RWE Renewables UK Dogger Bank South (East) Limited

RWE Renewables UK Dogger Bank South (West) Limited

Dogger Bank South Offshore Wind Farms

Environmental Statement

Volume 7

Appendix 11-2 – Marine Mammal Information Report

May 2024

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Glossary

Term	Definition
Agreement for Lease (AfL) Area	The Area of the seabed leased by The Crown Estate to the Applicants.
Array Areas	The DBS East and DBS West offshore Array Areas, where the wind turbines, offshore platforms and array cables will be located. The Array Areas do not include the Offshore Export Cable Corridor or that part of the Inter-Platform Cable Corridor within which no wind turbines are proposed. Each area is referred to separately as an Array Area.
Cetaceans	Commonly known as whales, dolphins, or porpoises.
Concurrent Scenario	A potential construction scenario for the Projects where DBS East and DBS West are both constructed at the same time.
Development Scenario	Description of how the DBS East and / or DBS West Projects would be constructed either in isolation, sequentially or concurrently.
Dogger Bank South (DBS) East Survey Area	The original Crown Estate Lease Area plus 4km buffer that was surveyed via the site specific digital aerial surveys.
Dogger Bank South (DBS) Offshore Wind Farms	The collective name for the two Projects, DBS East and DBS West.
Dogger Bank South (DBS) West Survey Area	The original Crown Estate Lease Area plus 4km buffer that was surveyed via the site specific digital aerial surveys.
Electrical Switching Platform (ESP)	The Electrical Switching Platform (ESP), if required would be located either within one of the Array Areas (alongside an Offshore Converter Platform (OCP)) or the Export Cable Platform Search Area.
European Site	Sites designated for nature conservation under the Habitats Directive and Birds Directive. This includes candidate Special Areas of Conservation, Sites of Community Importance, Special Areas of Conservation and Special Protection Areas, and is defined in regulation 8 of the Conservation of Habitats and Species Regulations 2017.

Term	Definition
In Isolation Scenario	A potential construction scenario for one Project which includes either the DBS East or DBS West array, associated offshore and onshore cabling and only the eastern Onshore Converter Station within the Onshore Substation Zone and only the northern route of the onward cable route to the proposed Birkhill Wood National Grid Substation.
landfall	The point on the coastline at which the Offshore Export Cables are brought onshore, connecting to the onshore cables at the Transition Joint Bay (TJB) above mean high water.
Management Unit	Management units provide an indication of the spatial scales at which impacts of plans and projects alone, cumulatively and in-combination, need to be assessed for the key cetacean species in UK waters, with consistency across the UK.
Offshore Development Area	The Offshore Development Area for ES encompasses both the DBS East and West Array Areas, the Inter-Platform Cable Corridor, the Offshore Export Cable Corridor, plus the associated Construction Buffer Zones.
Offshore Export Cable Corridor	This is the area which will contain the offshore export cables (and potentially the ESP) between the Offshore Converter Platforms and Transition Joint Bays at the landfall.
Pinnipeds	Commonly known as seals.
Sequential Scenario	A potential construction scenario for the Projects where DBS East and DBS West are constructed with a lag between the commencement of construction activities. Either Project could be built first.
The Applicants	The Applicants for the Projects are RWE Renewables UK Dogger Bank South (East) Limited and RWE Renewables UK Dogger Bank South (West) Limited. The Applicants are themselves jointly owned by the RWE Group of companies (51% stake) and Masdar (49% stake).
The Projects	DBS East and DBS West (collectively referred to as the Dogger Bank South offshore wind farms).

Acronyms

Term	Definition
ASCOBANS	Agreement on the Conservation of Small Cetaceans of the Baltic, North East Atlantic, Irish and North Seas
BDS	Baie de Somme
BEIS [1]	Department for Business, Energy & Industrial Strategy
CCW	Countryside Council for Wales
CES	Coastal East Scotland
CI	Confidence Intervals
CIS	Celtic and Irish Sea
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CGNS	Celtic and Greater North Sea
CL	Confidence Limit
CRoW	The Countryside and Rights of Way Act
CV	Coefficient of Variation
DBS	Dogger Bank South
DECC	Department of Energy and Climate Change
EC	European Communities
EPS	European Protected Species

[1] BEIS is now known as the Department for Energy Security and Net Zero as of the 8th February 2023

Term	Definition
ESAS	European Seabirds At Sea
FCS	Favourable Conservation Status
GNS	Greater North Sea
HiDef	HiDef Aerial Surveying Limited
HM	His Majesty's
IAMMWG	Inter-Agency Marine Mammal Working Group
IUCN	International Union for Conservation of Nature
JCP	Joint Cetacean Protocol
JNCC	Joint Nature Conservation Committee
km	Kilometre
MMO	Marine Management Organisation
MPS	Marine Policy Statement
MSFD	Marine Strategy Framework Directive
MUs	Management Units
NE	North East
NPS	National Policy Statements
NS	North Sea
NSIP	Nationally Significant Infrastructure Project
OESEA	Offshore Energy Strategic Environmental Assessment
ORCA	Organisation Cetacea

Term	Definition
OSPAR	Oslo and Paris Convention for the Protection of the Marine Environment 1992
SAC	Special Area of Conservation
SCANS	Small Cetaceans in European Atlantic waters and the North Sea
SCOS	Special Committee on Seals
SE	South East
TSEG	Trilateral Seal Expert Group
UK	United Kingdom
WS	West Scotland
WWT	The Wildfowl and Wetlands Trust

11.2 Marine Mammal Information

11.2.1 Introduction

1. This appendix provides further supporting marine mammal information and survey data for **Volume 7, Chapter 11 Marine Mammals (application ref: 7.11)**.

11.2.2 Marine Mammal Species

2. In United Kingdom (UK) waters, two groups of marine mammals occur: cetaceans (whales, dolphins, and porpoises) and pinnipeds (seals). During the site specific surveys for both the Dogger Bank South (DBS) offshore wind farms, harbour porpoise *Phocoena phocoena* were the most commonly sighted marine mammal species for both Projects, with the highest numbers being recorded in the summer months (APEM Ltd, 2022).
3. This is supported by other wider scale surveys and reporting for marine mammals, including by Department for Energy and Climate Change (DECC) (2016), Small Cetaceans in European Atlantic waters and the North Sea (SCANS) surveys (Hammond *et al.* 2013; 2021; Gilles *et al.* 2023) and Joint Cetacean Protocol (JCP) data resources (Paxton *et al.* 2016).
4. While a number of cetacean species have been recorded within the southern areas of the North Sea, only harbour porpoise occur regularly throughout the year, while minke whale *Balaenoptera acutorostrata* could occur in the southern North Sea, particularly during in the summer periods and white-beaked dolphin *Lagenorhynchus albirostris* are less frequently recorded (DECC 2016; Hammond *et al.* 2021; Paxton *et al.* 2016). Other cetacean species, including common dolphin *Delphinus delphis*, bottlenose dolphin *Tursiops truncatus* and Atlantic white-sided dolphin *Lagenorhynchus acutus* are relatively uncommon in the North Sea (DECC 2016). Although it should be noted that the number of bottlenose dolphin sightings has recently been increasing along the east coast of England, where a pod has been announced to be resident off the coast of Yorkshire (The Telegraph 2022).
5. Both UK seal species, grey seal, *Halichoerus grypus*, and harbour seal, *Phoca vitulina*, are present in the North Sea in relatively high number, due to nearby key breeding areas for both species (DECC, 2016).

6. Public sightings reported to the SeaWatch Foundation in the east of England (at the time of writing; February 2022 to October 2023) were predominantly harbour porpoise 138 sightings (n=151), bottlenose dolphin; 136 sightings (n=1,335), white-beaked dolphin; five sightings (n=63), common dolphin 16 sightings (n=168), minke whale; 11 sightings (n=13), humpback whale; four sightings (n=5), unknown cetacean species (n=2), grey seal; 55 sightings (n=125), two sightings of harbour seal (n=2) and one sighting of long-finned pilot whale (n=30) (SeaWatch Foundation, 2023).

7. Other marine mammal species, including Atlantic white-sided dolphin, bottlenose dolphin, killer whale, *Orcinus orca*, sperm whale, *Physeter macrocephalus*, long-finned pilot whale, *Globicephala melas*, Risso's dolphin, *Grampus griseus*, striped dolphin, *Stenella coeruleoalba*, and other seal species are occasional or rare visitors to the southern North Sea (e.g. Reid *et al.* 2003; Hammond *et al.* 2013, 2021; DECC 2016; SCOS 2022).

8. Sperm whale are a regular visitor to the Norwegian Sea and have been recorded to strand in the southern North Sea (Seawatch Foundation, 2016). In recent years there have been sightings of walrus (*Odobenus rosmarus*) in the North Sea, with the most recent being recorded in December 2022 in Scarborough (The Guardian, 2023).

9. Site characterisation has been undertaken using site specific data for DBS, as well as existing data from other Dogger Bank offshore wind farms and other available information for the region.

10. The marine mammals study area has been defined on the basis of marine mammals being highly mobile and transitory in nature; therefore, it is necessary to examine species occurrence not only within the DBS Offshore Development Area, but also over the wider area. Based on the site specific surveys and other data sources, the key species of interest and therefore the focus of the assessments would be on the following species:

    - Harbour porpoise – present throughout the year, although may be variations in seasonal occurrence;
    - Bottlenose dolphin – historically not common in the area, with limited data, however, recent reporting has indicated that the number are increasing in the area, and so have been included on a precautionary basis;
    - Common dolphin - seasonal occurrence in low numbers but historically not common in the area;
    - White-beaked dolphin – seasonal occurrence in low numbers;
    - Minke whale – seasonal occurrence in low numbers;

- Grey seal – present throughout the year; and
- Harbour seal – present throughout the year.

11.2.3 Study Area

11. 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 UK waters with consistency across the UK (IAMMWG, 2023). The study area, MUs and reference populations have been determined based on the most relevant information and scale at which potential impacts from DBS wind farms alone.

12. For each species of marine mammal, the following study areas have been defined based on the relevant MUs, current knowledge and understanding of the biology of each species:

    - Harbour porpoise: North Sea (NS) MU;
    - Bottlenose dolphin: Greater North Seas (GNS) MU and Celtic East coast Scotland (CES) MU;
    - Common Dolphin: Celtic and Greater North Seas (CGNS) MU;
    - White beaked dolphin: CGNS MU;
    - Minke whale: CGNS MU;
    - Grey seal: South-east (SE) England, and the North-east England (NE) MUs; and
    - Harbour seal: SE England MU.

13. There is the potential for seals from haul-out sites to move along the coast and offshore to forage in and around the Offshore Development Area. Key haul-out sites for both seal species within the vicinity of the Projects including the Offshore Export Cable Corridor are:

    - Filey Brigg;
    - Ravenscar;
    - Tees;
    - The Wash;
    - Donna Nook; and
    - Blakeney Point.

11.2.4 Policy, Legislation and Guidance

11.2.4.1 National Policy Statements

14. As outlined in **Volume 7 Chapter 11 Marine Mammals (application ref: 7.11)** there are a number of pieces of legislation, policy and guidance applicable to the assessment of marine mammals. These include:

- The Marine Strategy Framework Directive (MSFD) 2008/56/EC (European Communities, 2008);
- The Marine Policy Statement (MPS) (His Majesty's (HM) Government, 2011); and
- The East Inshore and East Offshore Marine Plans (HM Government, 2014).

11.2.4.1.1 The Marine Strategy Framework Directive

15. Annex I of the MSFD states that to ensure that good environmental status is met the following must be considered:

- Biological diversity should be maintained;
- The quality and occurrence of habitats, as well as the distribution and abundance of species are in line with prevailing physiographic, geographic, and climatic conditions;
- All elements of the marine food web, to the extent that they are known, occur at normal abundance and diversity levels capable of ensuring the long-term abundance of the species and the retention of their full reproductive capacity;
- Concentrations of contaminants are at levels not giving rise to pollution effects;
- Properties and quantities of marine litter do not cause harm to the coastal and marine environment; and
- Introduction of energy, including underwater noise, is at levels that do not adversely affect the marine environment.

11.2.4.1.2 The Marine Policy Statement

16. The MPS (HM Government, 2011) provides a high-level approach to marine planning and the general principles for decision making. It sets out the framework for environmental, social and economic considerations that need to be taken into account in marine planning. The high-level objective of 'Living within environmental limits' covers the points relevant to marine mammals, this requires that:

- Biodiversity is protected, conserved and where appropriate recovered and loss has been halted;
- Healthy marine and coastal habitats occur across their natural range and are able to support strong, biodiverse biological communities and the functioning of healthy, resilient and adaptable marine ecosystems; and
- Our oceans support viable populations of representative, rare, vulnerable, and valued species.

11.2.4.1.3 The East Inshore and East Offshore Marine Plans

17. Within both the East Inshore and East Offshore Marine Plans (HM Government, 2014), a set of objectives have been set out to ensure biodiversity protections and are of relevance to marine mammals as they cover policies and commitments on the wider ecosystem, as set out within the MPS and the MSFD.

- Objective 6: "*To have a healthy, resilient and adaptable marine ecosystem in the East Marine Plan areas*"; and
- Objective 7: "*To protect, conserve and, where appropriate, recover biodiversity that is in or dependent upon the East marine plan areas*".

11.2.4.2 Other National and International Legislation for Marine Mammals

18. **Table 11-2-1** provides an overview of national and international legislation in relation to marine mammals.

Table 11-2-1 Summary Table for National and International Legislations Relevant for Marine Mammals

Legislation	Level of Protection	Species Included	Details
Agreement on the Conservation of Small Cetaceans of the Baltic, North East Atlantic, Irish and North Seas (ASCOBANS)	International	Odontocetes	Formulated in 1992, this agreement has been signed by eight European countries bordering the Baltic and North Seas (including the English Channel) and includes the UK. Under the Agreement, provision is made for the protection of specific areas, monitoring, research, information exchange, pollution control and increasing public awareness of small cetaceans.
The Berne Convention 1979	International	All cetaceans, grey seal and harbour seal	The Convention conveys special protection to those species that are vulnerable or endangered. Appendix II (strictly protected fauna): 19 species of cetacean. Appendix III (protected fauna): all remaining cetaceans, grey and harbour seal. Although an international convention, it is implemented within the UK through the Wildlife and Countryside Act 1981 (with any aspects not implemented via that route brought in by the Habitats Directive).
The Bonn Convention 1979	International	All cetaceans	Protects migratory wild animals across all, or part of their natural range, through international co-operation, and relates particularly to those species in danger of extinction. One of the measures identified is the adoption of legally binding agreements, including ASCOBANS.
Oslo and Paris Convention for the Protection of the Marine Environment 1992 (OSPAR)	International	Bowhead whale *Balaena mysticetus*, northern right whale *Eubalaena glacialis*, blue whale *Balaenoptera musculus*, and harbour porpoise	OSPAR has established a list of threatened and/or declining species in the North East Atlantic. These species have been targeted as part of further work on the conservation and protection of marine biodiversity under Annex V of the OSPAR Convention. The list seeks to complement, but not duplicate, the work under the EC Habitats and Birds directives and measures under the Berne Convention and the Bonn Convention.
International Convention for the Regulation of Whaling 1956	International	All cetacean species	This Convention established the International Whaling Commission (IWC) who regulates the direct exploitation and conservation of large whales (in particular sperm and large baleen whales) as a resource and the impact of human activities on cetaceans. The regulation considered scientific matters related to small cetaceans, in particular the enforcing of a moratorium on commercial whaling which came into force in 1986.
Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) 1975	International	All cetacean species	Prohibits the international trade in species listed in Annex 1 (including sperm whales, northern right whales, and baleen whales) and allows for the controlled trade of all other cetacean species.
The Conservation of Habitats and Species Regulations 2017 and The Conservation of Offshore Marine Habitats and Species Regulations 2017	National	All cetaceans, grey and harbour seal	The Habitats Regulations 2017. Provisions of The Habitats Regulations are described further in Chapter 11 Marine Mammals. It should be noted that the Habitats Regulations apply within the territorial seas and to marine areas within UK jurisdiction, beyond 12 nautical miles.

Legislation	Level of Protection	Species Included	Details
The Wildlife and Countryside Act 1981 (as amended)	National	All cetaceans	Schedule five: all cetaceans are fully protected within UK territorial waters. This protects them from killing or injury, sale, destruction of a particular habitat (which they use for protection or shelter) and disturbance. Schedule six: Short-beaked common dolphin, bottlenose dolphin and harbour porpoise; prevents these species being used as a decoy to attract other animals. This schedule also prohibits the use of vehicles to take or drive them, prevents nets, traps or electrical devices from being set in such a way that would injure them and prevents the use of nets or sounds to trap or snare them.
The Countryside and Rights of Way Act (CroW) 2000	National	All cetaceans	Under the CroW Act 2000, it is an offence to intentionally or recklessly disturb any wild animal included under Schedule 5 of the Wildlife and Countryside Act.
Conservation of Seals Act 1970	International	Grey and harbour seal	As of 1st March 2021, a person commits an offence if they intentionally or recklessly kill, injure or take a seal. The legislative changes in England and Wales, amends the Conservation of Seals Act 1970, prohibiting the intentional or reckless killing, injuring or taking of seals and removing the provision to grant licences for the purposes of protection, promotion or development of commercial fisheries or aquaculture activities. These changes were enacted to ensure compliance with the US Marine Mammal Protection Act Import Provision Rule.

11.2.4.3 European Protected Species Guidance

19. All cetacean species are listed as European Protected Species (EPS) under Annex IV of The Habitats Directive and are therefore protected from the deliberate killing (or injury), capture and disturbance throughout their range. Within the UK, The Habitats Directive is enacted through The Conservation of Habitats and Species Regulations 2017 and the Conservation of Offshore Marine Habitats and Species Regulations 2017. Under these Regulations, it is an offence if cetaceans are deliberately disturbed in such a way as to:

- Deliberately capture, injure or kill any EPS;
- Deliberately disturb them; or
- Damage or destroy a breeding site or resting place.

20. The Joint Nature Conservation Committee (JNCC), Natural England and the Countryside Council for Wales (CCW) [2] (JNCC *et al.* 2010) produced draft guidance concerning the Regulations on the deliberate disturbance of marine EPS, which provides an interpretation of the regulations in greater detail, including for pile driving operations (JNCC, 2010a), seismic surveys (JNCC, 2017) and the use of explosives (JNCC, 2010b [3]).

21. The draft guidance provides the following interpretations of deliberate injury and disturbance offences under both the Habitats Regulations and Offshore Regulations (now the Habitats Regulations 2017), as detailed in the paragraphs below:

"*Deliberate actions are to be understood as actions by a person who knows, in light of the relevant legislation that applies to the species involved, and the general information delivered to the public, that his action will most likely lead to an offence against a species, but intends this offence or, if not, consciously accepts the foreseeable results of his action;*

22. Certain activities that produce loud sounds in areas where EPS could be present have the potential to result in an injury offence, unless appropriate mitigation measures are implemented to prevent the exposure of animals to sound levels capable of causing injury".

[2] Now part of Natural Resources Wales

[3] The DRAFT JNCC guidelines for minimising the risk of injury to marine mammals from unexploded ordnance clearance in the marine environment (October 2023) is currently out for consultation and measures will be updated accordingly once the requirements are finalised.

23. For the purposes of marine users, the draft guidance states that a disturbance which can cause offence should be interpreted as:

"*Disturbance which is significant in that it is likely to be detrimental to the animals of an EPS or significantly affect their local abundance or distribution*".

24. The draft guidelines further states that a disturbance offence is more likely where an activity causes persistent noise in an area for long periods of time, and highlights that sporadic "trivial disturbance" should not be considered as a disturbance offence under Article 12.

25. Any action that could increase the risk of a long-term decline of the population, increase the risk of a reduction of the range of the species, and/or increase the risk of a reduction of the size of the habitat of the species can be regarded as a disturbance under the Regulations. For a disturbance to be considered non-trivial, the disturbance to marine EPS would need to be likely to at least increase the risk of a certain negative impact on the species at Favourable Conservation Status (FCS).

26. JNCC *et al.* (2010) state that:

"*In any population with a positive rate of growth, or a population remaining stable at what is assumed to be the environmental carrying capacity, a certain number of animals can potentially be removed as a consequence of anthropogenic activities (e.g., through killing, injury or permanent loss of reproductive ability), in addition to natural mortality, without causing the population to decrease in numbers, or preventing recovery, if the population is depleted. Beyond a certain threshold however, there could be a detrimental effect on the population*".

27. Further discussion on the use of thresholds for significance and the permanent or temporary nature of any disturbance is considered by defining the magnitude of potential effect in the assessment. Consideration of any potential essential habitat or geographical structuring of EPS is provided in the existing environment section.

11.2.4.3.1 Marine Wildlife Licence Requirements

28. A marine wildlife licence is required if the risk of injury or disturbance to cetacean species is assessed as likely under the Habitats Regulations 2017. If a licence is required, an application must be submitted, the assessment of which comprises three tests, namely:

- Whether the activity falls within one of the purposes specified in Regulation 55 of the Habitats Regulations. Only the purpose of *"preserving public health or public safety or other imperative reasons of overriding public interest, including those of a social or economic nature and beneficial consequences of primary importance for the environment*" is of relevance to marine mammals in this context;
- That there are no satisfactory alternatives to the activity proposed (that would not incur the risk of offence); and
- That the licensing of the activity would not result in a negative impact on the species'/ population's FCS.

29. A marine wildlife licence would consider all cetacean species at potential risk of injury or disturbance. There is no legislation that requires seals to be included under a marine wildlife licence; disturbance is not an offence under the Conservation of Seals Act 1970 and, in the case of injury to seals, the Marine Management Organisation (MMO) is only able to grant licences under very specific circumstances as listed under Section 10(1) of the Conservation of Seals Act 1970 which would not apply in the case that a marine wildlife licence was required for the construction of DBS Array Areas.

30. Under the definitions of 'deliberate disturbance' in the Habitats Regulations, chronic exposure and / or displacement of animals could be regarded as a disturbance offence. Therefore, if these risks cannot be avoided, then the Applicant is likely to be required to apply for a marine wildlife licence from the MMO in order to be exempt from the offence.

31. If required, the marine wildlife licence application would be submitted post-consent. At that point in time, the project design envelope would have been further refined through detailed design and procurement activities and further detail would be available on the techniques selected for the construction of the wind farm, as well as the mitigation measures that would be in place following the development of the Marine Mammal Mitigation Protocol (MMMP) for piling.

11.2.4.3.2 Conservation Status of Marine Mammals

32. **Table 11-2-2** provides the current conservation status of marine mammal species occurring in UK and adjacent waters, based on the most recent 2013-2018 reporting by JNCC in 2019.

Table 11-2-2 Conservation Status of Marine Mammal Species Occurring in UK and Adjacent Waters (JNCC 2019), Relevant to the Project

Species	Conservation Status Assessment
Harbour porpoise	Unknown
Bottlenose dolphin	Unknown
White-beaked dolphin	Unknown
Minke whale	Unknown
Grey seal	Favourable
Harbour seal	Unfavourable-inadequate

33. The International Union for Conservation of Nature (IUCN)'s Red List of Threatened Species provides assessments of the conservation status of animals evaluated at a global scale using the IUCN Red List Categories and Criteria, with the aim of determining their relative risk of extinction. Assessments are updated periodically to reflect new information. Where sufficient information exists, the majority of marine mammal species occurring in UK waters fall into the lowest category of 'least concern' (**Table 11-2-3**).

Table 11-2-3 Global IUCN Red List of Threatened Species Assessments for Marine Mammal Species Relevant to the Project

Species	IUCN Red List Status	Year Assessed
Harbour porpoise	Least Concern	2020
Bottlenose dolphin	Least Concern	2018
White-beaked dolphin	Least Concern	2018
Minke whale	Least Concern	2018

Species	IUCN Red List Status	Year Assessed
Grey seal	Least Concern	2016
Harbour seal	Least Concern	2016

11.2.5 Site Specific Surveys

11.2.5.1 DBS Site Specific Surveys

34. 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 Agreement for Lease (AfL) Areas, including a 4km buffer (see **Plate 11-2-1** and **Plate 11-2-2**) which is referred to as DBS East Survey Area and DBS West Survey Area throughout the chapter. The project area has been refined which are now identified as DBS East Array Area and DBS West Array Area.

35. Since the aerial surveys were commissioned and undertaken the Array Area within the redline boundary of the Projects has been reduced for both the Projects. The presence and densities for marine mammals has been reported and calculated over the original site boundaries to include all available information and give a more accurate representation of the wider area.

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

37. The digital aerial survey was a grid-based design conducted along a series of strip transects (at 2km spacing), flown on a monthly basis from March 2021 to February 2022. The camera system captured abutting still imagery along survey transit lines spaced approximately 2km between-tracks (see **Plate 11-2-1** and **Plate 11-2-2**).

38. Both the original Projects AfL Areas were approximately 494.5km^2 each, (989km^2 combined) the digital aerial surveys covered this area plus a 4km buffer (**Plate 11-2-1** and **Plate 11-2-2**); a total of 1,404.91km^2 which includes the 4km buffer, making up the Survey Area.

39. The aircraft collected the data at an altitude of approximately 396m and a speed of approximately 120 knots. Images were collected continuously along the survey lines and a minimum of 30% coverage was captured, with 10% of the data subject to further analysis.

