal count; SCOS, 2022).
Ravenscar	45	235	Both Ravenscar and Filey Brigg are transient sites.
Filey Brigg	20	230	<10 harbour seal (harbour seal count; Yorkshire Seal Group, 2024).
Donna Nook	60	247	122 (2021 harbour seal count; SCOS, 2022).
The Wash	117	285	2,667 (2021 harbour seal count; SCOS, 2022).
Blakeney Point	135	257	181 (mean 2021 harbour seal count; SCOS, 2022).
Horsey	182	260	12 (mean 2021 harbour seal count; SCOS, 2022).
Scroby Sands	195	263	25 (mean 2021 harbour seal count; SCOS, 2022).

12.2.3.7.3 Abundance And Density

12.2.3.7.3.1. Seal Density Maps

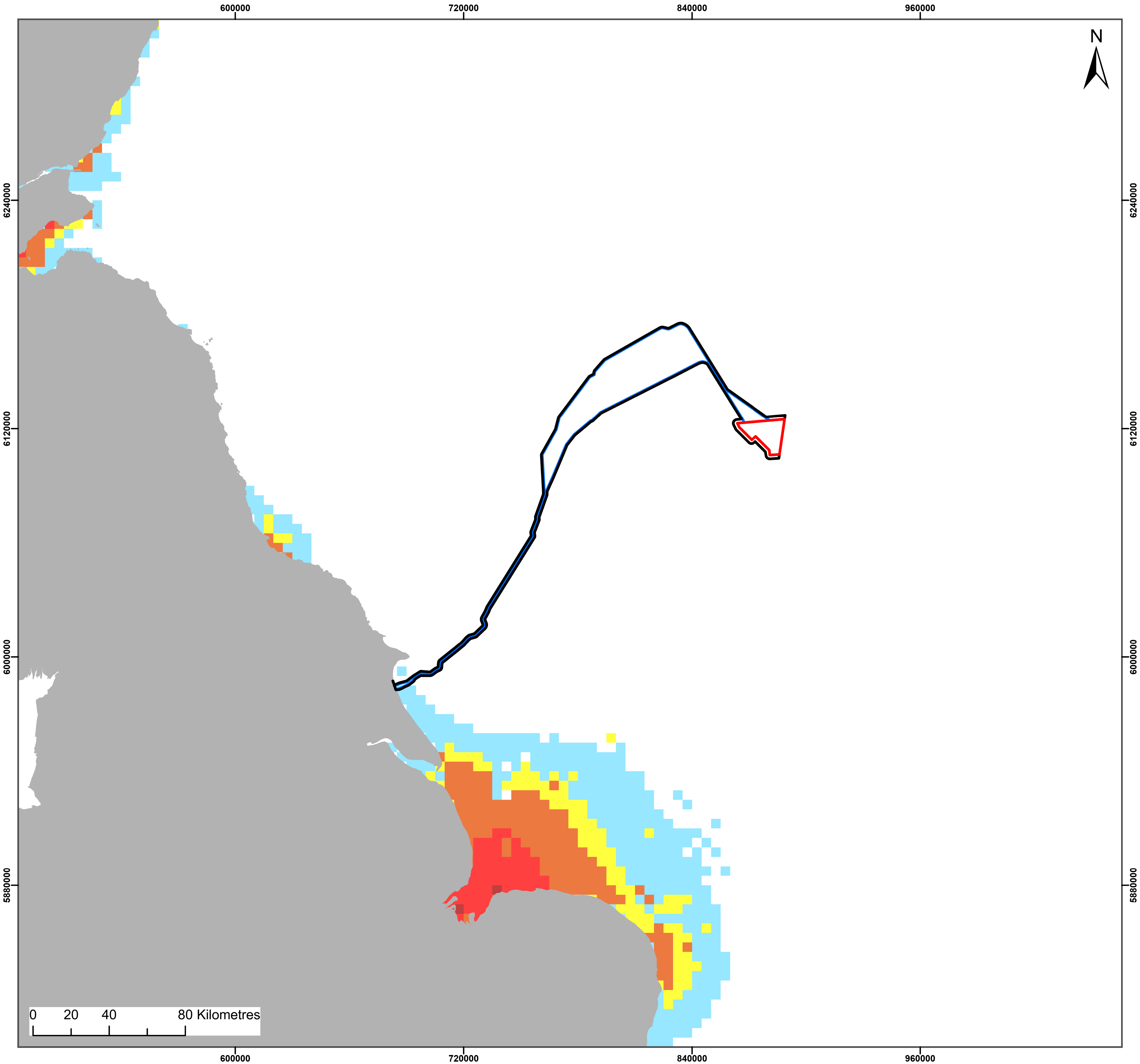
151. Impact assessments are based on densities as derived from desk-based sources. Carter *et al*. (2022) provides habitat-based predictions of at-sea distribution for harbour seal around the British Isles. The habitat preference approach predicted estimates per species, on a 5 x 5km grid of relative at-sea density for seals hauling-out in the British Isles.

