# MachairWind Offshore Windfarm

## Appendix 9.1 Fish (including Basking Shark) and Shellfish Baseline Technical Report

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# GLOSSARY OF ACRONYMS

| Term | Definition |
|---|---|
| CIEEM | Chartered Institute of Ecology and Environmental Management |
| DAS | Digital Aerial Surveys |
| DDV | Drop-Down Video |
| DSFB | District Salmon Fisheries Board |
| DVM | Diel vertical migration |
| EIA | Environmental Impact Assessment |
| EIAR | Environmental Impact Assessment Report |
| EUNIS | European Nature Information System |
| HWDT | Hebridean Whale and Dolphin Trust |
| IAC | Inter-array cables |
| ICES | The International Council for the Exploration of the Sea |
| MarESA | The Marine Evidence-Based Sensitivity Assessments |
| MarLIN | Marine Information Network |
| MD-LOT | Marine Directorate - Licensing Operations Team |
| MMO | Marine Management Organisation |
| MPA | Marine Protected Area |
| NBN | National Biodiversity Network |
| NCMPA | Nature Conservation Marine Protected Area |
| OAA | Option Agreement Area |
| OSP | Offshore Substation Platform |
| OSPAR | Convention for the Protection of the Marine Environment of the North-East Atlantic |
| PMF | Priority Marine Feature |
| PSD | Particle Size Distribution |
| SAC | Special Area of Conservation |
| SBL | Scottish Biodiversity List |
| UK | United Kingdom |
| UWN | Underwater Noise |
| WDA | Windfarm Development Area |
| WTG | Wind Turbine Generator |
| ZoI | Zone of Influence |

# GLOSSARY OF TERMS

| Term | Definition |
|---|---|
| Climate Change Impact | Climate Change Impact is defined as an impact from a climate hazard, such as asset damage or failure, which affects the ability of the receptor to maintain its function or purpose. |
| Demersal | Living on or near the seabed. |
| Development Area | Application boundary for consenting purposes which, for the Project, consists of a Windfarm Development Area, Offshore Export Cable Corridor, and Onshore Transmission Development Area. Separate consent and marine licence applications will be submitted for each Development Area where applicable. |
| Environmental Impact Assessment (EIA) | The process of evaluating the likely significant environmental effects of a proposed development over and above the existing circumstances (or 'baseline'). |
| Fleet | A physical group of vessels sharing similar characteristics (e.g., nationality). |
| Inter-array cables (IACs) | Armoured cable containing electrical and fibre optic cores which link the wind turbine generators to each other and to the offshore substation platform(s). |
| International Council for the Exploration of the Seas (ICES) statistical rectangles | The International Council for the Exploration of the Seas (ICES) standardise the division of sea areas to enable statistical analysis of data. Each ICES statistical rectangle is 30 min latitude by 1 degree longitude in size (approximately 30 x 30 nautical miles). A number of rectangles are amalgamated to create ICES statistical areas. |
| Landings | Quantitative description of the amount of fish returned to port for sale, in terms of value or weight. |
| MachairWind Offshore Windfarm | An offshore windfarm capable of exporting around 2 GW of renewable energy to the National Electricity Transmission System. MachairWind Offshore Windfarm comprises three Development Areas:<br>• The WDA – located on the west coast of Scotland to the northwest of Islay and west of Colonsay;<br>• The Offshore Export Cable Corridor – a preliminary boundary extending from the WDA to mean high water springs at a landfall location near Girvan, South Ayrshire; and<br>• The Onshore Transmission Development Area – a preliminary boundary which extends landward from mean low water springs and includes the land required for the landfall of the offshore export cables and their route up to but not including the proposed high voltage direct current switching station which will be developed and constructed by Transmission Owner, ScottishPower Transmission.<br>Separate consent and licence applications will be submitted for each Development Area. |
| National Electricity Transmission System | The high-voltage electricity power transmission network serving Great Britain which receives electricity from generators (such as offshore windfarms) and transmits that electricity to anywhere on the National Electricity Transmission System to satisfy demand. |
| Offshore export cable | Armoured cable containing electrical cores between the offshore substation platform(s) and landfall. Offshore export cables will include bundled fibre optic cables. The offshore export cables are subject to Marine Licence applications under the Marine (Scotland) Act 2010. The portion of the offshore export cable(s) located within the WDA is assessed as part of this MachairWind WDA EIA and a marine licence application to construct, alter or improve this portion has been submitted alongside the WDA application. A separate marine licence application will be submitted for the portion of the offshore export cable(s) from the WDA boundary to mean high water Mean High Water Springs. |

| Term | Definition |
|---|---|
| Offshore Export Cable Corridor (ECC) | The preliminary boundary extending from the WDA to mean high water springs near Girvan, South Ayrshire and within which the offshore export cable(s) will be located. A separate marine licence application will be submitted for the offshore export cable(s) located within the Offshore ECC. |
| Offshore Substation Platform (OSP) | An offshore platform with a fixed foundation located within the WDA which houses electrical equipment such as transformers, switchgear, protection and control systems, and enables the windfarm’s renewable electricity to be collected via inter-array cables and exported to the National Electricity Transmission System via offshore export cables. |
| Offshore Substation Platform (OSP) link cables | Electrical cables which link OSPs (if more than one OSP is required). These cables will include fibre optic cores or bundled fibre optic cables. OSP link cables will be wholly located within the WDA. |
| Onshore Transmission Development Area (OnTDA) | The preliminary boundary which extends landward from mean low water springs and includes the land required for the landfall of the offshore export cables and their route up to but not including the proposed high voltage direct current switching station which will be developed and constructed by Transmission Owner, ScottishPower Transmission. This Transmission Owner is responsible for consenting the high voltage direct current switching station. Onward connections to the National Electricity Transmission System will be consented by National Grid Electricity Transmission and ScottishPower Transmission. Where relevant, these are considered as part of cumulative effects assessment in the EIA. |
| Option Agreement Area (OAA) | The seabed area awarded to ScottishPower Renewables in January 2022 through the Scotwind leasing round. |
| OSPAR | OSPAR started in 1972 with the Oslo Convention against dumping and was broadened to cover land-based sources of marine pollution and the offshore industry by the Paris Convention of 1974. These two conventions were unified, updated and extended by the 1992 OSPAR Convention. OSPAR is so named because of the original Oslo and Paris Conventions ("OS" for Oslo and "PAR" for Paris). |
| ScotWind | A Crown Estate Scotland seabed leasing round which enabled developers to propose offshore wind projects and apply for seabed rights to plan and build windfarms in Scottish waters. |
| Scour protection | Protective measures to avoid sediment being eroded away from the base of the wind turbine generator foundations as a result of the flow of water. |
| The Applicant | The legal entity submitting consent applications for the MachairWind Offshore Windfarm, namely MachairWind Limited. |
| The Project | MachairWind Offshore Windfarm including all its Development Areas and associated infrastructure. |
| Vessel Monitoring System (VMS) | A system used in commercial fishing to allow environmental and fisheries regulatory organisations to monitor, minimally, the position, time at a position, and course and speed of fishing vessels. |
| Windfarm Development Area (WDA) | The application boundary within the OAA where consent will be sought for the proposed WDA infrastructure. The WDA infrastructure is subject to Section 36 consent and marine licence applications (generation and transmission) which are being applied for separately from the Offshore ECC infrastructure and OnTDA infrastructure. |
| WDA infrastructure | The offshore generation and transmission infrastructure located within the WDA including but not limited to: WTGs, WTG fixed foundations (and associated scour protection), OSP(s), OSP fixed foundations (and associated scour protection), IACs, OSP link and offshore export |

| Term | Definition |
| --- | --- |
| | cable(s) and their associated external cable protection (insofar as these are located within the WDA) and fibre optic cables. |
| Wind Turbine Generator (WTG) | A wind turbine generator which converts wind energy into electrical energy. Each wind turbine generator is a complex system composed of a high number of components. Typically, the main components include the rotor assembly (composed of three blades and a hub); the nacelle (containing a generator, shaft and gearbox, power electronic converter and transformer); and the tower (containing lifting equipment and the switchgear). |

# 1 FISH (INCLUDING BASKING SHARK) AND SHELLFISH TECHNICAL REPORT

## 1.1 INTRODUCTION

1. This Fish and Shellfish Baseline Technical Report provides a detailed baseline characterisation of the fish and shellfish ecology (e.g. species, communities, and habitats) of the Windfarm Development Area (WDA). The WDA infrastructure includes:

- Wind Turbine Generators (WTG) and associated fixed foundations and scour protection;
- Offshore Substation Platforms (OSP) and associated fixed foundations and scour protection;
- Inter-array cables (IACs) and associated cable protection;
- OSP link cables and associated cable protection; and
- The portion of the offshore export cable(s) located within the WDA, and associated cable protection.

2. This baseline characterisation has been informed using site-specific survey data, data from third-party organisations, and the most recent desktop data and published literature available for fish and shellfish within the Study Area (refer to **Section 1.2**).

3. The aim of the technical report is to provide a robust baseline characterisation of the fish and shellfish resources within a defined Study Area against which the potential impacts associated with the WDA can be assessed. To support the impact assessment in the Environmental Impact Assessment (EIA) Report (EIAR), the ecological information presented in this technical report has been used to identify a number of receptors. Receptors have been determined based on the conservation, ecological, and commercial importance of each identified feature within the Study Area and within the WDA, in line with published Ecological Impact Assessment guidelines (Chartered Institute of Ecology and Environmental Management (CIEEM), 2022) (**Chapter 5 EIA Methodology** of the EIAR).

## 1.2 STUDY AREA

4. Fish and shellfish populations are spatially and temporally variable and therefore, a Local Study Area and a Regional Study Area have been defined for the purposes of the fish and shellfish ecology characterisation as in the WDA EIA Scoping Report (hereafter referred to as 'Scoping Report').

5. Scoping Report Consultation feedback received from Marine Directorate - Licensing Operations Team (MD-LOT) (MD-LOT, 2025) advised that though they were *"broadly content with the two proposed fish and shellfish ecology study areas"*, they recommended highlighting the *"representation made by NatureScot regarding maximum tidal excursion for consideration"*. NatureScot representation stated, *"the maximum tidal excursion should also be considered to take account of impacts from suspended sediments and ensure that the local study area covers the full extent of this potential impact"* (MD-LOT, 2025). Therefore, this has been included and is presented in **Figure 1.1**.

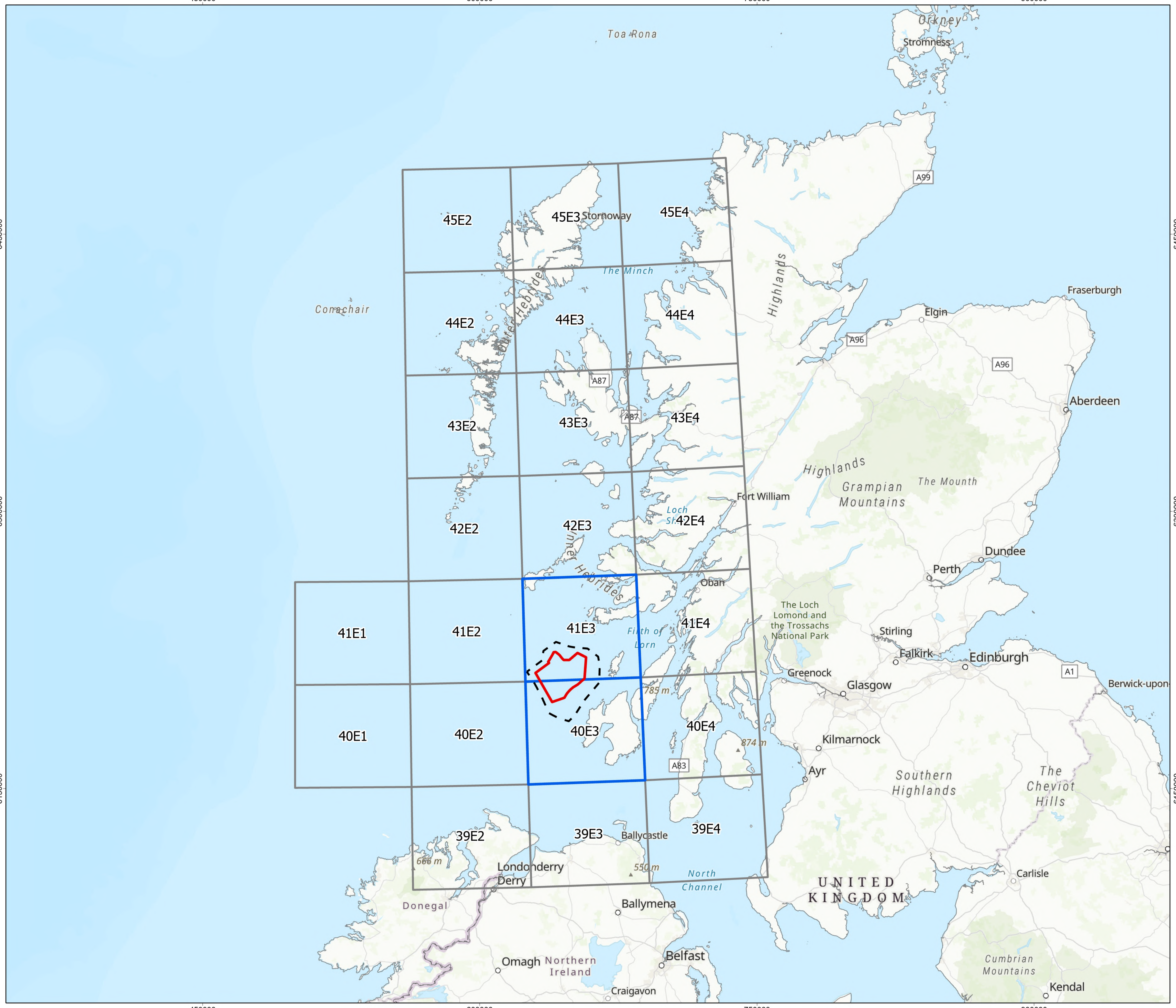
6. The International Council for the Exploration of the Sea (ICES) developed, in the 1970s, a gridded notation system covering the north-east Atlantic. The statistical rectangles are approximately 30 by 30 nautical miles and are used for simplified analysis and visualisation of spatial data. The WDA is located within the ICES Division 6a (West of Scotland), within United Kingdom (UK) Exclusive Economic Zone waters.

