Sheringham Shoal and Dudgeon Offshore Wind Farm Extension Projects

Environmental Statement

Volume 3

Appendix 10.1 - Marine Mammal Consultation Responses, Information and Survey Data

August 2022
Document Reference: 6.3.10.1
APFP Regulation: 5(2)(a)

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Title**:**		
Sheringham Shoal and Dudgeon Offshore Wind Farm Extensions **Environmental Statement** **Appendix 10.1 Marine Mammal Consultation Responses, Information and Survey Data**		
PINS no.: 6.3.10.1		
Document no.: C282-RH-Z-GA-00070		
Date:	Classification	
August 2022	**Final**	
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Approved by:		Date:
Sarah Chandler, Equinor		**August 2022**

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Glossary of Acronyms

ASCOBANS	Agreement on the Conservation of Small Cetaceans of the Baltic and North Seas
CBD	Convention on Biological Diversity
CCW	Countryside Council for Wales
Cefas	Centre for Environment, Fisheries and Aquaculture Science
CES	Coastal East Scotland
CITES	Convention on International Trade in Endangered Species
CI	Confidence intervals
CIS	Celtic and Irish Sea
cm	Centimetre
CRoW	The Countryside and Rights of Way Act
CV	Coefficient of variation
DCO	Development Consent Order
DECC	Department for Energy and Climate Change
DEP	Dudgeon Extension Project
DOW	Dudgeon Offshore Wind Farm
EC	European Commission
EEZ	Exclusive economic zone
EIA	Environmental Impact Assessment
EPS	European Protected Species
ETG	Expert Topic Group
EU	European Union
FCS	Favourable Conservation Status
IAMMWG	Inter-Agency Marine Mammal Working Group
IWC	International Whaling Commission
JCP	Joint Cetacean Protocol
JNCC	Joint Nature Conservation Committee
KDE	kernel density estimation

kg	Kilogram
km	Kilometre
km^2	Square kilometre
m	meter
MMMP	Marine Mammal Mitigation Plan
MMO	Marine Management Organisation
MPS	Marine Policy Statement
MSFD	Marine Strategy Framework Directive
MU	Management Unit
MW	Megawatts
NE	Natural England
nm	Nautical mile
NNR	National Nature Reserve
NS	North Sea
OWF	Offshore Wind Farm
PEIR	Preliminary Environmental Information Report
SCANS	Small Cetaceans in European Atlantic waters and the North Sea
SCOS	Special Committee on Seals
SEP	Sheringham Extension Project
SMRU	Sea Mammal Research Unit
SNS	Southern North Sea
TSEG	Trilateral Seal Expert Group
TWT	The Wildlife Trust
UK	United Kingdom
UXO	Unexploded Ordnance
WDC	Whale and Dolphin Conservation
WS	West Scotland
WWT	Wildfowl and Wetlands Trust

Glossary of Terms

Applicant	Equinor New Energy Limited
Dudgeon Offshore Wind Farm Extension site	The Dudgeon Offshore Wind Farm Extension offshore wind farm boundary.
Dudgeon Offshore Wind Farm Extension Project (DEP)	The Dudgeon Offshore Wind Farm Extension site as well as all onshore and offshore infrastructure.
Designated 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.
DEP North array area	The wind farm array area of the Dudgeon Offshore Wind Farm Extension site located to the north of the existing Dudgeon Offshore Wind Farm
DEP South array area	The wind farm array area of the Dudgeon Offshore Wind Farm Extension site located to the south of the existing Dudgeon Offshore Wind Farm
Evidence Plan Process (EPP)	A voluntary consultation process with specialist stakeholders to agree the approach, and information to support, the EIA and HRA for certain topics.
Expert Topic Group (ETG)	A forum for targeted engagement with regulators and interested stakeholders through the EPP.
Horizontal directional drilling (HDD) zones	The areas within the onshore cable route which would house HDD entry or exit points.
Infield cables	Cables which link the wind turbine generators to the offshore substation platforms.
Interlink cables	Cables linking two separate project areas. This can be cables linking: 1) DEP South array area and DEP North array area

	2) DEP South array area and SEP 3) DEP North array area and SEP 1 is relevant if DEP is constructed in isolation or first in a phased development. 2 and 3 are relevant where both SEP and DEP are built.
Landfall	The point at the coastline at which the offshore export cables are brought onshore, connecting to the onshore cables at the transition joint bay above mean high water
Offshore export cables	The cables which would bring electricity from the offshore substation platform(s) to the landfall. 220 – 230kV.
Offshore scoping area	An area that encompasses all planned offshore infrastructure, including landfall options at both Weybourne and Bacton, and allows sufficient room for receptor identification and environmental surveys. This will be refined following further site selection and consultation.
Offshore substation platform	A fixed structure located within the wind farm area, containing electrical equipment to aggregate the power from the wind turbine generators and convert it into a more suitable form for export to shore.
Study area	Area where potential impacts from the project could occur, as defined for each individual EIA topic.
Sheringham Shoal Offshore Wind Farm Extension site	Sheringham Shoal Offshore Wind Farm Extension offshore wind farm boundary.
Sheringham Offshore Wind Farm Extension Project (SEP)	The Sheringham Offshore Wind Farm Extension site as well as all onshore and offshore infrastructure.

10.1 MARINE MAMMAL CONSULTATION RESPONSES, INFORMATION AND SURVEY DATA

10.1.1 Introduction

1. This appendix provides a summary of the consultation responses, legislation and policy relevant to marine mammals in addition to further supporting marine mammal information and survey data for **Chapter 10 Marine Mammal Ecology**.

10.1.2 Consultation Responses

2. Consultation with regard to marine mammals has been undertaken in line with the general process described in **Chapter 5 EIA Methodology** and the **Consultation Report** (document reference 5.1). The key elements to date have included scoping, the ongoing Evidence Plan Process (EPP) via the Marine Mammal Expert Topic Group (ETG) and the Preliminary Environmental Information Report (PEIR).
3. Stakeholders represented on the Marine Mammal ETG are Natural England, the Marine Management Organisation (MMO), the Centre for Environment, Fisheries and Aquaculture Science (Cefas), and The Wildlife Trust (TWT). At their request, Whale and Dolphin Conservation (WDC) are not directly involved in the ETG, to date, but are informed on the SEP and DEP development.
4. The feedback received throughout this process has been considered in preparing the ES. This chapter has been updated following the consultation on the PEIR in order to produce the final assessment that will be submitted with the Development Consent Order (DCO) application.
5. The consultation process is described further in **Chapter 5 EIA Methodology**. Full detail of the consultation process is presented in the **Consultation Report** (document reference 5.1), which has been submitted as part of the DCO application.

10.1.2.1 Scoping, Method Statement and ETG Consultation Responses

Table 10.1.1: Scoping, Method Statement and Expert Topic Group Consultation Responses

Consultee	Date/ Document	Comment	Project Response
Scoping Responses			
Planning Inspectorate (PINS)	Scoping Opinion, November 2019	Barrier effects from underwater noise – operation: The Scoping Report proposes to assess barrier effects from construction and decommissioning activities only. No justification has been provided for excluding an assessment in the operational stage and paragraph 741 acknowledges the potential for disturbance from underwater noises during operation and maintenance. In the absence of a suitable justification, the Inspectorate does not agree to scope out barrier effects from underwater noise during operation.	Any potential barrier effects from underwater noise during the construction, operation and maintenance has been assessed in **Sections 10.6.1.5** and **10.6.2.4** of the ES chapter.
PINS	Scoping Opinion, November 2019	Barrier effects from physical presence of wind farm during construction, operation and decommissioning: The Scoping Report states that the SEP and DEP are not located on any known marine mammal migration routes and that data from operational wind farms show no evidence of exclusion of marine mammals. The Inspectorate agrees that barrier effects from the physical presence of the wind farm are unlikely to be significant and can therefore be scoped out of the Environmental Statement (ES).	Barrier effects from the physical presence of the wind farm have not been assessed.
PINS	Scoping Opinion, November 2019	Electromagnetic Fields (EMF) direct effects during construction, operation and decommissioning: The Inspectorate agrees that given the referenced literature in the Scoping Report, significant effects on marine mammals due to direct effects of EMF are unlikely. The Inspectorate is also content that indirect effects from changes to prey availability resulting from EMF during operation	Direct effects from EMF have not been assessed. However, the potential indirect effects from any changes in prey availability have been assessed in **Section 10.6.1.8** and **10.6.2.7** of the ES chapter.

Consultee	Date/ Document	Comment	Project Response
		will be assessed, therefore, the Inspectorate agrees that direct effects from EMF can be scoped out of the ES.	
PINS	Scoping Opinion, November 2019	Underwater noise during unexploded ordnance (UXO) clearance and piling – operation and decommissioning: The Inspectorate agrees that these matters are only relevant to the construction phase with no significant effects anticipated during operation and decommissioning and therefore can be scoped out of the assessment for operation and decommissioning.	Underwater noise from UXO clearance and piling during operation and decommissioning have not been assessed. However, the potential impacts of UXO clearance during construction have been addressed in **Appendix 10.4**.
PINS	Scoping Opinion, November 2019	Underwater noise from wind turbines – operation: The Inspectorate agrees that this matter is only relevant to the operational phase with no significant effects anticipated during operation and decommissioning and therefore can be scoped out of the assessment for construction and decommissioning.	The potential impacts of underwater noise from operational turbines have been assessed in **Section 10.6.2.1** of the ES chapter.
PINS	Scoping Opinion, November 2019	Cumulative barrier effects during construction, operation and decommissioning: The Scoping Report does not scope out barrier effects during operation from the Project alone. Therefore, the Inspectorate considers that likely significant cumulative effects may also occur and should be assessed in the ES.	The cumulative impact assessment has considered the potential for cumulative effects from underwater noise, including barrier effects in **Section 10.7.1** of the ES chapter.
PINS	Scoping Opinion, November 2019	Cumulative assessment – commercial fisheries: The Scoping Report states that the impact from commercial fisheries will not be addressed directly in the cumulative assessment as these are ongoing activities that are factored into the baseline conditions. The Inspectorate is content that the assessment of cumulative impacts from commercial fisheries will be informed with reference to ongoing activities in the baseline conditions. The Applicant is advised to have regard to the advice contained in the Inspectorate' Advice Note Seventeen when preparing their assessment of cumulative impacts.	**Appendix 10.3** outlines the justification for plans, projects and activities not included in the cumulative impact assessment, including commercial fisheries. **Section 10.4.4** of the ES includes consideration of the Planning Inspectorate Advice Note Seventeen.

Consultee	Date/ Document	Comment	Project Response
PINS	Scoping Opinion, November 2019	Existing environment: The ES should provide details of likely feeding areas; known birthing areas/haul out sites; nursery grounds; and known migration or commuting routes.	Information on the baseline environment for marine mammals is outlined in **Section 10.5** of the ES chapter and **Section 10.1.4**. This includes (where possible) details of likely feeding areas; known birthing areas/haul out sites; nursery grounds; and known migration or commuting routes.
PINS	Scoping Opinion, November 2019	Potential area of effects: Paragraph 325 of the Scoping Report states that all of the potential impacts screened in for further assessment will be related to the potential area of effect. The ES should clearly explain and justify the potential area of effect.	The ES includes an explanation of the potential area of effect under each impact assessment, and clearly explains and justifies the potential area of effect used in the assessments.
PINS	Scoping Opinion, November 2019	Reference populations: The Applicant should make efforts to agree with Natural England the relevant reference populations to be used in the assessment.	The reference populations, as outlined for each species in **Section 10.5** and summarised in **Section 10.5.7** of the ES chapter are based on the latest data and information available, and agreed with Natural England and the ETG as part of the EPP.
PINS	Scoping Opinion, November 2019	Impacts from underwater noise: The Scoping Report identifies a number of potential impacts from underwater noise on marine mammals, including physical injury, death, permanent/temporary auditory injury, disturbance and behavioural effects and barrier effects. The Scoping Report provides limited detail regarding the extent to which these impacts are anticipated to affect the marine mammals. The assessment should explain and assess the consequences of the indirect effects that would result from these impacts, for example the inability to forage.	**Sections 10.6.1.1 - 10.6.1.5** and **10.6.2.1 - 10.6.2.4** of the ES chapter assess the potential impacts of underwater noise. These assessments take into account the potential direct and indirect effects that could result from these impacts, such as the inability to forage.

Consultee	Date/ Document	Comment	Project Response
PINS	Scoping Opinion, November 2019	Underwater noise from UXO clearance: Paragraph 138 of the Scoping Report explains that consent for UXO removal will be sought in a future Marine Licence application, when geophysical survey data of suitable spatial resolution is available to identify and quantify UXO risk. The Inspectorate welcomes that despite this, the Scoping Report proposes to assess the potential impacts of underwater noise that could result from UXO clearance.	Consent for UXO removal will be sought in a future Marine Licence application, once further detail on potential risk of UXO is available. However, an initial assessment on the potential impacts of underwater noise from any UXO clearance has been included in **Appendix 10.4**.
PINS	Scoping Opinion, November 2019	Water quality: Where significant effects are likely to occur, the ES should assess the extent to which changes in water quality, including increases in suspended sediment, may affect foraging for relevant marine mammal species.	The potential impact of any changes to water quality on marine mammals' ability to forage during construction, operation and maintenance is assessed in **Sections 10.6.1.9** and **10.6.2.8** of the ES chapter.
PINS	Scoping Opinion, November 2019	Species density estimates: The methodology used to determine species density estimates should be clearly explained within the ES.	The methodology to derive species density estimates is provided in **10.1.4.3**. These have been based on the latest data and information available, as well as the aerial survey where possible, and have been agreed with Natural England and the ETG as part of the EPP.
PINS	Scoping Opinion, November 2019	Guidance: The Applicant should ensure that guidance relied upon in the assessment is sufficiently up to date and robust for its purpose. The Inspectorate is aware that the Chartered Institute of Ecology and Environmental Management (CIEEM): Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater and Coastal were updated in 2019. The ES should describe the guidance used and (where necessary) explain how it differs from more up to date guidance. This comment also applies to the Ecology and Ornithology aspect chapter.	**Section 10.4.1** of the ES chapter takes into account the relevant and latest guidance, policy and legislation.

Consultee	Date/ Document	Comment	Project Response
PINS	Scoping Opinion, November 2019	European Protected Species (EPS) licences: The ES should set out in full the potential risk to EPS and confirm if any EPS licences will be required for example, for harbour porpoises and grey seals.	**Section 10.4.1.5** of the ES chapter outlines the approach to determining the requirement for a marine wildlife licence for cetacean species.
Natural England	Scoping Opinion, November 2019	Natural England is satisfied with the species to be included in the marine mammal assessment, namely harbour porpoise, minke whale, white-beaked dolphin, grey seal and harbour seal.	The baseline environment for harbour porpoise, minke whale, white-beaked dolphin, grey seal and harbour seal is outlined in **Section 10.5** of the ES chapter with additional information provided in **Section 10.1.4**. Note that in addition, bottlenose dolphin have been included in the assessments, due to the very recent increase in presence of the species in the nearby area (see **Section 10.5.2** of the ES chapter).
Natural England	Scoping Opinion, November 2019	Natural England is content with the potential impacts to be included in the assessment and that direct impacts to marine mammals from EMF may be scoped out.	**Sections 10.6** and **10.7** of the ES chapter provide assessments of the potential impacts for marine mammals.
Natural England	Scoping Opinion, November 2019	Paragraph states digital aerial surveys for offshore ornithology and marine megafauna began in May 2018, but Table 2-16 says these surveys began in May 2019. Please can clarification be provided as to which date is correct.	As outlined in **Section 10.4.2.1** of the ES chapter, the monthly aerial surveys have been undertaken since May 2018 and were completed in April 2020, with 24 months of data collected for the SEP and DEP sites.
Natural England	Scoping Opinion, November 2019	Consideration should also be given within the ES to the possible requirement for a European Protected Species licence.	**Section 10.4.1.5** of the ES chapter outlines the approach to determining the requirement for a marine wildlife licence for cetacean species.

Consultee	Date/ Document	Comment	Project Response
Natural England	Scoping Opinion, November 2019	Natural England queries why floating turbines are not being considered as an alternative foundation option?	Due to the location, site conditions and water depth, floating turbines are not a suitable option for SEP and DEP.
Marine Management Organisation (MMO)	Scoping Opinion, November 2019	Recommendation: The use of soft start procedures on commencement of piling. The MMO's technical advisers Cefas recommend a 20-minute soft-start in accordance with the Joint Nature Conservation Committee (JNCC) protocol for minimising the risk of injury to marine mammals and other fauna from piling noise (JNCC, 2010b). Should piling cease for a period greater than 10 minutes, then the soft-start procedure must be repeated.	**Sections 10.3.4** of the ES chapter outlines the approach to developing a Marine Mammal Mitigation Protocol (MMMP) for piling. In addition, a **Draft MMMP** (document reference 9.4) has been submitted with the DCO application.
MMO	Scoping Opinion, November 2019	Recommendation: The use of air bubble curtains to reduce or mitigate the impacts of noise and vibration from piling.	**Section 10.3.4** of the ES chapter outlines the approach to developing a MMMP for piling. In addition, a **Draft MMMP** (document reference 9.4) has been submitted with the DCO application.
Method Statement			
MMO	Marine Mammal Method Statement comments, letter by email, 7th August 2020	The MMO understand that the mitigation measures will be finalised once an assessment of the potential impacts has been undertaken. Section 1.6 of the method statement outlines the embedded mitigation that will be incorporated into the design of the development to prevent or reduce any significant adverse effects. These measures will include soft start/ramp up of piling activity, and a mitigation zone, and are the standard measures that are typically seen for such developments. The method statement further states that if further mitigation is required and possible, these will be reviewed in the relevant impact sections of the PEIR and ES.	**Section 10.3.4** of the ES chapter outlines the approach to developing a MMMP for piling. In addition, a **Draft MMMP** (document reference 9.4) has been submitted with the DCO application. Further modelling (see **Appendix 10.2**) was undertaken following consultation on the PEIR. This has been included in the assessments in **Section 10.6** of the ES chapter.

Consultee	Date/ Document	Comment	Project Response
MMO	Marine Mammal Method Statement comments, letter by email, 7th August 2020	The MMO recommend the use of noise abatement technologies (i.e. bubble curtains) to reduce the risk of potential impact on marine receptors. Ideally, the MMO recommend that noise modelling is undertaken to assess the reduction in PTS/TTS zones that applying noise abatement measures will bring. Further steps on this are provided in Faulkner *et al*. (2018), and, on noise abatement, in Merchant (2019) and the report of the recent workshop at the Royal Society (Merchant and Robinson, 2020).	**Section 10.3.4** of the ES chapter outlines the approach to developing a MMMP for piling. Further underwater noise modelling was undertaken following consultation on the PEIR to include any mitigation / noise abatement measures required to reduce noise levels to reduce any potential significant impacts. This has been included in the assessments in **Section 10.6** of the ES chapter.
MMO	Marine Mammal Method Statement comments, letter by email, 7th August 2020	If more than one pile (monopile or pin pile) is anticipated to be installed within 24 hours, then the assessment (pile driving sequence) should account for this.	**Section 10.6.1.1.2.1** of the ES chapter outlines the methodology of the underwater noise modelling for piling, including the assumptions made with regard to cumulative piling in a 24 hour period. Further underwater noise modelling (see **Appendix 10.2**) was undertaken following consultation on the PEIR to account for potentially more than one pile being installed within a 24 hour period. This has been included in the assessments in **Section 10.6.1** of the ES chapter.
Marine Mammal ETG Meetings			
Natural England	Expert Topic Group (ETG) Meeting 1: 3rd	Results of the aerial surveys should be used when calculating seal density if possible, in addition to published Sea Mammal Research Unit (SMRU) data, and the highest density should be used in the assessment.	The methodology used to derive species density estimates is included within **Section 10.1.4.3**. These have been based on the latest data and information available, as well

Consultee	Date/ Document	Comment	Project Response
	December 2019		as the aerial survey where possible, and have been agreed with Natural England and the ETG as part of the EPP.
Natural England	ETG Meeting 1: 3rd December 2019	There will be an update to the Management Unit (MU) reference populations, but the date of the update is unknown.	The updated information on the MU reference populations has been included in the ES.
Natural England	ETG Meeting 1: 3rd December 2019	Natural England request the use of NOAA (National Oceanic and Atmospheric Administration) thresholds because they are familiar and comparable to other recent assessment.	**Section 10.6.1.1.2.1** of the ES chapter outlines that the Southall *et al.* (2019) use the same thresholds as NOAA, the only difference is names of some of the species hearing groups have been changed.
The Wildlife Trust (TWT)	ETG Meeting 1: 3rd December 2019	TWT suggest that UXO surveys as undertaken previously for nearby project infrastructure could be useful.	The number of UXO can vary considerably over a small distance, but the available data sources including the number of UXO identified at nearby wind farms on other project infrastructure have been used to inform the assessment, as outlined in **Appendix 10.4**.
Natural England	ETG Meeting 2: 18th June 2020	Lucke *et al*. (2009) was incorporated in Southall *et al*. (2019) for Permanent Threshold Shift (PTS) and Temporary Threshold Shift (TTS) and therefore does not have to be considered separately. Lucke *et al*. (2009) can still be used for behavioural response in harbour porpoise.	The potential for behavioural response of harbour porpoise to piling, based on the Lucke *et al*. (2009) thresholds, is assessed in **Section 10.6.1.2.2.4** of the ES chapter**.**
Natural England	ETG Meeting 2: 18th June 2020	UXO clearance at other sites should be included in the in-combination assessment.	**Section 10.7.1.2.1** of the ES chapter provides an assessment for the potential for cumulative impacts as a result of UXO clearance at other projects. The **Report to**

Consultee	Date/ Document	Comment	Project Response
			Inform Appropriate Assessment (RIAA) (document reference 5.4) provides an in-combination assessment of UXO activities at other offshore wind farms.
Natural England, MMO	ETG Meeting 3: 20th July 2021	UXO clearance will be managed through a separate Marine Licence application post consent and is not part of DCO submission. However, assessments based on potential worst-case for UXO will be provided for information in the ES, Information for the HRA report, and draft MMMP for UXO.	As agreed, UXO clearance is not part of the DCO application however assessments have been provided for information (see **Appendix 10.4**).
Natural England	ETG Meeting 3: 20th July 2021	Further underwater noise modelling for maximum UXO to include: • High-order detonation, including donor charge, without bubble curtain • High-order detonation, including donor charge, with bubble curtain • Low-order detonation, such as deflagration • Low-yield detonation, such as Hydra method • Low-yield detonation, such as Hydra method, with bubble curtain	**Appendix 10.2** includes underwater noise modelling for the various UXO detonation techniques which are incorporated into the assessment in **Section 10.6** of the ES chapter.
	ETG Meeting 3: 20th July 2021	Presentation outlined the proposed options that were being considered for further underwater noise (UWN) modelling. It was agreed that ETG would indicate within this agreement log if any additional information should be included in the further UWN modelling. Natural England response: Natural England advises that there were also two clarifications on the underwater noise modelling provided in our statutory response:	Continuous sources: Further underwater noise modelling has been undertaken for these activities over a 24 hour period and updated in the ES chapter and **Appendix 10.2**. Operational turbine noise: Section 6.2 in **Appendix 10.2** has been updated to include information from Tougaard *et al.* (2020) which investigated underwater noise data

Consultee	Date/ Document	Comment	Project Response
		• Modelling continuous sources for 12 hours only in a 24 hour period; • Modelling of operational turbine noise sounds. • Natural England requests a response on how these are going to be considered before agreeing to this point.	from 17 operational wind turbines in Europe and the United Sates. Although the datasets were acquired under different conditions, the authors devised a formula based on the published data for the operational wind farms, allowing a broadband noise level to be estimated based on the application of wind speed, turbine size (by nominal power output) and distance from the turbine.

10.1.2.2 Section 42 Consultation Responses

Table 10.1.2: Natural England Section 42 Comments Received 10th June 2021 – Summary of Main Points

Reference	NE Comment	Response
Summary of Main Points		
Impacts to Marine Mammals	Natural England's primary concern in relation to the assessment at this stage is in relation to the assessment of UXO and defining the WCS. We note that UXO charge weights up to 525kg have been presented. However, other offshore wind farms in the area (namely Dudgeon and Hornsea Project Two) have cleared UXOs with net explosive quantities up to 907kg (as mentioned in the Draft Information for Habitats Regulations Assessment for DEP and SEP, paragraph 378). Without evidence to confirm that UXO size within the DEP and SEP sites will not exceed 525kg, we request that the noise emissions of a 907kg UXO is also modelled, to ensure any mitigation measures are suitably precautionary and cover the worst-case scenario.	As clarified at the Expert Topic Group (ETG) 3 meeting on the 20th July 2021, UXO sizes were converted from lb to kg for consistency, however, this is not the same as the Net Explosive Quantity (NEQ) or TNT equivalent charge weights. As shown in **Table 10.4.8** of **Appendix 10.4**, a 525kg NEQ is equivalent to a 1,000lb (907.2kg) air-delivered bomb so the worst case scenario has been assessed. This has been clarified in **Appendix 10.4**. As discussed at the ETG3 and agreed by Natural England in the Agreement Log dated 20/07/2021, further underwater noise modelling for maximum UXO includes: • High-order detonation, including donor charge, without bubble curtain

Reference	NE Comment	Response
		• High-order detonation, including donor charge, with bubble curtain • Low-order detonation, such as deflagration The further UXO underwater noise modelling has been included in the assessments in **Appendix 10.4** and has been incorporated as appropriate into the **Draft MMMP** (document reference 9.4).
	As noted above, Natural England consider that given the adjacent Race Bank offshore windfarm encountered numerous UXO, for DEP and SEP, this should be dealt with through the Application process and not by a separate marine licence.	As discussed at the ETG3 meeting on the 20th July 2021 and agreed by Natural England in the Agreement Log dated 20/07/2021: UXO clearance will be applied for within a separate Marine Licence application post consent and is not part of the DCO submission. However, assessments based on potential worst-case for UXO have been provided for information in the ES, **RIAA** (document reference 5.4) and **Draft MMMP** (document reference 9.4). Although it should be noted that these are indicative only. The marine licence assessments post-consent will be based on the worst case number of UXO devices as identified through pre-construction magnetometer surveys. It is important to note that the final MMMP for UXO will be agreed prior to UXO clearance based on the latest information, modelling, guidance and requirements at that time.
NE position on WCS	Natural England consider most of the WCS is acceptable. However: The maximum UXO size should be increased based on data from nearby wind farms, from 525kg to 907kg.	As outlined above, UXO sizes were converted from lb to kg for consistency, however, this is not the same as the NEQ or TNT equivalent charge weights. As shown in **Table 10.4.8** of **Appendix 10.4** of the ES chapter, a 525kg NEQ is equivalent to a 1,000lb (907.2kg) air-delivered bomb so the worst case scenario has been assessed. This has been clarified in **Appendix 10.4** of the ES chapter.

Reference	NE Comment	Response
	There is a small discrepancy between the maximum pin pile diameter in the WCS, and that which has been modelled.	Further underwater noise modelling has been undertaken for 4m diameter pin-piles. This has been included in the assessments in **Section 10.6.1.1.**
Data gaps	Natural England consider the project-specific data is acceptable. However, in terms of the published literature, the following needs to be updated: Use of Carter et al. (2020) instead of Russell et al. (2017) for seal at sea density. There has been a recent (2019/20) decline in the harbour seal population of The Wash and North Norfolk Coast SAC that has not been captured in the baseline. There is no underwater noise baseline, despite this being a requirement of the NPS.	All data sources and information has been reviewed and updated for the ES. As discussed at the ETG3 meeting 20 July 2021, Carter *et al*. (2020) provides a relative index of seal density at sea, rather than absolute seal densities provided by Russell *et al*. (2017). Having assessed the data, the seal density estimates used in Russell *et al*. (2017) have been used in the ES assessments and information from Carter *et al*. (2020) included for context. The latest harbour seal counts in Special Committee on Seal (SCOS) (2020) have been used in the updated assessments. Information on baseline underwater noise has been included in **Appendix 10.2**.
Data analysis	Data analysis is fine overall. Minor points only to address. See detailed comments in Table 6.2 below	All points have been reviewed and amended or updated.
Underwater noise modelling	The modelling used is acceptable. There are some scenarios where the WCS has not been modelled, this needs to be updated. There are some references which we have requested they review and incorporate to the modelling as needed.	As above, further underwater noise modelling has been undertaken for 4m diameter pin-piles. This has been included in the assessments in **Section 10.6.1.1**. Additionally, the underwater noise modelling report in **Appendix 10.2** has been updated to address these comments.

Reference	NE Comment	Response
Use of qualitative and quantitative assessments	The Applicant has used quantitative assessment where needed e.g. EDRs and thresholds for disturbance. The Applicant has attempted to quantify some impacts that we would usually just expect to be assessed qualitatively. In these cases, we request for more context on the quantitative assessment provided.	Further clarification and justification has been provided in **Section 10.6** of the ES.
UXO impacts	An assessment of impacts from UXOs has been presented, although this is for information. The Applicant has stated a marine licence to cover UXO activities will be applied for separately to the DCO	As discussed at the ETG3 meeting on the 20th July 2021 and agreed by Natural England in the Agreement Log dated 20/07/2021: UXO clearance will be applied for within a separate Marine Licence application post consent and is not part of the DCO submission. However, assessments based on potential worst-case for UXO have been provided for information in the ES, **RIAA** (document reference 5.4) and **Draft MMMP** (document reference 9.4). Although it should be noted that these are indicative only. The marine licence assessments post-consent will be based on the worst case number of UXO devices as identified through pre-construction magnetometer surveys. It is important to note that the final MMMP for UXO will be agreed prior to UXO clearance based on the latest information, modelling, guidance and requirements at that time.
	We note that UXO charge weights up to 525 kg have been presented. However, other offshore wind farms in the area (namely Dudgeon and Hornsea Project Two) have cleared UXOs with net explosive quantities up to 907 kg (as mentioned in the Draft Information for Habitats Regulations Assessment for DEP and SEP, paragraph 378). Without evidence to confirm that UXO size within the DEP and SEP sites will not exceed 525	As outlined above, UXO sizes were converted from lb to kg for consistency, however, this is not the same as the NEQ or TNT equivalent charge weights. As shown in Table 10.4.8 of **Appendix 10.4** of the ES chapter, a 525kg NEQ is equivalent to a 1,000lb (907.2kg) air-delivered bomb so the worst case scenario has been assessed. This has been clarified in **Appendix 10.4** of the ES chapter.

