Spiorad na Mara Offshore Wind Farm

Offshore Project

Environmental Impact Assessment Report

Appendix 12.1: Fish Ecology Baseline, Volume 2c

Document Reference No.: SNM-SNM-PAC-APP-1121

Date: February 2026

Quality Control Page

Document details	
Document title	Offshore Project Environmental Impact Assessment Report
Document subtitle	Appendix 12.1: Fish Ecology Baseline
Document reference no.	SNM-SNM-PAC-APP-1121
Date	February 2026
Version	1.0
Author	WSP
Client Name	Spiorad na Mara Ltd

Document history

Version	Revision	Issued	Checked	Approved	Date	Comments
1.0	A	WSP	WSP	SnM Ltd	February 2026	Final for submission

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1 INTRODUCTION

1.1 OVERVIEW

1.1.1.1 This appendix of the Environmental Impact Assessment Report (EIAR) presents a detailed baseline characterisation of the proposed Spiorad na Mara Offshore Wind Farm (hereafter referred to as 'the Offshore Project') with respect to Fish Ecology.

1.1.1.2 This appendix should be read in conjunction with **Chapter 12: Fish Ecology, Volume 2a** and the project description provided in **Chapter 3: Project Description, Volume 1a** and the relevant parts of the following chapters and appendices:

- **Chapter 9: Physical and Coastal Processes, Volume 2a**;
- **Chapter 11: Benthic and Intertidal Ecology, Volume 2a**;
- **Chapter 20: Other Sea Users and Recreational, Volume 2a**;
- **Chapter 21: Commercial Fisheries, Volume 2a**;
- **Appendix 11.2: Benthic Habitat Assessment Survey Report, Volume 2c;**
- **Appendix 12.2: Atlantic salmon Assessment Consultation, Volume 2c;**
- **Appendix 13.1: Digital Aerial Bird and Marine Megafauna Surveys, Volume 2c;**
- **Appendix 13.2: Passive Acoustic Monitoring Survey Report, Volume 2c;**
- **Appendix 13.3: Underwater Noise Modelling Assessment, Volume 2c.**

1.2 PROJECT BACKGROUND

1.2.1.1 Spiorad na Mara Limited (hereafter referred to as 'the Applicant') is proposing to develop the Project. The Project is an offshore wind farm (OWF) that will consist of up to 60 fixed-bottom wind turbine generators (WTGs).

1.2.1.2 The Project will include both offshore and onshore infrastructure. This EIAR supports the application for the offshore components of the Project as outlined in **Chapter 1: Introduction, Volume 1a**. The offshore components of the Project (the Offshore Project) includes all infrastructure and activities located seaward of Mean High Water Springs (MHWS) within the Array Area and Offshore Cable Area of Search (OCAS) (**Figure 1.2: Offshore Project Location, Volume 1b**). Further detailed information is provided in **Chapter 3, Volume 1a**.

1.2.1.3 The Offshore Project is situated off the northwest coast of Isle of Lewis/*Eilean Leòdhais* and the Array Area is located approximately 5-13 km offshore and is approximately 161 km^2 in size. It will comprise WTGs, foundations, Offshore Cables, Offshore Substation Platform (OSP) (if required), and Landfall. The Array Area combined with the OCAS is defined as the Offshore Project Boundary. The water depths across the Turbine Area range from 37-67 m with the southwest corner of the

Array Area reaching 72 m. The proposed WTGs and fixed foundations will be located within a Turbine Area of approximately 140 km^2, within the Array Area.

1.3 PURPOSE OF THIS APPENDIX

1.3.1.1 This appendix defines the Study Areas (see Section 2) and methodology used (see Section 3) to describe the Fish Ecology baseline conditions within the spatial scope of the fish ecology assessment (see Section 4). A summary of the baseline environment presented in this appendix and identification of Important Ecological Features (IEFs) are presented in Section 12.6 of **Chapter 12, Volume 2a**.

1.3.1.2 The appendix is supported by the following figures:

- **Plate 2-1** Fish Ecology Study Area – comprising the Marine Fish Study Area, Diadromous Fish Study Area and Basking Sharks and Ocean Sunfish Study Area;
- **Plate 4-1** Pelagic fish spawning and nursery grounds: Atlantic mackerel, blue whiting, Atlantic herring, European sprat;
- **Plate 4-2** Distribution of preferred Atlantic herring spawning habitat across the Marine Fish Study Area based on site-specific survey data and modelling undertaken using the Reach *et al.* (2013) method;
- **Plate 4-3** Demersal fish spawning and nursery grounds: Whiting Atlantic Cod, European Hake, Ling, Plaice, Sandeel, Anglerfish, Haddock, Lemon Sole, Norway Pout and Saithe;
- **Plate 4-4** Lesser sandeel probability of occurrence and predicted density according to modelling by Langton *et al.* (2021);
- **Plate 4-5** Potential sandeel habitat across the Marine Fish Study Area based on site-specific survey data and modelling undertaken using the Latto *et al.* (2013) method;
- **Plate 4-6** Elasmobranch nursery and spawning areas: common skate, spotted ray, spurdog, thornback ray and tope shark;
- **Plate 4-7** Special areas of conservation designated for diadromous fish within the Diadromous Fish Study Area;
- **Plate 4-8** Map showing the two migration routes that post-smolts may take after leaving detection Zone 2 in Loch Roag (Figure 6, **Annex 12.1.3, Volume 2c**);
- **Plate 4-9** Locations of first (top) and last (bottom) detections within the Array Area of the 15 post-smolts that entered the Array Area (Figure 9, **Annex 12.1.3, Volume 2c**);
- **Plate 4-10** Map from Rodger et al. 2024 illustrating the estimated migratory pathways of Atlantic salmon post-smolts as they migrate from their natal rivers. The pathways of post-smolts from each region are represented by a unique colour, and each line represents a simplified representation of individual post-smolt pathways;
- **Plate 4-11** Reconstructed migration routes of 87 adult European eels. Dashed lines show the most direct routes between recorded locations.

2 STUDY AREA

2.1 ZONE OF INFLUENCE

2.1.1.1 The spatial scope of the fish ecology assessment is defined as the Offshore Project Boundary together with the area that may experience impacts from the Project known as the Zone of Influence (ZoI). Based on guidance from the Scottish Ministers and NatureScot received as part of the Scoping Opinion, the initial fish study area defined at scoping has been extended to account for modelled impacts from suspended sediment concentration changes and underwater noise. Of these, underwater noise - modelled based on noise and vibration from impact piling required for turbine installation - was predicted to have the wider spatial extent. Accordingly, the Marine Fish Study Area has been defined using the extent of underwater noise propagation from impact piling (detail provided Section 2.2). Additionally, it was advised by NatureScot as part of the Scoping Opinion that a separate migratory (diadromous) fish study area be included in the EIAR (detail provided in Section 2.3).

2.1.1.2 Ocean sunfish *Mola mola* and basking sharks *Cetorhinus maximus*, which were originally included in the Marine Mammal and Other Megafauna chapter at scoping, are now incorporated within the fish ecology chapter. As a result, a third study area is included here, reflecting the area originally defined at scoping for these species. All study areas are shown on **Plate 2-1**. Collectively these study areas are referred to as the Fish Ecology Study Area.

2.2 MARINE FISH STUDY AREA

2.2.1.1 The Marine Fish Study Area is determined by the extent of modelled impacts from suspended sediment mobilisation and underwater noise. A review of sediment and noise modelling indicates that noise impacts extend further than sediment mobilisation, making noise propagation the greatest ZoI. This study area applies to all marine fish species, excluding diadromous species, basking sharks, and ocean sunfish.

2.2.1.2 For the purposes of defining the Marine Fish Study Area, noise modelling based on impact piling applied an unmitigated, single-strike sound pressure level of 150 dB re 1 µPa (RMS), as used by the United States National Marine Fisheries Service. The 150 dB re 1 µPa (RMS) extent has been adopted as the Marine Fish Ecology Study Area, as shown in **Plate 2-1**. This threshold was selected as the only available criterion that defines a specific spatial extent of behavioural disturbance with measurable distances from the sound source. Other behavioural criteria rely on subjective distance classifications (e.g., near, intermediate, far), which, while suitable for assessing behavioural effects (Popper *et al.,* 2014), lack precise numerical definitions and cannot be readily used to establish distinct search areas. This threshold is for onset of potential effects and is not necessarily an 'adverse effect' threshold. Additionally, it is considered a conservative estimate of the sound pressure level required to provoke a behavioural response in many species (Popper *et al.,* 2014).

2.2.1.3 To support the assessment, fisheries data from the International Council for the Exploration of the Sea (ICES) has been used. ICES records fisheries data within statistical rectangles (ICES rectangles), which have been identified based on their intersection with the defined Marine Fish Study Area. The specific ICES rectangles relevant to this assessment are ICES 47E2, 47E3, 47E4, 46E1, 46E2, 46E3, 46E4, 45E1, 45E2, 45E3 and 44E2 and are shown on **Plate 2-1**.

2.3 DIADROMOUS FISH STUDY AREA

2.3.1.1 A wider regional context has been considered for diadromous fish species. Given the extensive open ocean and near shore migrations undertaken by these species, there is the potential for activities associated with the Offshore Project to cause potential significant effects to stocks within natal waters at a substantial distance from the Offshore Project.

2.3.1.2 On this basis, the Diadromous Fish Study Area has been defined as encompassing coastal and offshore waters extending along the west coast of Scotland/*Alba*, from the southern extent of the Outer Hebrides/*Na h-Eileanan Siar* to the mainland coast., as shown in **Plate 2-1**. This area is informed by published literature on the known or likely migratory pathways of the species relevant to the assessment. Due to the limited availability of detailed empirical data on migration routes and spatial ranges for some diadromous species, the defined area is relatively large, potentially exceeding the area of direct relevance. This precautionary approach has been adopted to ensure a robust and comprehensive assessment. Where species-specific data are available, a more refined analysis of potential interactions with the Offshore Project is presented in subsequent sections of this appendix (Section 4.4).

2.4 BASKING SHARKS AND OCEAN SUNFISH STUDY AREA

2.4.1.1 Ocean sunfish and basking sharks are highly mobile species with seasonal presence in the region. To account for the highly mobile nature of these species, the Basking Shark and Ocean Sunfish Study Area is defined as a 100 km around the Offshore Project Boundary in alignment with the Scoping Report (Spiorad na Mara Limited, 2023). This Study Area is shown in **Plate 2-1**.

Plate 2-1 Fish Ecology Study Area – comprising the Marine Fish Study Area, Diadromous Fish Study Area and Basking Sharks and Ocean Sunfish Study Area.

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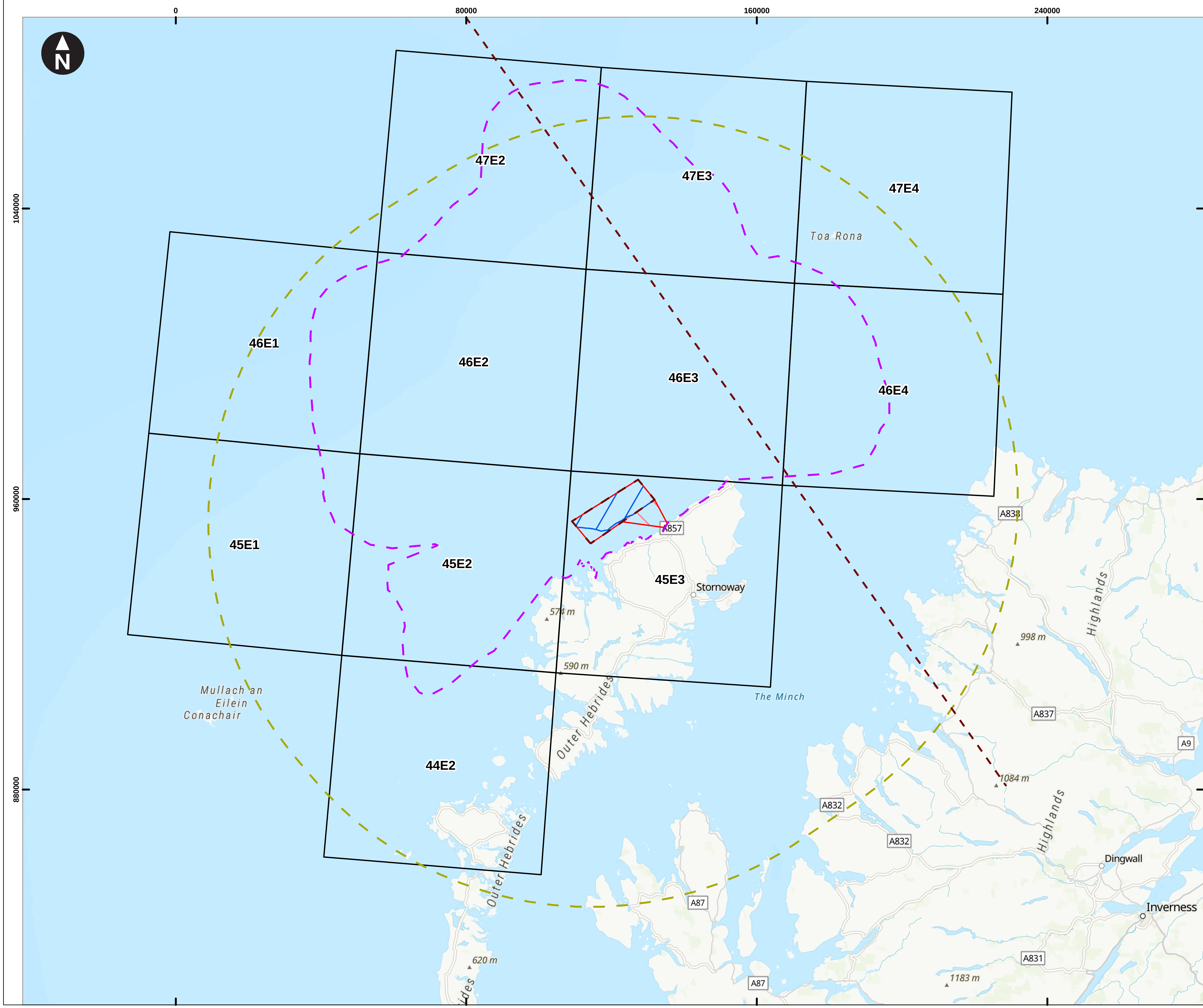
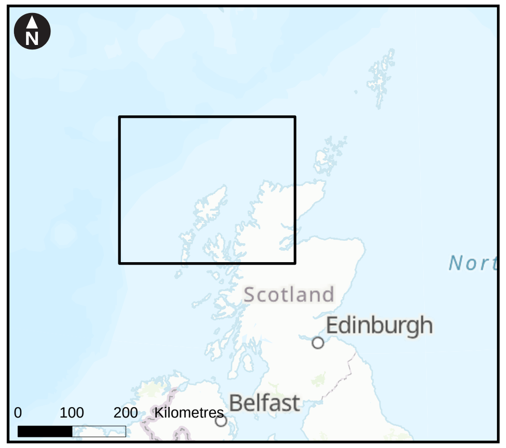


Key

- Offshore Project Boundary
- Offshore Cable Area of Search
- Array Area
- Turbine Area
- Basking Shark and Ocean Sunfish Study Area
- Marine Fish Study Area
- Diadromous Fish Study Area
- ICES Statistical Rectangles



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Scale at A3:1:1,000,000

World Topographic Map: Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community

Drawn: SS Checked: MS Approved: DA

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Plate 2-1
Fish Ecology Study Area

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3 METHODOLOGY

3.1 DESKTOP STUDY

3.1.1.1 Information on fish ecology within the Fish Ecology Study Area was gathered through a comprehensive desktop review of existing studies and datasets. **Table 3-1** summarises the key datasets and guidance literature (e.g., government reports). It does not provide an exhaustive list of all literature reviewed and rather focuses on primary data sources.

3.1.1.2 For the purpose of assessment, fish have been categorised into the following ecological groups:

- Pelagic fish species;
- Demersal fish species;
- Elasmobranchs species;
- Diadromous fish species.

3.1.1.3 Red listed, rare and/or legally protected marine species that were identified have been addressed in their respective ecological group as defined above.

Table 3-1: Summary of key publicly available datasets used to inform the Fish Ecology Baseline

Source	**Spatial Coverage of Study Area**	**Year**	**Summary**
Distribution of spawning and nursery grounds defined by Coull *et al.* (1998) and Ellis *et al.* (2012)	Full coverage of the Marine Fish Study Area	2012 (inclusive of Coull *et al.* (1998) data)	Distribution of potential nursery and spawning grounds for several key fish species in UK waters.
Updating Fisheries Sensitivity Maps in British Waters (Aires *et al.*, 2014)	Full coverage of the Marine Fish Study Area	2014	Distribution of 'sensitive areas' of key commercial species based on evidence of aggregations of 0 group fish (fish within their first year of life) and/or larvae.
ScotMER: Developing essential fish habitat maps (Franco *et al.*, 2022)	Full coverage of the Marine Fish Study Area	2022	Distribution of Essential Fish Habitat (EFH) (those waters and substrate necessary for spawning, breeding, feeding, or growth) of key fish species in Scottish waters.
Sandeel models (Langton *et al.* 2021)	Partial coverage of the Marine Fish Study Area	2021	Species distribution models developed to predict the occurrence and density of these species in parts of the Celtic Sea. This 'hurdle' model considers a number of factors including sediment silt and sand component percentage, seabed slope, and a depth range of 30-50 m as

Source	Spatial Coverage of Study Area	Year	Summary
			predictors of sandeel presence and density.
Scottish Sea Fisheries Statistics 2023 Landings Data (Scottish Government, 2023)	Full coverage of the Marine Fish Study Area	2019-2023	Detailed information on landings (tonnage and value) of fish species by ICES rectangle.
International Bottom Trawl Survey (ICES, 2024b)	Full coverage of the Marine Fish Study Area	2020-2024	The International Bottom Trawl Survey Working Group (IBTSWG) fishery-independent multispecies bottom-trawl surveys by ICES rectangle.
Eggs and Larvae Database (ICES, 2024d)	Full coverage of the Marine Fish Study Area	2020-2024	The IBTSWG fishery-independent multispecies egg and larvae surveys by ICES rectangle. While no ICES Larvae Working Group or survey campaign currently focuses explicitly on the waters west of Scotland/*Alba*, around the Isle of Lewis/*Eilean Leòdhais*, historical surveys have covered this region and have been considered.
Oyster Wave Array Environmental Statement (Royal Haskoning, 2012)	Partial coverage of the Fish Ecology Study Area	2012	Report identifies a fish and shellfish baseline and includes primary data (vantage point surveys) for basking shark.
Scottish Marine and Freshwater Science Volume 1 no. 14. Marine Directorate Science	Full coverage of the Diadromous Fish Study Area	2010	This report outlines major migration routes and behaviours of Atlantic salmon *Salmo salar*, brown trout *Salmo trutta*, and European eel *Anguilla anguilla* in and around the Diadromous Fish Study Area
Rod fishery statistics - reported catch by Stock Assessment Area (Dataset) (Marine Scotland, 2024)	Partial coverage of the Diadromous Fish Study Area	Salmon: 2011 to 2023 Sea trout: 2017-2023	Reported rod catches of salmon and sea trout provided by Stock Assessment Area and month.
Stock estimates of salmonid populations (Dataset) (Marine Scotland, 2023)	Partial coverage of the Diadromous Fish Study Area	2020-2024	Reported stock estimates of salmon and sea trout provided by Stock Assessment Area.
Fish tagging and genetic studies and reviews on migratory fish published by Marine Scotland (Malcolm *et al.*, 2010; Godfrey *et al.*, 2014; Cauwelier *et al.*, 2015;	Full coverage of the Diadromous Fish Study Area.	2010-2018	Research on the migratory patterns of salmonids and European eels within Scottish waters.

Source	Spatial Coverage of Study Area	Year	Summary
Downie *et al*., 2018; and Armstrong *et al*., 2018)			

3.2 SITE-SPECIFIC SURVEYS

3.2.1.1 Several surveys were conducted to support the baseline characterisation of fish ecology in the Offshore Project Boundary. These included the collection of environmental DNA (eDNA), a juvenile salmonid acoustic fish tracking study, drop-down camera (DCC) surveys, and baited remote underwater video (BRUV) sampling. Additionally, data from surveys carried out for benthic ecology and marine mammal baselines were used to inform the fish ecology baseline. This included seabed habitat characterisation to inform benthic ecology, such as particle size distribution data from grab samples. Particle size distribution data helped assess the presence of suitable habitat for key fish species. Digital Aerial Surveys (DAS) and Passive Acoustic Monitoring (PAM), conducted primarily for birds and marine mammals, also recorded incidental detections of fish or fish-related activity. A summary the site-specific surveys that have been used to inform the fish ecology baseline are outlined in **Table 3-2**.