Plate 11-2-1 Survey Area for DBS East AfL Area with 4km Buffer and 2km Transects

Plate 11-2-2 Survey area for DBS West AfL Area with 4km buffer and 2km transects

40. 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.

41. 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.

42. 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.

43. 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 of these 999 values were taken as the variability of the statistic over the population (Efron & Tibshirani, 1993).

44. 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.

45. **Table 11-2-4** and **Table 11-2-5** show the effort for all 24 surveys at DBS East and DBS West, as survey conditions can impact the ability to detect marine mammals.

Table 11-2-4 Environmental conditions recorded for digital aerial surveys March 2021 to February 2023 for DBS East

Survey no.	Date	Douglas Sea State[1]	Turbidity[2]	Wind speed (knots) / Direction	Cloud cover (%)[3]	Visibility (km)	Air Temp ℃
1	22/03/2021	0	0.5	5-20 /various	5-60	>10	4-9
1	25/03/2021	3	0	20 / SW	50	>10	12
2	04/04/2021	2- 3	0-2	20-35 / W	0-100	>10	8-10
3	07/05/2021	1-3	1-2	9-17 /NW	20-80	>10	4
4	09/06/2021	0	0	9-11 / SW	0	>10	17
5	21/07/2021	1- 2	0	10-14 / NE	0-96	>10	11-14
6	27/08/2021	2-3	1-2	11-18 / NE	20-65	>10	12
7	22/09/2021	2	1	13-14 / WSW	15	>10	13-14
8	14/10/2021	3-4	0	10-25 W/S	80 -100	>10	10-12
9	08/11/2021	1	2	11-17 / W	100	>10	6 -7
10	16/12/2021	0	0	8 -12 SW/N	96 -100	>10	8
11	18/01/2022	2	0	19-22 / SW	0	>10	11
12	11/02/2022	1	1 -2	6-12 / N	20	>10	2-3

Survey no.	Date	Douglas Sea State[1]	Turbidity[2]	Wind speed (knots) / Direction	Cloud cover (%)[3]	Visibility (km)	Air Temp ℃
13	03/03/2022	2	2	27/N	0	>10	5
14	10/04/2022	1-2	1	16/ W	15-30	>10	4
15	03/05/2022	1	2	11 / SW	75	>10	5
16	10/06/2022	3	2	22 / SW	20-30	>10	12
17	13/07/2022	3	2	18 / NW	20-40	>10	12
18	09/08/2022	0.5	0.8-1	9 / W	90	40	16
19	29/09/2022	2	1	20 / NE	60	>10	12
20	11/10/2022	1	0	270 / N	30-70	>10	9
21	25/11/2022	3	1	26 / S	0	>10	8
22	16/12/2022	2	0 1	7-15/ SW	30-50	>10	3
23	22/01/2023	1	0	8 / S	10-40	>10	3

[1] = *Calm (Glassy); 1 = Calm (Rippled); 2 = Smooth; 3 = Slight*
[2] = *Clear; 1 = Slightly Turbid; 2 = Moderately Turbid; 3 = Highly Turbid*
[3] = *Clear; 1-10 = Few; 11-50 = Scattered; 51-95 = Broken; 96-100 = Overcast*

Table 11-2-5 Environmental conditions recorded for digital aerial surveys March 2021 to February 2023 for DBS West

Survey no.	Date	Douglas Sea State [1]	Turbidity[2]	Wind speed (knots) / Direction	Cloud cover (%)[2]	Visibility (km)	Air Temp ℃
1	22/03/2021	0	1	5 / SE	10	>5	18
1	25/03/2021	3	0	20 / SW	0 -70	>10	9-12
2	04/04/2021	2- 3	1 -2	25-30 / W	0 -70	>10	10-12
3	07/05/2021	1	2	8-13 / NW	15-25	>10	4
4	09/06/2021	0- 1	0 -1	11-18 / SW	0	>10	17
5	21/07/2021	1-2	0	8-14 / Various	0-100	>10	12-13
6	27/08/2021	2	1	18 / NE	20	>10	12
7	22/09/2021	2- 3	1- 2	10 25 / W	5-20	>10	13-14
8	14/10/2021	4	0- 2	10-25 / Various	80-100	>10	10-12

Survey no.	Date	Douglas Sea State [1]	Turbidity[2]	Wind speed (knots) / Direction	Cloud cover (%)[2]	Visibility (km)	Air Temp ℃
9	08/11/2021	1	2	11-15 / SW	100	>10	6
10	16/12/2021	0	0	8 -12 /NW	96-100	>10	8
11	18/01/2022	2	0	19 22 /SW	0	>10	11
12	11/02/2022	1	1- 2	9/ NE; 6 -12 /W	20	>10	2 -3
13	03/03/2022	2-3	2-3	26-32 / SE to S	70-80	>10	5-7
14	10/04/2022	1	1	17-18 / SSW & W	15	>10	4
15	03/05/2022	1	1	3 /N	70-85	>10	4
16	10/06/2022	1	0-1	22-25 / WSW	0	>7	12
17	13/07/2022	2	1	11 14 / NW	20-30	>10	12

Survey no.	Date	Douglas Sea State [1]	Turbidity[2]	Wind speed (knots) / Direction	Cloud cover (%)[2]	Visibility (km)	Air Temp ℃
18	09/08/2022	0 -1	0-1	2 6 /S - WSW	20-40	>10	16-17
19	29/09/2022	3	3	17 -25 / NE	60-85	>10	11
20	11/10/2022	2	0	9-10 / W	60-95	>10	9
21	25/11/2022	3-4	0	20-25 / WSW	0-20	>10	7
22	16/12/2022	2	2	14-18 / SW	40	>10	3-4
23	22/01/2023	0-1	2-3	15 / S	30	>10	3

[1] = *Calm (Glassy); 1 = Calm (Rippled); 2 = Smooth; 3 = Slight*
[2] = *Clear; 1 = Slightly Turbid; 2 = Moderately Turbid; 3 = Highly Turbid*
[3] = *Clear; 1-10 = Few; 11-50 = Scattered; 51-95 = Broken; 96-100 = Overcast*

46. **Table 11-2-6** and **Table 11-2-7** show the raw numbers of marine mammals recorded during the digital aerial surveys in DBS East and West, respectively, from March 2021 to February 2023. These numbers are the raw count, therefore only present a relative abundance and not total abundances. The results indicate that harbour porpoise is present in the highest numbers, followed by dolphin or porpoise species which at worst case scenario can be considered as harbour porpoises. Unidentified seals are present in the high numbers, similar to dolphin / porpoise species followed by grey seals, white beaked dolphins, common dolphins, unidentified dolphin and with just one individual identified as a minke whale.

Table 11-2-6 APEM Surveys Species Counts for DBS East Array Area and 4km Buffer (March 2021 to February 2023)

Survey date	Grey seal	Seal species	Harbour porpoise	Dolphin / porpoise species	White-beaked dolphin	Minke whale	Marine mammal species
Mar-21	0	3	1	4	0	0	0
Apr-21	0	0	8	9	0	0	0
May-21	0	2	14	4	0	0	0
Jun-21	2	3	39	2	0	0	0
Jul-21	2	4	39	0	0	0	1
Aug-21	3	0	21	1	0	0	1
Sep-21	1	1	64	2	0	1	0
Oct-21	1	1	12	0	0	0	0
Nov-21	0	1	18	0	0	0	0
Dec-21	0	6	12	9	8	0	2
Jan-22	1	2	27	4	0	0	0
Feb-22	1	2	21	0	0	0	0
Mar-22	1	0	2	3	0	0	2
Apr-22	0	1	28	0	0	0	5
May-22	7	1	33	9	0	0	0

Survey date	Grey seal	Seal species	Harbour porpoise	Dolphin / porpoise species	White-beaked dolphin	Minke whale	Marine mammal species
Jun-22	2	0	44	52	0	0	2
Jul-22	3	0	18	0	0	0	0
Aug-22	1	5	106	9	0	2	0
Sep-22	4	0	18	34	0	0	0
Oct-22	2	4	31	0	0	0	0
Nov-22	1	0	6	0	0	0	0
Dec-22	6	0	40	0	2	0	0
Jan-23	1	3	32	0	6	0	0
Feb-23	3	1	34	0	0	0	1
Total	**62**	**49**	**668**	**50**	**8**	**3**	**14**

Table 11-2-7 APEM Surveys Species Counts for DBS West Array Area and 4km Buffer (March 2021 to February 2023)

Survey date	Grey seal	Seal species	Harbour porpoise	Dolphin / porpoise species	White-beaked dolphin	Common dolphin	Dolphin species	Minke whale	Marine mammal species
Mar-21	0	0	0	5	0	0	0	0	0
Apr-21	1	1	8	7	4	0	1	0	1
May-21	0	9	48	5	0	2	0	0	2
Jun-21	6	10	97	7	8	0	0	0	3
Jul-21	8	5	52	1	0	0	0	0	1
Aug-21	4	0	22	1	0	0	0	0	0
Sep-21	0	1	29	4	0	0	0	0	1
Oct-21	1	1	8	0	0	0	0	0	0
Nov-21	0	0	13	0	0	0	0	0	4
Dec-21	3	3	8	4	0	0	0	0	0
Jan-22	3	3	29	0	0	0	0	0	0
Feb-22	5	1	30	0	0	0	0	0	4

Survey date	Grey seal	Seal species	Harbour porpoise	Dolphin / porpoise species	White-beaked dolphin	Common dolphin	Dolphin species	Minke whale	Marine mammal species
Mar-22	1	0	4	0	0	0	0	0	0
Apr-22	2	5	26	4	0	0	0	0	4
May-22	16	4	61	2	0	2	0	2	1
Jun-22	5	0	33	2	0	0	0	0	4
Jul-22	4	1	21	0	0	0	0	3	3
Aug-22	7	16	51	2	0	0	1	1	0
Sep-22	4	1	45	1	0	0	0	0	1
Oct-22	2	5	12	0	0	0	0	0	0
Nov-22	0	0	19	1	4	0	0	0	2
Dec-22	25	0	48	0	0	0	0	0	0
Jan-23	7	5	46	0	0	0	0	0	0
Feb-23	4	1	95	0	3	0	0	0	1
Total	**88**	**63**	**805**	**46**	**19**	**4**	**2**	**6**	**31**

47. From the sightings numbers (as shown above) of each marine mammal species, or marine mammal species group, abundance and density estimates were calculated. Upper and lower confidence intervals (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).

48. 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.

49. Without these availability bias, or correction factors, being corrected for, any abundance or density estimate would be relative only, rather than being an absolute estimate. For the site-specific surveys, APEM have not calculated any correction factors for marine mammal data and no apportioning was applied.

50. Species distribution maps have also been generated from the site-specific survey data at the Projects.

11.2.5.2 Surveys Within the Dogger Bank Area

51. HiDef Aerial Surveying Limited (HiDef) carried out digital aerial video surveys over the Round 3 Dogger Bank zone with additional effort focused on Tranche C, see **Plate 11-2-3**. The surveys were used to generate species density and distribution maps for the area with a 4km buffer. Surveys took place from January to December 2013. Transects were placed 7.5km apart in the main Dogger Bank zone, and 2.5km apart in Tranche C. Twelve surveys were undertaken between January 2013 to December 2013.

52. Harbour porpoises were the most numerous marine mammals recorded (n=2,702) with high numbers were recorded in March to September, with a peak in July (n=1,095). Grey seals were recorded in all surveys (n=92), peaking in January, March, and June 2013. White-beaked dolphins were recorded in most months (n=56), peaking in May and July 2013. Minke whale were recorded May to September (n=8) and the total for harbour seal was (n=12), seal species (n=59), unidentified dolphin (n=4), small cetacean/seal species (n=82) and unidentified cetacean (n=18).

53. Digital aerial video surveys over the Round 3 Dogger Bank zone were also carried out between April 2010 to May 2012. Again, harbour porpoise was the most numerous marine mammal recorded (N=5,728), recorded in every survey, peaks in the spring and summer. White beaked dolphin was recorded (n=104). White-beaked dolphin was recorded in May and June 2010, January, March to May, November and December 2011, March, and April 2012. Grey seal were more present in the summer months (N=46). Minke whale were recorded in spring and summer (n-18). Additional sightings that could not be attributed to a species small cetacean (n=6,034); dolphin species (n=89); seal species (n=218); small cetacean/seal species (n=210); large cetacean (m=9), unidentified cetacean (n=5) and cetacean/seal/shark (n=241).

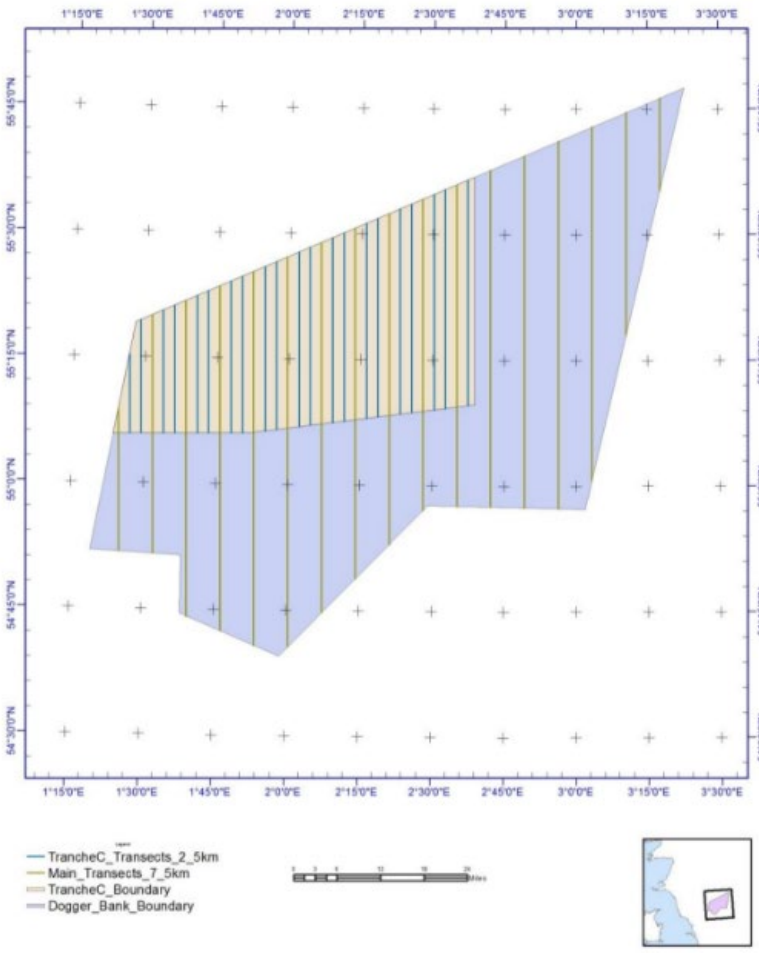


Plate 11-2-3 Location of Aerial Survey Transects Within Dogger Bank and Tranche C.

54. The abundance of each species observed within the survey area was estimated separately using a design-based strip transect analysis with variance and confidence intervals derived through bootstrapping.

55. Gardline Environmental Ltd carried out boat-based ornithology surveys for the Forewind Round 3 Dogger Bank zone (**Plate 11-2-4**).

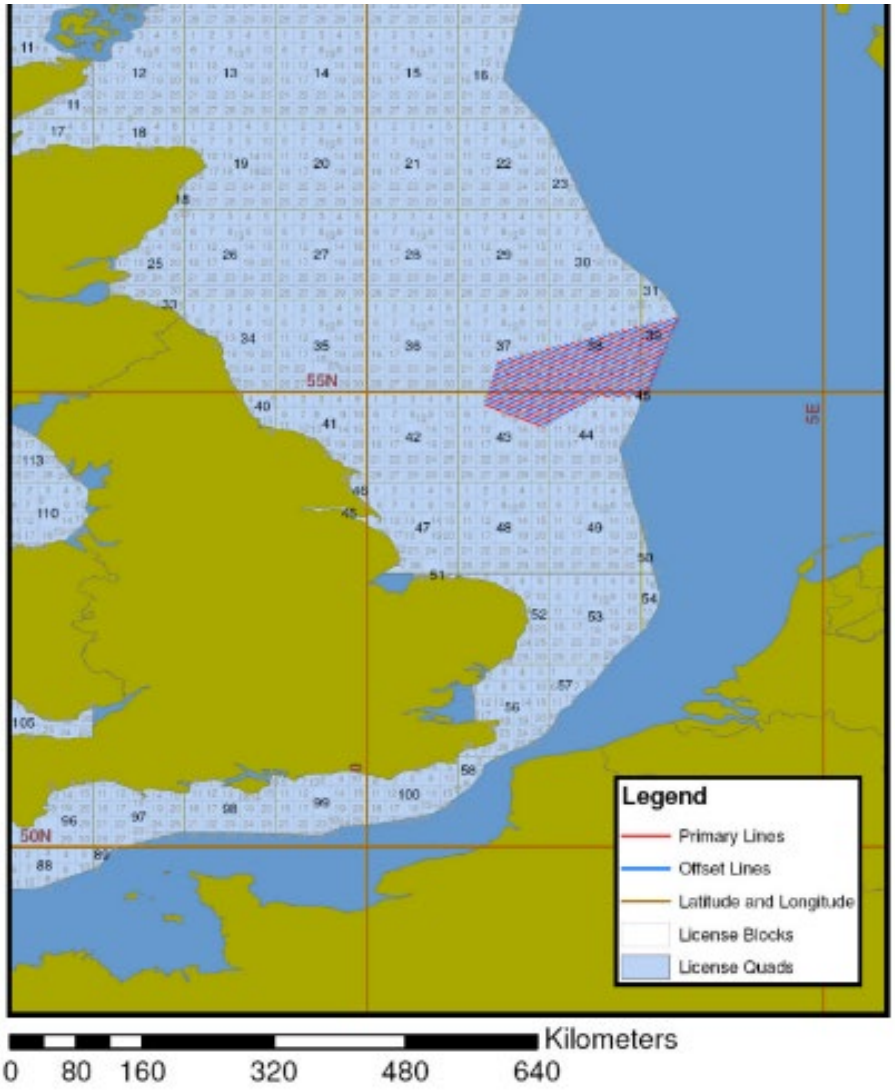


Plate 11-2-4 Boat-based Survey Transect Lines in Dogger Bank (Gardline)

56. European Seabirds At Sea (ESAS) trained Seabird Surveyors undertook intensive boat-based surveys using the Camphuysen approach (Camphuysen *et al.* 2004) as recommended by COWRIE (Collaborative Offshore Wind Research into the Environment). The methods were based on distance sampling (Buckland *et al.* 2001; Stone *et al.* 1995), permitting accurate density estimation. There were 41 transect lines in total, with 4km spacing.

57. In addition to seabird's, incidental marine mammal sightings were also recorded. White-beaked dolphin were the most numerous marine mammal (n=811), peaking in April to June each year; followed by harbour porpoise (n=703), with no obvious peaks or trends; grey seal (n=244) and minke whale (n=199), sightings in spring and summer. Other species included unidentified dolphin (n=64), bottlenose dolphin (n=25), Atlantic white-sided dolphin (n=5); sela species (n=19); harbour seal (n=15); baleen whale species (n=7), humpback whale (n=4) and fin whale (n=2). The number of odontocetes recorded during the surveys are presented in **Plate 11-2-5**.

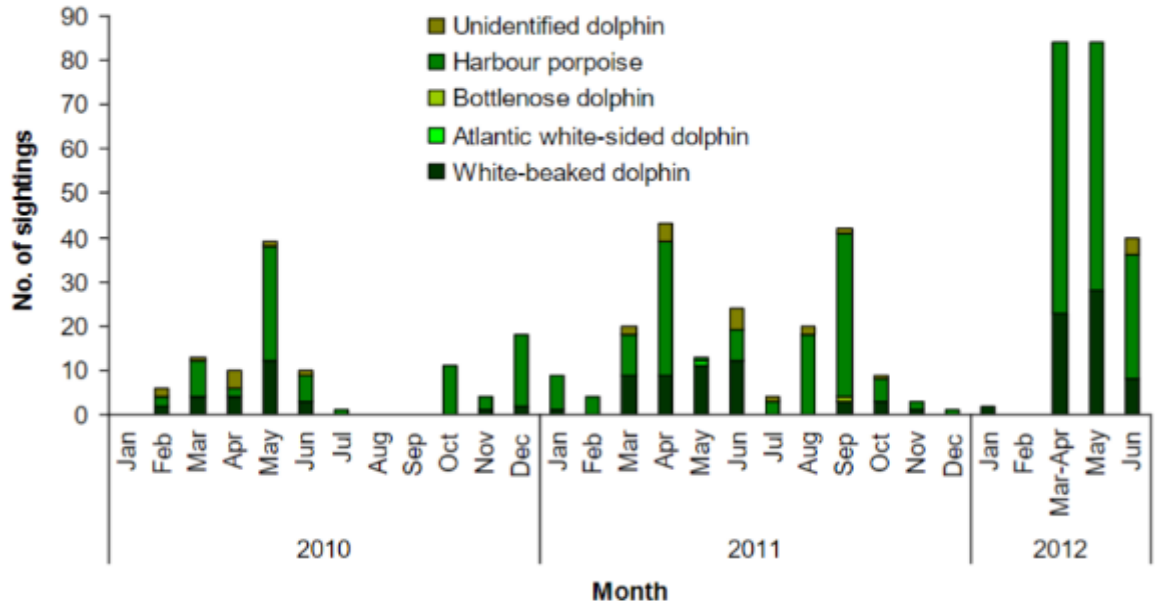


Plate 11-2-5 Incidental Odontocete Sightings During Ornithology Surveys for the Forewind Dogger Bank Offshore Wind Farm. January 2010 to June 2012

11.2.5.3 Other Available Sources

58. Other sources that have been used to inform the assessment are listed in **Table 11-2-8**.

Table 11-2-8 Other Available Data and Information Sources

Data Set	Spatial Coverage	Year	Notes
Small Cetaceans in the European Atlantic and North Sea (SCANS-IV) data (Gilles *et al.* 2023)	North Sea and European Atlantic waters	Summer 2022	Provides information including abundance and density estimates of cetaceans in European Atlantic waters in summer 2022, including the offshore project areas.
Management Units (MUs) for cetaceans in UK waters (IAMMWG, 2023)	UK waters	2023	Provides information on MU for the offshore project areas.
Offshore Energy Strategic Environmental Assessment (OESEA) (including relevant appendices and technical reports) (OESEA 3 (DECC, 2016); OESEA 4 (Business, Energy and Industrial Strategy (BEIS), 2022a)).	UK waters	2016 2022	Provides information on marine mammals in UK waters.
The identification of discrete and persistent areas of relatively high harbour porpoise density in the wider UK marine area (Heinänen and Skov, 2015)	UK waters	1994-2011	Data was used to determine UK harbour porpoise Special Area of Conservation (SAC) sites.
Revised Phase III data analysis of Joint Cetacean Protocol	UK EEZ	1994-2011	Provides information on cetaceans in UK waters.

Data Set	Spatial Coverage	Year	Notes
(JCP) data resources (Paxton *et al.* 2016)			
Seasonal habitat-based density models for a marine top predator, the harbour porpoise, in a dynamic environment (Gilles *et al.* 2016)	UK (SCANS II, Dogger Bank), Belgium, the Netherlands, Germany, and Denmark	2005-2013	Provides information for central and southern North Sea.
Distribution and abundance maps for cetacean species around Europe (Waggitt *et al.* 2019).	North-east Atlantic	1980-2018	Provides information on cetacean species in North Sea and UK waters.
Distribution of Cetaceans, Seals, Turtles, Sharks and Ocean Sunfish recorded from Aerial Surveys 2001-2008 (The Wildfowl and Wetlands Trust (WWT), 2009)	UK areas of the North Sea	2001-2008	Provides information on species in the North Sea.
Sea Watch Foundation volunteer sightings off eastern England (Sea Watch Foundation, 2023)	East coast of England	2022-2023	Provides information on species sighted along east coast of England.
Habitat-based predictions of at-sea distribution for grey and harbour seals in the British Isles (Carter *et al.* 2020 and 2022)	North Sea	1991-2019	Provides information on abundance and absolute density estimates (i.e. number of seals) for seal species.
Seal telemetry data (e.g. Russell and McConnell, 2014; Russell, 2016a; Carter *et al.* 2020, 2022)	North Sea	1988-2010; 2015	Provides information on movements and distribution of seal species.

Data Set	Spatial Coverage	Year	Notes
Special Committee on Seals (SCOS) annual reporting of scientific advice on matters related to the management of seal populations (SCOS 2020; SCOS 2021; SCOS 2022).	North Sea	2020; 2021 & 2022	Habitat-based predictions of at-sea distribution for grey and harbour seals in the British Isles.
Counts of grey seal in the Wadden Sea (Schop *et al.* 2022).	Wadden Sea	Winter 2021 to Spring 2022	Counts of grey seal during moult season.
Counts of harbour seal counts in the Wadden Sea (Galatius *et al.* 2022).	Wadden Sea	August 2022	Counts of harbour seal during pupping season.

11.2.6 Existing Environment

11.2.6.1 Harbour Porpoise

11.2.6.1.1 Desk-Based Review of Harbour Porpoise Presence

59. Heinänen & 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. High densities of harbour porpoise were predicted near both the Projects, while high densities in summer were predicted to be further offshore.