7. For the EIAR and because several data sources are based on these rectangles to provide information such as abundance estimates, the Study Areas are based on the following rectangles:

- The Local Study Area is defined as ICES rectangles 40E3 and 41E3 in which the WDA is located. This has been used to determine the assemblage, i.e. which species are to be considered as receptors for the EIA. The maximum tidal excursion (see **Chapter 7 Marine Physical**

**Environment** for further details) has also been considered to take account of impacts from suspended sediments and is covered within the Local Study Area; and

- The Regional Study Area is bounded by ICES rectangles 45E2, 45E4, 39E2 and 39E4. This has been used specifically to inform and assess impacts affecting fish and shellfish receptors over long distances (e.g., underwater noise (UWN) and capturing natal salmon rivers in northwest Scotland and basking shark (*Cetorhinus maximus*) hotspots throughout the Hebrides). Following UWN modelling, the Regional Study area has been extended through the addition of ICES rectangles 41E1 and 40E1 to ensure the worst-case UWN impact range is accounted for.




Windfarm Development Area

Regional Study Area

Local Study Area

Maximum Tidal Exclusion Zone

N

0 25 50 Kilometres


| 2 | 29/01/2026 | AB | GC | MI | PM |
|---|---|---|---|---|---|
| REV | REV DATE | GIS CREATOR | GIS REVIEWER | TECHNICAL CHECKER | TECHNICAL APPROVER |

| | | | |
|---|---|---|---|
| DRAWING NUMBER | MCW-DWF-ENV-MAP-RHS-000118 | | |
| DATUM | ETRS89 | PROJECTION | UTM Zone 29N |
| SCALE | 1:2,000,000 | PAGE SIZE | A3 |
| PROJECT TITLE | MachairWind | | |

**Figure 1.1: Fish (incl. Basking Shark) and Shellfish Study Areas**



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Name: Fig_1-1_MCW-DWF-ENV-MAP-RHS-000118_FishShellfishStudyArea

## 1.3 BASELINE METHODOLOGY

### 1.3.1 Methodology

8. A desktop review has been undertaken to inform the baseline for fish (including basking shark) and shellfish, including review of peer-reviewed publications and reports from surveys undertaken to inform other project assessments. These provide information on the fish and shellfish assemblages within the Study Areas. In addition, the Project's site investigation survey undertaken within the WDA in 2023 and the third-party benthic survey undertaken over a portion of the WDA in 2021 have informed baseline characterisation. The Project's and Third-Party Digital Aerial Surveys (DAS) have also been used to inform basking shark baseline characterisation. It should also be noted that one sunfish (*Mola mola*) and three Atlantic bluefin tuna (*Thunnus thynnus*) were also recorded as described in **Section 1.4.1**. These surveys are described in **Section 1.3.3**.

9. The fish and shellfish baseline has also been informed by the commercial fisheries and benthic ecology baseline characterisations in addition to consultation with relevant statutory bodies.

### 1.3.2 Desktop Study

10. A detailed desktop review of existing studies and datasets was undertaken to gather information on fish and shellfish ecology within the Study Areas. **Table 1.1** summarises the studies and datasets used. These data sources have been agreed via the Scoping Report, with additional sources suggested by the Scoping Opinion, Expert Topic Groups (ETGs) and wider stakeholder consultation also included.

*Table 1.1 Summary of key datasets and information sources*

| Dataset | Description | Author |
|---|---|---|
| Scottish salmon and sea trout fishery statistics 2024 | Summary of the Atlantic salmon (*Salmo salar*) and sea trout *(Salmo trutta)* fishery catch statistics updated for the 2024 season. | Scottish Government, 2025 |
| United Kingdom sea fisheries annual statistics | Illustrates species of commercial importance in terms of landings weight and value by vessels in relation to ICES rectangles. Current available reports from 2013 to 2024. | Marine Management Organisation (MMO), 2025 |
| 2024 Scottish Sea Fisheries Statistics, Fishing Effort and Landings Dataset | Provides detailed spatial information on fishing activity, including annual fishing effort and the tonnage and value of sea fish landed by UK and foreign vessels across ICES rectangles. | Scottish Government, 2025 |
| Diadromous Fish ScotMER Receptor Group | The Diadromous Fish Scottish Marine Energy Research (ScotMER) Receptor Group is concerned with evidence gaps related to the health, distribution, and impacts on Diadromous fish (salmon, sea trout, etc.). | ScotMER, 2025 |
| National Biodiversity Network Atlas species assemblage data | The National Biodiversity Network (NBN) Atlas is a species occurrence data portal, combining 995 datasets from 165 data partners at the time of writing. | NBN, 2025 |
| West Coast Tracking Project | The West Coast Tracking Project aims to advance understanding of the marine and near-coastal migratory distribution of wild Atlantic salmon around the west coast of Scotland. | Atlantic Salmon Trust, 2025 |
| Hebridean Whale and Dolphin Trust (HWDT) | Citizen science resource with basking shark sightings data. Data has been gathered from 2017 to present and any new data will be used at EIA stage. | Hebridean Whale and Dolphin Trust (HWDT), 2025 |

| Dataset | Description | Author |
|---|---|---|
| Whale Watch citizen sightings data | | |
| International Herring Larvae Survey | The International Council for the Exploration of the Sea (ICES) programme of international herring (*Clupea harengus*) larval surveys in the North Sea, undertaken from 2014 to 2024, provides annual quantitative estimates of herring larval abundance in Scottish waters. | ICES, 2024 |
| Aerial Surveys of Cetaceans in Irish waters | Aerial Surveys of Cetaceans and Seabirds in Irish waters: Occurrence, distribution and abundance in 2021-2023. | Government of Ireland, 2024a |
| Seasonal distribution of megafauna off the coast of Ireland | The seasonal distribution and abundance of seabirds, cetaceans and other megafauna off the south and southwest Irish coast. | Government of Ireland, 2024b |
| Atlantic salmon post-smolts migration patterns | Migration patterns and navigation cues of Atlantic salmon post-smolts migrating from 12 rivers through the coastal zones around the Irish Sea | Lilly et al., 2024 |
| Tracking and movement patterns of basking shark | Assessing the Potential of Acoustic Telemetry to Underpin the Regional Management of Basking Sharks (*Cetorhinus maximus*). | Thorburn et al., 2024 |
| Analysis of Basking Shark Watch Database 1987 to 2020 | Collates and analyses Basking Shark Watch public sightings data (which has operated since 1987) to enhance accessibility and utility of the dataset. Furthermore, the report investigates the spatial and temporal patterns within the Sea of the Hebrides Marine Protected Area (MPA) in Scotland and broader geographical areas. | Pikesley, 2024 |
| Nephrops functional units and suitable grounds in Scottish and adjacent waters | Mapped extents of stocks or ICES 'functional units' based on the discrete patches of mud which Nephrops (*Nephrops norvegicus*) inhabit. In addition, the suitable Nephrops ground within the ICES functional units around Scottish waters is also shown and is based on British Geological Survey information and Vessel Monitoring System data (to map inferred fishing distribution of the Nephrops fleet). | Scottish Government, 2022 |
| Developing Essential Fish Habitat maps for fish and shellfish species in Scotland Report | Modelled extent of essential fish habitat in Scottish waters for 16 species in offshore waters. The lower data availability in inshore waters i.e. where the WDA is located (due to higher survey fragmentation, lower method standardisation and coverage gaps) prevented the application of Essential Fish Habitat modelling in this region. However, habitat proxies for species/life stages that may have their essential fish habitat inshore were identified and mapped based on data layers for pre-defined habitat types (European Nature Information System (EUNIS) habitat classification). | Franco et al., 2022 |
| A verified distribution model for the lesser sandeel | Species distribution models were developed to predict the occurrence and density of sandeels (*Ammodytes marinus*) in parts of the North Sea and Celtic Seas regions. Hurdle model evaluation with independent data demonstrated that it had significant discrimination ability across the study region. The distribution model helps refine past inferences about sandeel availability to predators and indicates to marine planners, | Langton et al., 2021 |

| Dataset | Description | Author |
|---|---|---|
| | potential areas where anthropogenic impacts should be considered. | |
| Basking shark habitat suitability | Predicting habitat suitability for basking sharks in UK waters using ensemble ecological niche modelling | Austin et al., 2019 |
| Marine Information Network fish and shellfish sensitivity reports | Marine Information Network (MarLIN)'s The Marine Evidence-Based Sensitivity Assessments (MarESA) examine the biology or ecology of a fish or shellfish species, compile the evidence of the effect of a given pressure on the species, assess the likely sensitivity of the species to the pressure against standard scales, documenting the evidence used. | Tyler-Walters et al., 2018 |
| Spawning grounds of whiting | Examines the importance of environmental influences on spawning distribution of whiting *(Merlangius merlangus)* using generalised additive models. | González-Irusta, and Wright, 2017 |
| Basking shark satellite tagging project | A joint project between NatureScot and the University of Exeter has provided insights into basking sharks' horizontal and vertical use of the waters on Scotland's west coast. Basking shark satellite tagging project providing insights into basking shark movement, distribution and behaviour using satellite telemetry. | Witt et al., 2016 |
| Spawning grounds of haddock | Examines the importance of physical constraints on the spawning distribution of northern shelf haddock *(Melanogrammus aeglefinus)* using a two-stage generalised additive model applied to bottom trawl survey data from the North Sea and west of Scotland. | González-Irusta, and Wright, 2016 |
| Nephrops –<br>TV-assessed burrow density | Stock assessments make use of size composition data from catches, combined with information on stock abundance obtained from underwater television surveys. At each station, a custom-built sledge is towed along the seabed and all Nephrops burrow complexes are counted and used to derive density estimates. Surveys were undertaken from 2007 to 2014. | Scottish Government, 2015 |
| Species distribution models and supporting environmental data used to identify potential MPAs. | Statistical approaches to aid the identification of Marine Protected Areas for minke whale *(Balaenoptera acutorostrata)*, Risso's dolphin *(Grampus griseus)*, white-beaked dolphin *(Lagenorhynchus albirostris)* and basking shark. | Paxton et al., 2014a |
| Review of statistical methods for identifying Marine Protected Areas for cetaceans and basking sharks. | Review of available statistical approaches to help identify Marine Protected Areas (MPAs) for cetaceans and basking shark. | Paxton et al., 2014b |
| Updates to Fisheries Sensitivity Maps in British Waters | Updated modelling for probability of larvae presence for various fish species in British waters. Use and interpretation is recommended alongside the Coull et al. (1998) maps. | Aires et al., 2014 |
| Mapping the spawning and nursery grounds of selected fish for spatial planning | Mapped extents of spawning and nursery grounds of various fish species, using the original maps produced by Coull et al. (1998), updated with newer data on larvae, juvenile, and egg abundance. | Ellis et al., 2012 |

| Dataset | Description | Author |
|---|---|---|
| Argyll Array Offshore Windfarm Boat-Based Surveys | Twenty- seven months of boat-based marine mammal and basking shark survey data taken for the now withdrawn Argyll Array Offshore Windfarm. | Booth et al., 2013 |
| Islay Offshore Windfarm Boat-Based Surveys | Fourteen months of boat-based marine mammal and basking shark survey data undertaken for the now withdrawn Islay Offshore Windfarm. | AMEC, 2013 |
| DATRAS Scottish West Coast Groundfish Survey | The dataset includes age- and length-based catch per unit effort data for commercial fish species collected during the Scottish West Coast Bottom Trawl Survey. This survey has been conducted annually since 2011, replacing the historical DATRAS SWC-IBTS dataset. | ICES, 2013 |
| Fisheries sensitivity maps in British Waters | Mapped extents of the spawning and nursery grounds of various commercially important fish species and the relative intensity and duration of spawning. | Coull et al., 1998 |
| HWDT marine mammal and basking shark survey data | Visual and Passive Acoustic Monitoring data gathered during Silurian expeditions in the Hebrides. The analysis is primarily focussed on marine mammals but basking shark occurrence was also recorded. | Presented in **Appendix 10.3 Analysis of Hebridean Whale & Dolphin Trust Visual and Passive Acoustic Survey Data**. |

### 1.3.3 Site-Specific Survey Data

11. In addition to the existing data sources identified in **Section 1.3.2**, the Project has undertaken site-specific surveys to inform the EIA (**Table 1.2**).