152. To calculate a density estimate to be used in assessments from the Carter *et al*. (2022) data, the current at-sea population of each species must be used. A correction factor is also applied to the overall population level to take account of those individuals that are estimated to be on land **Figure 12.2-25** shows the mean percentage of at-sea population estimated to be present in each 5 x 5km grid square at any one time (Carter *et al.* 2022)).

153. The total harbour seal population in the British Isles, at-sea, is approximately 40,600 individuals, based on the correction factors for both the number of harbour seals not available to count (0.72; Lonergan *et al*. 2013), and for the those at-sea (0.8236; Russell *et al*. 2015), as well as the most recent haul-out counts for the UK and RoI (total count of 35,862 individuals; SCOS, 2022). The harbour seal density estimates for the wind farm site have been calculated from the latest seal at sea maps produced by SMRU (Carter *et al*. 2022), based on the 5 x 5km grids that overlap with the Project area.

154. The mean at-sea density estimate been calculated based on Carter *et al*. (2022) and taken forward in the assessment:

- 0.000011 harbour seal /km2 for DBD Array Area; and
- 0.00080 harbour seal /km^2 offshore ECC.



Legend:

- Dogger Bank D Array Area
- Offshore Development Area
- Offshore PEIR Corridors

Proportion of the population per 25km² (as a %)

- ≤ 0.001 (Transparent)
- 0.001 - 0.005
- 0.005 - 0.01
- 0.01 - 0.05
- 0.05 - 0.2
- 0.2 - 0.5

Project: Dogger Bank D Offshore Wind Farm

DOGGER BANK WIND FARM

Title: Harbour Seal at-sea distribution. Maps show mean percentage of at-sea population estimated to be present in each 5km x 5km grid square at any one time (Carter *et al.*, 2022)

Figure: 12.2-25 | Drawing No: PC6250-RHD-XX-OF-DR-GS-0052

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
01	19/12/2024	JH	AB	A3	1:2,000,000

Co-ordinate system: WGS 1984 UTM Zone 30N

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Harbour Seal Population Counts

155. Harbour seal are counted while they are on land during their August moult, giving a minimum estimate of population size (SCOS, 2022). Combining the most recent counts (2022) gives a total of 34,862 counted in the UK and RoI. Scaling this by the estimated proportion hauled out (0.72 (95% CL = 0.54-0.88)) produces an estimated total population for the UK in 2022 of 48,419 harbour seal.

156. Tagging maps show that seals that are present are most likely from neighbouring MUs and that the population is not independent from others, based on the available data. Despite the low population number in the NE England MU, the SE England MU and the NE MU are the most suitable to represent the wider reference population (considering Carter *et al*. (2020) tracking data), a more realistic approach for the harbour seal population.

157. The wider reference population for harbour seal is therefore currently based on the most recent estimates as shown in **Table 12.2-16**.

Table 12.2-16 Harbour Seal Counts and Population Estimates

Population area	Harbour seal haul-out count	Source of haul-out count data	Correction factor for seals not available to count	Harbour seal total population
NE England MU	89	SCOS, 2022	0.72	124
SE England MU	3,505	SCOS, 2022	0.72	4,868
Total wider reference population			**0.72**	**4,992**

12.2.3.7.4 Diet and Foraging

158. Harbour seal take a wide variety of prey including sandeels, gadoids, herring, sprat, flatfish and cephalopods. Diet varies seasonally and regionally, prey diversity and diet quality also showed some regional and seasonal variation (SCOS, 2020). It is estimated harbour seals eat 3-5kg per adult seal per day depending on the prey species (SCOS, 2020) and the likely daily ration suggests approximately 3kg of fatty fish or up to 5kg of whitefish per day (BEIS, 2022)

159. The range of foraging trips varies depending on the surrounding marine habitat. Telemetry studies indicate that the tracks of tagged harbour seals have a more coastal distribution than grey seals and do not travel as far from haul-outs.