Table 3-2: Summary of surveys undertaken to inform the fish ecology baseline characterisation.

Survey type	**Survey date**	**Scope of survey**	**Coverage of study area**	**Location of report**
eDNA[1]	17–27 October 2023	Collection of water eDNA samples from 3 water depths: surface, middle, and bottom. Samples were analysed for marine fish (excluding sharks and rays).	A total of 30 samples collected from 3 depths (surface, middle, and bottom) at 10 sampling stations, and sediment samples from 5 stations within the Offshore Project Boundary. Positioned specifically to target potential sensitive habitats.	Refer to **Annex 12.1.2: eDNA Report, Volume 2c** for further details.
Juvenile salmonid acoustic fish tracking study	20 April-6 September 2024	Acoustic tracking of 100 juvenile salmon caught, tagged and released at the lower River Grimersta to investigate the travel paths of out-migrating salmon post-smolts through East Loch Roag and within the Array Area.	A total of 20 receiver stations within the Array Area and 13 within the Loch Roag/*Loch Ròg* located from the release site to the seaward limit of East Loch Roag/*Loch Ròg*.	Refer to **Annex 12.1.3: Fish Tracking Study (Atlantic Salmon Fish Tagging Survey), Volume 2c** for further details.
BRUV[2]	17–27 October 2023	BRUV surveys undertaken to provide information on the marine fauna using the Offshore Project Boundary.	A total of 7 BRUV deployments positioned across the Offshore Project Boundary, with 1 hour of film analysed per deployment.	Refer to **Appendix 11.2, Volume 2c** for further details.
Digital Aerial Surveys	26 March 2022-3 March 2024	Aerial surveys flown at 2.2 km spaced flight lines to visually detect birds and marine megafauna.	A total of 24 aerial surveys flown across the Array Area and a 10 km buffer (DAS Survey Area).	Refer to **Appendix 13.1, Volume 2c** for further details.

[1] eDNA sampling involves collecting water samples containing environmental DNA shed by organisms, such as scales, mucus, or waste, to detect the presence of fish and other aquatic species.

[2] Baited underwater video surveys are a marine research technique where bait is used to attract aquatic species to a stationary underwater camera, allowing for non-invasive observation and assessment of fish abundance, diversity, and behaviour.

Survey type	Survey date	Scope of survey	Coverage of study area	Location of report
Passive Acoustic Monitoring	11 January 2024-9 February 2025	PAM moorings were deployed within the Array Area. Using the integrated hydrophone of the acoustic release system of the PAM moorings, monitoring for incidental fish tag signals was undertaken throughout the deployment period.	A total of 1 (Deployment 1) to 2 (Deployments 2 & 3) static PAM moorings were deployed within the Array Area.	Refer **Appendix 13.2, Volume 2c** for further details.
Grab samples and Drop-Down Cameran surveys	17–27 October 2023	Co-located DDC and grab surveys for macrobenthic, sediment particle size distribution (PSD) and chemical contaminant analysis.	55 DDC stations were sampled (550 still images and 70 videos), and 11 grab samples were collected across the Offshore Project Boundary and analysed for particle size distribution.	Refer to **Appendix 11.2, Volume 2c** for further details.

4 BASELINE CONDITIONS

4.1 PELAGIC FISH

4.1.1.1 Pelagic species are found predominantly in the mid and upper water layers of the water column, with their movement, distribution and spawning heavily influenced by hydrographic factors such as ocean currents. They are typically pelagic spawners with eggs released and fertilised within the water column, and are subsequently dispersed by ocean currents, although certain species such as Atlantic herring *Clupea harengus* are demersal spawners reliant on specific substratum for egg laying (ICES, 2005). Pelagic species are typically mobile when tracking food and can make extensive seasonal migrations, resulting in a highly variable distribution through time. Demersal spawning behaviour increases sensitivity to pressures such as seabed disturbance, as the suspension and subsequent resettlement of sediments can result in the smothering of eggs deposited on or near the seabed. As such, greater consideration is given to Atlantic herring in subsequent sections, as it is a key commercially and ecologically important pelagic species identified within the Marine Fish Study Area that exhibits this spawning behaviour.

4.1.1.2 Some species of ecological or commercial importance, identified from baseline searches and/or field surveys conducted in support of the Offshore Project within the Marine Fish Study Area, along with their conservation status, are shown in **Table 4-1**. A full list of all pelagic species detected, along with the source of their identification (i.e., database records and/or field surveys), is provided in **Annex 12.1.1: Species List, Volume 2c**. Some of these species have nursery and spawning grounds within the Marine Fish Study Area (Coull *et al.*, 1998; Ellis *et al.*, 2012) and are discussed in Section 4.1.2.

Table 4-1: Pelagic species of ecological or commercial importance identified from baseline searches and/or field surveys within the Marine Fish Study Area, along with their IUCN red list category and conservation status in Scotland.

Common Name	**Species Name**	**IUCN Category**	**Conservation Status**
Atlantic bluefin tuna*	*Thunnus thynnus*	LC	NERC, OSPAR, Bio List
Atlantic herring*	*Clupea harengus*	LC	NERC, PMF, Bio List
Atlantic mackerel*	*Scomber scombrus*	LC	NERC, PMF, Bio List
Blue whiting	*Micromesistius poutassou*	LC	NERC, PMF, Bio List
Horse mackerel*	*Trachurus trachurus*	LC	NERC, PMF
European pilchard*	*Sardina pilchardus*	NT	-
European sprat*	*Sprattus sprattus*	LC	-
Ocean sunfish*	*Mola mola*	DD	-

IUCN Red List Category (IUCN,2024): NT – near threatened; LC – least concern; DD – data deficient
Conservation Status: NERC – species of principal importance in England (Defra, 2022), OSPAR – OSPAR list of threatened and declining species & habitats (OSPAR, 2024); PMF – Scottish priority marine features (NatureScot, 2020a); Bio List – Scottish Biodiversity List (NatureScot, 2020b).
Detection Status: Species marked with an asterisk (*) were detected during site-specific surveys conducted in support of the Offshore Project. Species without an asterisk were identified only through desktop review and/or database searches.

4.1.2 PELAGIC FISH SPAWNING AND NURSERY GROUND

4.1.2.1 Potential spawning and nursery grounds were identified within the Marine Fish Study Area for the following pelagic species: Atlantic herring, Atlantic mackerel *Scomber scombrus*, Blue whiting *Micromesistius poutassou* and European sprat *Sprattus sprattus* (Coull *et al.*, 1998; Ellis *et al.*, 2012). Location of these nursery grounds in relation to the Offshore Project is provided in **Table 4-2** and shown on **Plate 4-1**. The main spawning periods for these species are identified in **Table 4-3**.

Table 4-2: Spatial extent of pelagic fish nursery and spawning grounds identified across the Marine Fish Study Area, Offshore Cable Area of Search and the Array Area (Coull *et al.*, 1998; Ellis *et al.*, 2012).

Species	**Spatial extent within:**					
	Marine Fish Study Area		**Offshore Cable Area of Search**		**Array Area**	
	Spawning	**Nursery**	**Spawning**	**Nursery**	**Spawning**	**Nursery**
Atlantic herring	✓(partial)	✓(partial)	✓	✓	✓	✓
Atlantic mackerel	✓(partial)	✓(partial)	-	✓	-	✓
Blue whiting	✓(partial)	✓	-	✓	-	✓
European sprat	✓(partial)	-	✓	-	✓	-

Key: *✓ present; – absent; (partial) indicates that the nursery or spawning ground only partially overlaps with the specified area.*

Table 4-3: Main periods of spawning activity for key pelagic species found within the Marine Fish Study Area. Light blue indicates spawning period, and dark blue indicates peak spawning period (Ellis *et al.,* 2012).

Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Atlantic herring*												
Atlantic mackerel												
Blue whiting												
European sprat												
**West of Scotland/Alba (WoS) populations*												

Plate 4-1 Pelagic fish nursery and spawning areas: Atlantic mackerel, Blue whiting, Atlantic herring, European sprat.

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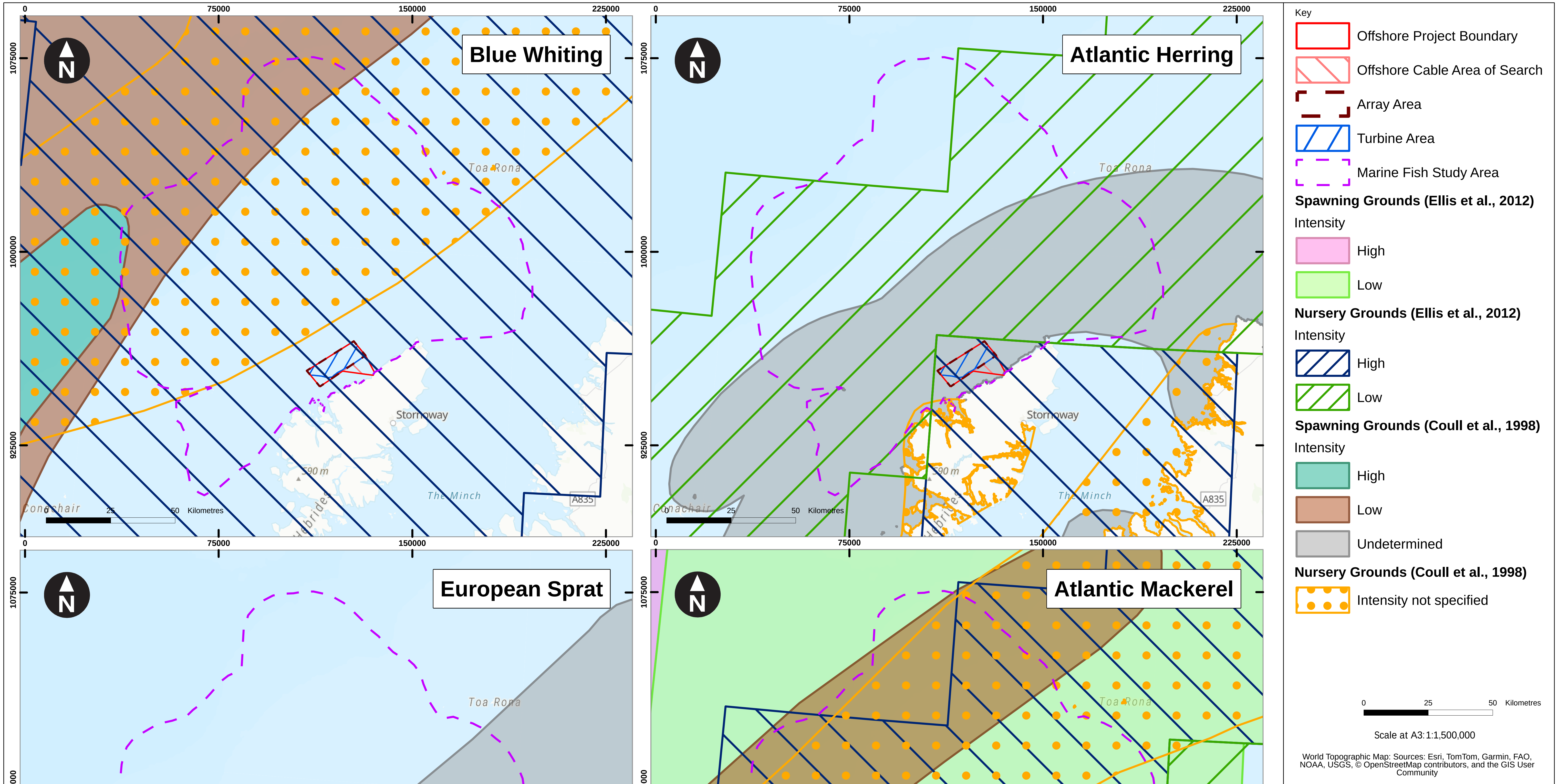

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Plate 4-1
Pelagic Fish Spawning and Nursery Grounds: Atlantic Mackerel, Blue Whiting, Atlantic Herring, European Sprat

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Atlantic herring

4.1.2.2 Atlantic herring are a widespread and abundant pelagic species with commercial and ecological importance. Atlantic herring, including their eggs and larvae acts as an important prey species for a number of fish, bird and marine mammal species (Rankine and Morrison, 1989). Atlantic herring are grouped into different management stocks, each with different spawning periods, and spawning and nursery grounds (ICES, 2015). Of relevance to the Marine Fish Study Area, is the West of Scotland/*Alba* (WoS) populations, which comprises 2 groups - one spawning during spring (February until April) and the other during autumn (late August until October). Fisheries have historically targeted both groups, and their relative contribution is believed to have varied over time (ICES, 2024b), although currently the stock is primarily considered an autumn-spawning stock (ICES, 2024b; Frost and Diele, 2022). It is acknowledged however that in spring 2018 and 2019, for the first time in over 50 years, large shoals of spring-spawning WoS Atlantic herring were observed on known former spawning grounds (Frost and Diele, 2022).

4.1.2.3 Overfishing in the latter part of the 20th century led to the collapse of WoS Atlantic herring stocks and although the stock has since recovered, active management is required to prevent recurrence. The Herring Assessment Working Group was developed, which annually elevates the state of Atlantic herring stocks and provides advice for annual quotas to ensure sustainable harvesting. Assessment by ICES in 2023 of the WoS stock suggests recruitment remains very low relative to long term trends, despite some overall improvement since 2019 (ICES, 2024b).

Spawning ecology

4.1.2.4 Atlantic herring form dense shoals that migrate between feeding areas in open water, overwintering grounds in coastal areas and discrete spawning grounds. Whilst Atlantic herring are a pelagic species during their adult life stage, spawning behaviour is demersal and relies on the availability of suitable seabed habitat on which to deposit eggs.

4.1.2.5 Historically, the spring-spawning WoS Atlantic herring spawned in the Minch/*Mhaoil* (the strait separating the Isle of Lewis/*Eilean Leòdhais* from the Scottish mainland), on known spawning grounds in the sea lochs from Cape Wrath/*Am Parbh*, in the north, to Wester Ross/*Ros an Iar*, in the south. Autumn-spawning WoS Atlantic herring are thought to spawn off Cape Wrath/*Am Parbh*, which is located approximately 90 km to the north-northeast of the Offshore Project Boundary, however the specific locations of spawning grounds are mostly unknown (Rankine, 1986).

4.1.2.6 Atlantic herring deposit eggs on discrete spawning beds that are located in high energy and/or structurally complex environments (Frost and Diele, 2022). Spawning beds are typically characterised by coarse sands, gravels and/or small rocks (ICES, 2015), with seabed composition typically ranging from sandy gravel to gravelly sand (Reach *et al.,* 2013). Spring-spawning WoS Atlantic herring spawning grounds were also often recorded over or near maerl (Morrison et al. 1991; Neervoort, 2013). Aquaria experiment of Atlantic herring has further demonstrated that, when given the choice of different spawning substrata, Atlantic herring preferentially choose complex spawning substrates (Blaxter and Holliday, 1958). Habitat suitability is also determined by a number of additional environmental factors, including seabed flow rate and sediment oxygenation and, thus, suitable seabed habitat alone is often not enough to allow for a viable population of Atlantic herring in a given location (O'Sullivan *et al.,* 2013).

4.1.2.7 Once deposited, Atlantic herring eggs take approximately 2–3 weeks to hatch, after which the larvae drift as plankton, typically towards key coastal nursery habitats.

Spawning across the Marine Fish Study Area

4.1.2.8 Historical sensitivity maps produced by Coull *et al.* (1998) indicate that potentially suitable spawning habitat exists across much of the Marine Fish Study Area, including across both the Array Area and OCAS (**Plate 4-1**). More recently, sensitivity mapping undertaken by Aires *et al.* (2014) suggests a high probability of larvae aggregations of Atlantic herring across the Marine Fish Study Area, with the highest probability concentrated along the coastal extent of the Offshore Project Boundary, and to the north around the northern point of the Isle of Lewis/*Eilean Leòdhais*.

4.1.2.9 Analysis of particle size distribution data can further assist in the identification of potentially suitable Atlantic herring spawning habitat. Reach *et al.* (2013) classified Atlantic herring spawning habitat into 4 categories, ranging from 'Prime' to 'Unsuitable', based on the species' habitat preferences (low % of mud and high % of gravel) (Maravelias *et al.,* 2000; ICES, 2015) using the Folk (1954) sediment classification triangle (**Table 4-4**).

Table 4-4: Atlantic herring preferred spawning habitat classifications derived from Reach *et al.* (2013).

Sediment type (% contribution)	Habitat sediment preference
<5% mud, >50% gravel	Prime
<5% mud, >25% gravel	Sub-prime
<5% mud, >10% gravel	Suitable
>5% mud, <10% gravel	Unsuitable

4.1.2.10 Habitat mapping across the Offshore Project Boundary indicates that approximately 95% of the seabed is characterised by hard substrate, with only 5% classified as sedimentary (**Appendix 11.2, Volume 2c**). Consequently, only 11 of the planned 38 sampling stations across the Offshore Project Boundary were suitable for grab sampling and subsequent particle size analysis. Habitat suitability classifications for Atlantic herring spawning, based on site-specific data, showed that the majority of the Offshore Project Boundary has unsuitable sediment for Atlantic herring spawning, with only a small patch of suitable habitat identified in the southern section of the Array Area (**Plate 4-2**). Maerl beds were not observed within the Offshore Project Boundary during survey, however these habitats have historically been recorded to the southwest of the Offshore Project Boundary adjacent the mouth of the Western Loch Roag/*Loch Ròg* (**Chapter 11, Volume 2a**).