Reference	NE Comment	Response
	kg, we request that the noise emissions of a 907 kg UXO is also modelled, to ensure any mitigation measures are suitably precautionary and cover the worst-case scenario. Furthermore, it is not clear if the Applicant has included the likely size of donor charge required for the UXO clearance.	
Assessment of the impacts from the project alone	There are some assessments that need revising: Assessment of vessel traffic per day in relation to harbour porpoise disturbance thresholds Update O&M vessel movements assessment as port is known.	The assessment of vessel traffic has been reviewed and updated in **Section 10.6.2.3** of the ES.
Cumulative Effect Assessment (CEA)	Natural England have identified some plans and projects that have been omitted, or changes to their status/tiers that need to be updated. Furthermore, there are some industries that have been screened out that Natural England don't agree with	The CIA screening (**Appendix 10.3**) has been reviewed and the CIA updated in **Section 10.7** of the ES.
Overall Assessment Conclusion	Natural England agree that from an EIA perspective, there will be no residual significant impact on marine mammals, alone or in-combination. However, there are sections where updates to the final magnitude / sensitivity of some of the impact assessments is required.	All assessments have been reviewed and updated, and the magnitude / sensitivity revised, where required.

Reference	NE Comment	Response
General comments that should be applied throughout the EIA	1. Natural England advises that the seal at-sea maps produced by Russell et al. (2017) have been updated by Carter et al. (2020). Recommendation: Use the updated Carter et al. (2020) to characterise the seal at sea baseline.	See above response regarding use of these references. All data sources have been reviewed and updated where appropriate in the ES.
	2. Natural England is aware of (currently) unpublished data that shows that the harbour seal population in The Wash has undergone a significant decline (20-30%) in the last 2 years (2019 and 2020) and that this should be factored into the assessment. Recommendation: Contact SMRU for more information on the recent decline of the harbour seal population in The Wash and North Norfolk SAC. Factor the reduction into the subsequent assessments e.g. revise the reference population so that it reflects the recent, lower counts.	All data sources have been reviewed and updated in the ES.
	3. We note that UXO charge weights up to 525 kg have been presented. However, other offshore wind farms in the area (namely Dudgeon and Hornsea Project Two) have cleared UXOs with net explosive quantities up to 907 kg (as mentioned in the Draft Information for Habitats Regulations Assessment for DEP and SEP, paragraph 378). Without evidence to confirm that UXO size within the DEP and SEP sites will not exceed 525 kg, we request that the noise emissions of a 907 kg UXO is also modelled, to ensure any mitigation measures are suitably precautionary and cover the worst-case scenario. Furthermore, it is not clear if the Applicant has included the likely size of donor charge required for the UXO clearance. Recommendation: Undertake further modelling of UXO charge sizes up to 907 kg. Ensure that representative donor charge sizes	As above.

Reference	NE Comment	Response
	are also included in the total explosive quantity detonated.	
Favourable Conservation Status (FCS)	4. Natural England understands that overall assessment of conservation status within the UK Marine Atlantic region is “unknown” for harbour porpoise, bottlenose dolphin, white-beaked dolphin, and minke whale. Our understanding is that there is currently too little data to confidently conclude whether there has been any change in the population. We have confirmed that this is also the interpretation of the JNCC.	FCS has been reviewed and updated in **Section 10.4.1.6** of the ES chapter and this appendix.

Table 10.1.3: Natural England Section 42 Comments Received 10th June 2021 – Detailed Comments

Point	Section	NE Comment	NE Recommendation	Applicant Response
Natural England comments on Marine Mammal Information and Survey Data (Appendix 10.1)				
6.1	12.1.2	Natural England considers the SeaWatch sightings should be presented on a map, in order to determine the distance and therefore relevance to the project.	Present the SeaWatch sightings on a Plate in the document.	Due to the general nature of the information provided within the SeaWatch data coupled with the fact that it is wide-ranging and lacks specific coordinates for location sightings, this has not been possible, and was not considered essential to the information provided in this appendix.
6.2	12.1.2	The Applicant has stated that the UK East Coast MUs have been screened into the assessment. As the Applicant has also mentioned the northeast and southeast England MUs, we request clarity on what is meant by the UK East Coast MUs. We note that in	Remove reference to the UK East Coast MUs or explain what is meant, also ensure that the appropriate MUs are	Reference to the UK East Coast Management Units (MU) has been reviewed and removed. No other reference is made to the East coast MU in this appendix.

Point	Section	NE Comment	NE Recommendation	Applicant Response
		other documents, such as the CIA (e.g. Table 12-3 and Annex 1), there is no mention of which projects are within this UK East Coast MUs (these tables specify the NE, SE and Waddenzee MUs only).	captured in the CIA when screening in projects.	
6.3	12.1.3	We welcome that the Applicant has screened in the Coastal East Scotland population for bottlenose dolphin.	No action needed	No action needed
6.4	12.1.4.2 Table 12-1	Natural England advises that changes have been made to the Conservation of Seals Act 1970 that came into force on 01 March 2021. It is now an offence if a person intentionally or recklessly kills, injures, or takes a seal. Closed seasons no longer apply.	Update the description of protection afforded by the Conservation of Seals Act.	Text referencing the Conservation of Seals Act 1970 has been updated in **Table 10.1.8**.
6.5	12.1.4.3	We assume that the Applicant meant "Under these Regulations, it is an offence if cetaceans are deliberately disturbed" (rather than specifying harbour porpoise)?	Change harbour porpoise to cetaceans.	**Section 10.1.3.3** has been amended.
6.6	12.1.4.3	We note that there is a broken link when cross-referencing the relevant paragraph in Chapter 12.	Update the broken link.	This has been amended.
6.7	12.1.4.3	We welcome the Applicant's commitment to applying for an EPS licence where required.	No action needed	Noted.
6.8	12.1.5 Plate 12-0-1	Natural England advise that Plate 12-0-1 should be updated to include the spatial extent of the extensions.	Update Plate 12-0-1 to include the DEP site extension.	**Plate 10.1.1** has been updated. The aerial surveys covered both the SEP and DEP extension sites.
6.9	12.1.6.1.2 Table 12-5	Could the Applicant please confirm if the densities presented in the tables are in animals/km^2, or the total density across the site? If the latter, could the km^2 of each site be provided to allow comparison with the published literature.	Add the units (if animals/ km^2) or confirm it is across the whole site and add the total area for each site.	Units have been added to text and tables in **Section 10.1.4**.
6.10	12.1.6.1.2 Table 12-5	The Applicant has specified that the DEP data in this table does not include the species grouping 'cetacean'	Remove the footnote reference to including	This has been clarified and updated in **Table 10.1.12**.

Point	Section	NE Comment	NE Recommendation	Applicant Response
		as no density estimate available. Does that mean the SEP or the whole survey area data does include the 'cetacean' grouping? Natural England understood that this table was meant to represent known harbour porpoise sightings only.	cetaceans, assuming this is not meant to be included. If the footnote reference needs to be included, then clarify the wording.	
6.11	12.1.6.2.3	We welcome the Applicant's use of the Block R density estimates for bottlenose dolphin in relation to the DEP and SEP site.	No action needed.	Noted.
6.12	12.1.6.2.3	Natural England notes that the IAMMWG have recently reviewed the abundance estimates for the MUs and the results of this review have just been published and are available at https://hub.jncc.gov.uk/assets/3a401204-aa46-43c8-85b8-5ae42cdd7ff3. We advise that the reference populations in the baseline are updated. Notes this also applies to paragraphs 93 and 104.	Update the baseline with the revised MU abundance estimates.	All Inter-Agency Marine Mammal Working Group (IAMMWG) MU populations have been updated in **Appendix 10.1** and in the ES and RIAA assessments.
6.13	12.1.6.5.4	See general comment 1: Natural England advises that the seal at-sea maps produced by Russell et al. (2017) have been updated by Carter et al. (2020). Recommendation: Use the updated Carter et al. (2020) to characterise the seal at sea baseline.	See general comment 1	As discussed at the ETG3 meeting 20 July 2021, Carter *et al*. (2020) provides a relative index of seal density at sea, rather than absolute seal densities provided by Russell *et al*. (2017). Having assessed the data, the seal density estimates used in Russell *et al*. (2017) have been used in the ES assessments and information from Carter *et al*. (2020) included for context.
6.14	12.1.6.6.2 Table 12-12	See general comment 2: Natural England is aware of (currently) unpublished data that shows that the harbour seal population in The	General comment 2	Harbour seal population has been updated based on most recent

Point	Section	NE Comment	NE Recommendation	Applicant Response
		Wash has undergone a significant decline (20-30%) in the last 2 years (2019 and 2020) and that this should be factored into the assessment. Recommendation: Contact SMRU for more information on the recent decline of the harbour seal population in The Wash and North Norfolk SAC. Factor the reduction into the subsequent assessments e.g. revise the reference population so that it reflects the recent, lower counts.		seal counts in SCOS (2020) in ES and this appendix.
Natural England comments on Marine Mammal CIA Screening (Appendix 10.3)				
6.26	12.3.1	The Applicant has specified that they will screen in any projects and plans within the Wadden Sea region for grey and harbour seal, which we welcome. We request that the Applicant provides a figure showing the spatial extent of this region that is being screened in, for clarity.	Include a figure/plate showing the extent of the Wadden Sea region used for screening in plans and projects.	Information and maps of the relevant MU areas and Wadden Sea region have been included in this appendix.
6.27	12.3.1.1	We acknowledge that the list of sources provided by the Applicant does not comprise the full list of sources used for the CIA. However, we wish to note that the MMO public register is a useful source that could be consulted, if it has not been already.	If the MMO public register has not been consulted, it is recommended that it is.	The MMO public register has been reviewed and the relevant information included / updated in **Appendix 10.3**.
6.28	12.3.2	The Applicant has stated that Unexploded Ordnance (UXO) clearance has been initially considered in the CIA, however there is no further mention of this activity type in the CIA.	The Applicant should clarify how UXO projects have been considered.	Further text and clarification has been included in **Appendix 10.3**.
6.29	12.3.2.1	The Applicant has stated that all known aggregate projects are operational. However, we wish to make the Applicant aware of that there was a marine aggregates tender round in 2018/19 [redacted], and the dredging sites that were successful in this phase have now been	Further assess the potential for marine aggregates to act in-combination with the proposed project, including consideration of the latest tender round(s).	Further consideration of aggregate extraction and dredging projects has been included in **Appendix 10.3** and **Section 10.7.1.2.3** of the ES chapter.

Point	Section	NE Comment	NE Recommendation	Applicant Response
		offered five-year exploration and option agreements, prior to any extraction occurring. We therefore do not agree that all potential aggregate sites are operational. Furthermore, we note that although the BEIS Review of Consents states that it is not possible to assess the extent of physical (seabed) impacts from dredging, they do provide an assessment of other impact pathways e.g. underwater noise. We therefore advise that aggregate extraction and dredging require further consideration in the CIA.		
6.30	12.3.2.2	Natural England understands that the Applicant has utilised the Cefas data layer of licensed disposal sites to determine the presence of any disposal sites in the region. Has the Applicant taken steps to ensure that there are no current applications for disposal sites?	Confirm if/how future disposal sites have been identified.	Reviewed and updated in **Appendix 10.3**.
6.31	12.3.2.3	Natural England concurs that shipping and navigation are considered as part of the baseline and do not require further consideration in the CIA.	No action needed.	Noted.
6.32	12.3.2.4	Natural England does not agree that planned construction of sub-sea cables and pipelines can be screened out of the CIA. Though we understand that the underwater noise produced may not exceed PTS threshold, there are still other effects from underwater noise (e.g. disturbance), and there are also other pathways of effect from cable and pipelines activities e.g. effects on prey, visual disturbance.	Further assess the potential for sub-sea cables and pipelines to act in- combination with the proposed project.	Reviewed and updated in **Appendix 10.3** and included in **Section 10.7.1.2.5** of the ES chapter.
6.33	12.3.2.5	Natural England does not agree that all currently known oil and gas installation projects are fully commissioned. To illustrate, there are three developments that have submitted EIAs in 2021 and are awaiting decision (https://www.gov.uk/government/collections/eia-submissions-and-decisions-2021).	Further assess the potential for oil and gas to act in-combination with the proposed project, including consideration of the	Reviewed and updated in **Appendix 10.3**.

Point	Section	NE Comment	NE Recommendation	Applicant Response
			applications currently submitted.	
6.34	12.3.3.1.1	Natural England notes that the evidence base on underwater noise from operational wind farms has been collated from wind turbines with notably smaller capacity than is being proposed for current developments. At a strategic level, Natural England recommends that further data on operational noise from larger turbines is collected, to inform these assessments. Nevertheless, Natural England agrees with the conclusions of the Review of Consent based on best available evidence, and that operational noise from offshore wind farms can be screened out of the CIA.	No action needed.	Noted.
6.35	12.3.3.1.2 Table 12-1	Natural England considers that the following projects/project details are missing: • Blyth Offshore Demonstrator Project – Array 4. The developer has submitted a variation to the existing licence for construction of floating offshore wind platforms in Array 4 of the consented Blyth Offshore Demonstrator array area. Construction is predicted to occur in 2025. • Norfolk Vanguard – the consent decision has been recently quashed, however, re determination is being considered so we are content for the figures to remain in at this time. • Wave Hub - granted consent. We also consider that the following projects should be considered, as they occur within the MUs specified: • Seagreen 1A • Salamander • Isle of Man	Review and update the list of projects, their status, and their tiers prior to DCO application submission.	Reviewed and updated in **Appendix 10.3** based on relevant spatial area and potential to overlap with construction of SEP and DEP.

Point	Section	NE Comment	NE Recommendation	Applicant Response
		• Draig y Mor • Pembrokeshire Demonstration Zone • Celtic Sea – Floating Lease demonstration zone • Round 4 offshore wind farms These projects should be assessed in Table 12-3 too, and included in the long list in Annex I.		
6.36	12.3.3.2	Could the Applicant please clarify whether any pathways for cumulative impacts from other marine renewable developments are being screened into the assessment?	Clarify whether any pathways for cumulative impacts from other marine renewable developments are being screened into the assessment.	Reviewed and updated in **Appendix 10.3**, however wave and tidal projects were screened out from further consideration in the CIA.
Natural England comments on PEIR chapter				
6.38	12.2 Table 12-1	In Natural England's Scoping Response in 2019, we raised the following question: "Natural England queries why floating turbines are not being considered as an alternative foundation option?" This comment should be included in Table 12-1 and responded to accordingly.	Include this Natural England comment and a response in Table 12-1.	Due to the location, site conditions and water depth, floating turbines are not a suitable option for SEP and DEP.
6.39	12.2 Table 12-1	Natural England is content with the way that the consultation responses have been addressed.	No action needed.	Noted.
6.40	12.3.3.1 Table 2-12	See general comment 3: We note that UXO charge weights up to 525 kg have been presented. However, other offshore wind farms in the area (namely Dudgeon and Hornsea Project Two) have cleared UXOs with net explosive quantities up to 907 kg (as mentioned in the Draft Information for Habitats Regulations Assessment for DEP and SEP, paragraph 378). Without evidence to confirm that UXO size within the DEP and SEP sites will not exceed 525 kg, we request that the noise emissions of a 907 kg	See general comment 3.	As above. UXO sizes were converted from lb to kg for consistency, however, this is not the same as the NEQ or TNT equivalent charge weights. As shown in **Table 10.4.8** of **Appendix 10.4** of the ES chapter, a 525kg NEQ is equivalent to a 1,000lb (907.2kg) air-delivered

Point	Section	NE Comment	NE Recommendation	Applicant Response
		UXO is also modelled, to ensure any mitigation measures are suitably precautionary and cover the worst-case scenario. Furthermore, it is not clear if the Applicant has included the likely size of donor charge required for the UXO clearance. Recommendation: Undertake further modelling of UXO charge sizes up to 907 kg. Ensure that representative donor charge sizes are also included in the total explosive quantity detonated.		bomb so the worst case scenario has been assessed. Underwater noise modelling for UXO includes donor charge, this has been clarified in the ES chapter and **Appendix 10.2**.
6.41	Table 12-4	Natural England welcomes the commitment of the Applicant to implement additional mitigation measures including a MMMP for piling activities and UXO clearance, and an SNS SAC SIP. We welcome consultation on these documents.	No action needed.	A **Draft MMMP** (document reference 9.4) and **In Principle Site Integrity Plan (SIP) for the Southern North Sea Special Area of Conservation (SAC)** (document reference 9.6) have been submitted with the DCO application incorporating any relevant consultation responses received from Natural England and the MMO at the pre-application stage.
6.42	12.4.1.1 Table 12-5	Paragraph 2.6.92 of the NPS EN-3 states that the assessment of the effects on marine mammals should include details of baseline noise levels. Such an assessment should be added to this chapter.	Characterise the baseline noise levels in the development area.	Information on baseline underwater noise levels has been included in **Section 10.6.1.3.2**and in **Appendix 10.2**.
6.43	12.4.1.1 Table 12-5	Natural England welcomes the commitment of the Applicant to draft an IPMP and welcomes consultation on this document.	Please see all other matters Annex 12.	An **In Principle Monitoring Plan (IPMP)** (document reference 9.5) has been submitted with the DCO application incorporating any relevant consultation responses received from Natural England

Point	Section	NE Comment	NE Recommendation	Applicant Response
				and the MMO at the pre-application stage.
6.46	12.4.1.6 Table 12-6	See general comment 4: Natural England understands that overall assessment of conservation status within the UK Marine Atlantic region is “unknown” for harbour porpoise, bottlenose dolphin, white-beaked dolphin, and minke whale. Our understanding is that there is currently too little data to confidently conclude whether there has been any change in the population. We have confirmed that this is also the interpretation of the JNCC.	Update the favourable conservation status of marine mammals.	FCS has been reviewed and updated in **Section 10.4.1.6** of the ES chapter and this Appendix.
6.47	12.4.2.2 Table 12-7	See general comment 1: Natural England advises that the seal at-sea maps produced by Russell et al. (2017) have been updated by Carter et al. (2020). Recommendation: Use the updated Carter et al. (2020) to characterise the seal at sea baseline.	As above	All data and information sources have been reviewed and updated for the ES. This includes, where relevant, updates to density estimates and reference populations. As discussed at the ETG3 meeting on the 20th July 2021, Carter *et al*. (2020) provides a relative index of seal density at sea, rather than absolute seal densities provided by Russell *et al*. (2017). Having assessed the data, the seal density estimates used in Russell *et al*. (2017) have been used in the ES assessments and information from Carter *et al*. (2020) included for context.

Point	Section	NE Comment	NE Recommendation	Applicant Response
6.48	12.5.8	See general comment 2: Natural England is aware of (currently) unpublished data that shows that the harbour seal population in The Wash has undergone a significant decline (20-30%) in the last 2 years (2019 and 2020) and that this should be factored into the assessment. Recommendation: Contact SMRU for more information on the recent decline of the harbour seal population in The Wash and North Norfolk SAC. Factor the reduction into the subsequent assessments e.g. revise the reference population so that it reflects the recent, lower counts.	As above	All data sources have been reviewed and updated for the ES. The latest harbour seal counts in SCOS (2020) have been used in the updated assessments.
6.49	12.6.1.1.2	Natural England considers that, in terms of impulsive characteristics, work by Hastie et al (2019) suggested a transition from impulsive to non-impulsive noise could take place between 3 and 10 km from the piling source. However, this is preliminary work and Martin et al (2020) suggest that the change in noise characteristics from impulsive to non-impulsive does not make a difference to assessment of injury.	No action; for information only.	Noted. All data and information sources have been reviewed and updated for the ES.
6.50	12.6.1.1.4	Natural England notes that, according to Table 12-6, the impact significant from PTS during underwater UXO clearance for minke whale is major adverse, not minor adverse as written in the text.	Change text to read major adverse for minke whale.	This has been updated to major adverse in **Table 10.4.14** of **Appendix 10.4**
6.51	12.6.1.1.5	Natural England agrees that the MMMP measures will likely reduce the potential impact to marine mammals from UXO clearance, however we cannot comment on the suitability of the MMMP measures until we have reviewed it. Natural England understands that a draft MMMP is being submitted with the DCO application.	Provide a draft MMMP in the DCO application, to enable review of suitability of measures to reduce impact severity.	A **Draft MMMP** (document reference 9.4) has been submitted with DCO application.
6.52	12.6.1.2.1	Natural England understands that more than one UXO detonation could occur in a 24-hour period. We note that Table 12-27 (and Tables 12-25 and 12-24)	Clarify how the potential for multiple UXO detonations in a 24-hour	There will be only one high order detonation in a 24-hour period. There could be more than one

Point	Section	NE Comment	NE Recommendation	Applicant Response
		presents the maximum number of individuals that may be affected from a single detonation. Please clarify how the potential for multiple detonations (which may affect a greater number of individuals across clearance activities), have been considered in the context of percentage of the reference population affected?	period has been taken into account in the assessment.	low-order clearance in a 24 hour period. These have been assessed as individual discrete events (see **Section 10.4.5** and **10.4.6** of **Appendix 10.4**). However, further consideration will be given to potential for multiple UXO clearance events, if required, for the final MMMP.
6.53	12.6.1.3.3.1 Table 12-38	Natural England understands that in row 1 of the table, the percentage of the reference population that could be affected is 0.02% and 0.03% (based on different density estimates). As both of these are in the range 0.01%-1%, we would expect that the magnitude for both numbers would be medium, rather than the "Low to Medium" stated.	Change "Low to Medium" to read "Medium".	This has been reviewed and updated.
6.54	12.6.1.3.7.1 Table 12-45	Natural England notes that for minke whale, 0.01% of the MU population is predicted to be impacted from monopiles. We would therefore expect the magnitude of the impact to be Medium, as opposed to Low. Though Natural England acknowledges that 0.01% is the boundary for the Low and Medium magnitude categories, in previous instances that Applicant has determined that 0.01% of the population affected constitutes Medium magnitude (in the case of PTS). For example, in Table 12-38 the magnitude of impact to harbour porpoise at SEP is Medium, as 38 individuals or 0.01% of the MU is predicted to be impacted.	Change the "Low" to "Medium".	This has been reviewed and updated.
6.55	12.6.1.3.7.2; and subsequent sections	Natural England note that there are several instances in the document where a range of magnitudes are presented in a table, however only the lower of the two is mentioned in the text describing the table, and only	Where a range of magnitudes is presented in the table that determines the magnitude, either both	This has been reviewed and updated.

Point	Section	NE Comment	NE Recommendation	Applicant Response
	301 and Table 12-48; and subsequent paragraph and tables	the lower of the two is carried forward into the assessment table. For example, Table 12-47 lists the magnitude of impact on harbour and grey seal as negligible to low, whereas in paragraph 301 and Table 12-48, only negligible magnitude is written. Natural England requests that, where a range of magnitudes is presented, either both or the higher of the two (i.e. the most precautionary) is mentioned in the text and taken forward to the assessment table. The places where this has been noted are: • Table 12-47, paragraph 301, and Table 12-48 • Table 12-73, paragraph 461, and Table 12-74 • Table 12-76, paragraph 467, and Table 12-75 • Table 12-77, paragraph 482, and Table 12-78 • Table 12-79, and Table 12-80 (noting the paragraph is correct here) • Table 12-84, paragraph 546, and Table 12-85 • Table 12-91, paragraph 589, and Table 12-92 • Table 12-93, paragraph 593, and Table 12-94	or the higher of the two (i.e. the most precautionary) is mentioned in the text and taken forward to the assessment table. Alternatively, justification should be provided in the text as to why the higher of the two magnitudes is not considered in the summary of the assessment.	
6.56	12.6.1.4.2.1	Natural England requests that the Applicant clarify how long a break there may be between installation of pin piles, for them to be classed as sequential and not require ADD activation in between.	Add text on anticipated duration of breaks between pin pile installation and cross-reference the MMMP (which we understand will be submitted alongside ES).	Underwater noise modelling has been undertaken to include sequential piling for four pin-piles in the same 24 hour period (**Appendix 10.2**). The modelling does not assume any break in piling which is a worst case. The length of time in between each pin pile installation is anticipated to be two hours and therefore the Applicant does not consider that ADD re-activation and full soft start procedures would need to be implemented, as per the mitigation

Point	Section	NE Comment	NE Recommendation	Applicant Response
				(and breaks in piling) procedure set out in the **Draft MMMP** (document reference 9.4). This will be clarified for the final MMMP based on the latest information and guidance.
6.57	12.6.1.4.2.4 Table 12-52	We advise that it is unclear why for example the value in the column 50% of individuals is not half of the value in the column 100% of individuals.	Provide further explanation/clarify in the text on how the values were calculated.	This has been reviewed and updated.
	12.6.1.4.2.5 Table 12-53	Natural England understands that the worst case (at DEP) for pin piling and one substation, plus ADD activation prior to both, would be 400 hours plus 25.5 hours = 425.5 hours, rather than 826 hours.	Provide an explanation of how the figure of 826 was reached and/or change to 425.5 hours.	This has been reviewed and updated.
6.58	12.6.1.6	Could the Applicant please clarify if there are any existing main vessel routes in the SEP wind farm site?	Add in text stating if there are any main vessel routes in the SEP site.	Text added to **Section 10.6.1.6** of the ES **Chapter 13 Shipping and Navigation** (document reference 6.1.13). Data indicates 13 existing main routes within the study area, with two routes crossing the SEP wind farm site, four routes crossing the DEP wind farm site and 10 crossing the export cable corridor.
6.59	12.6.1.6	Natural England understands that current vessel traffic in the area may be up to 75 vessels per day (along the main vessel routes). The project may add up to 16 vessels per day in the site. These are the only two quantified aspects of the assessment, and together they would mean that the threshold of 80 vessels per	Provide further detail on the aspects that will reduce the overall vessel traffic, such as displacement and site area.	The Heinänen and Skov (2015) threshold level in terms of impact is for 20,000 ships per year (approximately 80 vessels per day within a 5km^2 area). Therefore, taking into account the area of

Point	Section	NE Comment	NE Recommendation	Applicant Response
		day is exceeded. Natural England therefore requires further detail on the aspects that the Applicant state will reduce the overall vessel traffic, such as displacement and site area, before it can agree that this threshold is not exceeded.		SEP and DEP, the threshold of 80 vessels per day within a 5km^2 area will not be exceeded. This has been clarified in **Section 10.6.1.4.3.1** of the ES.
6.60	12.6.1.9.2	Natural England notes that the text in paragraph 511 is repeated almost verbatim in paragraph 513.	Assess whether the repeated text is needed in paragraph 513.	This has been amended.
6.61	12.6.1.9.2	Natural England acknowledge that seals are likely to be habituated to vessel noise, to an extent. However, we advise that it is more appropriate to consider this in the assessment of the sensitivity of the receptor, rather than the magnitude of the effect. In order to determine the magnitude, could the Applicant provide further information on the number of individuals anticipated to be exposed to the effect?	Include an assessment of the number of seals that may be impacted, in order to determine the magnitude of the effect. Consider the habituation in the overall sensitivity of the receptor.	It is not possible to provide a quantitative assessment of the number of seals that could be disturbed at seal haul-out sites, given the variables such as number of seals at the site, time of year, reaction to vessels. However, further text has been included for the assessment in **Section 10.6.1.7** of the ES chapter.
6.62	12.6.1.10.2.1	The Applicant has provided the percentage of the wind farm area only that could be subject to seabed disturbance. Could the Applicant provide a similar area of seabed disturbance for the export cable corridor?	Provide a figure of the seabed disturbance along the export cable corridor.	The maximum percentage of sea bed area that could potentially be disturbed across the windfarm sites and cable corridors has been included in **Section 10.6.1.8.2.1** of the ES chapter.
6.63	12.6.1.10.2.4 Table 12-84	Natural England notes that the percentage of the bottlenose dolphin CES MU that may be impacted due to changes in prey availability during construction at DEP is 5%. In line with previous values on the boundary between magnitude definitions, we	Change to medium magnitude rather than low, and update rest of assessment accordingly.	Reviewed and updated the magnitude level as suggested.

Point	Section	NE Comment	NE Recommendation	Applicant Response
		recommend that a precautionary approach is taken, and the 5% is considered to be medium magnitude.		
6.64	12.6.1.10.5.1 Table 12-87	We advise that the magnitudes listed in the table should reflect the worst-case magnitudes in Table 12-86 and paragraph 553, i.e. medium for bottlenose dolphin, and low for the harbour and grey seal.	Update the magnitudes accordingly.	Reviewed and updated the magnitude levels as suggested.
Blank	12.6.2.1.1	We note that this paragraph states that all marine mammals are considered as having a low sensitivity to disturbance from underwater noise from operational wind turbines. However, Table 12-92 lists marine mammals as having low to medium sensitivity.	Update text in paragraph 581 to say low to medium sensitivity, in accordance with Table 12-92.	Reviewed and updated the sensitivity levels as suggested.
6.65	12.6.2.1.1	The Applicant states that all marine mammals are assessed as having the same level of sensitivity to underwater noise from operational wind farms. However, we consider that minke whale is notably more sensitive to operational wind turbine noise, due to their sensitivity to low frequency noise. Marmo et al. (2013) used several different methods to determine sensitivity of marine mammals to operational noise from wind farms. Using one of the methods (audiogram plus sensational level), it was determined that a behavioural response could be observed in minke whale up to 18 km away. We acknowledge that there is limited evidence on the behavioural response of minke whales to operational wind farms; however, in line with the precautionary principle, we advise that the sensitivity of minke whales to operational wind turbine noise should be considered medium. We also request that the results of Marmo et al. (2013) are considered in the assessment of disturbance distance from operational wind farms. This should also be considered when	Update sensitivity of minke whales to medium. Include the results of Marmo et al. (2013) in the assessment.	Reviewed and updated. Minke whale sensitivity to operational turbines has been updated to medium in **Section 10.6.2.1.1** of the ES chapter. Further information from Marmo *et al*. (2013) has also been included in **Section 10.6.2.1.1** of the ES chapter.

Point	Section	NE Comment	NE Recommendation	Applicant Response
		assessing barrier effects from operational noise (Section 12.6.2.4).		
6.66	12.6.2.6.2	It is noted that the Applicant has stated that the port for operation and maintenance will be Great Yarmouth. Therefore, it should be possible to have a better understanding of the main vessel routes during operation and maintenance, and therefore the proximity to any seal haul out sites. We note that the Scroby Sands grey seal haul out is in close proximity to Great Yarmouth port. If the details of the potential operation and maintenance vessel routes are available, we request that they are incorporated into the assessment.	Provide a more detailed assessment of disturbance to seal haul outs as a result of O&M vessel transits from Great Yarmouth.	Reviewed and further information included in **Section 10.6.2.6** of the ES chapter .
6.67	12.7.1	Natural England requests clarity on how the impact screening was undertaken. It is stated that impacts assessed as 'no impact" are not taken forward, however this terminology has not been used in the assessment conclusions so far i.e. residual impacts have been presented as 'negligible' as a minimum.	Update the text for clarity.	Text has been moved to **Appendix 10.3**, reviewed and clarified. Further information has been included in **Section 10.3.2** of **Appendix 10.3** on the screening of potential cumulative impacts.
6.68	12.7.3.1.1.2 Table 12-103	Based on the information presented in the CIA (Table 12-3), Natural England understands that the 'East Anglia Hub' comprises East Anglia ONE North, East Anglia THREE, and East Anglia TWO, and that any two of these projects may be piled at the same time (footnote 1 to the table). Therefore, in Table 12-103, we consider that piling at two of these projects need to be considered, rather than just one (which is how we interpret the current assessment as it states "ONE North or TWO"). This comment applies to all similar subsequent tables.	Update the tables to reflect that impacts may arise from two East Anglia Hub projects at the same time, rather than just one.	The CIA has been updated to include two East Anglia Hub projects (East Anglia ONE North and East Anglia TWO).