12.2.4 Density and Reference Population Overview

160. **Table 12.2-17** summarises the densities for each marine mammal discussed in this report. Numbers in red were taken forward for the impact assessment.

Table 12.2-17 Summary of Marine Mammal Densities and Reference Populations (Red= Densities Taken Forward For Assessment; Grey = No Data Available / Not Applicable; ECC = Export Cable Corridor; MU= Management Unit; SE= Southeast; NE= Northeast)

Data Source	Average of season / year	Harbour porpoise	Bottlenose dolphin	Common dolphin	White-beaked dolphin	Minke whale	Grey seal	Harbour seal
Waggitt *et al.* 2019 (DBD Array Area)	Summer	0.732	0.00017	0.0080	0.0073	0.0017		
	Winter	0.760	0.00010	0.0042	0.0062	0.00082		
	Annual	0.746	0.00013	0.0061	0.0067	0.0013		
Waggitt *et al.* 2019 (offshore ECC)	Summer	0.637	0.00070	0.013	0.028	0.0040		
	Winter	0.617	0.0005	0.007	0.021	0.0022		
	Annual	0.627	0.0006	0.010	0.024	0.0031		
Waggitt *et al.* (2019) over SCANS-IV block NS-H for DBD Array Area	Summer	0.800	0.00050	**0.012**	**0.0104**	0.0014		
	Winter	0.836	0.00030	0.007	0.0088	0.0007		
	Annual	0.818	0.00040	0.010	0.0096	0.0010		
Waggitt *et al.* (2019) over SCANS-IV block NS-C for offshore ECC	Summer	0.574	0.0009	**0.017**	0.030	0.0048		
	Winter	0.545	0.0007	0.009	**0.034**	0.0026		
	Annual	0.559	0.0008	0.013	0.025	0.0037		

SCANS-IV (block NS-H) (location of DBD Array Area)	Summer	0.8034	**0.0014**		0.0023	**0.0153**		
SCANS-IV (block NS-C) (location of offshore ECC)	Summer	**0.6027**	**0.0419**	0.0032	0.0149	**0.0068**		
Site-specific (APEM aerial survey)	Summer	0.833						
	Winter	**0.842**						
	Annual	0.825						
Carter *et al.* (2022) (DBD Array Area)	-						**0.080**	**0.000011**
Carter *et al.* (2022) (offshore ECC)	-						**0.274**	**0.00080**
Reference Population		**338,918 (NS AU)**	**2,022 (CGNS MU)** **226 (CES MU)**	**102,656 (CGNS MU)**	**43,951 (CGNS MU)**	**20,118 (CGNS MU)**	**56,505 (NE & SE MU)**	**4,992 (NE & SE MU)**

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Acronyms

Term	Definition
ASCOBANS	Agreement on the Conservation of Small Cetaceans of the Baltic, North East Atlantic, Irish and North Seas
AU	Assessment Unit
BEIS	Department for Business, Energy & Industrial Strategy
CCW	Countryside Council for Wales
CES	Coastal East Scotland
CGNS	Celtic and Greater North Sea
CI	Confidence Intervals
CIS	Celtic & Irish Sea
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CL	Confidence Limit
CODA	Cetacean Offshore Distribution and Abundance in the European Atlantic
CRoW	The Countryside and Rights of Way Act
CV	Coefficient of Variation
DBD	Dogger Bank D
DBS	Dogger Bank South
ECC	Export Cable Corridor
EPS	European Protected Species
ES	Environmental Statement
ETG	Expert Topic Group
FCS	Favourable Conservation Status
Gardline	Gardline Environmental Ltd
GNS	Greater North Sea
HiDef	HiDef Aerial Surveying Limited