*Table 1.2 Site-specific survey data*

| Dataset | Year(s) | Description |
|---|---|---|
| Third-party Digital Aerial Survey | 2020 to 2021 | Digital Aerial Surveys (DAS) undertaken by APEM on behalf of a third-party developer across a portion of the Option Agreement Area (OAA), (Plate 10.2 of **Chapter 10 Marine mammals and Leatherback Turtle**), including a 6 km buffer. Monthly surveys were actioned over 16 months from October 2020 to January 2022 inclusive. This survey covered the WDA. |
| Project's Digital Aerial Survey | 2021 to 2023 | DAS undertaken by APEM for the Project across the full OAA, including a 4 km buffer (analysed) and 6 km buffer, extending to 10 km during the survey. Monthly surveys were actioned over 30 months from April 2021 to September 2023 inclusive. |
| Third-party benthic survey | 2021 | Benthic survey undertaken by Briggs Marine which overlaps with the OAA. The survey work comprised of the following:<br>• 60 benthic sediment grab samples contaminants, faunal, biomass and particle size distribution analysis; and<br>• 20 transects of Drop-Down Video (DDV).<br>This data has been acquired by the Applicant to supplement the Project's site investigation survey data which together has been used to characterise the WDA.<br>See **Appendix B of the Scoping Report**. |

| Dataset | Year(s) | Description |
|---|---|---|
| Project's site investigation | 2023 | Site Investigation survey undertaken across the OAA by Fugro on behalf of the Project. The survey works comprised of the following:<br>• Geophysical survey (2 km x 500 m line spacing)<br>o Side Scan Sonar<br>o Multibeam Echosounder<br>o Sub Bottom Profiler<br>o Magnetometer<br>• 57 benthic sediment grabs for contaminants, faunal, biomass and particle size distribution analysis;<br>• 59 transects of DDV with seabed photographs; and<br>• 29 water samples for environmental DNA analysis.<br>See **Appendix C, Appendix D** and **Appendix E of the Scoping Report.** |

## 1.4 BASELINE CHARACTERISATION

12. The following sections set out the existing baseline environment for fish and shellfish ecology, including their conservation designations.

### 1.4.1 Pelagic Fish, Demersal Fish and Shellfish Species in the Local Study Area

13. Within the Local Study Area, given the close proximity to the coast, fishing effort is dominated by shellfish fisheries.

14. Landings data indicates that the following key target species are likely to be present: Nephrops, velvet crab *(Necora puber)*, king scallops *(Pecten maximus)*, European lobster *(Homarus gammarus),* brown crab *(Cancer pagarus)*, common whelk (*Buccinum undatum),* and razor clam *(Ensis* spp.[1]) (**Table 1.3**).

15. Commercial fish species landings are generally lower in quantity compared to shellfish (**Table 1.3**) and indicate the following demersal and elasmobranch species as likely to be present: haddock, cod (*Gadus morua*), monkfish *(Lophius piscatorius),* Anglerfish *(Lophiidae* spp), and thornback ray (*Raja clavate)*.

16. Other fish species include the following pelagic species (**Appendix D of the Scoping Report**; Coull et al., 1998; Ellis et al., 2012): Norway pout *(Trisopterus esmarkii)*, sandeels, (semi-pelagic species as they are buried in sand between September and February), sprat *(Sprattus sprattus),* herring, whiting, *,* blue whiting (*Micromesistius poutassou)*,.

17. In addition, the following demersal species are also likely to be present (**Appendix D of the Scoping Report**): dragonet (*Callionymus* spp.), ling *(Molva molva)*, thickback sole (*Microchirus variegatus),* solenette / yellow sole (*Buglossidium luteum),* saithe *(Pollachius virens)*, European plaice *(Pleuronectes platessa),* European hake *(Merluccius merluccius),* common sole *(Solea solea)*, common (blue) skate *(Dipturus batis),* flapper skate *(Dipturus intermedius)* and common dab (*Limanda limanda)*.

18. In addition to common skate and flapper skate mentioned above, other elasmobranch species likely to be present include spurdog *(Squalus acanthias)*, thornback ray, undulate ray *(Raja undulata)* and spotted ray *(Raja montagui)* (**Appendix D of the Scoping Report**; Ellis et al., 2012). Two individuals

[1] Note that fishing and landing of razor clams in Scotland is restricted to hand caught techniques (UK Government, 2017) and a trial exploring the use of electrofishing (and subsequent retrieval by hand) which began in 2018 has been extended to January 2025 (Scottish Government, 2023).

belonging to the family *Rajidae* were observed in photographic stills imagery during the Project's site investigation survey (at stations MCW-A-ST02 (Thornback ray) and MCW-D-ST88A (unidentified to species level)), indicating the potential presence of thornback ray, undulated ray or spotted ray (**Appendix D of the Scoping Report**). Basking shark, an elasmobranch species, is described separately at **Section 1.4.3.1**.

19. In addition to these records, the Project's and third-party DAS have also contributed to the wider fish baseline. These surveys recorded one sunfish and three Atlantic bluefin tuna, both pelagic species, which are therefore included within the broader species assemblage for the WDA.

20. Adult and juvenile ocean quahogs (*Arctica islandica*), an Oslo and Paris Commission (OSPAR) threatened species and Priority Marine Feature (PMF) in Scotland, were recorded at 18 stations from grab sampling and observed within 18 stations in photographic data during the 22 August to 08 November 2023 environmental surveys, with partial overlap between the two datasets (**Appendix D of the Scoping Report**).

21. In summary, the following species have been recorded within the WDA and/or are likely to be present in the Local Study Area. In addition to the below, basking shark are also likely to pass through the WDA en-route to favoured grounds in the Sea of the Hebrides Nature Conservation Marine Protected Area (NCMPA) as described in **Section 1.4.3.1**.

- **Pelagic Fish**
  - Norway pout
  - Sandeel
  - Sprat
  - Herring
  - Whiting
  - Saithe
  - Ling
  - European hake
  - Sunfish
  - Blue whiting
  - Atlantic blue fin tuna
- **Demersal Fish**
  - Haddock
  - Cod
  - Monkfish
  - Dragonet
  - Thickback sole
  - Yellow sole
  - Common sole
  - European plaice
  - Common dab
  - Raja spp.
  - Squalidae spp
  - Anglerfish
- **Shellfish**
  - Nephrops
  - Velvet crab
  - King scallop
  - Brown crab
  - European lobster
  - Common whelk
  - Razor clam
  - Ocean quahog

22. The mean annual landings of key fish species landed by commercial vessels over the period 2018-2023 within the Local Study Area are listed in **Table 1.3** (Scottish Government, 2025). At the time of writing (January 2026), the 2024 annual landings data has not been published (originally scheduled for release in October 2025) and is currently delayed indefinitely. As noted above landings are dominated by shellfish species.

*Table 1.3 Mean[2] annual quantity and value of species landed from the Local Study Area, where landings were greater than or equal to 3 tonnes, between 2020-2024*

| Species | 40E3 | | 41E3 | |
|---|---|---|---|---|
| | Quantity (tonnes) | Value (Great British Pound) | Quantity (tonnes) | Value (Great British Pound) |
| Brown crab | 358.2 | 830,712.0 | 394.8 | 891,955.2 |
| Crabs - Velvet | 73.9 | 234,666.7 | 71.3 | 217,098.3 |
| Green Crab | 7.8 | 7,538.2 | 2.5 | 1,861.9 |
| Lobsters | 30.0 | 408,006.8 | 46.1 | 677,385.9 |
| Nephrops (Norway Lobster) | 50.8 | 206,805.6 | 241.8 | 989,812.2 |
| Razor Clam | 48.3 | 448,430.1 | 77.0 | 499,779.9 |
| Scallops | 164.4 | 358,097.5 | 244.1 | 562,730.9 |
| Spider Crabs (*Maja squinado*) | 7.8 | 6,527.3 | <3 | 891,955.2 |
| Sprats | <3 | N/A | 71.7 | 22,898.5 |
| Common Whelk | 47.5 | 19,032.6 | 4.0 | 3,675.0 |

### 1.4.2 Diadromous Fish Species

23. Diadromous fish migrate between saltwater and freshwater during their life cycle. Anadromous species migrate from saltwater to freshwater to spawn, while catadromous species migrate from freshwater to saltwater. Relevant diadromous species that may pass through the Regional and Local Study Area during spawning migrations or during foraging and maturation stages include:

- Atlantic salmon;
- Sea trout;
- Sea lamprey (*Petromyzon marinus*);
- River lamprey (*Lampetra fluviatilis*); and
- European eel (*Anguilla anguilla*).

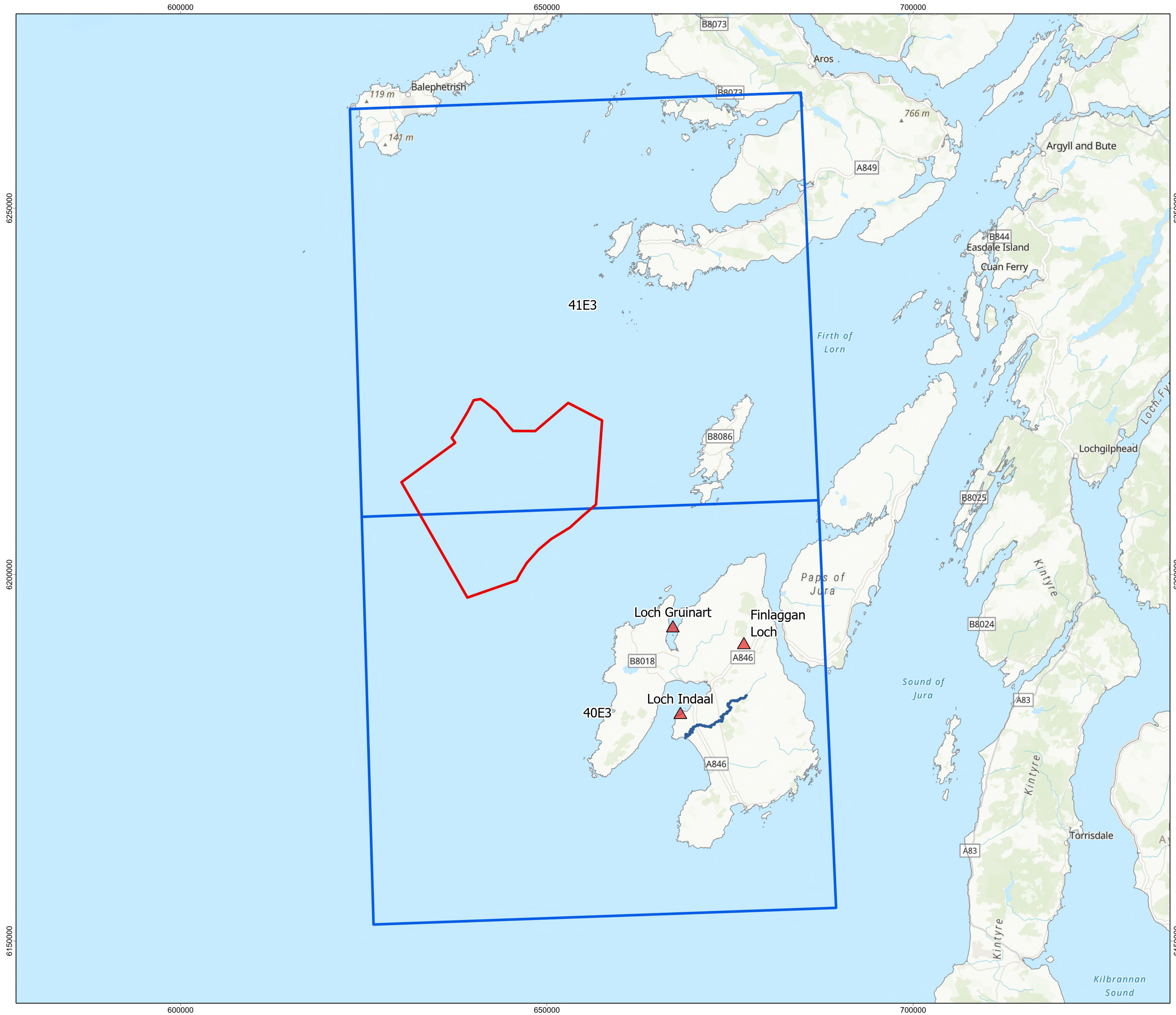
24. River lamprey and sea lamprey are anadromous, spending most of their adult life in marine waters but spawning in rivers. The European eel is catadromous, migrating from freshwater rivers to spawn in the sea. These species are not considered further in this assessment because there is no identified pathway for likely significant effect within the Study Areas.

[2] Note that for any species with annual catches of fewer than 3 tonnes in certain years, those years have been excluded from the calculation of mean landings to ensure a precautionary baseline.

25. The only known Scottish populations of Allis shad *(Alosa alosa)* and twaite shad *(Alosa fallax)* (which are also Annex II diadromous fish)[3] are closely associated with the Solway Estuary. The Solway Firth / Estuary is located approximately 260 km southeast from the Local Study Area. Due to this distance, there is no pathway for impact on these species. These species are not considered further in this assessment because the Study Areas are located at a substantial distance from the freshwater river systems required for spawning (lampreys) or growth phases (European eel). As a result, there is no spatial or ecological overlap, or pathway for likely significant effect between the species' critical habitats or migratory corridors and the Study Areas.