60. The JCP Phase III Report (Paxton et al. 2016) identifies a similar distribution of high harbour porpoise density, with a relatively high density in the southern North Sea, with an estimated density of 8.1 to 18.3 individuals per km^2 in the vicinity of the Offshore Development Area (2.4% MU; Paxton et al. 2016).

61. Seasonal maps produced by Gilles et al. (2016) for harbour porpoise density across the central and south-eastern North Sea, indicated that in spring there were higher density areas in the southern and south-eastern part of the North Sea (with an estimated density of 0.53 individuals per km^2 in the vicinity of the Offshore Development Area). In summer, there was an apparent shift, compared to spring, toward offshore and western areas (with an estimated density of 0.59 individuals per km^2 in the vicinity of the Offshore Development Area. In autumn, there were higher densities compared to spring and lower densities compared to summer, (with an estimated density of 0.58 individuals per km^2 in the vicinity the Offshore Development Area) and in the winter, same density as spring (with an estimated density of 0.53 individuals per km^2 in the vicinity of the Offshore Development Area).

62. Distribution and abundance maps were developed by Waggitt *et al.* (2019) for cetacean species around Europe. 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 (**Plate 11-2-6**, Waggitt *et al.* 2019). Interrogation of this data [4], including all 10km 'grids' that overlap with the specified area, reveals an average annual density estimate of:

- 0.59 individuals per km^2 (average of all overlapping 10km 'grids') for the DBS East AfL Area;
- 0.58 individuals per km^2 (average of all overlapping 10km 'grids') for the DBS West AfL Area;
- 0.56 individuals per km^2 (average of all overlapping 10km 'grids') for the Offshore Export Cable Corridor; and
- 0.415 individuals per km^2 for the total Offshore Development Area.

[4] Available from: https:// doi.org/10.5061/dryad.mw6m905sz

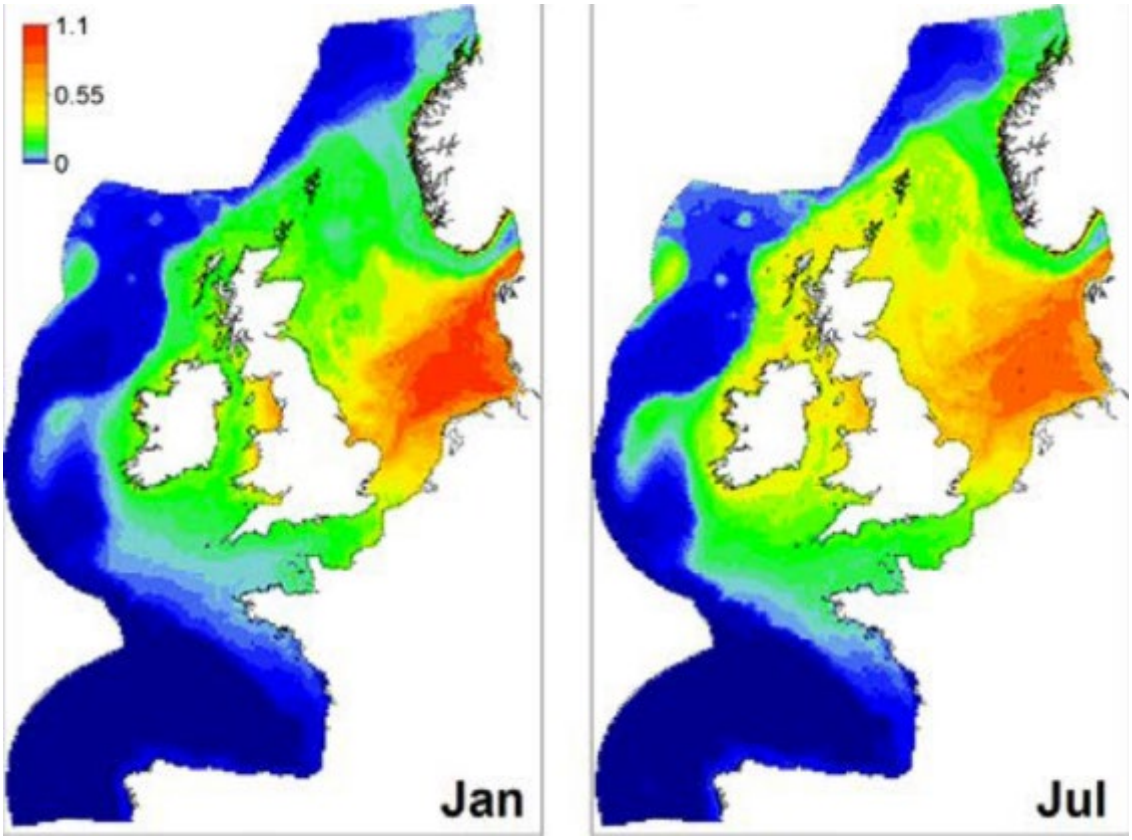


Plate 11-2-6 Spatial Variation in Predicted Densities (Individuals per km of Harbour Porpoise in January and July in the North-East Atlantic). Values are Provided at 10km Resolution. Source: Waggitt et al. 2019.

63. The distribution and abundance of harbour porpoise from the SCANS-IV survey in summer 2022 showed similar results observed in the SCANS-III survey in summer 2016 (Hammond *et al.* 2021). In the North Sea, the estimate for 2022 (339,000, CV = 0.17) is very similar to the estimates for 2016 (345,000, CV = 0.18) and 2005 (355,000, CV = 0.22) (Gilles *et al.* 2023) compared with a slightly smaller estimate from 1994 (289,000, CV = 0.14) (Hammond *et al.* 2021). However, the data only have sufficient power to detect a decline of around 1% per year, there is no evidence for a change in harbour porpoise abundance in the North Sea.

11.2.6.1.2 Results From the Site-Specific Surveys for Harbour Porpoise

64. Data from the DBS Survey Areas site specific surveys were used to generate species distribution maps for both DBS AfL Areas with a 4km buffer, referred to as Survey Area.

65. As noted above, harbour porpoise was the most commonly sighted marine mammal species during the surveys, with a total of 668 individuals recorded through the 24 survey dates at DBS East Survey Area and 805 individuals recorded through the 24 survey dates at DBS West Survey Area. Totalling at 1,473 individuals at both DBS Survey Areas.

66. The distribution of harbour porpoise within DBS Survey Area varied, with individuals present across both DBS East Survey Area and DBS West Survey Area. There is no evident pattern of harbour porpoise distribution within the DBS Survey Area, therefore no indication of a particular area of importance.

11.2.6.1.3 Results From Surveys in the Dogger Bank Area

67. During the Dogger Bank Tranche C site specific video digital aerial surveys (12 surveys undertaken between January 2013 to December 2013), a total of 2,702 harbour porpoises were recorded.

68. Throughout the Round 3 Dogger Bank Zone site specific video digital aerial surveys (26 surveys undertaken between April 2010 to May 2012), harbour porpoises were recorded every month, with a total of 5,728 harbour porpoises. In addition, there were 306 small cetaceans recorded which most likely can be attributed to harbour porpoise. No species abundance or density estimates were undertaken.

69. During the ornithological surveys for the Forewind Dogger Bank Zone (monthly surveys January 2010 to June 2012 (excluding February 2012)), there were 344 incidental sightings of harbour porpoises with 703 individuals. No species abundance or density estimates were undertaken.

11.2.6.1.4 Site-Specific Density Estimates for Harbour Porpoise

70. Density estimates of animals/km^2 have been calculated from the raw data counts for harbour porpoise and are set out below. These abundance and densities are for the DBS East AfL Area and the 4km buffer (**Table 11-2-10**) and DBS West AfL Area and the 4km buffer (**Table 11-2-10**). A correction factor has been used to count for diving porpoises from Voet (2017) (**Table 11-2-9**) which has been applied to **Table 11-2-10** and

    Table 11-2-11.

71. The recordings from the survey attributed to unidentified dolphin and porpoise species was not apportioned in the survey data analysis. The number of individuals recorded as 'Dolphin / porpoise species' equates to less than 10% of the harbour porpoise recorded, across either site. Due to the low number of unidentified dolphin and porpoise recorded there would not be a significant difference to the individual densities if they were included in the calculations.

Table 11-2-9 Correction factors used for harbour porpoise (Voet 2017)

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

72. The abundance estimates of harbour porpoise is presented on a graph in **Graph 11-2-1** for DBS East Survey and **Graph 11-2-2** for DBS West Survey Area.

Table 11-2-10 Raw Counts, Abundance and Density Estimates of Harbour Porpoises in DBS East AfL Area Plus 4km Buffer (DBS East Survey Area)

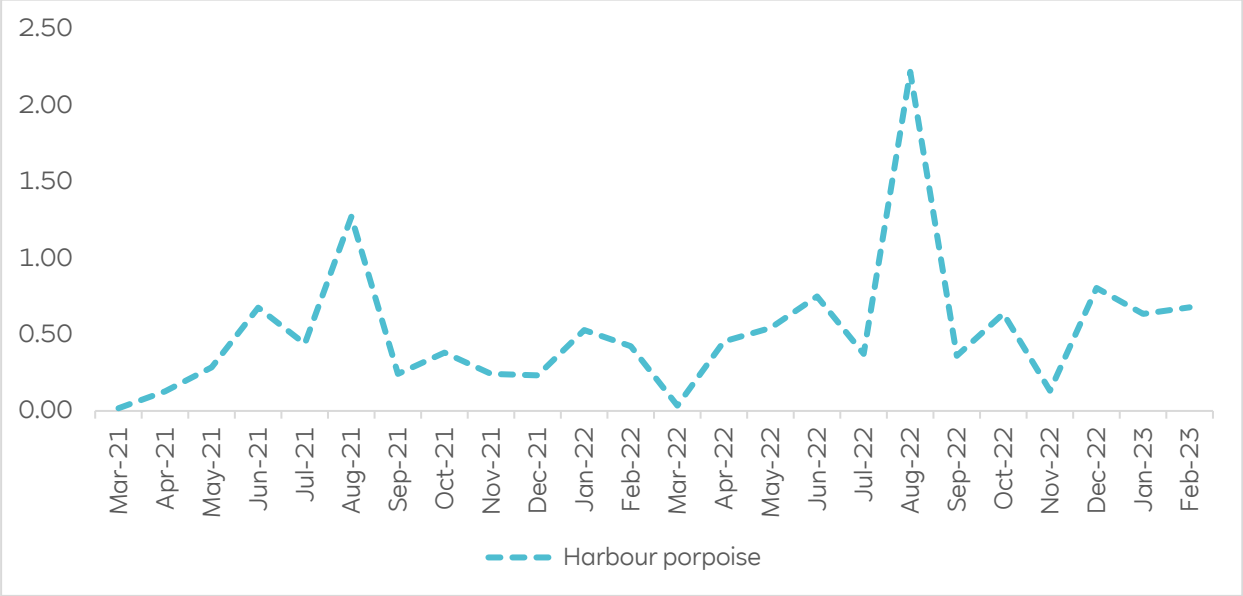
Survey date	Raw count	Abundance	Lower CI	Upper CI	Precision	Density (animals /km²)	Density with correction factor (animals /km²)
Mar-21	1	9	1	26	1.00	0.01	0.02
Apr-21	8	69	26	129	0.35	0.07	0.13
May-21	14	121	52	199	0.27	0.13	0.29
Jun-21	39	338	205	486	0.16	0.37	0.68
Jul-21	39	334	189	506	0.16	0.20	0.44
Aug-21	21	181	69	302	0.22	0.60	1.27
Sep-21	64	549	214	1029	0.13	0.11	0.24
Oct-21	12	101	42	168	0.29	0.18	0.38
Nov-21	18	162	72	271	0.24	0.11	0.24
Dec-21	12	103	43	172	0.29	0.11	0.23
Jan-22	27	234	138	337	0.19	0.25	0.53
Feb-22	21	180	112	258	0.22	0.20	0.42

Survey date	Raw count	Abundance	Lower CI	Upper CI	Precision	Density (animals /km²)	Density with correction factor (animals /km²)
Mar-22	2	17	2	43	0.71	0.02	0.04
Apr-22	28	242	147	354	0.19	0.26	0.46
May-22	33	287	174	417	0.17	0.31	0.54
Jun-22	44	379	250	535	0.15	0.41	0.75
Jul-22	18	156	78	251	0.24	0.17	0.37
Aug-22	106	932	536	1406	0.10	1.01	2.22
Sep-22	18	155	69	258	0.24	0.17	0.36
Oct-22	31	264	77	519	0.18	0.29	0.64
Nov-22	6	52	17	95	0.41	0.06	0.13
Dec-22	40	347	234	460	0.16	0.38	0.81
Jan-23	32	281	175	395	0.18	0.3	0.64
Feb-23	34	293	181	431	0.17	0.32	0.68

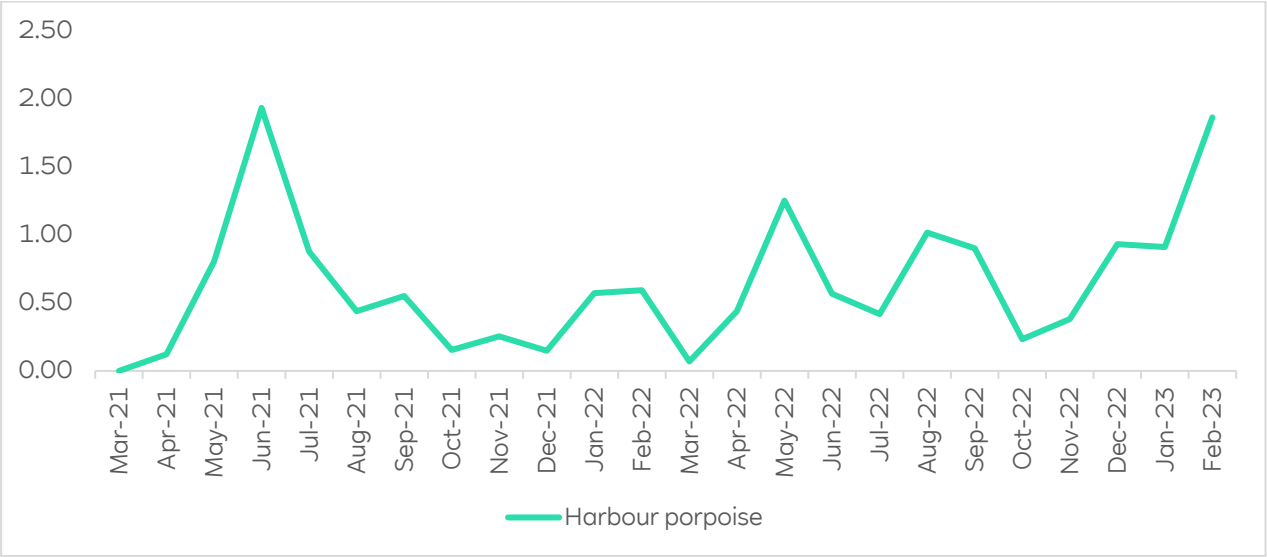
Table 11-2-11 Raw Counts, Abundance and Density Estimates of Harbour Porpoises in DBS West AfL Area plus 4km buffer (DBS West Survey Area)

Survey date	Raw count	Abundance	Lower CI	Upper CI	Precision	Density (animals/ km²)	Density with correction factor (animals/km²)
Apr-21	8	68	26	128	0.35	0.07	0.12
May-21	48	400	283	550	0.14	0.44	0.80
Jun-21	97	808	625	1017	0.10	0.88	1.93
Jul-21	52	436	285	596	0.14	0.48	0.88
Aug-21	22	184	84	301	0.21	0.20	0.44

Survey date	Raw count	Abundance	Lower CI	Upper CI	Precision	Density (animals/ km²)	Density with correction factor (animals/km²)
Sep-21	29	238	107	402	0.19	0.26	0.55
Oct-21	8	68	17	143	0.35	0.07	0.15
Nov-21	13	110	51	177	0.28	0.12	0.25
Dec-21	8	67	25	126	0.35	0.07	0.15
Jan-22	29	244	143	344	0.19	0.27	0.57
Feb-22	30	253	160	346	0.18	0.28	0.59
Mar-22	4	34	9	68	0.5	0.04	0.07
Apr-22	26	221	127	314	0.2	0.24	0.44
May-22	61	521	367	691	0.13	0.57	1.25
Jun-22	33	280	170	416	0.17	0.31	0.57
Jul-22	21	175	92	284	0.22	0.19	0.42
Aug-22	51	440	18	854	0.14	0.48	1.02
Sep-22	45	380	220	549	0.15	0.41	0.90
Oct-22	12	104	26	225	0.29	0.11	0.23
Nov-22	19	162	85	247	0.23	0.18	0.38
Dec-22	48	401	267	535	0.14	0.44	0.93
Jan-23	46	395	275	532	0.15	0.43	0.91
Feb-23	95	810	605	1031	0.1	0.88	1.86



Graph 11-2-1 Estimated Abundance of Harbour Porpoise Within DBS East AfL Area plus 4km buffer (DBS East Survey Area)



Graph 11-2-2 Estimated Abundance of Harbour Porpoise Within DBS West AfL Area plus 4km buffer (DBS West Survey Area)

73. The results from the site-specific surveys provide seasonal absolute density estimates for harbour porpoise which are presented in **Table 11-2-12**.

Table 11-2-12 Seasonal Density Estimates for Harbour Porpoise from APEM Ltd Survey

Season	DBS East Survey Area absolute density estimates (animals/km²)	DBS West Survey Area absolute density estimates (animals/km²)
Summer average	0.600	0.662
Winter average	0.442	0.625
Yearly average	0.521	0.643

11.2.6.1.5 Review of Abundance and Density Estimates for Harbour Porpoise

74. A series of large-scale surveys for cetaceans in European Atlantic waters was initiated in summer 1994, in the North Sea and adjacent waters (SCANS, 1995; Hammond *et al.* 2002) and continued in summer 2005 in all shelf waters (SCANS-II, 2008; Hammond *et al.* 2013). Despite no overall change in population size between the SCANS-I and SCANS-II surveys, large scale changes in the distribution of harbour porpoise were observed between 1994 and 2005, with the main concentration shifting from north-eastern UK and Denmark to the southern North Sea. Such large-scale changes in the distribution of harbour porpoise are likely the result of changes to the availability of principal prey within the North Sea (SCANS-II, 2008).

75. Calculating Waggitt *et al.* (2019) densities with all 10km 'grids' that overlap with the specified area, reveals an average annual density estimate of 0.59 individuals per km^2 for the DBS East Array Area; 0.58 individuals per km^2 for the DBS West Array Area; and 0.56 individuals per km^2 (average of all overlapping 10km 'grids') for the Offshore Development Area.

76. Average Waggitt *et al.* (2019) summer densities across the area of the SCANS-IV block NS-C have also been calculated to show the density across a wider area in comparison and results in 0.572 harbour porpoise per km^2 for the Projects.

77. Results from the SCANS-IV survey (the most recent available; undertaken in summer 2022; Gilles *et al.* 2023) also indicate that the occurrence of harbour porpoise is greater in the central and southern areas of the North Sea compared to the northern North Sea.

78. Within the impact assessments for harbour porpoise, in addition to the site specific density estimates for harbour porpoise, density estimates from the SCANS-IV surveys (Gilles *et al.* 2023) would also be used to provide context for the wider area. The DBS sites are both in SCANS-IV survey block NS-C (**Plate 11-2-7**; **Plate 11-2-8**): Abundance = 36,286 harbour porpoise (CV = 0.035; 95% Confidence Limit (CL) = 23,346-56,118) Density = 0.6027 harbour porpoise/km^2 (CV=0.228).

Plate 11-2-7 Area Covered by the SCANS-IV Survey, and the Locations of the SCANS-IV Survey Blocks (The Projects Are Within Survey Block NS-C) (Gilles et al. 2023)

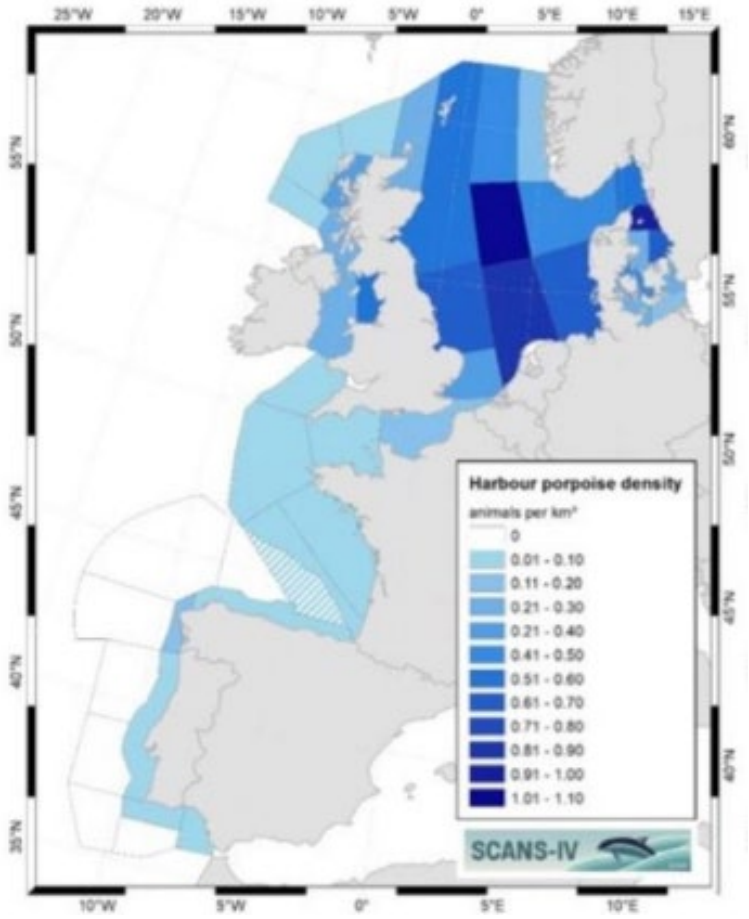


Plate 11-2-8 Estimated Harbour Porpoise Density in Each SCANS-IV Survey Block (Gilles et al. 2023)

79. Harbour porpoise within the eastern North Atlantic is 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).

80. IAMMWG defined three MUs for harbour porpoise: North Sea (NS); West Scotland (WS); and the Celtic and Irish Sea (CIS). DBS is located in the NS MU (**Plate 11-2-1**).

81. The estimate of harbour porpoise abundance in the North Sea MU is 346,601 (CV = 0.09; 95%; CI = 289,498 – 419,967; IAMMWG, 2023). This is the reference population for harbour porpoise, of which any potential impacts would be assessed against.

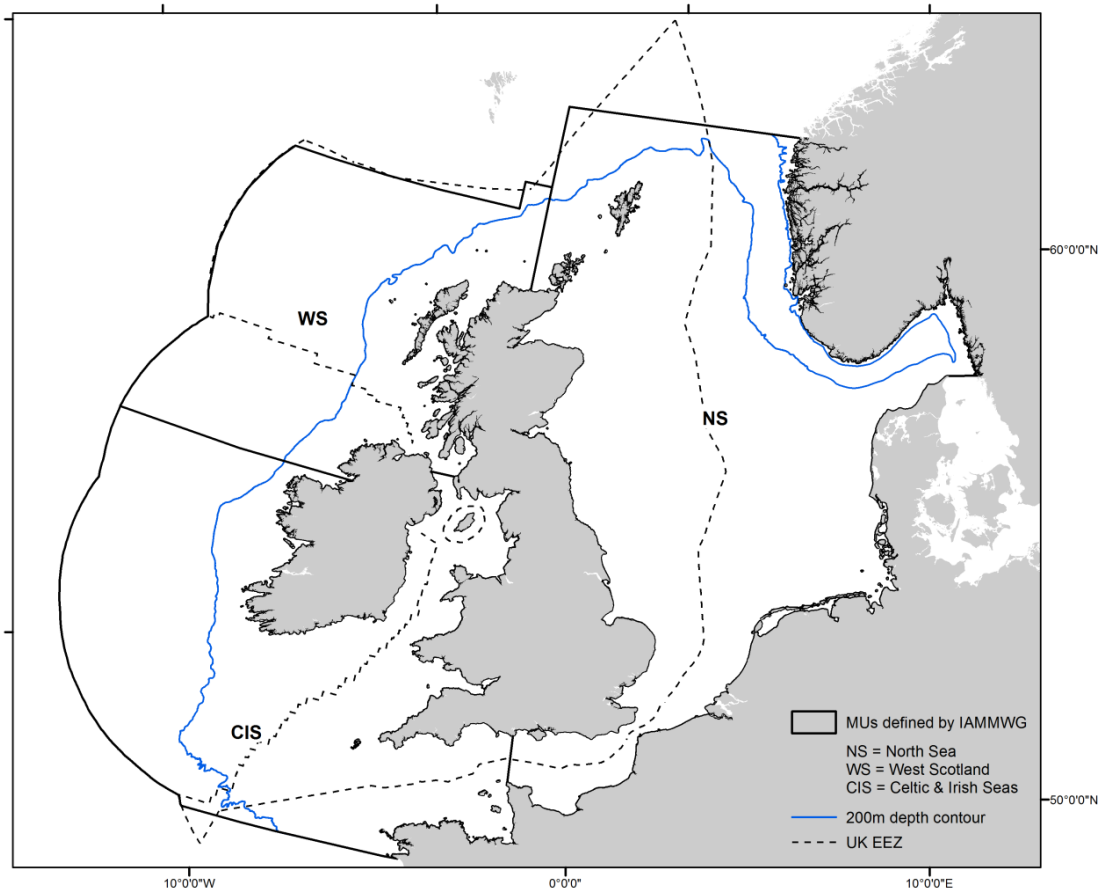


Plate 11-2-1 Harbour porpoise Management Units (MUs), noting that this species is largely confined to the continental shelf (i.e. waters <200m depth) (IAMMWG, 2023).