HM	His Majesty's
IAMMWG	Inter-Agency Marine Mammal Working Group
ICES	International Council for the Exploration of the Sea
IFAW	International Fund for Animal Welfare
IUCN	International Union for Conservation of Nature
IWC	International Whaling Commission
JCP	Joint Cetacean Protocol
JNCC	Joint Nature Conservation Committee
km	Kilometre
MCRI	Marine Conservation Research International
MMMP	Marine Mammal Mitigation Protocol
MMO	Marine Management Organisation
MPS	Marine Policy Statement
MSFD	Marine Strategy Framework Directive
MU	Management Unit
NS	North Sea
ORCA	Organisation Cetacea
OSPAR	Oslo and Paris Convention for the Protection of the Marine Environment 1992
OWF	Offshore Wind Farm
RoI	Republic of Ireland
SAC	Special Area of Conservation
SCANS	Small Cetaceans in European Atlantic waters and the North Sea
SCOS	Special Committee on Seals
SWF	Sea Watch Foundation
UK	United Kingdom
UXO	Unexploded Ordnance

List of Figures and Tables

List of Tables

List of Figures

Appendix A APEM Survey Conditions

Survey No.	Date	Douglas Sea State*	Turbidity**	Wind Speed (knots)/ Direction	Cloud Cover (%)***	Visibility (km)	Air Temp (°C)
October 2021	20/10/2021	4	1	15/W	30–60	>10	11
November 2021	02/11/2021	3	1	8-11/W-SW	40-60	15	7-8
December 2021	12/12/2021	2	1	5-9/NW	60-80	>10	9
January 2022	06/01/2022	1.5	1-2	21-24/S-SW	0	>30	2
February 2022	26/02/2022	1	0.5	30/SW	0	>30	5
March 2022	18/03/2022	1	1	7/S-SE	0	>10	4-6
April 2022	11/04/2022	1-2	1	10-15/SE	40	>10	3
May 2022	09/05/2022	1	1	19-27/S-SW	40-60	>10	9
June 2022	01/06/2022	1	1	11-13/NE	25-40	>10	8
July 2022	16/07/2022	3	2	10/NW	20-25	>10	11
August 2022	03/08/2022	3	1	27-30/W-SW	10-70	>10	16-17
September 2022	21/09/2022	2	0	13-14/SW	100	>10	13-14
October 2022	18/10/2022	3	1	14-19/NW	80	>10	9
November 2022	09/11/2022	2	0	23/W-SW	80-95	>10	9

Survey No.	Date	Douglas Sea State*	Turbidity**	Wind Speed (knots)/ Direction	Cloud Cover (%)***	Visibility (km)	Air Temp (°C)
December 2022	16/12/2022	2	1	18-22/SW	80-90	15	4
January 2023	05/01/2023	2	1	10-18/W	50	>10	6
February 2023	06/02/2023	3	0	14-19/W	0	>10	4-6
March 2023	03/04/2023	2	0	12-14/SE	0	>10	3
April 2023	11/04/2023	4	0	25-26/W	100	8->10	4
May 2023	17/05/2023	1	1	5/W-NW	30	>10	5
June 2023	12/06/2023	2-3	1-2	26-27/SE	50	>10	22
July 2023	26/07/2023	2	1-2	17-20/W	60-90	>10	11-12
August 2023	09/08/2023	3	2	11/W-NW	30-70	>10	12
September 2023	05/09/2023	1	2	11-15/S – W-SW	5-10	30	19-20

*0= Calm (Glassy), 1 = Calm (Rippled), 2 = Smooth, 3 = Slightly Moderate, 4 = Moderate
** 0 = Clear, 1 = Slightly Turbid, 2 = Moderately Turbid, 3 = Highly Turbid
***0 = Clear, 1-10 = Few, 11-50 = Scattered, 51-95 = Broken, 96-100 = Overcast

Appendix B Apportionment and Attribution of Marine Mammals

161. Although most marine megafauna recorded from the surveys are identified to species level, a number remained identified to group level only. To account for these unidentified individuals, the abundance estimates attached include an attribution of unidentified individuals into the monthly abundance estimates and densities. This is based upon an apportionment of the group level identified individuals between those species within that group that were identified to species level within each individual monthly abundance estimate.