Point	Section	NE Comment	NE Recommendation	Applicant Response
6.69	12.7.3.1.1.2	Natural England has summed the number of grey seals at risk presented in Table 12-107 and has found the total to be 218, rather than 281. The text in paragraph 735 should be updated to reflect the correct total.	Update table and paragraph text to 218.	Reviewed and updated the number of seals.
6.70	12.7.3.3.2	Natural England considers that it would be beneficial to also present the contribution of DEP and SEP together, as a percentage of the overall cumulative impact.	Present the contribution of DEP and SEP combined to the overall total too.	Reviewed and included the contribution of SEP and DEP together in **Section 10.7.1.3.1** of the ES chapter.
6.71	12.10 Table 12-122	For ease of navigation, Natural England suggests that the Applicant includes hyperlinks in Table 12-122 to each impact summary table within the individual section.	Include hyperlinks to earlier assessment tables in the document.	Links to assessment table included in **Table 10-114** of the ES chapter.

Table 10.1.4: MMO Section 42 Comments Received 10th of June 2021

Ref	MMO Comment	Applicant Response
MMO comments on PEIR chapter		
9.1	The embedded mitigation measures are detailed in Table 12-3 of Chapter 12. Measures include soft start and ramp-up procedures. Table 12-4 also details the additional committed mitigation measures and MMO support these proposals.	Noted.
9.2	Table 12-1 states that Section 12.6.1.3.2.1 outlines the methodology of the underwater noise modelling for piling, including the assumptions made with regard to cumulative piling in a 24-hour period. Further underwater noise modelling will be undertaken following consultation on the PEIR if more than one pile will be installed during 24-hour period, which will be appropriate. Furthermore, Table 12-2 indicates that "*assessments have been based on one pile per 24 hour, as during the installation of the first pile in any 24 hour period, marine mammals would move away from the area and would not be at risk of any further cumulative impacts from subsequent piles in the same 24 hour period. If required, this will be reviewed and updated for the ES*". Although it is expected that a marine mammal would swim away during the installation of the first pile, the piling activity over a 24-hour period still needs to be appropriately assessed.	Further underwater noise modelling has been undertaken to include sequential piling for two monopiles installed in the same 24 hour period or four pin-piles in the same 24 hour period in **Appendix 10.2**. This has been included in the assessments in **Section 10.6.1.3.**

Ref	MMO Comment	Applicant Response
MMO comments on Underwater Noise Modelling Report (Appendix 10.2)		
10.1	It appears that the appropriate receptors have been scoped into the PEIR, with the key marine mammal species including the harbour porpoise, bottlenose dolphin (included as a precautionary basis), white-beaked dolphin, minke whale, grey seal and harbour seal.	Noted.
10.2	Appropriate data sources have been identified and evidence being proposed is generally consistent with that submitted for operations of a similar nature.	Noted.
10.3	The MMO notes that there is a minor discrepancy within this report and Chapter 5 -the project description. While Volume 3 Appendix 12.2 indicates the worst-case pin pile to be up to 3.5 m in diameter, installed using a maximum blow energy of 3,000 kJ, the Project Description states the worst-case will be a 4 m diameter pin pile (for 18+ MW) with a maximum hammer energy of 3,000 kJ. The MMO point towards Table 5-13 in Chapter 5 Project Description as an example.	Further underwater noise modelling has been undertaken for 4m diameter pin-piles in **Appendix 10.2**. This has been included in the assessments in **Section 10.6.1.3** of the ES chapter.
10.4	The MMO consider it would be useful to have additional information to support Figure 3-1, such as details of the piles size and hammer energy etc, in order to provide necessary context. Without this information, the MMO do not consider Figure 3-1 to be overly informative.	Underwater noise modelling report in **Appendix 10.2** has been updated to address comments.
10.5	Furthermore, in relation to the above point (Paragraph 10.4), the MMO believe it would also be useful to show a selection of measured versus INSPIRE outputs for the single strike SEL, in addition to the peak sound pressure level (SPL_{peak}), especially as the SPL_{peak} is not so relevant at far ranges.	Underwater noise modelling report in **Appendix 10.2** has been updated to address comments.
10.6	Section 5 and Section 5.1 state that "The calculation of underwater noise transmission loss for the non-impulsive sources is based on an empirical analysis of the noise measurements taken on transects around these sources by Subacoustech. The predictions use the following principle fitted to the measured data, where R is the range from the source, N is the transmission loss and α is the absorption loss: Source level (SL) – N log R – αR". The MMO request further clarification from the Applicant/Subacoustech that that the equation is N log R – αR (and not N log R + αR)?	N log R and αR are reduction elements of the equation and taken off the SL. That could be SL (– N log R) (- αR) or SL - (N log R + αR), the result is the same.
10.7	The MMO note that Table 5-2 provides a summary of the estimated unweighted source levels and transmission losses for the different construction (continuous) noise sources considered. Figure 5-1 shows the 1/3 octave frequency bands used as a basis for the Southall et al. (2019) weightings used in the simple modelling. The MMO are of the understanding that propagation loss is a function of the environment. But further information is required in order to explain why	There are many contributors to the propagation as well as the environment, for example the size and position of the source. In these cases, there is limited data available and reliance on data from specific sites with specific conditions is required. As

Ref	MMO Comment	Applicant Response
	the propagation loss varies quite significantly between the different sources, particularly when the source spectra (as per Figure 5-1) are not that different.	these sources are relatively quiet at source, the difference in the propagation coefficients have a relatively small effect on the overall conclusion.
10.8	Table 5-4 shows the predicted impact ranges for the various continuous sources. The MMO request that Applicant/Subacoustech confirm whether fleeing was considered for marine mammals.	All SELcum for marine mammals is based on fleeing response model, as most appropriate.
10.9	The MMO recommend that the noise modelling report/assessment includes a plot showing the predicted received levels versus range, for reference, particularly for impact piling.	Underwater noise modelling report in **Appendix 10.2** has been updated to address comments.

Table 10.1.5: TWT Section 42 Comments Received 10th of June 2021

Ref	Section	TWT Comment	Response
23	Table 12-1	Again TWTs comments on the Scoping Report, provided directly to Equinor, have not been included in the table	TWTs scoping opinion response has been incorporated into the consultation tables of the relevant ES chapters and supporting documentation. However, there were no comments relevant to marine mammals.
24	Table 12-2 p37	It would be useful to know if the worst case scenario for offshore construction presented here (4 years if both projects are constructed sequentially, with 2 years per wind farm), is a likely scenario. Does Equinor have a preferred construction scenario out of the three they have presented in this chapter?	The Applicant's intention is to build both projects concurrently however flexibility is required within the consent in case this approach is not feasible (as set out in **Chapter 4 Project Description**). Furthermore, the Applicant will seek to develop SEP and DEP as an integrated project, with an integrated grid option providing transmission infrastructure which serves both of the wind farms being the preferred option (however, a separated grid option is also a possibility).

Ref	Section	TWT Comment	Response
25	Table 12-2 p41-42	Whilst it is likely that impacts to marine mammals from decommissioning the two offshore wind farms will be no worse than the impacts during construction, is there any evidence that proves that this is the case?	There will be no piling during decommissioning, which is the worst-case for underwater noise for marine mammals, therefore any impacts during decommissioning would be less than construction. As outlined in **Section 10.6.3** of the ES chapter, potential impacts on marine mammals associated with the decommissioning have not been assessed in detail, as further assessments will be carried out ahead of any decommissioning works to be undertaken, taking account of known information at that time, including relevant guidelines and requirements. A detailed decommissioning programme will be provided to the regulator prior to construction that will give details of the likely techniques to be employed and any relevant mitigation measures required.
26	Table 12-4	We welcome the approach by Equinor in engaging with TWT on Sheringham and Dudgeon Extensions during the evidence plan process and we hope that this can continue into the post-consent stage to reflect the best practice we have been developing with other wind farm developers post-consent. TWT requests to be named on the piling and UXO MMMP, Site Integrity Plan for the Southern North Sea SAC and any marine mammal monitoring documents (including the In Principle Monitoring Plan (IPMP)). We look forward to discussing this in more detail with you over the coming months.	TWT are a named consultee on the **Draft MMMP** (document reference 9.4), **In Principle SIP for the Southern North Sea SAC** (document reference 9.6) and any marine mammal monitoring documents (including the **Offshore IPMP** (document reference 9.5). TWT will also be consulted during production of the final plans post consent.
27	Table 12-5 p49	We look forward to engaging with Equinor on the development of marine mammal monitoring, which is of particular importance for the Southern North Sea SAC. TWT also suggests that a strategic approach to monitoring should be implemented within the SAC which would yield better results and be a better use of individual developer resources. We recognise that this lies largely outside of Equinor's gift in	Equinor is supportive of a strategic approach to monitoring see the **Offshore IPMP** (document reference 9.5). As outlined in **Section 10.11**, the monitoring requirements for marine mammals will be finalised post-consent based on the latest information, guidance and requirements and will be in accordance with monitoring proposals outlined the **Offshore IPMP** (document reference 9.5).

Ref	Section	TWT Comment	Response
		terms of this project, but we would welcome a conversation with industry, regulators and SNCBs on how this can be achieved.	
28	59	We are disappointed that fishing has been considered as part of the baseline and has not been included in the CIA for marine mammals. Fishing has been scoped into the CIA for other receptors in this report, such benthic ecology (Table 10-22, p106) and we are uncertain as to why this approach has not been consistently applied across the PEIR. Fishing is a licensable activity that has the potential to have an adverse impact on the marine environment, including marine mammals. This is supported in the leading case C-127/02 Waddenzee [2004] ECR I-7405, the CJEU held at para. 6. "*The act that the activity has been carried on periodically for several years on the site concerned and that a licence has to be obtained for it every year, each new issuance of which requires an assessment both of the possibility of carrying on that activity and the site where it may be carried on, does not itself constitute an obstacle to considering it, at the time of each application, as a distinct plan or project within the meaning of the Habitats Directive*" This case law demonstrates that fishing is considered a plan or a project and therefore, not part of the baseline.	This approach is consistent with the Review of Consents (RoC) HRA for the SNS SAC and CIA for other OWFs, such as Norfolk Boreas, Hornsea Project 4. Further text and justification is provided in **Appendix 10.3**.
29	154-155	Is Equinor satisfied that 525kg is the maximum worst case charge weight that will be encountered across the project? Equinor mentions in the following paragraph that a maximum charge weight of 907.2kg (for a 2,000lb UXO) was needed at the original Dudgeon project and Hornsea Project Two, both situated in close proximity to SEP and DEP. Is there reason to believe that a charge weight of this size will not be needed for SEP and DEP?	As clarified at the ETG3 meeting on the 20th of July 2021, UXO sizes were converted from lb to kg for consistency, however, this is not the same as the NEQ or TNT equivalent charge weights. As shown in **Table 10.4.8** of **Appendix 10.4**, a 525kg NEQ is equivalent to a 1,000lb (907.2kg) air-delivered bomb so the worst case scenario has been assessed. This has been clarified in **Appendix 10.4**.

Ref	Section	TWT Comment	Response
30	155	Whilst we appreciate the inclusion of UXO information from nearby projects, Equinor has not provided an indicative figure for UXO clearances specific to DEP and SEP. We expect all offshore wind farm developers to undertake more pre-consent surveys to gain a realistic figure of required UXO clearances. TWT believes UXO clearance activity should be conditioned at the DCO stage, through the inclusion of a dML, then it could be better planned and managed in combination with other projects. TWT suggests that a condition is included as part of the licence where the applicant will submit refined data on the number of UXO clearances once seismic surveys have been undertaken, in order to further support and justify UXO clearance activity, similar to the East Anglia One North and East Anglia Two applications.	As agreed with Natural England and the MMO at the ETG3 meeting on the 20th July 2021 and agreed by Natural England in the Agreement Log dated 20/07/2021, UXO clearance will be applied for within a separate Marine Licence application post consent and is not part of the DCO submission. However, assessments based on potential worst-case for UXO have been provided for information in the ES, **RIAA** (document reference 5.4) and **Draft MMMP** (document reference 9.4). Although it should be noted that these are indicative only. The marine licence assessments post-consent will be based on the worst case number of UXO devices as identified through pre-construction magnetometer surveys. It is important to note that the final MMMP for UXO will be agreed prior to UXO clearance based on the latest information, modelling, guidance and requirements at that time.
31	160	We would appreciate if the applicant could please clarify whether they are referring to low-order or low-yield clearance technologies or both in future documents? We request that when the draft UXO-specific MMMP is developed, Equinor commits to recording and providing information on the success rate of the technology during the project to regulators, SNCBs and other interested parties such as TWT to confirm the effectiveness of the technique in mitigating the impacts of underwater noise. If Equinor intends to use low-yield technology then the requirement to use a bubble curtain should form part of the licence condition, due to the lack of evidence surrounding this technique.	Text clarified when referring to low-order clearance. A **Draft MMMP** (document reference 9.4) has been submitted with the DCO application. All UXO clearance operations will be conducted based on the latest guidance and requirements for mitigation and monitoring at that time. This will be agreed for the final MMMP. Assessment of potential impacts from UXO clearance have been provided with the ES for information (see **Appendix 10.4**).
32	Table 12-24	We do not agree with the assessment of medium magnitude to describe a permanent impact (PTS) to 870.73 harbour porpoise individuals.	Assessments of magnitude have been reviewed.

Ref	Section	TWT Comment	Response
		Harbour porpoise are a European Protected Species (EPS) which are afforded strict protection under Article 12 of the Habitats Directive, transposed into UK law by The Offshore Marine Conservation (Natural Habitats, &c.) Regulations 2007 (as amended in 2009 and 2010). The Regulations prohibit the deliberate capture, injury, killing or disturbance of EPS. We do not feel that permanent damage to 870.73 individuals, which may be linked to the nearby SNS SAC, should be ranked the same as permanent damage to 2.84 minke whale individuals.	Assessments are based on the agreed approach on percentage of the population (MU) that could be impacted. It is important to note that the magnitude of impact referenced is prior to the application of mitigation that would be implemented to reduce the risk of PTS in marine mammals. Assessments are based on worst-case scenario without mitigation.
33	184	Does Equinor intend to employ bubble curtains for low order disposal as well as high order disposal?	All UXO clearance operations will be conducted based on the latest guidance and requirements for mitigation and monitoring. This will be agreed for the final MMMP.
34		TWT note the commitment that there will be no concurrent UXO clearance between the two sites. If construction is occurring simultaneously, careful planning and scheduling between the projects will be necessary to ensure that these projects do not overlap and cause an adverse impact to the Southern North Sea SAC.	Noted. As agreed with Natural England and the MMO at the ETG3 meeting on the 20th July 2021 and agreed by Natural England in the Agreement Log (see **Consultation Report Appendix 1 Evidence Plan** (document reference 5.2.1)), UXO clearance will be applied for within a separate Marine Licence application post consent and is not part of the DCO submission. However, assessments based on potential worst-case for UXO have been provided for information in the ES, **RIAA** (document reference 5.4) and **Draft MMMP** (document reference 9.4). Although it should be noted that these are indicative only. The marine licence assessments post-consent will be based on the worst case number of UXO devices as identified through pre-construction magnetometer surveys.
35	286, 288-289	The worst case PTS range for harbour porpoise (13.6km) is greater than the stated ADD effectiveness range for reducing harbour porpoise PTS (4.9km), even if the ADD is employed for 55 minutes to increase the effectiveness range (10.3km).	The use of ADDs is provided as an example of proposed mitigation. The final MMMP for piling, including mitigation and monitoring will be agreed prior to piling based on latest information, guidance and requirements.

Ref	Section	TWT Comment	Response
		Therefore we do not agree with the residual impact conclusion of minor adverse in paragraphs 288-289. A great deal more work is required to understand the effectiveness of current mitigation for underwater noise impacts and to develop better options if the current mitigation is found to be inadequate. TWT suggests that monitoring is undertaken to confirm the effectiveness of ADD if this is utilised.	
36	564	Could Equinor please confirm that they will not be undertaking UXO clearance and piling concurrently at DEP or SEP in isolation or across both of the projects? If there is a possibility that UXO clearance activities and piling will be happening at the same time, the worst case scenario will need to be altered to reflect this.	UXO clearance will be assessed through a separate marine licence (see Ref 34 above). It is not anticipated that UXO clearance and piling would be undertaken concurrently at or between SEP and DEP however through development of the final SIP, mitigation and scheduling measures will be implemented to ensure avoidance of significant disturbance of harbour porpoise during piling and UXO works, in relation to the SNS SAC Conservation Objectives.
37	571-575	All of the research mentioned in this section concerning the impacts from underwater noise associated with operational wind turbines is based on turbines smaller in size than the turbines being considered for DEP and SEP. There is recent evidence to suggest that operational noise increases with size of wind turbines[1]. Therefore, it would be useful to consider monitoring and verification of operational noise levels of larger turbines as part of this project.	Reference to Stober and Thomson (2020) and Tougaard *et al.,* (2020) which looked at underwater noise from operational turbines has been added to the ES chapter. The potential impact is assessed as negligible and therefore it is not proposed to monitor operational turbine noise at SEP and DEP.
38	Table 12-108	We cannot currently agree with the conclusions of Table 12-108 that the use of a project specific SIP for the SNS SAC would reduce the residual impact to 'minor adverse' as there is currently no regulatory mechanism in place for managing the in-combination impacts from multiple SIPs.	The **In Principle SIP for the SNS SAC** (document reference 9.6) sets out the approach to delivering measures for SEP and DEP to ensure the avoidance of significant disturbance of harbour porpoise during piling works, in relation to the SNS SAC Conservation Objectives.

Ref	Section	TWT Comment	Response
		TWT is hopeful that this mechanism will be in place by the time construction commences on this project, through the efforts of the Underwater Noise Strategic Advisory Group, but as it is not yet in place we cannot agree with the conclusion presented in this table. We suggest that mitigation is likely to be required for cumulative impacts, especially in relation to EPS.	The approach and measures in the SIP are in relation to SEP and DEP only and are in response to the conclusions of the **RIAA** (document reference 5.4).

Table 10.1.6: National Trust Section 42 Comments Received 10th of June 2021

NT Comment	Applicant Response
Impact on Seal Populations National Trust has noted that the PEIR has assessed the impact of the proposed extensions during both construction and operation on the grey and harbour seal populations. The closest haul-out site to the extension area is at Blakeney Point which is within National Trust ownership. It has been noted that it is considered there will be negligible to minor adverse impact on this site as a result of the proposals, given the minimum 12km distance, however National Trust would request that the proposed mitigation of maintaining transiting vessels 600m or more off the coast near seal haul-out areas, especially during sensitive period, is incorporated into any future management regime.	Where possible and safe to do so, transiting vessels would maintain distances of 600m or more off the coast, particularly in areas near known seal haul-out sites during sensitive periods. Vessel movements to SEP and DEP from the chosen construction port(s) (anticipated to be Great Yarmouth therefore avoiding interaction with the Blakeney Point seal haul out site) would use direct established routes and are unlikely to be close to the shore, or within the distance required to cause a disturbance impact, based on the distance thresholds (300m for grey seal and 600m for harbour seal), except when near the port to avoid the risk of collision and grounding. This has been incorporated into the **Outline Project Environmental Management Plan (PEMP)** (document reference 9.10).

Table 10.1.7: Vattenfall Wind Power Limited Section 42 Comments Received 10th of June 2021

Vattenfall Comment	Applicant Response
VWPL note that both the DEP and SEP projects include monopile and piled jacket options for foundations and that although only indicative programs for construction have been provided at this stage there is potential for the Unexploded Ordnance (UXO) clearance and piling activities to overlap with the construction programmes for both Norfolk Vanguard (no piling overlap currently identified) and Norfolk Boreas (possible piling overlap currently identified). Equinor have identified the potential for cumulative impacts for a number of species including harbour porpoise, bottlenose dolphin, white beaked dolphin, minke whale, and grey and harbour seal. Given the potential for overlapping construction programmes it will be essential that Equinor keep VWPL, and Norfolk Boreas and Norfolk Vanguard updated as UXO and construction programmes are developed and once more certainty around these timeframes is available.	The Applicant will endeavour to keep VWPL, and Norfolk Boreas and Norfolk Vanguard updated as UXO and construction programmes are developed and once more certainty around these timeframes is available. Similarly, the Applicant requests if VWPL, and Norfolk Boreas and Norfolk Vanguard could also keep the Applicant updated as UXO and construction programmes are developed and once more certainty around these timeframes is available.
VWPL note that the DEP and SEP projects are located outside of the Southern North Sea Special Area of Conservation (SAC) but are within 14.1km at the closest point. Therefore, there is potential for Likely Significant Effects on the SAC to occur. It will therefore be important to consider the cumulative effects of the DEP and SEP projects with the Norfolk projects within the Habitats Regulations Assessment and further information on timing of activities will be key to reducing the risk of possible effects to the SAC. VWPL are willing to share current anticipated construction programmes for Norfolk Vanguard and Norfolk Boreas with Equinor during the development of the DEP and SEP DCO application documents.	The Applicant welcomes that VWPL are willing to share current anticipated construction programmes for Norfolk Vanguard and Norfolk Boreas during the development of the SEP and DEP DCO application documents. Similarly, the Applicant would be willing to share current anticipated construction programmes for SEP and DEP with VWPL during the development of the Norfolk Vanguard and Norfolk Boreas post-consent / pre-construction documents.

10.1.3 Policy, Legislation and Guidance

10.1.3.1 National and Regional Marine Policies

6. As outlined in the **Chapter 10 Marine Mammal Ecology** 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 (EC, 2008);
   - The Marine Policy Statement (MPS) (HM Government, 2011); and
   - The East Inshore and East Offshore Marine Plans (HM Government, 2014).

10.1.3.1.1 The Marine Strategy Framework Directive

7. 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.

10.1.3.1.2 The Marine Policy Statement

8. 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.
   - Our oceans support viable populations of representative, rare, vulnerable, and valued species.

10.1.3.1.3 The East Inshore and East Offshore Marine Plans

9. 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”.

10.1.3.2 Other National and International Legislation for Marine Mammals

10. **Table 10.1.8** provides an overview of national and international legislation in relation to marine mammals.

Table 10.1.8: Summary Table for National and International Legislations Relevant for Marine Mammals

Legislation	Level of Protection	Species Included	Details
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 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 Berne Convention 1979	International	All cetaceans, grey seal and harbour seal	The Berne 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.
Agreement on the Conservation of Small Cetaceans of the Baltic and North Seas (ASCOBANS)	International	Odontocetes	Signed in 1992, this agreement has been signed by eight European countries bordering the Baltic and North Seas (including the English Channel) and includes the United Kingdom (UK). Under the Agreement, provision is made for the protection of specific areas,

Legislation	Level of Protection	Species Included	Details
			monitoring, research, information exchange, pollution control and increasing public awareness of small cetaceans.
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.
Convention on Biological Diversity (CBD) 1993	International	All marine mammal species	Requires signatories to identify processes and activities that are likely to have impacts on the conservation of and sustainable use of biological diversity, inducing the introduction of appropriate procedures requiring an EIA and mitigation procedures.
Conservation of Seals Act 1970	National	Grey and harbour seal	As of 1st March 2021, a person commits an offence if they intentionally or recklessly kills, injures or takes 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.
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

Legislation	Level of Protection	Species Included	Details
			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.
The Conservation of Habitats and Species Regulations 2017, The Conservation of Offshore Marine Habitats and Species Regulations 2017, and the Conservation of Habitats and Species (Amendment) (EU Exit) Regulations 2019 (referred to as the *Habitats Regulations* and the *Offshore Regulations,* or collectively as the *Regulations*)	National	All cetaceans, grey and harbour seal	Provisions of The Habitats Regulations are described further in **Chapter 10 Marine Mammal Ecology**. It should be noted that the Habitats Regulations apply within the territorial seas and to marine areas within UK jurisdiction, beyond 12 nautical miles (nm).

10.1.3.3 European Protected Species Guidance

11. All cetacean species are all 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;
- to deliberately disturb them; or
- to damage or destroy a breeding site or resting place.

12. The Joint Nature Conservation Committee (JNCC), Natural England (NE) and the Countryside Council for Wales (CCW) (JNCC *et al.,* 2010) have produced draft guidance[2] concerning the Habitats 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).

13. 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;*
>
> *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".*

14. 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*".

15. The draft guidance 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.

[2] *Draft EPS Guidance - The protection of marine European Protected Species from injury and disturbance. Guidance for the marine area in England and Wales and the UK offshore marine area*

16. 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) .

17. 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*".

18. 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 (**Section 10.4.3.1** of **Chapter 10 Marine Mammal Ecology**). Consideration of any potential essential habitat or geographical structuring of EPS is provided in the existing environment section (**Section 10.5** of **Chapter 10 Marine Mammal Ecology**).

10.1.3.3.1 Marine Wildlife Licence Requirements

19. Under the Habitats Regulations 2017, a marine wildlife licence is required if the risk of injury or disturbance to cetacean species, from any potential effect (i.e. underwater noise, collision risk) is assessed as likely, following the application of mitigation. 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 will not result in a negative impact on the species'/ population's FCS.

20. A marine wildlife licence would consider all cetacean species at potential risk of injury or disturbance. It is likely that SEP and DEP would require a licence for disturbance to cetacean species, as a result of the piling activities.

21. 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 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 SEP and DEP.

22. 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.

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

10.1.4 Marine Mammal Baseline Review

10.1.4.1 Marine Mammal Species of the North Sea

24. In the 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 Dudgeon and Sheringham Shoal 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 spring and summer months (Dudgeon Offshore Wind Limited, 2009; Scira Offshore Energy Ltd, 2006).

25. This is supported by other wider scale surveys and reporting for marine mammals in the area, 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.*, 2017) and Joint Cetacean Protocol (JCP) data resources (Paxton *et al*., 2016).

26. 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 area, particularly during in the summer periods and white-beaked dolphin (*Lagenorhynchus albirostris*) are less frequent (DECC, 2016; Hammond *et al.,* 2017; Paxton *et al*., 2016). Other cetacean species, including bottlenose dolphin (*Tursiops truncatus)* and white-sided dolphin (*Lagenorhynchus acutus*) are relatively uncommon in the area (DECC, 2016), although it should be noted that the number of bottlenose dolphin sightings has recently been increasing along the east coast of England.

27. Both UK seal species, grey seal (*Halichoerus grypus*) and harbour seal (*Phoca vitulina*) are present in the area in relatively high number, due to nearby key breeding areas for both species (DECC, 2016).

28. The most recent public sightings reported to the SeaWatch Foundation in the east of England (at the time of writing; August 2019 to February 2021) were predominantly harbour porpoise (n=133), common dolphin (*Delphinus delphis*) (n=31), bottlenose dolphin (n=13), northern bottlenose whale (*Hyperoodon ampullatus*) (n=7), unknown cetacean species (n=6), humpback whale (*Megaptera novaeangliae*) (n=4), unidentified whale (n=3), unknown dolphin species (n=2), minke whale (n=2), Sowerby's beaked whale (*Mesoplodon bidens*) (n=2), harbour seal (n=1) (SeaWatch Foundation, 2021). Of these, only harbour porpoise and bottlenose dolphin (which have been specifically recorded at Sheringham) have been sighted near SEP and DEP in significant number, with low numbers of minke whale, humpback whale, northern bottlenose whale, and Sowerby's beaked whale also recorded nearby (SeaWatch Foundation, 2021).

29. 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, 2017; DECC, 2016; SCOS, 2020).

30. Site characterisation has been undertaken using site specific data for SEP and DEP, as well as existing data from other offshore wind farms in the area and other available information for the region.

31. Based on the site-specific surveys and other data sources, the key species of interest and therefore the focus of the assessments will be on the following species:

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

10.1.4.2 Study Area

32. 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 (Inter-Agency Marine Mammal Working Group (IAMMWG), 2022). The study area, MUs and reference populations have been determined based on the most relevant information and scale at which potential impacts from SEP and DEP alone and in-combination with other plans and projects could occur.

33. 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 Sea and Coastal East Scotland[3];
- White-beaked dolphin: Celtic and Greater North Seas MU;
- Minke whale: Celtic and Greater North Seas MU;
- Grey seal: South-east England, North-east England, and the Wadden Sea region; and
- Harbour seal: South-east England MU and the Wadden Sea region.

34. There is the potential for seals from haul-out sites to move along the coast and offshore to forage in and around the offshore sites. Key haul-out sites for both seal species within the vicinity of the SEP and DEP offshore sites include:

- Blakeney Point (located 12km from the nearest part of either DEP or SEP (closest swimmable distance[4]), including export cable corridors and landfall locations).
- Other haul-out sites are located at Horsey (44km), Scroby Sands (58km), the Wash (57km) and Donna Nook (66km).

10.1.4.3 Site-Specific Surveys

35. In order to provide site specific and up to date information on which to base the impact assessment, a site-specific aerial survey was conducted for both marine mammals and seabirds. HiDef Aerial Surveying Limited ('HiDef') collected high resolution aerial digital still imagery for marine megafauna (combined with ornithology surveys) over both SEP and DEP, including a 4km buffer (the survey area; **Plate 10.1.1**). In October 2018, the survey area was revised to include an extension to the offshore sites (**Plate 10.1.1**).

36. The aerial survey was conducted along a series of strip transects (at 2.5km spacing), flown on a monthly basis from May 2018 to April 2020. A site coverage of 10% was achieved through this strip-transect design. Additional surveys were undertaken from April to August 2019 in order to collect additional data through the sandwich tern breeding season.

[3] Evidence of the recent change in bottlenose dolphin distribution in the North Sea suggests that individuals are travelling south from the Moray Firth population which is within the Coastal East Scotland MU; therefore, for bottlenose dolphin both MUs will be used to define the study area for bottlenose dolphin.

[4] Swimmable distance is the distance at which a marine mammal would have to travel to reach the location of interest (i.e. it takes into account areas of land).