82. Within the impact assessments for harbour porpoise, the density estimate that would be used are:

- Site specific survey 0.6 individuals per km^2 for DBS East AfL Area;
- Site specific surveys 0.66 individuals per km^2 for DBS West AfL Area.

83. For the assessment of the wider area such as the Offshore Development Area and Offshore Export Cable Corridor the highest density has been applied.

11.2.6.1.6 Diet of Harbour Porpoise

84. The distribution and occurrence of harbour porpoise, as well as other marine mammal species is most likely to be related the availability and distribution of their prey species. For example, sandeels Ammodytidae species, which are known prey for harbour porpoise, exhibit a strong association with key surface sediments (Gilles *et al.* 2016; Clarke *et al.* 1998).

85. 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 (Berrow & Rogan, 1995; Kastelein *et al.* 1997; Börjesson *et al.* 2003; Santos & Pierce, 2003; Santos *et al.* 2004).

86. Harbour porpoise tend to concentrate their movements in small focal regions (Johnston *et al.* 2005), which often approximate to particular topographic and oceanographic features and are associated with prey aggregations (Raum-Suryan & Harvey, 1998; Johnston *et al.* 2005; Keiper *et al.* 2005; Tynan *et al.* 2005). Consequently, habitat use is highly correlated with prey density rather than any particular habitat type.

87. Harbour porpoise have relatively high daily energy demands and need to capture enough prey to meet its daily energy requirements. 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).

11.2.6.2 Bottlenose Dolphin

11.2.6.2.1 Desk-Based Review of Bottlenose Dolphin Presence

88. 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 [5].

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

90. A resident population of bottlenose dolphin is present in the Moray Firth, with an estimated 224 individuals (95% CI 214 – 234; Arso Civil *et al.* 2021; IAMMWG, 2023). 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).

91. Hackett (2022) conducted a photo ID study of bottlenose dolphins that were sighted along the northeast coast of England, where 38 individuals were identified by photo ID techniques from 584 recorded sightings between 2014 and 2022 along the Northumbrian coast. Of the 38 individuals, all except for one individual has been recorded in the Moray Firth SAC. Out of the 38, 14 of these dolphins have been exclusively recorded along the northeast coast. Whereas 24 dolphins have been recorded to travel between the Moray Firth and the northeast coast of England, with eight being recorded making annual migrations between the two areas.

[5] https://sac.jncc.gov.uk/species/S1349/

92. Since 2014, bottlenose dolphin sightings have increased along the northeast coast (Hackett, 2022). Other locations with numerous sightings were Scarborough, Hartlepool, Seahouses, and Berwick-upon-Tweed. Bottlenose dolphin along the northeast coast have been recorded to be foraging, where foraging activity has increases from 2020 to 2022 with increasing foraging activity recorded in the summer months (Hackett, 2022).

93. Hackett (2022) study is the first multi-year study focusing on the bottlenose dolphins found off the northeast coast of England. The study shows that bottlenose dolphin sightings are increasing every year, and that previously were considered residents all year round in the Moray Firth SAC, but are now recorded travelling south more frequently. Short-range movements of bottlenose dolphins are not uncommon, and studies have shown that seasonal transience occurs in populations all around the world (Toth, *et al.* 2010; Durden, 2011), but the data presented in Hackett (2022) study show that the presence of bottlenose is increasing every year, particularly in the summer months. This could be evidence of a new population becoming resident in the area or perhaps an expansion of the range of the Moray Firth bottlenose dolphin.

94. The results of the JCP Phase III Report (Paxton *et al.* 2016) identified that for bottlenose dolphin, densities are low across much of UK waters, with higher densities off the west coast of Wales, and within the Moray Firth. The density of bottlenose dolphin within the southern North Sea for DBS is low, with 0.5 to 1.7 individuals per km^2 (2.6% MU) (Paxton *et al.* 2016).

95. As sightings of bottlenose dolphin have been increasingly reported along the north-east coast of England, they have also been included in the assessment. For the entire SCANS-IV survey area, bottlenose dolphin abundance in the summer of 2022 was estimated to be 13,854, with an overall estimated density of 0.0094/km^2 (CV = 0.224; 95% CL = 4,887-27,867; Gilles *et al.* 2023).

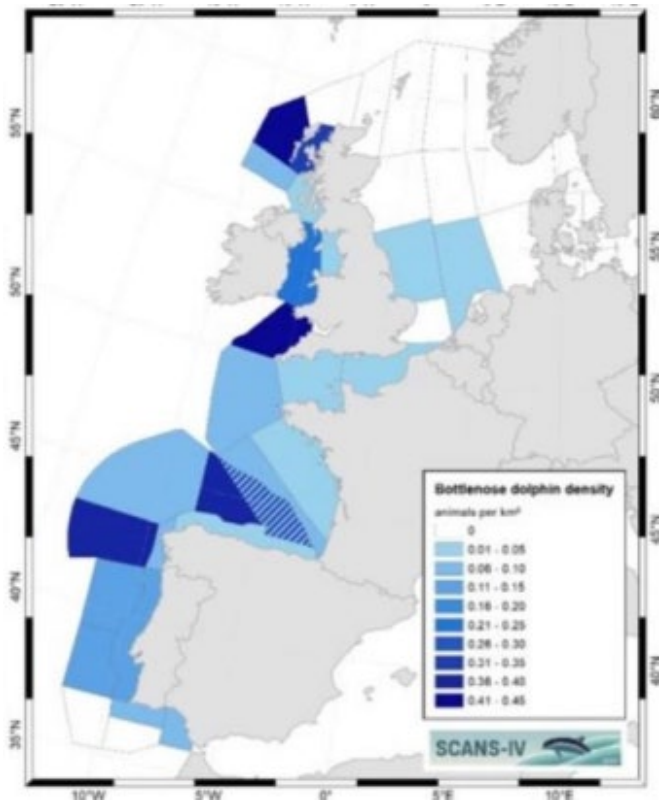


Plate 11-2-9 Estimated Bottlenose Dolphin Density in Each SCANS-IV Survey Block (Giles et al. 2023)

96. For bottlenose dolphin, the 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 (**Plate 11-2-10**, Waggitt *et al.* 2019). Densities of bottlenose dolphin in the North Sea are very low in comparison. Interrogation of this data [6], including all 10km 'grids' that overlap with the specified area, reveals an average annual density estimate of:

- 0.00014 individuals per km^2 for the DBS East AfL Area;
- 0.00025 individuals per km^2 for the DBS West AfL Area;
- 0.0013 individuals per km^2 for the Offshore Export Cable Corridor; and
- 0.0014 individuals per km^2 for the total Offshore Development Area.

[6] Available from: https:// doi.org/10.5061/dryad.mw6m905sz

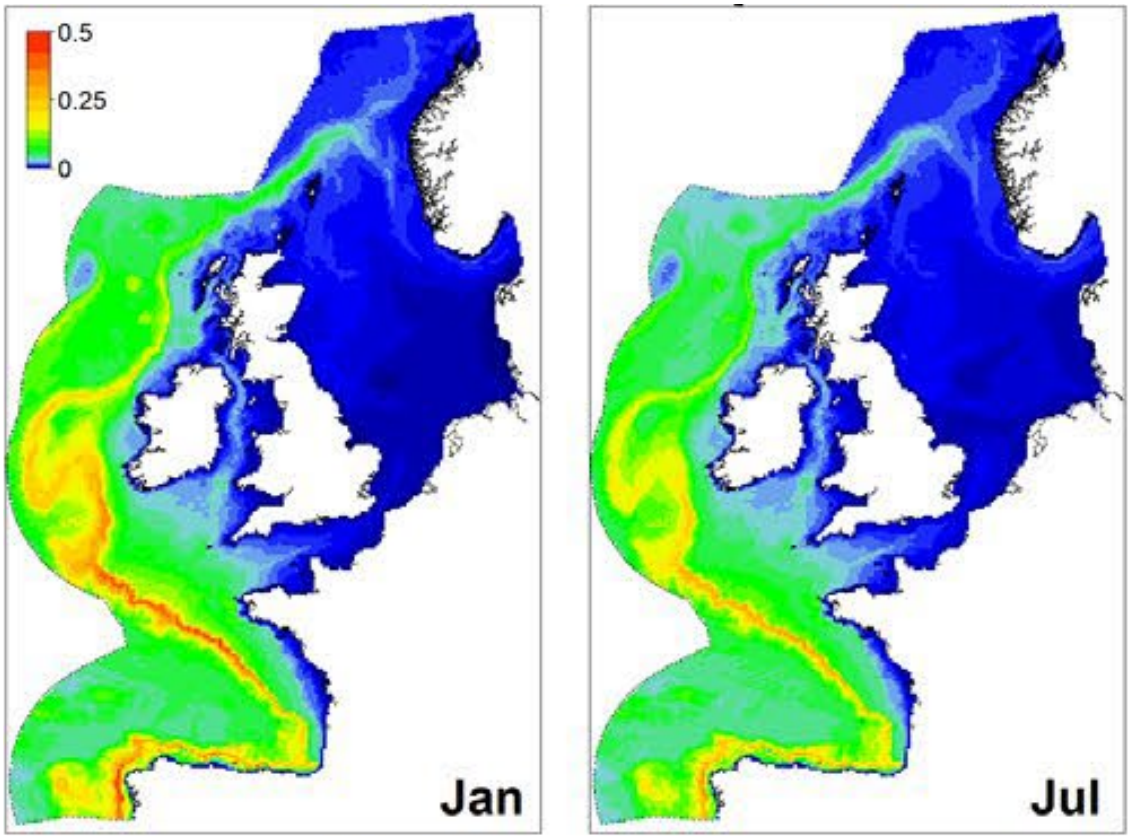


Plate 11-2-10 Spatial Variation in Predicted Densities (Individuals per km of Bottlenose Dolphin in January and July in the North-East Atlantic). Values are Provided at 10km Resolution. Source: Waggitt et al. 2019.

11.2.6.2.2 Results From the Site-Specific Surveys for Bottlenose Dolphin

97. During the site specific digital aerial surveys of both DBS East Survey Area and DBS West Survey Area, undertaken from March 2021 to February 2023, no bottlenose dolphin was recorded. However, two sightings of individual unidentified dolphin were recorded, which could have been attributed to bottlenose dolphin.

11.2.6.2.3 Results From Surveys in the Dogger Bank Area

98. During the Dogger Bank Tranche C site specific video digital aerial surveys (12 surveys undertaken between January 2013 to December 2013), no bottlenose dolphins were recorded. However, during the 12 surveys, 190 sightings were recorded with 'no species ID' some of which were further recorded as a cetacean/small cetacean which could possibly be bottlenose dolphins. No abundance or density estimated were calculated for unknown species.

99. Throughout the Dogger Bank Zone 3 site specific video digital aerial surveys (26 surveys undertaken between April 2010 to May 2012), no bottlenose dolphins were recorded. In addition, there were 306 small cetaceans recorded which possibly can be attributed to bottlenose dolphins, along with 89 unidentified delphinid species. No species abundance or density estimates were undertaken.

100. During the ornithological Surveys for the Forewind Round 3 Dogger Bank Offshore Wind Farm (monthly surveys January 2010 to June 2012 (excluding February 2012)), there was one sighting of bottlenose dolphins with 25 individuals. There were also 24 incidental sightings of unidentified delphinid species, and one acoustic detection, resulting in 64 individuals which could possibly be attributed to bottlenose dolphins. No species abundance or density estimates were undertaken.

11.2.6.2.4 Site-Specific Density Estimates for Bottlenose Dolphin

101. Based on the DBS site specific surveys, density estimates of animals/km^2 have been calculated from the raw data counts for unidentified dolphin species as there is a possibility that these can be bottlenose dolphins. In total, one unidentified dolphin was recorded during the April 2021 and the August 2022 survey, resulting in an abundance estimate of nine with a density of 0.01 marine mammal/km^2.

11.2.6.2.5 Review of Abundance and Density Estimates for Bottlenose Dolphins

102. During the SCANS-IV survey in the summer 2022, the density estimate for bottlenose dolphin in NS-C block in and around the Projects are:

- Abundance = 2,520 bottlenose dolphin (CV=0.68395% CL=57-6,616);
- Density = 0.0419 bottlenose dolphin/km^2 (CV=0.683).

103. Bottlenose dolphin have seven MU's within the UK (**Plate 11-2-11**) and two that are relevant to this area is the GNS MU, which the Projects are located within, has a population estimate for the bottlenose dolphin of 2,022 (95% CI = 548 – 7,453; IAMMWG, 2023) and the CES MU, which has a population estimate of 224 (95% CI = 214 – 234; IAMMWG, 2023). These are the reference populations for bottlenose dolphin, of which any potential impacts would be assessed against.

104. The results from Waggitt et al. (2019) seasonal absolute density estimates for bottlenose dolphin are presented in **Table 11-2-13**.

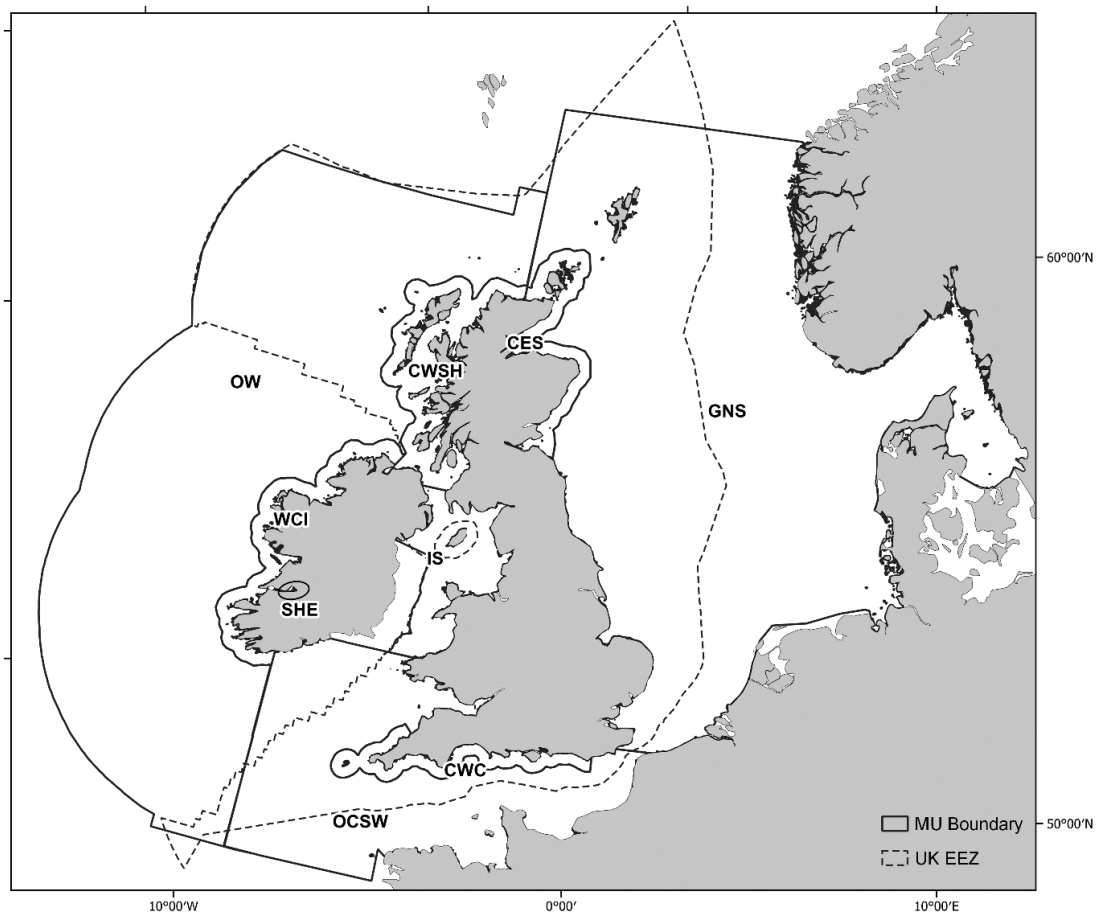
Table 11-2-13 Seasonal Density Estimates for Bottlenose Dolphin from Waggitt et al. (2019) Densities

Season	DBS East Array Area absolute density estimates (animals/km²)	DBS West Array Area absolute density estimates (animals/km²)	Offshore Development Area (animals/km²)
Summer average	0.00014	0.00025	0.0013
Winter average	0.00009	0.00020	0.0011
Yearly average	0.00011	0.00023	0.0012

105. Average Waggitt et al. (2019) summer densities across the area of the SCANS-IV block NS-C have also been calculated to show the density across a wider area in comparison and results in 0.0009 bottlenose dolphin per km² for the Projects.

106. Therefore, within the impact assessments for bottlenose dolphin, the worst-case density estimates relative to the Projects from the SCANS-IV NS-C survey block (Gilles et al. 2023) data would be used in the assessment:

- 0.0419 individuals per km² for the Projects, Offshore Development Area and Offshore Export Cable Corridor.



GNS = Greater North Sea
CES = Coastal East Scotland
CWSH = Coastal West Scotland & Hebrides
IS = Irish Sea
CWC = Coastal West Channel
OCSW = Offshore Channel & South West England
WCI = West Coast of Ireland
SHE = Shannon Estuary
OW = Offshore Waters

Plate 11-2-11 Bottlenose Dolphin MU (IAMMWG, 2023).

11.2.6.2.6 Diet of Bottlenose Dolphin

107. 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*, blue whiting *Micromesistius poutassou*, bass *Dicentrarchus labrax*, mullet *Mugilidae*, mackerel *Scombridae*, salmon *Salmo salar*, sea trout *Salmo trutta trutta*, flounder *Platichthys flesus*, sprat *Sprattus sprattus* and sandeels, as well as octopus and other cephalopods have all been recorded in the diet of bottlenose dolphin (Santos *et al.* 2001; Santos *et al.* 2004; Reid *et al.* 2003).

108. 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).

109. 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).

110. A 2004 study shows that bottlenose dolphins in the Moray Firth lived in smaller group sizes and occurred less frequently where there was fewer salmon available (Lusseau *et al.* 2004). Salmon stocks have increased in rivers along the east coast of England thanks salmon stocking programmes in rivers such as the River Tyne (Mawle & Milner, 2003; Milner *et al.* 2008). This increase in food abundance could be a driving factor in the increase in dolphins seen in the area (Hackett, 2022).

11.2.6.3 Common Dolphin

11.2.6.3.1 Desk-Based Review of Common Dolphin Presence

111. The short-beaked common dolphin is a widespread species of common dolphin occurring in warm-temperate oceans. Being one of the most abundant species of cetacean, the common dolphin has a global population estimated to be around six million (Hammond *et al.* 2008).

112. Throughout its range, the common dolphin is primarily distributed in the Celtic Sea and Western Approaches to the Channel, and off southern and western Ireland (BEIS, 2022b; Hammond *et al.* 2021; Waggitt *et al.* 2019). The common dolphin is recorded as rare in the North Sea (Reid *et al.* 2003; Camphuysen & Peet 2006; Evans *et al.* 2003; Murphy *et al.* 2013; Murphy *et al.* 2021)

113. 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).

114. 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, 2023).

115. 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, with 102,656 (0.29) MU in CGNS (Plate 11-16), but low in DBS <0.01 individuals per km^2 (0.000009% MU) (Paxton et al. 2016).

116. For the entire SCANS-IV survey area, common dolphin abundance in the summer of 2022 was estimated to be 317,527, with an overall estimated density of 0.2164/km2 (CV = 0.204; 95% CL = 220,543-498,040; Gilles *et al.* 2023).

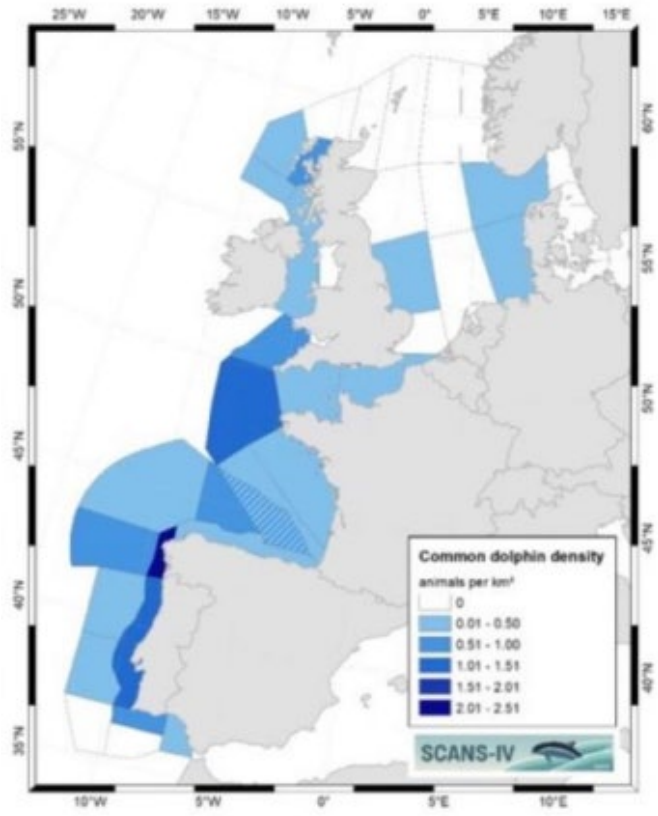


Plate 11-2-12 Estimated Common Dolphin Density in Each SCANS-IV Survey Block (Gilles et al. 2023)

117. For common dolphin, the 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 (**Plate 11-2-13**; Waggitt *et al.* 2019). Densities of common dolphin in the North Sea are very low in comparison, with the peak recorded in the summer months. The distribution maps also indicate 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.

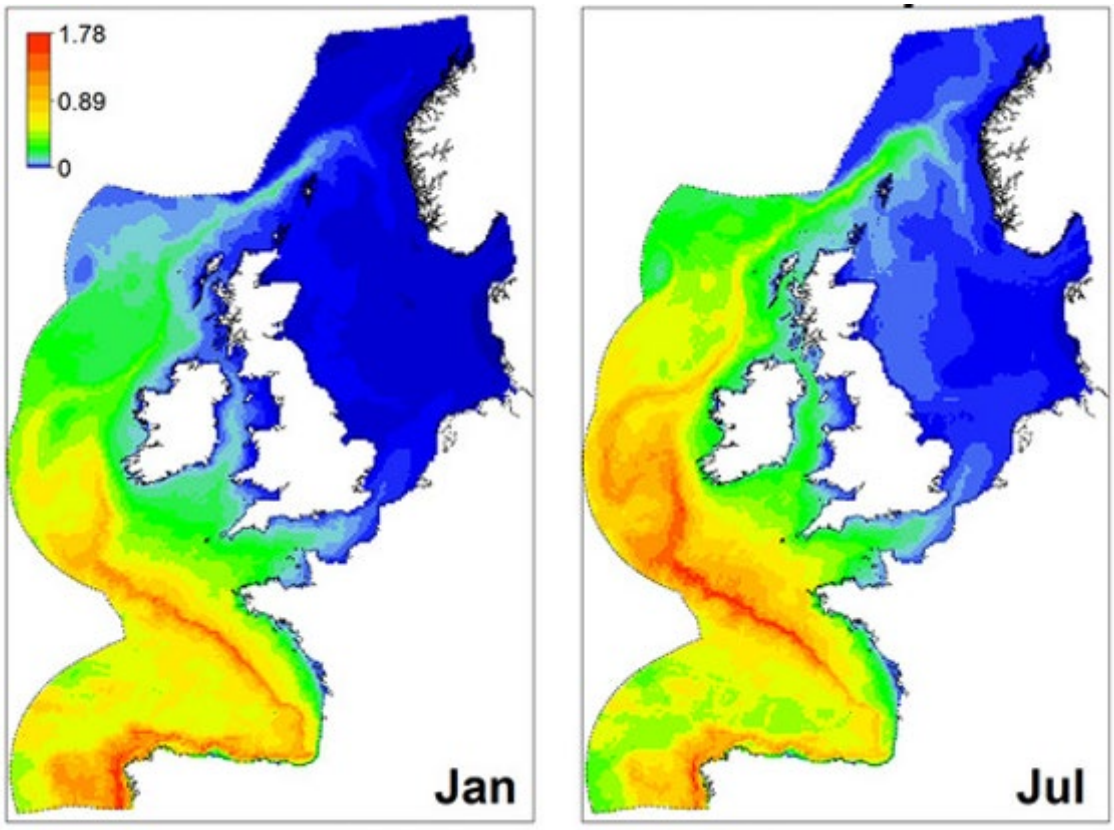


Plate 11-2-13 Spatial Variation in Predicted Densities Individuals per km of Common Dolphin in January and July in the North-East Atlantic). Values are Provided at 10km Resolution. Source: Waggitt et al. 2019.

11.2.6.3.2 Results From the Site-Specific Surveys for Common Dolphin

118. During the site specific digital aerial surveys of both DBS East Survey Area and DBS West Survey Area undertaken from March 2021 to February 2023, two sightings of two individuals was recorded in the DBS West Survey Area in March 20221 and May 2022 (

119. **Table** 11-2-14).

