DOGGER BANK D WIND FARM

Preliminary Environmental Information Report

Volume 2
Appendix 11.2 Fish and Shellfish Ecology Technical Report

Document Reference No: 2.11.2
Date: June 2025
Revision: V1

sse Renewables equinor

www.doggerbankd.com

Document Title:	**Volume 2, Appendix 11.2 Fish and Shellfish Ecology Technical Report**
Document No.	**2.11.2**
Prepared By:	**Royal HaskoningDHV**
Prepared For:	**Dogger Bank D Wind Farm**

Revision No.	Date	Status / Reason for Issue	Author	Checked By	Approved By
V1	23/05/2025	Final	EB	RR	GA

Table of Contents

Glossary

Term	Definition
Development Consent Order (DCO)	A consent required under Section 37 of the Planning Act 2008 to authorise the development of a Nationally Significant Infrastructure Project, which is granted by the relevant Secretary of State following an application to the Planning Inspectorate.
Environmental Statement (ES)	A document reporting the findings of the EIA which describes the measures proposed to mitigate any likely significant effects.
Study Areas	A geographical area and / or temporal limit defined for each EIA topic to identify sensitive receptors and assess the relevant likely significant effects.
The Applicant	SSE Renewables and Equinor acting through 'Doggerbank Offshore Wind Farm Project 4 Projco Limited'.
The Project	Dogger Bank D Offshore Wind Farm Project, also referred to as DBD in this PEIR.

11.2 Fish and Shellfish Ecology Technical Report

11.2.1 Introduction

1. This appendix to the Dogger Bank D Offshore Wind Farm (hereafter the 'Project' or 'DBD') Preliminary Environmental Information Report (PEIR) supports **Volume 1, Chapter 11 Fish and Shellfish Ecology**. This appendix forms part of the PEIR for the offshore elements of the Project.

2. The purpose of this appendix is to provide granular detail on the baseline for Fish and Shellfish Ecology, including all species that have been identified as present within the Fish and Shellfish Ecology Study Area, key aspects of their ecology, and information on their conservation value. The offshore elements of the Project will include offshore export cables and the Offshore Platform(s). A full description of the Project is provided in **Volume 1, Chapter 4 Project Description**.

3. This Fish and Shellfish Ecology Appendix presents all species identified as potentially present within the Fish and Shellfish Ecology Study Area, defined by the International Council for the Exploration of the Sea (ICES) rectangles 40F1, 40F2, 39F0, 39F1, 39F2, 39F3, 38F0, 38F1, 38F2, 38F3, 37E9, 37F0, 36E9, and 36F0. The appendix includes species identified as present in the site-specific benthic surveys, in addition to those identified via desk-based baseline characterisation. Key aspects of the species' ecology and conservation value are presented in **Section 11.2.2**Baseline Data

4. Table 11.2.2-1 Elasmobranch Species Identified as Having Potential for Presence Within the Fish and Shellfish Ecology Study Area, Including Key Aspects of their Ecology and Conservation Importance.

5. Identified species are ordered based on the receptor groups that are used within **Volume 1**, **Chapter 11 Fish and Shellfish Ecology**, namely:

    - Elasmobranchs;
    - Demersal fish;
    - Pelagic fish;
    - Diadromous fish; and
    - Shellfish.

6. The purpose of this appendix is also to provide details of the methods followed in the production of heat maps of potential herring *Clupea harengus* spawning habitat and potential sandeel *Ammodytidae spp*. habitat within the Fish and Shellfish Ecology Study Area, as part of the offshore development of the Project (see **Section 11.2.3**). The methods set out here have been followed to produce **Figure 11-7** and **Figure 11- 8** of **Volume 1, Chapter 11 Fish and Shellfish Ecology**. The 'heat' displayed in these figures represents an estimate of the distribution of preferred herring spawning habitat and preferred sandeel habitat. These heat maps provide a useful comparison to the distribution of preferred habitat indicated by project-specific Particle Size Distribution (PSD) data (**Figure 11-5** and **Figure 11-6** of **Volume 1, Chapter 11 Fish and Shellfish Ecology**).