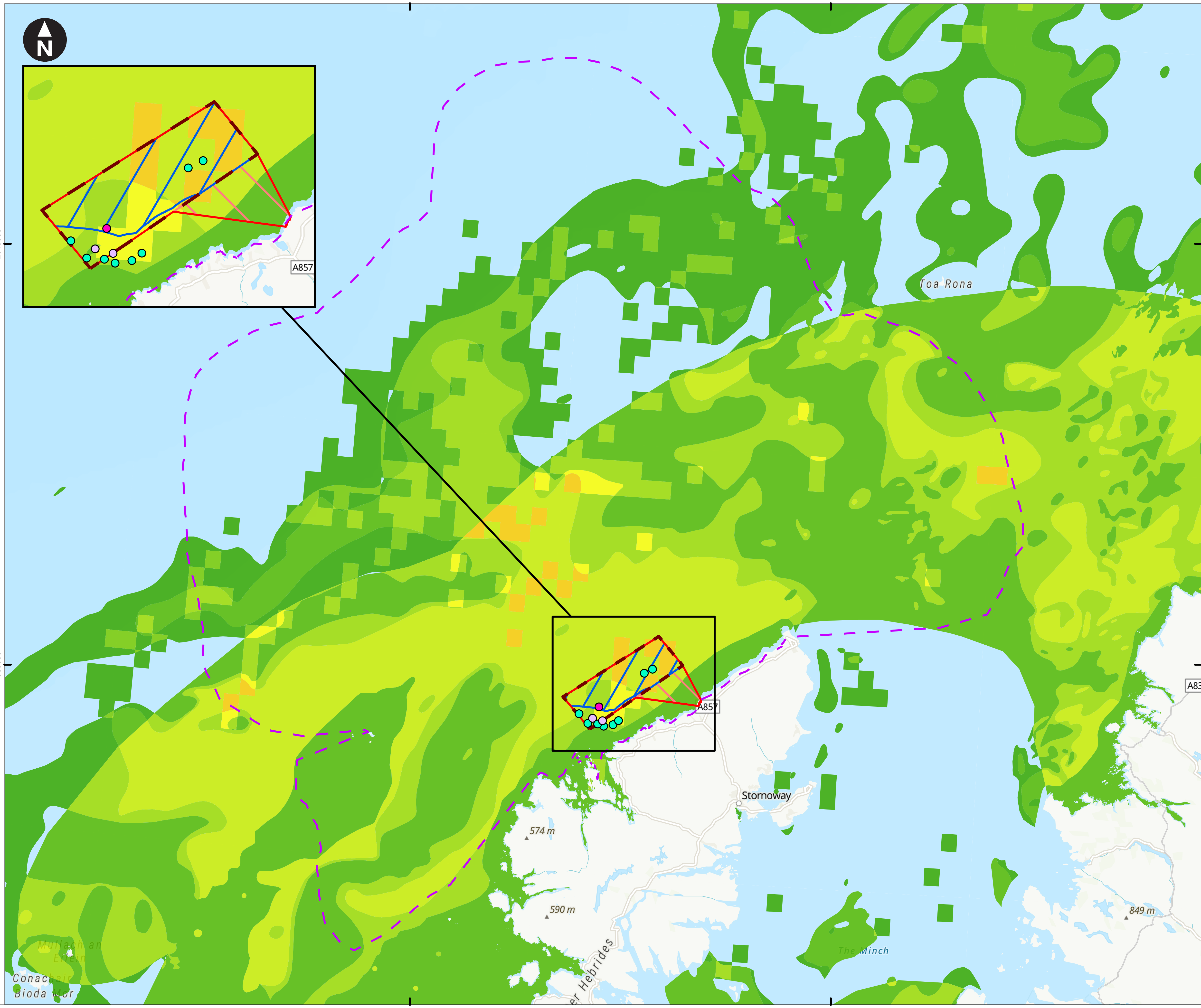
4.1.2.11 Larval Atlantic herring abundance can also be used to assess whether potential spawning grounds are currently active. The presence of larvae <10 mm in length indicates 'newly hatched' individuals that can help determine the location and intensity of spawning activity (ICES, 2024d). While no ICES Larvae Working Group or survey campaign currently focuses explicitly on the waters west of Scotland/*Alba*, around the Isle of Lewis/*Eilean Leòdhais*, historical surveys have covered this region. In particular, survey efforts during the 1970s and 1980s, as part of the International Atlantic herring Larvae Surveys (IHLS), recorded Atlantic herring larvae west of Scotland/*Alba*, suggesting spawning activity in the area at that time (e.g., McKay, 1980). In contrast, more recent surveys have been limited. Between 2020 and 2024, a total of 39 egg and larvae hauls were undertaken across the Marine Fish Study Area. Of these, 24 hauls coincided with the spawning period for the spring-spawning stock (February–April), while none coincided with the spawning period for the autumn-spawning stock (late August–October). No Atlantic herring eggs or larvae were explicitly recorded in any of the 39 hauls (ICES, 2024d).

4.1.2.12 Modelling was undertaken using the methodology described in Reach *et al.* (2013), incorporating the following datasets; spawning ground data (e.g., Coull *et al.,* 1998), British Geological Survey (BGS) sediment data (BGS, 2011), IHLS data (ICES, 2024d), and available fishing data. The results are presented alongside site-specific survey data in **Plate 4-2**. The combined data indicate that the Offshore Project Boundary is generally of medium suitability for Atlantic herring spawning, though suitability decreases to low within the inshore portion of the OCAS.

4.1.2.13 Overall, and considering both site-specific survey data and modelled data, Atlantic herring spawning is likely to occur in some parts of the Offshore Project Boundary and across the broader Marine Fish Study Area. The highest probability of spawning within the Offshore Project Boundary is in its southern region. Due to the predominance of hard substrate across much of the remaining Offshore Project Boundary and the absence of maerl beds, large-scale Atlantic herring spawning is unlikely outside the identified area. However, small, scattered patches of suitable seabed habitat may exist, providing isolated areas of potential spawning habitat.

Plate 4-2 Distribution of preferred Atlantic herring spawning habitat across the Marine Fish Study Area based on site-specific survey data and modelling undertaken using the Reach *et al*. (2013) method.

Page 4-18



Key

- Offshore Project Boundary
- Offshore Cable Area of Search
- Turbine Area
- Array Area
- Marine Fish Study Area

Atlantic Herring Spawning Habitat Potential

- 2 (Low)
- 3 (Low)
- 4 (Low)
- 5 (Low)
- 6 (Medium)
- 7 (Medium)
- 8 (Medium)
- 9 (High)
- 10 (High)
- 11 (High)
- 12 (High)
- Unsuitable

Atlantic Herring Habitat Suitability (Grab Samples)

- Prime
- Suitable
- Unsuitable

0 7 14 21 28 Kilometres

Scale at A3:1:700,000

World Topographic Map: Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community

Drawn: SS Checked: MS Approved: DA

Spiorad na Mara Offshore Wind Farm

Plate 4-2
Distribution of Preferred Atlantic Herring Spawning Habitat Across the Marine Fish Study Area Based on Site-specific Survey Data and Modelling Undertaken Using the Reach et al. (2013) Method

Document Number

70103316-WSPE-XX-XX-FG-OE-00031_S0_1.2

03/02/2026

4.1.3 OCEAN SUNFISH

4.1.3.1 Ocean sunfish are the largest bony fish in the world and globally distributed throughout temperate and tropical seas. Ocean sunfish are classified as vulnerable on the IUCN red list and have a decreasing population trend (IUCN, 2024). Ocean sunfish are vulnerable to entanglement and vessel strikes but are not protected under UK or EU legislation.

4.1.3.2 The species has been recorded in low numbers off Scottish and Irish coasts, the south and west coasts of England, and into the Baltic Sea (Bleach, 2002; Hinrichsen *et al.,* 2022). While their frequency in northern climates appears to be increasing, they are not frequent visitors to UK waters and occur seasonally in low numbers, due to winter temperatures falling below their thermal tolerance (Rogan and Mackey, 2007). Range expansion of ocean sunfish has been suggested due to an increase in sightings in Irish waters (Lyashevska *et al.,* 2022). The latest population estimate for the North Atlantic is 18,000 individuals (Potter et al., 2011). Aerial surveys in the Irish Sea, conducted across an area of 11,951 km between 2003-2004, detected 68 individuals (Houghton et al., 2006). Abundance of ocean sunfish in this region may therefore be higher than previous studies have concluded. Density was lower in the north Irish Sea, compared with St George's Channel and the Bristol Channel, and this trend is likely to extend northward into Scottish waters.

4.1.3.3 Site-specific DAS for the Offshore Project recorded 2 ocean sunfish, 1 in September 2022 and 1 in August 2023. Abundance for these months were estimated at 9 (95% CI=1-34), with a density of 0.01 animals/km^2. In September 2022, the individual was recorded in the southwest of the DAS Survey Area, adjacent Loch Roag, and in August 2023 the species was detected in the north of the DAS Survey Area. Both recordings were not within the Array Area (**Appendix 13.1, Volume 2c**). In addition, Ocean sunfish eggs and larvae were recorded in 24 of the 39 egg and larvae hauls undertaken across the Marine Fish Study Area between 2020-2024 (ICES, 2024d).

4.1.4 ATLANTIC BLUEFIN TUNA

4.1.4.1 Atlantic bluefin tuna *Thunnus thynnus* are large, highly migratory fish which range throughout the Atlantic Ocean and are being increasingly observed within northeast Atlantic (Horton *et al.,* 2025). Atlantic bluefin tuna is an important species for commercial fisheries, and stocks have previously experienced over-exploitation. Atlantic bluefin tuna forage in the Northeast Atlantic between the months of August and December, where they feed at the surface (Atlantic bluefin tuna follow a diel diving pattern, where vertical migrations follow the movements of prey species). They have previously been a regular occurrence along the coasts of western Ireland, however in 2005 became regionally scarce. In recent years, Atlantic bluefin tuna have reappeared in UK and Irish coastal and offshore waters, with Japanese longline fleets working in the northeast Atlantic also indicating increased catches of the species (Horton *et al.,* 2020).

4.1.4.2 Site-specific DAS for the Offshore Project recorded 1 single Atlantic bluefin tuna in November 2023. This provided an abundance estimate of 9 (95% CI=1-26), and a density estimate of 0.01 animals/km^2. The single recording of Atlantic bluefin tuna was in the east of the DAS Survey Area, outside of the Array Area (**Appendix 13.1, Volume 2c**).

4.2 DEMERSAL FISH

4.2.1.1 Demersal species live on or near the seabed, and whilst the egg and larval stages are often subject to passive dispersal (advection), distribution of juvenile and adult life stages are principally determined by hydrography and sediment type (abiotic factors). However, biotic factors such as competition and predator-prey interactions may also influence abundance and distribution (Drazen and Haedrich, 2012). This group includes several important commercial species such as Atlantic cod *Gadus morhua*, haddock *Melanogrammus aeglefinus*, lemon sole *Microstomus kitt* and plaice *Pleuronectes platessa*. Epibenthic species include important keystone species such as sandeels *Ammodytes* spp.

4.2.1.2 Species afforded protection in Scotland/*Alba*, identified from baseline searches and/or field surveys conducted in support of the Offshore Project within the Marine Fish Study Area, along with their conservation status, are shown in **Table 4-5**. A full list of all demersal species detected, along with the source of their identification (i.e., database records and/or field surveys), is provided in **Annex 12.1.1, Volume 2c**. Some of these species have nursery and spawning grounds within the Marine Fish Study Area (Coull *et al.,* 1998; Ellis *et al.,* 2012) and are discussed in Section 4.2.2.

Table 4-5: Demersal fish species afforded protection in Scotland identified from baseline searches and/or field surveys within the Marine Fish Study Area, along with their IUCN red list category and conservation status in Scotland .

Common Name	Species Name	IUCN Category	Conservation Status
Anglerfish (Sea monkfish)	*Lophius budegassa*	LC	NERC, PMF, Bio List
Atlantic cod*	*Gadus morhua*	VU	NERC, OSPAR, PMF, Bio List
Atlantic halibut	*Hippoglossus hippoglossus*	VU	NERC, PMF, Bio List
Black scabbard fish	*Aphanopus carbo*	LC	NERC, PMF, Bio List
Blue ling	*Molva dypterygia*	VU	NERC, PMF, Bio List
Common sole*	*Solea solea*	LC	NERC, Bio List
European hake	*Merluccius merluccius*	LC	NERC, Bio List
European plaice*	*Pleuronectes platessa*	LC	NERC, Bio List
Ling*	*Molva molva*	LC	NERC, PMF, Bio List
Norway pout*	*Trisopterus esmarkii*	LC	PMF, Bio List
Roundnose grenadier	*Coryphaenoides rupestris*	CR	NERC, PMF, Bio List
Saithe*	*Pollachius virens*	LC	PMF
Whiting*	*Merlangius merlangus*	LC	NERC, PMF, Bio List

IUCN Red List Category (IUCN,2024): CR – critically endangered; EN – endangered; VU – vulnerable; NT – near threatened; LC – least concern; DD – data deficient.
Conservation Status: NERC – species of principal importance in England (Defra, 2022), OSPAR – OSPAR list of threatened and declining species & habitats (OSPAR, 2024); PMF – Scottish priority marine features (NatureScot, 2020a); Bio List – Scottish Biodiversity List (NatureScot, 2020b).
Detection Status: Species marked with an asterisk (*) were detected during site-specific surveys conducted in support of the Offshore Project. Species without an asterisk were identified only through desktop review and/or database searches.

4.2.2 DEMERSAL FISH SPAWNING AND NURSERY GROUNDS

4.2.2.1 Potential spawning and nursery grounds were identified within the Marine Fish Study Area for the following demersal species: Anglerfish *Lophius budegassa*, Atlantic cod, European hake *Merluccius merluccius*, European plaice, haddock, lemon sole, ling *Molva molva*, Norway pout *Trisopterus esmarkii*, saithe *Pollachius virens*, sandeels, and whiting *Merlangius merlangus* (Coull *et al.*, 1998; Ellis *et al.*, 2012). Location of these nursery grounds in relation to the Offshore Project is provided in **Table 4-6** and shown on **Plate 4-3**. The main spawning periods for these species are identified in **Table 4-7**.

Table 4-6: Spatial extent of demersal fish nursery and spawning grounds identified across the Marine Fish Study Area, Offshore Cable Area of Search and the Array Area (Coull *et al.*, 1998; Ellis *et al.*, 2012).

Species	**Spatial extent within:**					
	Marine Fish Study Area		**Offshore Cable Area of Search**		**Array Area**	
	Spawning	**Nursery**	**Spawning**	**Nursery**	**Spawning**	**Nursery**
Anglerfish	-	✓	-	✓	-	✓
Atlantic cod	✓(partial)	✓(partial)	✓	✓	✓	✓
European hake	✓(partial)	✓(partial)	-	✓	-	✓
European plaice	✓(partial)	✓(partial)	-	-	-	-
Haddock	✓(partial)	✓(partial)	-	✓	-	✓
Lemon sole	✓(partial)	✓(partial)	✓	✓	✓	✓
Ling	-	✓(partial)	-	✓	-	✓
Norway pout	✓(partial)	✓(partial)	✓	✓	✓	✓
Saithe	✓(partial)	✓(partial)	-	-	-	-
Sandeel	-	✓(partial)	-	-	-	-
Whiting	✓(partial)	✓(partial)	-	✓	-	✓
Key: *✓present; – absent; (partial) indicates that the nursery or spawning ground only partially overlaps with the specified area.*						

Table 4-7: Main periods of spawning activity for key demersal fish species in the Marine Fish Study Area. Light blue indicates spawning period, and dark blue indicates peak spawning period (Coull *et al.,* 1998; Ellis *et al.,* 2012).

Species	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Anglerfish	Light blue	Light blue	Light blue	Light blue	Light blue	Light blue						
Atlantic cod	Light blue	Dark blue	Dark blue	Light blue								
European hake	Light blue	Dark blue	Dark blue	Light blue	Light blue	Light blue						
European plaice	Light blue	Light blue	Dark blue									
Haddock		Dark blue	Dark blue	Dark blue	Light blue							
Lemon Sole			Light blue	Dark blue	Light blue							
Ling		Light blue	Light blue	Light blue	Light blue							
Norway pout	Light blue	Dark blue	Dark blue	Light blue								
Saithe	Dark blue	Dark blue	Light blue	Light blue								
Sandeel	Light blue	Light blue									Light blue	Light blue
Whiting	Light blue	Light blue	Light blue	Light blue	Light blue	Light blue						

Plate 4-3 Demersal fish nursery and spawning areas: anglerfish, Atlantic cod, European hake, European plaice, haddock, lemon sole, ling, Norway pout, saithe, sandeel, whiting.

Page 4-24

Key

- Offshore Project Boundary
- Offshore Cable Area of Search
- Array Area
- Turbine Area
- Marine Fish Study Area

Spawning Grounds (Ellis et al., 2012)

Intensity

- Low

Nursery Grounds (Ellis et al., 2012)

Intensity

- High
- Low

Spawning Grounds (Coull et al., 1998)

Intensity

- Undetermined

Nursery Grounds (Coull et al., 1998)

- Intensity not specified

0 25 50 Kilometres

Scale at A3:1:1,500,000

World Topographic Map: Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community

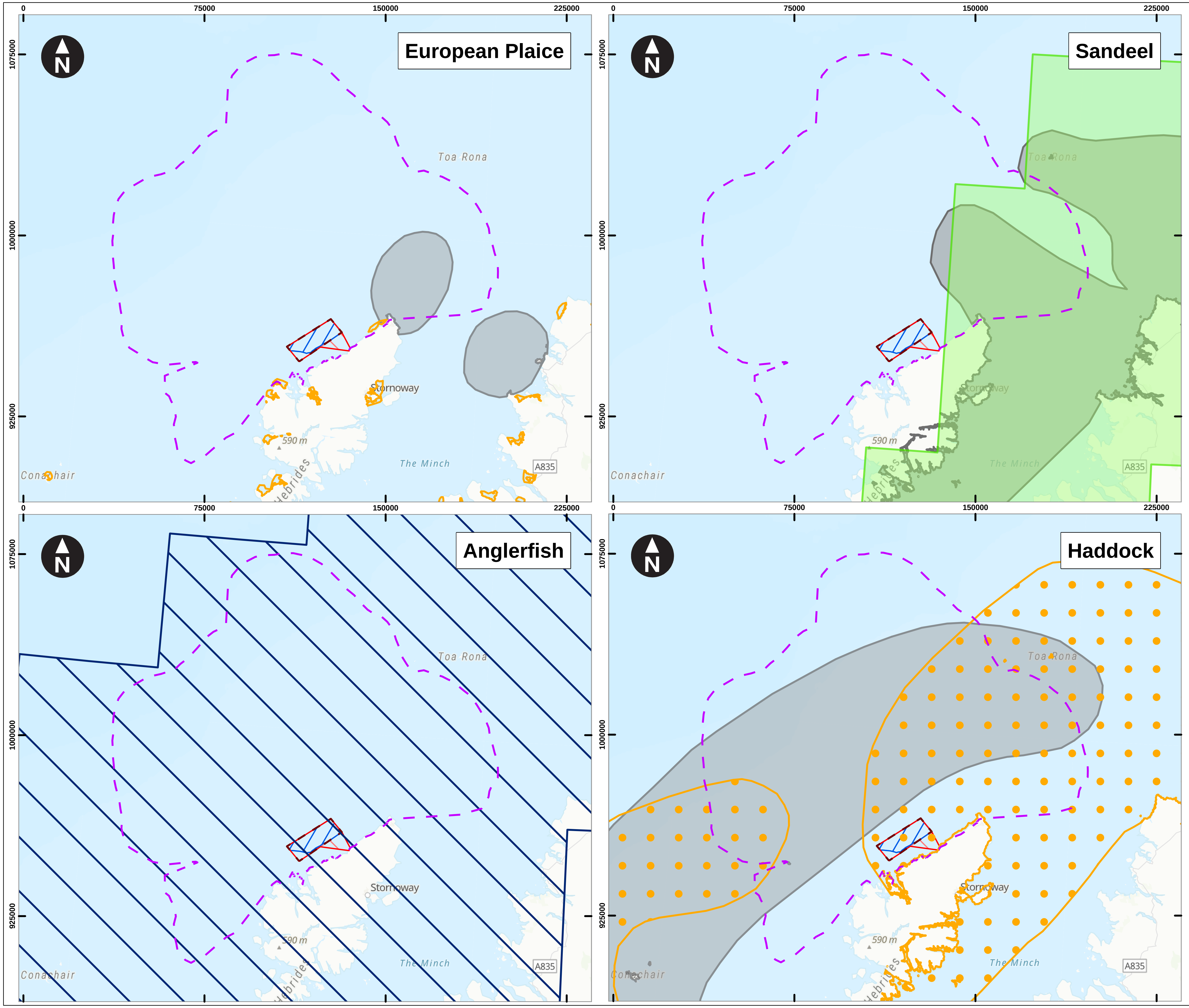
wsp | Spiorad na Mara

Drawn: SS Checked: MS Approved: DA

Spiorad na Mara Offshore Wind Farm

Plate 4-3a
Demersal Fish Spawning and Nursery Grounds: Whiting,Atlantic Cod, European Hake, Ling, Plaice, Sandeel, Anglerfish, Haddock, Lemon Sole, Norway Pout and Saithe

Document Number	03/02/2026
70103316-WSPE-XX-XX-FG-OE-00032_S0_1.2a	



Key

- Offshore Project Boundary
- Offshore Cable Area of Search
- Array Area
- Turbine Area
- Marine Fish Study Area

Spawning Grounds (Ellis et al., 2012)

Intensity

- Low

Nursery Grounds (Ellis et al., 2012)

Intensity

- High

Spawning Grounds (Coull et al., 1998)

Intensity

- Undetermined

Nursery Grounds (Coull et al., 1998)