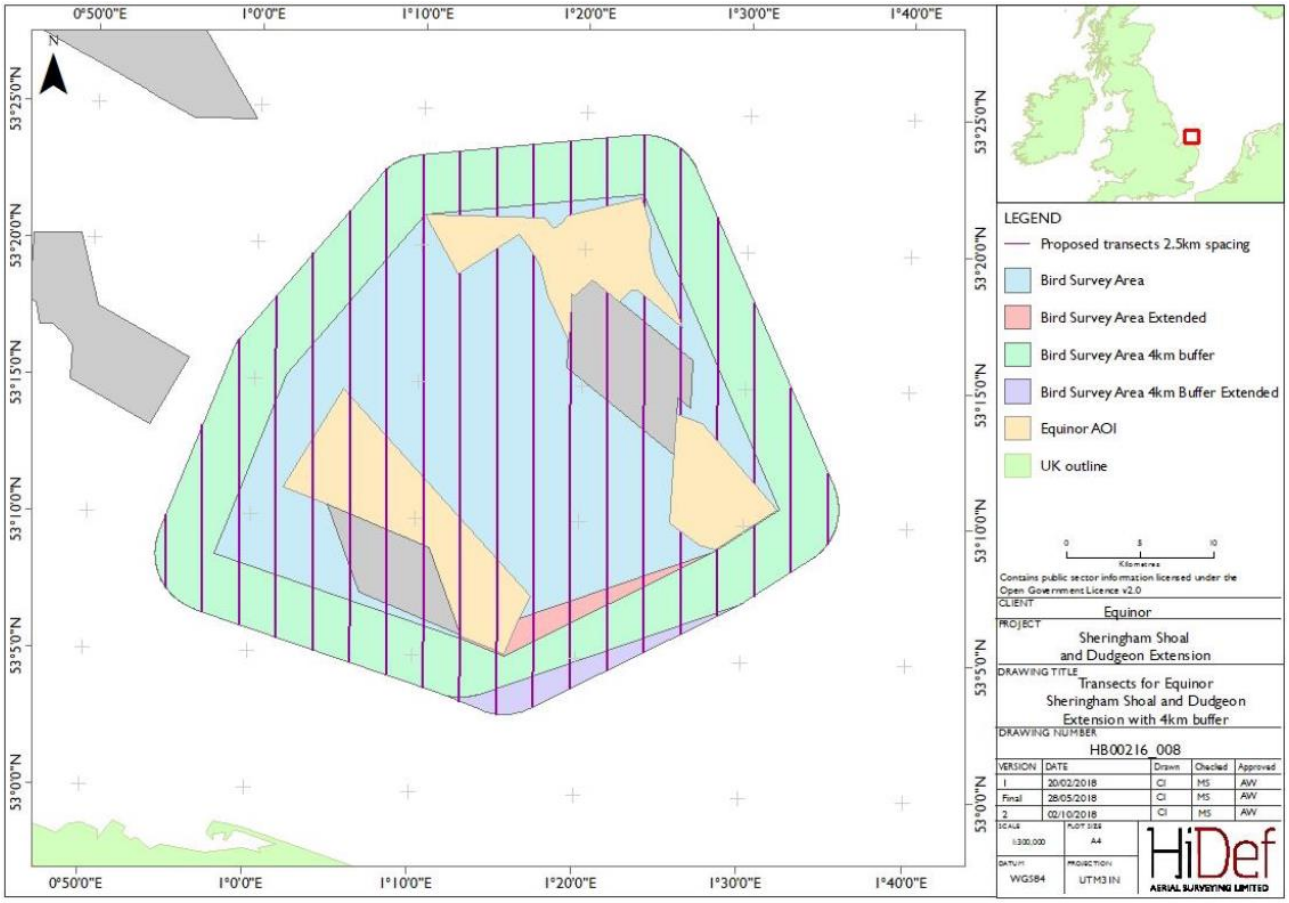

Plate 10.1.1 Survey area for SEP and DEP with 4km buffer (including extension) and 2.5km transects [existing offshore wind farms shown in grey]

37. Data analysis follows a two-stage process in which video footage is reviewed (with a 20% random sample used for audit) then the detected objects are identified to species or species group level (again with 20% selected at random for audit). The audit of both stages requires 90% agreement to be achieved.

38. Density and abundance estimates are calculated using strip transect analysis and a statistical technique called kernel density estimation (KDE) was used to create density surface maps.

39. The aerial survey method has been designed to optimise the data collection for all bird and marine mammal species using a grid-based survey design at 2cm resolution to achieve a minimum of 10% coverage using a twin-engine aircraft.

40. **Table 10.1.9** shows the numbers of marine mammals recorded during the aerial surveys from May 2018 to April 2020. The results indicate that harbour porpoise and unidentified seals are present in the highest numbers, with just one individual identified as a minke whale.

Table 10.1.9: HiDef surveys species counts for SEP and DEP and 4km buffer (May 2018 to April 2020; (survey number in brackets where relevant))

Survey Date	Grey seal	Harbour seal	Minke whale	Harbour porpoise	Seal species	Seal/ small cetacean species
May-18	2	0	0	16	3	4
Jun-18	0	0	0	12	6	4
Jul-18	0	0	1	16	3	4
Aug-18	1	5	0	29	7	2
Sep-18	2	0	0	14	0	1
Oct-18	2	6	0	18	2	0
Nov-18	1	0	0	8	2	1
Dec-18	0	0	0	2	2	2
Jan-19	2	2	0	2	5	0
Feb-19	1	0	0	18	4	5
Mar-19	0	0	0	8	7	1
Apr-19 (1)	0	0	0	4	3	0
Apr-19 (2)	1	2	0	34	9	0
May-19 (1)	0	0	0	31	3	0
May-19 (2)	0	0	0	26	9	0
Jun-19 (1)	1	2	0	25	9	1
Jun-19 (2)	5	0	0	20	14	1
Jul-19 (1)	1	3	0	34	21	2

Survey Date	Grey seal	Harbour seal	Minke whale	Harbour porpoise	Seal species	Seal/ small cetacean species
Jul-19 (2)	3	0	0	33	41	0
Aug-19 (1)	0	0	0	21	12	0
Aug-19 (2)	1	0	0	20	4	0
Sep-19	0	0	0	6	4	1
Oct-19	1	1	0	10	5	0
Nov-19	1	0	0	7	3	1
Dec-19	3	0	0	1	1	0
Jan-20	0	0	0	2	1	5
Feb-20	1	0	0	2	4	1
Mar-20	2	0	0	3	6	0
Apr-20	0	0	0	20	8	0
TOTAL	31	21	1	442	198	36

41. 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 coefficient of variation (CV) were also calculated for these density and abundance estimates. The density of animals at the site (and hence the population size), the standard deviation, 95% CI and CV are then estimated using a non-parametric bootstrap method with replacement (Buckland *et al*., 2001).

42. 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. 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.

43. The correction factors applied for harbour porpoise are dependent on the month, and time of day for which data was collected (see **Table 10.1.10**). For other species, and species groups, the relevant correction factors are described in more detail in the relevant section below.

44. Density maps have also been generated from the site-specific survey data at the Projects. To build a density map, the study area is covered with a fine mesh of study points and the density is calculated at each point in the mesh in turn.

Table 10.1.10: Correction factors used to account for the availability bias for harbour porpoise for different months, and times of day (taken from Teilmann et al., 2013)

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

10.1.4.4 Detailed Baseline Review of Key Marine Mammal Species

10.1.4.4.1 Harbour Porpoise

Desk-Based Review of Harbour Porpoise Presence

45. Within the southern North Sea area, harbour porpoise are the most common marine mammal species. During the Dudgeon Offshore Windfarm (DOW) baseline boat-based surveys (from December 2007 to April 2009; Dudgeon Offshore Wind Limited, 2009) a total of 33 harbour porpoise were recorded, mostly in pairs (although some groups of four to six individuals were also recorded). It was noted in the DOW Surveys that the survey methodology was likely to result in underestimation of harbour porpoise numbers present near the site.

46. Through the Sheringham Shoal Offshore Wind Farm baseline surveys (also boat-based; Scira Offshore Energy Ltd, 2006), undertaken from March 2004 to February 2006, harbour porpoise were recorded relatively frequently, and was the most commonly sighted marine mammal species within the survey, with counts of up to 13 individuals in a survey day (July 2004).

47. Heinänen and Skov (2015) identified one area of high harbour porpoise density in the summer period; from the western slopes of Dogger Bank south along a 30m depth contour towards an area off the Norfolk coast. High densities in winter were also identified in the southern North Sea, within an area between Flamborough Head and the outer Thames Estuary. High densities of harbour porpoise were predicted near both SEP and DEP, while high densities in summer were predicted to be further offshore.

48. 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 0.6-1.0 individuals per km^2 in the vicinity of SEP and DEP (0.2-0.6 per km^2 – 1.0-2.0 per km^2 97.5% CI; Paxton *et al.,* 2016).

49. 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 0-0.8 individuals per km^2 in the vicinity of SEP and DEP). In summer, there was an apparent shift, compared to spring, toward offshore and western areas (with an estimated density of 0.81-2.5 individuals per km^2 in the vicinity of SEP and DEP). In autumn, there were lower densities compared to spring and summer, and the distribution was spatially heterogeneous (with an estimated density of 0.41-1.50 individuals per km^2 in the vicinity of SEP and DEP; Gilles *et al.,* (2016).

50. Distribution and abundance maps were developed by Waggitt *et al.* (2020) 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 10.1.2**; Waggitt *et al*., 2019). Interrogation of this data[5], including all 10km 'grids' that overlap with the specified area, reveals an average annual density estimate of:

[5] Available from: [redacted]

- 0.565 individuals per km^2 (average of all overlapping 10km 'grids') for the SEP Site;
- 0.546 individuals per km^2 (average of all overlapping 10km 'grids') for the DEP Site; and
- 0.558 individuals per km^2 (average of all overlapping 10km 'grids') for SEP, DEP, and all export cables.

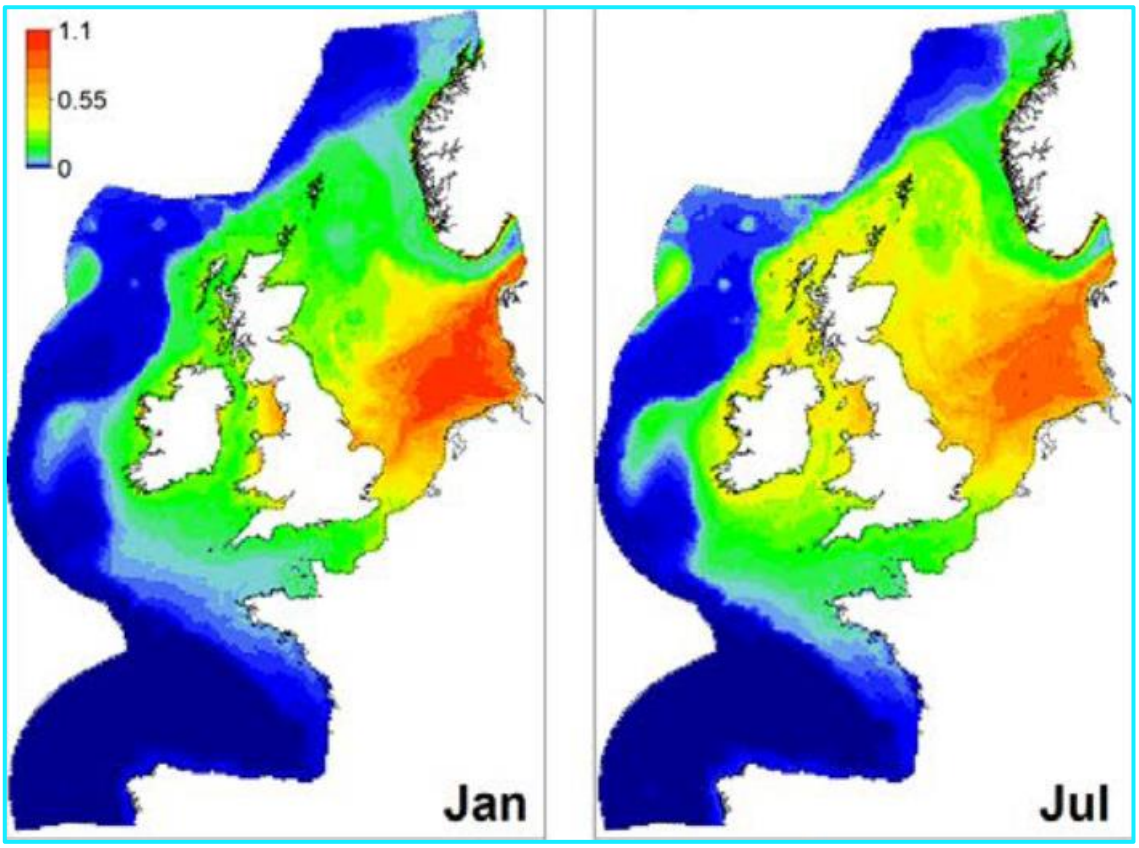

Plate 10.1.2: Spatial variation in predicted densities (individuals per km of harbour porpoise in January and July in the North-East Atlantic). Values are provided at 10 km resolution. Source: Waggitt et al., 2019.

Results from the Site-Specific Surveys for Harbour Porpoise

51. Data from the SEP and DEP site specific surveys were used to generate abundance and density estimates for the sites with a 4km buffer.

52. As noted above, harbour porpoise was the most commonly sighted marine mammal species during the surveys, with a total of 442 individuals recorded through the 29 survey dates.

Site-Specific Survey Density Estimates for Harbour Porpoise

53. Density estimates of animals/km^2 have been calculated from the raw data counts for (i) harbour porpoise; (ii) cetacean species, and (iii) seal / small cetacean. These have also been corrected for availability bias. Individuals from the two species groupings listed above are assumed to all be harbour porpoise as a worst-case, and are considered together within the density and abundance estimates as set out below. These abundance and densities are for the entire survey area, plus 4km buffer (i.e. they relevant for both SEP and DEP).

54. Correction factors were then be applied to the density estimates to account for the presence of individuals below 2m water depth (the depth at which it is no longer possible to detect marine mammals from aerial imagery).

55. The correction factors used for harbour porpoise are detailed in **Section 10.1.4.3** above. These are based on Teilmann *et al.* (2013), with different correction factors applied for different months, times of day, and for whether individuals would be at the surface or within the top 2m of the water column. More general correction factors have been applied to the species groups that have the potential to be harbour porpoise, and are set out below.

56. Voet *et al.* (2017) have determined seasonal correction factors for harbour porpoise that can be used to determine abundance and density estimates obtained from aerial digital surveys (**Table 10.1.11**). These seasonal correction factors are based on published dive profile data from harbour porpoise tagged in the North Sea. The Teilmann *et al.* (2013) tagging study indicated significant differences in the percentage of time that each harbour porpoise spent between 0 and 2m water depth with the time of year. Spring and summer had a higher average time spent between 0 and 2m compared autumn and winter. Therefore, to take this into account, Teilmann *et al.* (2013) suggest that aerial survey data should be corrected for time submerged as well as for seasonal effects.

57. The seasonal correction factors in **Table 10.1.11** has been used to generate harbour porpoise site specific density estimates for the SEP and DEP sites and 4km buffer.

Table 10.1.11: Harbour Porpoise Seasonal Correction Factors

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

58. Site specific density estimates for harbour porpoise have then been calculated, based on the density estimate (with availability bias) for harbour porpoise and for the density estimates with correction factors as set out in **Table 10.1.11** for the other species groups that could be harbour porpoise (i.e. cetaceans, and seals / small cetaceans). Different densities have been calculated for the winter (October to March) and summer (April to September) to account for the difference in abundance. Due to the lack of data for the species group 'cetaceans' no estimate could be calculated for DEP or SEP site specific densities.

59. The maximum density of each month was taken for each of the species groups, and corrected for availability. The average of the winter months, summer months, and annual density has then been calculated based on the maximum calculated for each month. **Table 10.1.12** shows the density estimates for harbour porpoise only, and **Table 10.1.13** shows the densities when the two other species groups are included (i.e. all individuals that have the potential to be harbour porpoise).

Table 10.1.12: Maximum harbour porpoise density estimate calculated for each month, corrected for availability bias, with summer, winter and annual density estimate for whole survey area, DEP plus 4km buffer, and SEP plus 4km buffer (note that the whole survey area covers a larger area than for SEP and DEP (plus 4km buffers) combined)

Month	Maximum density estimate (corrected) for whole survey area (animals/km^2)	Maximum density estimate (corrected) for DEP + 4km buffer (animals/km^2)	Maximum density estimate (corrected) for SEP + 4km buffer (animals/km^2)
January	0.11	0.13	0.000
February	0.98	1.63	1.140
March	0.31	0.72	0.179
April	0.69	2.41	0.552
May	1.19	2.88	0.173
June	1.07	1.50	1.063
July	1.52	3.55	1.117
August	1.00	2.08	0.489
September	0.73	1.85	0.231
October	0.94	1.73	0.863
November	0.34	0.48	0.718
December	0.13	0.15	0.000

Month	Maximum density estimate (corrected) for whole survey area (animals/km^2)	Maximum density estimate (corrected) for DEP + 4km buffer (animals/km^2)	Maximum density estimate (corrected) for SEP + 4km buffer (animals/km^2)
Average winter	**0.47**	**0.81**	**0.48**
Average summer	**1.03**	**2.38**	**0.60**
Average annual	**0.75**	**1.59**	**0.54**

Table 10.1.13: Maximum harbour porpoise density estimate (including cetaceans and seal / small cetacean species group) calculated for each month, corrected for availability bias, with summer, winter and annual density estimate for whole survey area, DEP Site plus 4km buffer, and SEP Site plus 4km buffer (note that the whole survey area covers a larger area than for DEP Site and SEP Site (plus 4km buffers) combined)

Month	Maximum density estimate (corrected) for whole survey area (animals/km^2)	Maximum density estimate (corrected) for DEP Site+ 4km buffer* (animals/km^2)	Maximum density estimate (corrected) for SEP Site + 4km buffer* (animals/km^2)
January	0.19	0.30	0.064
February	1.30	1.71	1.140
March	0.45	0.72	0.179
April	1.15	2.41	0.552
May	1.65	2.98	0.225
June	1.51	1.54	1.063
July	2.05	3.59	1.172
August	1.37	2.15	0.489
September	1.02	1.90	0.297
October	1.27	1.73	0.863
November	0.47	0.48	0.784
December	0.21	0.15	0.064
Average winter	**0.65**	**0.85**	**0.52**

Month	Maximum density estimate (corrected) for whole survey area (animals/km^2)	Maximum density estimate (corrected) for DEP Site+ 4km buffer* (animals/km^2)	Maximum density estimate (corrected) for SEP Site + 4km buffer* (animals/km^2)
Average summer	**1.46**	**2.43**	**0.63**
Average annual	**1.05**	**1.64**	**0.57**

** does not include the species grouping 'cetacean' as no density estimate available.*

Site-Specific Survey Abundance Estimates for Harbour Porpoise

60. The abundance estimates of harbour porpoise within whole survey area SEP and DEP have been derived and estimates have been corrected in the same way as the density estimates above. All species groupings that have the potential to be harbour porpoise are included (i.e. harbour porpoise have been corrected, the species groups cetaceans and seals / small cetaceans have been corrected as shown in **Table 10.1.13** above).

61. These abundance estimates are shown in **Table 10.1.14**. As shown in **Plate 10.1.3**, and mentioned above, there is a clear seasonal pattern in the abundance of harbour porpoise within the entire survey area, with higher numbers present in the summer months, including the species that may be harbour porpoise. After being corrected for availability bias, the highest abundance estimate for harbour porpoise was in July 2019, with 2,556 individuals, while the lowest abundance estimate was 75 in March 2020.

Table 10.1.14: Estimated abundance of harbour porpoise within whole survey area, corrected for availability bias

Month	Maximum abundance estimate (corrected) for harbour porpoise	Maximum abundance estimate (corrected) for harbour porpoise (including cetaceans and seal / small cetaceans)
22-May-18	790	1,160
18-Jun-18	655	948
02-Jul-18	846	1,213
06-Aug-18	1,264	1,743
12-Sep-18	927	1,252
09-Oct-18	1,205	1,601
14-Nov-18	479	655
04-Dec-18	136	204
19-Jan-19	119	163

Month	Maximum abundance estimate (corrected) for harbour porpoise	Maximum abundance estimate (corrected) for harbour porpoise (including cetaceans and seal / small cetaceans)
14-Feb-19	1,257	1,660
05-Mar-19	415	574
04-Apr-19	176	248
26-Apr-19	1,368	1,927
10-May-19	1,521	2,064
24-May-19	1,131	1,534
15-Jun-19	1,347	1,824
20-Jun-19	971	1,393
03-Jul-19	1,912	2,556
17-Jul-19	1,804	2,387
08-Aug-19	577	780
22-Aug-19	1,054	1,403
18-Sep-19	357	476
03-Oct-19	673	893
13-Nov-19	349	811
03-Dec-19	65	86
10-Jan-20	119	479
08-Feb-20	140	693
06-Mar-20	56	75
03-Apr-20	861	1,211

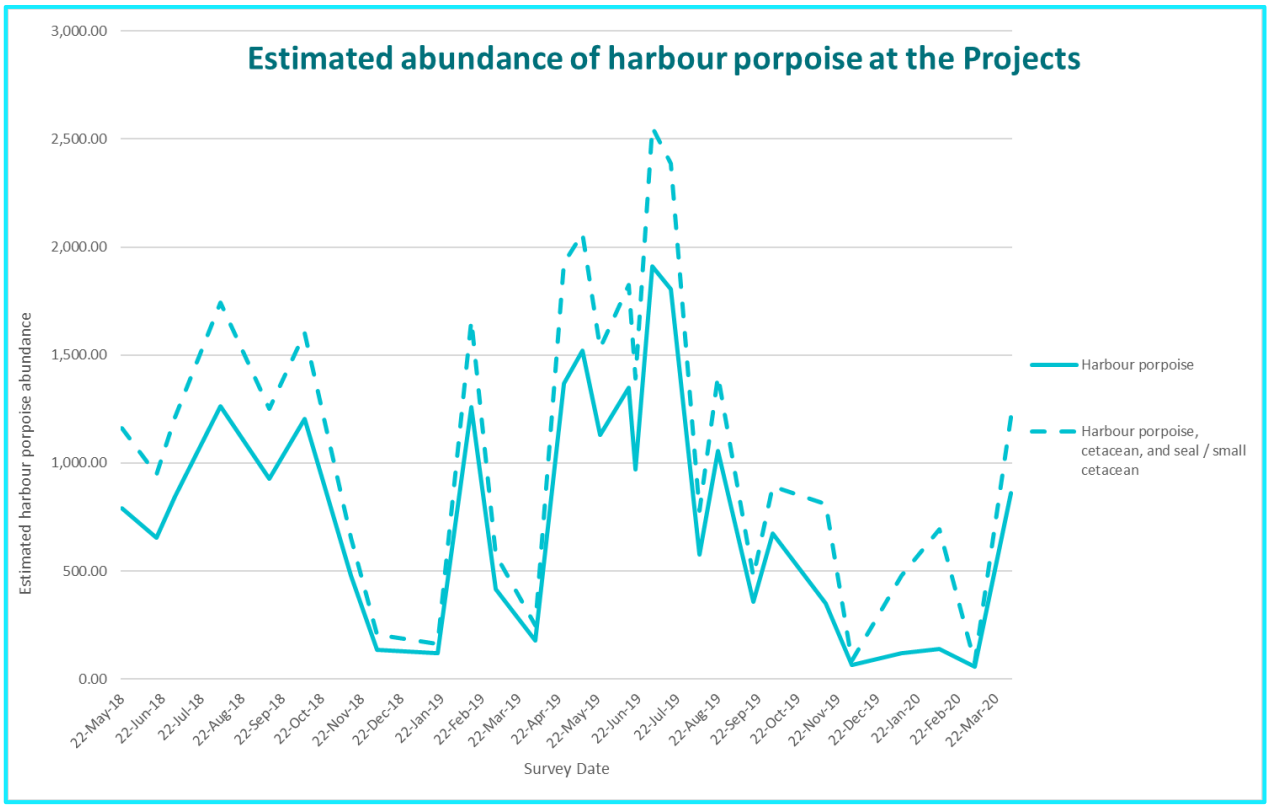

Plate 10.1.3: Estimated abundance of harbour porpoise within whole survey area, corrected for availability bias

Harbour Porpoise Distribution Patterns as shown by the Site-Specific Surveys

62. The distribution of harbour porpoise within SEP and DEP varied, with individuals present across the survey area (both SEP and DEP, with a 4km buffer), including within the existing Dudgeon and Sheringham Shoal offshore wind farms. There is no evident pattern of harbour porpoise distribution within the survey area, with no indication of a particular area of importance. See **Annex 1** – Site Specific Harbour Porpoise Density Maps for harbour porpoise monthly density maps.

Review of Abundance and Density Estimates for Harbour Porpoise

63. 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).

64. Results from the SCANS-III survey (the most recent available; undertaken in summer 2016; Hammond *et al.,* 2021) 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.

65. Within the impact assessments for harbour porpoise, and in addition to the site specific density estimates for harbour porpoise, density estimates from the SCANS-III surveys (Hammond *et al.*, 2021) will also be used to provide context for the wider area. The SEP and DEP sites are both in SCANS-III survey blocks O (**Plate 10.1.4**; Plate 10.1.5):

- Abundance = 53,485 harbour porpoise (CV = 0.209; 95% CI = 37,413-81,695)
- Density = 0.888 harbour porpoise/km^2 (CV=0.209)

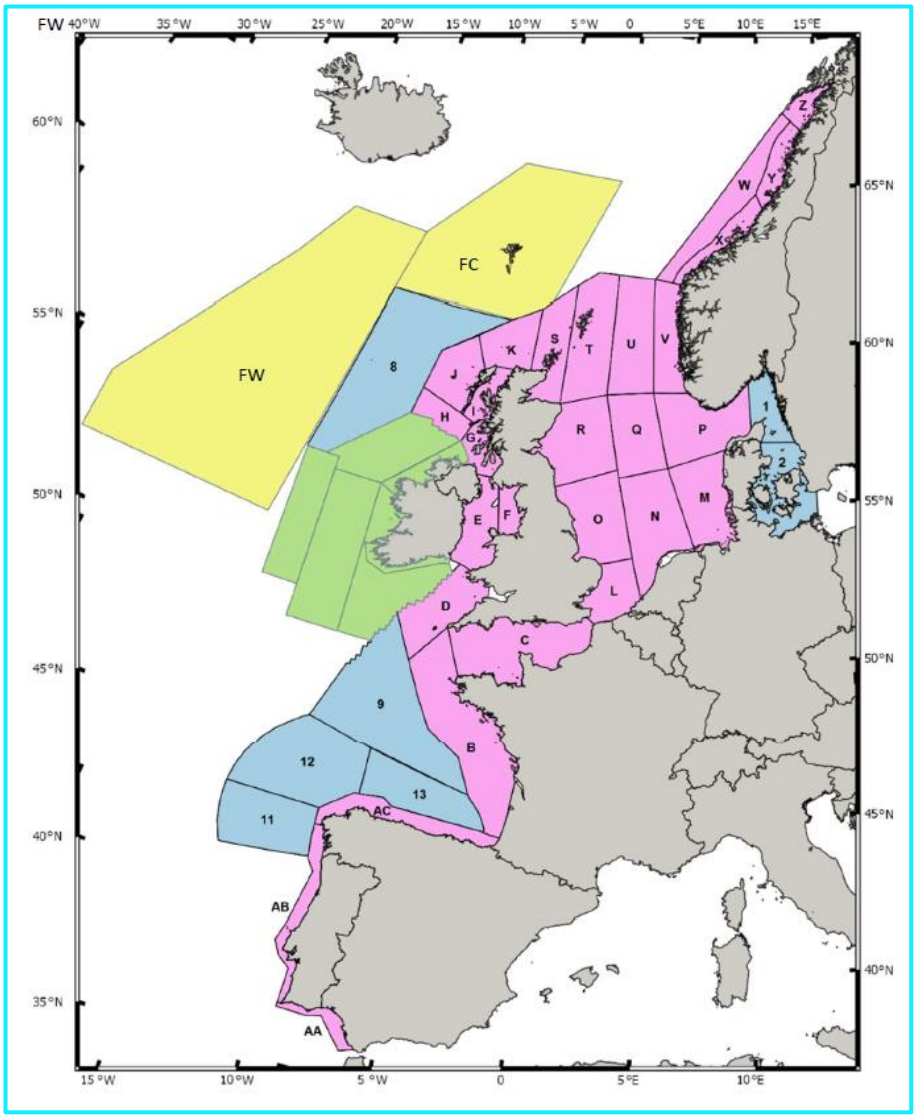

Plate 10.1.4 Area covered by the SCANS-III survey, and the locations of the SCANS-III survey blocks (SEP and DEP are within Survey Block O) (Hammond et al., 2021)

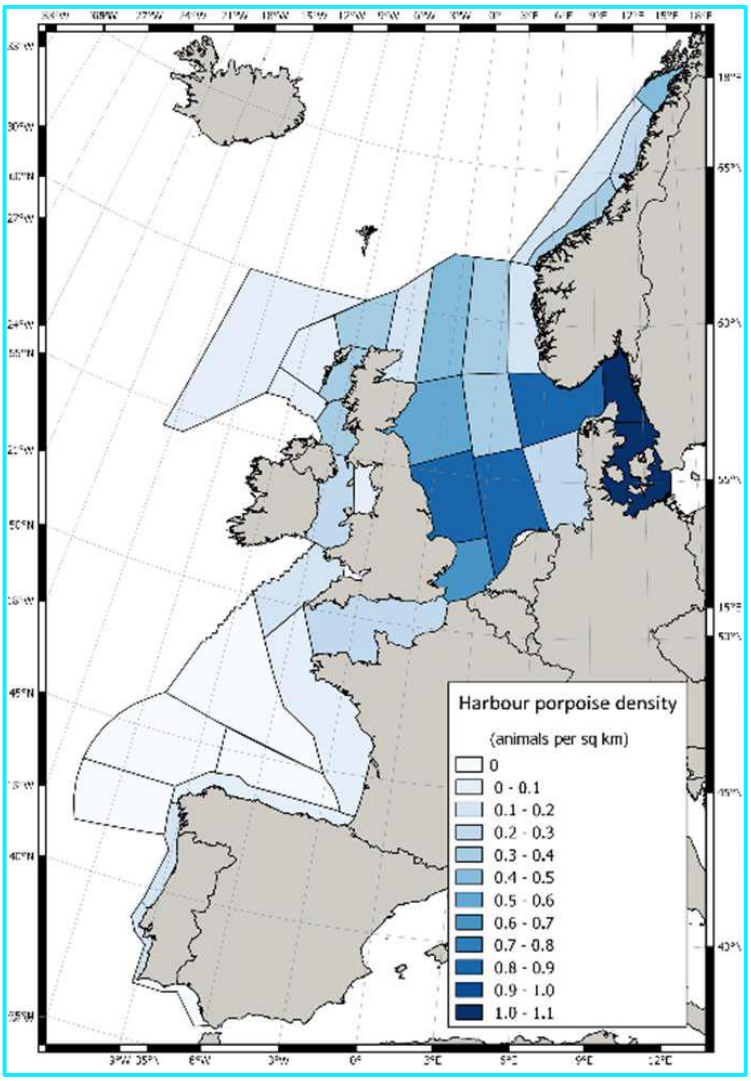

Plate 10.1.5 Estimated harbour porpoise density in each SCANS-III survey block (Hammond et al., 2021)

66. Harbour porpoise within the eastern North Atlantic are generally considered to be part of a continuous biological population that extends from the French coastline of the Bay of Biscay to northern Norway and Iceland (Tolley and Rosel, 2006; Fontaine *et al.*, 2007, 2014; IAMMWG, 2022). 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, 2022).

67. IAMMWG defined three MUs for harbour porpoise: North Sea (NS); West Scotland (WS); and the Celtic and Irish Sea (CIS). SEP and DEP are located in the NS MU (**Plate 10.1.6)**.