26. Whilst sites designated for Annex II diadromous fish, and their distance to the WDA are set out in **Table 1.4**, other non-designated river systems have populations of diadromous fish that may pass through the WDA, for example the River Laggan on Islay has an active Atlantic salmon and brown trout fishery (catch and release) and there are numerous lochs on Islay with active sea trout fisheries (**Figure 1.2**).

[3] i.e. species listed on Annex II of the Habitats Directive and whose conservation requires the designation of SACs.




- Windfarm Development Area
- Local Study Area
- River Laggan (Atlantic salmon and brown trout fishery)
- Lochs (sea trout fisheries)

N

0 10 20 Kilometres


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**Figure 1.2: Known Atlantic salmon and sea trout, or freshwater brown trout fisheries on Islay with drainage to the sea**



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Name: Fig_1-2_MCW-DWF-ENV-MAP-RHS-000119_AtlanticSalmonTrout

27. Within the WDA EIAR, diadromous fish are considered as a receptor group, with a specific focus on Atlantic salmon and sea trout. These species are ecologically and economically important, and known to migrate through the Regional and Local Study Area during key stages of their life cycle, including spawning migrations and foraging.

*Table 1.4 Designated sites for diadromous fish ecology features*

| Designated Site | Protected fish and shellfish ecology feature(s) | Closest approximate distance from the WDA (km) |
|---|---|---|
| **Special Areas of Conservation (SAC)** | | |
| Endrick Water SAC | Brook lamprey (*Lampetra planeri*)[1]<br>River lamprey<br>Atlantic salmon (not primary reason for designation) | 122.7 |
| Little Gruinard River SAC | Atlantic salmon | 202.6 |
| North Harris SAC | Freshwater pearl mussel<br>Atlantic salmon (not primary reason for designation) | 199.6 |
| Langavat SAC | Atlantic salmon | 206.2 |
| [1] This species spends its entire lifecycle in freshwater and hence is not considered in **Section 1.4.2.** | | |

28. Since diadromous fish species, such as Atlantic salmon and sea trout have fresh and marine life stages, designated rivers that intersect within the Regional Study Area and outflow at the west coast have been included. The proposed list of sites included within the WDA Scoping Report mistakenly included rivers which outflowed to the east coast such as the River Oykel SAC and the River Moriston SAC, which have since been removed and have been screened out of the assessment.

#### *1.4.2.1 Atlantic Salmon*

29. Atlantic salmon is an Annex II species under the European Union (EU) Habitats Directive and is listed as a qualifying feature of several SACs within close proximity to the Regional Study Area, such as Endrick Water SAC. In addition to its designation under European legislation, Atlantic salmon is recognized as a PMF in Scotland for its marine life stage and is also considered a Priority Species under the UK Biodiversity Framework 2024. These designations reflect the species' ecological significance and its role in supporting biodiversity across freshwater and marine environments.

30. The species is known to be a relatively large-bodied fish that can be encountered in clean and healthy rivers throughout the UK. Like other salmonid species, the Atlantic salmon spends most of its life at sea, returning to spawn in the same stretch of river or stream in which they were hatched (natal river).

31. Despite its considerable cultural and conservation importance (Hindar et al., 2010), Atlantic salmon populations have declined significantly over the past 25 years. Recent assessments indicate that the species is now classified as Endangered in Great Britain, with declines of 30-50% since 2006 and projections of up to 80% by 2025 (IUCN, 2023a). In Scotland, the majority of river populations are assessed as being in less than "good" conservation status. These declines are driven by multiple pressures across the species' life cycle. In freshwater, threats include habitat degradation, barriers to migration such as dams and weirs, water abstraction, and rising river temperatures linked to climate change. In marine environments, pollution, the introduction of non-native salmon stocks, physical barriers to migration, exploitation from netting and angling, physical degradation of spawning and nursery habitat, and increased marine mortality are major concerns (Gilson et al., 2019).

32. The 2024 Scottish salmon and sea trout fishery statistics 2024 reported an increase in the total rod catch of wild salmon in 2024, to 46,978, representing a 14% increase compared to the five year average (2019-2023). Catch and release practices remained exceptionally high, with 98% of rod-caught salmon being subsequently released. Nevertheless, the report still reflects a general decline in wild salmon populations returning to Scottish rivers despite a high rate of catch and release which is indicative of a strong conservation effort (Scottish Government, 2025). Over the past 25 years, Atlantic salmon populations in Scotland have declined significantly (Youngson et al., 2002). This trend is reflected in salmon fishery districts in the vicinity of the Project, including key rivers in the Laggan and Sorn District Salmon Fisheries Board (DSFB) and Argyll and Bute DSFB areas. Most rivers have either remained stable with low rod catch levels over the data timeseries, or have shown a general trend of decline since 1952, as exemplified by the River Awe district catch data (**Plate 1.1**). Overall, when combining rod catches from key rivers in the Regional Study Area, a declining trend is observed since 1952 (**Plate 1.2**).

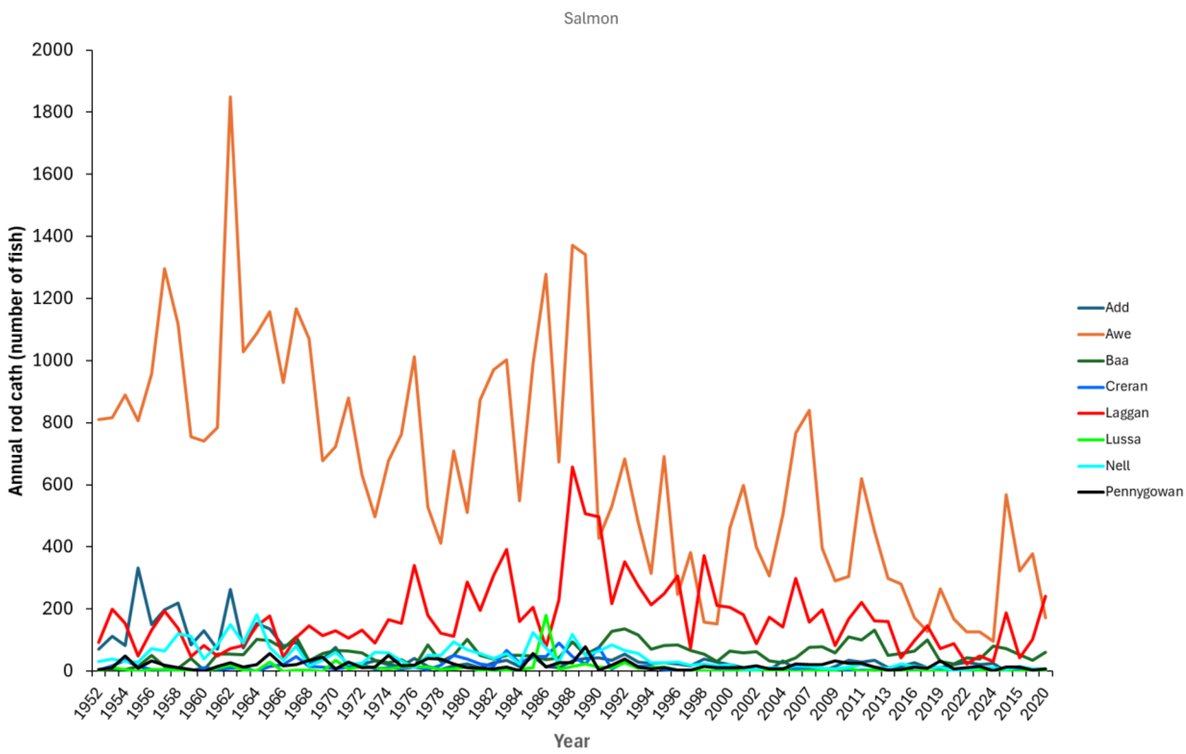


*Plate 1.1 Annual Rod Catches of Atlantic Salmon from Individual Scottish West Coast, and North West Rivers in the Laggan and Sorn DSFB, and Argyll and Bute DSFB Areas, for the Years 1952-2024 (Scottish Government, 2025)*

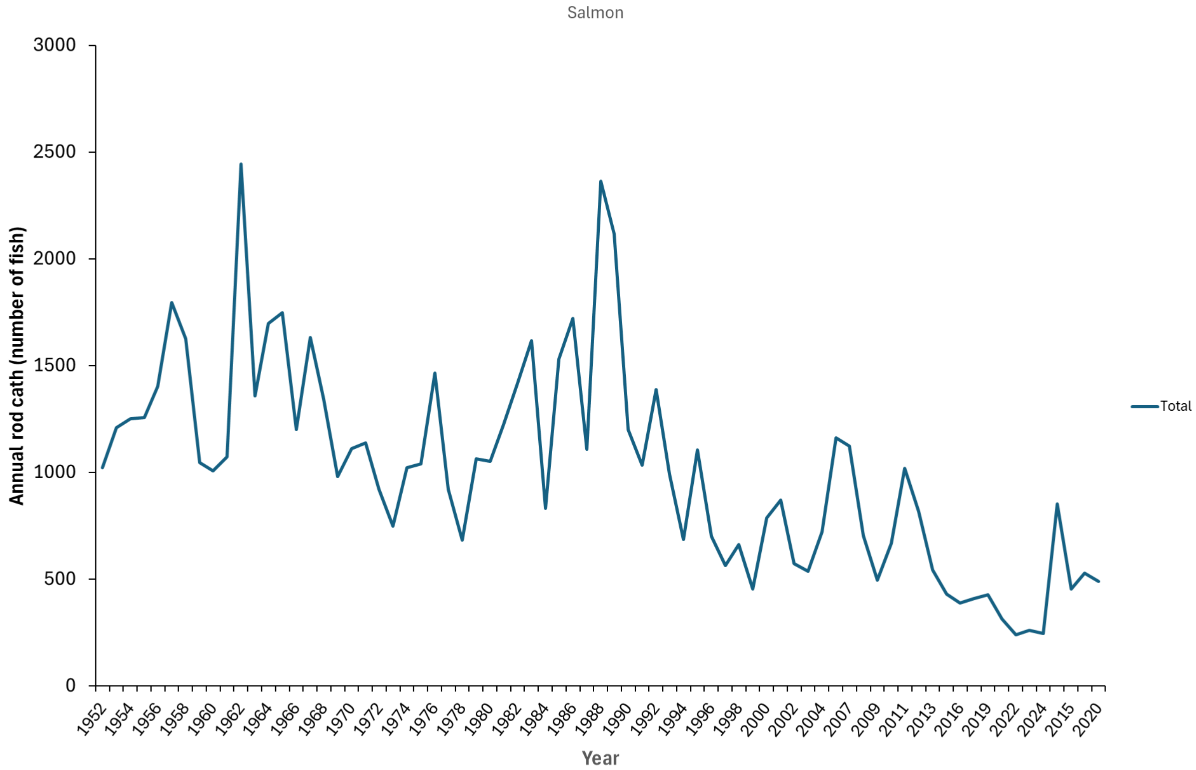


*Plate 1.2 Annual Rod Catches of Atlantic Salmon from all Scottish West Coast, and North West Rivers in the Laggan and Sorn DSFB, and Argyll and Bute DSFBareas, for the Years 1952-2024 (Scottish Government, 2025)*

33. Recent research has improved understanding of Atlantic salmon migration pathways. Telemetry studies show that post-smolts from Scottish rivers typically migrate through the Irish Sea, exiting between Islay and Malin Head before moving toward the Norwegian Sea (Rodger et al., 2024). These patterns suggest that fish originating from the same coastal region exhibit similar migratory routes, and survival during this phase is strongly influenced by oceanographic conditions. Such findings highlight the importance of considering marine survival bottlenecks alongside freshwater habitat restoration in future conservation strategies.

34. To summarise, Atlantic salmon is a species of high ecological, cultural, and legislative importance, yet its populations across Scotland have experienced severe declines over recent decades. While recent telemetry studies and fishery statistics provide valuable insights into migration routes and conservation outcomes, significant uncertainties remain regarding marine survival bottlenecks and cumulative impacts of climate change. Data on juvenile survival rates, oceanographic influences on post-smolt mortality, and the effectiveness of habitat restoration measures are still limited, making it challenging to predict long-term impacts of offshore windfarm infrastructure.

#### 1.4.2.2 Sea Trout

35. Sea trout is listed as a PMF in Scotland during the marine phase of its life cycle, reflecting its ecological importance and the need for targeted conservation measures. Fishery catch data indicate that overall stocks are highly variable and may be declining in many parts of the UK. Rarely recorded outwith the coastal zone, sea trout are commonly found in rivers, streams and lakes, often preferring cold and well oxygenated waters. Sea trout spawn in rivers and streams that have swift currents,

which are usually characterised by the downward movement of water into gravel, favouring large streams and mountainous areas that have adequate cover resulting from submerged rocks, undercut banks, and overhanging vegetation (Fishbase, 2021). Like other salmonids, sea trout is vulnerable to a range of pressures, including poor water quality, over-abstraction, habitat degradation, barriers to migration, increased predation, genetic introgression from introduced fish, and the effects of climate change.