120. In additional to the common dolphins; there was one sighting recorded as unidentified dolphin, which could have been attributed to common dolphin (**Table 11-2-6** and **Table 11-2-7**).

11.2.6.3.3 Results From Surveys in the Dogger Bank Area

121. During the Dogger Bank Tranche C site specific video digital aerial surveys (12 surveys undertaken between January 2013 to December 2013), no common dolphins were recorded. However, during the 12 surveys, 190 sightings were recorded with 'no species ID' some of which were further recorded as a cetacean/small cetacean which could possibly be attributed to common dolphins. No abundance or density estimated were calculated for unknown species.

122. Throughout the Dogger Bank Zone 3 site specific video digital aerial surveys (26 surveys undertaken between April 2010 to May 2012), no common dolphins were recorded. In addition, there were 306 small cetaceans recorded which possibly can be attributed to bottlenose dolphins, along with 89 unidentified delphinid species. No species abundance or density estimates were undertaken.

123. During the ornithological Surveys for the Forewind Round 3 Dogger Bank Offshore Wind Farm (monthly surveys January 2010 to June 2012 (excluding February 2012)), there was one sighting of bottlenose dolphins with 25 individuals. There were also 24 incidental sightings of unidentified delphinid species, and one acoustic detection, resulting in 64 individuals which could possibly be attributed to common dolphin. No species abundance or density estimates were undertaken.

11.2.6.3.4 Site-Specific Density Estimates for Common Dolphin

124. **Table 11-2-14** presents the abundance and density estimates of common dolphins from the DBS site-specific surveys (APEM, 2022). Common dolphin was recorded in the DBS West Survey Area, with one occurrence in March 2021, and one occurrence in May, 2022 with two individuals. Therefore, the density estimate represents March 2021 and May 2022 and is zero for all other months of the year's survey. A correction factor of 0.675 was applied to account for any diving animals (De Boer *et al.* 2008).

Table 11-2-14 Raw Counts, Abundance and Density Estimates of Common Dolphins in DBS West AfL Area Plus 4km (DBS West Survey Area)

Survey date	Raw count	Abundance	Lower CI	Upper CI	Precision	Density (animals /km²)	Density with correction factor (animals/km²)
Mar-21	2	17	2	42	0.71	0.02	0.03
May-22	2	17	2	43	0.71	0.02	0.03

125. Calculating the average density over the two years of surveys, with common dolphin only recorded in those months presented in

126. **Table 11-2-14** provides an average density of 0.002.

11.2.6.3.5 Review of Abundance and Density Estimates for Common Dolphin

127. For both SANS-II and SCANS-III surveys, there are no abundance or density estimates for common dolphin in the North Sea (Hammond *et al.* 2021). However, for the SCANS-IV survey common dolphin was recorded in the survey block NS-C which is the first-time common dolphin has been recorded in the North Sea via a SCANS survey.

- Abundance = 192 common dolphin (CV=0.966% CL=6-724); and
- Density = 0.0032 common dolphin/km^2 (CV=0.966).

128. Calculating Waggitt *et al.* 2019 densities including all 10km 'grids' that overlap with the DBS areas, reveals an average annual density estimate of:

- 0.037 individuals per km^2 for the DBS East AfL Area;
- 0.041 individuals per km^2 for the DBS West AfL Area; and
- 0.073 individuals per km^2 for the Offshore Export Cable Corridor (**Table 11-2-15**).

129. Average Waggitt *et al.* (2019) summer densities across the area of the SCANS-IV block NS-C have also been calculated to show the density across a wider area in comparison and results in 0.017 common dolphin per km^2 for the Projects.

130. For the site-specific surveys (APEM Ltd), the abundance estimate for common dolphin is eight and the density is 0.03km^2, with an average density of 0.002 individuals per km^2.

Table 11-2-15 Seasonal Density Estimates for Common Dolphin from Waggitt et al. (2019) Densities

Season	DBS East Array Area absolute density estimates (animals/km^2)	DBS West Array Area absolute density estimates (animals/km^2)	Offshore Development Area (animals/km^2)
Summer average	0.037	0.041	0.073
Winter average	0.021	0.021	0.041
Yearly average	0.029	0.029	0.057

131. Therefore, within the impact assessments for common dolphin, density estimates from the site-specific surveys, SCANS and Waggitt *et al.* 2019 data over the SCANS block have been considered and Waggitt *et al.* (2019) density over SCANS block NS-C would be used in the assessment:

- 0.017 individuals per km^2 for the Projects, Offshore Development Area and Offshore Export Cable Corridor.

132. For the density estimate, the CGNS MU (**Plate 11-2-14**) in which the Projects are located, has a population estimate for common dolphin of 102,656 (95% CI = 58,932 – 178,822; IAMMWG, 2023). This is the reference population for common dolphin, of which any potential impacts would be assessed against.

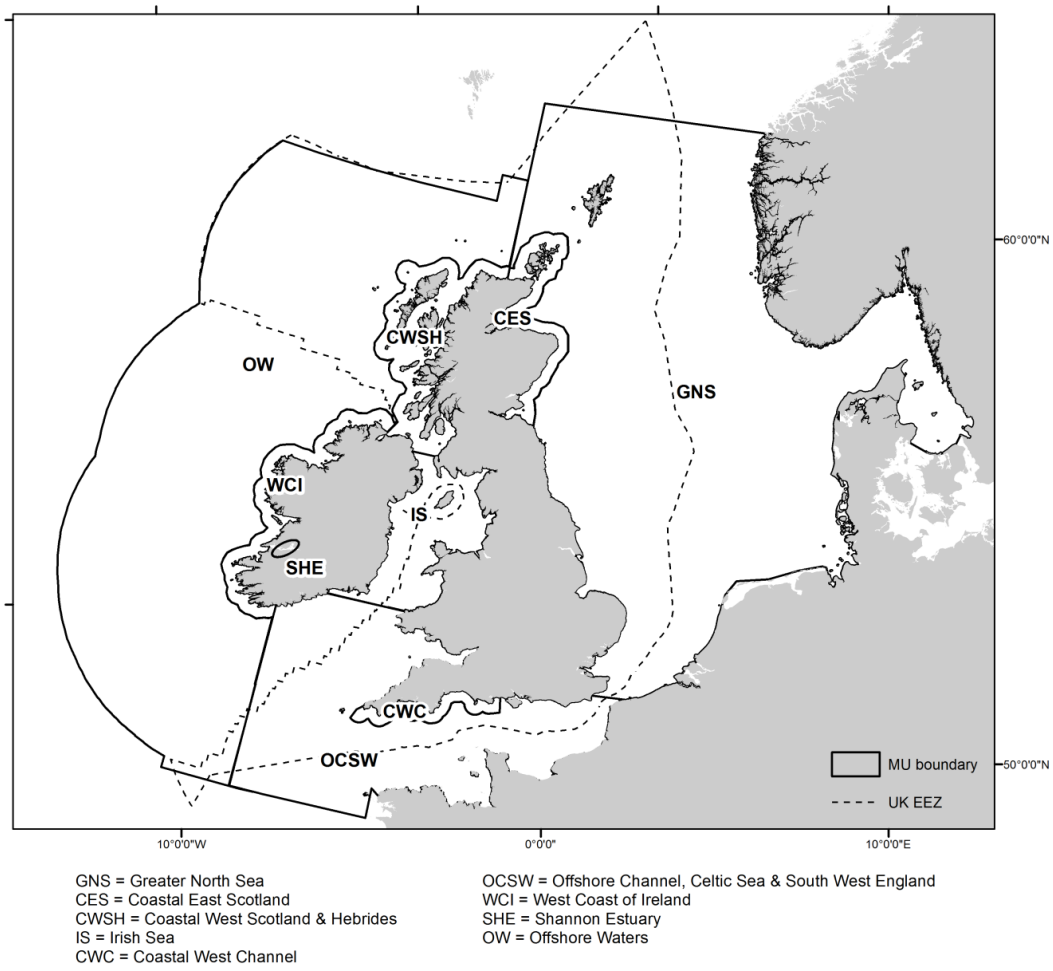


Plate 11-2-14 Common Dolphin, White-beaked Dolphin and Minke Whale MU (IAMMWG 2023).

11.2.6.3.6 Diet of Common Dolphin

133. 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, anchovy *Engraulida* spp., and sardine *Sardina pilchardus* (Couperus, 1997; Silva, 1999; Meynier, 2004) which are also exploited by fisheries. Other prey items recorded in common dolphins include cephalopods and crustacean (Brophy *et al.* 2009).

134. 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).

11.2.6.4 White-Beaked Dolphin

11.2.6.4.1 Desk-Based Review of White-Beaked Dolphin Presence

135. White-beaked dolphin are widely distributed within the central North Sea, however, very few sightings are recorded along the east coast of England or south of the Humber Estuary, with a small number of sightings in offshore waters within the shallow waters near the North Norfolk Sandbanks and Dogger Bank areas (Gilles *et al.* 2012; DECC, 2016). The occurrence of white-beaked dolphin in the southern North Sea is relatively low (Reid *et al.* 2003; Hammond *et al.* 2013; 2021).

136. A review of the strandings data of white-beaked dolphin in the North Sea were collated and assessed by ASCOBANS (IJsseldijk *et al.* 2018) in order to determine temporal and spatial trends in the distributions of white-beaked dolphin in the south-western North Sea. Strandings data used within the review were from Belgium, Germany, the Netherlands and the UK, from 1991 to 2017. This review indicates that there has been a reduction in the abundance of white-beaked dolphin in the south-east coasts of the UK, with an increase in the north-east area (IJsseldijk *et al.* 2018).

137. Data on the distribution of marine mammals in UK areas of the North Sea have been collected opportunistically during aerial surveys for birds conducted by WWT Consulting from 2001-2008 (WWT, 2009). A number of unknown dolphin species were recorded, with local clusters present north-east off Flamborough Head. White-beaked dolphin were also recorded in small numbers in the north-east, again off Flamborough Head (WWT, 2009).

138. The results of the JCP Phase III Report (Paxton *et al.* 2016) identified that for 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 Offshore Development Area is 0.1 to 2.7 individuals per km^2 (1.3% MU; Paxton *et al.* 2016).

139. The SCANS-III survey shows a similar distribution pattern, with no white-beaked dolphin identified within the southern North Sea survey block L, and low but increasing densities with the more northerly North Sea survey blocks (blocks O and R) (Hammond *et al.* 2021).

140. However, the SCANS-IV survey recorded white-beaked dolphin in the southern North Sea survey block NS-C which shows the number of white-beaked dolphin have been increasing in the southern North Sea. For the entire SCANS-IV survey area, white-beaked dolphin abundance in the summer of 2022 was estimated to be 67,138, with an overall estimated density of 0.0458/km^2 (CV = 0.325; 95% CL = 33,978-119,349; Gilles *et al.* 2023).

141. For white-beaked dolphin, the distribution maps (developed by Waggitt *et al.* 2019) show a clear pattern of higher density 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 (**Plate 11-2-15**; Waggitt *et al.* 2019).

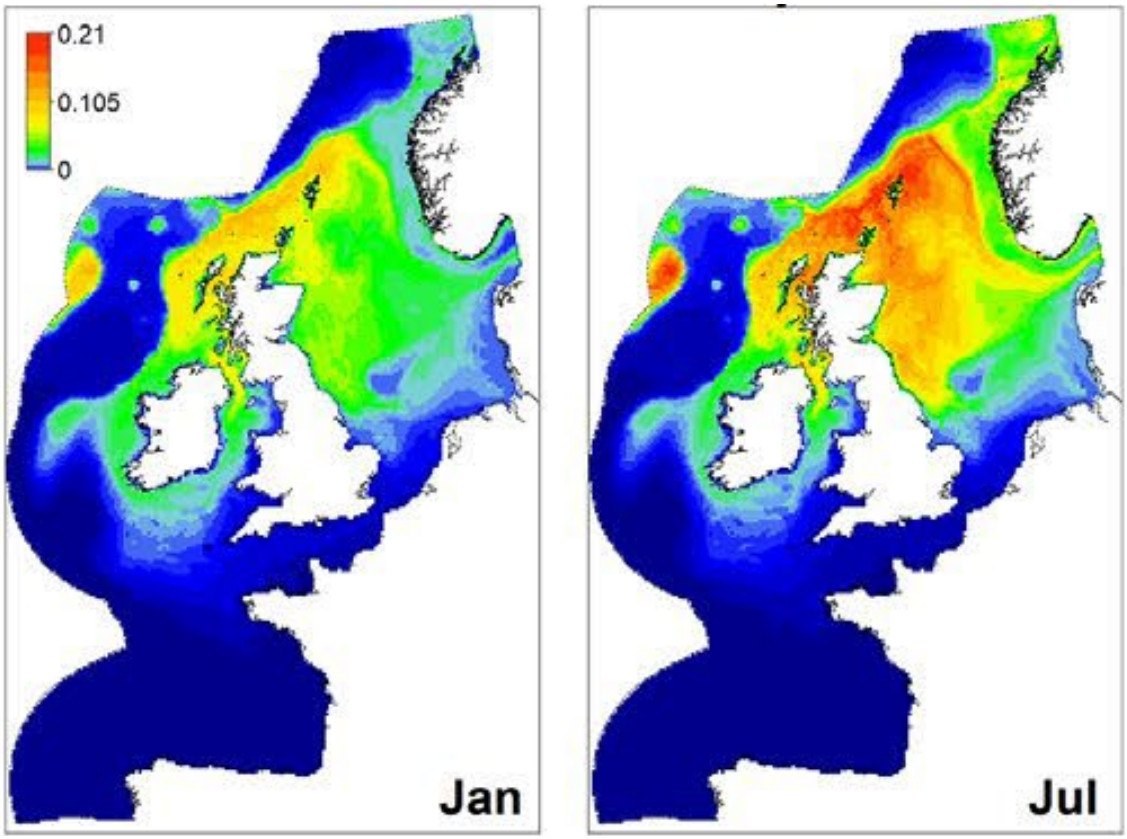


Plate 11-2-15 Spatial Variation in Predicted Densities Individuals per km of White-beaked Dolphin in January and July in the NE Atlantic). Values are Provided at 10km Resolution. Source: Waggitt et al. 2019.

11.2.6.4.2 Results From the Site-Specific Surveys for White-Beaked Dolphin

142. During the site-specific aerial surveys of both the Projects AfL Areas, plus 4km buffers (DBS East and West Survey Areas), undertaken from March 2021 to February 2023, there were three detections of white-beaked dolphins in the DBS East Survey Area during December 2021, December 2022 and January 2023 totalling of 16 individuals. In the DBS West Survey Area, white-beaked dolphins were recorded on four occasions, in April and June 2021, November 2022 and February 2023, totalling at 19 individuals (**Table 11-2-16** and **Table 11-2-17**).

143. However, several sightings were recorded as unidentified dolphin, dolphin / porpoise species and marine mammal species, some of which could have been white-beaked dolphin (**Table 11-2-6** and **Table 11-2-7**).

11.2.6.4.3 Results From Surveys in the Dogger Bank Area

144. Data from the Dogger bank Tranche C site specific surveys with a 4km buffer (12 surveys undertaken between January 2013 to December 2013); 56 individuals were recorded through the 12 survey dates, peaking May to July.

145. Throughout the Dogger Bank Zone 3 site specific video digital aerial surveys (26 surveys undertaken between April 2010 to May 2012), a total of 104 white-beaked dolphins were recorded, peaking in the spring. In addition, there were 306 small cetaceans recorded which possibly can be attributed to white-beaked dolphins, along with 89 unidentified delphinid species. No species abundance or density estimates were undertaken.

146. During the ornithological Surveys for the Forewind Round 3 Dogger Bank Offshore Wind Farm (monthly surveys January 2010 to June 2012 (excluding February 2012)), there were 138 incidental sightings of white-beaked dolphins, with 811 individuals. There was also a further 24 sightings of unidentified delphinid species, which could be attributed to white-beaked dolphins. No species abundance or density estimates were undertaken.

147. Abundance and density estimate of animals/km^2 have been calculated from the raw data counts for (i) white-beaked dolphin and (ii) dolphin species which can be attributed to white-beaked dolphin. White-beaked dolphins were recorded in DBS East during the December 2021 survey, with eight individuals resulting in 0.07 dolphins/km^2. In DBS West, white-beaked dolphins were recorded in April and June 2012, resulting in a density estimate of 0.07 dolphins/km^2.

11.2.6.4.4 Site-Specific Density Estimates for White-Beaked Dolphin

148. Abundance and density estimate of animals/km^2 have been calculated from the raw data counts for white-beaked dolphin, in DBS East Survey Area, totalling of 16 individuals, with a relative density estimate of 0.07 individuals per km^2. In DBS West Survey Area, 19 individuals were recorded, resulting in a density estimate of 0.07 dolphins/km^2 (**Table 11-2-16** and **Table 11-2-17**).

149. A correction factor was used for white-beaked dolphin of 0.18 (Rasmussen *et al.* 2013; Mate *et al.* 1994 & 1995).

Table 11-2-16 Raw Counts, Abundance, and Density Estimates of white-beaked Dolphins DBS East AfL Area Plus 4km (DBS East Survey Area)

Survey date	Raw count	Abundance	Lower CI	Upper CI	Precision	Density (animals/km²)	Density with correction (animals/km²)
Dec-21	8	69	8	155	0.35	0.07	0.388
Dec-22	2	17	2	52	0.71	0.02	0.111
Jan-23	6	53	6	158	0.41	0.06	0.333

150. From the three detections of white-beaked dolphin during the site-specific surveys on DBS East Survey Area, an average density total of 0.034 white-beaked dolphin per km^2 using the correction factor.

Table 11-2-17 Raw Counts and Abundance and Density Estimates of white-beaked Dolphins DBS West AfL Area Plus 4km (DBS West Survey Area)

Survey date	Raw count	Abundance	Lower CI	Upper CI	Precision	Density (animals /km²)	Density with correction (animals/ km²)
Apr-21	4	34	4	136	0.50	0.04	0.22
Jun-21	8	67	8	200	0.35	0.07	0.39
Nov-22	4	34	4	102	0.5	0.04	0.22
Feb-23	3	26	3	77	0.58	0.03	0.16

151. With the four detections of white-beaked dolphin during the site-specific surveys on DBS West Survey Area, an average density of 0.041 white-beaked dolphin per km^2 using the correction factor.

11.2.6.4.5 Review of Abundance and Density Estimates for White-Beaked Dolphin

152. For the entire SCANS-IV survey area, white-beaked dolphin abundance in the summer of 2022 was estimated to be 67,138 with an overall estimated density of 0.045/km^2 (CV = 0.33; 95% CL = 33,978-119,349); which is higher than previous SCANS surveys (Gilles *et al.* 2023). DBS is located in SCANS-IV survey block NS-C (Gilles *et al.* 2023):

- Abundance = 894 white-beaked dolphin (CV=0.76; 95% CL= 12-2,387); and
- Density = 0.0149 white-beaked dolphin/km^2 (CV=0.76).

153. Scientific evidence supports the assumption that white-beaked dolphin from around the British Isles and North Sea represent one population, with movement between Scottish waters and the Danish North Sea and Skagerrak (Banguera-Hinestroza *et al.* 2010; IAMMWG, 2023).

154. However, it is worth noting that this species usually occurs on the continental shelf (Reid *et al.* 2003; IAMMWG, 2023). The UK EEZ white-beaked dolphin abundance is 34,025 (CV = 0.28; 95% CL = 20,026 – 57,807), which are derived from the SCANS-III (Hammond et al. 2021) and ObSERVE data (Rogan et al. 2018). The reference population for white-beaked dolphin in the CGNS MU is 43,951 animals (CV=0.22; 95% CI= 28,439 – 67,924; IAMMWG, 2023). This is the reference population for white-beaked dolphin, of which any potential impacts would be assessed against.

155. The results from Waggitt *et al.* (2019) seasonal absolute density estimates for white-beaked dolphin are presented in **Table 11-2-18**.

Table 11-2-18 Seasonal Density Estimates for White-beaked Dolphin from Waggitt et al. 2019 Densities.

Season	DBS East Array Area absolute density estimates (animals/km^2)	DBS West Array Area absolute density estimates (animals/km^2)	Offshore Development Area (animals/km^2)
Summer average	0.0055	0.012	0.046
Winter average	0.0048	0.009	0.035
Yearly average	0.0052	0.011	0.041

156. Average Waggitt *et al.* (2019) summer densities across the area of the SCANS-IV block NS-C have also been calculated to show the density across a wider area in comparison and results in 0.032 white-beaked dolphin per km^2 for the Projects.

157. Within the impact assessments for white-beaked dolphin, the worse-case density estimates for the offshore sites would be used. Therefore, within the impact assessments the density estimates from the site specific surveys:

- Site specific surveys: 0.034 individuals per km^2 for the DBS East AfL Area; and
- Site specific surveys: 0.041 individuals per km^2 for the DBS West AfL Area.

158. For the assessment of the wider area such as the Offshore Development Area and Offshore Export Cable Corridor the highest density has been applied.

11.2.6.4.6 Diet of White-Beaked Dolphin

159. Analysis of the stomach contents of white-beaked dolphin have shown that the species feed on a wide range of fish and squid species, including cod, whiting, and hake (Kinze *et al.* 1997; Reeves *et al.* 1999). White-beaked dolphin have also been observed to associate with herring *Clupea harengus* (Harmer, 1927; Fraser, 1946; Evans, 1980) and mackerel (Evans *et al.* 1987) shoals, and anecdotal evidence from fisherman in Scotland suggests that individuals seen inshore may coincide with mackerel appearing in the same areas (Canning *et al.* 2008).

160. Dietary analysis for 22 white-beaked dolphin stranded around the UK coast between 1992 and 2003 (Canning *et al.* 2008) found that while a wide variety of prey species were identified, the majority of prey were from a much smaller number of species. Haddock and whiting were the most predominantly found, representing 43% and 24% respectively of the total reconstructed weight, with cod representing a further 11% of the total reconstructed weight.

11.2.6.5 Minke Whale

11.2.6.5.1 Desk-Based Review of Minke Whale Presence

161. Minke whales are widely distributed along the Atlantic seaboard of Britain and Ireland and throughout the North Sea. The JNCC Cetacean Atlas (Reid *et al.* 2003), indicates that minke whale occur regularly in the North Sea to the north of Humberside, but are comparatively scarce in the southern North Sea. 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).

162. 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).

163. The JCP Phase III Report (Paxton *et al.* 2016) identified a total of 1,860 minke whale sightings within the UK offshore area. The density of minke whale was predicted to be highest along the northern coast of the UK, from Yorkshire north to the Kintyre Peninsula. The resultant density maps produced in the JCP Phase III Report (Paxton *et al.* 2016) show a minke whale density of less than 0.04 per km^2 for the southern North Sea (97.5% CI 0-0.02 – 0.08 per km^2) below the Humber Estuary and Flamborough Head. The JCP report estimated 0.8 to 4.9 individuals per km^2 in the offshore development area (1.3% MU; Paxton *et al.* 2016).

164. For the entire SCANS-IV survey area, minke whale abundance in the summer of 2022 was estimated to be 12,417, with an overall estimated density of 0.0085/km^2 (CV = 0.361; 95% CL = 7,038-26,943; Gilles *et al.* 2023). During the SCANS-IV summer survey, in the survey block NS-C where the Protects are situated, the abundance of minke whale is 412 minke whale (CV=0.88; 95% CL=4-1,392) with a density estimate of 0.0068 minke whale/km^2 (CV=0.881) (Gilles *et al.* 2023).

165. For minke whale, the distribution maps (developed by Waggitt *et al.* 2019) show a clear pattern of higher density in the northern North Sea, and around the coasts of Scotland, Ireland and within the CIS, with decreasing densities southwards of Scotland along the east coast of England. There is a clear seasonal difference in the densities of minke whale, with higher densities in July, which is particularly evident in the north of their range (**Plate 11-2-16**; Waggitt *et al.* 2019).

166. In addition, the distribution maps indicate a 'corridor' of increased minke whale density travelling from north of Orkney, around the north and west coasts of the UK to Northern Ireland. DBS Array Areas are located to the very southern end of the area with relatively higher densities, and there appears to be a slight difference in their seasonal distributions with higher densities in this area during the summer months. Interrogation of this data[7], including all 10km 'grids' that overlap with the specified area, reveals an average annual density estimate of:

- 0.0025 individuals per km^2 (average of all overlapping 10km 'grids') for the DBS East AfL Area;
- 0.0034 individuals per km^2 (average of all overlapping 10km 'grids') for the DBS West AfL Area;
- 0.0073 individuals per km^2 (average of all overlapping 10km 'grids') for the Offshore Export Cable Corridor; and
- 0.0075 individuals per km^2 for the total Offshore Development Area.