7. This appendix should be read alongside **Volume 1**, **Chapter 11 Fish and Shellfish Ecology**.

11.2.2 Baseline Data

Table 11.2.2-1 Elasmobranch Species Identified as Having Potential for Presence Within the Fish and Shellfish Ecology Study Area, Including Key Aspects of their Ecology and Conservation Importance

Species	Hearing Group	Evidence for Areas Overlapping the Study Area		Conservation Designation
		Spawning	Nursery	
Elasmobranchs				
Basking shark *Cetorhinus maximus*	Group 1: Fish with no swim bladder or other gas chamber	No	No	IUCN (Vulnerable), UK BAP, OSPAR, Wildlife & Countryside Act
Blonde ray *Raja brachyura*	Group 1: Fish with no swim bladder or other gas chamber	No	No	IUCN Near Threatened (Global and Europe)
Common smoothhound *Mustelus mustelus*	Group 1: Fish with no swim bladder or other gas chamber	No	No	IUCN (Vulnerable)
Common skate *Dipturus batis*	Group 1: Fish with no swim bladder or other gas chamber	No	No	IUCN Critically Endangered (Global) with

Species	Hearing Group	Evidence for Areas Overlapping the Study Area		Conservation Designation
		Spawning	Nursery	
				decreasing population, UK BAP, OSPAR
Cuckoo ray *Leucoraja naevus*	Group 1: Fish with no swim bladder or other gas chamber	No	No	IUCN (Least Concern)
Lesser spotted dogfish *Scyliorhinus canicula*	Group 1: Fish with no swim bladder or other gas chamber	No	No	IUCN (Least Concern)
Spotted ray *Raja montagui*	Group 1: Fish with no swim bladder or other gas chamber	No	No	IUCN (Least Concern)
Spurdog *Squalus acanthias*	Group 1: Fish with no swim bladder or other gas chamber	No	Yes (low intensity)	UK BAP, OSPAR, IUCN (Vulnerable)
Starry smoothhound *Mustelus asterias*	Group 1: Fish with no swim bladder or other gas chamber	No	No	IUCN Global: (Least Concern) Europe: Near threatened
Thornback ray *Raja clavata*	Group 1: Fish with no swim bladder or other gas chamber	No	No	IUCN Near Threatened (Global and Europe)
Tope shark *Galeorhinus galeus*	Group 1: Fish with no swim bladder or other gas chamber	No	Yes (low intensity)	UK BAP, IUCN (Vulnerable)
Velvet belly lanternshark *Etmopterus spinax*	Group 1: Fish with no swim bladder or other gas chamber	No	No	IUCN (Least Concern)

Table 11.2.2-2 Demersal Species Identified as Having Potential for Presence Within the Fish and Shellfish Ecology Study Area, Including Key Aspects of their Ecology and Conservation Importance

Species	Hearing Group	Evidence for Areas Overlapping the Study Area		Conservation Designation
		Spawning	Nursery	
Demersal fish				
Anglerfish *Lophius piscatorius*	Group 1: Fish with no swim bladder or other gas chamber	No	Yes (low intensity)	UK BAP
Atlantic Halibut *Halibut hippoglossus*	Group 1: Fish with no swim bladder or other gas chamber	No	No	UK BAP, IUCN (Endangered)
Blue whiting *Micromesistius moutassou*	Group 3: Fish in which hearing involves a swim bladder or other gas volume	No	Yes (low intensity)	UK BAP
Cod *Gadhus morhua*	Group 3: Fish in which hearing involves a swim bladder or other gas volume	Yes (low intensity)	Yes (high intensity)	IUCN Status Global: (Vulnerable) Europe: (Least Concern)
Common sole *Solea solea*	Group 1: Fish with no swim bladder or other gas chamber	Yes (low intensity)	Yes (low intensity)	IUCN: data deficient
Dab *Limanda limanda*	Group 1: Fish with no swim bladder or other gas chamber	No	No	IUCN (Least Concern)
European flounder *Platichthys flesus*	Group 1: Fish with no swim bladder or other gas chamber	No	No	IUCN (Least Concern)

Species	Hearing Group	Evidence for Areas Overlapping the Study Area		Conservation Designation
		Spawning	Nursery	
European hake *Merluccius merluccius*	Group 3: Fish in which hearing involves a swim bladder or other gas volume	No	Yes (low intensity)	UK BAP
Gobies Pomatoschistus spp.	Group 1: Fish with no swim bladder or other gas chamber	No	No	IUCN (Least Concern)
Grey gurnard *Eutrigla gurnardus*	Has a swim bladder – hearing status unknown	No	No	IUCN (Least Concern)
Haddock *Melanogrammus aeglefinus*	Group 3: Fish in which hearing involves a swim bladder or other gas volume	No	No	IUCN (Least Concern)
Lemon sole *Microstomus kitt*	Group 1: Fish with no swim bladder or other gas chamber	Yes (undetermined intensity)	Yes (undetermined intensity)	-
Ling *Molva molva*	Group 3: Fish in which hearing involves a swim bladder or other gas volume	No	Yes (low intensity)	UK BAP
Plaice *Pleuronectes plattessa*	Group 1: Fish with no swim bladder or other gas chamber	Yes (high intensity)	Yes (low intensity)	International Union for Conservation of Nature (IUCN): (Least Concern)
Pollock *Pollachius pollachius*	Group 3: Fish in which hearing involves a swim bladder or other gas volume	No	No	IUCN (Least Concern)
Red gurnard *Chelidonichthys cuculus*	Has a swim bladder – hearing status unknown	No	No	IUCN (Least Concern)