36. Recent fishery statistics highlight the ongoing challenges faced by sea trout populations. In 2024, anglers recorded 13,876 sea trout caught by rod across Scotland, a total that falls below the recent five-year average of 14,436 fish. This places the 2024 catch among the lowest ever recorded, ranking fourth lowest in a monitoring record that stretches back to 1952. Long-term trends show a general decline in catches since the 1960s, despite periodic fluctuations. Catch-and-release practices are widely adopted, with 94% of sea trout released in 2024, indicating strong compliance with conservation measures. Nevertheless, these figures suggest that sea trout continues to experience sustained pressures within Scottish waters, and population recovery remains uncertain (Scottish Government, 2025). For trout fishery districts in the vicinity of the Project, including key rivers in the Laggan and Sorn DSFB, and Argyll and Bute DSFB areas, there is not a clear trend in the number of rod catches. The data presented in **Plate 1.3** and **Plate 1.4** reflects retained catch only, as reporting of released fish did not begin until 1994. Retained catch numbers for these rivers have tended to vary greatly interannually since then, with Awe and Laggan often having higher annual catch numbers than other rivers (**Plate 1.3** and **Plate 1.4**).

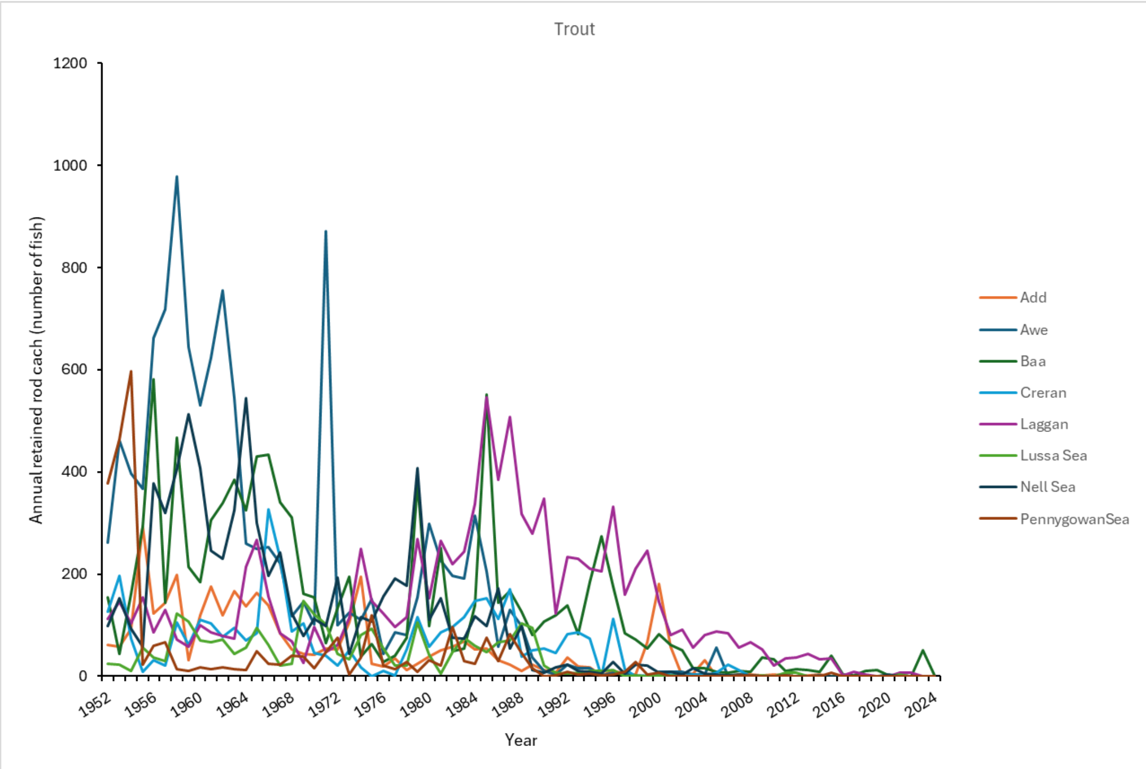


*Plate 1.3 Annual Retained Rod Catches of Sea Trout from Individual Scottish West Coast, and North West Rivers in the Laggan and Sorn DSFB, and Argyll and Bute DSFB, for the Years 1952-2024 (Scottish Government, 2025)*

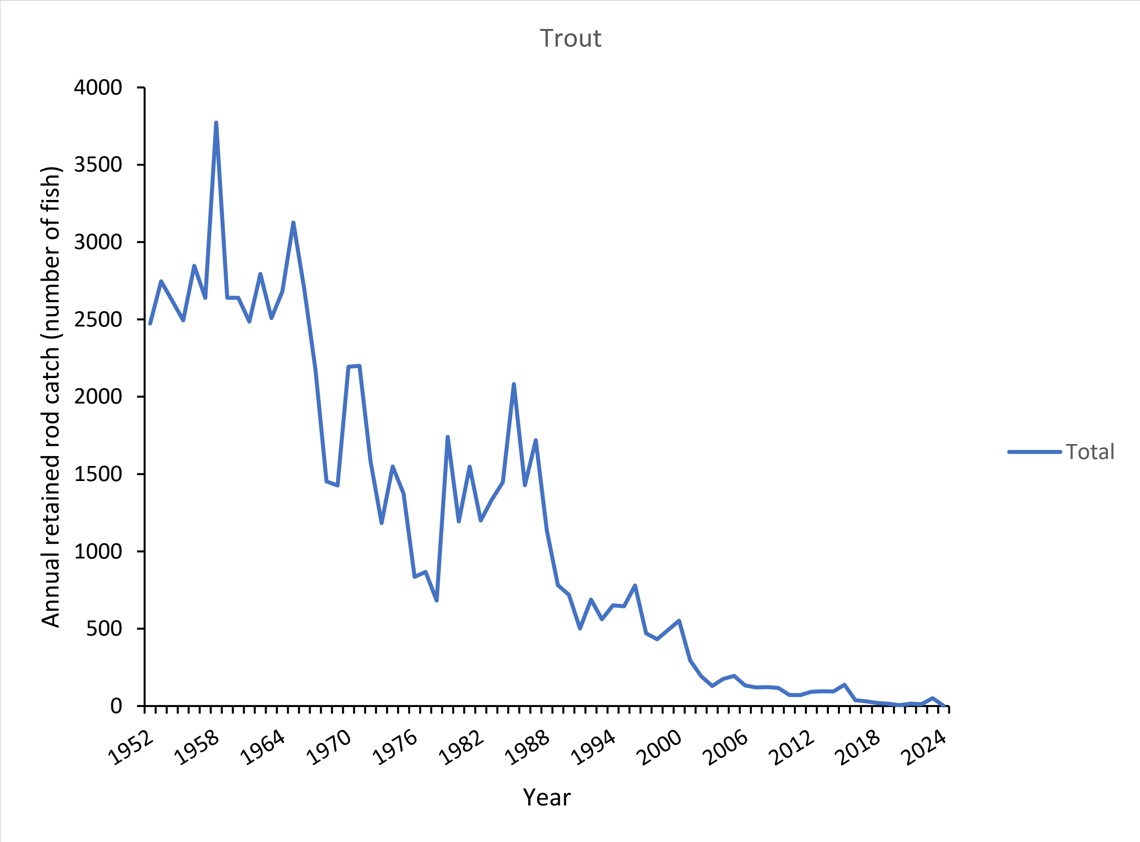


*Plate 1.4 Annual Retained Rod Catches of Sea Trout from all Scottish West Coast, and North West Rivers in the Laggan and Sorn DSFB, and Argyll and Bute DSFB for the Years 1952-2024 (Scottish Government, 2025)*

37. While there is limited information regarding sea trout migration patterns, the information suggests that marine movements are primarily restricted to inshore and local waters, with individuals rarely venturing far offshore (Aldvén & Davidsen, 2017; Artero et al., 2025). This localised distribution underscores the importance of maintaining high-quality coastal and freshwater habitats to support the species throughout its life cycle.

### 1.4.3 Spawning and Nursery Grounds

38. Spawning and nursery habitats for a variety of fish species are found within the waters of Scotland's west coast (**Figure 1.3** to **Figure 1.10**). Species likely to be spawning in the vicinity of the Local Study Area are listed in **Table 1.5**. This is primarily informed by Coull et al., 1998 and Ellis et al., 2012.

*Table 1.5 Spawning grounds, nursery grounds, and conservation designations of fish and shellfish species overlapping the Fish and Shellfish Local Study Area*

| Species | Spawning | Time of Year of Spawning (inclusive)* (Ellis et al., 2012) | Nursery | Conservation Designations |
|---|---|---|---|---|
| **Pelagic species** | | | | |
| Herring | Undetermined intensity (Coull et al., 1998)<br>No overlap (Ellis et al., 2012) | Summer spawning occurs in August – September<br>Spring-spawning herring spawn in shallower nearshore environments along the west coast (Frost and Diele, 2022) | Undetermined intensity (Coull et al., 1998)<br>Low intensity (Ellis et al., 2012) | International Union for Conservation of Nature (IUCN) (vulnerable), Scottish Biodiversity List (SBL) |
| Sandeel | Undetermined intensity (Coull et al., 1998)<br>No overlap (Ellis et al., 2012) | November – February | Undetermined intensity (Coull et al., 1998)<br>Low intensity (Ellis et al., 2012) | PMF, SBL |
| Norway pout | Spawns in higher concentrations across a small overlap of the north/northwest portion of the Local Study Area (Coull et al., 1998)<br>No overlap (Ellis et al., 2012) | January - April<br>Peak February – March | Undetermined intensity (Coull et al., 1998)<br>No overlap (Ellis et al., 2012) | PMF, SBL |
| Sprat | Undetermined intensity but covers most waters around the British Isles (Coull et al., 1998)<br>No overlap (Ellis et al., 2012) | May – August<br>Peak May – June | No overlap (Coull et al., 1998 and Ellis et al., 2012) | N/A |
| Mackerel | No overlap (Coull et al., 1998 and Ellis et al., 2012) | May – August<br>Peak May – July | No overlap (Coull et al., 1998)<br>Low intensity (Ellis et al., 2012) | PMF, IUCN (least concern), SBL |
| Blue Whiting | | April – June.<br>Peak: May – June | No overlap (Coull et al., 1998)<br>Partial overlap with high intensity nursery grounds (Ellis et al., 2012) | PMF, IUCN (least concern), SBL |

| Species | Spawning | Time of Year of Spawning (inclusive)* (Ellis et al., 2012) | Nursery | Conservation Designations |
|---|---|---|---|---|
| **Demersal species** | | | | |
| Plaice | Undetermined intensity (Coull et al., 1998)<br>No overlap (Ellis et al., 2012) | January – March<br>Peak: January – February | Undetermined intensity (Coull et al., 1998)<br>No overlap (Ellis et al., 2012) | IUCN (least concern), SBL |
| Cod | No overlap (Coull et al., 1998 and Ellis et al., 2012) | January - April<br>Peak: February – March | Undetermined intensity (Coull et al., 1998)<br>Low intensity (Ellis et al., 2012) | PMF, Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR) species, IUCN (vulnerable), SBL |
| Haddock | | February – May.<br>Peak: February – April | No overlap (Coull et al., 1998 and Ellis et al., 2012) | IUCN (vulnerable) |
| Saithe | | January – April<br>Peak: January – February | Undetermined intensity (Coull et al., 1998)<br>No overlap (Ellis et al., 2012) | PMF |
| Whiting | | February – June | Undetermined intensity (Coull et al., 1998)<br>Overlap with both low and high intensity nursery grounds (Ellis et al., 2012) | PMF, SBL |
| Ling | | February – May | No overlap (Coull et al., 1998)<br>Partial overlap with low intensity nursery grounds (Ellis et al., 2012) | PMF, SBL |
| European Hake | | January – June<br>Peak: February – March. | No overlap (Coull et al., 1998)<br>Low intensity (Ellis et al., 2012) | SBL |
| Anglerfish | | January – June | No overlap (Coull et al., 1998)<br>Low intensity (Ellis et al., 2012) | PMF, SBL |

| Species | Spawning | Time of Year of Spawning (inclusive)* (Ellis et al., 2012) | Nursery | Conservation Designations |
|---|---|---|---|---|
| **Shellfish** | | | | |
| Nephrops | Undetermined intensity (Coull et al., 1998). | January – December Peak: April – June | Undetermined intensity (Coull et al., 1998)<br>No overlap (Ellis et al., 2012)` | N/A |
| **Elasmobranchs** | | | | |
| Spurdog | No overlap (Coull et al., 1998 and Ellis et al., 2012). | Gravid females present year-round | No overlap (Coull et al., 1998)<br>High intensity (Ellis et al., 2012) | Scottish NCMPA search feature (marine life stages), PMF, OSPAR, IUCN (Vulnerable), SBL |
| Common skate (species complex) | | Unknown. | No overlap (Coull et al., 1998)<br>Low intensity (Ellis et al., 2012) | Scottish NCMPA search feature (marine life stages), OSPAR, PMF, SBL |
| Spotted ray | | May – July | No overlap (Coull et al., 1998)<br>Low intensity (Ellis et al., 2012) | OSPAR, IUCN (Least concern) |
| *Coull et al., 1998 did not assess time of year of spawning. | | | | |

39. As above, many of these species form important prey resources for marine mammals and seabirds. For this reason, the findings of the fish and shellfish assessment has been considered in the marine mammals and offshore ornithology chapters in the EIAR.