68. The estimate of harbour porpoise abundance in the North Sea MU is 346,601 (CV = 0.09; 95%; CI = 289,498 – 419,967 IAMMWG, 2022). This is the reference population for harbour porpoise, of which any potential impacts will be assessed against.

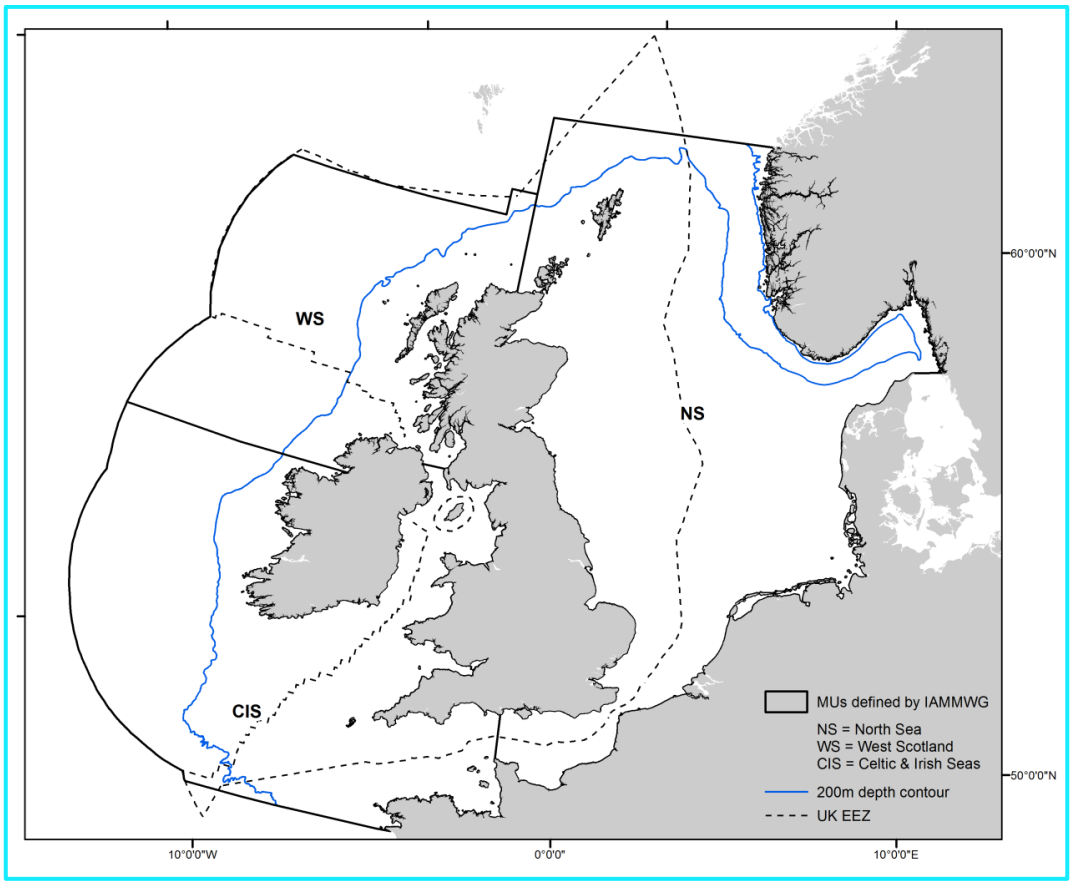

Plate 10.1.6 Harbour porpoise Management Units (MUs), noting that this species is largely confined to the continental shelf (i.e. waters <200m depth) (IAMMWG, 2022).

Diet of Harbour Porpoise

69. 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).

70. 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 and Rogan 1995; Kastelein *et al.,* 1997; Börjesson *et al.,* 2003; Santos and Pierce 2003; Santos *et al.,* 2004).

71. 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 and 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.

72. 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).

10.1.4.4.2 Bottlenose Dolphin

Desk-Based Review of Bottlenose Dolphin Presence

73. 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[6].

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

75. A resident population of bottlenose dolphin is present in the Moray Firth, with an estimated 209 individuals (95% CI 198 – 230; Arso Civil *et al*., 2019) which are known to travel south along the Aberdeenshire coast. Historically, very few sightings of bottlenose dolphin were recorded further south on the east coast of the UK, however, in recent years an increase in bottlenose dolphins in the north-east of England have been reported (Aynsley, 2017), with one individual from the Moray Firth population being recorded as far south as The Netherlands.

76. Bottlenose dolphin sightings were made year-round along the north-east England coast (between 2013 and 2016; Aynsley, 2017), suggesting that there is no seasonal pattern to the increase in recent sightings numbers. A total of 48 of the individuals sighted within this period on the north-east coast were attributed to being part of the Moray Firth population using photo-identification. A total of 11 calves were also sighted, indicating that bottlenose dolphin in this area of coastline are reproductively active.

77. 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 (and near to both SEP and DEP) is low, with less than 0.1 individuals per km^2 (97.5% CI 0-0.1 – 0-0.1 per km^2) (Paxton *et al.*, 2016).

78. The SCANS -III survey shows a similar distribution pattern, with no bottlenose dolphin identified within the southern North Sea survey block L or the more northerly block O, and higher densities with block R, for the east coast of Scotland (**Plate 10.1.7**, Hammond *et al.*, 2021).

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

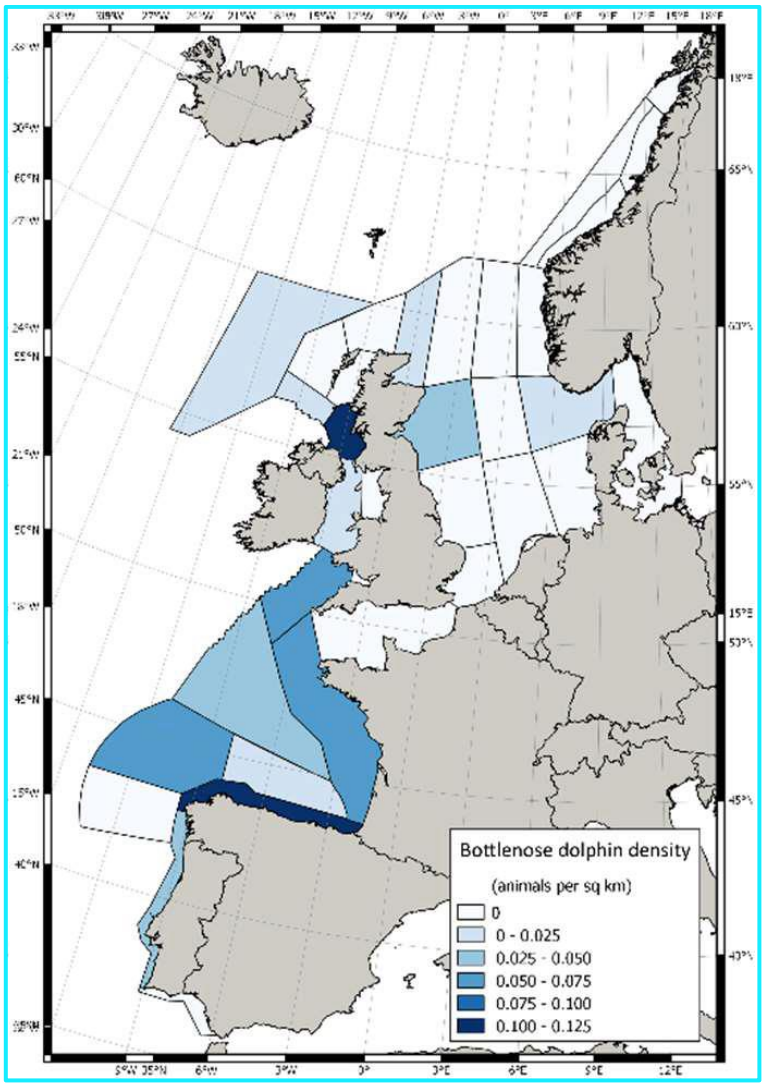

Plate 10.1.7 Estimated bottlenose dolphin density in each SCANS-III survey block (Hammond et al., 2021)

79. 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 10.1.8;** Waggitt *et al*., 2019). Densities of bottlenose dolphin in the North Sea are very low in comparison. The distribution maps also indicate a 'corridor' of increased bottlenose 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. Interrogation of this data[7], including all 10km 'grids' that overlap with the specified area, reveals an average annual density estimate of:

- 0.0001 individuals per km^2 (average of all overlapping 10km 'grids') for the SEP Site;

[7] Available from: [redacted]

- 0.00015 individuals per km^2 (average of all overlapping 10km 'grids') for the DEP Site; and
- 0.00013 individuals per km^2 (average of all overlapping 10km 'grids') for SEP, DEP, and all export cables.

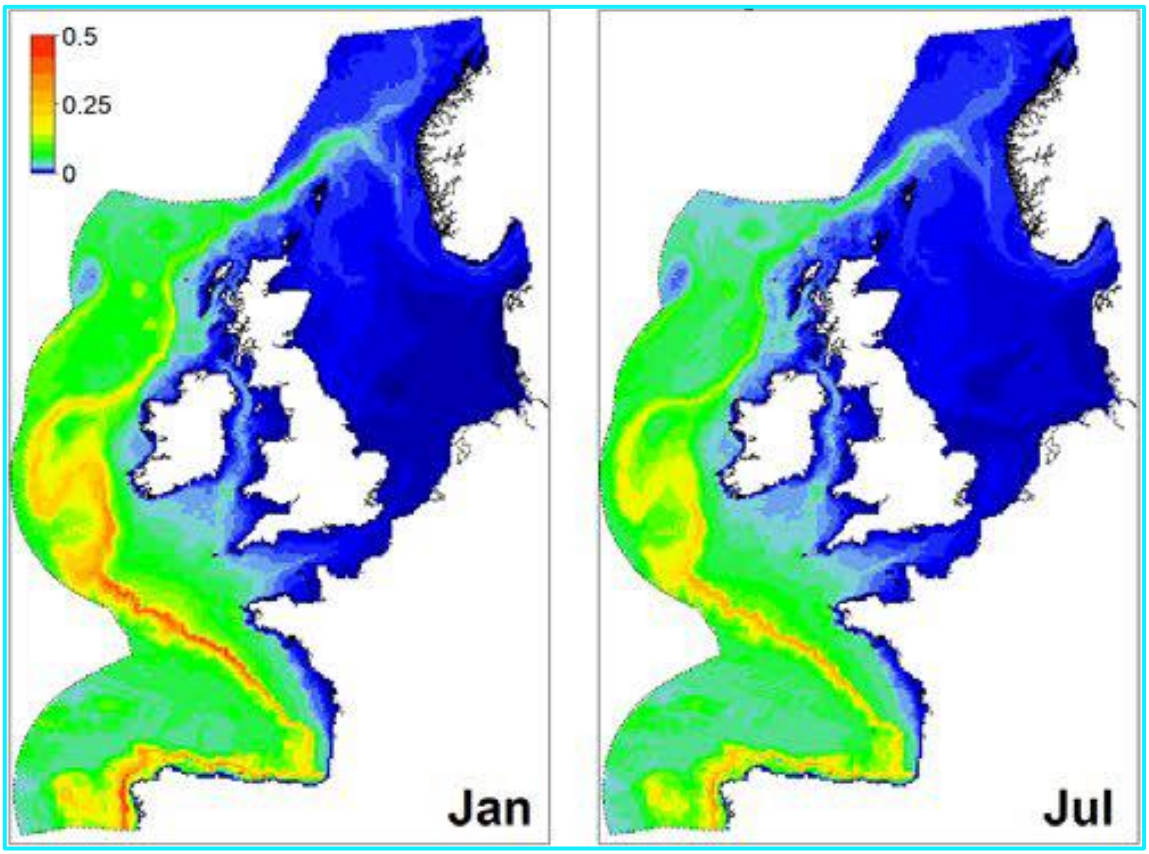

Plate 10.1.8: Spatial variation in predicted densities (individuals per km of bottlenose dolphin in January and July in the North-East Atlantic). Values are provided at 10 km resolution. Source: Waggitt et al., 2019.

Results from the Site-Specific Surveys for Bottlenose Dolphin

80. During the site specific aerial surveys of both SEP and DEP, undertaken from May 2018 to April 2020, no bottlenose dolphin were recorded. However, a number of sightings were recorded as seal / small cetacean species, or cetacean species, some of which could have been bottlenose dolphin.

Review of Abundance and Density Estimates Bottlenose Dolphin

81. 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-III survey area, bottlenose dolphin abundance in the summer of 2016 was estimated to be 19,201, with an overall estimated density of 0.00159/km^2 (CV = 0.242; 95% CI = 11,404-29,670; Hammond *et al.*, 2021).

82. There is currently no density estimate for bottlenose dolphin in and around DEP or SEP, therefore, the number of bottlenose dolphins that could be impacted has been based on the SCANS-III density estimates for the adjacent survey block R, which covers the Moray Firth area, of which includes the same bottlenose dolphin population as had recently been recorded off the east coast of England.

83. Therefore, within the impact assessments for bottlenose dolphin, density estimates from the SCANS-III surveys will be used for block R (Hammond *et al.*, 2021):

- Abundance = 1,924 bottlenose dolphin (CV=0.861; 95% CI=0-5,048)
- Density = 0.0298 bottlenose dolphin/km^2 (CV=0.861)

84. As for the density estimate, the Greater North Sea MU (**Plate 10.1.9**), of which sits SEP and DEP, has a population estimate for the bottlenose dolphin of 2,022 (95% CI = 548 – 7,453; IAMMWG, 2022). In addition, the assessments are out into context of the Coastal East Scotland (CES) MU; with a population estimate for the bottlenose dolphin of 224 (CV = 0.023; 95% CI = 214 -234; IAMMWG, 2022).

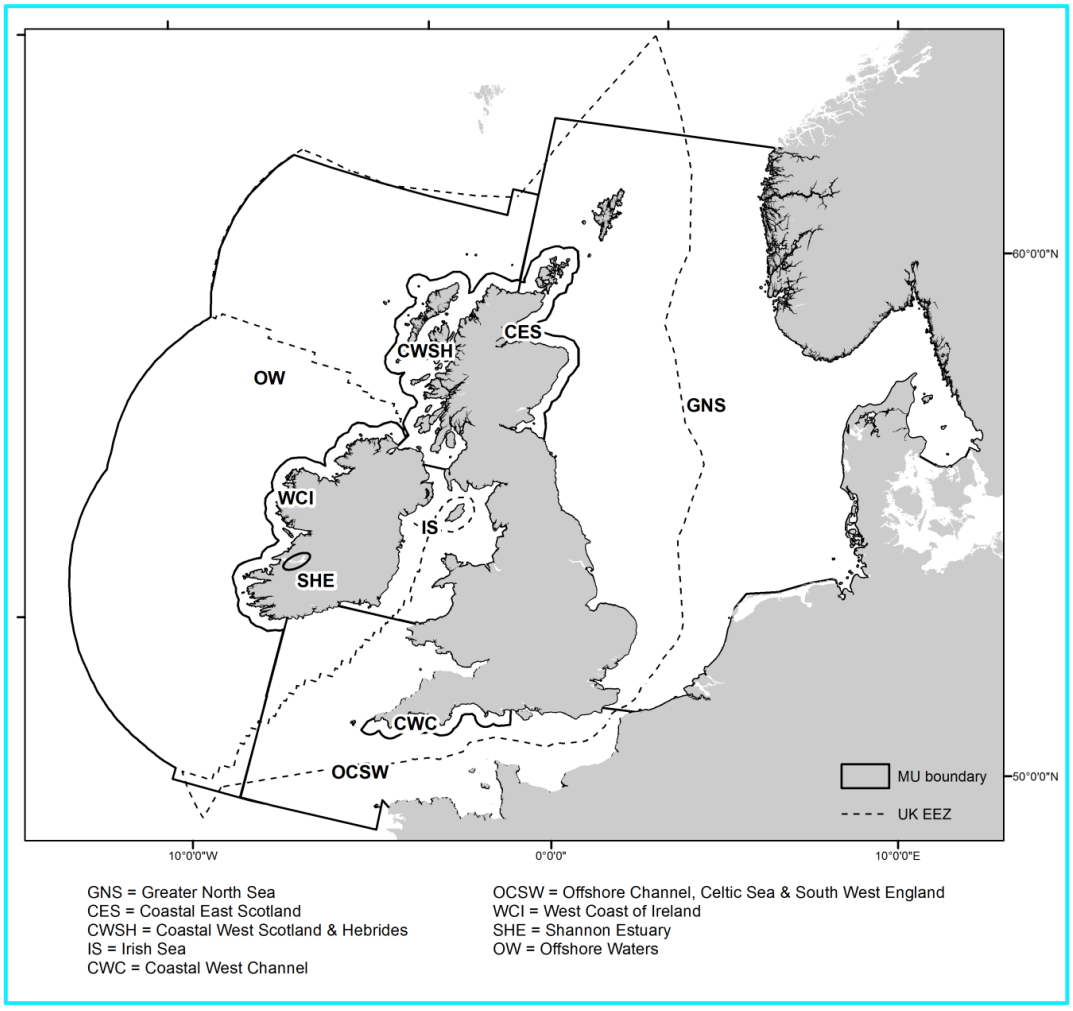

Plate 10.1.9 Bottlenose dolphin MU (IAMMWG, 2022).

Diet of Bottlenose Dolphin

85. 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 *adus 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).

86. 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).

87. 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).

10.1.4.4.3 White-beaked Dolphin

Desk-Based Review of White-Beaked Dolphin Presence

88. 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).

89. 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).

90. 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 Wildfowl and Wetlands Trust (WWT) Consulting from 2001-2008 (WWT, 2009). A number of unknown dolphin species were also 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).

91. Marine mammal sightings made at oil and gas installations in the central North Sea through the Danish offshore marine mammal sightings reporting programme from 2013 to 2016 (sightings are incidental reporting's from staff at oil and gas platforms, which are located approximately 200km from the west coast of Denmark) indicate that white-beaked dolphin are one of the less common species sighted in the far offshore areas (Delefosse *et al*., 2018).

92. 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 (and near to both SEP and DEP) is low, with less than 0.1 individuals per km^2 (97.5% CI 0-0.1 – 0-0.2 per km^2) (Paxton *et al.*, 2016).

93. 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).

94. 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 10.1.10**; Waggitt *et al*., 2019). SEP and DEP are located to the very southern end of the area with relatively higher densities, and there appears to be no significant different in their seasonal distributions within this area. Interrogation of this data[8], including all 10km 'grids' that overlap with the specified area, reveals an average annual density estimate of:

- 0.0055 individuals per km^2 (average of all overlapping 10km 'grids') for the SEP Site;
- 0.0075 individuals per km^2 (average of all overlapping 10km 'grids') for the DEP Site; and
- 0.0058 individuals per km^2 (average of all overlapping 10km 'grids') for SEP, DEP, and all export cables.

[8] Available from: [redacted]

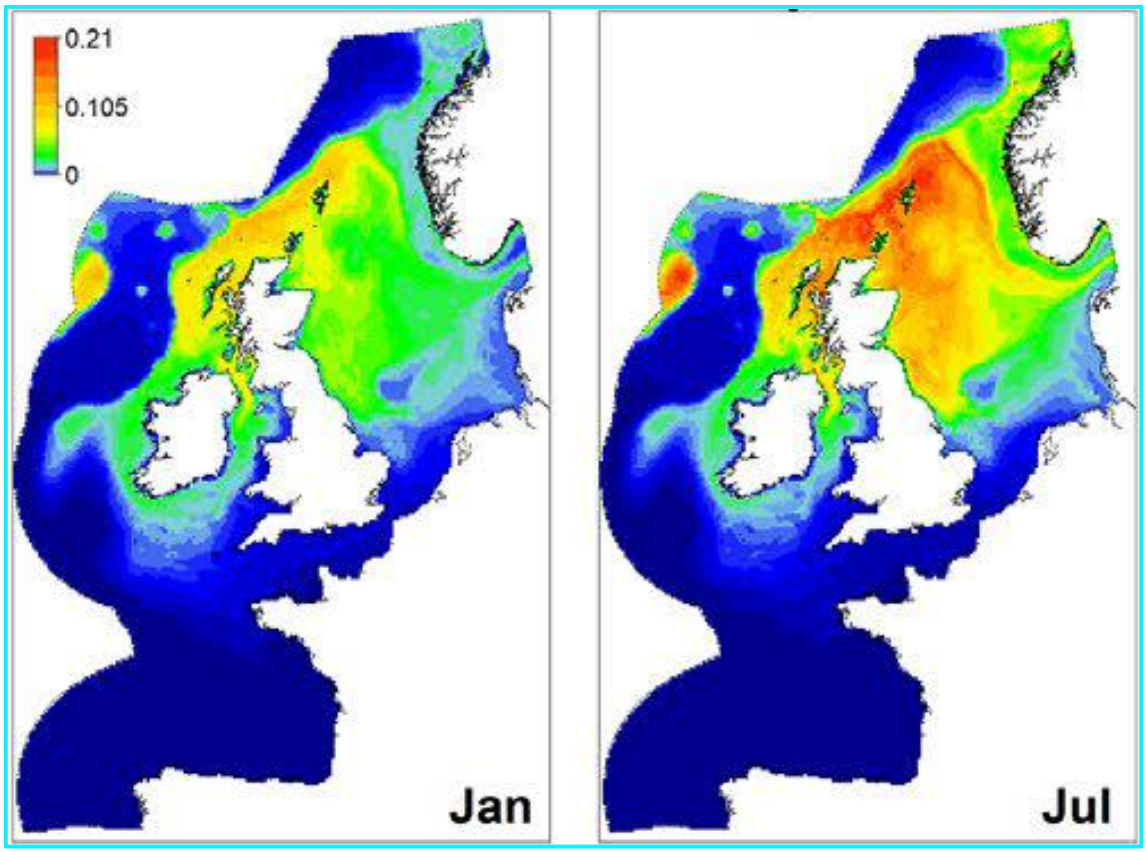

Plate 10.1.10: Spatial variation in predicted densities (individuals per km of white-beaked dolphin in January and July in the North-East Atlantic). Values are provided at 10 km resolution. Source: Waggitt et al., 2019.

Results from the Site-Specific Surveys for White-Beaked Dolphin

95. During the site specific aerial surveys of both SEP and DEP, undertaken from May 2018 to April 2020, no white-beaked dolphin were recorded. However, a number of sightings were recorded as seal / small cetacean species, or cetacean species, some of which could have been white-beaked dolphin.

Review of Abundance and Density Estimates for White-Beaked Dolphin

96. For the entire SCANS-III survey area, white-beaked dolphin abundance in the summer of 2016 was estimated to be 36,287 with an overall estimated density of 0.030/km^2 (CV = 0.29; 95% CI = 18,694-61,869; Hammond *et al.*, 2017). SEP and DEP are located in SCANS-III survey block O (Hammond *et al*., 2021):

- Abundance = 143 white-beaked dolphin (CV=0.97; 95% CI= 0-490)
- Density = 0.002 white-beaked dolphin/km^2 (CV=0.97)

97. Within the impact assessments for white-beaked dolphin, the worse-case density estimates for the offshore sites will be used. For white-beaked dolphin the highest density estimate was from the distribution maps developed by Waggitt *et al.* (2019), with a project wide (for both SEP and DEP) density estimate of 0.006 individuals per km^2.

98. 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, 2022).

99. The single MU for white-beaked dolphin, the Celtic and Greater North Seas MU (**Plate 10.1.11)**, comprises all UK waters and extends to the seaward boundary used by the European Commission for Habitats Directive reporting (area known as Marine Atlantic, termed MATL) (IAMMWG, 2022). However, it is worth noting that this species usually occurs on the continental shelf (Reid *et al.*, 2003; IAMMWG, 2022). The UK EEZ white-beaked dolphin abundance is 34,025 (CV = 0.28; 95% CI = 20,026 – 57,807), which are derived from the SCANS-III (Hammond *et al.*, 2017) and ObSERVE data (Rogan *et al.,* 2018).The reference population for white-beaked dolphin in the Celtic and Greater North Sea MU is 43,951 animals (CV=0.22; 95% CI= 28,439 – 67,924; IAMMWG, 2022). This is the reference population for white-beaked dolphin, of which any potential impacts will be assessed against, as agreed as part of the marine mammal ETG (see **Section 10.2** of **Chapter 10 Marine Mammals**) at the meeting on 20th July 2021.

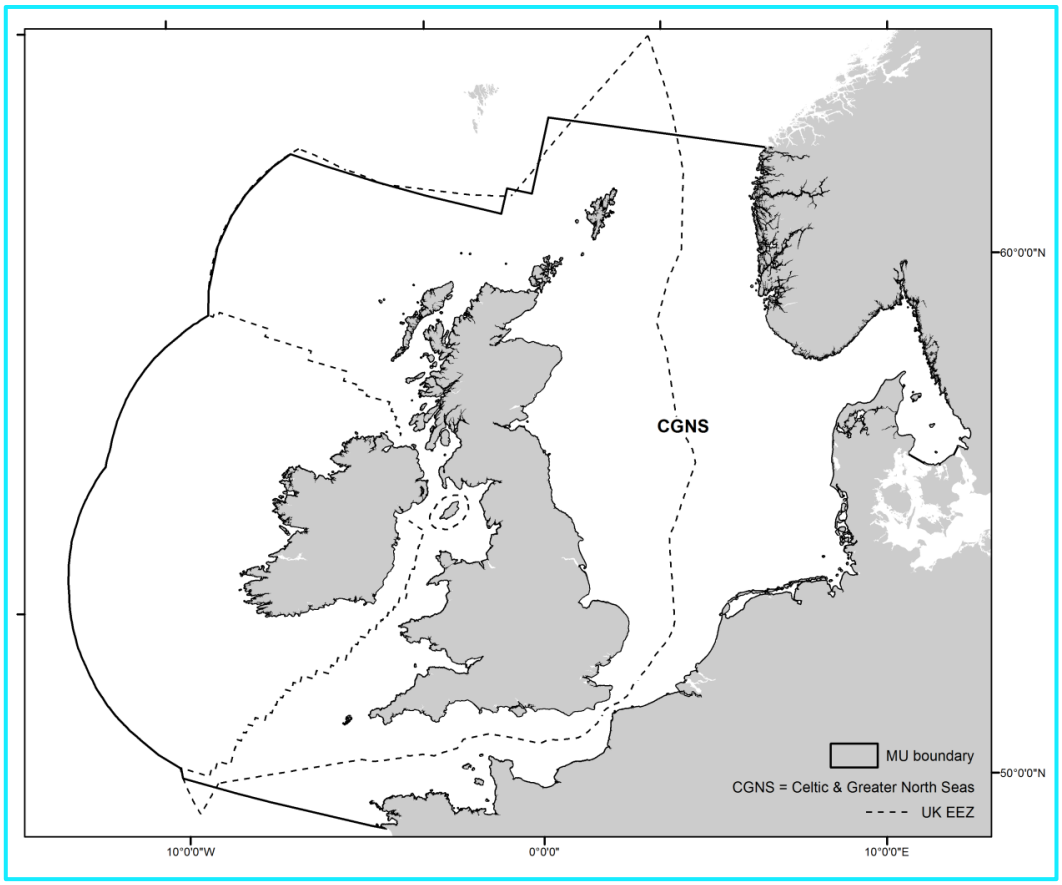

Plate 10.1.11: MU for common dolphin, white-beaked dolphin and minke whale (IAMMWG, 2022).

Diet of White-Beaked Dolphin

100. 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 mackeral (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).

101. 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, cod represented a further 11% of the total reconstructed weight.

10.1.4.4.4 Minke Whale

Desk-Based Review of Minke Whale Presence

102. 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).

103. 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).

104. 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.

105. 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 10.1.12**; Waggitt *et al*., 2019). 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. SEP and DEP are located to the very southern end of the area with relatively higher densities, and there appears to be no significant different in their seasonal distributions within this area. Interrogation of this data[9], including all 10km 'grids' that overlap with the specified area, reveals an average annual density estimate of:

- 0.002 individuals per km^2 (average of all overlapping 10km 'grids') for the SEP Site;
- 0.0025 individuals per km^2 (average of all overlapping 10km 'grids') for the DEP Site; and
- 0.0022 individuals per km^2 (average of all overlapping 10km 'grids') for SEP, DEP, and all export cables.

[9] Available from: [redacted]

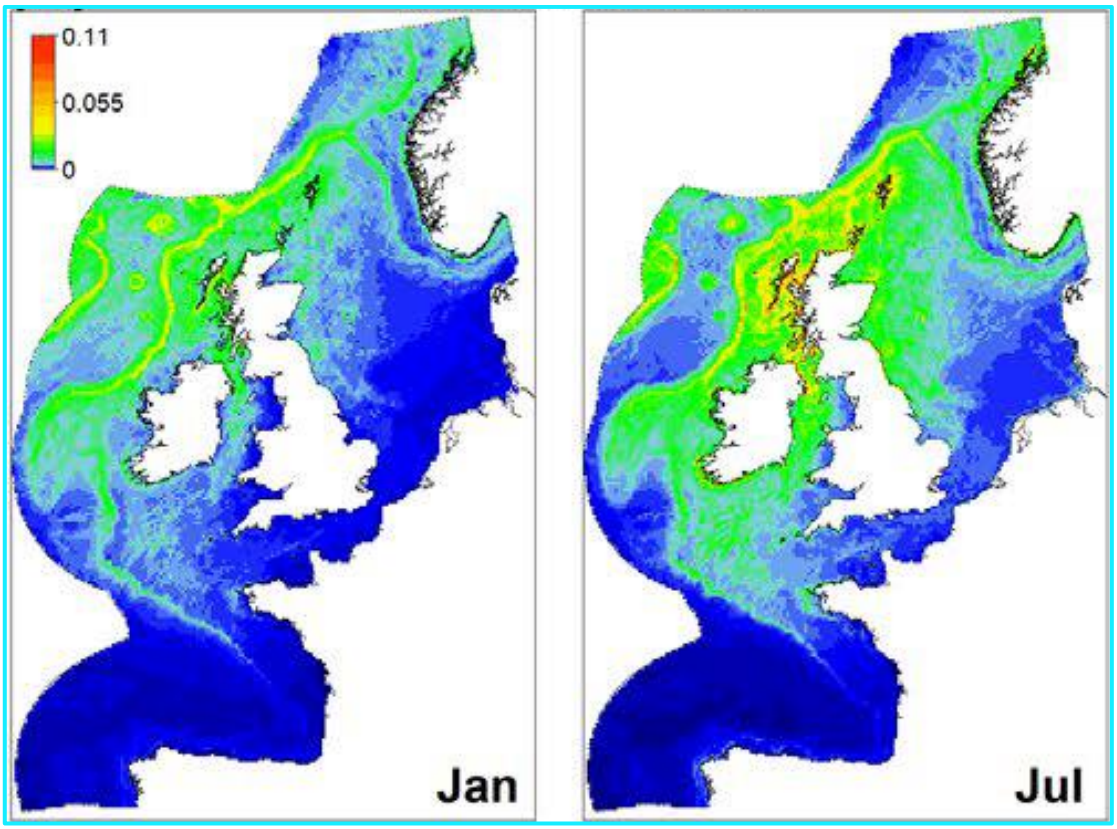

Plate 10.1.12: Spatial variation in predicted densities (individuals per km of minke whale in January and July in the North-East Atlantic). Values are provided at 10 km resolution. Source: Waggitt et al., 2019.