- Intensity not specified

0 25 50 Kilometres

Scale at A3:1:1,500,000

World Topographic Map: Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community

wsp

Spiorad na Mara

Drawn: SS Checked: MS Approved: DA

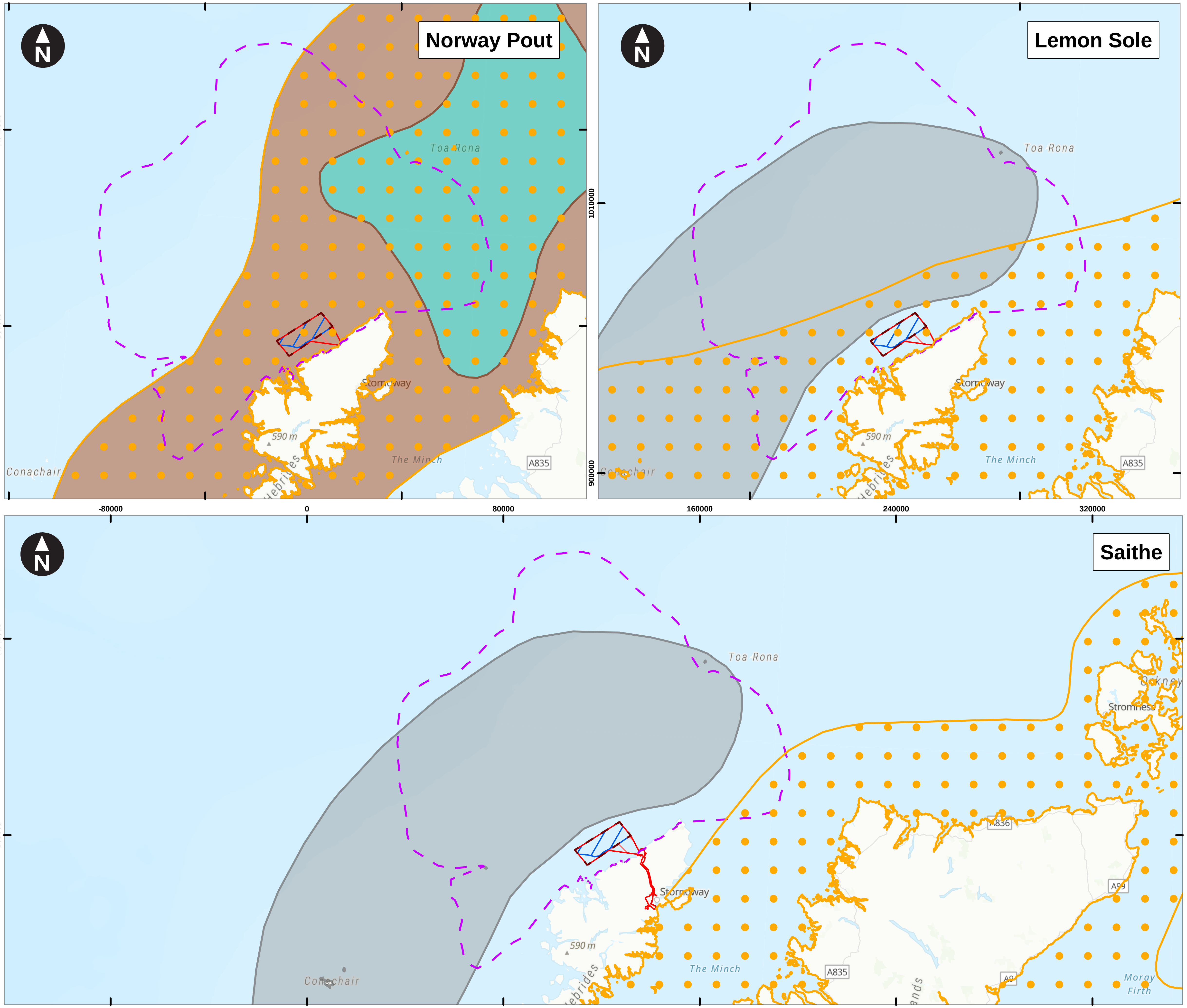
Spiorad na Mara Offshore Wind Farm

Plate 4-3b
Demersal Fish Spawning and Nursery Grounds: Whiting, Atlantic Cod, European Hake, Ling, Plaice, Sandeel, Anglerfish, Haddock, Lemon Sole, Norway Pout and Saithe

Document Number

70103316-WSPE-XX-XX-FG-OE-00032_S0_1.2b

03/02/2026



Key

- Offshore Project Boundary
- Offshore Cable Area of Search
- Array Area
- Turbine Area
- Marine Fish Study Area

Spawning Grounds (Coull et al., 1998)

Intensity

- High
- Low
- Undetermined

Nursery Grounds (Coull et al., 1998)

- Intensity not specified

0 25 50 Kilometres

Scale at A3:1:1,500,000

World Topographic Map: Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community

wsp

Spiorad na Mara

Drawn: SS Checked: MS Approved: DA

Spiorad na Mara Offshore Wind Farm

Plate 4-3c
Demersal Fish Spawning and Nursery Grounds: Whiting, Atlantic Cod, European Hake, Ling, Plaice, Sandeel, Anglerfish, Haddock, Lemon Sole, Norway Pout and Saithe

Document Number

70103316-WSPE-XX-XX-FG-OE-00032_S0_1.4c

03/02/2026

Sandeel

4.2.2.2 Sandeel species are of high conservation importance (Engelhard, 2018; Regnier, 2024; Sharples *et al.,* 2009) within the Marine Fish Study Area and designated as a feature of the North-east Lewis MPA (located approximately 21 km east of the Array Area) **(Plate 4-4**). A total of 5 species of sandeel are found within Scottish waters, with Raitt's sandeel (*Ammodytes marinus*), and the lesser sandeel (*Ammodytes tobianus*) the most common. Sandeel from the genus *Ammodytes* were recorded at 1 BRUV station located adjacent to the Offshore Cable Area of Search (**Plate 4-5**) and eDNA of Smooth sandeel (*Gymnammodytes semisquamatus*) was detected within the Offshore Project Boundary (**Annex 12.1.2, Volume 2c**).

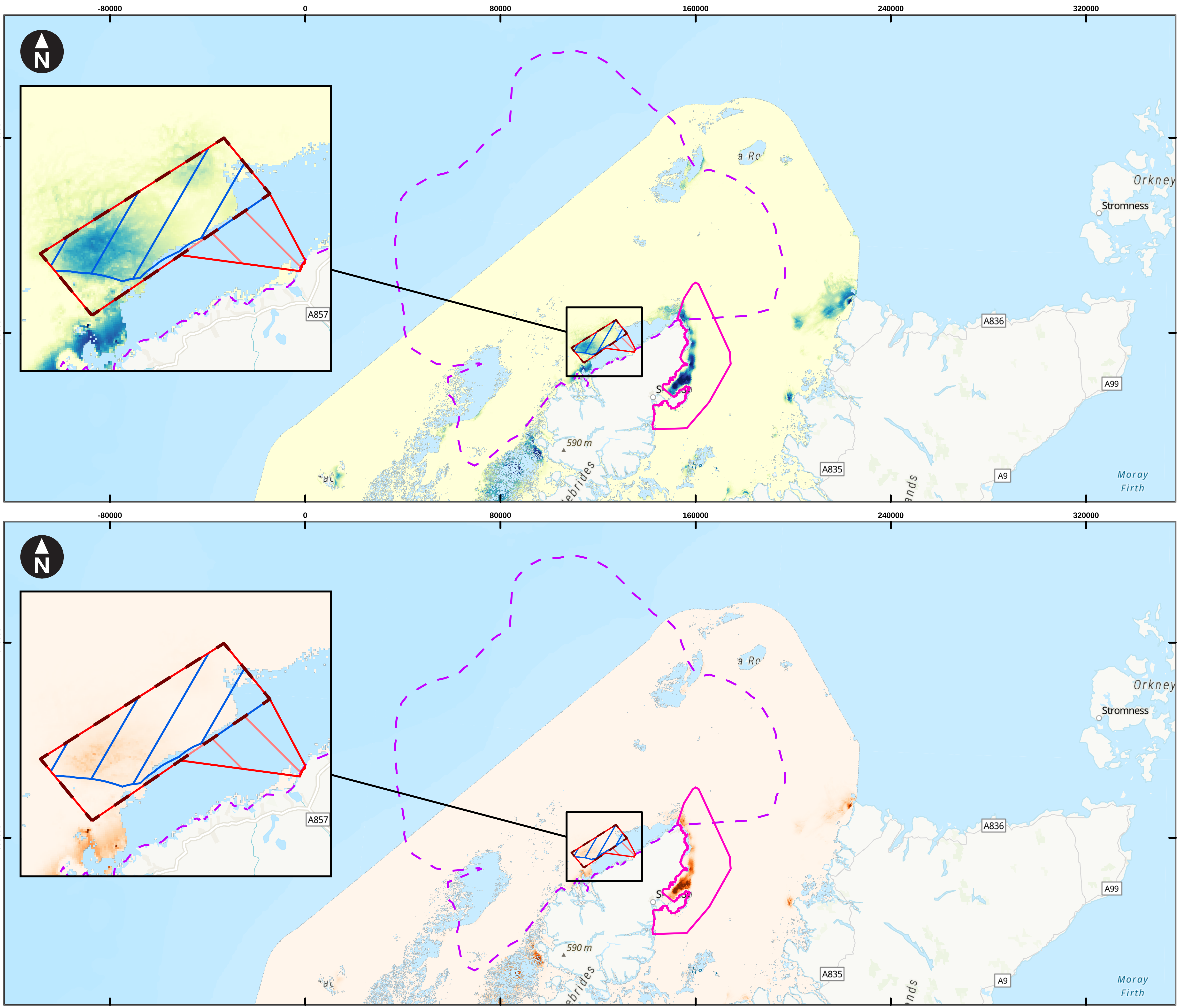
4.2.2.3 Sandeel are of high ecological importance as a food source for a wide variety of predators, including many fish (Engelhard, 2008), seabirds (Regnier, 2024) and some mammals (Sharples et al., 2009). While industrial fishing of sandeel in all Scottish waters has been banned – with a full ban on non-UK vessels now in force as of April 2024 under the Sandeel (Prohibition of Fishing) (Scotland) Order 2024) – the species remains a commercially important species across Europe.

4.2.2.4 Sandeel typically spawn between November to February. Eggs are demersal and are deposited on sandy substrate (Wright *et al.,* 2000). Larvae hatch after several weeks (usually between February and March), and drift in the water column as pelagic larvae for 1–3 months. After this period, they settle on sandy seabed habitat. Typically, Raitt's sandeel's settle in deeper water between depths of 20-80 m (Wright *et al.,* 2000) whilst the lesser sandeel is rarely observed deeper than 20 m (Langton *et al.,* 2021). Both species typically settle in areas characterised by sandy substrate with limited fine particles of silt and clay (Holland *et al.,* 2005). Sandeels prefer sediment with a high percentage of medium to coarse grained sand (particle size 0.25 mm to 2 mm) and have been shown to avoid sediment containing >4% silt (particle size <0.063 mm) and >20% fine sand (particle size 0.063 mm to 0.25mm) (Wright *et al*., 2000a; Holland *et al.,* 2005). Once settled in appropriate habitat, adult sandeels bury into sediment when not feeding in the water column (Engelhard, 2008). Adult sandeels also remain dormant (referred to as 'overwintering') in the sediment over the winter period (van Deurs *et al*., 2012; Winslade, 1974); aside from emerging briefly to spawn between November to February (Wright *et al.,* 2000).

4.2.2.5 Species distribution models have been developed to predict the occurrence and density of these species in parts of the Celtic Sea (Langton *et al.,* 2021). These maps in the context of the Marine Fish Study Area are shown on **Plate 4-**. This 'hurdle' model considered a number of factors including sediment silt and sand component percentage, seabed slope, and a depth range of 30-50 m. Much of the Array Area is indicated as having a predicted density of 0 sandeel per m². An area of increased predicted density is, however, present in the southwest component of the Array Area. Density is predicted to be between 10-20 per m², with some discrete points up to 40 per m². A small patch of higher predicted density ranging between 30 to 70 per m², with some discrete points of >120 per m² is also present within the Marine Fish Study Area, just to the south of the Array Area. No data exists for the majority of the OCAS, aside for isolated areas along the coast identified with a predicted density of 0 sandeel per m^2, and a small area within the northwest corner of the Offshore Cable Area of Search, which generally ranges from 10-20 per m^2.

Plate 4-4 Lesser sandeel predicted density according to modelling by Langton *et al.* (2021) across the Marine Fish Study Area.

Page 4-27



Key

- Offshore Project Boundary
- Offshore Cable Area of Search
- Array Area
- Turbine Area
- Marine Fish Study Area
- North-east Lewis Marine Protected Area (MPA)

Probablility of Occurence of Buried Sandeel

Value

High: 1

Low: 0

Predicted Density of Buried Sandeel (Number per m²)

Value

High: 120

Low: 0

0 20 40 60 Kilometres

Scale at A3:1:524,246

World Topographic Map: Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community

wsp Spiorad na Mara

Drawn: EH Checked: EH Approved: DA

Spiorad na Mara Offshore Wind farm

Plate 4-4
Lesser sandeel probability of occurrence and predicted density according to modelling by Langton et al. (2021)

Document Number

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03/02/2026

4.2.2.6 The habitat suitability models developed by Langton *et al.* (2021), as described above, provide a higher degree of accuracy in predicting the presence and usage of habitats by sandeel in Scottish waters, as they were specifically developed for this region. However, additional analysis of particle size distribution data and seabed habitat mapping undertaken in support of the Offshore Project can further aid in the identification of sandeel habitat (Reach *et al.*, 2024), particularly in areas where Langton *et al.* (2021) modelling data is unavailable. It is acknowledged that alternative models, such as Reach *et al.* (2024), may underestimate the importance of smaller patches of sandeel habitat (NatureScot, pers. comm.).

4.2.2.7 Reach *et al.* (2024) classified sandeel habitat into 4 categories, ranging from 'Prime' to 'Unsuitable', based on the species' habitat preferences (i.e., low mud content and high gravel content) using the Folk (1954) sediment classification triangle (Wright *et al.*, 2000; Holland *et al.*, 2005). These sediment type classifications, alongside seabed substrate maps and seabed habitat classification undertaken for the Offshore Project, can be used to assess the potential distribution of preferred substrate within the Offshore Project Boundary. **Table 4-8** presents these habitat preference categories along with the corresponding Folk (1954) sediment classifications used in EMODnet seabed substrate maps.

Table 4-8: Sandeel preferred habitat classifications derived from Reach *et al.* (2024).

Sediment type (% contribution)	Habitat sediment preference	Habitat substrate classification	Corresponding BGS modified folk classification (Folk, 1954)
<1% mud, >85% sand	Prime	Preferred	Sand (S), Slightly gravelly sand ((g)S) and Gravely sand (gS)
<4% mud, >70% sand	Sub-prime		
<10% mud, >50% sand	Suitable	Marginal	Sandy gravel (sG)
>10% mud, <50% sand	Unsuitable	Unsuitable	All other sediment classifications

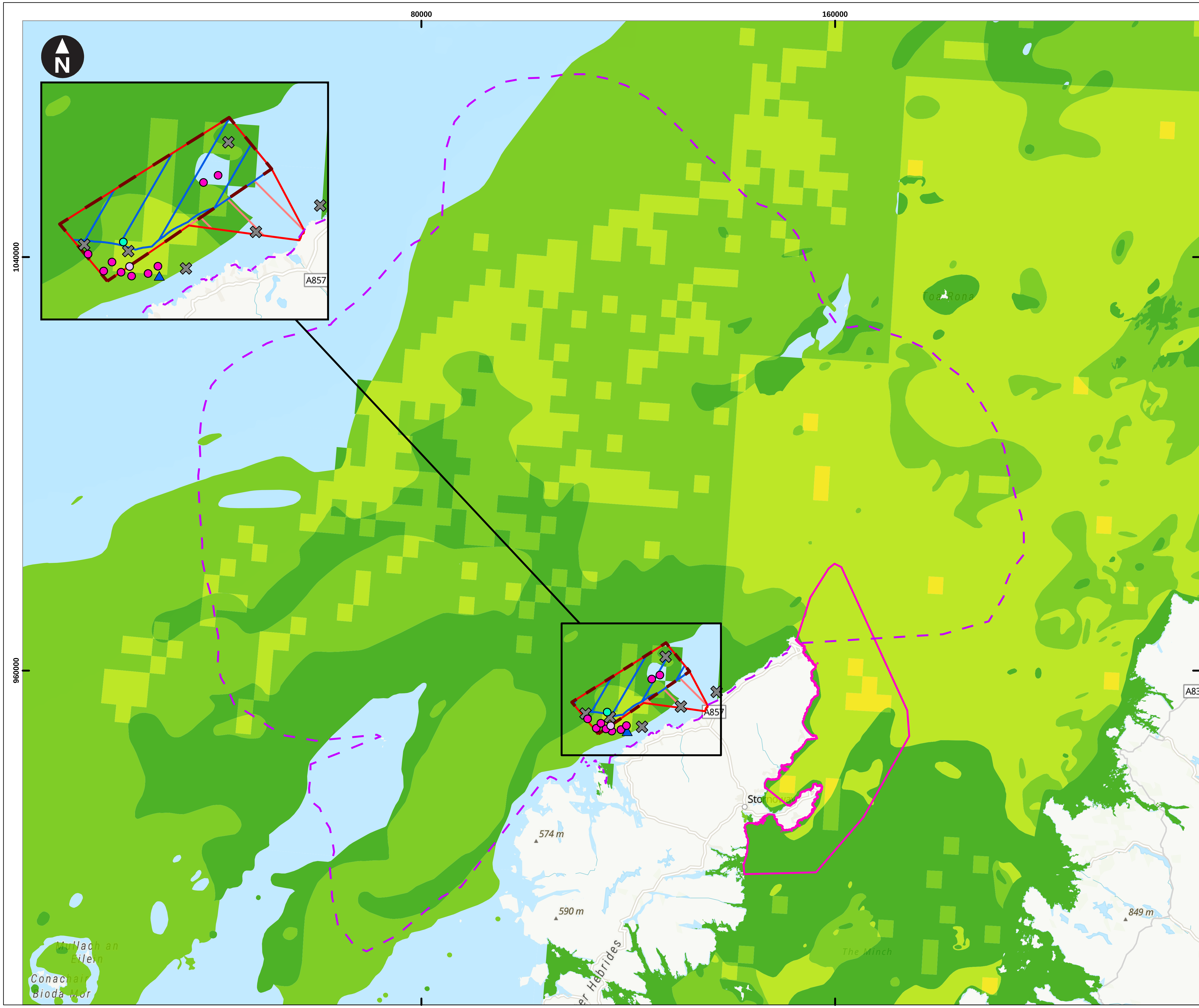
4.2.2.8 Habitat mapping across the Offshore Project Boundary indicates that approximately 95% of the seabed is characterised by hard substrate, with only 5% classified as sedimentary (**Appendix 11.2, Volume 2c**). Consequently, only 11 of the planned 38 sampling stations across the Offshore Project Boundary were suitable for grab sampling and subsequent particle size analysis. **Plate 4-5** presents the results of site-specific grab sampling alongside the EMODnet seabed substrate data in relation to the Reach *et al.* (2024) sandeel habitat categories.

4.2.2.9 Of the sites where ground conditions permitted grab sampling, 9 were classified as 'prime' habitat, 1 as 'sub-prime', and 1 as 'unsuitable'. The majority of 'prime' habitat sites are located in the southwestern corner of the Offshore Project Boundary. Additionally, 2 'prime' habitat sites were identified further north, within the central portion of the Array Area (**Plate 4-5**). EMODnet substrate mapping largely aligns with site-specific survey findings, indicating an area of preferred sandeel habitat in the southwestern portion of the Offshore Project Boundary, marginal habitat in the central region, and unsuitable habitat in the northern part of the Array Area.

4.2.2.10 Modelling was undertaken using the methodology described in Reach *et al.* (2024), incorporating the datasets discussed above was undertaken to provide a basis for informed assessment in those areas not covered by Langton *et al.* (2021) outputs. These datasets included within the Reach *et al.* (2024) model incorporate spawning ground data (e.g., Coull *et al.,* 1998), British BGS sediment data (BGS, 2011), and available fishing data. The results are presented alongside site-specific survey data in **Plate 4-5**. The modelled data indicates that the Offshore Project Boundary is generally of low suitability for sandeel species, with the exception of the southwest region which is indicated to be of medium potential. In addition, an area of prime habitat was identified from site-specific surveys in the northern portion of the Array Area as identified in **Plate 4-5**.

4.2.2.11 Taken together, site-specific survey data and desktop analysis indicate that sandeel are present within the Offshore Project Boundary, with the highest likelihood and densities occurring in the southwestern region of the Array Area. In addition, a small patch of suitable habitat was also identified in the northern section of the Array Area. Due to the predominance of hard substrate across much of the remaining Offshore Project Boundary, significant sandeel densities are unlikely outside these identified areas. It is acknowledged that small pockets of suitable habitat may exist elsewhere across the Offshore Project Boundary that support localised populations.