Species	Hearing Group	Evidence for Areas Overlapping the Study Area		Conservation Designation
		Spawning	Nursery	
Sandeel *Ammmodytidae,sp.*	Group 1: Fish with no swim bladder or other gas chamber	Yes (high intensity)	Yes (low intensity)	The lesser sandeel is a Priority Species under the UK Post-2010 Biodiversity Framework.
Seabass *Dicentrarchus labrax*	Group 3: Fish in which hearing involves a swim bladder or other gas volume	No	No	IUCN (Least Concern)
Striped red mullet *Mullus surmuletus*	Has a swim bladder – hearing status unknown	No	No	IUCN (Least Concern)
Tub gurnard *Chelidonichthys lucerna*	Has a swim bladder – hearing status unknown	No	No	IUCN (Least Concern)
Turbot *Scophthalmus maximus*	Group 1: Fish with no swim bladder or other gas chamber	No	No	IUCN (Least Concern)
Two-spotted clingfish *Diplecogaster bimaculata*	Group 1: Fish with no swim bladder or other gas chamber	No	No	IUCN (Least Concern)
Whiting *Merlangius merlangus*	Group 3: Fish in which hearing involves a swim bladder or other gas volume	Yes (low intensity)	Yes (high intensity)	UK BAP, IUCN (Least Concern)
Witch *Glyptocephalus cynoglossus*	Group 1: Fish with no swim bladder or other gas chamber	No	No	UK BAP, IUCN (Least Concern)

Table 11.2.2-3 Pelagic Species Identified as Having Potential for Presence Within the Fish and Shellfish Ecology Study Area, Including Key Aspects of their Ecology and Conservation Importance

Species	Hearing Group	Evidence for Areas Overlapping the Study Area		Conservation Designation
		Spawning	Nursery	
Pelagic Fish				
Albacore *Thunnus alalunga*	Group 1: Fish with no swim bladder or other gas chamber	No	No	UK BAP, OSPAR, IUCN (Least Concern)
Atlantic bluefin tuna *Thunnus thynnus*	Has a swim bladder – hearing status unknown	No	No	UK BAP, OSPAR, IUCN (Near Threatened)
Atlantic Bonito *Sarda sarda*	Group 1: Fish with no swim bladder or other gas chamber	No	No	IUCN (Least Concern)
European Pilchard *Sardina pilchardus*	Has a swim bladder – hearing status unknown	No	No	IUCN Global: Threatened Europe: Least Concern
Herring *Clupea harengus*	Group 3: Fish in which hearing involves a swim bladder or other gas volume	Yes (undetermined intensity)	Yes (high intensity)	UK BAP, IUCN (Least Concern)
Horse mackerel *Trachurus trachurus*	Has a swim bladder – hearing status unknown	No	No	IUCN Global: Vulnerable Europe: Least Concern
Mackerel *Scomber scombrus*	Group 1: Fish with no swim bladder or other gas chamber	Yes (high intensity)	Yes (low intensity)	UK BAP, IUCN (Least Concern)
Round sardinella *Sardinella aurita*	Has a swim bladder – hearing status unknown	No	No	IUCN (Least Concern)

Species	Hearing Group	Evidence for Areas Overlapping the Study Area		Conservation Designation
		Spawning	Nursery	
Sprat *Sprattus sprattus*	Group 3: Fish in which hearing involves a swim bladder or other gas volume	Yes (undetermined intensity)	Yes (undetermined intensity)	-
Sunfish *Mola mola*	Group 1: Fish with no swim bladder or other gas chamber	No	No	OSPAR, IUCN Global: Vulnerable

Table 11.2.2-4 Diadromous Species Identified as Having Potential for Presence Within the Fish and Shellfish Ecology Study Area, Including Key Aspects of their Ecology and Conservation Importance