[7] Available from: https:// doi.org/10.5061/dryad.mw6m905sz

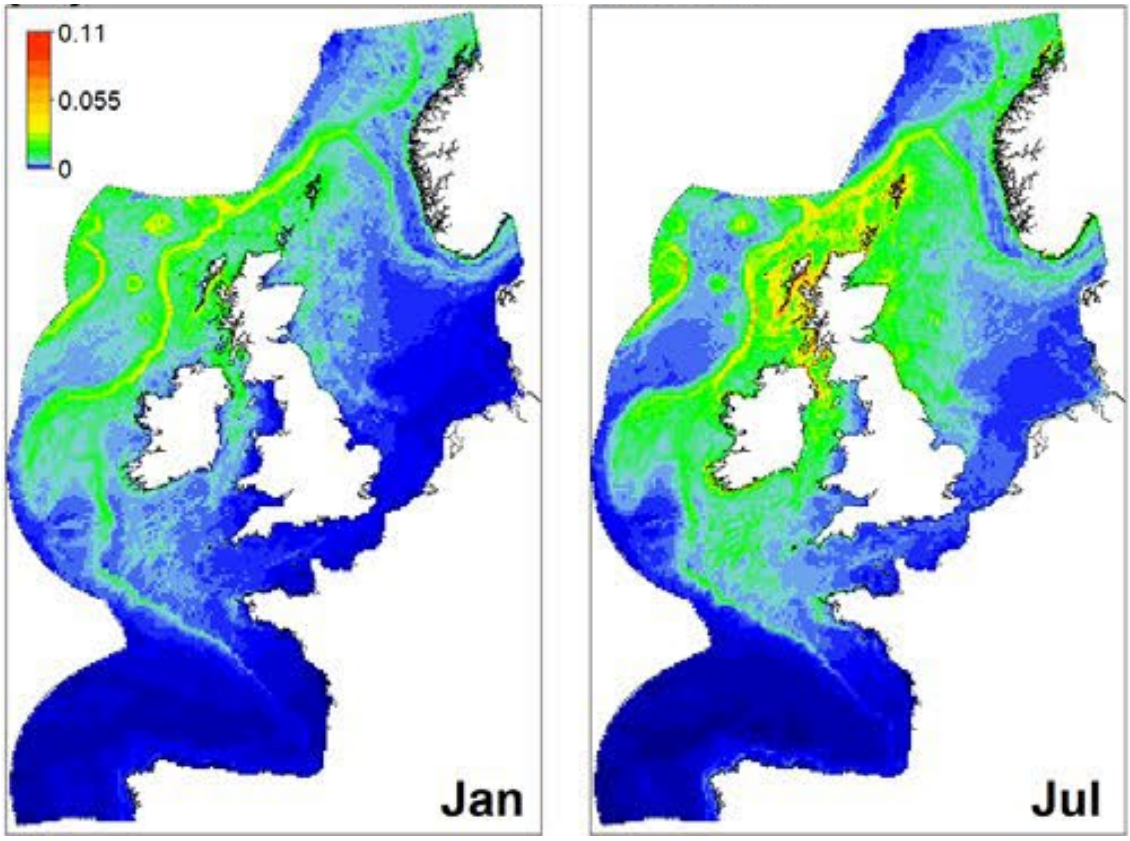


Plate 11-2-16 Spatial Variation in Predicted Densities (Individuals per km of Minke Whale in January and July in the North-East Atlantic). Values are Provided at 10km Resolution. Source: Waggitt et al. 2019.

11.2.6.5.2 Results From the Site-Specific Surveys for Minke Whale

167. During the DBS Survey Areas site specific digital aerial surveys (24 surveys undertaken between March 2021 and February 2023), a single minke whale was positively identified in September 2021 inside DBS East Survey Area and two individuals were recorded in August 2022 (**Table 11-2-19**). At DBS West, individual minke whale was recorded in June and September 2022, with two individuals recorded in May 2022, and three in August 2022 (**Table 11-2-20**). A correction factor of 0.12 was used (Hedie-Jorgensen *et al.* 2010).

Table 11-2-19 Raw Counts, Abundance and Density of Minke Whale at DBS East AfL Area Plus 4km (DBS East Survey Area)

Survey date	Raw count	Abundance	Lower CI	Upper CI	Precision	Density (animals /km²)	Density with correction factor (animals/km²)
Sept-21	1	9	1	34	1.0	0.01	0.08
Aug-22	2	18	2	44	0.71	0.02	0.16

Table 11-2-20 Raw Counts, Abundance and Density Estimates of Minke Whale at DBS West AfL Area Plus 4km (DBS West Survey Area)

Survey date	Raw count	Abundance	Lower CI	Upper CI	Precision	Density (animals/km²)	Density with correction factor (animals/km²)
May-22	2	17	2	43	0.71	0.02	0.16
Jun-22	1	8	1	25	<1	0.01	0.08
Aug-22	3	26	3	60	0.58	0.03	0.25
Sep-22	1	8	1	34	<1	0.01	0.08

168. Using the correction factor of 0.12 (Hedie-Jorgensen *et al.* 2010) and calculating the average density from all 24 surveys, for DBS East Survey Area; the average density estimate is 0.01 mink whale per km² and for DBS West Survey Area; the average density estimate is 0.02 minke whale per km².

11.2.6.5.3 Results From Surveys in the Dogger Bank Area

169. During the Dogger Bank Tranche C site specific video digital aerial surveys (12 surveys undertaken between January 2013 to December 2013), eight minke whale were recorded.

170. Throughout the Dogger Bank Zone 3 site specific video digital aerial surveys (26 surveys undertaken between April 2010 to May 2012), a total of 18 minke whales were recorded, peaking in June 2010, and 2011. In addition, there were nine large cetaceans recorded which possibly can be attributed to minke whales. No species abundance or density estimates were undertaken.

171. During the ornithological Surveys for the Forewind Round 3 Dogger Bank Offshore Wind Farm (monthly surveys January 2010 to June 2012 (excluding February 2012)), there were 183 incidental sightings of minke whales, with 199 individuals. There was also a further six sightings of solitary unidentified baleen whales, which most probably can be attributed to minke whales.

11.2.6.5.4 Site-Specific Density Estimates for Minke Whale

172. During the DBS Survey Areas site specific digital aerial surveys (24 surveys undertaken between March 2021 and February 2023), the two individual minke whale recorded at DBS East, resulted in a relative density estimate of 0.02 individuals per km^2. At DBS West the four minke whale detections resulted in a relative density estimate of 0.03 individuals per km^2. This is higher compared to the density estimate as from the SCANS-III survey (section 11.2.6.5.2).

173. Abundance and density estimate of animals/km^2 have been calculated from the raw data counts for minke whales. These results are set out below.

11.2.6.5.5 Review of Abundance and Density Estimates for Minke Whale

174. For the entire SCANS-IV survey area, minke whale abundance in the summer of 2022 was estimated to be 12,417 with an overall estimated density of 0.0085/km^2 (CV = 0.361; 95% CL = 7,038-26,943; **Plate 11-2-17**, Gilles *et al.* 2023).

175. Calculating Waggitt *et al.* 2019 densities with all 10km 'grids' that overlap with the specified area, reveals an average annual density estimate of 0.0025 individuals per km^2 for the DBS East Survey Area; 0.0034 individuals per km^2 for the DBS West Survey Area.

176. Average Waggitt *et al.* (2019) summer densities across the area of the SCANS-IV block NS-C have also been calculated to show the density across a wider area in comparison and results in 0.004 minke whale per km^2 for the Projects.

177. Within the impact assessments for minke whale, the worst case density - specific surveys would be used:

- 0.01 minke whale per km^2 for DBS East; and

- 0.02 minke whale per km^2 for DBS West.

178. For the assessment of the wider area such as the Offshore Development Area and Offshore Export Cable Corridor the highest density has been applied.

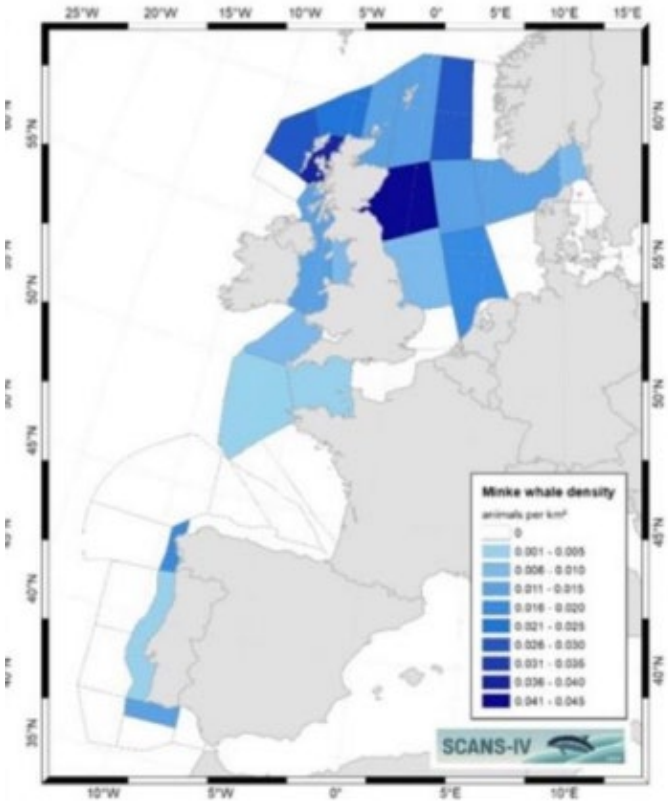


Plate 11-2-17 Estimated Minke Whale Density in Each SCANS-IV Survey Block (Gilles et al. 2023)

179. Genetic evidence suggests that the minke whales 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 whales in European waters.

180. The single MU for minke is the CGNS MU (**Plate 11-2-14**), covering the same geographical area as described for white-beaked dolphin and common dolphin (IAMMWG, 2023). The reference population for minke whales in the CGNS MU is 20,118 animals (CV = 0.18; 95% CI = 14,061 – 28,786; IAMMWG, 2023). This is the reference population for minke whale, of which any potential impacts would be assessed against. This estimate was derived from using the SCANS-III (Hammond *et al.* 2017) and ObSERVE data (Rogan *et al.* 2018). The IAMMWG (2023) note the abundance of minke whales is highly seasonal, with abundance peaking during migration south into waters around the UK for summer.

11.2.6.5.6 Diet of Minke whale

181. 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 of through their baleen plates and swallow their prey whole.

182. A study into the diet of minke whale in the north-eastern Atlantic sampled a total of 210 minke whale for stomach 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).

11.2.6.6 Grey Seal

11.2.6.6.1 Desk-Based Review of Grey Seal Presence

183. 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).

184. Approximately 35% of the world's grey seals breed in the UK, and 80% of these breeds 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).

185. Grey seals are wide ranging and can breed and forage in different areas (Russell *et al.* 2013). They may range widely to forage and frequently travel over 100km between haulout sites (SCOS, 2022). Maximum foraging ranges for grey seal has been recorded to be up to 448km (Carter *et al.* 2022). Grey seals have larger foraging extents from haulouts and are much less faithful to these haulouts, often using multiple areas (e.g., Donna Nook, The Wash, Blakeney, Scroby Sands) over a period of months (SCOS 2022). For example, tags deployed on grey seals at Donna Nook and Blakeney Point in May 2015, indicated that they used multiple haul-outs sites; with one hauling out in the Netherlands and one in Northern France (Russell, 2016). **Plate 11-2-18** shows the tagged seal movements along the east coast of England and indicates that grey seal travel between haul-out sites along the east coast of England, as well as to the north of France, Firth of Forth and Dogger Bank, and travel through the DBS project areas (Russell, 2016).

186. The north Dutch coastline is also an important foraging zone and migration route for grey seal (Brasseur *et al.* 2010). A study on the grey seal population in the Dutch part of the Wadden Sea shows that the growth of the breeding population is fuelled by the annual immigration of grey seals from the UK, indicating connectivity with the Wadden Sea area (Brasseur et al. 2018).

187. This is shown through further telemetry tagging studies of grey seals, undertaken from key haul-out sites along the north coast of France (for tagged individuals from 2012; Vincent et al. 2017). The results of this tagging study show connectivity of grey seals from the east coast of England to the north coasts of France, Belgium, and the Netherlands, including the Wadden Sea (**Plate 11-2-18**; **Plate 11-2-19**).

188. The Wadden Sea covers the coastal areas of the Netherlands, Germany and Denmark (approximately 500km). It is an intertidal zone in the southeastern North Sea with an area of approximately 10,000km^2.

189. Coordinated aerial, boat and land surveys of the Dutch, German and Danish Wadden Sea grey seal areas including Helgoland (Germany) are aimed at estimating changes in numbers of grey seal in the Wadden Sea area. Annual surveys are conducted in the Wadden Sea, during the moult and breeding season by the Trilateral Seal Expert Group (TSEG). TSEG counts for adult grey seals were conducted by aerial surveys during the moulting period in the spring 2020. Studies show that in moult period, the animals present are not necessarily animals breeding in the Wadden Sea and considerable exchange occurs with the much larger UK population (Brasseur *et al.* 2015; 2017).

190. The most recent counts in the pupping season in November-January of 2021- 2022 resulted in a total of 2,214 pups in the whole Wadden Sea and Helgoland, (Schop et al. 2022), representing a growth of 15% compared to 2020- 2021 (Brasseur *et al*. 2021). Previous counts have shown the number of grey seal recorded in the Wadden Sea area has been steadily increasing, with a mean annual 10% increase over the past five years, with the most recent count of grey seal in 2021 being of 7,649, (Schop *et al.* 2022).

191. Unger *et al.* (2022) recorded juvenile grey seals travelling from the haul out sites in Helgoland, Germany throughout the North Sea, showing that grey seals travelling in the DBS Array Areas can be from the Wadden Seas.

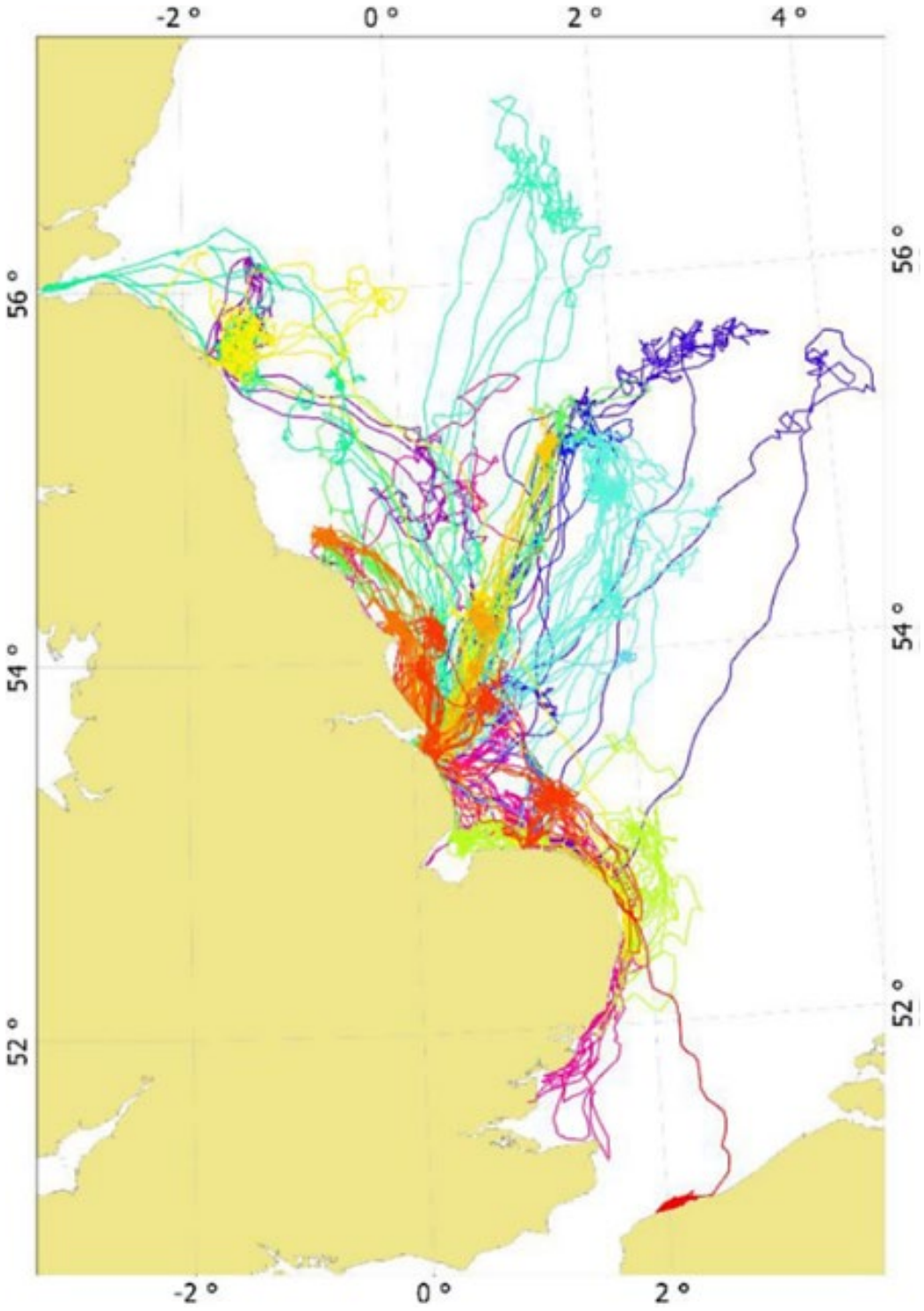


Plate 11-2-18 Tagged Grey Seal Movements Along the East Coast of England (Russell 2016).

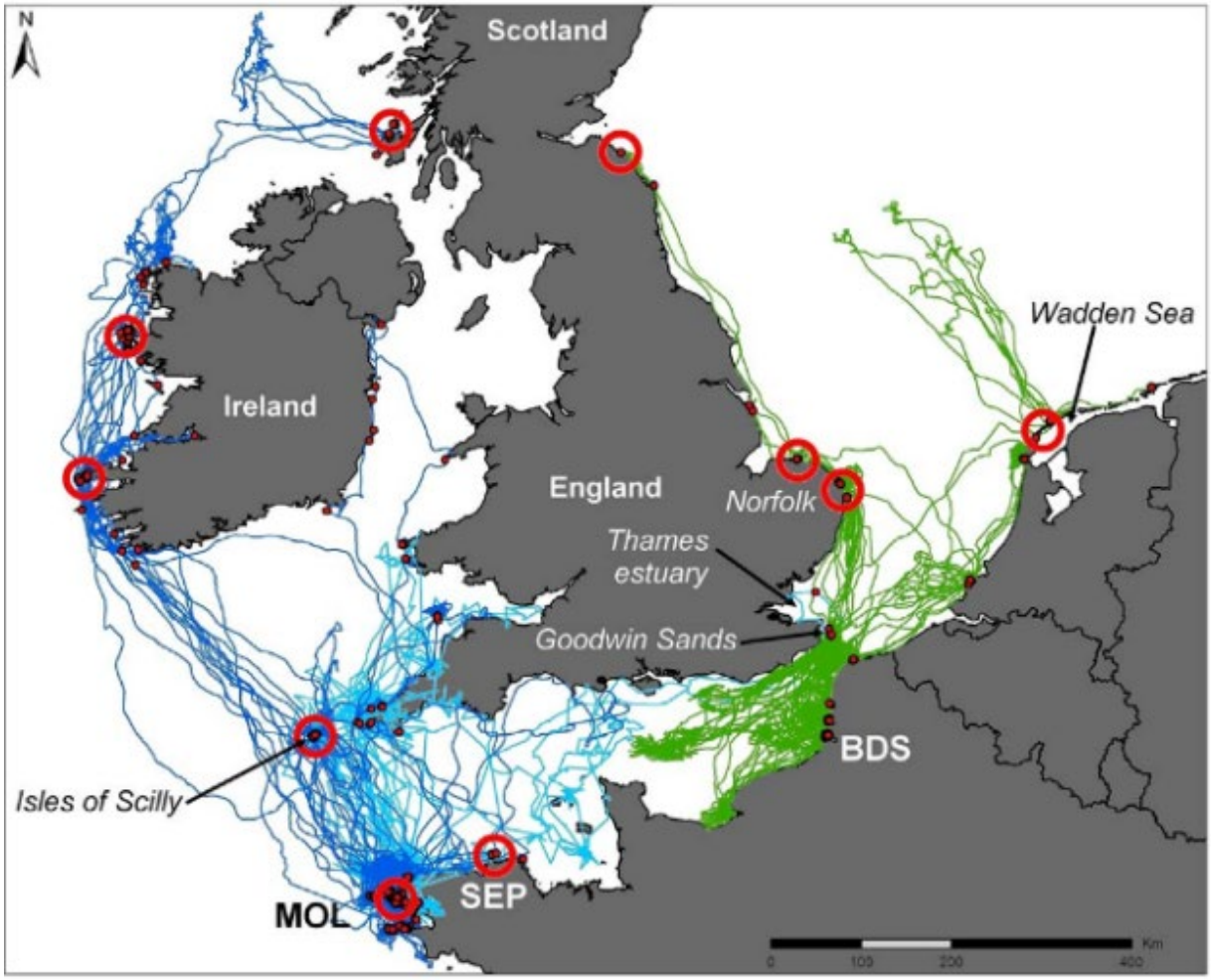


Plate 11-2-19 Grey Seal Telemetry Tags (Shown in Green are the Results from the Tagging of 11 Individuals in 2012, from the Baie de Somme (BDS) Haul-out Site on the North Coast of France. Red Dots Indicate Haul-out Sites, and Red Circles Indicate Breeding Locations.

192. There is a considerable amount of movement of grey seals that occurs (as observed from telemetry data) among the different areas and regional subunits of the North Sea, and no evidence to suggest that grey seals on the North Sea coasts of Denmark, Germany, the Netherlands or France are independent from those in the UK (SCOS, 2021).

11.2.6.6.2 Grey Seal Haul-Out Sites

193. 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 (SCOS, 2022).

194. In eastern England, pupping occurs mainly between early November and mid-December (SCOS, 2022). 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, 2022).

195. Principal grey seal haul-out sites are included in **Table 11-2-21** which shows the approximate distance to the closest point of DBS East Array Area, DBS West Array Area, and the Offshore Export Cable Corridor; in addition with the most recent grey seal count for each haul out location.

Table 11-2-21 The Most Recent Grey Seal Count at Each of the Nearby Haul-out Sites, and the Distance to DBS

Haul-out site	Distance to DBS East and DBS West	Grey seal count
Holy Island	223km from landfall* 214km from Offshore Export Cable Corridor 260km from DBS East Array Area 225km from DBS West Array Area	4,251 (2020 mean grey seal count; SCOS, 2020)
Farne Islands, (Northumberland)	212km from landfall* 205km from Offshore Export Cable Corridor 248km from DBS East Array Area 215km from DBS West Array Area	
Tees	93km from landfall* 116km Offshore Export Cable Corridor 189km from DBS East Array Area 161km from DBS West Array Area	30 (2021 mean grey seal count; SCOS, 2022)
Ravenscar	52km from landfall* 51km from Offshore Export Cable Corridor 145km from DBS East Array Area 120km from DBS West Array Area	Both Ravenscar and Filey Brigg are transient sites.

Haul-out site	Distance to DBS East and DBS West	Grey seal count
Filey Brigg	28km from landfall* 27km from Offshore Export Cable Corridor 135km from DBS East Array Area 117km from DBS West Array Area	15 grey seal (grey seal count, Yorkshire seal org, 2023)
Donna Nook	62km from landfall* 67km from Offshore Export Cable Corridor 150km from DBS East Array Area 143km from DBS West Array Area	3,897 grey seal (2021 mean grey seal count; SCOS, 2022).
The Wash	108km from landfall* 126km from Offshore Export Cable Corridor 190km from DBS East Array Area 194km from DBS West Array Area	799 grey seal (2021 mean grey seal count; SCOS, 2022).
Blakeney Point National Nature Reserve (NNR)	131km from landfall* 134km from Offshore Export Cable Corridor 166km from DBS East Array Area 179km from DBS West Array Area	493 grey seal (2021 mean grey seal count; SCOS, 2022).
Horsey	185km from landfall* 182km from Offshore Export Cable Corridor 202km from DBS East Array Area 183km from DBS West Array Area	380 grey seal (2021 mean grey seal count; SCOS, 2022)
Scroby Sands	198km from landfall* 201km from Offshore Export Cable Corridor 195km from DBS East Array Area 215km from DBS West Array Area	1,377 grey seal (2021 mean grey seal count; SCOS 2022).

**Measured in a straight line from landfall site*

11.2.6.6.3 Results From the Site-Specific Surveys for Grey Seal

196. During the site-specific surveys from March 2021 to February 2023, 62 grey seals were recorded in DBS East Survey Area on 19 surveys. At DBS West Survey Area 88 individuals were recorded during 18 surveys. In addition to grey seal, there were a number of sightings that was recorded as 'unidentified seal'; in DBS East Survey Area (n=49) and DBS West Survey Area (n=34). Furthermore, marine mammals that were recorded that could not be attributed to a species were recorded as 'marine mammal species', DBS West Survey Area (n=63), some of which could have been grey seals. The number of definite grey seal recordings peaked in the summer months.

197. During the Dogger Bank Tranche C site specific video digital aerial surveys (12 surveys undertaken between January 2013 to December 2013), 92 grey seals were recorded, with peak numbers recorded in January. March, June and July.

198. Throughout the Dogger Bank Zone 3 site specific video digital aerial surveys (26 surveys undertaken between April 2010 to May 2012), a total of 46 grey seals were recorded. In addition, there were 218 unidentified seals recorded which possibly can be attributed to grey seals, along with 210 unidentified small cetacean or seal species. No species abundance or density estimates were undertaken. There were no obvious seasonal peaks.