Plate 4-5 Potential sandeel habitat across the Marine Fish Study Area based on site-specific survey data and methods described by Reach *et al*. (2024).



Key

- Offshore Project Boundary
- Offshore Cable Area of Search
- Array Area
- Turbine Area
- Marine Fish Study Area
- North-east Lewis Marine Protected Area (MPA)

Sandeel Habitat Potential

- 2 (Low)
- 3 (Low)
- 4 (Low)
- 5 (Low)
- 6 (Medium)
- 7 (Medium)
- 8 (Medium)
- 9 (Medium)
- 10 (High)
- 11 (High)
- 12 (High)
- 13 (High)
- Unsuitable

Sandeel Detected in BRUV Footage

- Yes
- No

Sandeel Habitat Suitability (Grab Samples)

- Prime
- Sub-prime
- Unsuitable

0 7 14 21 28 Kilometres

Scale at A3:1:700,000

World Topographic Map: Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community

Drawn: SS Checked: MS Approved: DA

Spiorad na Mara Offshore Wind farm

Plate 4-5
Potential Sandeel Habitat Across the Marine Fish Study Area Based on Site-specific Survey Data and Modelling Undertaken Using the Latto et al. (2013) Method

Document Number

70103316-WSPE-XX-XX-FG-OE-00034_S0_1.2

03/02/2026

4.3 ELASMOBRANCHS

4.3.1.1 The elasmobranchs consist of sharks, skates, and rays, all 3 of which generally feature low reproductivity, low fecundity and late maturity when compared to other marine fish. Many species are protected due to their declining numbers, sensitivity to disturbance and slow rate of recovery from population loss (McCully *et al.,* 1998). Mobility varies between species, with some undergoing extensive migration (Doherty *et al.,* 2017) and others remaining more localised (Strong, 1989). Spawning behaviour is similarly diverse with egg laying (oviparous) and live birth (viviparous) strategies found within the group. Majority of benthopelagic and pelagic shark species are likely to move through the Marine Fish Study Area, as opposed to being resident, due to their widespread ranges.

4.3.1.2 Species afforded protection in Scotland/*Alba*, identified from baseline searches and/or field surveys conducted in support of the Offshore Project within the Marine Fish Study Area, along with their conservation status, are shown in **Table 4-9**. A full list of all elasmobranch species detected, along with the source of their identification (i.e., database records and/or field surveys), is provided in **Annex 12.1.1, Volume 2c**. Some of these species have nursery grounds within the Marine Fish Study Area (Ellis *et al.,* 2012) and are discussed in Section 4.3.2.

Table 4-9: Elasmobranch species identified from baseline searches and/or field surveys within the Marine Fish Study Area afforded protection in Scotland, along with their International Union for Conservation of Nature (IUCN) red list category and conservation status in Scotland.

Common Name	**Species Name**	**IUCN Category**	**Conservation Status**
Basking shark*	*Cetorhinus maximus*	EN	NERC, OSPAR, PMF, Bio List
Blue shark*	*Prionace glauca*	NT	NERC, Bio List
Spiny dogfish (spurdog)*	*Squalus acanthias*	EN	NERC, OSPAR, PMF, Bio List
Tope shark	*Galeorhinus galeus*	VU	NERC, Bio List
Sandy ray	*Leucoraja circularis*	EN	PMF, Bio List
Thornback ray	*Raja clavata*	NT	OSPAR, Bio List
Common skate	*Dipturus batis*	CR	NERC, OSPAR, PMF, Bio List
Flapper skate	*Dipturus intermedius*	CR	PMF
White skate (bottlenosed skate)	*Rostroraja alba*	CR	NERC, OSPAR
IUCN Red List Category (IUCN, 2024): CR – critically endangered; EN – endangered; VU – vulnerable; NT – near threatened **Conservation Status**: NERC – species of principal importance in England (Defra, 2022), OSPAR – OSPAR list of threatened and declining species & habitats (OSPAR, 2024); PMF – Scottish priority marine features (NatureScot, 2020a); Bio List – Scottish Biodiversity List (NatureScot, 2020b). **Detection Status:** Species marked with an asterisk (*) were detected during site-specific surveys conducted in support of the Offshore Project. Species without an asterisk were identified only through desktop review and/or database searches.			

4.3.2 ELASMOBRANCH SPAWNING AND NURSERY GROUNDS

4.3.2.1 Potential nursery grounds were identified within the Marine Fish Study Area for the following elasmobranchs: common skate complex (including both the blue skate *Dipturus batis* and flapper skate *Dipturus intermedius*, spotted ray *Raja montagui*, thornback ray *Raja clavata*, spurdog *Squalus acanthias*, and tope shark *Galeorhinus galeus* (Ellis *et al.*, 2012)). Location of these nursery grounds in relation to the Offshore Project is provided in **Table 4-10** and shown on **Plate 4-6**. The main spawning periods for these species are identified in **Table 4-11**.

Table 4-10: Spatial extent of elasmobranch nursery grounds identified across the Marine Fish Study Area, Offshore Cable Area of Search and the Array Area (Ellis *et al.*, 2012).

Species	**Spatial extent within:**		
	Marine Fish Study Area	**Offshore Cable Area of Search**	**Array Area**
Common skate complex[3]	✓(partial)	✓	✓
Spotted ray	✓(partial)	✓	✓
Spurdog	✓(partial)	✓	✓
Thornback ray	✓(partial)	–	–
Tope shark	✓(partial)	–	–
Key: *✓ present; – absent; (partial) indicates that the nursery or spawning ground only partially overlaps with the specified area.*			

Table 4-11: Main periods of spawning activity for key elasmobranch species found within the Marine Fish Study Area. Light blue indicates spawning period, and dark blue indicates peak spawning period (Ellis *et al.*, 2012).

Species	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Common skate complex*												
Spotted ray												
Spurdog	*Viviparous species (gravid females can be found all year round)*											
Thornback ray												
Tope shark	*Viviparous species (gravid females can be found all year round)*											
**As the spawning period for the common skate complex is unknown, a precautionary approach has been adopted, and it is assumed that spawning may be occurring all year round.*												

Common skate complex

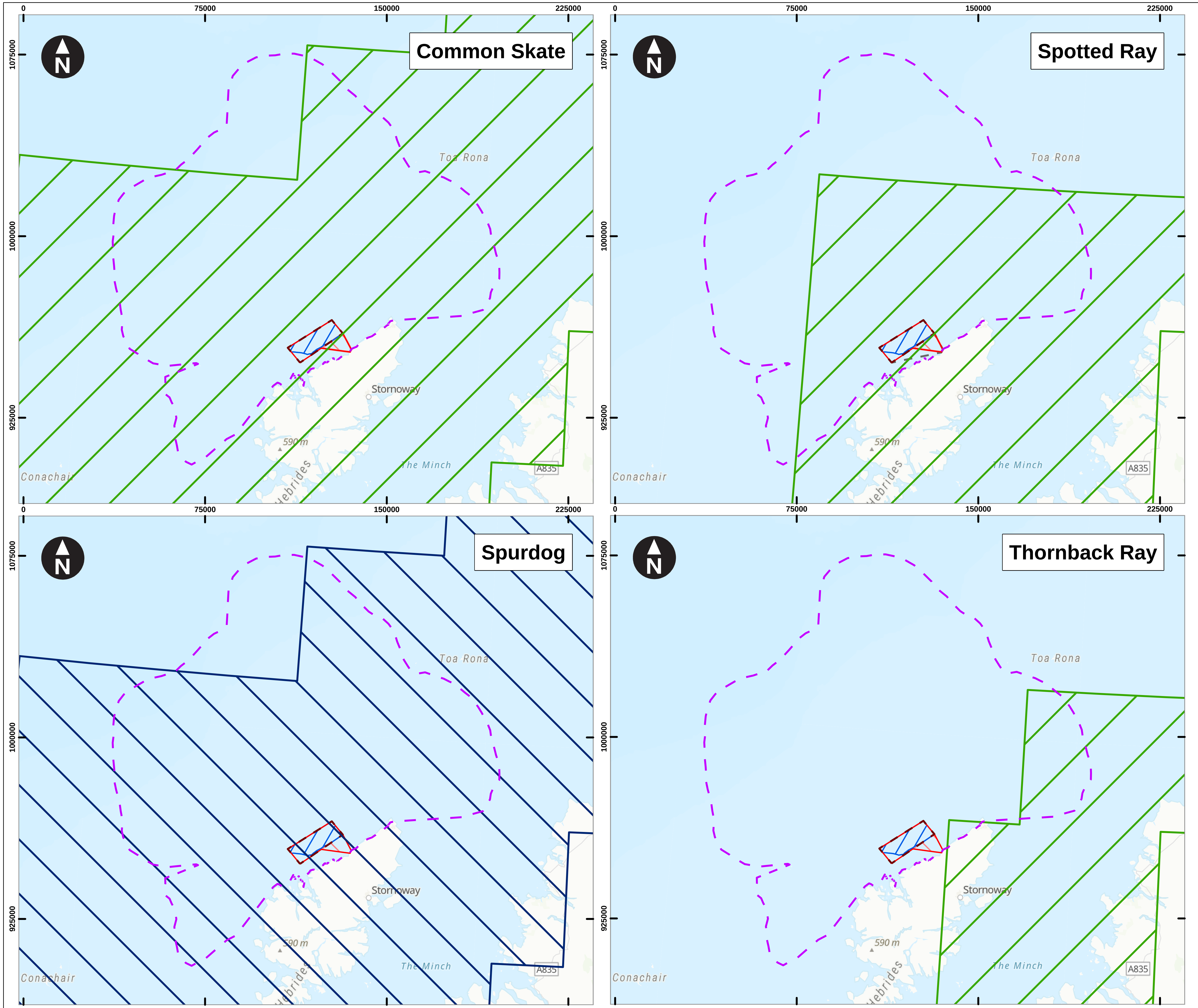
4.3.2.2 The common skate complex includes 2 oviparous species: the blue skate and the flapper skate. Over the past 60+ years, populations have declined by more than 80% due to historical targeting and bycatch in multispecies trawl and tangle net fisheries (Ellis *et al.*, 2021). As a result, the species was classified as critically endangered on the IUCN Red List in 2006 (IUCN, 2024) and added to the OSPAR list of threatened and declining species in 2001 (OSPAR, 2024).

[3] Includes both the blue skate (*Dipturus batis*) and flapper skate (*Dipturus intermedius*).

4.3.2.3 Limited data is available on egg-case distribution for these species, which is used to identify spawning grounds for oviparous species. However, where suitable habitat exists, spawning areas are expected to broadly overlap with nursery grounds (Ellis *et al.,* 2012). Observations in the Orkney Isles/*Arcaibh* indicate that flapper skates favour egg-laying habitat categorised by reef habitat with boulder or cobbles in shallow waters (<20 m) with moderate current (0.3-2.8 knots) and low sedimentation (Phillips *et al.,* 2021). Laboratory studies have also shown that flapper skate embryos have an extended development period of approximately 18 months (NatureScot, 2020).

4.3.2.4 Extensive areas of reef habitat have been identified across the Array Area and the OCAS (**Chapter 11, Volume 2a**). However, across the majority of the Marine Fish Study Area – including the entire Array Area and much of the OCAS – water depths range between approximately 25–72 m (**Chapter 9, Volume 2a**). As such, it is considered unlikely that suitable conditions exist for egg-laying across much of the Marine Fish Study Area. Potentially suitable areas for egg-laying are constrained to nearshore areas of the Marine Fish Study Area, where water depth is less than 20 m.

Plate 4-6 Elasmobranch nursery and spawning areas: common skate, spotted ray, spurdog, thornback ray and tope shark.



Key

- Offshore Project Boundary
- Offshore Cable Area of Search
- Array Area
- Turbine Area
- Marine Fish Study Area

Nursery Grounds (Ellis et al., 2012)

Intensity

- High
- Low

0 25 50 Kilometres

Scale at A3:1:1,500,000

World Topographic Map: Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community

Drawn: SS Checked: MA Approved: DA

Spiorad na Mara Offshore Wind farm

Plate 4-6
Elasmobranch Spawning and Nursery Grounds:
Common Skate, Spotted ray, Spurdog, Thornback Ray and Tope Shark

Document Number

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4.3.3 BLUE SHARKS

4.3.3.1 Blue sharks *Prionace glauca* are one of the most abundant and widely distributed pelagic shark species, ranging from 60°N to 50°S in tropical and temperate waters (Nykänen *et al.,* 2018). They are highly migratory, with tagging studies indicating that individuals are capable of large migrations, potentially travelling tens of thousands of kilometres (Nykänen *et al.,* 2018; Vandeperre *et al.,* 2014). Blue sharks are globally distributed; however, populations have undergone severe exploitation and as a result, populations are depleted. Blue sharks are regarded as Near Threatened by the IUCN, with a decreasing population trend in the North Atlantic (IUCN, 2024).

4.3.3.2 They spend much of their time at depth, resurfacing more often during the morning and afternoon while remaining deeper between midnight and 6 am (Nykänen *et al.,* 2018). Limited sightings of the shark in winter compared to summer also suggest that the species does not occur in large numbers in Scottish waters during this time, and that they likely migrate to warmer lower-latitude waters during the winter (Doyle *et al.,* 2015; Nykänen *et al.,* 2018). This diel change in depth preference has been linked to foraging, where blue sharks swim at the surface post-dawn to take advantage of changing light conditions to surprise prey at the surface. This behaviour has also been linked to reverse vertical zooplankton migrations which attract large schools of pelagic fish such as clupeids and mackerel, which blue sharks are known to feed on (Stevens, 1973).

4.3.3.3 Site-specific DAS surveys for the Offshore Project were conducted in August and September 2022, recording 1 and 25 blue sharks respectively. The abundance estimate for blue sharks in August 2022 was 9 (95% CI = 1-26), while in September, it was 214 (95% CI = 129-292). Density estimates were 0.01 animals/km^2 in August and 0.22 animals/km^2 in September. In August, blue sharks were observed northeast of the Array Area, whereas in September, they were distributed throughout the north, east, and south of the DAS Survey Area, including the Array Area (**Appendix 13.1, Volume 2c**).

4.3.4 BASKING SHARKS

4.3.4.1 Basking sharks have a global distribution and are the largest cartilaginous fish present in Scottish waters (Dolton *et al.,* 2020). Basking sharks have a history of over-exploitation in the Northeast Atlantic, and were hunted in Scotland/*Alba* until 1995, when the last basking shark fishery closed in the Firth of Clyde (Doherty *et al.,* 2017; HWDT, 2018). Today, the species is listed as Endangered by the IUCN and within Scotland/*Alba* it has legal protection under the Conservation of Offshore Marine Habitats and Species Regulations 2017. Basking sharks are also listed as a designated feature within the Sea of the Hebrides Marine Protected Area (MPA) (**Figure 13.2, Volume 2b**), which is within the Basking Shark and Ocean Sunfish Study Area, located approximately 93 m to the south of the Offshore Project Boundary (by sea-distance).

4.3.4.2 Basking sharks are present in UK coastal waters primarily in the summer months, between May and October. In the Sea of the Hebrides MPA, peak sightings occur between the months of June and October (Witt *et al.,* 2012). During the winter months, basking sharks typically move further offshore to deeper shelf waters (HWDT, 2018; Johnston *et al.,* 2019; Sims *et al.,* 2022). Their distribution is linked to oceanographic features such as thermal fronts and productive chlorophyll patches which aggregate their plankton prey. Basking sharks are ram filter-feeders, and preferentially forage on zooplankton, predominately targeting energy rich calanoid copepods (e.g., *Calanus finmarchicus* and *C. helgolandicus*) (Sims *et al.,* 1997).

4.3.4.3 Sightings of most individuals are made in shallow, coastal waters, although more recent telemetry studies suggest that basking sharks also utilise deeper, offshore waters, and it is likely that the results of observational data are a function of observer effort. The coastal waters of Ireland and the UK have been identified as a North Atlantic hotspot, with individuals frequently observed in coastal Hebridean waters (HWDT, 2018). Most sightings of basking sharks occur within the Sea of the Hebrides/*An Cuan Barrach*, particularly off the south coast of Tiree/*Tiriodh* as well as Gunna Sound and up to the Small Isles/*Na h-Eileanan Tarsainn* and Hyskier/*Òigh-sgeir* and the west coast of the Isle of Mull/*Muile* (Austin et al., 2019; HWDT, 2018). These areas have been reported as hotspots for the species, where individuals return year after year (HWDT, 2018; Sims *et al.,* 2022; Speedie *et al.,* 2009; Witt *et al.,* 2012).

4.3.4.4 Vessel surveys conducted by HWDT from 2003 to 2017 recorded a high basking shark sighting per unit effort (0.060–0.520 sightings per km) along the northwest coast of the Isle of Lewis/*Eilean Leòdhais*, an area that overlaps with the Array Area. Year-round surveys from 2000 to 2012 reported basking shark surface densities of 0.00–0.1 animals/km² in this region (Paxton *et al.,* 2014). Additionally, site-specific surveys undertaken in support of the Oyster Wave Array Environmental Statement, conducted from September 2010 to September 2011, recorded basking sharks on 6 days between May and August. The Oyster Wave Array Project survey area overlaps with the Offshore Project Boundary (Royal Haskoning, 2012).

4.3.4.5 Site-specific DAS undertaken in support of the Offshore Project recorded 1 basking shark in the northeast region of the DAS Survey Area during July 2023. The abundance estimate for basking shark was 9 (95% CI=1-26), with density estimated at 0.01 animals per km². No basking sharks were recorded within the Array Area during DAS surveys completed in support of the Offshore Project (**Appendix 13.1, Volume 2c**). In addition, a basking shark (tag transmitter ID A69-9001-3153) tagged off Achill (Ireland) by Marine Institute (Ireland) was also detected within the Array Area on the 15th of July (**Appendix 13.1, Volume 2c**).

4.4 DIADROMOUS FISH

4.4.1.1 Diadromous fish spend part of their life in both freshwater and sea water, migrating between the two biotopes. Some species are anadromous (e.g., Atlantic salmon *Salmo salar*), spending most of their adult lives at sea and only returning to freshwater to spawn. Catadromous species (e.g., European eel *Anguilla Anguilla*) spend much of the lives in freshwater environments before returning to the sea to spawn. Given the extensive open ocean and near shore migrations undertaken by diadromous fish (Malcolm *et al.*, 2010), there is potential for these species to migrate through the Offshore Project Boundary during certain periods of the year.

4.4.1.2 Based on the review of desktop sources it is expected that the following migratory species may be present within the Diadromous Fish Study Area:

- Atlantic salmon;
- Sea trout (*Salmo trutta*);
- European eel.

4.4.1.3 A review of conservation designations in the Diadromous Fish Study Area was undertaken to identify sites with fish as qualifying features. Sites which are designated for diadromous fish are listed in **Table 4-12**.