Species	Hearing Group	Evidence for Areas Overlapping the Study Area		Conservation Designation
		Spawning	Nursery	
Diadromous fish				
Atlantic salmon *Salmo salar*	Group 2: Fish with a swim bladder not involved in hearing	No	No	UK BAP, OSPAR, Habitats Directive Annex II, SPII, IUCN Least Concern
Brown/sea trout *Salmo trutta*	Group 2: Fish with a swim bladder not involved in hearing	No	No	UK BAP, IUCN Least Concern
European eel *Anguilla anguilla*	Group 3: Fish in which hearing involves a swim bladder or other gas volume	No	No	UK BAP, SPII, IUCN (Critically Endangered)
River lamprey *Lampetra fluviatilis*	Group 1: Fish with no swim bladder or other gas chamber	No	No	UK BAP, Habitats Directive Annex II, SPII, IUCN Least Concern

Species	Hearing Group	Evidence for Areas Overlapping the Study Area		Conservation Designation
		Spawning	Nursery	
Sea lamprey *Petromyzon marinus*	Group 1: Fish with no swim bladder or other gas chamber	No	No	UK BAP, OSPAR, Habitats Directive Annex II, SPII, IUCN Least Concern
Allis shad *Alosa alosa*	Group 3: Fish in which hearing involves a swim bladder or other gas volume	No	No	UK BAP, OSPAR, Habitats Directive Annex II, SPII, UK Wildlife and Countryside Act 1981 (WLCA), IUCN Least Concern
Twaite shad *Alosa fallax*	Group 3: Fish in which hearing involves a swim bladder or other gas volume	No	No	UK BAP, Habitats Directive Annex II, UK Wildlife and Countryside Act 1981 (WLCA), IUCN Least Concern

Table 11.2.2-5 Shellfish Species Identified as Having Potential for Presence Within the Fish and Shellfish Ecology Study Area, Including Key Aspects of their Ecology and Conservation Importance

Species	Hearing Group	Evidence for Areas Overlapping the Study Area		Conservation Designation
		Spawning	Nursery	
Shellfish				
Brown crab *Cancer pagurus*	-	Yes	N/A	-
Brown Shrimp *Crangon crangon*	-	Yes	N/A	-
Clams *Bivalvia* spp.	-	Yes	N/A	-
Common cockle *Cerastoma edule*	-	Yes	N/A	-

Species	Hearing Group	Evidence for Areas Overlapping the Study Area		Conservation Designation
		Spawning	Nursery	
Common cuttlefish *Sepia officinalis*	-	Yes	N/A	-
Common octopus *Octopus vulgaris*	-	Yes	N/A	-
Common whelk *Buccinium undatum*	-	Yes	N/A	-
European lobster *Homarus gammarus*	-	Yes	N/A	-
European spider crab *Maja squinado*	-	Yes	N/A	-
European spiny lobster *Palinurus elephas*	-	Yes	N/A	-
European squid *Loligo vulgaris*	-	Yes	N/A	-
Green crab *Carcinus maenas*	-	Yes	N/A	-
King scallop *Pecten maximus*	-	Yes	N/A	-
Norway lobster *Nephrops norvegicus*	-	Yes	N/A	-
Ocean quahog *Arctica islandica*	-	Yes	N/A	-
Queen scallop *Aequipecten opercularis*	-	Yes	N/A	-

Species	Hearing Group	Evidence for Areas Overlapping the Study Area		Conservation Designation
		Spawning	Nursery	
Shortfin squid *Illex illecebrosus*	-	Yes	N/A	-
Velvet swimming crab *Necora puber*	-	Yes	N/A	-

Table 11.2.2-6 Mean annual fisheries landings data between 2019 – 2023 by species (over three tonne) in the Study Area

ICES Rectangle	Species Group	Species Name	Landings (tonnes)	Value (£)	Project Area Overlap
36E9	Shellfish	European lobster	54	818,723	Offshore ECC (within 12nm)
36E9	Shellfish	Brown crab	45	103,475	
36E9	Shellfish	Nephrops	5	14,128	
36F0	Demersal	Whiting	10	10,896	
36F0	Shellfish	Brown crab	2,617	5,471,334	
36F0	Shellfish	European lobster	428	6,672,921	
36F0	Shellfish	King scallop	217	435,047	
36F0	Shellfish	Whelk	134	150,816	
36F0	Shellfish	Velvet crab	8	13,103	
36F0	Shellfish	Squid	5	17,987	
36F0	Shellfish	Brown shrimp	4	22,374	
37E9	Demersal	Cod	8	12,858	
37E9	Pelagic	Herring	2,083	1,472,015	
37E9	Shellfish	King scallop	684	1,395,023	
37E9	Shellfish	Brown crab	490	1,075,341	