199. During the ornithological Surveys for the Forewind Round 3 Dogger Bank Offshore Wind Farm (monthly surveys January 2010 to June 2012 (excluding February 2012)), there were 244 incidental sightings of grey seals, with 244 individuals. There was also a further 19 sightings of unidentified seal species, with 17 individuals plus two dead seals, with which could be possibly attributed to grey seals. No species abundance or density estimates were undertaken. There was no clear seasonal trend of grey seal, however numbers peaked from December 2010 to April 2011 which would be the pupping, breeding and moulting seasons.

200. Density estimates of animals/km^2 have been calculated from the raw data counts for (i) grey seals and (ii) unidentified seal species and are set out below. These abundance and densities are for the DBS East Array Area plus 4km buffer (**Table 11-2-22**; **Table 11-2-24**) and DBS West Array Area plus 4km buffer (**Table 11-2-23**; **Table 11-2-25**). A correction factor of 0.2709 has been applied for grey seal and in this instance unidentified seal (SMRU, 2011).

11.2.6.6.4 Site-Specific Density Estimates for Grey Seal

201. Density estimates of animals/km^2 have been calculated from the raw data counts for (i) grey seals and (ii) unidentified seal species and are set out below. These abundance and densities are for the DBS East Survey Area (**Table 11-2-22**; **Table 11-2-24**) and DBS West Survey Area (**Table 11-2-23**; **Table 11-2-25**). The correction factor used for grey seal is 0.2709 (SMRU, 2011).

202. Seasonal calculation of grey seal relative density estimates has been calculated from the data from the site-specific surveys and are presented in **Table 11-2-26**.

203. The abundance estimates of grey seal and unidentified seal species are presented on a graph in **Graph 11-2-3** for DBS East Survey Area and **Graph 11-2-4** for DBS West Survey Area. The months with no sightings are not included in the graphs.

Table 11-2-22 Raw Counts, Abundance and Density Estimates of Grey Seal in DBS East AfL Area Plus 4km Buffer (DBS East Survey Area)

Survey date	Raw count	Abundance	Lower CI	Upper CI	Precision	Density (animals/ km^2)	Density with correction (animals/km^2)
Apr-21	1	9	1	34	1.00	0.01	0.04
May-21	-	-	-	-	-	-	-
Jun-21	6	50	17	92	0.41	0.05	0.18
Jul-21	8	67	17	126	0.35	0.07	0.26
Aug-21	4	33	8	75	0.50	0.04	0.15
Sep-21	-	-	-	-	-	-	-
Oct-21	1	8	1	25	1.00	0.01	0.04
Nov-21	-	-	-	-	-	-	-
Dec-21	3	25	3	59	0.58	0.03	0.11
Jan-22	3	25	3	59	0.58	0.03	0.11
Feb-22	5	42	8	84	0.45	0.05	0.18

Survey date	Raw count	Abundance	Lower CI	Upper CI	Precision	Density (animals/ km²)	Density with correction (animals/km²)
Mar-22	1	9	1	35	<1	0.01	0.04
Apr-22	-	-	-	-	-	-	-
May-22	7	61	17	113	0.38	0.07	0.26
Jun-22	2	17	2	43	0.71	0.02	0.07
Jul-22	3	26	3	61	0.58	0.03	0.11
Aug-22	1	9	1	26	<1	0.01	0.04
Sep-22	4	34	9	69	0.5	0.04	0.15
Oct-22	2	17	2	43	0.71	0.02	0.07
Nov-22	1	9	1	26	1	0.01	0.04
Dec-22	6	52	9	121	0.41	0.06	0.22
Jan-23	1	9	1	26	<1	0.01	0.04
Feb-23	3	26	3	60	0.058	0.03	0.11

Table 11-2-23 Raw Counts, Abundance and Density Estimates of Grey Seal in DBS West AfL Area Plus 4km Buffer (DBS West Survey Area)

Survey date	Raw count	Abundance	Lower CI	Upper CI	Precision	Density (animals/km²)	Density with correction (animals/km²)
Mar-21	-	-	-	-	-	-	-
Apr-21	-	-	-	-	-	-	-
May-21	-	-	-	-	-	-	-
Jun-21	2	17	2	43	0.71	0.02	0.07
Jul-21	2	17	2	43	0.71	0.02	0.07

Survey date	Raw count	Abundance	Lower CI	Upper CI	Precision	Density (animals/km²)	Density with correction (animals/km²)
Aug-21	3	26	3	78	0.58	0.01	0.04
Sep-21	1	9	1	26	1.00	0.01	0.04
Oct-21	1	8	1	25	1.00	0.01	0.04
Nov-21	-	-	-	-	-	-	-
Dec-21	-	-	-	-	-	-	-
Jan-22	1	9	1	26	1.00	0.01	0.04
Feb-22	1	9	1	26	1.00	0.01	0.04
Mar-22	1	9	1	26	<1	0.01	0.04
Apr-22	2	17	2	42	0.71	0.02	0.07
May-22	16	137	68	213	0.25	0.15	0.55
Jun-22	5	42	8	85	0.45	0.05	0.18
Jul-22	4	33	8	75	0.50	0.04	0.15
Aug-22	7	60	17	112	0.38	0.07	0.26
Sep-22	4	34	8	68	0.50	0.04	0.15
Oct-22	2	17	2	43	0.71	0.02	0.07
Nov-22	-	-	-	-	-	-	-
Dec-22	25	209	100	343	0.2	0.23	0.85
Jan-23	7	60	17	112	0.38	0.07	0.26
Feb-23	4	34	9	Mar-21	0.5	0.04	0.15

204. The data presented in **Table 11-2-24** and **Table 11-2-25** has been attributed to unidentified seal and has not been apportioned. A correction factor of 0.2709 that has been calculated to sue for grey seal (SMRU 2011) has been applied. Due to the fact that this data has not been apportioned, this data would not be used for the assessment.

Table 11-2-24 Raw Counts, Abundance and Density Estimates of Grey seal and unidentified Seal Species in DBS East AfL Area Plus 4km Buffer (DBS East Survey Area)

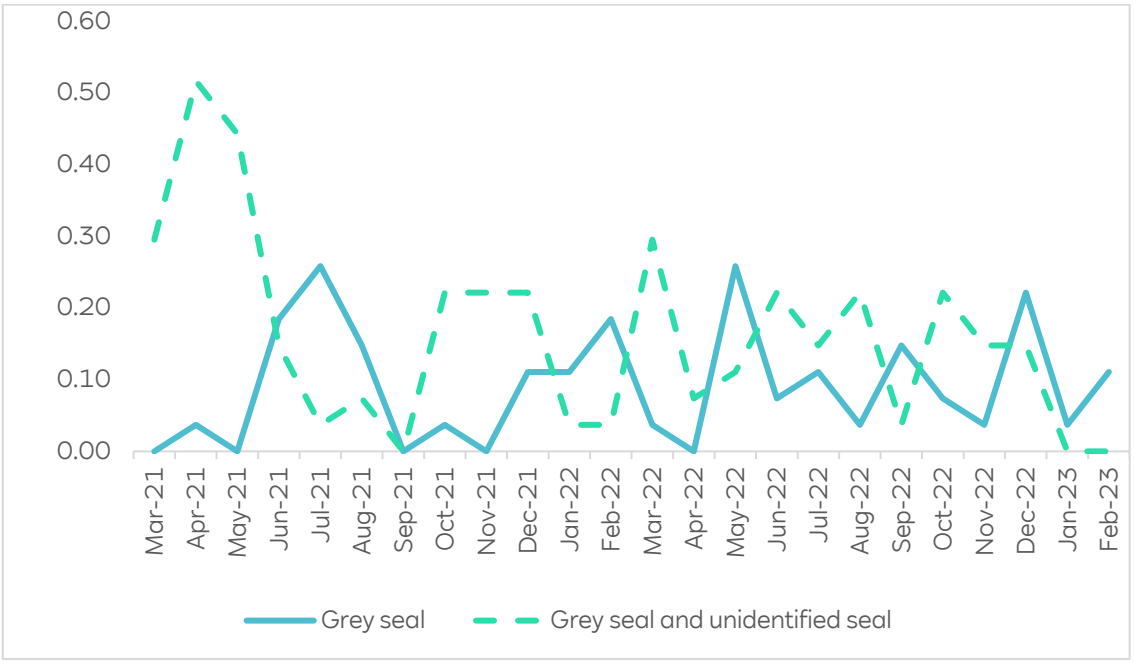
Survey date	Raw count	Abundance	Lower CI	Upper CI	Precision	Density (animals /km²)	Density with correction (animals/km²)
Mar-21	-	-	-	-	-	-	-
Apr-21	2	18	2	34	2.00	0.02	0.07
May-21	9	75	25	0	0.33	0.08	0.30
Jun-21	16	133	50	92	0.73	0.14	0.52
Jul-21	13	109	25	126	0.80	0.12	0.44
Aug-21	4	33	8	75	0.50	0.04	0.15
Sep-21	1	8	1	25	1.00	0.01	0.04
Oct-21	2	16	2	25	2.00	0.02	0.07
Nov-21	-	-	-	-	-	-	-
Dec-21	6	50	6	192	1.16	0.06	0.22
Jan-22	6	50	6	201	1.16	0.06	0.22
Feb-22	6	50	9	168	1.45	0.06	0.22
Mar-22	1	9	1	35	0.01	0.01	0.04
Apr-22	1	9	1	25	0.01	0.01	0.04
May-22	8	70	18	138	0.01	0.08	0.30
Jun-22	2	17	2	43	0.71	0.02	0.07
Jul-22	3	26	3	120	0.58	0.03	0.11

Survey date	Raw count	Abundance	Lower CI	Upper CI	Precision	Density (animals /km²)	Density with correction (animals/km²)
Aug-22	6	53	10	93	0.01	0.06	0.22
Sep-22	4	34	9	94	0.50	0.04	0.15
Oct-22	6	51	6	43	1.21	0.06	0.22
Nov-22	1	9	1	52	1.00	0.01	0.04
Dec-22	6	52	9	147	0.41	0.06	0.22
Jan-23	4	35	4	26	0.01	0.04	0.15
Feb-23	4	35	4	60	0.01	0.04	0.15

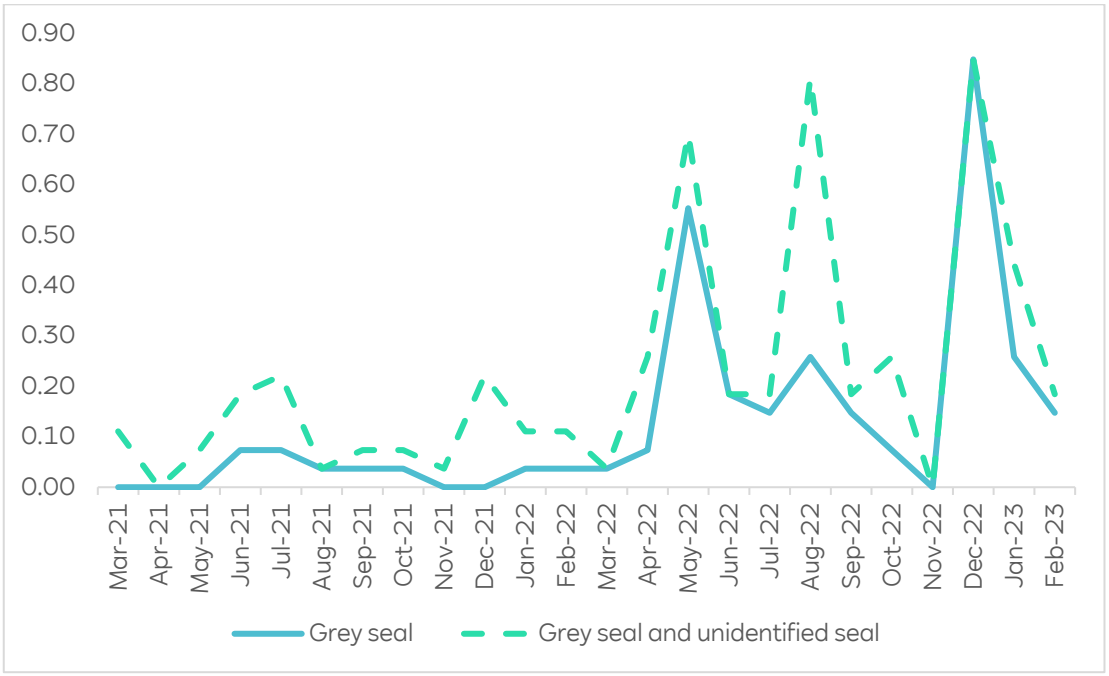
Table 11-2-25 Raw Counts, Abundance and Density Estimates of grey seal and unidentified Seal Species in DBS West AfL Area Plus 4km Buffer (DBS West Survey Area)

Survey date	Raw count	Abundance	Lower CI	Upper CI	Precision	Density (animals /km²)	Density with correction factors (animals/km²)
Mar-21	3	26	3	60	0.58	0.03	0.11
Apr-21	-	-	-	-	-	-	-
May-21	2	17	2	52	0.71	0.02	0.07
Jun-21	5	43	5	104	1	0.05	0.18
Jul-21	6	51	11	112	1	0.06	0.22
Aug-21	3	26	3	78	0.58	0.01	0.04
Sep-21	2	18	2	52	2	0.02	0.07
Oct-21	2	16	2	50	2	0.02	0.07
Nov-21	1	9	1	36	1	0.01	0.04

Survey date	Raw count	Abundance	Lower CI	Upper CI	Precision	Density (animals /km²)	Density with correction factors (animals/km²)
Dec-21	6	51	17	94	0.41	0.06	0.22
Jan-22	3	26	3	69	1	0.03	0.11
Feb-22	3	26	3	69	1	0.03	0.11
Mar-22	1	9	1	26	0.01	0.01	0.04
Apr-22	7	59	10	135	1	0.07	0.26
May-22	20	171	77	290	0.75	0.19	0.70
Jun-22	5	42	8	85	0.45	0.05	0.18
Jul-22	5	41	9	100	0.01	0.05	0.18
Aug-22	23	195	95	319	0.63	0.22	0.81
Sep-22	5	42	9	93	0.01	0.05	0.18
Oct-22	7	60	11	130	1	0.07	0.26
Nov-22	-	-	-	-	-	-	-
Dec-22	25	209	100	343	0.2	0.23	0.85
Jan-23	12	103	26	198	0.83	0.12	0.44
Feb-23	5	43	10	94	0.01	0.05	0.18



Graph 11-2-3 Estimated Abundance of Grey Seal at DBS East AfL Area plus 4km Buffer (DBS East Survey Area)



Graph 11-2-4 Estimated Abundance of Grey Seal at DBS West AfL Area plus 4km Buffer (DBS West Survey Area)

Table 11-2-26 Seasonal densities for grey seal from APEM

Season	DBS East Survey Area absolute density estimates (animals/km²)		DBS West Survey Area absolute density estimates (animals/km²)	
	Grey seal	Grey seal and unidentified seal	Grey seal	Grey seal and unidentified seal
Summer average	0.070	0.188	0.132	0.241
Winter average	0.080	0.142	0.123	0.203
Yearly average	0.091	0.165	0.128	0.222

11.2.6.6.5 Review of Abundance and Density Estimates for Grey Seal

205. The following sections provide the grey seal at-sea density estimates from grey seal mapping dataset; Carter *et al.* (2022) (**Figure 11-2-1**).

206. The relative seals at-sea density maps have also been used to calculate grey seal density estimates for the Projects Array Areas. 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.

207. The resultant density of seals at-sea maps (Carter *et al.* 2022; **Plate 11-2-20**; **Figure 11-2-1**) differ from the Russell *et al.* (2017) maps, in that they show the relative density of seals in each 5km 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. To calculate a density estimate to be used in assessments from the Carter *et al.* (2020) 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, and therefore not included in the density mapping.

208. Carter *et al.* (2022) provides habitat-based predictions of at sea distribution for seals around the British Isles. The habitat preference approach predicted distribution maps provide estimates per species, on a 5km by 5km grid, of relative at sea density for seals hauling-out in the British Isles. It is important to note that Carter *et al.* (2022) provides relative density (i.e. percentage of the total at sea population in each grid at any one time), whereas previous usage maps (Russell *et al.* 2017) have presented absolute density (i.e. number of animals within each grid at any one time).

209. The grey seal density estimates for DBS East Array Area and DBS West Array Area have been calculated from the seal at sea usage maps (Carter *et al.* 2022) based on the 5km by 5km grids that overlap with the Project Array Areas. The total grey seal population in the British Isles, at sea, is approximately 178,626 individuals, based on the corrected values and most recent haul-out counts for the UK (SCOS, 2022). This is the population estimate used with the Carter *et al.* (2022) data to calculate density estimates for DBS East Array Area and DBS West Array Areas.

210. Within the impact assessments for grey seal, the worst case density estimates for the Projects calculated from the site survey data and the seal at sea usage maps (Carter *et al.* 2022) would be used.

211. The mean at sea relative density estimates for these areas are:

- Site specific surveys: 0.188 individuals per km^2 for the DBS East AfL Area;
- Carter *et al.* (2022): 0.260 individuals per km^2 for the DBS West AfL Area; and
- Carter *et al.* (2022): 0.531 individuals per km^2 for the Offshore Export Cable Corridor; and
- Carter *et al.* (2022): 0.386 individuals per km^2 for the total Offshore Development Area.

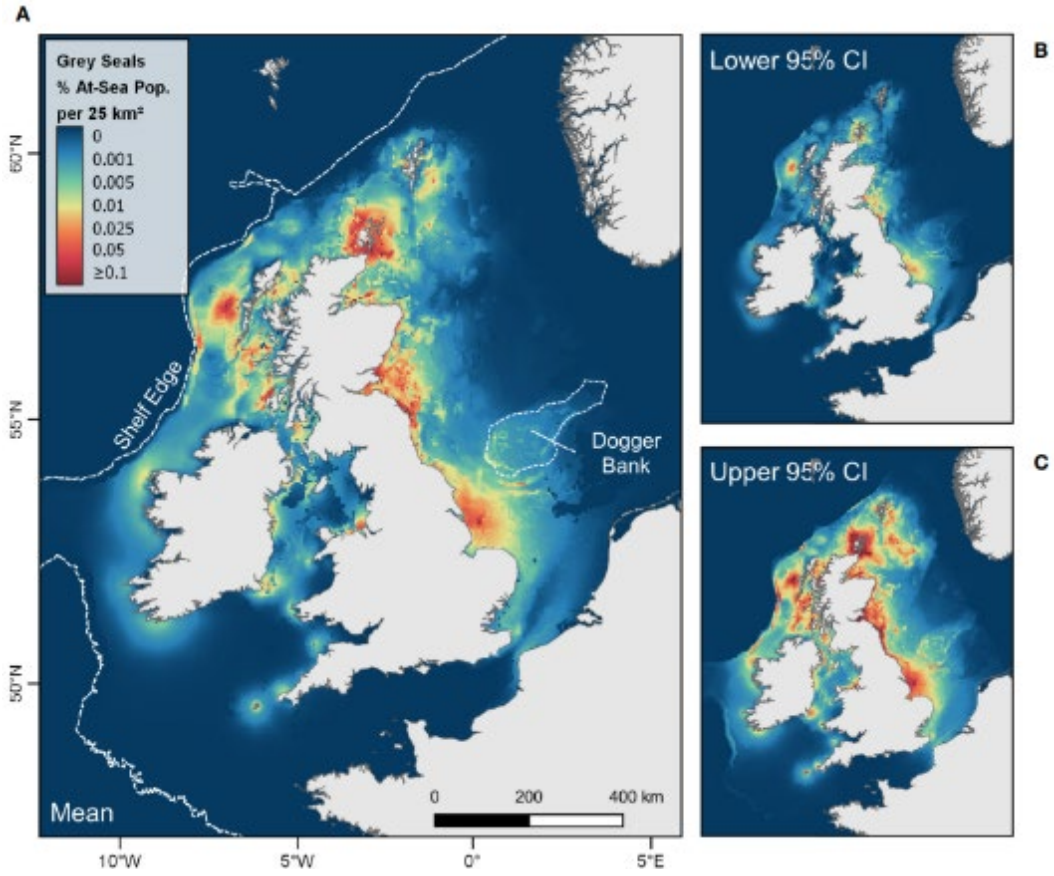


Plate 11-2-20 Relative Density of Grey Seals a) Mean With Associated Cell-wise b) Lower and c) Upper 95% Confidence Intervals of the Percentage of the at Sea Population (Excluding Hauled-out Seals) Estimated to be Present in Each 5km by 5km Grid Cell at Any One Time (Carter et al. 2022)

11.2.6.6.6 Grey Seal Population Counts

212. 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).

213. The most recent surveys of the principal grey seal breeding sites in Scotland, Wales, Northern Ireland and south-west England resulted in an estimate of 67,850 pups (95% CI = 50,250-85,400; SCOS, 2022). When the pup production estimates are converted to estimates of total population size, there was an estimated 162,000 grey seals in 2022 (approximate 95% CI = 146,700-178,500; SCOS, 2022).

214. Based on 2016 and 2019 pup production and projecting the model forward. This is an increase of approximately 1.6% per year between 2012 and 2019 (SCOS, 2022).

215. In the southern North Sea, the rates of increase in pup production from 2010 to 2014 by an average 22% per year suggests that there must be some immigration from colonies further north (SCOS, 2019). The colonies in the southern North Sea are still increasing in population size, but the rate has been much lower in the last three years, giving an early indication that they may be reaching carrying capacity (SCOS, 2019).

216. 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).

217. In accordance with the agreed approach for other offshore wind farms, and as agreed during the 2nd ETG meeting on the 21st February 2023, the reference population extent for grey seal would incorporate the south-east England and MU, north-east England MU (IAMMWG 2013; SCOS, 2020).

218. The reference population for grey seal is therefore currently based on the following most recent estimates for the:

- South-east England MU = 7,695 grey seal (SCOS, 2022); and
- North-east England MU = 6,517 grey seal (SCOS, 2022).

219. Assessments would be done in the context of the nearest MU as well as the wider reference population. As a worst case it is assumed that all seals are from the nearest MU, the south-east England MU, although the more realistic assessment is based on wider reference population which takes into account movement of seals.

220. The reference population for grey seal is therefore currently based on the most recent estimates as shown in **Table 11-2-27**.

Table 11-2-27 Grey Seal Count 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**

221. Having an understanding of these movements of seals in the Wadden Sea and their fluctuating dependency on the different areas is key to managing the populations and ensuring their long-term protection (Unger *et al.* 2022).

222. The total reference population for the assessment is 30,592 grey seal. Assessments are in the context of the nearest MU as well as the wider reference population (of 56,505). As a worst case it is assumed that all seals are from the nearest MU, the south-east England MU, although the more realistic assessment is based on wider reference population which takes into account movement of seals.

11.2.6.6.7 Diet and Foraging of Grey Seal

223. 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).

224. 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, 2019). 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).

225. Grey seals are generalist feeders, feeding on a wide variety of prey species (SCOS, 2021; Hammond and Grellier 2006). Diet varies seasonally and from region to region (SCOS, 2021).

226. In the North Sea, principal prey items are sandeel, whitefish (such as cod, haddock, whiting and ling *Molva molva*) and flatfish (plaice *Pleuronectes platessa*, sole, flounder, and dab *Limanda limanda* (Hammond and Grellier, 2006). Amongst these, sandeels are typically the predominant prey species.

227. Food requirements depend on the size of the seal and fat content (oiliness) of the prey, but an average consumption estimate of an adult is 4 to 7kg per seal per day depending on the prey species (SCOS, 2021).

11.2.6.7 Harbour seal

11.2.6.7.1 Desk-Based Review of Harbour Seal Presence

228. Harbour seals have a circumpolar distribution in the Northern Hemisphere and are divided into five sub-species. The population in European waters represents one subspecies *Phoca vitulina vitulina* (SCOS, 2022).

229. 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).

230. Approximately 32% of European harbour seals are found in the UK; this proportion has decreased from approximately 40% in 2002 due to the more rapid recovery and higher sustained rates of increase in the Wadden Sea population. Harbour seals are widespread around the west coast of Scotland and throughout the Hebrides and Northern Isles. On the east coast, their distribution is more restricted with concentrations in the major estuaries of the Thames, The Wash, the Firths of Forth and Tay, and the Moray Firth. Scotland holds approximately 85% of the UK harbour seal population, with 12% in England and 3% in Northern Ireland (SCOS, 2022).

231. 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 (**Plate 11-2-21**; Carter *et al.* 2022).