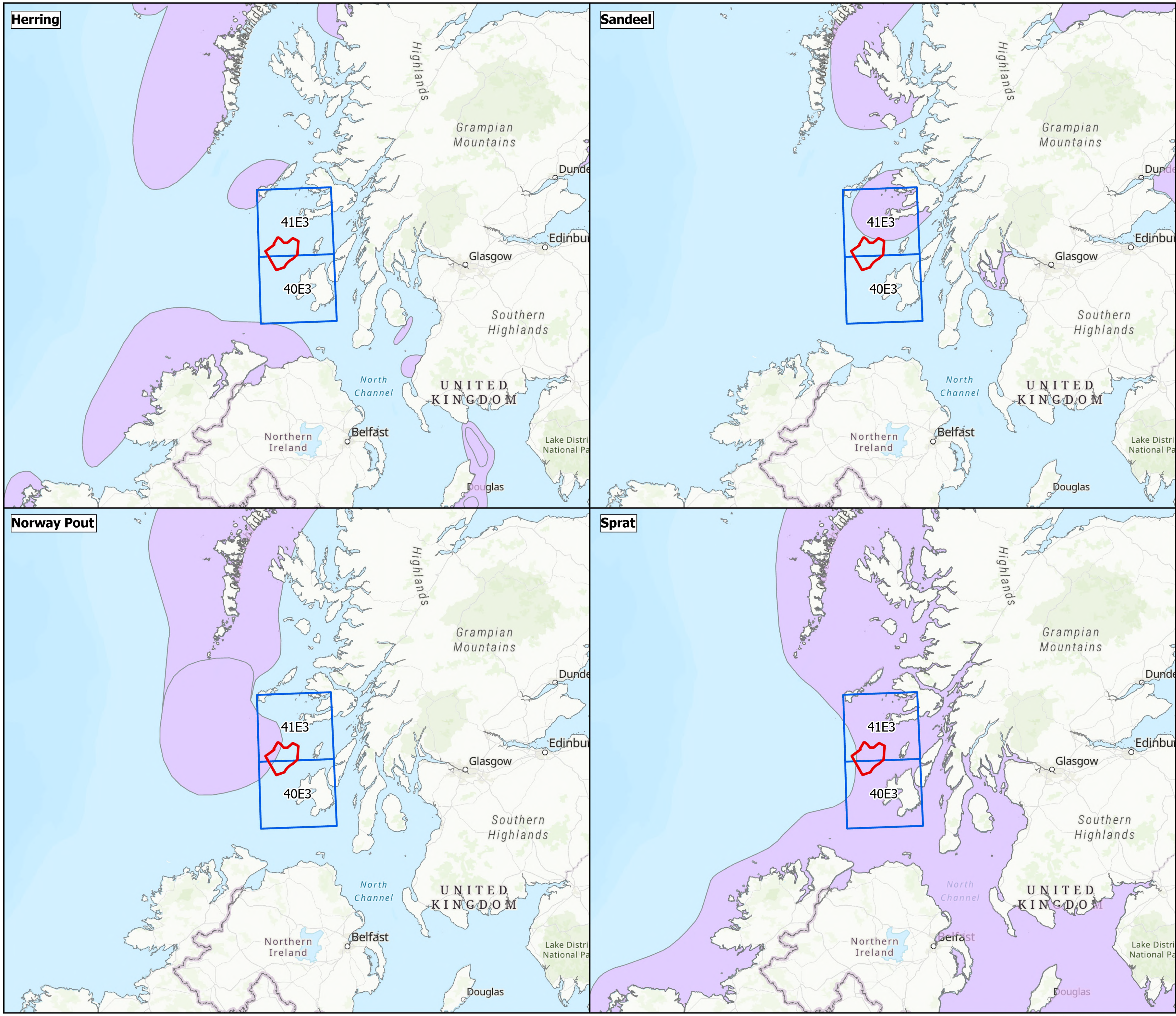



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**Figure 1.3: Pelagic Fish Species Spawning Grounds Which Overlap with the Local Study Area**



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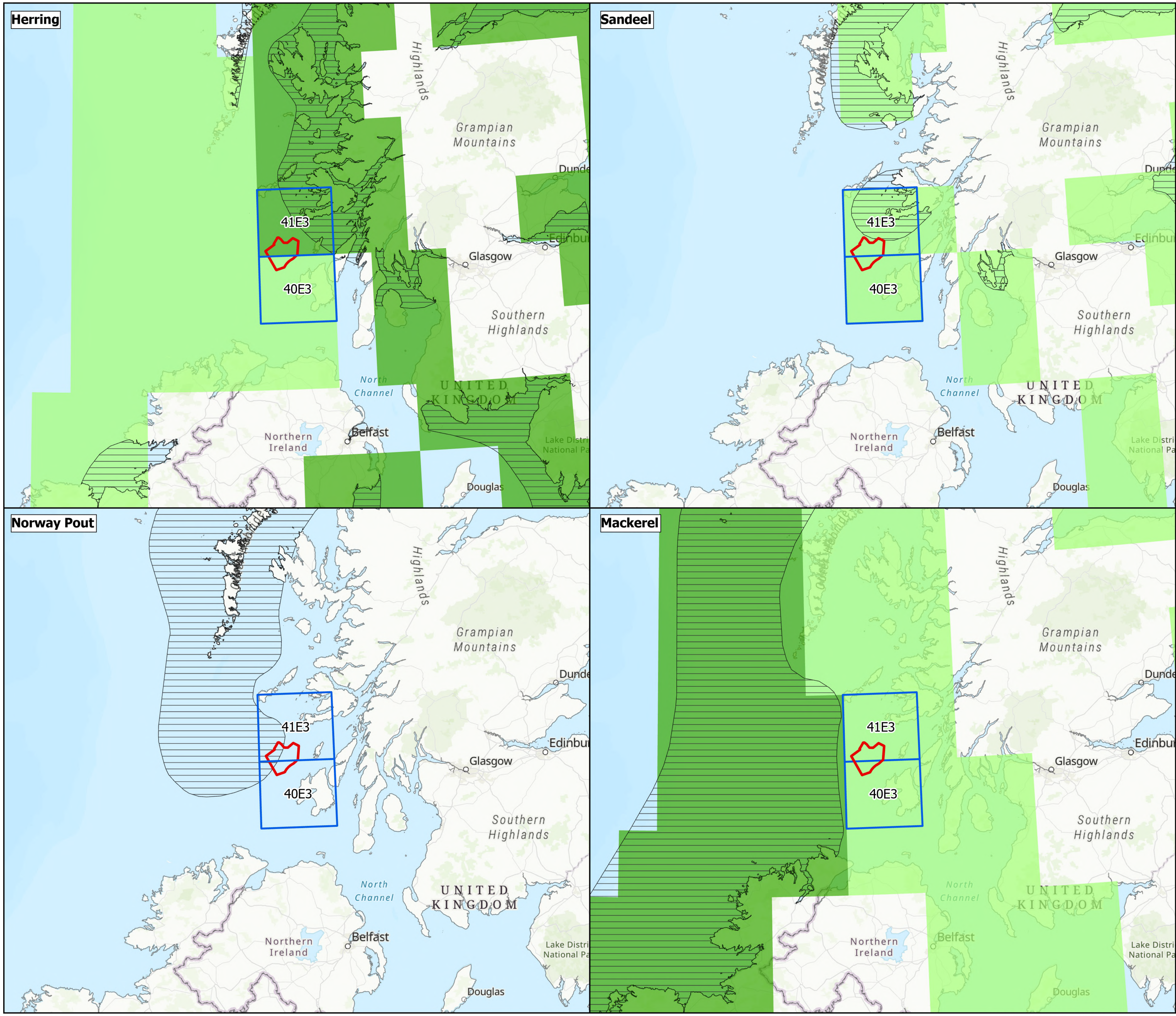


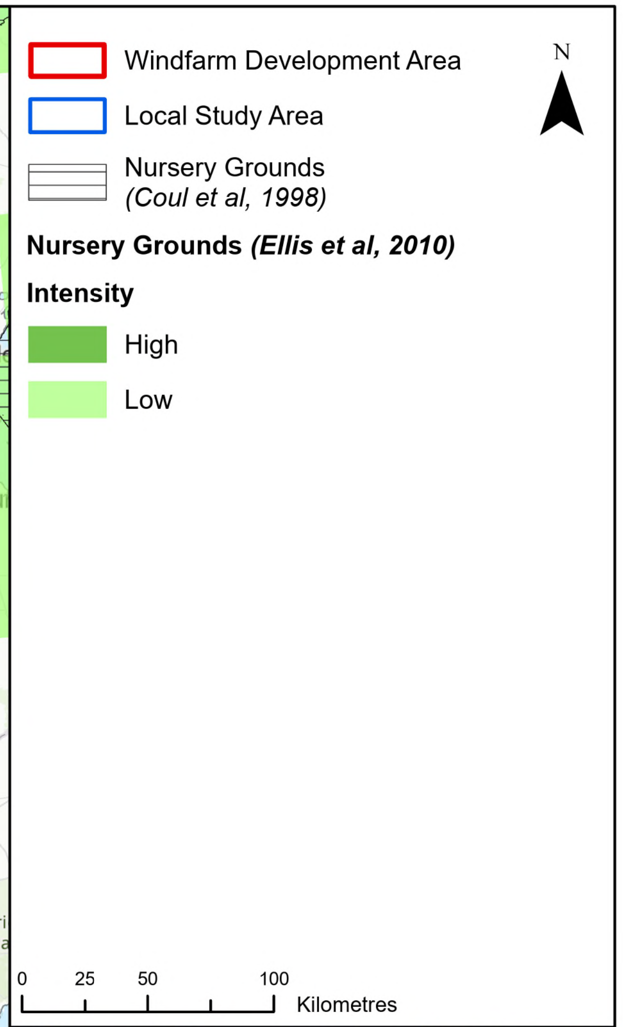



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**Figure 1.4: Pelagic Fish Species Nursery Grounds which Overlap with the Local Study Area**



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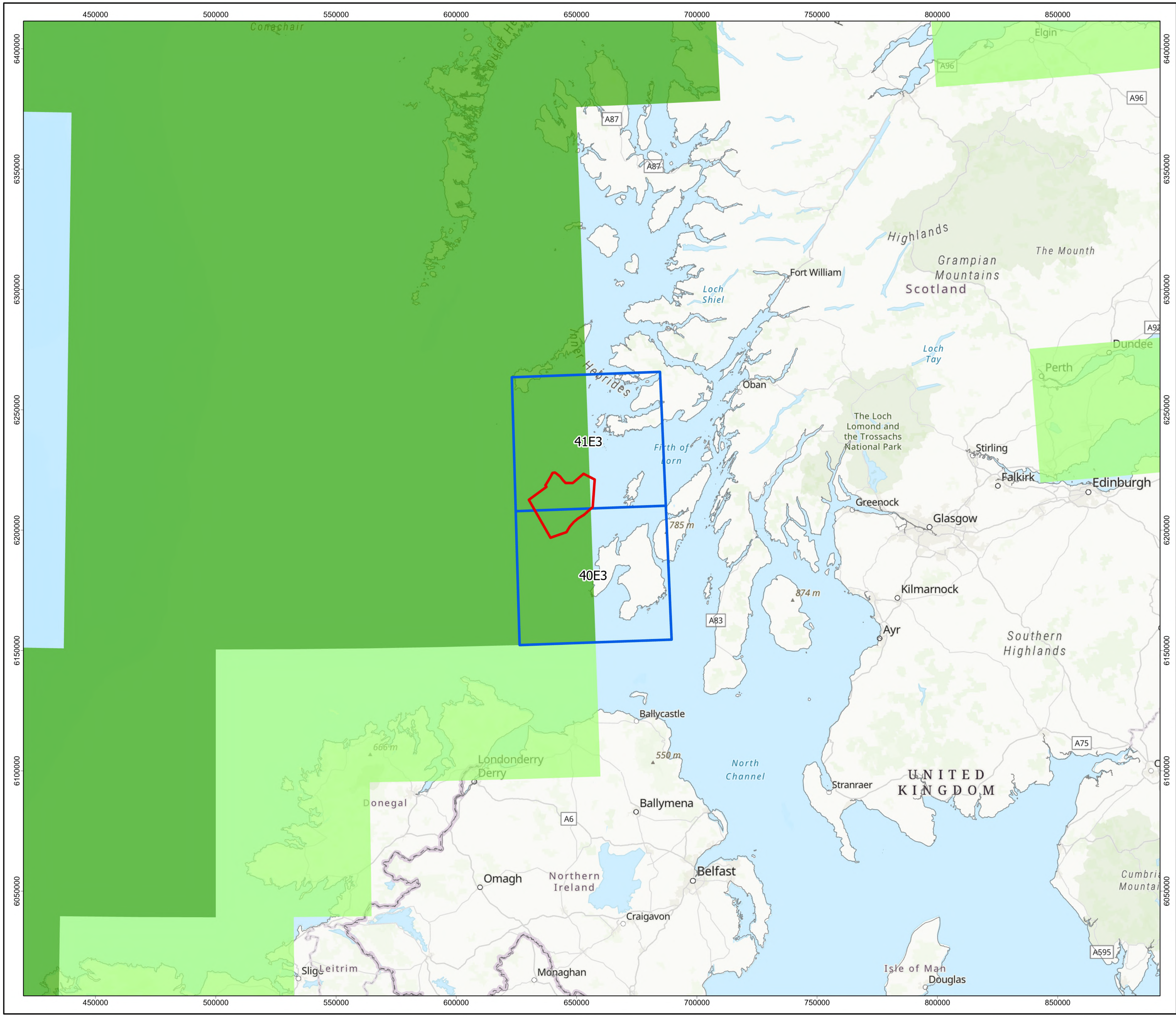