ICES Rectangle	Species Group	Species Name	Landings (tonnes)	Value (£)	Project Area Overlap
37E9	Shellfish	European lobster	192	2,927,725	
37E9	Shellfish	Whelk	15	16,026	
37E9	Shellfish	Squid	4	17,782	
37F0	Demersal	Sandeels	132	34,385	Offshore ECC (within, and beyond 12nm)
37F0	Demersal	Whiting	61	59,463	
37F0	Demersal	Red mullet	21	41,712	
37F0	Demersal	Haddock	17	12,175	
37F0	Demersal	Cod	4	6,690	
37F0	Pelagic	Herring	3,578	2,426,364	
37F0	Pelagic	Mackerel	15	17,875	
37F0	Pelagic	Horse Mackerel	4	2,699	
37F0	Shellfish	Brown crab	495	1,038,121	
37F0	Shellfish	King scallop	392	790,809	
37F0	Shellfish	European lobster	50	816,398	
37F0	Shellfish	Squid	39	151,674	
37F0	Shellfish	Mixed Squid and Octopi	31	126,325	
37F1	Demersal	Sandeels	235	59,886	Offshore ECC (beyond 12nm)
37F1	Demersal	Plaice	12	16,612	
37F1	Demersal	Dab	4	1,151	
37F1	Demersal	Haddock	3	2,699	
37F1	Shellfish	Brown crab	120	248,803	
37F1	Shellfish	Whelk	61	72,877	
37F1	Shellfish	King scallop	28	57,459	
37F1	Shellfish	Nephrops	15	47,685	

ICES Rectangle	Species Group	Species Name	Landings (tonnes)	Value (£)	Project Area Overlap
37F2	Demersal	Sandeels	172	45,084	
37F2	Demersal	Plaice	55	73,222	
37F2	Demersal	Dab	6	2,044	
37F2	Demersal	Grey gurnard	5	2,805	
37F2	Demersal	Whiting	4	4,283	
37F2	Demersal	Haddock	3	2,594	
37F2	Demersal	Gurnards (species unknown)	3	2,076	
37F2	Demersal	Turbot	3	17,160	
37F2	Pelagic	Mackerel	6	8,938	
37F2	Shellfish	Nephrops	45	129,860	
37F2	Shellfish	Whelk	28	33,475	
37F2	Shellfish	King scallop	11	25,225	
38F0	Demersal	Dab	4	2,568	
38F0	Demersal	Grey gurnard	3	3,189	
38F0	Pelagic	Herring	545	350,699	
38F0	Pelagic	Sprats	108	96,179	
38F0	Shellfish	Brown crab	188	437,864	
38F0	Shellfish	King scallop	42	78,029	
38F0	Shellfish	Nephrops	5	18,746	
38F0	Shellfish	European lobster	4	71,351	
38F1	Demersal	Sandeels	133	34,671	
38F1	Demersal	Plaice	42	54,275	
38F1	Shellfish	Brown crab	314	662,276	
38F1	Shellfish	King scallop	134	216,776	

ICES Rectangle	Species Group	Species Name	Landings (tonnes)	Value (£)	Project Area Overlap
38F1	Shellfish	Whelk	13	16,727	
38F2	Demersal	Plaice	214	283,321	DBD Array Area
38F2	Demersal	Sandeels	118	31,006	
38F2	Demersal	Dab	5	4,176	
38F2	Demersal	Turbot	5	18,182	
38F2	Demersal	Lemon Sole	4	6,334	
38F2	Shellfish	King scallop	37	54,411	
38F2	Shellfish	Brown crab	18	36,330	
38F3	Demersal	Plaice	142	281,946	
38F3	Demersal	Lemon Sole	5	10,837	
38F3	Demersal	Turbot	4	27,855	
39F1	Demersal	Sandeels	674	181,105	Offshore ECC (beyond 12nm)
39F1	Demersal	Plaice	36	55,448	
39F1	Shellfish	King scallop	373	625,948	
39F1	Shellfish	Brown crab	197	452,112	
39F2	Demersal	Sandeels	846	218,098	Offshore ECC (beyond 12nm) and DBD Array Area
39F2	Demersal	Plaice	130	169,774	
39F2	Demersal	Dab	5	4,027	
39F2	Demersal	Lemon Sole	4	5,640	
39F2	Demersal	Turbot	3	13,102	
39F2	Shellfish	Brown crab	26	59,798	
39F2	Shellfish	King scallop	11	16,924	
39F3	Demersal	Plaice	342	653,243	DBD Array Area
39F3	Demersal	Turbot	10	64,245	