162. The number of unidentified individuals in a group is proportioned to the specific species that are contained within that group based on the relative abundance of the positively identified species in that month's survey. For example, in the case of dolphins, the count consists of:

Positively identified dolphin + proportion of group level marine mammals

163. For the DoggerBank surveys, the individuals identified to group level contained within the marine megafauna dataset were:

- Seal Species
- Dolphin / Porpoise
- Marine Mammal Species

164. Instances can occur when there are no positively identified species in months where group level identified individuals have been recorded. A hierarchical approach was used in such cases, in order of preference according to available data:

- Use the proportion from the same month, same year.
- Use the proportion from the same month, different year.
- Use the proportion from the same bio-season / season, same year.
- Use the proportion from the same bio-season / season, different year.
- Use the proportion from the same month, wider area.
- Use the proportion from the same bio-season, wider area.

165. Where proxy data from another year / month was used for a species group, the following applied:

- Seal Species – Whole Survey Area

  - In October 2021, February 2022, March 2022 and April 2022, data for combined behaviours of seal species followed the second hierarchical approach, taking data from the same month in a different year (October 2022, February 2023, March 2023, and April 2023, respectively).
  - In January 2023, data for combined behaviours of seal species followed the third hierarchical approach, taking data from February 2023 - the same season (winter) in the same year.
  - In October 2021 and January 2023, data for submerged seal species followed the third hierarchical approach, taking data from the same season in the same year (November 2021, autumn, and February 2023, winter)
  - In December 2021 and March 2022, data for submerged seal species followed the second hierarchical approach, taking data from the same month in a different year (December 2022 and March 2023, respectively).
  - In February 2022 and March 2022, data for surfacing seal species in the Survey Area followed the second hierarchical approach, taking data from the same month in a different year (February 2023 and March 2023 respectively).
  - In April 2022, data for surfacing seal species followed the fourth hierarchical approach, taking data from the same season in a different year (March 2023).
  - In January 2023, data for surfacing seal species followed the third hierarchical approach, taking data from February 2023 - the same season (winter) in the same year.
- Seal Species – Array Area Only
  - In October 2021 and January 2023, data for combined behaviours of seal species followed the third hierarchical approach, taking data from the same season in the same year (November 2021, autumn and February 2023, winter)
  - In December 2021, March 2022, and May 2022, data for combined behaviours of seal species followed the second hierarchical approach, taking data from same month in a different year (December 2022, March 2023, and May 2023 respectively).
  - In April 2022 and October 2022, data for combined behaviours of seal species followed the fourth hierarchical approach, taking data from the same season in a different year (March 2023, spring, and September 2023, autumn).

- In October 2021, March 2022, and March 2023, data for submerged seal species followed the sixth hierarchical approach, using data from the same bioseason in a wider area. Data was taken from the buffer in November 2021, May 2022, and March 2023, respectively.
- In November 2021 and May 2022, data for submerged seal species followed the fifth hierarchical approach - data captured from the same month (November 2021 and May 2022) in a wider area, here using data from the buffer.
- In December 2021, data for submerged seal species followed the second hierarchical approach, taking data from the same month in a different year (December 2022).
- In January 2023, data for submerged seal species followed the third hierarchical approach, taking data from the same season in the same year (December 2022).
- In April 2022 and October 2022, data for surfacing seal species followed the fourth hierarchical approach, taking data from the same season in a different year (March 2023 and September 2023)
- In January 2023, data for surfacing seal species followed the third hierarchical approach, taking data from the same season in the same year (February 2023, winter).

- Seal Species – 4 km Buffer Only
  - In February 2022, March 2022 and April 2022, data for combined behaviours of seal species followed the second hierarchical approach, taking data from same month in a different year (February 2023, March 2023, and April 2023 respectively).
  - In January 2023, data for combined behaviours of seal species followed the third hierarchical approach, taking data from the same season in the same year (February 2023).
  - In December 2021, data for submerged seal species followed the fourth hierarchical approach, taking data from the same season in a different year (February 2023, winter).
  - In January 2023, data for submerged seal species followed the third hierarchical approach, taking data from the same season in the same year (February 2023).
  - In February 2022 and March 2022, data for surfacing seal species followed the second hierarchical approach, taking data from same month in a different year (February 2023 and March 2023).

- In April 2022, data for surfacing seal species followed the fourth hierarchical approach, taking data from the same season in a different year (March 2023).
- In January 2023, data for surfacing seal species followed the third hierarchical approach, taking data from the same season in the same year (February 2023).

- Dolphin Species – 4 km Buffer Only
  - In February 2022, data for surfacing dolphin species followed the second hierarchical approach, taking data from same month in a different year (February 2023).