Results from the Site-Specific Surveys for Minke Whale

106. During the SEP and DEP site specific aerial surveys (29 surveys undertaken between May 2018 and April 2020), a single minke whale was positively identified in July 2018 just north of DEP, resulting in a relative density estimate of 0.01 individuals per km^2. This is the same density estimate as for the SCANS-III survey (see below).

Review of Abundance and Density Estimates for Minke Whale

107. For the entire SCANS-III survey area, minke whale abundance in the summer of 2016 was estimated to be 13,101 with an overall estimated density of 0.0108/km^2 (CV = 0.345; 95% CI = 7,050-26,721; Hammond *et al.*, 2021).

108. Within the impact assessments for minke whale, density estimates from the SCANS-III surveys will be used. SEP and DEP are located in SCANS-III survey block O (Hammond *et al*., 2021):

- Abundance = 603 minke whale (CV=0.62; 95% CI=109-1,670)
- Density = 0.0100 minke whale/km^2 (CV=0.621)

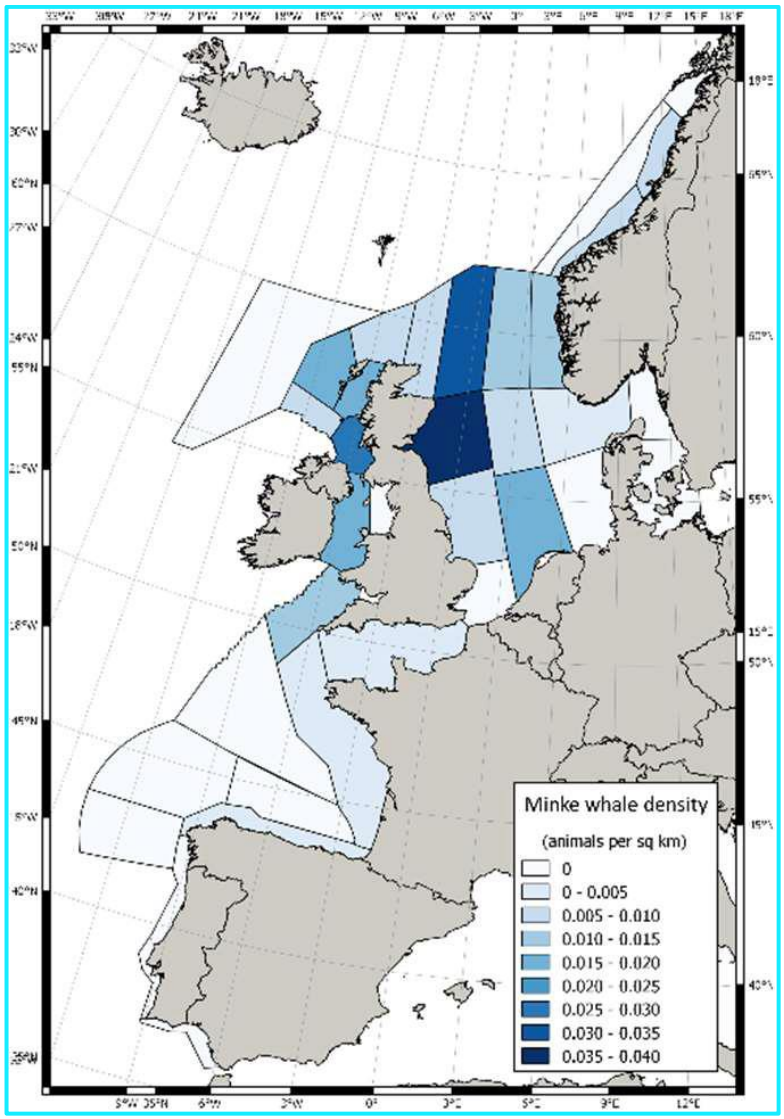

Plate 10.1.13 Estimated minke whale density in each SCANS-III survey block (Hammond et al., 2021)

109. 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 (2022) considers a single MU is appropriate for minke whales in European waters.

110. The single MU for minke is the Celtic and Greater North Seas MU (**Plate 10.1.13)**, covering the same geographical area as described for white-beaked dolphin in **Section 10.1.4.4.3** (IAMMWG, 2022). The reference population for minke whales in the Celtic and Greater North Seas MU is 20,118 animals (CV = 0.18; 95% CI = 14,061 – 28,786; IAMMWG, 2022). This estimate was derived from using the SCANS-III (Hammond *et al.*, 2017) and ObSERVE data (Rogan *et al.,* 2018). The IAMMWG (2022) note the abundance of minke whales is highly seasonal, with abundance peaking during migration south into waters around the UK for summer.

Diet of Minke Whale

111. 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.

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

10.1.4.4.5 Grey Seal

Desk-Based Review of Grey Seal Presence

113. 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, 2020).

114. Approximately 36% of the worlds grey seals breed in the UK, and 81% of these breed at colonies in Scotland with the main concentrations in the Outer Hebrides and in Orkney. There are also breeding colonies in Shetland, on the north and east coasts of mainland Britain and in south-west England and Wales (SCOS, 2020).

115. Grey seals are wide ranging and can breed and forage in different areas (Russell *et al.,* 2013). 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 10.1.14** 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 both SEP and DEP (Russell, 2016).

116. 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).

117. 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 10.1.15**).

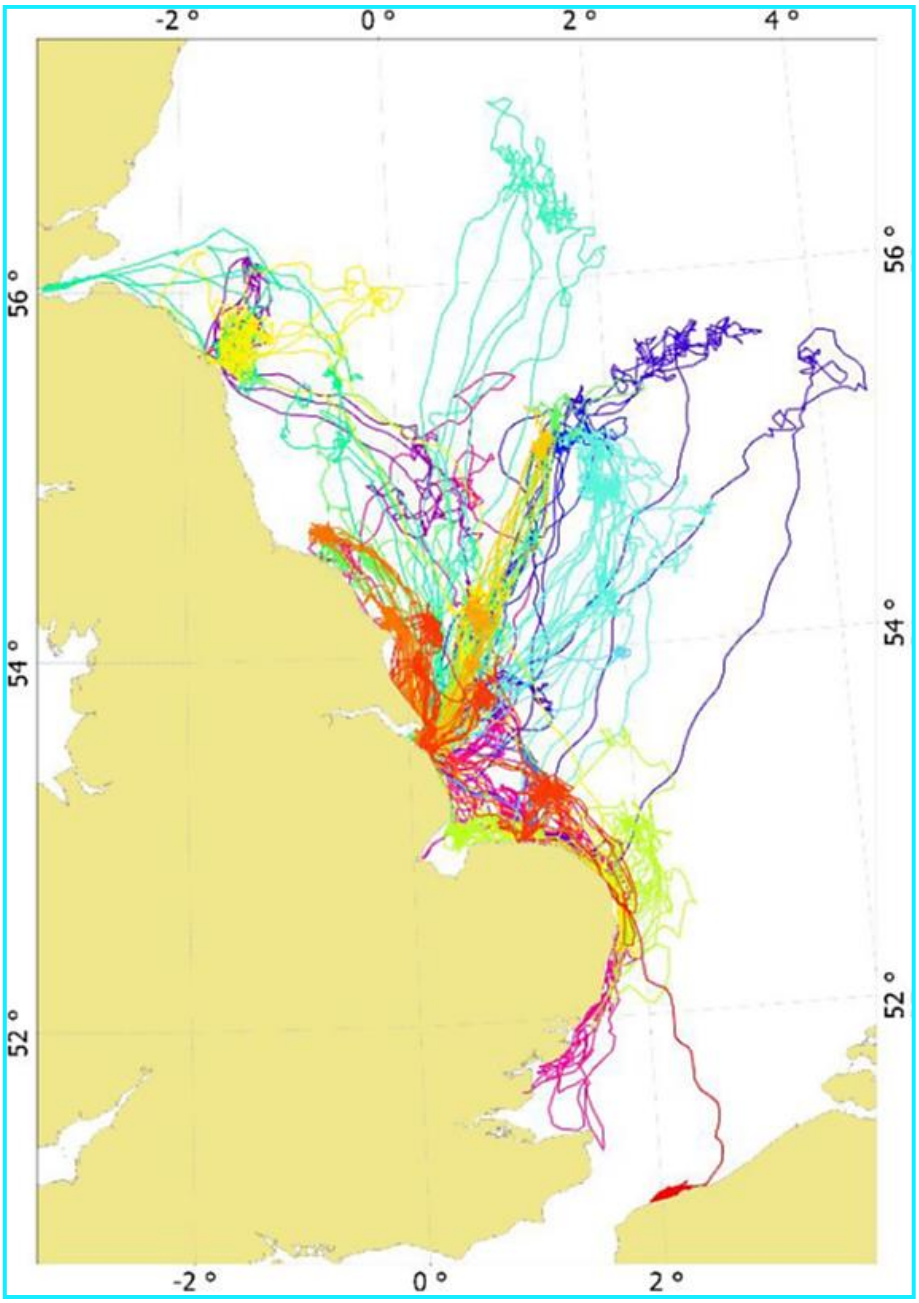

Plate 10.1.14: Tagged grey seal movements along the East coast of England (Russell, 2016).

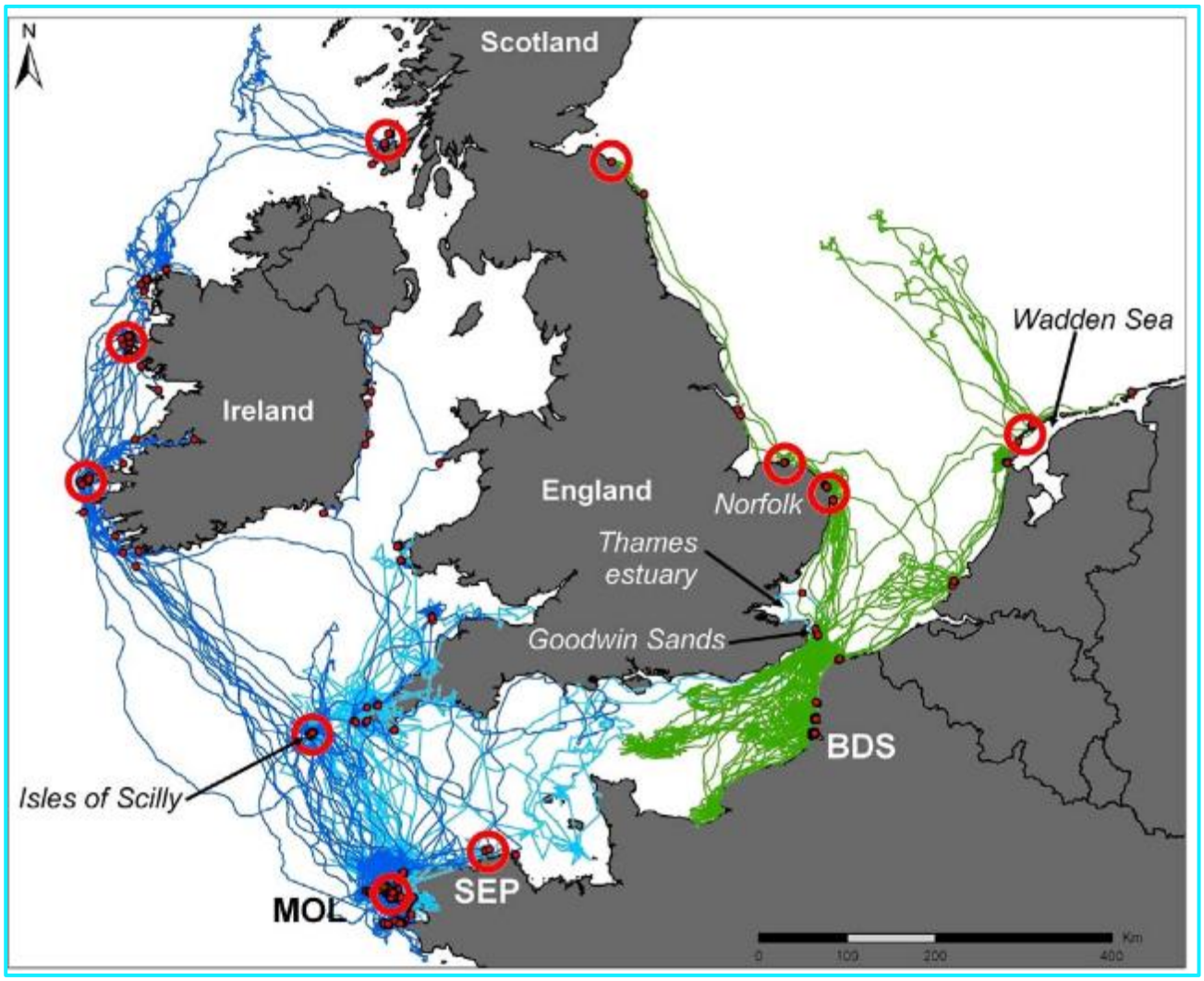

Plate 10.1.15: Grey seal telemetry tags (shown in green are the results from the tagging of 11 individuals in 2012, from the baie de Somme (BDS) haul-out site on the north coast of France. Red dots indicate haul-out sites, and red circles indicate breeding locations. Source: Vincent et al. (2017).

118. 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 2019).

Grey Seal Haul-Out Sites

119. 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, 2020).

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

121. SEP and DEP is located approximately 13.6km offshore (at the closest point). Principal grey seal haul-out sites are included in **Table 10.1.15**, which shows the approximate distance to the closest point of SEP and DEP, and the most recent grey seal count for each location.

Table 10.1.15: The most recent grey seal count at each of the nearby haul-out sites, and the distance to SEP and DEP

Haul-out site	Distance to SEP and DEP	Grey seal count
Blakeney Point National Nature Reserve (NNR)	12km from landfall 12km from export cable corridor 38km from DEP 22km from SEP	635 (2019 grey seal count; SCOS, 2020)
Horsey Corner	44km from landfall 44km from the export cable corridor 50km from DEP 50km from SEP	1,698 adults recorded at any one time; 2,500 pups born over the 2020-2021 season (Friends of Horsey Seals, 2021)
The Wash	58km from landfall 58km from export cable corridor 75km from DEP 57km from SEP	540 (2018 grey seal count; SCOS, 2020)
Scroby Sands	59km from landfall 58km from the export cable corridor 64km from DEP 64km from SEP	497 (2019 grey seal count; SCOS, 2020)
Donna Nook	59km from landfall 58km from the export cable corridor 64km from DEP 64km from SEP	5,265 (2019 grey seal count; SCOS, 2020)

Results from the Site-Specific Surveys for Grey Seal

122. As noted above, a relatively low number of grey seal were recorded during the site-specific aerial surveys, with a total of 31 individuals recorded through the 29 survey dates, however, in addition a total of 198 unidentified seal species were recorded, as well as 36 seal / small cetacean species, a proportion of which are expected to be grey seal.

123. With the exception of a large spike in unidentified seal sightings in July 2019 (with a total of 62 over two survey days), numbers of grey seal, or individuals that could be grey seal (i.e. seal species and seal / small cetacean species) were relatively similar year-round, with small spikes in sightings number, but no clear change seasonally.

Site-Specific Survey Density Estimates for Grey Seal

124. Due to the low number of grey seal sightings, absolute density and abundance estimates were not possible to derive. However, relative density and abundance estimates were calculated (see **Section 10.1.4.3** for more information on how these have been calculated). These have been provided in order to provide site-specific information on the number of grey seal expected to be present at SEP and DEP, however, impact assessments will be based on absolute densities as derived from desk-based sources (see below).

125. Relative density estimates have been calculated from the raw data counts for (i) grey seal; (ii) seal species, and (iii) seal / small cetacean species. These have also been corrected for availability bias. Individuals from the two species groupings listed above are assumed to all be grey seal as a worst-case, and are considered together within the density and abundance estimates as set out below. These abundance and densities are for the entire survey area, plus 4km buffer (i.e. they relevant for both SEP and DEP).

126. Correction factors were then be applied to the relative density estimates to account for the presence of individuals below 2m water depth (the depth at which it is no longer possible to detect marine mammals from aerial imagery).

127. For grey and harbour seal, the Sea Mammal Research Unit (SMRU) used tagging studies of 44 grey seals (1997) and 17 harbour seals (2003-2004) in the Pentland Firth and Orkney (SMRU, 2011). For grey seal, data collected from 22,012 dives found an average of 27.09% time spent at the waters surface. This did not account for the time that the seals would be just below the water's surface and so would still be detectable in aerial surveys. Therefore, the correction factor for grey seal is 0.27.

128. This seasonal correction factors (of 0.27) has been used to generate grey seal relative density and abundance estimates for the SEP and DEP sites and 4km buffer.

129. Relative density estimates for grey seal have then been calculated, based on the density estimate (with correction factor applied) for grey seal and for the other species groups that could be grey seal (i.e. seal species, and seals / small cetacean species).

130. The maximum density of each month was taken for each of the species groups, and corrected for availability. The average of the annual density has then been calculated based on the maximum calculated for each month. **Table 10.1.16** shows the density estimates for grey seal only, and **Table 10.1.17** shows the densities when the two other species groups are included (i.e. all individuals that have the potential to be grey seal).

Table 10.1.16: Maximum grey seal relative density estimates calculated for each month, corrected for availability bias, with annual density estimate for whole survey area, DEP plus 4km buffer, and SEP plus 4km buffer (note that the whole survey area covers a larger area than for SEP and DEP (plus 4km buffers) combined)

Month	Maximum density estimate (corrected) for whole survey area	Maximum density estimate (corrected) for DEP + 4km buffer	Maximum density estimate (corrected) for SEP + 4km buffer
January	0.074	0.380	0.170
February	0.037	0.074	-
March	0.074	-	0.223
April	0.037	0.124	-
May	0.074	0.307	-
June	0.148	0.745	0.531
July	0.074	0.314	0.861
August	0.037	-	0.319
September	0.074	-	0.222
October	0.074	0.161	-
November	0.037	0.074	0.074
December	0.074	0.153	0.111
Average annual	**0.068**	**0.259**	**0.314**

Table 10.1.17: Maximum grey seal relative density estimates (including seal species and seal / small cetacean species groups) calculated for each month, corrected for availability bias, with annual density estimate for whole survey area, DEP plus 4km buffer, and SEP plus 4km buffer (note that the whole survey area covers a larger area than for SEP and DEP (plus 4km buffers) combined)

Month	Maximum density estimate (corrected) for whole survey area	Maximum density estimate (corrected) for DEP + 4km buffer	Maximum density estimate (corrected) for SEP + 4km buffer
January	0.481	0.972	0.392
February	0.333	0.370	0.222

Month	Maximum density estimate (corrected) for whole survey area	Maximum density estimate (corrected) for DEP + 4km buffer	Maximum density estimate (corrected) for SEP + 4km buffer
March	0.333	0.074	0.631
April	0.333	0.420	0.222
May	0.444	0.825	0.222
June	0.778	1.337	0.865
July	1.444	1.425	1.713
August	0.481	0.444	0.541
September	0.222	0.222	0.333
October	0.407	0.235	0.222
November	0.185	0.074	0.407
December	0.222	0.227	0.444
Average annual	**0.472**	**0.552**	**0.518**

Site-Specific Survey Abundance Estimates for Grey Seal

131. In addition to the density estimates as described above, abundance estimates of grey seal at SEP and DEP have been derived. These abundance estimates have been corrected in the same way as the density estimates above, and all species groupings that have the potential to be grey seal are included (i.e. grey seal have been corrected as stated above).

132. These abundance estimates are shown in **Table 10.1.18** and **Plate 10.1.16**. As shown in **Plate 10.1.16**, and outlined above, there is no clear seasonal pattern in the abundance of grey seal within the entire survey area, with the exception of a peak in grey seal sightings in July 2019, with an estimate of 1,700 individuals, predominantly formed of sightings within the grouping 'seal species'.

Table 10.1.18: Estimated abundance of grey seal within the survey area, corrected for availability bias

Month	Maximum abundance estimate (corrected) for grey seal	Maximum abundance estimate (corrected) for grey seal (including seal species and seal / small cetacean species)
22-May-18	78	411
18-Jun-18	0	374

Month	Maximum abundance estimate (corrected) for grey seal	Maximum abundance estimate (corrected) for grey seal (including seal species and seal / small cetacean species)
02-Jul-18	0	189
06-Aug-18	37	596
12-Sep-18	78	193
09-Oct-18	74	489
14-Nov-18	41	189
04-Dec-18	0	115
19-Jan-19	74	411
14-Feb-19	37	407
05-Mar-19	0	300
04-Apr-19	37	148
26-Apr-19	0	370
10-May-19	0	111
24-May-19	0	296
15-Jun-19	37	519
20-Jun-19	185	893
03-Jul-19	41	933
17-Jul-19	111	1,700
08-Aug-19	37	374
22-Aug-19	0	152
18-Sep-19	0	200
03-Oct-19	41	300
13-Nov-19	37	226

Month	Maximum abundance estimate (corrected) for grey seal	Maximum abundance estimate (corrected) for grey seal (including seal species and seal / small cetacean species)
03-Dec-19	111	259
10-Jan-20	0	226
08-Feb-20	0	230
06-Mar-20	41	300
03-Apr-20	78	374

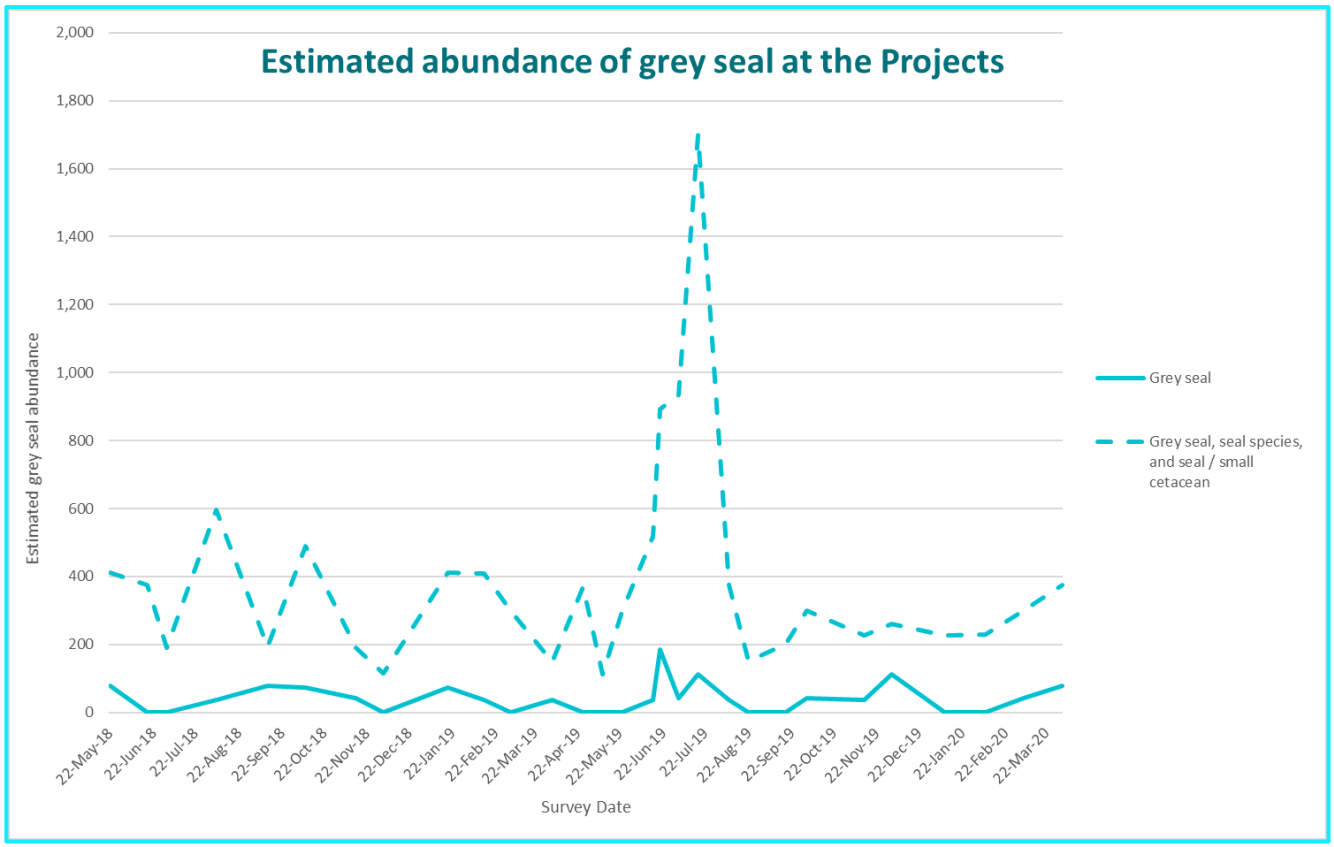

Plate 10.1.16: Estimated abundance of grey seal within the survey area, corrected for availability bias

Review of Abundance and Density Estimates for Grey Seal

Grey Seal Density Maps

133. The following sections provide the grey seal at-sea density estimates from two grey seal mapping datasets; Russell *et al.* (2017) and Carter *et al.* (2020).

134. The absolute seals at-sea maps (Russell *et al.,* 2017; **Figure 10.1.1**), were produced by SMRU by combining information about the movement patterns of electronically tagged seals with survey counts of seals at haul-out sites. The resulting maps show estimates of mean seal usage (seals per 5km x 5km grid cell) around the UK coastline.

135. The grey seal absolute density estimates for SEP and DEP have been calculated from the 5km x 5km cells (Russell *et al.,* 2017) based on the 5km x 5km grids that overlap with each project area. The upper at-sea density estimates for these areas have been calculated, as the worst-case;

- 0.47 individuals per km^2 for the SEP Site;
- 0.09 individuals per km^2 for the DEP Site; and
- 0.35 individuals per km^2 for SEP, DEP, and all export cables.

136. The relative seals at-sea density maps have also been used to calculate grey seal density estimates for SEP and DEP. The Carter *et al*. (2020) 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.

137. The resultant density of seals at-sea maps (Carter *et al.,* 2020; **Figure 10.1.2**) 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.

138. For grey seal, it has been estimated that at any one time, 77% of all grey seals may be at-sea at any one time (Russell *et al*., 2015), and that 23.9% would have been available to count during the yearly surveys (Russell *et al,* 2016). Therefore, the total grey seal population in the British Isles, at-sea, is approximately 150,700 individuals (Carter *et al*., 2020). This is the population estimate used with the Carter *et al*. (2020) data to calculate density estimates for SEP and DEP.

139. The mean at-sea relative density estimates for these areas have been calculated from Carter *et al.* (2020), as the worst-case;

- 0.853 individuals per km^2 for the SEP Site (95% CI = 0.528 – 1.184);
- 0.739 individuals per km^2 for the DEP Site (95% CI = 0.458 – 1.022); and
- 0.735 individuals per km^2 for SEP, DEP, and all export cables (95% CI = 0.449 – 1.038).

Sheringham Shoal and Dudgeon Extension Projects

Title:

Figure 10.1.1 Grey Seal Absolute Density and Haul-Out Sites

Document:
Environmental Statement (ES)
Chapter 10 Marine Mammal Ecology

Application Doc. no.: 6.2.10

Legend:

- Order Limits
- Dudgeon Offshore Wind Farm Extension Site
- Sheringham Shoal Offshore Wind Farm Extension Site
- Offshore Cable Corridors
- Existing Offshore Wind Farm Export Cable
- Existing Offshore Wind Farm
- Seal Haul Out Area

Grey Seal at-sea Usage *(Russel et al., 2017)*

Number of seals per 25km²

- 0-1
- 1-5
- 5-10
- 10-50
- 50-100
- 100-150
- 150+

Coordinate Reference System: WGS 1984 UTM Zone 31N
Transformation WGS84: OSGB_1936_To_WGS_1984_7

0 10 20 30 km
0 10 20 Miles

Scale: 1:500,000 Scale at size: A3

Equinor Doc. no.: C282-RH-Z-GA-00053
RHDHV Doc. no.: PB8164_RHD_ZZ_OF_DR_Z_0152

REV	DATE	STATUS	DRW	CHK	APR
A	03/03/2022	First Issue	AZ	GS	PM

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Enhancing Society Together

equinor

Data Sources: Russell et al., 2017

Sheringham Shoal and Dudgeon Extension Projects

Title:

Figure 10.1.2 Grey Seal Relative Density and Haul-out Sites

Document:

Environmental Statement (ES)
Chapter 10 Marine Mammal Ecology

Application Doc. no.: 6.2.10

Legend:

- Order Limits
- Dudgeon Offshore Wind Farm Extension Site
- Sheringham Shoal Offshore Wind Farm Extension Site
- Offshore Cable Corridors
- Existing Offshore Wind Farm Export Cable
- Existing Offshore Wind Farm
- Seal Haul Out Area

Grey Seals Mean Population *(Carter et al., 2020)*

% British Isles at-sea pop per 25 sq/km

- 0.0000
- 0.0001 - 0.0010
- 0.0011 - 0.0050
- 0.0051 - 0.0100
- 0.0101 - 0.0250
- 0.0251 - 0.0500
- 0.0501 - 0.1000
- > 0.1000

Coordinate Reference System: WGS 1984 UTM Zone 31N
Transformation WGS84: OSGB_1936_To_WGS_1984_7

0 10 20 30 km
0 10 20 Miles

Scale: 1:500,000 Scale at size: A3

Equinor Doc. no.: C282-RH-Z-GA-00053
RHDHV Doc. no.: PB8164_RHD_ZZ_OF_DR_Z_0225

REV	DATE	STATUS	DRW	CHK	APR
A	03/03/2022	First Issue	AZ	GS	PM

Data Sources: Carter et al., 2020
Base Map:© British Crown and OceanWise, 2021. All rights reserved. License No. EMS-EK001-627782. Not to be used for Navigation; Crown copyright and database rights 2020, Ordnance Survey 0100031673; © OpenStreetMap (and) contributors, CC-BY-SA

Grey Seal Population Counts

140. 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, 2020). The pup production estimates are converted to estimates of total population size (1+ aged population) using a mathematical model and projected forward (SCOS, 2020).

141. The most recent surveys of the principal grey seal breeding sites Scotland, Wales, Northern Ireland and south-west England, resulted in an estimate of 68,050 pups (95% CI = 60,500-75,100; SCOS 2020). When the pup production estimates are converted to estimates of total population size, there was an estimated 149,700 grey seals in 2019 (approximate 95% CI = 120,000-174,900; SCOS, 2020).

142. Based on 2016 and 2018 pup production and projecting the model forward. This is an increase of approximately 1.4% per year between 2012 and 2019 (SCOS, 2020).

143. 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).

144. The most recent counts of grey seal in the August surveys 2016-2019, estimated that the minimum count of grey seals in the UK was 42,765 (SCOS, 2020).