ICES Rectangle	Species Group	Species Name	Landings (tonnes)	Value (£)	Project Area Overlap
39F3	Demersal	Lemon Sole	9	20,861	
39F3	Demersal	Dab	9	5,916	
39F3	Demersal	Grey gurnard	3	1,740	
40F1	Demersal	Plaice	3	6,867	Offshore ECC (beyond 12nm)
40F1	Shellfish	Nephrops	11	60,729	
40F2	Demersal	Sandeels	660	170,900	
40F2	Demersal	Plaice	26	57,207	
40F2	Shellfish	Nephrops	3	7,995	

11.2.3 Herring and Sandeel Heat Map Methodologies

11.2.3.1 Herring

8. The heat map for identifying potential spawning habitat for herring has been derived from the methodology set out in Kyle-Henney *et al* (2024).

9. The heat map has been created by overlapping multiple data-layers. Each layer has been assigned a confidence score based on its ability to identify potential spawning habitat. The confidence scores for each data layer are based on the criteria outlined in Kyle-Henney *et al* (2024). The following datasets have been used to inform the heat map:

    - EMODnet 1:250k seabed sediments map (preferred habitat – Gravel and sandy Gravel; and marginal habitat – gravelly Sand);
    - 2002-2023 International Herring Larval Survey (IHLS) (General)[1];
    - Known spawning grounds as defined by Coull *et al* (1998); and
    - 2020 Vessel Monitoring System (VMS) data for fishing vessels targeting Atlantic herring.

10. It should be noted that whilst the heat map displays areas with higher herring spawning habitat *potential*, it does not confirm the presence of suitable herring spawning habitat. For this reason, areas of higher herring spawning habitat potential overrepresent the true extent of herring spawning habitat. It is therefore important to compare the outputs of this heat map method with site-specific sediment samples, which provide contemporary and direct evidence of sediment suitability for herring spawning[2]. It is also important for interpretation of the heat map to understand the data layers that contribute to the final 'heat' score result; the characteristics of these data layers are detailed below.

11.2.3.1.1 Individual Data-Layers

11. The individual data-layers used to develop the heat map are presented in this section.

[1] The IHLS (General) data-layer depicts the extent of IHLS survey stations that have recorded 0-ringer larvae at any time during the dataset timeseries (2002-2023). This data-layer makes no reference to the abundance of larvae caught.

[2] Ground-truthing involves the collection of site-specific survey data to characterise current seabed sediment type and 'fact-check' interpolated datasets that use historic data sources (e.g. the EMODnet 1:250k seabed sediments dataset).

11.2.3.1.1.1. Seabed Sediment Type

12. The EMODnet 1:250k seabed sediments map incorporates the British Geological Society (BGS) 1:250k seabed sediments map used within the Reach *et al* (2013) method. The EMODnet map selected for use in this process was chosen in preference to the BGS map within the updated Kyle-Henney *et al* (2024) methodology as it is not limited to the UK Exclusive Economic Zone (EEZ), and therefore presents a wider representation of seabed sediments at a population scale.

13. As detailed in Reach *et al* (2013), Atlantic herring is known to prefer Gravel and sandy Gravel seabed sediments; and have a marginal habitat sediment class of gravelly Sand. Therefore, the Folk sediment classification provides a spatially variable indicator to spawning and hence the level of confidence is also variable.

11.2.3.1.1.2. Known Spawning Grounds

14. Known spawning grounds are primarily defined by the extent of the IHLS (General) and the Coull *et al* (1998) data-layers. However, both of these data-layers are relatively low in resolution and do not account for variation in seabed sediment type (particularly unsuitable sediment types). Therefore, the IHLS (General) and Coull *et al* (1998) data-layers are considered to over-represent potential spawning habitat for herring in this region.

15. The IHLS data have a high confidence score, as they are a direct indicator of presence/absence of 0-ringer larvae at the surface of the spawning habitat i.e. where the 0-ringer larvae are caught indicates that spawning has occurred at that seabed location; it is a direct measure of spawning.

11.2.3.1.1.3. Fishing Activity

16. The 2020 VMS data (MMO, 2023) show the extent of the pelagic fishery within the vicinity of the Project, which includes the herring fishery. Whilst herring fisheries target spawning aggregations, there is limited confidence in VMS data providing an indication of the presence of substrates known for their herring spawning potential as the pelagic gears used target a number of species and may not be targeting herring (Kyle-Henney *et al.*, 2024). Similar to the IHLS (General) and Coull *et al* (1998) data-layers, the VMS data over-represent potential spawning habitat for herring.