Windfarm Development Area

Local Study Area

**Nursery Grounds *(Ellis et al, 2010)***

**Intensity**

High

Low

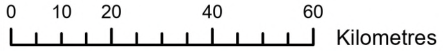



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**Figure 1.5: Pelagic fish species nursery grounds which overlap with the Local Study Area - Blue Whiting**



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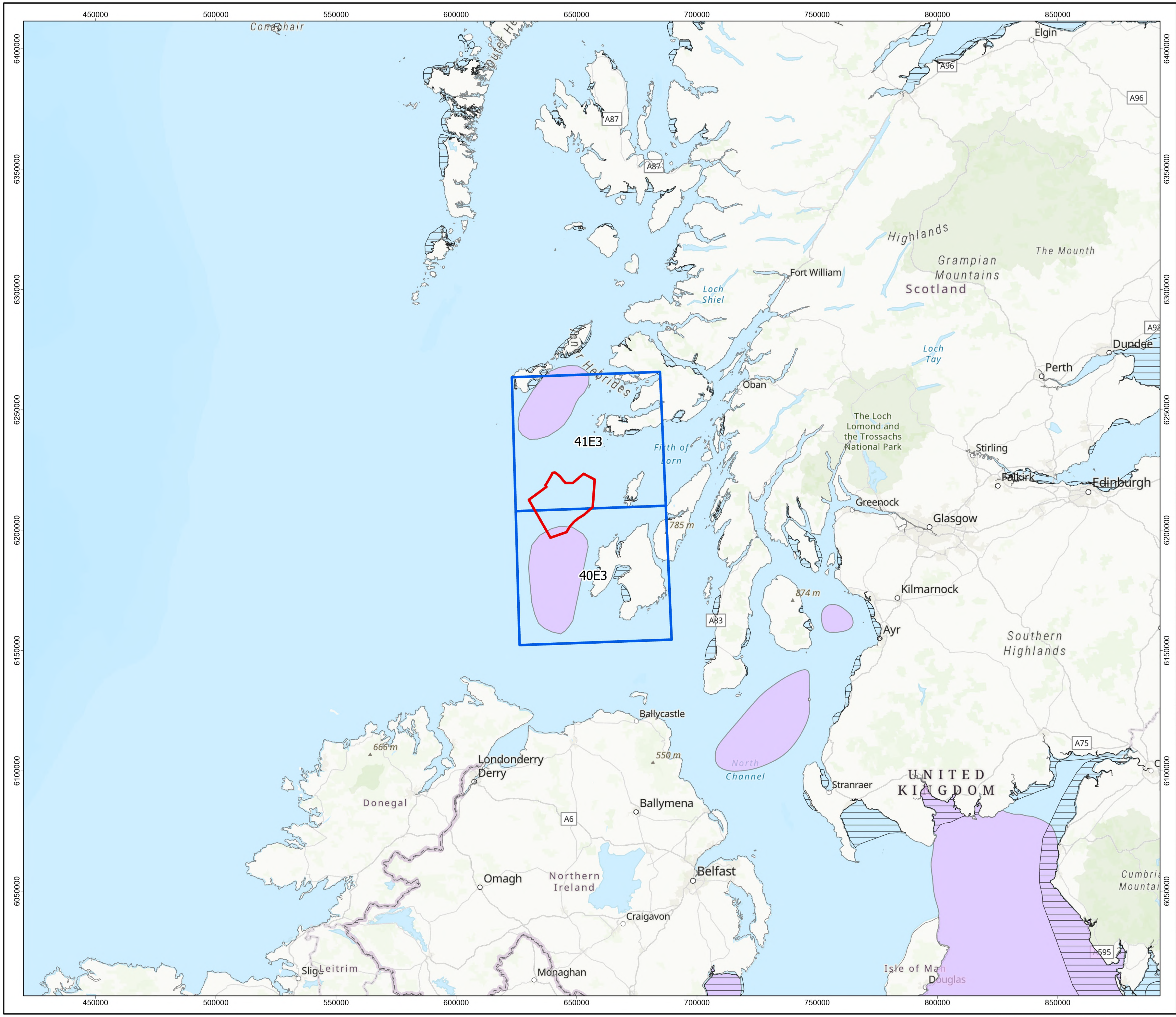


- Windfarm Development Area
- Local Study Area
- Spawning Grounds *(Coul et at, 1998)*
- Nursery Grounds *(Coul et al, 1998)*

N

0 10 20 40 60 Kilometres


| 2 | 17/02/2026 | AB | GC | MI | PM |
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**Figure 1.6: Demersal fish species spawning grounds which overlap with the Local Study Area - Plaice**


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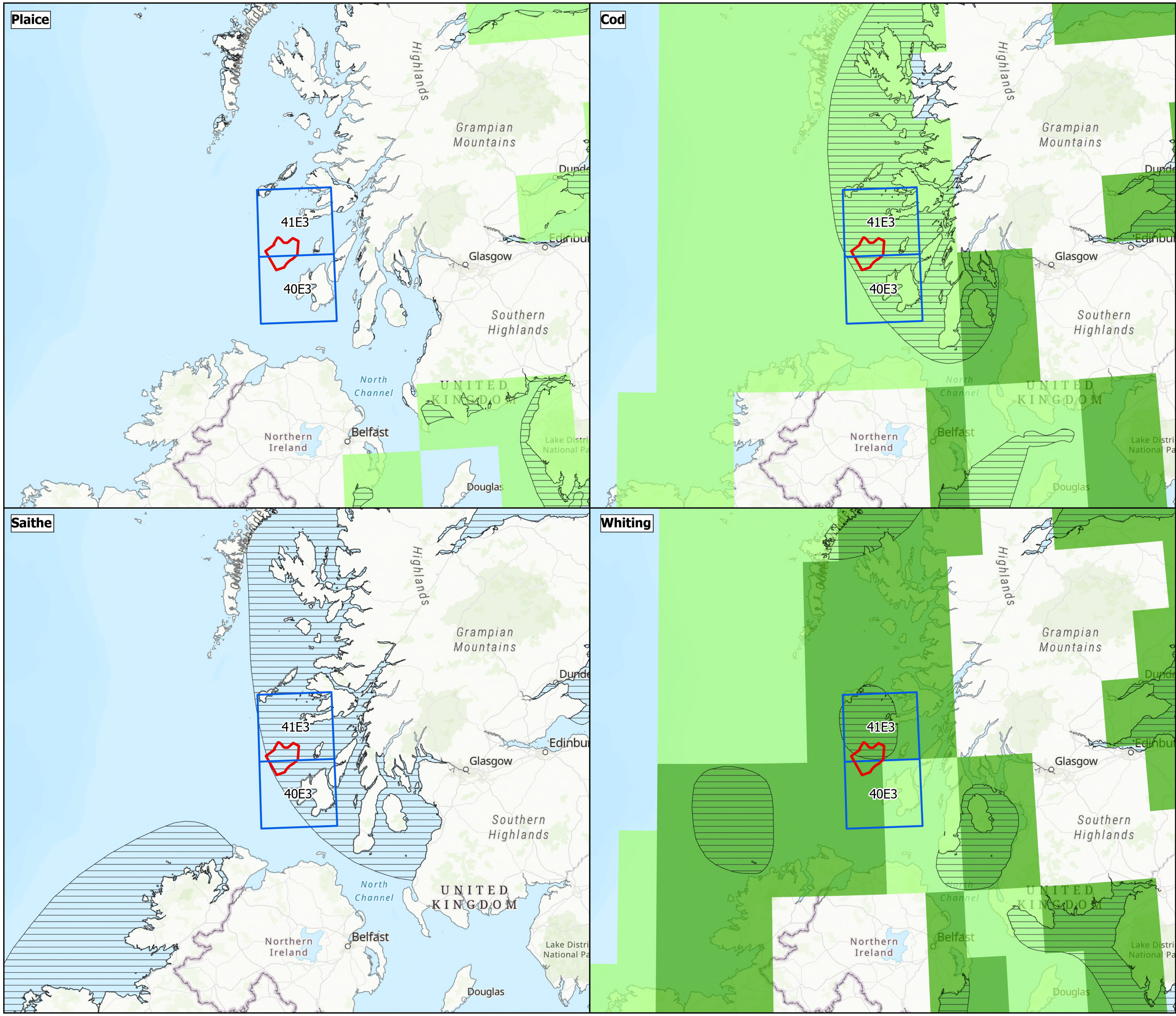



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**Figure 1.7: Demersal fish species nursery grounds which overlap with the Local Study Area - Plaice, Cod, Saithe and Whiting**



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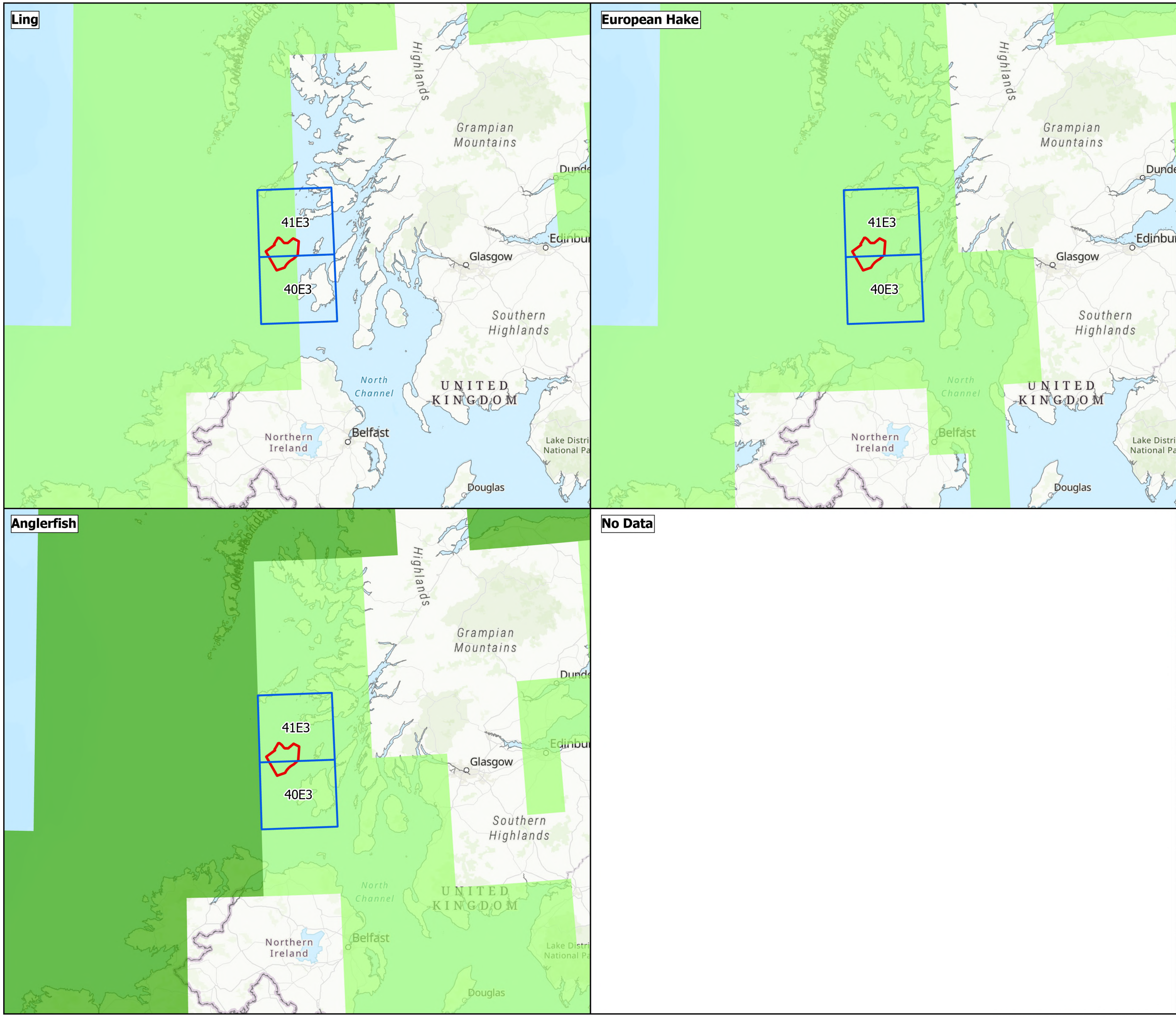



Windfarm Development Area

Local Study Area

**Nursery Grounds *(Ellis et al, 2010)***

**Intensity**

High

Low

0 25 50 100 Kilometres

| | | | | | |
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**Figure 1.8: Demersal fish species nursery grounds which overlap with the Local Study Area - Ling, European hake and Anglerfish**