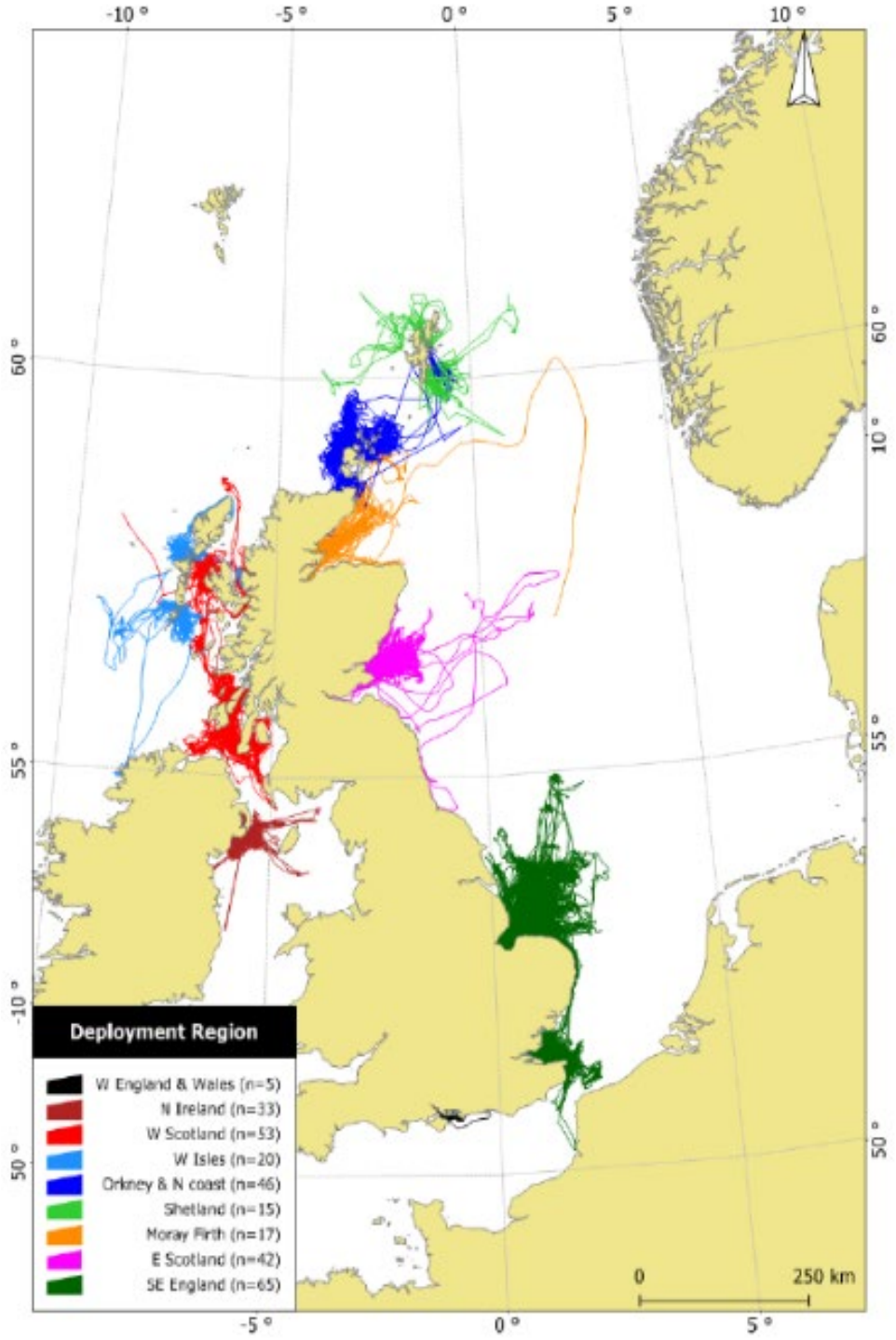


Plate 11-2-21 Telemetry Tracks by Deployment Region for Harbour Seals Aged One Year or Over (Russell and McConnell 2014).

232. Harbour seals generally make smaller foraging trips than grey seal, typically travelling 40-50km from their haul-out sites to foraging areas (SCOS, 2022). 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. Tagging studies undertaken on harbour seal at The Wash (2003-2005) have shown that this population travels larger distances for their foraging trips than for other harbour seal populations and repeatedly forage between 75km and 120km offshore (average was 80km), with one seal travelling 220km (Sharples *et al.* 2012). Foraging ranges vary substantially both regionally and within sites. Some harbour seals forage >100km from their nearest haulout sites while others remain very close inshore within only a few kilometres of haulout sites (SCOS, 2022), with a maximum foraging range of up to 273km (Carter *et al.* 2022).

233. Research has looked at harbour seal movements from the Wadden Sea and the connectivity into the North Sea. Tougaard *et al.* 2003 recorded three harbour seals undertaking long trips, travelling up to three weeks (**Plate 11-2-22**), therefore harbour seals in the Wadden Sea MU might travel to the DBS Array Areas.

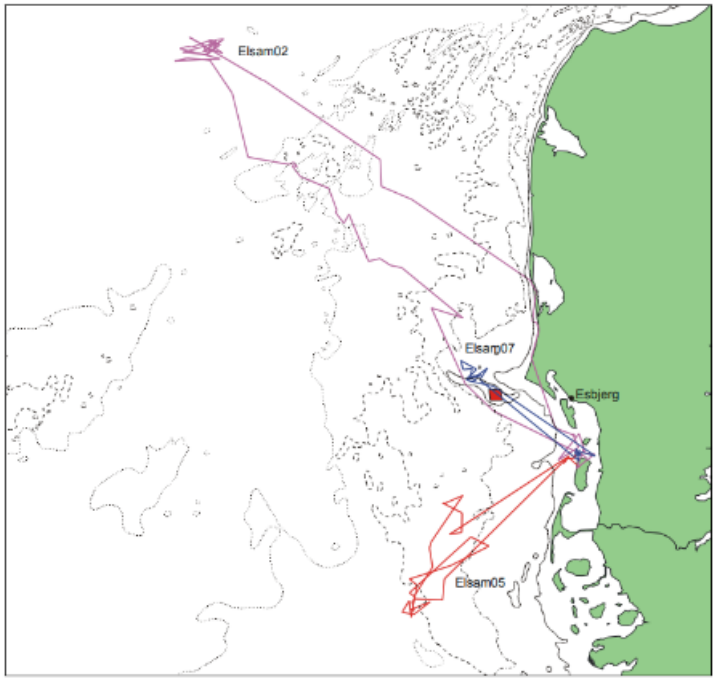


Plate 11-2-22 Selected Examples of Foraging Trips. Purple: Elsam02 On an 18-day Trip to the Deeper Parts of the North Sea.. Red: Elsam05 on a 15-day Trip to the German Bight. Blue: Elsam08 on a 10-day Trip to Horns Reef (Tougaard et al. 2003)

234. The most recent counts in the Wadden Sea area in the molt season in 2022 resulted in 23,654 harbour seals a 12% decrease since the count in 2021. In 2022, there was a total of 8,514 pups counted which is 22% lower than the count of 10,903 in 2021 which is the lowest count since 2011 (Galatius *et al.* 2022). Since 2012, the harbour seal population has been stable with an annual increase of 5% (Brasseur *et al.* 2018) until recent years. Having an understanding of these movements of seals in the North Sea and the Wadden Sea along with their fluctuating dependency on the different areas is key to managing the populations and ensuring their long-term protection (Unger *et al.* 2022).

235. Harbour seal come ashore in sheltered waters, typically on sandbanks and in estuaries, but also in rocky areas. Harbour seal regularly haul-out on land in a pattern that is often related to the tidal cycle (SCOS, 2022). Harbour seal give birth to their pups in June and July and pups can swim almost immediately after birth (SCOS, 2022). Harbour seals moult in August and spend a higher proportion of their time on land during the moult than at other times (SCOS, 2022).

236. Principal harbour seal haul-out sites are included in **Table 11-2-28**, which shows the approximate distance to the closest point of the Offshore development area, and the most recent harbour seal count for each location. These harbour seal haul-out sites are also shown in **Table 11-2-28**.

237. The Carter *et al.* (2022) density maps include updated tagging studies (**Plate 11-2-23**. These density maps only include tagging studies from the UK.

238. The harbour seal density estimates for the Projects Array Areas have been calculated from the seal at sea usage maps (Carter *et al.* 2022) based on the 5km by 5km grids that overlap with the Projects. The total harbour seal population in the British Isles, at sea, is approximately 42,900 individuals, based on the corrected values and most recent haul-out counts for the UK (SCOS, 2022). This is the population estimate used with the Carter *et al.* (2022) data to calculate density estimates for the Projects Array Areas.

11.2.6.7.2 Harbour Seal Haul-Out Sites

Table 11-2-28 The Most Recent Harbour Seal Count at Each of the Nearby Haul-out Sites, and the Distance to DBS

Haul-out site	Distance to DBS East and DBS West	Harbour seal count
Tees	93km from landfall* 116km Offshore Export Cable Corridor 189km from DBS East Array Area 161km from DBS West Array Area	86 (2021 harbour seal count; SCOS, 2022)
Ravenscar	52km from landfall 62km from Offshore Export Cable Corridor 140km from DBS East Array Area 150km from DBS West Array Area	Both Ravenscar and Filey Brigg are transient sites. <10 harbour seal (harbour seal count, Yorkshire seal org, 2023)
Filey Brigg	52km from landfall* 51km from Offshore Export Cable Corridor 145km from DBS East Array Area 120km from DBS West Array Area	
Donna Nook	28km from landfall* 27km from Offshore Export Cable Corridor 135km from DBS East Array Area 117km from DBS West Array Area	122 (2021 harbour seal count; SCOS, 2022)
The Wash	62km from landfall* 67km from Offshore Export Cable Corridor 150km from DBS East Array Area 143km from DBS West Array Area	2,667 (2021 harbour seal count; SCOS, 2022)
Blakeney Point NNR	108km from landfall* 126km from Offshore Export Cable Corridor 190km from DBS East Array Area 194km from DBS West Array Area	181 (mean 2021 harbour seal count; SCOS, 2022).

Haul-out site	Distance to DBS East and DBS West	Harbour seal count
Horsey	185km from landfall* 182km from Offshore Export Cable Corridor 202km from DBS East Array Area 183km from DBS West Array Area	12 (mean 2021 harbour seal count; SCOS, 2022).
Scroby Sands	198km from landfall* 201km from Offshore Export Cable Corridor 195km from DBS East Array Area 215km from DBS West Array Area	25 (mean 2021 harbour seal count; SCOS, 2022).

**Measured in a straight line from landfall site*

11.2.6.7.3 Results From the Site-Specific Surveys for Harbour Seals

239. During the site specific digital aerial surveys of both DBS AfL Areas and 4km buffers, undertaken from March 2021 to February 2022, no harbour seals were recorded. However, several sightings were recorded as unidentified seals, some of which could be attributed to harbour seals as well as grey seals (**Table 11-2-24**; **Table 11-2-25**).

11.2.6.7.4 Results From Surveys in the Dogger Bank Area

240. During the Dogger Bank Tranche C site specific video digital aerial surveys (12 surveys undertaken between January 2013 to December 2013), 12 harbour seals were recorded, with peak numbers recorded in January, and Spring.

241. Throughout the Dogger Bank Zone 3 site specific video digital aerial surveys (26 surveys undertaken between April 2010 to May 2012), six harbour seals were recorded. In addition, there were 218 unidentified seals recorded which possibly can be attributed to harbour seals, along with 210 unidentified small cetacean ort seal species. No species abundance or density estimates were undertaken.

242. During the ornithological Surveys for the Forewind Round 3 Dogger Bank Offshore Wind Farm (monthly surveys January 2010 to June 2012 (excluding February 2012)), there were 15 incidental sightings of harbour seals, with 15 individuals. There was also a further 18 sightings of unidentified seal species, with 16 individuals plus two dead seals, with which could be possibly attributed to harbour seals. No species abundance or density estimates were undertaken.

11.2.6.7.5 Site-Specific Density Estimates for Harbour Seal

243. Based on the DBS site specific surveys, no Harbour seal was recorded during the first year of surveys. However density estimates of unidentified seals/km^2 have been calculated from the raw data counts for unidentified seal species as there is a possibility that these can be harbour seal (**Table 11-2-24** and **Table 11-2-25** in Section 11.2.6.6.4). Unidentified seal had a maximum density of 0.06 seals/km^2 at DBS East in December 2021 and 0.09 seals/km^2 in June 2021 at DBS West.

11.2.6.7.6 Review of Abundance and Density Estimates for Harbour Seal

244. The relative seals at-sea density maps (Carter *et al.* 2022; **Plate 11-2-23** and **Figure 11-2-2**) have been used to calculate harbour seal density estimates for the Projects Array Areas.

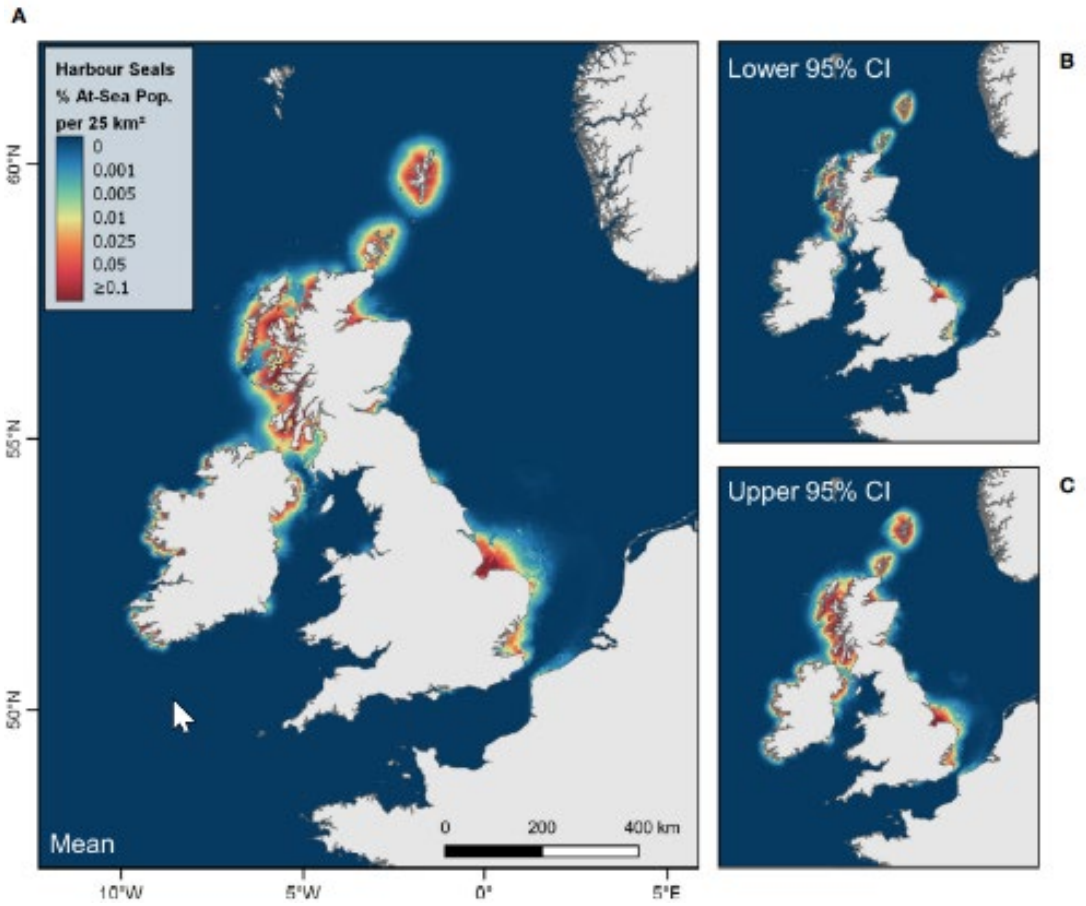


Plate 11-2-23 Relative Density of Harbour Seals a) Mean With Associated Cell-wise b) Lower and c) Upper 95% Confidence Intervals of the Percentage of the at Sea Population (Excluding Hauled-out Seals) Estimated to be Present in Each 5km by 5km Grid Cell at Any One Time.

245. For harbour seal, it has been estimated that at any one time, 83.4% of all harbour seals may be at-sea (Russell *et al.* 2015), and that 72% of all harbour seals would be hauled-out during the population counts (Lonergan *et al.* 2013); therefore, the total harbour seal population in the British Isles, at-sea, is approximately 48,419 individuals (SCOS, 2022).

246. The harbour seal density estimates for the Projects have been calculated from the latest seal at sea maps produced by SMRU (Carter *et al.* 2022), based on the grids that overlap with each area.

247. The following mean at sea density estimates have been used in the assessment:

- 0.0017 individuals per km^2 for the DBS East AfL Area;
- 0.0010 individuals per km^2 for the DBS West AfL Area;
- 0.0017 individuals per km^2 for the Offshore Export Cable Corridor; and
- 0.0015 individuals per km^2 for the total Offshore Development Area.

11.2.6.7.7 Harbour Seal Population Counts

248. 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 (2016-2021) gives a total of 30,800 counted in the UK. Scaling this by the estimated proportion hauled out (0.72 (95% CI = 0.54-0.88)) produces an estimated total population for the UK in 2021 of 42,900 harbour seal (approximate 95% CI = 35,100-57,100; SCOS 2022).

249. Recent trends in harbour seal populations (over the last two years) indicate that the harbour seal populations in the Wash are in decline. Since 2010, the numbers of harbour seal in the region had been stable. The combined counts for the Southeast England MU reached a maximum around 2015-2018, but the 2019 count (3,081) was 27.6% lower than the 2012 to 2018 mean count. Additional surveys in 2020 and 2021 confirmed the decrease (SCOS 2022).

250. In accordance with the agreed approach for other offshore wind farms, and as agreed during the 2nd ETG meeting on the 23rd February 2023, the reference population extent for harbour seal will incorporate the south-east England MU (IAMMWG 2013; SCOS 2022).

251. These have also been corrected to take account of the number of seals not available to count during the surveys. Approximately 0.72 harbour seals (Lonergan *et al.* 2013) are available to count within the August surveys (i.e. are hauled-out), and therefore this has been used as a correction factor, to derive total harbour seal numbers within the SE England MU.

252. The reference population for harbour seal is therefore currently based on the following most recent estimates as shown in **Table 11-2-29**.

Table 11-2-29 Harbour Seal Counts and Population Estimates in the SE England MU

Population area	Harbour seal haul-out count	Harbour seal haul-out count data	Correction factor for seals not available to count	Harbour seal total population
SE England MU	3,505	SCOS, 2022	0.72	4,868

253. The total reference population for the assessment is currently 4,868 for harbour seal. Assessments will be done in the context of the nearest MU which is the SE England MU.

11.2.6.7.8 Diet and Foraging of Harbour Seal

254. Harbour seal take a wide variety of prey including sandeels, gadoids, herring and sprat, flatfish, and cephalopods. Diet varies seasonally and regionally; prey diversity and diet quality also showed some regional and seasonal variation (SCOS, 2021). It is estimated harbour seals eat 3-5kg per adult seal per day depending on the prey species (SCOS, 2021).

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Figures

Figure 11-2-1 Grey Seal At-sea Distribution. Maps Show Mean Percentage of At-sea Population Estimated to be Present in Each 5km x 5 km Grid Square at Any One Time, and the Square-wise (Carter et al. 2022)

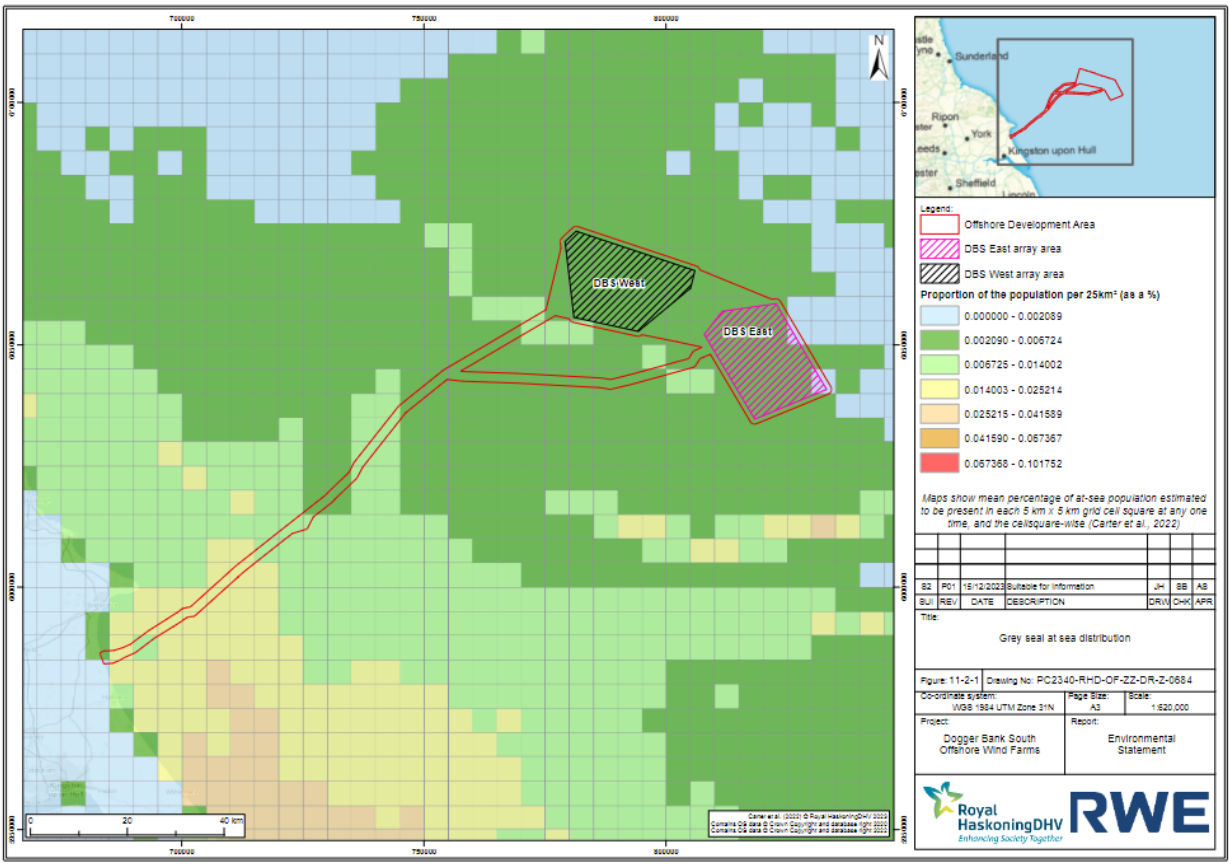
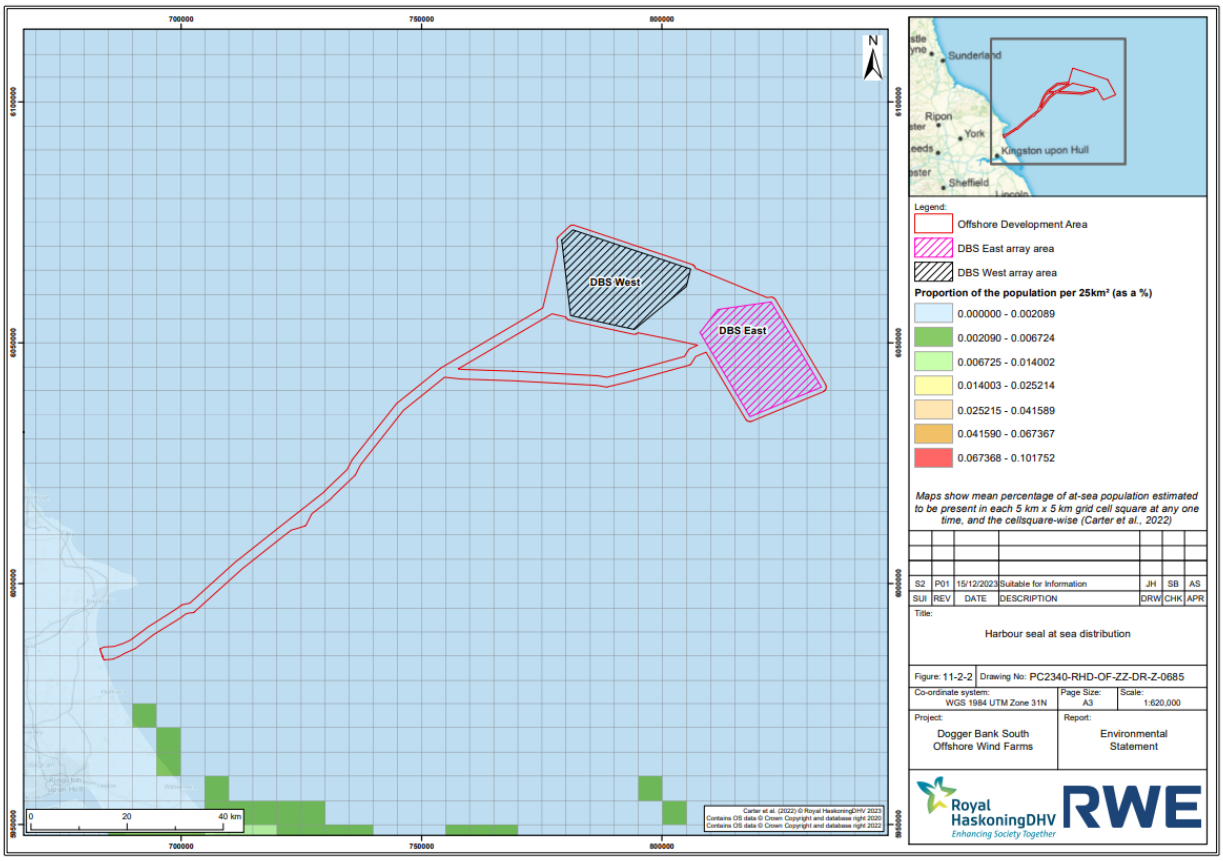


Figure 11-2-2 Harbour Seal at Sea Distribution. Maps Show Mean Percentage of At-sea Population Estimated to be Present in Each 5km x 5km Grid Square at Any One Time, and the Square-wise (Carter et al. 2022)



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