11.2.3.2 Sandeel

17. The heat map for identifying potential supporting habitat for sandeel has been derived from the methodology set out in Reach *et al* (2024).

18. The heat map has been created by overlapping multiple data-layers. Each layer has been assigned a confidence score based on its ability to identify potential spawning habitat. The confidence scores for each data layer used are based on the criteria outlined in Reach *et al* (2024). In the case of the Project, the following datasets have been used to inform the heat map:

    - EMODnet 1:250k seabed sediments map (preferred habitat – Sand, slightly gravelly Sand, and gravelly Sand; marginal habitat – sandy Gravel);
    - Known sandeel grounds defined by Coull *et al* (1998);
    - Known sandeel grounds defined by Wright *et al* (2019);
    - OneBenthic sandeel presence; and
    - 2020 VMS for fishing vessels targeting sandeel.

19. It should be noted that whilst the heat map displays areas with higher sandeel habitat *potential*, it does not confirm the presence of suitable sandeel habitat. For this reason, areas of higher sandeel habitat potential overrepresent the true extent of sandeel habitat. It is therefore important to compare the outputs of this heat map method with site-specific sediment samples, which provide contemporary and direct evidence of sediment suitability for sandeel. It is also important for interpretation of the heat map to understand the data layers that contribute to the final 'heat' score result, the characteristics of these data layers are detailed below.

11.2.3.2.1 Individual Data-Layers

20. The individual data-layers used to develop the heat map are presented in this section.

11.2.3.2.1.1. Seabed Sediment Type

21. As stated in **Section 11.2.3.1.1**, the EMODnet 1:250k seabed sediments map is selected for use in preference to the BGS map as it is not limited to the UK EEZ, thereby presenting a wider representation of sediment types at a population scale (Kyle-Henney *et al.,* 2024). PSD data from site-specific samples is presented separately, to ground truth the heat map findings derived from the EMODnet data.

22. As detailed in Latto *et al* (2013), sandeel species are known to prefer Sand, slightly gravelly Sand and gravelly Sand seabed sediments; and also have a marginal habitat sediment class of sandy Gravel. Therefore, the EMODnet 1:250k Folk sediment classification provides a spatially variable indicator to habitat and hence the level of confidence is also variable.

11.2.3.2.1.2. Known Sandeel Grounds

23. Data included within the heat map relating to known sandeel grounds include OneBenthic sandeel presence, Wright *et al* (2019) sandeel grounds, and Coull *et al* (1998) sandeel grounds.

24. The OneBenthic sandeel presence data are a by-product of a 'big data' approach, whereby the sandeel presence data is collected from multiple surveys over a long time series, in which the surveys themselves may not have targeted sandeel specifically. The OneBenthic portal is a live Open Science portal with new data being added routinely, therefore the formation of this data layer has taken account of the most recent data at the time of writing. Sandeel presence records are limited to specific areas due to the nature of the OneBenthic data, representing individual sandeel records as points rather than polygons. These point data have had a 5km buffer added to create polygons for the purposes of the heat map in accordance with Reach *et al* (2024). Sandeel records collected on behalf of the Project have not been included within the OneBenthic database, and are discussed separately in **Section 11.5.6** and **Section 11.6.1** in **Volume 1, Chapter 11 Fish and Shellfish Ecology**. The use of OneBenthic sandeel presence data is considered best practice for inclusion within the heat map (Reach *et al.*, 2024).

25. The Wright *et al* (2019) data-layer comprises the authors' broadscale chart of sandeel fishing grounds, which in turn were derived from ICES fisheries data. This is over-representative of the distribution of sandeel habitat, whereas the OneBenthic sandeel presence data-layer under-represents the same distribution (due to some surveys utilising techniques that are inefficient methods for sampling sandeel).

11.2.3.2.1.3. Fishing Activity

26. The 2020 VMS data (MMO, 2023) show the extent of the demersal fishery within the vicinity of the Project, of which the sandeel fishery is included. Whilst sandeel fisheries target sandeel on the seabed, there is limited confidence in VMS data indicating suitable substrate types (Reach *et al.*, 2024). Similarly to the Wright *et al* (2019) and Coull *et al* (1998) data-layers, the VMS data are over-representative of potential supporting habitat for sandeel, due to the inclusion of demersal fishing that is targeting different species.

References

Coull, K.A., Johnstone, R., and Rogers, S.I. (1998). Fisheries Sensitivity Maps in British Waters. Published and distributed by UKOOA Ltd.