145. The Wadden Sea covers the coastal areas of the Netherlands, Germany and Denmark (approximately 500km) (**Figure 10.1.3**). It is an intertidal zone in the southeastern North Sea with an area of approximately 10.000km^2.

Sheringham Shoal and Dudgeon Extension Projects

Title:

Figure 10.1.3 Wadden Sea Seal Management Unit Area

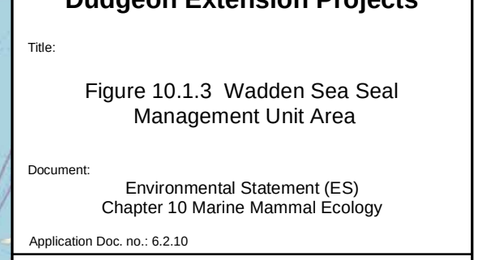
Document:

Environmental Statement (ES)
Chapter 10 Marine Mammal Ecology

Application Doc. no.: 6.2.10

Legend:

- Order Limits
- The Wadden Sea World Heritage Site



Coordinate Reference System: WGS 1984 UTM Zone 31N
Transformation WGS84: OSGB_1936_To_WGS_1984_7

0 50 100 150 km
0 50 100 Miles

Scale: 1:2,500,000 Scale at size: A3

Equinor Doc. no.: C282-RH-Z-GA-00053
RHDHV Doc. no.: PB8164_RHD_ZZ_OF_DR_Z_0226

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146. 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). The most recent 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). In total, the number of grey seal recorded in the Wadden Sea area has been steadily increasing, with a mean annual 9% increase over the past five years, with the most recent count of grey seal in 2020 being of 7,649, with 1,726 pups counted in the previous pupping season (winter 2019) (Schop *et al.,* 2022).

147. In accordance with the agreed approach for other offshore wind farms, and as agreed during the 2nd ETG meeting on the 18th June 2020, the reference population extent for grey seal will incorporate the south-east England MU, north-east England MU (IAMMWG, 2013; SCOS, 2020) and the Waddenzee population (Schop *et al.*, 2022).

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

- South-east England MU = 8,667 grey seal (SCOS, 2020);
- North-east England MU = 6,501 grey seal (SCOS, 2020); and
- Wadden Sea Count = 8.948 grey seal (adults and pups; Schop *et al.*, 2022).

149. The total reference population for the assessment is therefore 24,116 grey seal.

150. Assessments will 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.

151. It is acknowledged that the UK grey seal counts are based on surveys conducted in August and the Wadden Sea region is based on counts in winter / spring (and is not a population estimate). When the pup production estimates from autumn counts are converted to estimates of total population size, there was an estimated 149,700 grey seals in 2019 (approximate 95% CI = 120,000-174,900; SCOS, 2020). The most recent counts of grey seal in the August surveys 2016-2019, estimated that the minimum count of grey seals in the UK was 42,765 (SCOS, 2020). Therefore, using the August grey seal counts for the reference population is a precautionary approach and is likely to be an underestimate of the number of grey seals in the UK MUs.

152. It is also acknowledged that the counts for the Wadden Sea region are not corrected for seals in the water and are therefore an indication of the minimum estimates of the number of seals in the area and not actual population counts.

Diet and Foraging of Grey Seal

153. 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, 2019). Grey seal generally travel between known foraging areas and back to the same haul-out site, but will occasionally move to a new site. For example, movements have been recorded between haul-out sites on the east coast of England and the Outer Hebrides (SCOS, 2019).

154. 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).

155. Grey seals are generalist feeders, feeding on a wide variety of prey species (SCOS, 2019; Hammond and Grellier, 2006). Diet varies seasonally and from region to region (SCOS, 2019).

156. 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.

157. 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, 2019).

10.1.4.4.6 Harbour Seal

Desk-Based Review of Harbour Seal Presence

158. 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, 2020).

159. 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, 2019).

160. 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 and 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 10.1.17**; Russell and McConnell, 2014).

161. Harbour seals generally make smaller foraging trips than grey seal, typically travelling 40-50km from their haul-out sites to foraging areas (SCOS, 2019). 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). The typical and average foraging range for harbour seal is 50-80km (SCOS, 2017).

162. 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, 2019). Harbour seal give birth to their pups in June and July and pups can swim almost immediately after birth (SCOS, 2019). Harbour seals moult in August and spend a higher proportion of their time on land during the moult than at other times (SCOS, 2019).

163. SEP and DEP is located approximately 13.6km offshore (at the closest point). Principal harbour seal haul-out sites are included in **Table 10.1.19** below, which shows the approximate distance to the closest point of SEP and DEP, and the most recent harbour seal count for each location. These harbour seal haul-out sites are also shown on **Plate 10.1.17**.

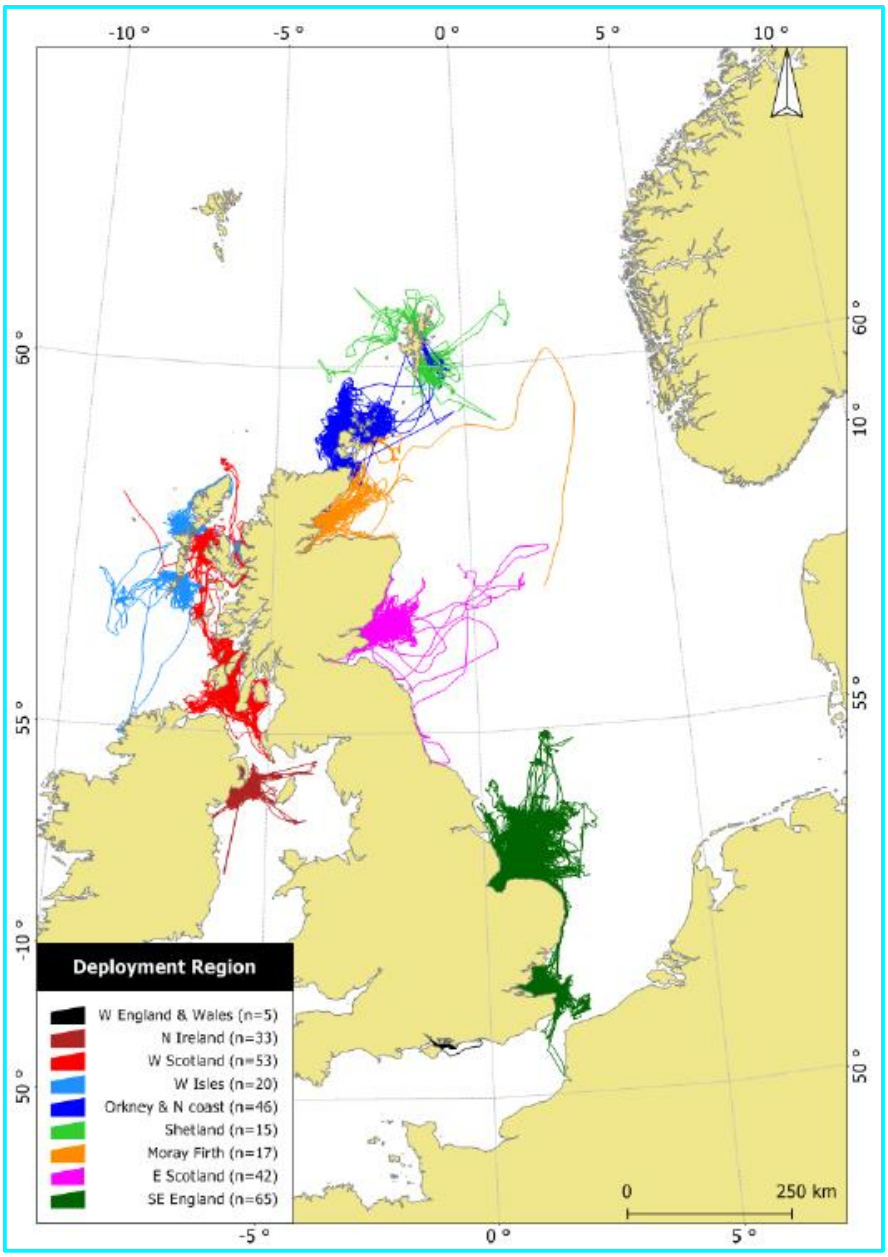


Plate 10.1.17: Telemetry tracks by deployment region for harbour seals aged one year or over (Russell and McConnell, 2014).

Harbour Seal Haul-Out Sites

Table 10.1.19: The most recent harbour seal count at each of the nearby haul-out sites, and the distance to SEP and DEP

Haul-out site	Distance to SEP and DEP	Harbour seal count
Blakeney Point NNR	12km from landfall 12km from export cable corridor 38km from DEP 22km from SEP	329 (2019 harbour seal count; SCOS, 2020)
The Wash	58km from landfall	2,415 (2019 harbour seal count; SCOS, 2020)

Haul-out site	Distance to SEP and DEP	Harbour seal count
	58km from export cable corridor 75km from DEP 57km from SEP	
Scroby Sands	59km from landfall 58km from the export cable corridor 64km from DEP 64km from SEP	193 (2019 harbour seal count; SCOS, 2020)
Donna Nook	87km from landfall 86km from export cable corridor 68km from DEP 66km from SEP	128 (2019 harbour seal count; SCOS, 2020)

Results from the Site-Specific Surveys for Harbour Seal

164. As noted above, a relatively low number of harbour seal were recorded during the site-specific aerial surveys, with a total of 21 individuals recorded through the 29 survey dates, however, in addition a total of 198 unidentified seal species were recorded, as well as 36 seal / small cetacean species, a proportion of which are expected to be harbour seal.

165. With the exception of a large spike in unidentified seal sightings in June and July 2019 (with a total of 85 over four survey days), and elevated numbers of harbour seal in August and October 2018, the number of individuals that could be harbour seal (i.e. seal species and seal / small cetacean species) were relatively similar year-round, with small spikes in sightings number, with an indication of an increase in the summer periods.

Density Estimates for Harbour Seal

166. Due to the low number of harbour seal sightings, absolute density and abundance estimates were not possible to derive. However, relative density and abundance estimates were calculated (see **Section 10.1.4.3** for more information on how these have been calculated). These have been provided in order to provide site-specific information on the number of harbour seal expected to be present at SEP and DEP, however, impact assessments will be based on absolute densities as derived from desk-based sources (see below).

167. Relative density estimates have been calculated from the raw data counts for (i) harbour seal; (ii) seal species, and (iii) seal / small cetacean species. These have also been corrected for availability bias. Individuals from the two species groupings listed above are assumed to all be harbour seal as a worst-case, and are considered together within the density and abundance estimates as set out below. These abundance and densities are for the entire survey area, plus 4km buffer (i.e. they relevant for both SEP and DEP).

168. Correction factors were then be applied to the relative density estimates to account for the presence of individuals below 2m water depth (the depth at which it is no longer possible to detect marine mammals from aerial imagery).

169. As described above, SMRU used tagging studies of 44 grey seals (1997) and 17 harbour seals (2003-2004) in the Pentland Firth and Orkney (SMRU, 2012). For harbour seal, data collected from 44,156 dives found an average of 18.32% if time spent at the water's surface. This did not account for the time that the seals would be just below the water's surface and so would still be detectable in aerial surveys. Therefore, the correction factor for harbour seal is 0.18.

170. This seasonal correction factors (of 0.18) has been used to generate harbour seal relative density and abundance estimates for the SEP and DEP sites and 4km buffer.

171. Relative density estimates for harbour seal have then been calculated, based on the density estimate (with correction factor applied) for harbour seal and for the other species groups that could be harbour seal (i.e. seal species, and seals / small cetacean species).

172. The maximum density of each month was taken for each of the species groups, and corrected for availability. The average of the annual density has then been calculated based on the maximum calculated for each month. **Table 10.1.20** shows the density estimates for harbour seal only, and **Table 10.1.21** shows the densities when the two other species groups are included (i.e. all individuals that have the potential to be harbour seal). Note that relative densities could not be derived for all months, due to the low number of harbour seal sightings.

Table 10.1.20: Maximum harbour seal relative density estimates calculated for relevant months, corrected for availability bias, with annual density estimate for whole survey area, DEP plus 4km buffer, and SEP plus 4km buffer (note that the whole survey area covers a larger area than for SEP and DEP (plus 4km buffers) combined)

Month	Maximum density estimate (corrected) for whole survey area	Maximum density estimate (corrected) for DEP + 4km buffer	Maximum density estimate (corrected) for SEP + 4km buffer
January	0.11	-	0.239
February	-	-	-
March	-	-	-
April	0.11	0.186	-
May	-	-	-
June	0.11	-	-
July	0.11	0.887	0.813
August	0.22	0.898	-
September	-	-	-

Month	Maximum density estimate (corrected) for whole survey area	Maximum density estimate (corrected) for DEP + 4km buffer	Maximum density estimate (corrected) for SEP + 4km buffer
October	0.28	-	0.500
November	-	-	-
December	-	-	-
Average annual	**0.016**	**0.657**	**0.517**

Table 10.1.21: Maximum harbour seal relative density estimates (including seal species and seal / small cetacean species groups) calculated for each month, corrected for availability bias, with annual density estimate for whole survey area, DEP plus 4km buffer, and SEP plus 4km buffer (note that the whole survey area covers a larger area than for SEP and DEP (plus 4km buffers) combined)

Month	Maximum density estimate (corrected) for whole survey area	Maximum density estimate (corrected) for DEP + 4km buffer	Maximum density estimate (corrected) for SEP + 4km buffer
January	0.519	0.889	0.572
February	0.296	0.444	0.333
March	0.259	0.111	0.611
April	0.407	0.631	0.333
May	0.370	0.778	0.333
June	0.741	0.889	0.500
July	1.481	2.554	2.091
August	0.667	1.564	0.333
September	0.148	0.333	0.167
October	0.611	0.111	0.833
November	0.148		0.500
December	0.148	0.111	0.500
Average annual	**0.483**	**0.765**	**0.592**

Site-Specific Survey Abundance Estimates for Harbour Seal

173. In addition to the density estimates as described above, abundance estimates of harbour seal at SEP and DEP have been derived. These abundance estimates have been corrected in the same way as the density estimates above, and all species groupings that have the potential to be harbour seal are included (i.e. harbour seal have been corrected as stated above).

174. These abundance estimates are shown in **Table 10.1.22** and **Plate 10.1.18** below. As shown in **Plate 10.1.18**, and mentioned above, there is an indication of increased sightings in the summer periods, with a peak in sightings in July 2019, with an estimate of 2,342 individuals, predominantly formed of sightings within the grouping 'seal species'. Elevated abundance estimates are also seen for August and October 2018, with estimated relative abundances of 1,104 and 951 respectively, and in June and July 2019, with estimates of 1,044 and 1,484 respectively.

Table 10.1.22: Estimated abundance of harbour seal at SEP and DEP, corrected for availability bias, at SEP and DEP

Month	Maximum abundance estimate (corrected) for harbour seal	Maximum abundance estimate (corrected) for harbour seal (including seal species and seal / small cetacean species)
22-May-18	0	496
18-Jun-18	0	555
02-Jul-18	0	282
06-Aug-18	278	1,104
12-Sep-18	0	170
09-Oct-18	339	951
14-Nov-18	0	219
04-Dec-18	0	170
19-Jan-19	117	613
14-Feb-19	0	551
05-Mar-19	0	443
04-Apr-19	117	280
26-Apr-19	0	546

Month	Maximum abundance estimate (corrected) for harbour seal	Maximum abundance estimate (corrected) for harbour seal (including seal species and seal / small cetacean species)
10-May-19	0	164
24-May-19	0	437
15-Jun-19	111	822
20-Jun-19	0	1,044
03-Jul-19	167	1,484
17-Jul-19	0	2,342
08-Aug-19	0	498
22-Aug-19	0	224
18-Sep-19	0	296
03-Oct-19	56	438
13-Nov-19	0	279
03-Dec-19	0	218
10-Jan-20	0	338
08-Feb-20	0	339
06-Mar-20	0	382
03-Apr-20	0	437

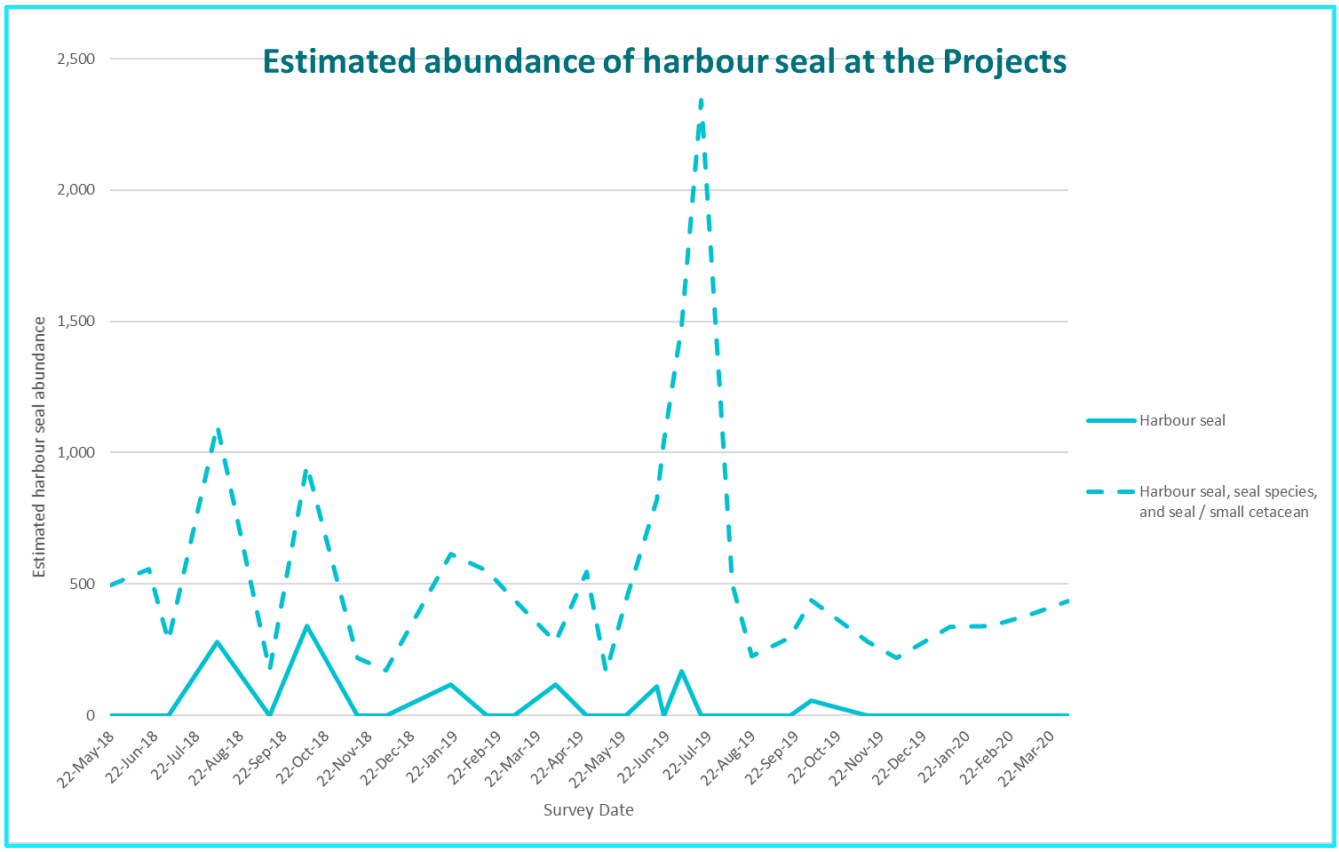


Plate 10.1.18: Estimated abundance of harbour seal at SEP and DEP, corrected for availability bias

Review of Abundance and Density Estimates for Harbour Seal

Harbour Seal Density Maps

175. The following sections provide the harbour seal at-sea density estimates from two seal mapping datasets; Russell *et al.* (2017) and Carter *et al.* (2020).

176. The harbour seal absolute density estimates for SEP and DEP have been calculated from the latest seal at sea maps produced by SMRU (Russell *et al.,* 2017; **Figure 10.1.4**), based on the 5km x 5km grids that overlap with each project area. The upper at-sea density estimates for these areas have been used in the assessment, as the worst-case;

- 0.21 individuals per km^2 for the SEP Site;
- 0.24 individuals per km^2 for the DEP Site; and
- 0.19 individuals per km^2 for SEP, DEP, and all export cables.

177. As for grey seal, the relative seals at-sea density maps (Carter *et al.,* 2020; **Figure 10.1.5**) have also been used to calculate harbour seal density estimates for SEP and DEP.

Sheringham Shoal and Dudgeon Extension Projects

Title:

Figure 10.1.4 Harbour Seal Absolute Density and Haul-Out Sites

Document:

Environmental Statement (ES)
Chapter 10 Marine Mammal Ecology

Application Doc. no.: 6.2.10

Legend:

- Order Limits
- Dudgeon Offshore Wind Farm Extension Site
- Sheringham Shoal Offshore Wind Farm Extension Site
- Offshore Cable Corridors
- Existing Offshore Wind Farm Export Cable
- Existing Offshore Wind Farm
- Seal Haul Out Area

Harbour Seal at-sea Usage *(Russel et al., 2017)*

Density of Seals per 25km²

- 0-1
- 1-5
- 5-10
- 10-50
- 50-100
- 100-150
- 150+

Coordinate Reference System: WGS 1984 UTM Zone 31N
Transformation WGS84: OSGB_1936_To_WGS_1984_7

0 10 20 30 km
0 10 20 Miles

Scale: 1:500,000 Scale at size: A3

Equinor Doc. no.: C282-RH-Z-GA-00053
RHDHV Doc. no.: PB8164_RHD_ZZ_OF_DR_Z_0153

REV	DATE	STATUS	DRW	CHK	APR
A	03/03/2022	First Issue	AZ	GS	PM

Data Sources: Russell et al., 2017
Base Map: © OpenStreetMap (and) contributors, CC-BY-SA

Sheringham Shoal and Dudgeon Extension Projects

Title:

Figure 10.1.5 Harbour Seal Relative Density and Haul-out Sites

Document:

Environmental Statement (ES)
Chapter 10 Marine Mammal Ecology

Application Doc. no.: 6.2.10

Legend:

- Order Limits
- Dudgeon Offshore Wind Farm Extension Site
- Sheringham Shoal Offshore Wind Farm Extension Site
- Offshore Cable Corridors
- Existing Offshore Wind Farm Export Cable
- Existing Offshore Wind Farm
- Seal Haul Out Area

Harbour Seals Mean Population *(Carter et al., 2020)*

% British Isles at-sea pop per 25 sq/km

- 0.0000
- 0.0001 - 0.0010
- 0.0011 - 0.0050
- 0.0051 - 0.0100
- 0.0101 - 0.0250
- 0.0251 - 0.0500
- 0.0501 - 0.1000
- > 0.1000

Coordinate Reference System: WGS 1984 UTM Zone 31N
Transformation WGS84: OSGB_1936_To_WGS_1984_7

0 10 20 30 km
0 10 20 Miles

Scale: 1:500,000 Scale at size: A3

Equinor Doc. no.: C282-RH-Z-GA-00053
RHDHV Doc. no.: PB8164_RHD_ZZ_OF_DR_Z_0227

REV	DATE	STATUS	DRW	CHK	APR
A	03/03/2022	First Issue	AZ	GS	PM

Data Sources: Carter et al., 2020
Base Map:

178. For harbour seal, it has been estimated that at any one time, 83.4% of all harbour seals may be at-sea at any one time (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 42,800 individuals (Carter *et al*., 2020). This is the population estimate used with the Carter *et al*. (2020) data to calculate density estimates for SEP and DEP.

179. The mean at-sea relative density estimates for these areas have been calculated from Carter *et al.* (2020), as the worst-case;

- 0.274 individuals per km^2 for the SEP Site (95% CI = 0.169 – 0.388);
- 0.080 individuals per km^2 for the DEP Site (95% CI = 0.044 – 0.129); and
- 0.189 individuals per km^2 for SEP, DEP, and all export cables (95% CI = 0.116 – 0.274).

Harbour Seal Population Counts

180. Harbour seal are counted while they are on land during their August moult, giving a minimum estimate of population size (SCOS, 2020). Combining the most recent counts (2016-2019) gives a total of 31,774 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 2019 of 44,100 harbour seal (approximate 95% CI = 36,100-58,800 ; SCOS, 2020).

181. Recent trends in harbour seal populations (over the last two years) indicate that the harbour seal populations in the Wash are in decline. As the survey area represents the majority of harbour seals in the South East England Seal MU including the population in the Wash and North Norfolk SAC, this likely drop in abundance is significant and of concern. Since 2010, the numbers of harbour seal in the region have been stable. However, the population count in 2019 was 27% lower than the 2012 to 2018 mean count and the initial examination of the 2020 survey produced a similar estimate (SCOS, 2020). This represents a fall of approximately 10%-12% per annum over the two years, or around 25% between 2018 and 2019 (SCOS, 2020).

182. The most recent TSEG counts for adult harbour seal seals were conducted by aerial surveys during the pupping period in June 2020, and during the moult in August 2020. In total, the number of harbour seal pups recorded in the Wadden Sea in 2020 was the highest since 2000, with a total of 9,954 pups, representing a 3% increase from the 2019 pup count. A total of 28,352 adult harbour seals were recorded during the moult, a small increase of 2% from 2019 count (Galatius *et al.,* 2021).

183. In accordance with the agreed approach for other offshore wind farms, and as agreed during the 2nd ETG meeting on the 18th June 2020, the reference population extent for harbour seal will incorporate the south-east England MU (IAMMWG, 2013; SCOS, 2019) and the Waddenzee population (Galatius *et al.,* 2021).

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

- South-east England MU = 3,752 harbour seal (SCOS, 2020); and

- Wadden Sea Count = 26,838 harbour seal (adults and pups; Galatius *et al.,* 2021).

185. The total reference population for the assessment is currently 30,590 harbour seal.

186. Assessments will 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.

Diet and Foraging of Harbour Seal

187. 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, 2020). It is estimated harbour seals eat 3-5 kg per adult seal per day depending on the prey species (SCOS, 2020).

188. The range of foraging trips varies depending on the surrounding marine habitat (e.g. 25km on the west of Scotland (Cunningham *et al.,* 2009); 30km-45km in the Moray Firth (Tollit *et al.,* 1998; Thompson and Miller 1990). However, data from The Wash (from 2003- 2005) suggest that harbour seal in this area travel further, and repeatedly forage between 75km and 120km offshore (with one seal travelling 220km; Sharples *et al.,* 2008). Telemetry studies indicate that the tracks of tagged harbour seals have a more coastal distribution than grey seals and do not travel as far from haul-outs.

References

Anderwald, P., Brandecker, A., Coleman, M., Collins, C., Denniston, H., Haberlin, M. D., Donovan, M., *et al*. 2012. Displacement responses of a mysticete, an odontocete, and a phocid seal to construction related vessel traffic. Endangered Species Research, 21: 231–240.

Arso Civil, M., Quick, N.J., Cheney, B., Pirotta, E., Thompson, P.M. and Hammond, P.S. (2019). Changing distribution of the east coast of Scotland bottlenose dolphin population and the challenges of area-based management. Aquatic Conservation: Marine and Freshwater Ecosystems, 29, pp.178-196.

Aynsley, C.L. (2017) Bottlenose dolphins (*Tursiops truncatus*) in north-east England: A preliminary investigation into a population beyond the southern extreme of its range. MSc Thesis, Newcastle University.

Banguera-Hinestroza, E., Bjørge, A., Reid, R.J., Jepson, P. and Hoelzel, A.R., 2010. The influence of glacial epochs and habitat dependence on the diversity and phylogeography of a coastal dolphin species: Lagenorhynchus albirostris. Conservation Genetics, 11(5), pp.1823-1836.

Berrow, S.D. and Rogan, E. (1995). Stomach contents of harbour porpoises and dolphins in Irish waters. European Research on Cetaceans, 9, pp.179-181.

Börjesson, P., Berggren, P. and Ganning, B. (2003). Diet of harbour porpoises in the Kattegat and Skagerrak seas: accounting for individual variation and sample size. Marine Mammal Science, 19(1), pp.38-058.

Brasseur, S., van Polanen Petel, T., Aarts, G., Meesters, E., Dijkman, E., and Reijnders, P. (2010). Grey seals (Halichoerus grypus) in the Dutch North Sea: population ecology and effects of wind farms. In: we@sea (Ed.), IMARES Report number C137/10. Available at: [redacted]

Brasseur, S.M.J.M, van Polanen Petel. T.D., Gerrodette, T., Meesters, E.H.W.G., Reijnders, P.J.H. and Aarts G. (2015). Rapid recovery of Dutch grey seal colonies fuelled by immigration. Marine Mammal Science 31:405-426.

Brasseur S., Cremer J., Czeck R., Galatius A., Jeß A., Körber P., Pund R., Siebert U.,Teilmann J. & Klöpper S. (2018) TSEG grey seal surveys in the Wadden Sea and Helgoland in 2017-2018. Common Wadden Sea Secretariat, Wilhelmshaven, Germany.

Buckland, S. T., Anderson, D. R., Burnham, K. P. Laake, J. L. Borchers, D. L. & Thomas, L. (2001). Introduction to Distance Sampling. OUP, Oxford.

Canning, S.J., Santos, M.B., Reid, R.J., Evans, P.G., Sabin, R.C., Bailey, N. and Pierce, G.J., 2008. Seasonal distribution of white-beaked dolphins (Lagenorhynchus albirostris) in UK waters with new information on diet and habitat use. Marine Biological Association of the United Kingdom. Journal of the Marine Biological Association of the United Kingdom, 88(6), p.1159.

Carter, M.I.D., Boehme, L., Duck, C.D., Grecian, W.J., Hastie, G.D., McConnell, B.J., Miller, D.L., Morris, C.D., Moss, S.E.W., Thompson, D., Thompson, P.M. and Russell, D.J.F. (2020).Habitat-based predictions of at-sea distribution for grey and harbour seals in the British Isles. Sea Mammal Research Unit, University of St Andrews, Report to BEIS, OESEA-16-76/OESEA-17-78.

Clarke, M.R., Santos, M.B. and Pierce, G.J. (1998). The importance of cephalopods in the diets of marine mammals and other top predators. ICES CM, 1000, p.8.

Corkeron, P.J., Bryden, M.M. and Hedstrom, K.E. (1990). Feeding by bottlenose dolphins in association with trawling operations in Moreton Bay, Australia. In The bottlenose dolphin (pp. 329-336). Academic Press.

Cunningham, L., Baxter, J.M., Boyd., I.L., Duck, C.D., Lonergan, M., Moss, S.E. and McConnell, B. (2009) 'Harbour seal movements and haul-out patterns: implications for monitoring and management'. Aquatic Conservation: Marine and Freshwater Ecosystems, 19 398-407.

DECC (now Department for Business, Energy and Industrial Strategy (BEIS)) (2016), UK Offshore Energy Strategic Environmental Assessment 3 (OESEA3)

De Boer, M.N., 2010. Spring distribution and density of minke whale Balaenoptera acutorostrata along an offshore bank in the central North Sea. Marine Ecology Progress Series, 408, pp.265-274.