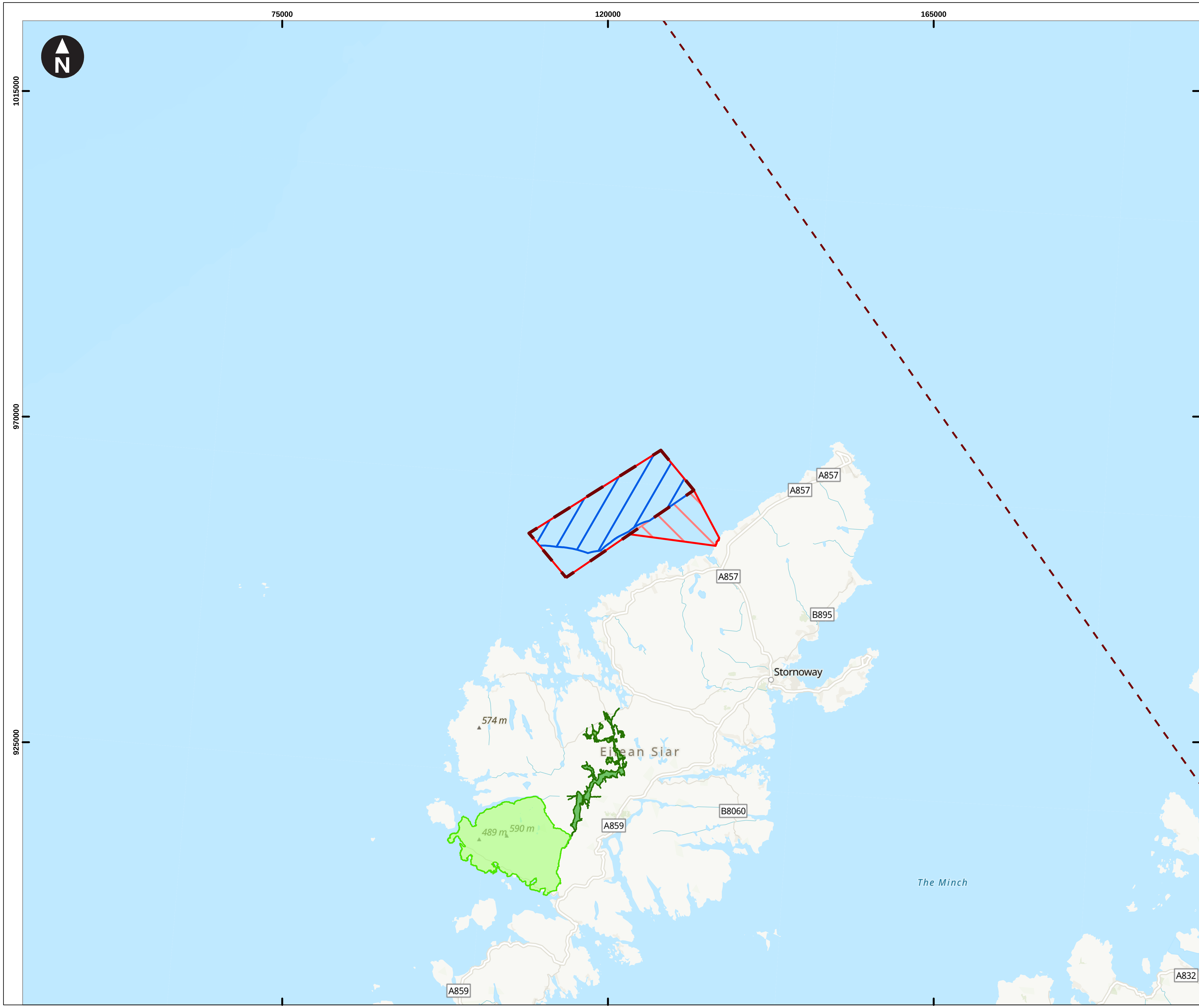
Table 4-12: SACs designated for diadromous fish within the Diadromous Fish Study Area.

Designated Site	**Relevant Fish Qualifying Feature**	**Approximate Sea Range from:**	
		Array Area	**Offshore Cable Corridor Area of Search**
Langavat SAC	Atlantic salmon	20 km	20 km
North Harris SAC	Atlantic salmon	43 km	43 km
Little Gruinard River SAC	Atlantic salmon	110 km	110 km

4.4.1.4 While the Little Gruinard River Special Area of Conservation (SAC), designated for Atlantic salmon, is within the Diadromous Fish Study Area – approximately 110 km by sea from the Offshore Project Boundary – it is not considered further in this assessment. Given the distance, interactions with salmon from this river are expected to be minimal. This is supported by an understanding of smolt migrations and their movement towards northern feeding grounds (refer Section 4.4.2) and aligns with advice received from NatureScot during scoping that only the North Harris and Langavat SACs should be considered within the Habitats Regulations Appraisal (HRA). It is acknowledged that adult salmon may occasionally transit through the Offshore Project Boundary on return migrations, however such occurrences are expected to be infrequent (refer Section 4.4.2).

4.4.1.5 Location of the North Harris and Langavat SACs in relation to the Offshore Project are shown on **Plate 4-7**.

Plate 4-7 Special areas of conservation designated for migratory fish within the Diadromous Fish Study Area.

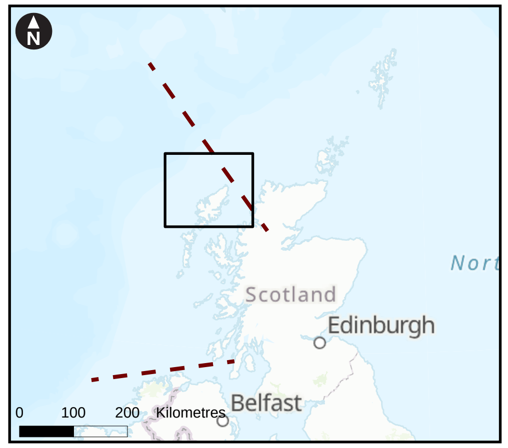


Key

- Offshore Project Boundary
- Offshore Cable Area of Search
- Array Area
- Turbine Area
- Diadromous Fish Study Area

Special Area of Conservation (SAC)

- Langavat
- North Harris



0 5 10 15 20 Kilometres

Scale at A3:1:500,000

World Topographic Map: Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community

Drawn: SS Checked: MS Approved: DA

Spiorad na Mara Offshore Wind Farm

Plate 4-7
Special Areas of Conservation Designated for Diadromous Fish Within the Diadromous Fish Study Area

Document Number

70103316-WSPE-XX-XX-FG-OE-00035_S0_1.2

03/02/2026

4.4.2 SALMONID SPECIES

Atlantic salmon

4.4.2.1 Atlantic salmon are widely distributed in Scotland/*Alba*, with the Scottish population recognised as being of both national and international importance (Malcolm et al., 2010). In recent decades there has been a decline in the total reported rod catch for wild salmon across much of the species' range (Marine Scotland, 2023). In recognition of the European importance of Scotland/*Alba*'s salmon populations, 11 rivers are designated as SACs for Atlantic salmon, and they are a qualifying feature at an additional 6 sites (JNCC, 2023b).

4.4.2.2 Across estuaries within the Outer Hebrides/*Na h-Eileanan Siar*, Atlantic salmon spawning peaks between November and December (Ashley, 2019; Marine Scotland, 2023), however may extend from October to late February (Webb and McLay, 1996). Juveniles typically remain within natal rivers between 1–4 years, before migrating down river as smolts. Smolts typically migrate downstream and enter coastal waters during the spring, most often during April and May (Thorstad *et al.,* 2012). Following entry into coastal waters, the fish are referred to as post-smolts until the spring of the following year (Malcolm *et al.,* 2010).

Post-smolts ecology and out migration

4.4.2.3 Feeding grounds of Atlantic salmon are known to be in the in the Norwegian Sea and west Greenland (Thorstad *et al.,* 2012). Stomach analyses of post-smolts taken in fjords and coastal areas in Norway suggest however that fish start to extensively feed on marine organisms immediately after entrance to saltwater (Rikardsen *et al.,* 2004). Post-smolts are opportunistic feeders and have been reported to feed on a wide variety of fish and invertebrates (Rikardsen and Dempson, 2011), although crustacean and marine fish larvae constitute the vast majority of post-smolt diets (Utne *et al.,* 2022). Stomach content analyses suggests that 0-group sandeel (sandeel in the first year of their life) and blue whiting are the most important food source for post-smolts in the west and north of Scotland/*Alba*, and in the Faroe Shetland Channel (up to 62ºN) (Haugland *et al.,* 2006).

4.4.2.4 Results of the acoustic tracking study undertaken in support of the Offshore Project (**Annex 12.1.3, Volumes 2c**) suggests there are two possible migration routes for out-migrating smolt from the River Grimersta (**Plate 4-8**). Fish either continue northwards through East Loch Roag/*Loch Ròg* or take the westward channel towards West Loch Roag/*Loch Ròg*. A total of 100 smolts were tagged in the study. Of the 52 fish that reached the Zone 2 receivers (refer **Plate 4-8**), 10 individuals were last detected on the receiver within the channel leading to West Loch Roag/*Loch Ròg* and were therefore assumed to have taken the westerly migration route. None of these fish were subsequently detected within the Array Area. Of the 78 individuals that successfully reached the R1 receiver, a total of 38 (49%) reached the Zone 4 receivers, the outermost zone in East Loch Roag/*Loch Ròg*, and were thus deemed to have successfully emigrated from East Loch Roag/*Loch*

Ròg. Of these fish, 15 individuals (39%) subsequently entered the Array Area. Extraction of the locations of first and last detections of the 15 post-smolts indicated a tendency for fish to enter at the southwest corner of the Array Area (**Plate 4-9**).

Plate 4-8: Map showing the two migration routes that post-smolts may take after leaving detection Zone 2 in Loch Roag (Figure 6, Annex 12.1.3, Volume 2c).

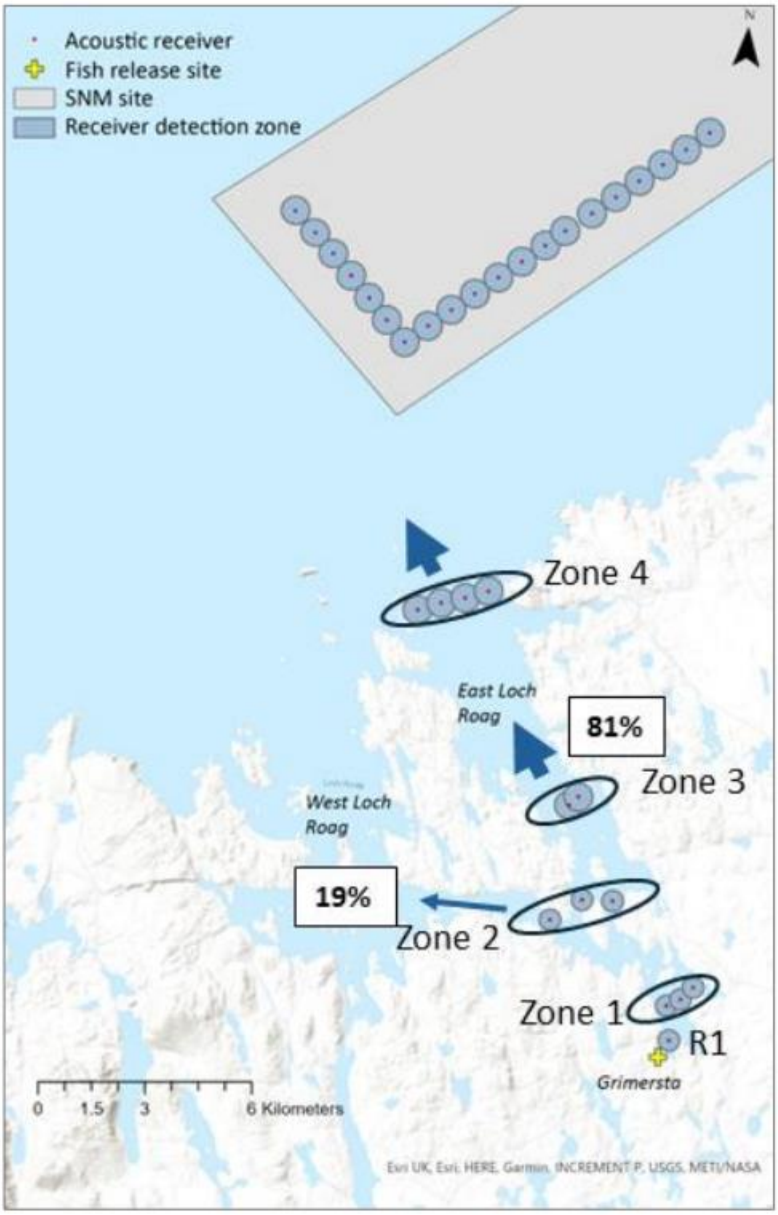
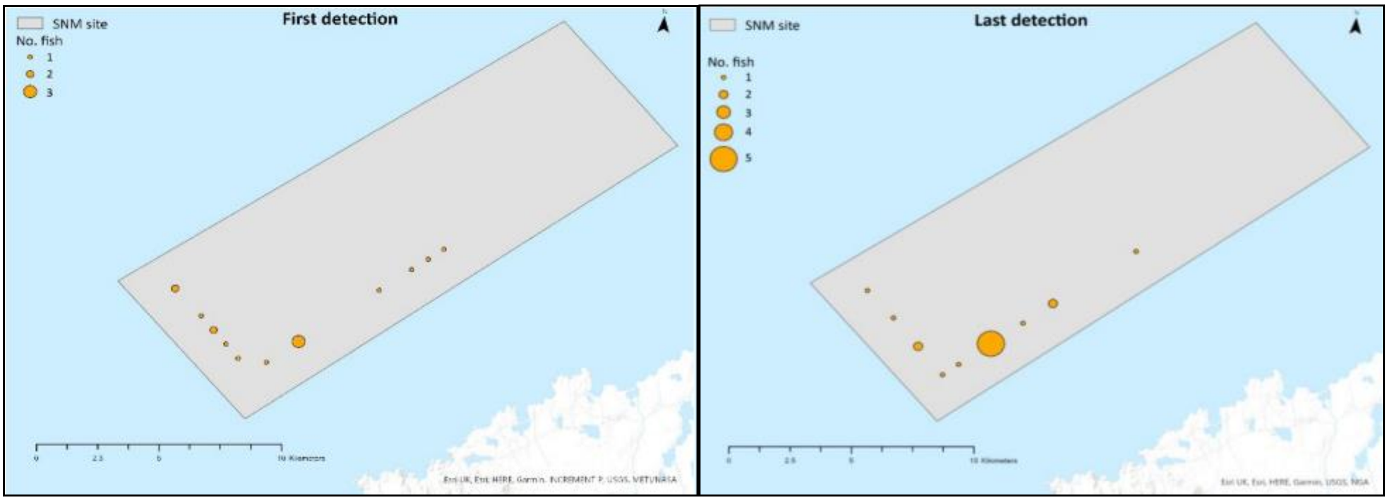


Plate 4-9: Locations of first (top) and last (bottom) detections within the Array Area of the 15 post-smolts that entered the Array Area (Figure 9, Annex 12.1.3, Volume 2c).



4.4.2.5 Total minimum duration of tagged smolts within the Array Area, ranged from 31 seconds to 2.0 h. The median time fish spent within the detection area of the Array Area was 16 minutes and estimated swim paths demonstrated that the majority of individuals passed through in a relatively direct manner. However, large variation between individuals was observed, with 3 individuals spending over 80 minutes in the Array Area. Further, from the observed repeated movements into and out of the detection zone among a small number of individuals, it may be inferred that they were in the region of the Array Area for longer periods (up to 27 hours). The observed doubling-back, looping and east to west trajectories highlighted non-direct migration routes among a few individuals, which sometimes included extended periods spent in the vicinity of a single receiver.

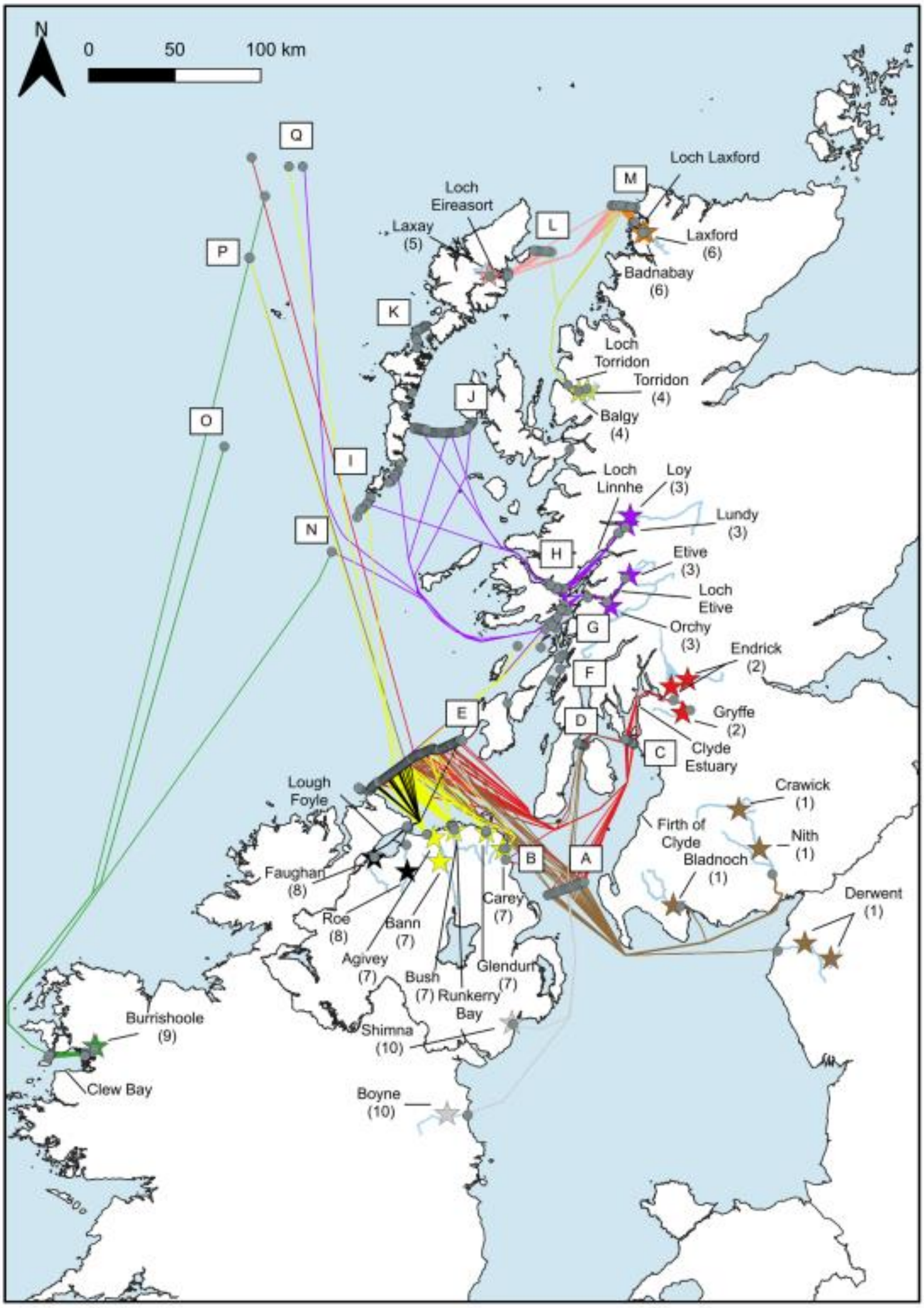
4.4.2.6 Activity patterns indicated that while some individuals emigrated from Loch Roag/*Loch Ròg* during daylight hours, the majority left during periods of darkness. In contrast, activity within the Array Area occurred during both the day and night, with a peak between 07:30 and 09:00. These data only reflect detected events and do not necessarily represent the total time smolts spent within the Array Area. Some individuals may have remained in the area for longer periods but were not detected due to factors such as movement patterns or distance from receivers.

4.4.2.7 Of the 20 fish tagged with temperature and pressure (depth) sensor tags, 7 were detected within the Array Area. Recorded temperatures within the Array Area ranged from 9.57 to 10.98°C (median 9.88°C), and swim depths to 4.51 m (median 0.3 m). In one of the more extensive datasets, fish ID 1589171 was present within the Array Area during the period from 01:12 to 08:53 and utilised the surface layers, predominantly within a zone ~1 to 2.5 m depth, undertaking a single deeper dive to 4.51 m. Diving patterns observed within this study is consistent with previous studies, with post-smolts generally recorded migrating at shallow depths, typically between 1-3 m (Davidsen *et al.,* 2008; Main *et al.,* 2023), although irregular dives to depths of 6 m have been recorded (Main *et al.*, 2023).

4.4.2.8 The tracking study commissioned for the Offshore Project focused on smolts emigrating from the River Grimersta in the East Loch Roag/*Loch Ròg* estuary. It is, however, also important to consider the migratory patterns of smolts emigrating from a broader front considering the species northerly feeding grounds (Holm *et al.,* 2000). A large-scale tracking study of Atlantic salmon post-smolt from rivers along the west coast of Scotland/*Alba* and England and from Northern Ireland and Ireland was recently undertaken (Rodger *et al.,* 2024). Results of this tracking study suggest that post-smolts from rivers draining into marine areas such as the Solway, Clyde, Boyne, Bush, and Foyle (regions 1, 2, 10, 7, 8 on **Plate 4-10**) exhibit a northerly trajectory, often passing through the North Channel at the northern end of the Irish Sea (**Plate 4-10**). Similarly, post-smolts from Clew Bay (region 9 on **Plate 4-10**) on Ireland's west coast were detected to the west of the Hebrides/*Innse Gall*, suggesting a broadly northerly migration pathway (**Plate 4-10**).