Callaway, R., Alsvåg, J., de Boois, I., Cotter, J., Ford, A., Hinz, H., Jennings, S., Kröncke, I., Lancaster, J., Piet, G., Prince, P., & Ehrich, S. (2002). Diversity and community structure of epibenthic invertebrates and fish in the North Sea. ICES Journal of Marine Science, 59(6), 1199–1214. https://doi.org/10.1006/jmsc.2002.1288

Daan, N., Bromley, P. J., Hislop, J. R. G., & Nielsen, N. A. (1990). Ecology of North Sea fish. Netherlands Journal of Sea Research, 26(2), 343–386. https://doi.org/10.1016/0077-7579(90)90096-Y

Froese, R., and Pauly, D. (2021). FishBase. Accessed November 2024. Available at: https://www.fishbase.se/.

IUCN (2024). The IUCN Red List of Threatened Species. Version (2024-2). Accessed November 2024. Available at: https://www.iucnredlist.org.

Kyle-Henney, M., Reach, I., Barr, N., Warner, I., Lowe, S., and Lloyd Jones, D. (2024). Identifying and Mapping Atlantic Herring Potential Spawning Habitat: An Updated Method Statement. Available at: https://www.erm.com/globalassets/insights/documents/Identifying_and_Mapping_Atlantic_Herring_Potential_Spawning_Habitat_An_Updated_Method_2024_w_Appendices.pdf [Accessed January 2025].

Latto, P.L., Reach, I.S., Alexander, D., Armstrong, S., Backstrom, J., Beagley, E., Murphy, K., Piper, R., and Seiderer, L.J. (2013). Screening Spatial Interactions between Marine Aggregate Application Areas and Supporting habitat for sandeel. A Method Statement produced for the British Marine Aggregates Producers Association (BMAPA).

MarLIN (2024). The Marine Line Information Network. Accessed November 2024. Available at: https://www.marlin.ac.uk/.

Marine Management Organisation (MMO) (2023a). UK sea fisheries annual statistics report (2022). Available at: https://www.gov.uk/government/statistics/uk-sea-fisheries-annual-statistics-report-2022

MMO (2023b). Fishing activity for over 15 metre United Kingdom vessels. Available at: https://environment.data.gov.uk/dataset/bf55694c-3330-4c1d-a48e-db6bbe82ad77 [Accessed January 2025].

Pierce, G. (2005). An overview of Cephalopods relevant to the SEA6 Area. A report prepared for the Department of Trade and Industry.

Reach, I., Kyle-Henney, M., Barr, N., Warner, I., Lowe, S., and Lloyd Jones, D. (2024). Identifying and Mapping Sandeel Potential Supporting Habitat: An Updated Method Statement. Available at: https://www.erm.com/globalassets/insights/documents/Identifying_and_Mapping_Sandeel_Potential_Supporting_Habitat_An_Updated_Method_2024_w_Appendices.pdf [Accessed January 2025].

Reach, I.S., Latto, P., Alexander, D., Armstrong, S., Backstrom, J., Beagley, E., Murphy, K., Piper, R. and Seiderer, L.J. (2013). Screening Spatial Interactions between Marine Aggregate Application Areas and Atlantic Herring Potential Spawning Areas. A Method Statement produced for the British Marine Aggregates Producers Association (BMAPA).

SeaFish (2024). SeaFish. Accessed November 2024. Available at: https://www.seafish.org/.

Wright, P.J., Christensen, A., Régnier, T., Rindorf, A., and van Deurs, M. (2019). Integrating the scale of population processes into fisheries management, as illustrated in the sandeel, *Ammodytes marinus*. ICES Journal of Marine Science, 76 (6): pp. 1453-1463.

Acronyms

Acronym	Definition
BAP	Biodiversity Action Plan
BMAPA	British Marine Aggregates Producers Association
DBD	Dogger Bank D
EEZ	Exclusive Economic Zone
EIA	Environmental Impact Assessment
EMODnet	European Marine Observation and Data Network
IHLS	International Herring Larval Survey
ICES	International Council for the Exploration of the Sea
IUCN	International Union for Conservation
OSPAR	The Convention for the Protection of the Marine Environment of the North-East Atlantic
PEIR	Preliminary Environmental Information Report
MMO	Marine Management Organisation
PDS	Particle Size Distribution
PEIR	Preliminary Environmental Information Report
UK	United Kingdom
VMS	Vessel Monitoring System
WLCA	UK Wildlife and Countryside Act 1981

List of Tables