Delefosse, M., Rahbek, M.L., Roesen, L. and Clausen, K.T., (2018). Marine mammal sightings around oil and gas installations in the central North Sea. Journal of the Marine Biological Association of the United Kingdom, 98(5), pp.993-1001.

Dudgeon Offshore Wind Limited (DOWL) (2009) Dudgeon Offshore Wind Farm Environmental Statement.

EC (2008). 56/EC of the European Parliament and of the Council of 17 June 2008 establishing a framework for community action in the field of marine environmental policy (Marine Strategy Framework Directive). OJEC L, 164, p.40.

Evans P.G.H. (1980) Cetaceans in British waters. Mammal Review 10, 1–52.

Evans P.G.H., Anderwald P. and Baines M.E. (1987) UK Cetacean Status

Review. Report to English Nature and Countryside Council for Wales pp. 160. Oxford: Sea Watch Foundation.

Fontaine, M.C., Tolley, K.A., Siebert, U., Gobert, S., Lepoint, G., Bouquegneau, J.M. and Das, K., 2007. Long-term feeding ecology and habitat use in harbour porpoises Phocoena phocoena from Scandinavian waters inferred from trace elements and stable isotopes. BMC Ecology, 7, p.1.

Fraser F.C. (1946) Report on Cetacea stranded on the British coasts from 1933 to 1937. No. 12. London: British Museum (Natural History).

Friends of Horsey (2019). Seal Pup Count 2018-2019.

Galatius, A., Abel, C., Brackmann, J., Brasseur, S., Jeß, A., Meise, K., Meyer, J., Schop, J., Siebert, U., Teilmann, J. and Bie Thøstesen, C. (2021).EG-Marine Mammals harbour seal surveys in the Wadden Sea and Helgoland 2021. Common Wadden Sea Secretariat, Wilhelmshaven, Germany.

Gilles, A., Peschko, V., Scheidat, M. and Siebert, U. (2012). Survey for small cetaceans over the Dogger Bank and adjacent areas in summer 2011. Document submitted by Germany to 19th ASCOBANS Advisory Committee Meeting in Galway, Ireland, 20-22 March 2012. AC19/Doc.5-08(P). 16pp.

Gilles, A., Viquerat, S., Becker, E. A., Forney, K. A., Geelhoed, S. C. V., Haelters, J., Nabe-Nielsen, J., Scheidat, M., Siebert, U., Sveegaard, S., van Beest, F. M., van Bemmelen, R.and Aarts, G. (2016). Seasonal habitat-based density models for a marine top predator, the harbour porpoise, in a dynamic environment. Ecosphere 7(6):e01367. 10.1002/ecs2.1367.

Hammond, P.S. and Grellier, K. (2006). Grey seal diet composition and prey consumption in the North Sea. Final report to Department for Environment Food and Rural Affairs on project MF0319.

Hammond, P.S., Lacey, C., Gilles, A., Viquerat, S., Boerjesson, P., Herr, H., Macleod, K., Ridoux, V., Santos, M., Scheidat, M. and Teilmann, J. (2017). Estimates of cetacean abundance in European Atlantic waters in summer 2016 from the SCANS-III aerial and shipboard surveys. Wageningen Marine Research.

Hammond, P.S., Lacey, C., Gilles, A., Viquerat, S., Boerjesson, P., Herr, H., Macleod, K., Ridoux, V., Santos, M.B., Scheidat, M., Teilmann, J., Vingada, J. and Øien, N. (2021). Estimates of cetacean abundance in European Atlantic waters in summer 2016 from the SCANS-III aerial and shipboard surveys. June 2021. Available from: [redacted]

Hammond, P.S., Macleod, K., Berggren, P., Borchers, D.L., Burt L., Cañadas, A., Desportes, G., Donovan, G.P., Gilles, A., Gillespie, D., Gordon, J., Hiby, L., Kuklik, I., Leaper, R., Lehnert, K, Leopold, M., Lovell, P., Øien, N., Paxton, C.G.M., Ridoux, V., Rogano, E., Samarraa, F., Scheidatg, M., Sequeirap, M., Siebertg, U., Skovq, H., Swifta, R., Tasker, M.L., Teilmann, J., Canneyt, O.V. and Vázquez, J.A. (2013). Cetacean abundance and distribution in European Atlantic shelf waters to inform conservation and management. Biological Conservation 164, 107-122.

Harmer, S.F. (1927) Report of Cetacea stranded on the British Isles from 1913 to 1926. No. 10. London: British Museum (Natural History).

Heinänen, S. and Skov, H. (2015). The identification of discrete and persistent areas of relatively high harbour porpoise density in the wider UK marine area, JNCC Report No.544 JNCC, Peterborough.

IAMMWG (2013). Management Units for marine mammals in UK waters (June 2013).

IAMMWG (2022). Updated abundance estimates for cetacean Management Units in UK waters. JNCC Report No. 680, JNCC Peterborough, ISSN 0963-8091.

IJsseldijk, L.L., Brownlow, A., Davison, N.J., Deaville, R., Haelters, J., Keijl, G., Siebert, U. and ten Doeschate, M.T.I. (2018). Spatiotemporal trends in white-beaked dolphin strandings along the North Sea coast from 1991–2017. Lutra 61 (1): 153-163: [redacted]

Ingram, S.N. and Rogan, E. (2002). Identifying critical areas and habitat preferences of bottlenose dolphins Tursiops truncatus. Marine Ecology Progress Series. 244, pp.247-255.

JNCC (2010a). JNCC guidelines for minimising the risk of injury to marine mammals from using explosives. August 2010.

JNCC (2010b). Statutory nature conservation agency protocol for minimising the risk of injury to marine mammals from piling noise. August 2010.

JNCC (2017) SAC Selection Assessment: Southern North Sea. January, 2017. Joint Nature Conservation Committee, UK. Available from: http://jncc.defra.gov.uk/page-7243.

JNCC (2019). Article 17 Habitats Directive Report 2019: Species Conservation Status Assessments 2019. Available at: https://jncc.gov.uk/our-work/article-17-habitats-directive-report-2019-species/#regularly-occurring-species-vertebrate-species-mammals-marine

JNCC, Natural England and CCW (2010). Draft EPS Guidance - The protection of marine European Protected Species from injury and disturbance. Guidance for the marine area in England and Wales and the UK offshore marine area. Joint Nature Conservation Committee, Natural England and Countryside Council for Wales. October 2010.

Johnston, D.W., Westgate, A.J. and Read, A.J. (2005). Effects of fine-scale oceanographic features on the distribution and movements of harbour porpoises Phocoena phocoena in the Bay of Fundy. Marine Ecology Progress Series, 295, pp.279-293.

Kastelein, R.A., Hardemann, J. and Boer, H. (1997). Food consumption and body weight of harbour porpoises (*Phocoena phocoena*). In The biology of the harbour porpoise Read, A.J., Wiepkema, P.R., Nachtigall, P.E (1997). Eds. Woerden, The Netherlands: De Spil Publishers. pp. 217–234.

Keiper, C.A., Ainley, D.G., Allen, S.G. and Harvey, J.T. (2005). Marine mammal occurrence and ocean climate off central California, 1986 to 1994 and 1997 to 1999. Marine Ecology Progress Series, 289, pp.285-306.

Kinze C.C., Addink M., Smeenk C., Hartmann M.G., Richards H.W., Sonntag R.P. and Benke H. (1997) The white-beaked dolphin (Lagenorhynchus albirostris) and the white-sided dolphin (Lagenorhynchus acutus) in the North and Baltic Seas: review of available information. Report of the International Whaling Commision 47, 675–681.

Lewis, E.J. and Evans, P.G.H. (1993). Comparative ecology of bottlenose dolphins (Tursiops truncatus) in Cardigan Bay and the Moray Firth, pp.57-62. In: European

Research on Cetaceans - 7. Proc. 7th Ann. Conf. ECS, Inverness, ed P.G.H. Evans. European Cetacean Society, Cambridge, England. 306pp.

Liret, C. (2001). Domaine vital, utilisation de l'espace et des ressources :les grands dauphins, Tursiops truncatus, de l'île de Sein. Thèse de doctorat de l'Université de Bretagne Occidentale, Brest. 155 p.

Liret, C., Creton, P., Evans, P. G. H., Heimlich-Boran, J. R. and Ridoux, V. (1998). English and French coastal Tursiops from Cornwall to the Bay of Biscay, 1996. Photo-identification Catalogue. Project sponsored by Ministere de l'Environnement, France and Sea Watch Foundation, UK.

Lonergan, M., Duck, C., Moss, S., Morris, C. and Thompson, D., 2013. Rescaling of aerial survey data with information from small numbers of telemetry tags to estimate the size of a declining harbour seal population. Aquatic Conservation: Marine and Freshwater Ecosystems, 23(1), pp.135-144.

Lowry, L.F., Frost, K.J., Hoep, J.M. and Delong, R.A. (2001). Movements of satellite-tagged subadult and adult harbor seals in Prince William Sound, Alaska. Marine Mammal Science 17(4): 835−861.

Macleod, K., Burt, M.L., Cañadas, A., Rogan, E., Santos, B., Uriarte, A., Van Canneyt, O., Vázquez, J.A. and Hammond, P.S., 2012. Design-based estimates of cetacean abundance in offshore European Atlantic waters. Appendix I of the Final Report of project CODA, SMRU, University of St Andrews, Scotland NOAA.

Matthiopoulos, J., McConnell, B.J., Duck, C. and Fedak, M.A. (2004). Using satellite telemetry and aerial counts to estimate space use by grey seals around the British Isles. Journal of Applied Ecology. 41(3):476-491.

Northridge, S.P., Tasker, M.L., Webb, A. and Williams, J.M., 1995. Distribution and relative abundance of harbour porpoises (Phocoena phocoena L.), white-beaked dolphins (Lagenorhynchus albirostris Gray), and minke whales (Balaenoptera acutorostrata Lacepède) around the British Isles. ICES Journal of Marine Science, 52(1), pp.55-66.

Paxton, C.G.M., Scott-Hayward, L., Mackenzie, M., Rexstad, E. and Thomas, L. (2016). Revised Phase III Data Analysis of Joint Cetacean Protocol Data Resources with Advisory Note, JNCC Report 517, ISSN 0963-8091: http://jncc.defra.gov.uk/page-7201.

Raum-Suryan, K.L. and Harvey, J.T. (1998). Distribution and abundance of and habitat use by harbor porpoise, Phocoena phocoena, off the northern San Juan Islands, Washington. Fishery Bulletin, 96(4), pp.808-822.

Reid, J.B, Evans, P.G.H. and Northridge, S.P. (2003). Atlas of cetacean Distribution in North west European waters. JNCC, Peterborough.

Reeves, R., Smeenk, C., Kinze, C.C., Brownell, R.L. Jr and Lien, J. (1999) White-beaked dolphn Lagenorhynchus albirostris, Gray 1846. In

Handbook of marine mammals vol. 6, pp. 1–30. Academic Press.

Rogan, E., Breen, P., Mackey, M., Cañadas, A., Scheidat, M., Geelhoed, S. & Jessopp, M. (2018). Aerial surveys of cetaceans and seabirds in Irish waters: Occurrence, distribution and abundance in 2015-2017. Department of Communications, Climate Action & Environment and National Parks and Wildlife Service (NPWS), Department of Culture, Heritage and the Gaeltacht, Dublin, Ireland. 297pp

Russell, D.J.F (2016). Movements of grey seal that haul out on the UK coast of the southern North Sea. Report for the Department of Energy and Climate Change (OESEA-14-47).

Russell, D.J.F., Duck, C., Morris, C. and Thompson, D., (2016). Independent estimates of grey seal population size: 2008 and 2014. SCOS Briefing paper, 16(3).

Russell, D.J., McClintock, B.T., Matthiopoulos, J., Thompson, P.M., Thompson, D., Hammond, P.S., Jones, E.L., MacKenzie, M.L., Moss, S. and McConnell, B.J., (2015). Intrinsic and extrinsic drivers of activity budgets in sympatric grey and harbour seals. Oikos, 124(11), pp.1462-1472.

Russell, D.J.F. and McConnell, B.J. (2014). Seal at-sea distribution, movements and behavior. Report to DECC. URN: 14D/085. March 2014 (final revision).

Russell, D.J., McConnell, B., Thompson, D., Duck, C., Morris, C., Harwood, J. and Matthiopoulos, J. (2013). Uncovering the links between foraging and breeding regions in a highly mobile mammal. Journal of Applied Ecology, 50(2), pp.499-509.

Russell, D.J.F, Jones, E.L. and Morris, C.D. (2017). Updated Seal Usage Maps: The Estimated at-sea Distribution of Grey and Harbour Seals. Scottish Marine and Freshwater Science Vol 8 No 25, 25pp. DOI: 10.7489/2027-1.

Santos, M.B., Pierce, G.J., Reid, R.J., Patterson, I.A.P., Ross, H.M. and Mente, E., (2001). Stomach contents of bottlenose dolphins (Tursiops truncatus) in Scottish waters. Marine Biological Association of the United Kingdom. Journal of the Marine Biological Association of the United Kingdom, 81(5), p.873.

Santos, M.B. and Pierce, G.J. (2003). The diet of harbour porpoise (Phoceona phoceona) in the North east Atlantic. Oceanography and Marine Biology: an Annual Review 2003, 41, 355–390.

Santos, M.B., Pierce, G.J., Learmonth, J.A., Reid, R.J., Ross, H.M., Patterson, I.A.P., Reid, D.G. and Beare, D. (2004). Variability in the diet of harbor porpoises (Phocoena phocoena) in Scottish waters 1992–2003. Marine Mammal Science, 20(1), pp.1-27.

SCANS-II (2008). Small cetaceans in the European Atlantic and North Sea. Final Report submitted to the European Commission under project LIFE04NAT/GB/000245, SMRU, St Andrews.

Schop J., Abel C., Brasseur S., Galatius A., Jeß A., Meise K., Meyer J., van Neer A., Stejskal O., Siebert U., Teilmann J., Thøstesen C. B. (2022) Grey Seal Numbers in the Wadden Sea and on Helgoland in 2021-2022. Common Wadden Sea Secretariat, Wilhelmshaven, Germany. Available at: [redacted]

Scira Offshore Energy Ltd. (2006) Sheringham Shoal Offshore Wind Farm Environmental Statement.

SCOS (2017). Scientific Advice on Matters Related to the Management of Seal Populations: 2017. Available at: [redacted]

SCOS (2019). Scientific Advice on Matters Related to the Management of Seal Populations: 2019. Available at: [redacted]

SCOS (2020). Scientific Advice on Matters Related to the Management of Seal Populations: 2020. Available at: [redacted]

Sea Watch Foundation (2021). Reports of cetacean sightings eastern England: [redacted]

Sharples, R.J., Matthiopoulos, J. and Hammond, P.S. (2008). Distribution and movements of harbour seals around the coast of Britain: Outer Hebrides, Shetland, Orkney, the Moray Firth, St Andrews Bay, The Wash and the Thames, Report to DTI July 2008.

Sharples, R.J., Moss, S.E., Patterson, T.A. and Hammond, P.S. (2012). Spatial Variation in Foraging Behaviour of a Marine Top Predator (Phoca vitulina) Determined by a Large-Scale Satellite Tagging Program. PLoS ONE 7(5): e37216.

Stober, U., and Thomsen, F. (2020) How could operational underwater sound from future offshore wind turbines impact marine life? Journal of Acoustical Society of America. 149(3):1791 doi:10.1121/10.0003760.

Teilmann, J., Christiansen, C.T., Kjellerup, S., Dietz, R. and Nachman, G. (2013). Geographic, seasonal and diurnal surface behaviour of harbour porpoise. Marine Mammal Science 29(2): E60-E76.

Thompson, P.M. and Miller, D., (1990) 'Summer foraging activity and movements of radio-tagged common seals (Phoca vitulina. L.) in the Moray Firth, Scotland'. Journal of applied Ecology, pp.492-501.

Tolley, K.A. and Rosel, P.E., 2006. Population structure and historical demography of eastern North Atlantic harbour porpoises inferred through mtDNA sequences. Marine Ecology Progress Series, 327, pp.297-308.

Tollit, D.J., Black, A.D., Thompson, P.M., Mackay, A., Corpe, H.M., Wilson, B., Parijs, S.M., Grellier, K. and Parlane, S. (1998) 'Variations in harbour seal Phoca vitulina diet and dive-depths in relation to foraging habitat'. Journal of Zoology, 244(2), pp.209-222.

Tougaard, J., Hermannsen, L. and Madsen, P.T. (2020). How loud is the underwater noise from operating offshore wind turbines? J. Acoust. Soc. Am. 148 (5). doi.org/10.1121/10.0002453.

Tynan, C.T., Ainley, D.G., Barth, J.A., Cowles, T.J., Pierce, S.D. and Spear, L.B. (2005). Cetacean distributions relative to ocean processes in the northern California Current System. Deep Sea Research Part Ii: Topical studies in Oceanography, 52(1), pp.145-167.

Vincent, C., Huon, M., Caurant, F., Dabin, W., Deniau, A., Dixneuf, S., Dupuis, L., Elder, J.F., Fremau, M.H., Hassani, S. and Hemon, A., 2017. Grey and harbour seals in France: Distribution at sea, connectivity and trends in abundance at haulout sites. Deep Sea Research Part II: Topical Studies in Oceanography, 141, pp.294-305.

Voet H., Rehfisch M., McGovern S. and Sweeney S. (2017). Marine Mammal Correction Factor for Availability Bias in Aerial Digital Still surveys. Case Study: Harbour porpoise (Phocoena phocoena) in the Southern North Sea. APEM Ltd.

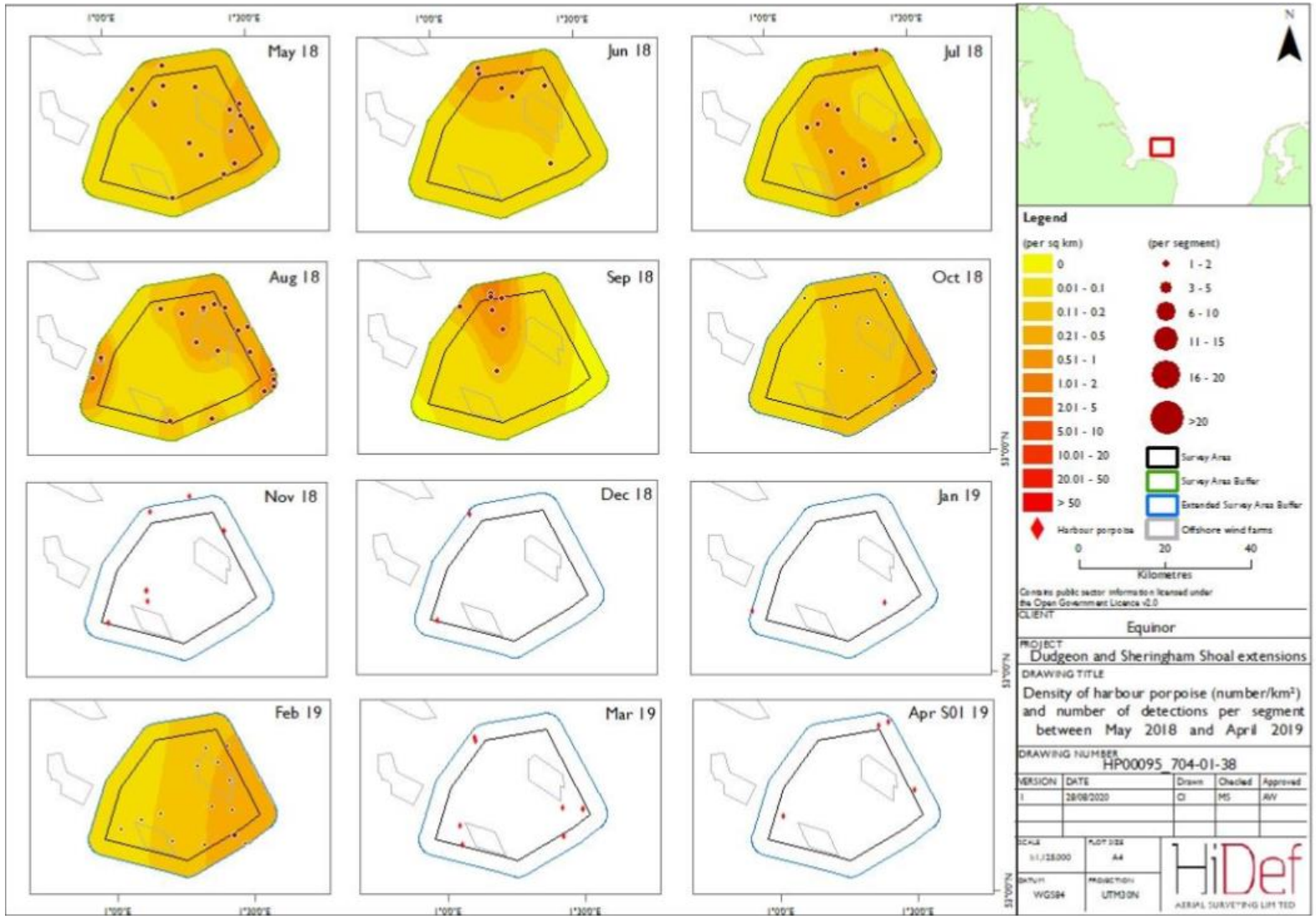
Waggitt, J.J., Evans, P.G., Andrade, J., Banks, A.N., Boisseau, O., Bolton, M., Bradbury, G., Brereton, T., Camphuysen, C.J., Durinck, J. and Felce, T. (2019). Distribution maps of cetacean and seabird populations in the North-East Atlantic. Journal of Applied Ecology, 57(2), pp.253-269.

Windsland, K., Lindstrom U., Nilssen, K.T. and Haug, T. (2007). Relative abundance and size composition of prey in the common minke whale diet in selected areas of the north-eastern Atlantic during 2000-04. J. Cetacean Res. Manage, 9(3), pp.167-178.

Wilson, B., Thompson, P.M., Hammond, P.S. (1997). Habitat use by bottlenose dolphins: seasonal distribution and stratified movement patterns in the Moray Firth Scotland. The Journal of Applied Ecology 34, pp.1365–1374.

WWT (2009). Distributions of Cetaceans, Seals, Turtles, Sharks and Ocean Sunfish recorded from Aerial Surveys 2001-2008. The Wildfowl and Wetlands Trust.

Annex 1 – Site Specific Harbour Porpoise Density Maps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Apr S01 19
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Legend
(per sq km)
0
0.01 - 0.1
0.11 - 0.2
0.21 - 0.5
0.51 - 1
1.01 - 2
2.01 - 5
5.01 - 10
10.01 - 20
20.01 - 50
> 50
Harbour porpoise
(per segment)
1 - 2
3 - 5
6 - 10
11 - 15
16 - 20
>20
Survey Area
Survey Area Buffer
Extended Survey Area Buffer
Offshore wind farms
0
20
40
Kilometres
Contains public sector information licensed under the Open Government Licence v2.0
CLIENT
Equinor
PROJECT
Dudgeon and Sheringham Shoal extensions
DRAWING TITLE
Density of harbour porpoise (number/km²) and number of detections per segment between May 2018 and April 2019
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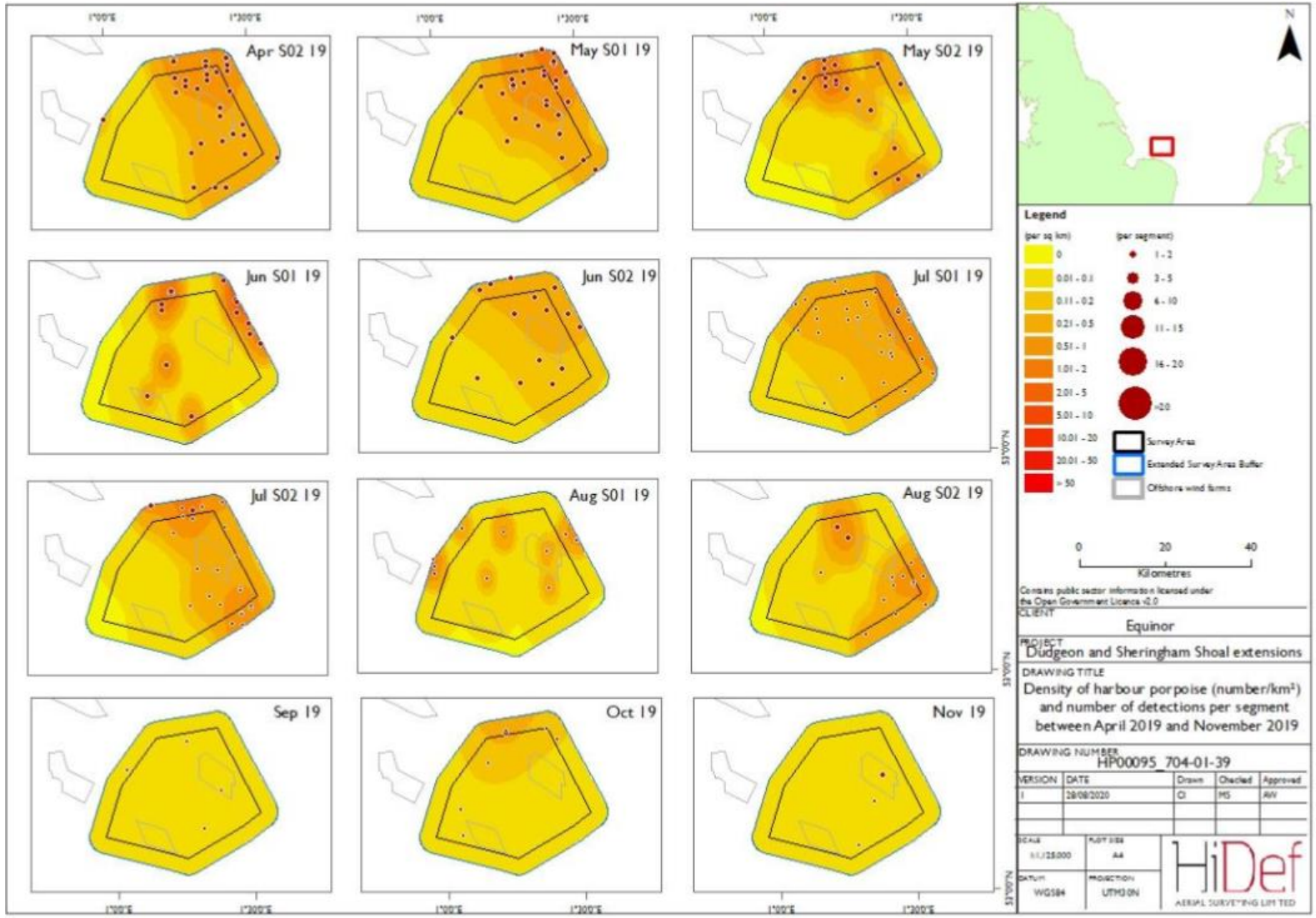
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(per sq km)
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10.01 - 20
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> 50
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Survey Area
Extended Survey Area Buffer
Offshore wind farms
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Kilometres
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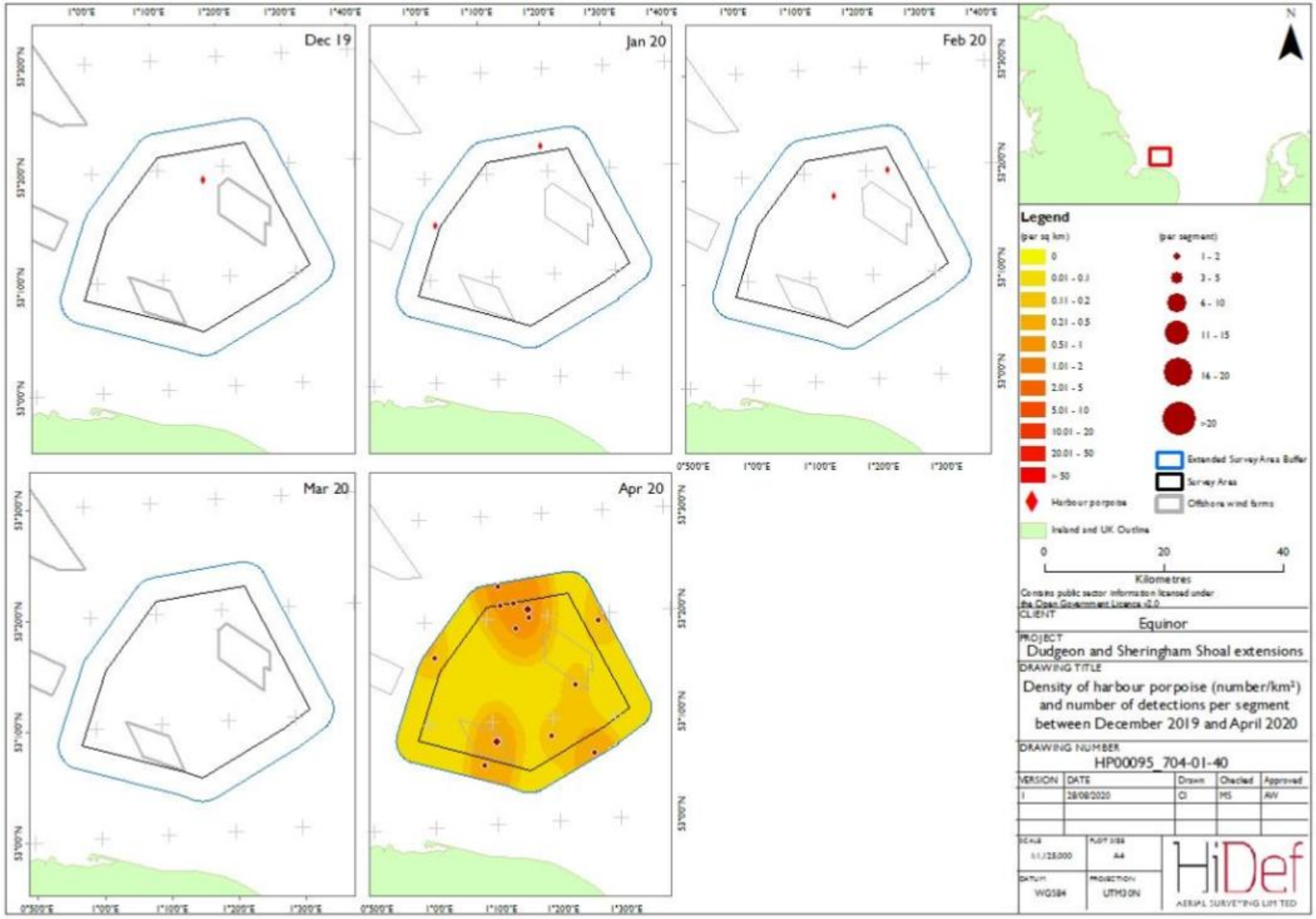
Dec 19
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5.01 - 10
10.01 - 20
20.01 - 50
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(per segment)
1 - 2
3 - 5
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11 - 15
16 - 20
>20
Extended Survey Area Buffer
Survey Area
Offshore wind farms
Harbour porpoise
Ireland and UK Outline
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