4.4.2.9 This possibility is further supported by data from salmon post-smolts emigrating from rivers draining into the Loch Linnhe marine area (region 3 on **Plate 4-10**). Only 4 out of the 150 salmon post-smolts that left the waters around the island of Mull/*Muile* were detected migrating through the Minch/*Mhaoil* (the channel separating the Outer Hebrides/*Na h-Eileanan Siar* from mainland Scotland/*Alba*), suggesting that the majority of these post-smolts also migrated west in the waters between the south of the Hebrides/*Innse Gall* and the island of Ireland (Rodger *et al.,* 2024). These findings are consistent with trawl netting studies, which have recorded post-smolts along the continental shelf edge west of the UK and Ireland in early summer. Towards the end of their first summer at sea, these fish have been found in the vicinity of the Vøring Plateau, west of Norway (Holm *et al.,* 2000), supporting the notion that salmon populations utilise the western shelf edge as a migration route to feeding grounds in the Norwegian Sea (Gilbey *et al.,* 2021).

Plate 4-10: Map from Rodger et al. 2024 illustrating the estimated migratory pathways of Atlantic salmon post-smolts as they migrate from their natal rivers. The pathways of post-smolts from each region are represented by a unique colour, and each line represents a simplified representation of individual post-smolt pathways.



4.4.2.10 While patterns in smolt emigration suggest that most smolts from rivers along the west coast of mainland Scotland/*Alba*, the wider UK, and Ireland are unlikely to pass through or near the Offshore Project Boundary, it is important to acknowledge the high degree of individual and within-population variation in migration routes (Rodger *et al.,* 2024). Additionally, Atlantic salmon are present in a greater number of rivers than those studied by Rodger *et al.* (2024), introducing some uncertainty regarding potential interactions with the Offshore Project Boundary. Given the northerly feeding grounds of post-smolts and adults, alongside the general northwest migration pattern observed in this region, smolts emigrating from rivers draining to the west of the Isle of Lewis/*Eilean Leòdhais* are considered the most likely to transit through or near the Offshore Project Boundary. It is important to consider that these post-smolts may also remain in proximity to the Offshore Project Boundary for some time before continuing their migration to northern feeding grounds. Those rivers draining to the west of the Isle of Lewis/*Eilean Leòdhais* are identified, and population trends are discussed in the following section.

Adult (grilse, kelts and repeat spawners) ecology and return migration

4.4.2.11 Atlantic salmon typically spend between 2 and 6 years at sea before returning to natal rivers to spawn. Navigation through the open ocean is thought to be related to mechanisms such as map-and-compass systems, geomagnetism (earth's magnetic field), visual cues and rheotaxis in relation to oceanic currents (Petersson, 2016). Migratory behaviour in nearshore environments suggests that visual and olfactory orientation may become increasingly important as the fish approach the coast (Bett and Hinch, 2015).

4.4.2.12 Returning adult salmon migrate close to the surface (0-40 m) and typically remain within the top few metres of the water column (1-5 m) (Godfrey *et al.,* 2015). Diving behaviour (~13-118 m) (Godfrey *et al.,* 2015) has also been recorded in homing salmon, and although this behaviour is more frequent in offshore areas it has also been observed close to the coast (Hedger *et al.,* 2022; Strøm *et al.,* 2018). A tracking study by Davidsen *et al.* (2013) in a Norwegian fjord indicated that salmon movements during the latter part of their marine migration and river entry were unidirectional and relatively rapid, with a mean speed of 9.7 km per day. However, as the salmon approached the estuary, their migratory speed slowed significantly, with much lower speeds recorded in the innermost areas of the estuary compared to the open fjord.

4.4.2.13 In many Scottish rivers, adult Atlantic salmon return to freshwater over an extended period (Sparholt *et al.,* 2018). The earliest returning fish are older, multi-sea-winter salmon[4], entering from the sea in late winter or early spring. Later in the season, from May onwards, grilse (1-sea-winter salmon (1SW)) enter the river, some returning only weeks before spawning, which takes place during late autumn and winter (Youngson *et al.,* 1994). Rod catch data can offer more detailed insights into the seasonal patterns of return migration at the scale of individual river systems or

[4] Multi-sea-winter spawners are salmon that return to spawn after spending 2 or more winters at sea.

catchments as the presence of adult salmon in freshwater is indicative of recent upstream movement from the marine environment. Monthly rod catch data from the River Grimersta (Langavat SAC) indicate that female grilse (1SW), which constitute by far the largest proportion of the salmon population in the Langavat SAC, peak in numbers in June and July. Two-sea-winter (2SW) females begin to appear in May, with peak numbers observed in June, while three-sea-winter (3SW) females are detected earlier in the season, with first records as early as April (Marine Scotland, 2024).

4.4.2.14 Carlin tag studies undertaken from the 1930s to 1970s of Scottish and British adult salmon, as summarised by Malcolm *et al.* (2010), suggest that adult salmon may approach their spawning rivers from multiple directions, using different migratory pathways on their return migration. In some of the studies reviewed, adult salmon were reported to be recaptured up to 500 – 600 km from their tagging site (Malcolm *et al.,* 2010). A review of tagged salmon undertaken more recently by Downie *et al.* (2018) further supports this notion. In this review, returning adult salmon to 4 major east coast river stocks (Tay/*Tatha*, North Esk/*Easg Thuath*), Dee/*Uisge Dhè* and Conon/*Conann*) were recorded over a widely dispersed area. For example, adult fish from the rivers Tay/*Tatha* and North Esk/*Easg Thuath* (on the east coast of Scotland/*Alba*) were recaptured in both west coast and Solway fisheries (Downie *et al.,* 2018).

4.4.2.15 Kelts refer to salmon that have completed their spawning in the previous autumn and later return to the marine environment. Depending on river conditions, most kelts overwinter in pools within natal rivers and begin their descent in spring (Bardonnet and Baglinière, 2000). In some cases, particularly in rivers with extensive estuarine zones, kelts may remain in the estuary for extended periods before migrating onwards to the ocean. For example, in the LaHave River (Canada), a study found that some kelts remained in the estuary for up to 5 weeks before migrating out to the ocean (Hubley *et al.,* 2008).

4.4.2.16 In consideration of this behaviour, it is necessary to consider that adult salmon may migrate through the Offshore Project Boundary multiple times during their adult life, as grilse, kelts and repeat spawners[5], and may include fish from a number of rivers across the Diadromous Fish Study Area. It is evident, however, considering geographical proximity that the majority of adult Atlantic salmon that may occur within, or within proximity to the Offshore Project Boundary will be from those rivers draining to the west of the Isle of Lewis/*Eilean Leòdhais*. These rivers are identified, and population trends are discussed in the following section (refer Section 4.4.2.21–4.4.2.22).

[5] Grilse are salmon that return to spawn after spending only 1 winter at sea; kelts are post-spawning salmon that survive spawning and return to the sea; and repeat spawners are salmon that survive spawning and return to spawn again in subsequent years.

Sea trout

4.4.2.17 Sea trout are widely distributed in Scotland/*Alba*'s freshwater environments and exhibit diverse life history strategies. Some remain in freshwater for their entire lives as resident or "brown" trout, while others migrate to estuaries (semi-anadromous) or out to sea (anadromous). The anadromous form, referred to as sea trout, is the focus of this section, as freshwater-resident trout will not interact with the Offshore Project. Sea trout are recognised as a species of principal importance in England (Defra, 2022), a priority marine feature in Scotland/*Alba* (NatureScot, 2020a), and the species is listed on the Scottish biodiversity list (NatureScot, 2020b). Despite these local listings, it is globally listed as "Least Concern" by the IUCN (IUCN, 2024). Sea trout spend a variable amount of time in freshwater before migrating to sea, and like salmon, are referred to as post-smolts upon entry to the sea, and until spring of the following year.

4.4.2.18 Marine dispersal of sea trout post-smolts differs from that of salmon. Post-smolts move from rivers to sea lochs primarily between April and early June and subsequently move to the open sea in late June and July (Pemberton, 1976). Sea trout tend to remain in coastal and estuarine environments rather than dispersing widely across the marine environment (Main *et al.*, 2023; Middlemas *et al.*, 2009; Thorstad *et al.*, 2004). Acoustic tracking studies provide insight into this behaviour. For instance, research on Scotland/*Alba*'s west coast found that only 36% of tagged post-smolts travelled more than 6 km from their release sites within their natal rivers (Middlemas *et al.*, 2009). A more recent study on sea trout from the Rivers Dee/*Uisge Dhè* and Don/*Abhainn Dheathain* observed similar patterns, with post-smolts either remaining in estuaries or staying close to the shore (within 3.5 km on the shore). Those that ventured into marine waters were predominantly recorded near the surface (down to depths of 3.4 m), with no evidence of diving behaviour (Main *et al.*, 2023).

4.4.2.19 Adult sea trout exhibit varied marine behaviour. Some spend summers at sea and winters in freshwater, while others remain at sea year-round, returning to freshwater only to spawn. Like Atlantic salmon, sea trout demonstrate strong natal homing, migrating back to their rivers of origin for spawning. For those returning from the sea, the peak migration period occurs in August and September (Pemberton, 1976). Most adult sea trout remain within 80 km of their natal rivers, but longer-distance coastal migrations exceeding 500 km have been recorded (Thorstad *et al.*, 2016). Adults typically occupy near-surface waters (less than 3 m), although they have been observed diving to depths of 10–90 m in coastal environments (Kristensen *et al.*, 2018).

4.4.2.20 Given the nearshore location of the Offshore Project and its proximity to estuarine habitats, it is likely that sea trout post-smolts may pass through or utilise habitats within the Offshore Project Boundary. As post-smolts typically remain close to their natal rivers, those near the Offshore Project Boundary are expected to originate from local populations – specifically, from rivers and estuaries draining to the west of the Isle of Lewis/*Eilean Leòdhais*. Adult sea trout however exhibit more variable marine distribution patterns and may undertake long-distance migrations. As such, it is possible that adult trout from rivers across the broader Diadromous Fish Study Area could transiently pass through or, on occasion, utilise habitats within the Offshore Project Boundary. It is evident however, considering geographical proximity, that the majority of adult sea trout that may occur within, or within proximity to the Offshore Project Boundary will be from those rivers draining to the west of the Isle of Lewis/*Eilean Leòdhais*. These rivers are identified, and population trends are discussed in the following section.

Stock assessments

4.4.2.21 Salmonid rivers draining to the west of the Isle of Lewis/*Eilean Leòdhais* have been identified in **Table 4-13** (Marine Scotland, 2015). Salmon rivers draining to the west of the Isle of Lewis/*Eilean Leòdhais* have been identified as this represents the most likely stocks to transient through the Offshore Project Boundary. It is acknowledged that there are a greater number of salmon rivers across the Diadromous Fish Study Area. It is possible, that salmon and sea trout, particularly adult life-phases, originating from this broader region, may transient through the Offshore Project Boundary however, such occurrences are expected to be infrequent.

4.4.2.22 Rod catch data for salmon and sea trout and stock estimates for salmon for rivers along the west coast of the Isle of Lewis/*Eilean Leòdhais* can provide insight into the general trends of salmonid populations within vicinity of the Offshore Project. Rod catch data provided by Marine Scotland (2024) and stock estimates, where available as provided by Marine Scotland (2023) for this region are provided in **Table 4-13**. Stock estimates are based on both returning adult salmon collected from rod fisheries along with data from fish counters (where available).

4.4.2.23 Rod catch data and stock assessments have also been used to estimate the proportion of the adult Atlantic salmon returning to rivers within the ZoI of the Offshore Project that would be exposed to underwater noise impacts. This analysis is presented in full within Section 1.4 of **Appendix 12.2, Volume 2c** and summarised in Section 12.8.3 of **Chapter 12, Volume 2a**.

Table 4-13: Rod catch data for Atlantic salmon and sea trout and 2023 stock estimates for Atlantic salmon for salmon rivers draining to the west of the Isle of Lewis (Marine Scotland, 2023; Marine Scotland, 2024).

Salmon Fishery District Area	Stock Assessment Area	River(s)	Salmon			Sea Trout	
			Average from 2011 – 2023	Recorded 2023	Stock Estimate 2023 (median)	Average from 2017 – 2023	Recorded 2023
Loch Roag	River Barvas	River Barvas	131	38	320	1	1
	River Carloway	River Carloway	7	6	33	1	0
	River Blackwater (Lewis)	River Blackwater	174	42	267	105	58
	Langavat SAC	River Grimersta	409	163	1,483	277	212
	Loch Morsgail system	Loch Morsgail system	20	No data	Not available	28	No data
	Mhor a' Ghlinne Ruaidh and Geisiada*	River Glenroe Loch Geisiadar system	1	No data	Not available	2	No data
	Forsa River (Lewis)	River Forsa	72	11	91	14	10
	Caslabhat and Tamanabhaigh	River Caslabhat River Tamanabhaigh	28	7	58	597	213
Resort / Fincastle	North Harris**	River Miavhaig Amhuinnsuidhe Leosavay River Big Head River Loch a' Ghlinne system	169	No data	Not available	135	No data
Fincastle	River Laxdale (Harris)	River Laxdale	29	9	58	34	38
	Loch Steisavat system	Loch Steisavat system	33	22	179	53	61
Mullanageren	North Uist Lochs	Loch Grogary system Loch nan Geireann system	17	0	Not available	40	92

Salmon Fishery District Area	Stock Assessment Area	River(s)	Salmon			Sea Trout	
			Average from 2011 – 2023	**Recorded 2023**	**Stock Estimate 2023 (median)**	**Average from 2017 – 2023**	**Recorded 2023**
		Loch Sgealtair system					
	Horisary River[†]	Horisary River	6	2	6	22	19
Howmore	Howmore and Loch Bi	Howmore River Loch Bi system	41	23	167	335	343
	Kildonan and Loch a' Bharp	Loch a' Bharp system Loch Kildonan system	9	3	25	91	64

*Data only available from 2013 and 2019 for Atlantic salmon, and 2019 for trout

**Data only available from 2013-2017 for Atlantic salmon, and from 2017 for trout

[†]Data is only available from 2016-2023 for Atlantic salmon

4.4.3 EUROPEAN EEL

4.4.3.1 European eel is widely distributed across Scotland/*Alba*, and is found within Scottish freshwater rivers, estuaries and marine environments. European eel is listed in Appendix II of the Bonn Convention (The Convention on Migratory Species), Appendix II of Convention on International Trade in Endangered Species (CITES) and is considered critically endangered globally (IUCN, 2024) and locally across Great Britain (JNCC, 2023a).

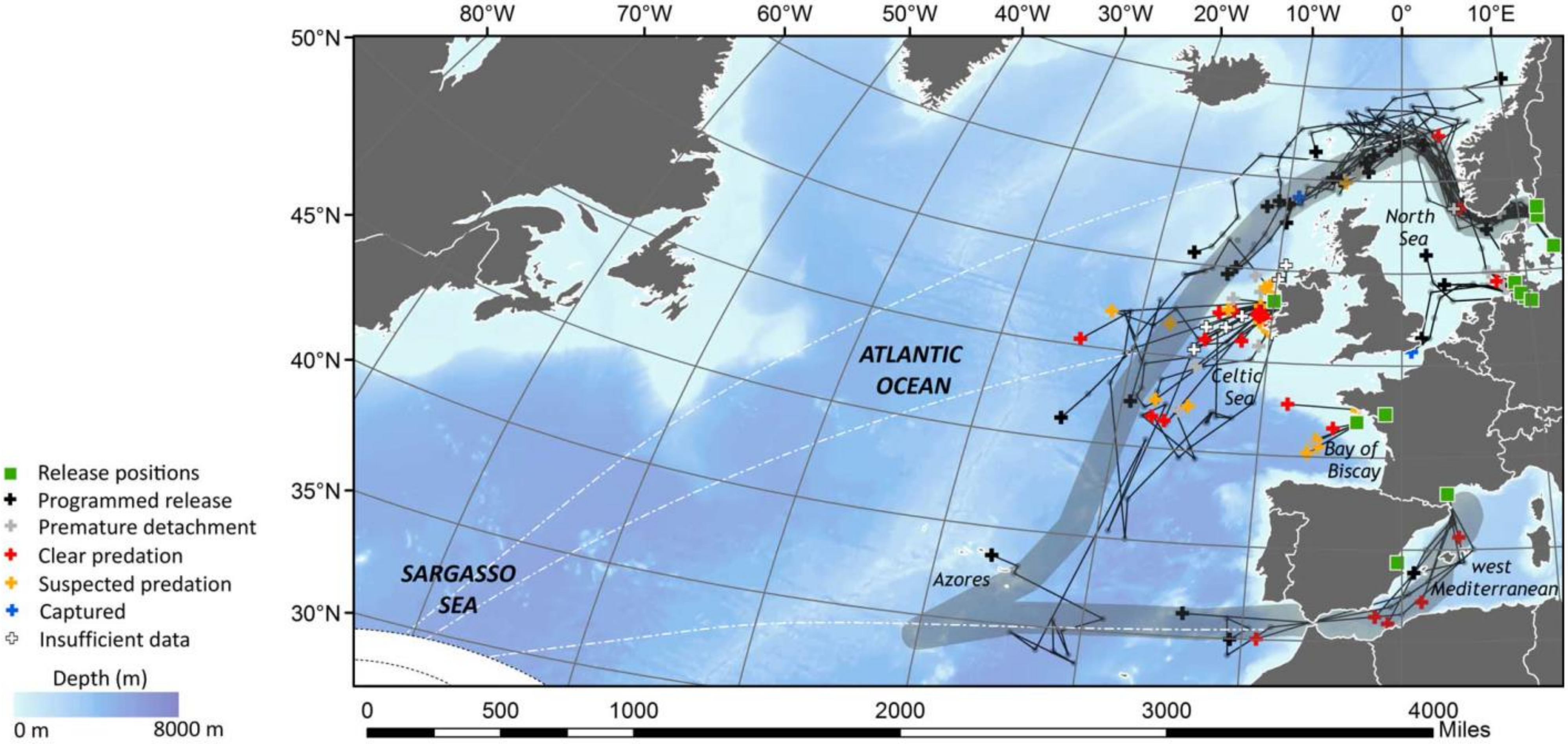
4.4.3.2 European eel is also recorded on the OSPAR list of threatened and/or declining species and habitats (OSPAR, 2024). Assessment by OSPAR in 2022 indicates that the status of European eel remains very poor across all OSPAR regions where the species occurs. While glass eel recruitment has remained stable since 2010, it is still at a very low level, with no clear indication of recovery (OSPAR, 2022). Although commercial fishing pressure has decreased during the 2010–2021 period, other significant threats, such as dams, turbines, habitat destruction, pollution, poaching, diseases, pathogens, and climate change continue to pose considerable risks to the species (OSPAR, 2022). Similarly, ICES assessment indicates that the eel stock remains in a critical state, with recruitment levels well below historical averages. In 2024, the "Elsewhere Europe" index series, which includes the Celtic Sea, recorded a glass eel recruitment rate[6] of 7.2%, slightly lower than recorded in 2023 (7.4%). Yellow eel recruitment was similarly low in 2023 (11.4%) (ICES, 2024a).

4.4.3.3 European eels are catadromous and based on the distribution and size of eel larvae caught in Atlantic trawls, spawning is thought to occur in the vicinity of the Sargasso Sea (Miller *et al.*, 2019). Satellite tagging has also provided direct evidence of European eels migrating to Sargasso Sea from the Azores (Wright *et al.*, 2022) and the Scotian Shelf in Canada (Béguer-Pon *et al.*, 2015).

4.4.3.4 European eels undergo an autumn migration (Sandlund *et al.*, 2017) however, individuals may begin to leave the rivers at almost any point of the year, with much variation between peak migration periods at particular sites (Righton *et al.*, 2016). Very little is known about the migration route of adult European eels traveling to spawning grounds from the west coast of Scotland/*Alba*. Tracking studies of European eel released from the Swedish west coast, the west coast of Ireland (Celtic Sea) and the Bay of Biscay (France) suggest that European eels typically follow routes that converge on the Azores region (Righton *et al.*, 2016). The last segment of the migration route was confirmed by Wright *et al.* (2022) who satellite tagged and tracked the movements of 21 adult European eel in the Azores, demonstrating that the eels migrate towards the Sargasso Sea along the Mid-Atlantic Ridge. Considering the migration route taken by the Scandinavian populations and Irish populations (**Plate 4-11**), eel populations along the west coast of Scotland/*Alba*, including the Hebrides/*Innse Gall*, may head directly west or southwest towards the Azores (Righton *et al.*, 2016).

[6] Recruitment rates reflect the percentage of eels entering European waters compared to the 1960–1979 period.

Plate 4-11: Reconstructed migration routes of 87 adult European eels. Dashed lines show the most direct routes between recorded locations



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4.4.3.5 During migration, eels exhibit a diurnal depth cycle, swimming at greater depths during daylight hours and moving to shallower water during the night. Even with this diurnal behaviour however, European eels typically remain in deep water (>140 m depth) throughout their entire migration.

4.4.3.6 Once hatched, larval eels cross the Atlantic Ocean and, by the time they reach the European continental shelf, metamorphose into post-larvae referred to as glass eels. Although there is some debate about the reliance of larval eels on oceanic currents as opposed to activity swimming, it appears that migration is primarily driven by oceanic currents, including the Gulf Stream and its extension, the North Atlantic Drift (Adams *et al.,* 2013; Knights, 2003). As they near land, typically during the period from September to November (Tesch, 2003), the northerly flowing Continental Shelf Current and wind-driven coastal currents are thought to influence their final approach. Given these oceanographic conditions – particularly the exposure to the North Atlantic Drift, Continental Shelf Current, and prevailing south-westerly winds – the west of the British Isles, and especially western Scotland/A*lba*, is likely to be a key region of first landfall for a significant proportion of the returning eel population in most years (Adams *et al.,* 2013).

4.4.3.7 Glass eels either ascend rivers around Europe, remain at sea or move back and forth between freshwater, estuarine and marine environments (Daverat *et al.,* 2006). Eventually, all glass eels become yellow eels. Yellow eels exhibit a similar behaviour as glass eels, either settling and remaining in marine or freshwater, or shifting between the 2 habitats (Rohtla *et al.,* 2023). Following a continental growth phase (ranging from 3-60 years) they begin their return migration to the spawning grounds in the Sargasso Sea.

4.4.3.8 Given the variability in migratory patterns exhibited by European eels (Daverat et al., 2006; Rohtla et al., 2023), and the findings of Adams *et al.* (2013), it is considered likely that European eels may pass through the Offshore Project Boundary during migration, both as adults on their way to the Sargasso Sea and as 'landing' glass eels. In addition to these migratory movements, marine residents – including both glass and yellow eels – may infrequently inhabit and utilise the coastal areas around the Offshore Project Boundary.

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6 GLOSSARY OF TERMS AND ABBREVIATIONS

6.1.1.1 A list of key terms and acronyms used in this appendix are provided in **Table 6-1** and **Table 6-2**.

Table 6-1 Acronyms and abbreviations

Term	Definition
BGS	British Geological Survey
BMAPA	British Marine Aggregate Producers Association
Cefas	Centre for Environment, Fisheries and Aquaculture Science
CIEEM	Chartered Institute for Ecology and Environmental Management
CITES	Convention on International Trade in Endangered Species
DAS	Digital Aerial Survey
DEFRA	Department for Environment, Food and Rural Affairs
EFH	Essential Fish Habitat
EIA	Environmental Impact Assessment
EIAR	Environmental Impact Assessment Report
EPS	European Protected Species
HAWG	Herring Assessment Working Group
HRA	Habitat Regulations Assessment
IBTSWG	International Bottom Trawl Survey Working Group
ICES	International Council for Exploration of the Seas
IHLS	International Herring Larvae Surveys
MPA	Marine Protected Area
MD-LOT	Marine Directorate - Licensing Operations Team
OHFT	Outer Hebrides Fisheries Trust
PAC	Preliminary Application Consultation
PMF	Priority Marine Features
RMS	Root Mean Square
SAC	Special Area of Conservation
SNH	Scottish Natural Heritage
WKWEST	Workshop on West of Scotland Herring
ZoI	Zone of Influence
1SW	One-sea-winter

Table 6-2 Glossary

Term	Meaning
the Applicant	Spiorad na Mara Limited (the Project owner)
Array Area	The offshore area within which the offshore wind turbine generators (WTGs), associated foundations, Offshore Cables, and Offshore Substation Platform (OSP) (if required), will be located. This area encompasses the Turbine Area that will contain all above water surface infrastructure (WTGs / OSP) and an additional area within which further below water infrastructure (foundations and cables) may also be located.
Basking Shark and Ocean Sunfish Study Area	Study area for basking sharks and ocean sunfish and includes a 100 km buffer around the Offshore Project Boundary.
Benthic species	Fish that live on or near the seabed.
DAS Study Area	Includes the Array Area and a 10 km buffer, and represents the area surveyed via aerial surveys
Diadromous species	Fish that spend part of their life in both freshwater and sea water and migrate between the two.
Diadromous Fish Study Area	Study area for salmonid species (Atlantic salmon and sea trout) and European eel, and includes all waters located within the northwest anadromous fish region boundary.
Elasmobranchs	A subclass of cartilaginous fish that includes sharks, rays, and skates.
Embedded or 'Designed-in' Mitigation	Mitigation measures to avoid or reduce environmental effects that are directly incorporated into the preferred design for the Project. This can include standard practice in accordance with or without guidance. Embedded mitigation is considered as part of the impact assessment, before effect significance is identified.
Fish Ecology Study Area	Region encompassing the Marine Fish Study Area, Diadromous Fish Study Area and the Basking Shark and Ocean Sunfish Study Area.
Grilse	A one-sea-winter (1SW) salmon that returns to freshwater to spawn after spending one year in the ocean.
Impact	Change that is caused by an action; for example, foundation installation (action) during construction which results in habitat loss (impact).
ICES rectangles	International Council for Exploration of the Seas (ICES) statistical rectangles provide a grid covering the area between 36°N and 85°30'N and 44°W and 68°30'E. Fisheries data collected by the ICES is recorded and collated according to these statistical rectangles.
Kelts	Salmon that have spawned in the previous autumn and subsequently return to the marine environment.
Marine Fish Study Area	Study area for all fish species excluding diadromous species, basking shark and ocean sunfish, and has been taken to be the modelled extent an unmitigated, single-strike sound pressure level of 150 dB re 1 µPa (RMS).
Offshore Cable Area of Search (OCAS)	The area within which the offshore cable infrastructure between the Array Area and Landfall up to Mean High Water Springs (MHWS) will be located.
Pelagic fish	Species that are found predominantly in the mid- and upper water layers of

Term	Meaning
	the water column.
Spawning bed	A discrete patch of seabed where eggs are deposited.
Spawning ground	A larger geographic area than a spawning bed, encompassing one or more spawning beds and all the adjoining potential spawning habitat.
Root Mean Square	Indicates that the measurement represents the time-averaged or "effective" pressure level over a given period, not just instantaneous values.
Offshore Project	Components of the Project seaward of Mean High Water Springs (MHWS) which includes Array Area and Offshore Cable Area of Search.
Offshore Project Boundary	The ‘red line boundary’ encompassing the Offshore Project.
Turbine Area	A reduced area within the Array Area where above water surface infrastructure would be located i.e. wind turbine generators (WTG) or Offshore Substation Platform (OSP) (if required). This area has been developed and refined through stakeholder consultation and environmental assessment.
0 group fish	Fish within their first year of their lives.

7 ANNEX 12.1.1: SPECIES LIST

Table 7-1: All species identified from baseline searches and/or field surveys from the Marine Fish Study Area, Diadromous Fish Study Area and the Basking Shark and Ocean Sunfish Study Area (as relevant).

Common Name	Species Name	Project Surveys			Database / desktop								Protection Status
		BRUV (MaxN)	eDNA	DAS Survey (Counts)	PAM Surveys	Landing Data (Tonnage)	Bottom Trawl Survey	Eggs & Larvae	Spawning & Nursery	Fisheries Sensitivity Maps	Known or Possible Migration Routes	IUCN Status	
Elasmobranch													
Blonde ray	*Raja brachyura*					✓(1.6)	✓					NT	
Cuckoo ray	*Leucoraja naevus (previously Raja)*					✓(63)	✓					LC	
Sandy ray	*Leucoraja circularis*					✓(0.07)						EN	PMF, Bio List
Thornback Ray	*Raja clavata*					✓(348)	✓		N			NT	OSPAR, Bio List
Spotted ray	*Raja montagui*					✓(88)	✓		N			LC	
Starry ray	*Amblyraja radiata (previously Raja)*					✓(2)						LC	
Basking shark	*Cetorhinus maximus*			✓(1)	✓							EN	NERC, OSPAR, PMF, Bio List
Blackmouth catshark	*Galeus melastomus*						✓					LC	
Blue shark	*Prionace glauca*			✓(26)								NT	NERC, Bio List
Bluntnose sixgill shark	*Hexanchus griseus*						✓					NT	
Common smoothhound	*Mustelus mustelus*					✓(0.7)	✓					EN	
Nursehound	*Scyliorhinus stellaris*	✓(1)				✓(2)						NT	
Small-spotted catshark	*Scyliorhinus canicula*					✓(106)	✓					LC	
Spiny dogfish (spurdog)	*Squalus acanthias*	✓(6)				✓(32)	✓		N			EN	NERC, OSPAR, PMF, Bio List
Starry smooth-hound	*Mustelus asterias*						✓					NT	
Tope shark	*Galeorhinus galeus*					✓(0.5)	✓		N			VU	NERC, Bio List
Arctic skate	*Amblyraja hyperborea*					✓(1.5)						LC	
Common skate	*Dipturus batis*					✓(0.2)	✓		N			CR	NERC, OSPAR, PMF, Bio List
Flapper skate	*Dipturus intermedius*						✓					CR	PMF
Shagreen skate	*Leucoraja fullonica*					✓(8)	✓					VU	
White skate (bottlenosed skate)	*Rostroraja alba (Raja Alba in FAO)*					✓(1)						CR	NERC, OSPAR
Skates and rays	*Raja spp.*					✓(7)							
Pelagic species													
Atlantic bluefin tuna	*Thunnus thynnus*		✓	✓(1)								LC	NERC, OSPAR, Bio List
Atlantic herring	*Clupea harengus*		✓			✓(665)	✓	✓	S&N			LC	NERC, PMF, Bio List
Atlantic mackerel	*Scomber scombrus*		✓			✓(122534)	✓	✓	S&N	✓		LC	NERC, PMF, Bio List
Beryx	*Beryx spp.*					✓(0.2)							
Blue whiting	*Micromesistius poutassou*					✓(14561)			S&N	✓		LC	NERC, PMF, Bio List

Common Name	Species Name	Project Surveys			Database / desktop								Protection Status
		BRUV (MaxN)	eDNA	DAS Survey (Counts)	PAM Surveys	Landing Data (Tonnage)	Bottom Trawl Survey	Eggs & Larvae	Spawning & Nursery	Fisheries Sensitivity Maps	Known or Possible Migration Routes	IUCN Status	
European pilchard	*Sardina pilchardus*		✓				✓					NT	
European sprat	*Sprattus sprattus*		✓				✓		S&N	✓		LC	
Greater argentine	*Argentina silus*					✓(0.3)						LC	
Horse mackerel	*Trachurus trachurus*		✓			✓(4273)		✓		✓		LC	NERC, PMF
Ocean sunfish	*Mola mola*			✓(2)								DD	
Demersal													
Anglerfish (Sea monkfish)	*Lophius budegassa*						✓		N	✓		LC	NERC, PMF, Bio List
Atlantic cod	*Gadus morhua*	✓(1)	✓			✓(1906)	✓		S&N	✓		VU	NERC, OSPAR, PMF, Bio List
Atlantic halibut	*Hippoglossus hippoglossus*					✓(4.7)						VU	NERC, PMF, Bio List
Atlantic john dory	*Zeus faber*					✓(41)	✓					DD	
Ballan wrasse	*Labrus bergylta*					✓(29)						LC	
Bib (pouting)	*Trisopterus luscus*					✓(18)						LC	
Black belly rosefish (bluemouth, blue mouth redfish)	*Helicolenus dactylopterus*	✓(1)				✓(361)						LC	
Black scabbard fish	*Aphanopus carbo*					✓(836)						LC	NERC, PMF, Bio List
Blackbellied angler	*Lophius piscatorius*						✓					LC	
Blue ling	*Molva dypterygia*					✓(2296)						VU	NERC, PMF, Bio List
Boarfish	*Capros aper*		✓									LC	
Brill	*Scophthalmus rhombus*					✓(1.3)	✓					LC	
Catfish (Atlantic wolffish)	*Anarhichas lupus*					✓(6.9)						DD	
Common dab	*Limanda limanda*	✓(2)	✓			✓(1.4)						LC	
Common mora	*Mora moro*					✓(43)						LC	
Common sole	*Solea solea*		✓			✓(1.4)						LC	NERC, Bio List
Conger eel	*Conger conger*					✓(0.09)						LC	
Corkwing wrasse	*Symphodus melops*					✓(8)						LC	
Crystal goby	*Crystallogobius linearis*		✓*									LC	
Cuckoo wrasse	*Labrus mixtus*	✓(5)	✓									LC	
Deep-Water Redfish (Rose Fish)	*Sebastes mentella*					✓(1)						EN	
Dragonet	*Callionymus lyra*		✓									LC	
European hake	*Merluccius merluccius*					✓(6845)	✓	✓	S&N	✓		LC	NERC, Bio List
European plaice	*Pleuronectes platessa*		✓			✓(217)	✓		S&N	✓		LC	NERC, Bio List
Forkbeard	*Phycis phycis*					✓(0.9)						DD	
Giant cusk eel	*Spectrunculus grandis*					✓(0.01)						LC	
Goldsinny-wrasse	*Ctenolabrus rupestris*		✓			✓(32)						LC	
Greater Forked Beard	*Phycis blennoides*					✓(772)						DD	

Common Name	Species Name	Project Surveys			Database / desktop								Protection Status
		BRUV (MaxN)	eDNA	DAS Survey (Counts)	PAM Surveys	Landing Data (Tonnage)	Bottom Trawl Survey	Eggs & Larvae	Spawning & Nursery	Fisheries Sensitivity Maps	Known or Possible Migration Routes	IUCN Status	
Greater pipefish	*Syngnathus acus*		✓									LC	
Grey gurnard	*Eutrigla gurnardu*					✓(357)						LC	
Gurnard and latchet	*Triglidae spp.*					✓(71)							
Haddock	*Melanogrammus aeglefinus*	✓(8)	✓			✓(7155)	✓		S&N	✓		LC	
Lemon Sole	*Microstomus kitt*		✓			✓(147)	✓		S&N			LC	
Ling	*Molva molva*	✓(3)	✓*			✓(5173)	✓	✓	N			LC	NERC, PMF, Bio List
Long-Spined Bullhead	*Taurulus bubalis*		✓									LC	
Lumpsucker	*Cyclopterus lumpus*		✓									NT	
Megrim	*Lepidorhombus spp.*					✓(2746)							
Megrim	*Lepidorhombus whiffiagonis*						✓					LC	
Monks and anglers	*Lophiidae spp.*					✓(7188)							
Northern rockling	*Ciliata septentrionalis*		✓*									LC	
Norway bullhead	*Micrenophrys lilljeborgii*		✓*									LC	
Norway pout	*Trisopterus esmarkii*		✓*				✓		S&N	✓		LC	PMF, Bio List
Norwegian Topknot	*Phrynorhombus norvegicus*		✓*									LC	
Painted goby	*Pomatoschistus pictus*		✓									LC	
Pollack	*Pollachius pollachius*		✓			✓(55)	✓					LC	
Poor cod	*Trisopterus minutus*	✓(42)	✓									LC	
Portuguese blenny	*Parablennius ruber*		✓									LC	
Rabbit fish (rattail)	*Chimaera monstrosa*					✓(271)						VU	
Red gurnard	*Chelidonichthys cuculus*					✓(195)						LC	
Red scorpionfish	*Scorpaena scrofa*					✓(0.2)						LC	
Redfishes	*Sebastes spp.*					✓(32)							
Rock cook	*Centrolabrus exoletus*		✓*			✓(3.5)						LC	
Rock gunnel	*Pholis gunnellus*		✓									LC	
Rockling	*Gaidropsarus spp.*					✓(0.004)							
Roughead grenadier	*Macrourus berglax*					✓(2.1)						LC	
Roundnose grenadier	*Coryphaenoides rupestris*					✓(84)						CR	NERC, PMF, Bio List
Saithe	*Pollachius virens*		✓			✓(2759)	✓		S&N			LC	PMF
Sandeel	*Ammodytes spp.*	✓(100)							S&N			LC	NERC, PMF, Bio List
Sea breams	*Sparidae*					✓(0.0002)							
Shanny	*Lipophrys pholis*		✓									LC	
Smooth sandeel	*Gymnammodytes semisquamatus*		✓									LC	
Striped red mullet	*Mullus surmuletus*					✓(0.001)						DD	
Tadpole fish	*Raniceps raninus*		✓*									LC	
Three-spined stickleback	*Gasterosteus aculeatus*		✓									LC	

Common Name	Species Name	Project Surveys			Database / desktop								Protection Status
		BRUV (MaxN)	eDNA	DAS Survey (Counts)	PAM Surveys	Landing Data (Tonnage)	Bottom Trawl Survey	Eggs & Larvae	Spawning & Nursery	Fisheries Sensitivity Maps	Known or Possible Migration Routes	IUCN Status	
Topknot	*Zeugopterus punctatus*		✓*									LC	
Torsk (tusk)	*Brosme brosme*					✓(309)						LC	
Tub gurnard	*Chelidonichthys lucerna*					✓(0.2)						LC	
Turbot	*Scophthalmus maximus*		✓*			✓(48)	✓					VU	
Two-spotted clingfish	*Diplecogaster bimaculata*		✓*									LC	
Whiting	*Merlangius merlangus*		✓			✓(1134)	✓		S&N	✓		LC	NERC, PMF, Bio List
Witch flounder	*Glyptocephalus cynoglossus*					✓(141)	✓					VU	
Wrasses	*Labridae spp.*					✓(9)							
Wreckfish	*Polyprion americanus*					✓(0.04)						NT	
Yarrell's blenny	*Chirolophis ascanii*		✓*									LC	
Diadromous species													
Atlantic salmon	*Salmo salar*		✓								✓	NT	NERC, OSPAR, PMF, Bio List
European eel	*Anguilla anguilla*										✓	CR	NERC, OSPAR, PMF, Bio List
Rainbow trout	*Oncorhynchus mykiss*		✓									LC	Invasive
Sea/brown trout	*Salmo trutta*		✓								✓	LC	NERC, PMF, Bio List

Key

IUCN Status (IUCN, 2024): CR – critically endangered EN – endangered; VU – vulnerable; NT – near threatened; LC – least concern; DD – data deficient.

Protection Status: NERC – species of principal importance in England (Defra, 2022), OSPAR – OSPAR list of threatened and declining species & habitats (OSPAR, 2024); PMF – Scottish priority marine features (NatureScot, 2020a); Bio List – Scottish Biodiversity List (NatureScot, 2020b).

*ü * low confidence in the identification of their Operational Taxonomic Unit (OTUs), as it was based on fewer than 3 matches to sequences in the reference database, and/or limited geographic occurrence records for the taxon*

S – Spawning ground; N – Nursery ground; S&N – Spawning and nursery ground

Project Surveys

BRUV - Baited Remote Underwater Video footage (**Appendix 11.2, Volume 2c**). Max N, representing the maximum number of one species within the video frame at one point in time, is provide in brackets.

eDNA - Water eDNA samples collected and analysed for marine fish (excluding sharks and rays) (**Annex 12.1.2, Volume 2c**)

DAS survey - Aerial surveys flown in support of the Offshore Project (**Appendix 13.1, Volume 2c**). Total counts of species detected is provided in brackets.

Database / desktop sources

Landing data - Scottish Sea Fisheries Statistics data between 2019-2023 (Scottish Government, 2023). Pooled catch (tonnage) from 2019 - 2023 is provided in brackets.

Bottom trawl survey - International Bottom Trawl Survey data between 2020-2024 (ICES, 2024b)

Eggs and larvae – ICES Eggs and Larvae Database data between 2020-2024 (ICES, 2024d)

Spawning & nursery - Distribution of spawning and nursery grounds defined by Coull *et al.* (1998) and Ellis *et al.* (2012).

Fisheries sensitivity maps - Updating Fisheries Sensitivity Maps in British Waters (Aires *et al.,* 2014).

Known or possible migration routes - Various literature reviewed throughout Section 4.4.