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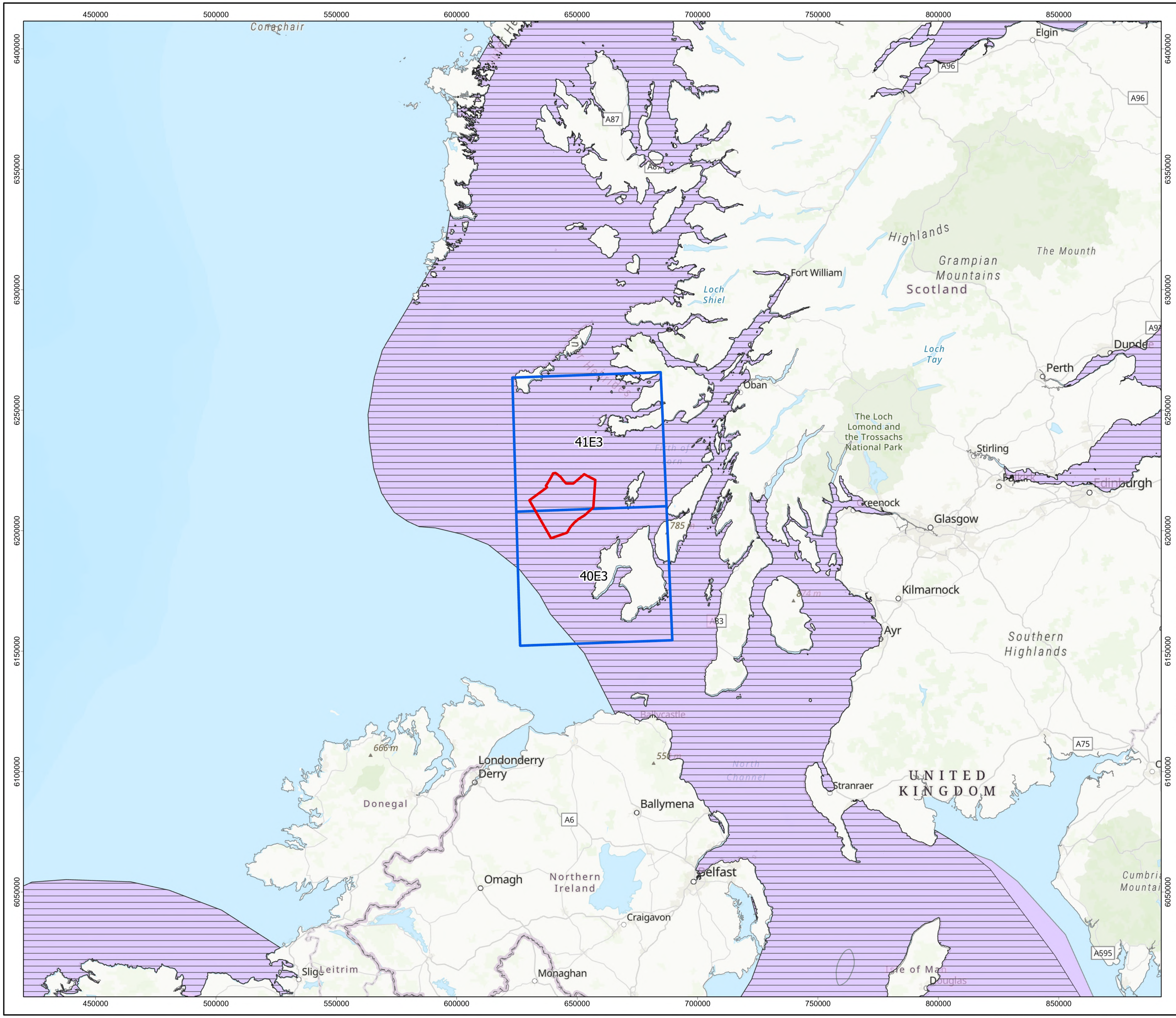


Windfarm Development Area

Local Study Area

Spawning Grounds *(Coul et at, 1998)*

Nursery Grounds *(Coul et al, 1998)*

N

0 10 20 40 60 Kilometres


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**Figure 1.9: Nephrops spawning and nursery grounds which overlap with the Local Study Area**



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**Figure 1.10: Elasmobranch nursery grounds which overlap with the Local Study Area**



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#### *1.4.3.1 Herring*

40. Herring is a commercially important pelagic fish species in the North Atlantic and is listed on the SBL and as a PMF, making it a high-priority species for conservation in Scotland (Fauchald et al., 2011; Casini et al., 2004). The species plays a critical ecological role as a key prey item for numerous fish, marine mammals, and seabirds, supporting wider ecosystem functioning. Herring is also highly vulnerable to anthropogenic pressures due to its specific spawning requirements and sensitivity to UWN.

41. Herring spawn on particular seabed substrates, including coarse sand, gravel, small stones, and rock, where eggs adhere in dense layers (Cefas, 2001). These substrates provide stability and prevent smothering by fine sediments, which is critical for egg survival. Spawning grounds are often located in areas with moderate water movement, ensuring sufficient oxygen supply and removal of waste products. Consequently, habitats dominated by gravelly sand or sandy gravel are considered highly suitable for herring spawning, while finer sediments such as mud or silty sand are generally unsuitable due to the risk of egg burial and reduced oxygen availability. Spawning typically occurs in shallow waters between 15 m and 40 m depth, with females releasing eggs in a single batch once per year. These eggs form extensive carpets that can cover large areas and take approximately three weeks to hatch, depending on water temperature; warmer conditions shorten incubation time (Cefas, 2001). After hatching, larvae drift with prevailing currents, with some retained on the west coast of Scotland while others are transported through the Fair Isle Channel into the North Sea (Barreto and Bailey, 2015). Juveniles develop in coastal nursery areas before migrating offshore to feed until reaching sexual maturity. Evidence from tagging and biological markers suggests that some individuals return to west coast spawning grounds after maturing, indicating complex connectivity between regional stocks (Barreto and Bailey, 2015). Larvae and juveniles feed on fish eggs, copepods, euphausiids, and juvenile sandeels (Last, 1989).

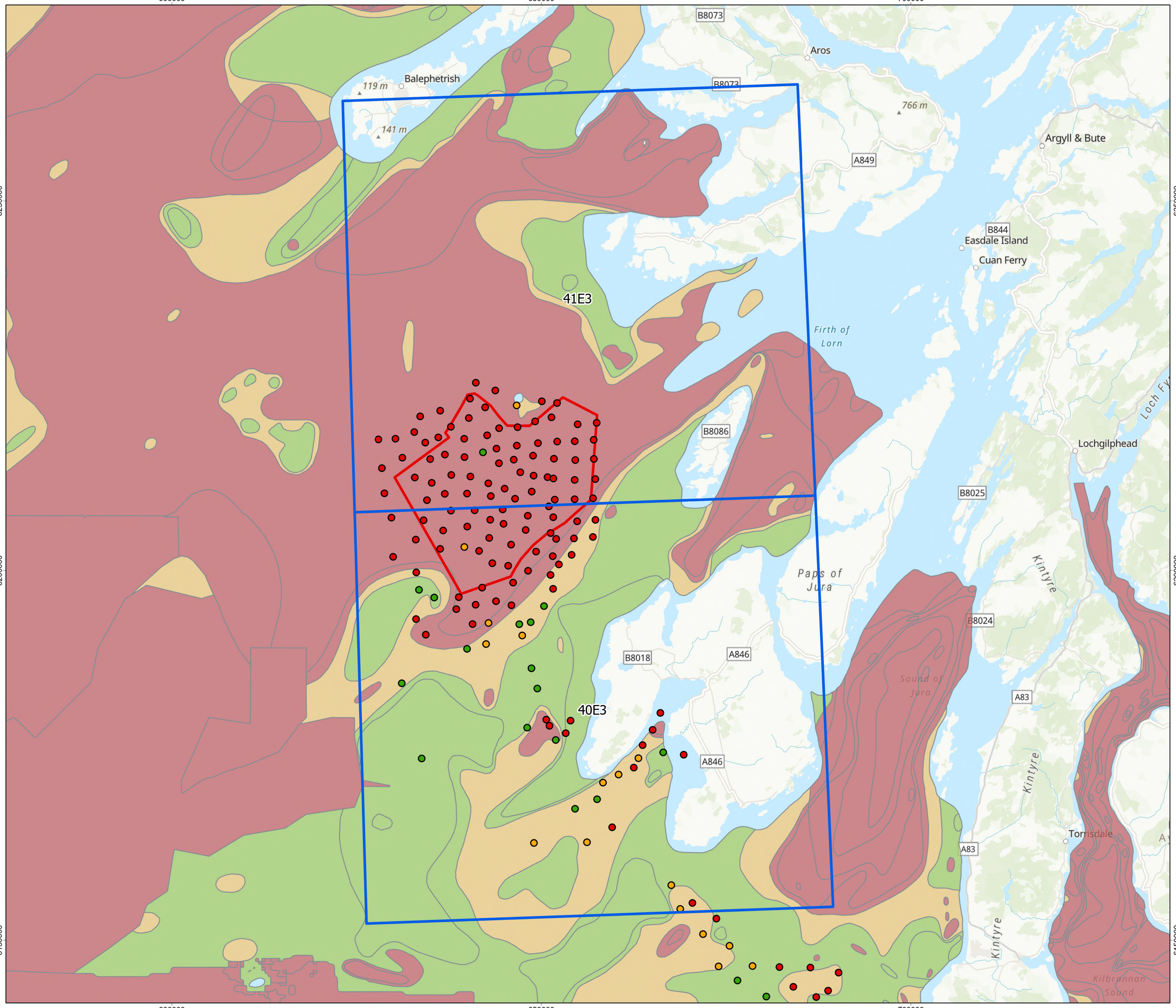
42. The species' reliance on specific substrates for spawning makes it highly vulnerable to seabed disturbance from activities such as dredging, construction, and sediment deposition. Based on site-specific sediment data alongside EMODnet seabed substrate information, **Figure 1.11**, illustrates the distribution of potentially suitable herring spawning habitat within the WDA and demonstrates that it is generally made up of unsuitable habitat for herring, due to a lack of preferred sediment. The Folk (1954) classification system was applied to Particle Size Distribution (PSD) data for the Project. When analysed using this system, only two stations within the WDA classified as 'gravelly Sand', 'sandy Gravel', or 'Gravel', i.e. the substrates that make up preferred herring spawning habitat. Under the Folk system, these coarser fractions are essential because they represent stable, heterogeneous seabed types capable of supporting the adhesive egg layers characteristic of herring reproduction. In contrast, sediments dominated by sand or finer material lack the necessary structure and are typically unsuitable for spawning.

43. Herring is also sensitive to UWN due to a specialised adaptation linking the swim bladder to the inner ear, enabling detection of sound pressure. This makes the species particularly vulnerable to anthropogenic noise sources such as vessel traffic, pile driving, and seismic surveys (Popper et al., 2022).

44. Historically, the West of Scotland herring stock was managed as a predominantly spring-spawning population that spawned inshore along the west coast, with smaller numbers of autumn spawners (Coull, 1986). Today, the stock is managed exclusively as an autumn-spawning population, spawning offshore to the west of the Hebrides (Farrell et al., 2020). The stock collapsed entirely in the 1970s due to overfishing and has remained in decline since, with significant changes in composition over the 20th century (Mackinson et al., 2024; Frost and Diele, 2022 ICES, 2020a). In 2022, ICES

provided a new assessment of autumn-spawning herring and advised that a small catch could be permitted in 2023 for the first time in several years, reflecting cautious optimism about stock recovery (ICES, 2022).

45. Spawning and nursery grounds for herring are shown in **Figure 1.3** and **Figure 1.4** respectively. Nursery grounds are widespread across the North Sea and the west coast of Scotland, with higher-intensity areas occurring in coastal waters where post-larval juveniles feed before migrating offshore (Ellis et al., 2012; ICES, 2006). The species' dependence on specific spawning substrates and its sensitivity to noise underline the importance of protecting suitable habitats and minimizing disturbance during critical life stages.




- Windfarm Development Area
- Local Study Area

**Herring Habitat Preference (Particle Size Analysis Data)**

- Preferrred
- Marginal
- Unsuitable

**Herring Habitat Preference (EMODnet data)**

- Preferred
- Marginal
- Unsuitable

0 5 10 20 Kilometres


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**Figure 1.11: Herring Habitat Assessment**



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#### *1.4.3.2 Sandeel*

46. Sandeels are small, elongate fish that play a critical role in marine ecosystems as a key prey species for seabirds, marine mammals, and commercially important fish. Their ecology is closely linked to sediment type and seasonal behaviour. During the growth season in spring and early summer, sandeels feed in the water column during the day and bury in sand at night. Preferred habitats consist of well-oxygenated sand with a silt and clay fraction of less than 2% (Winslade, 1974; Jensen 2011; Wright et al., 2000; van Deurs et al., 2012). Outside of spring and summer, sandeels rarely leave their refuge in the sand (Høines and Bergstad, 2001).

47. Sandeels are demersal spawners, with eggs forming batches that attach to the seabed. In Scottish waters, spawning occurs between December and February, and larvae remain planktonic for approximately three months before settling onto the seabed. Sandeels exhibit strong associations with particular sediment types and display high site fidelity, making the maintenance of suitable habitat critical. Preferred habitat, based on Folk's (1954) classification, includes Sand, slightly gravelly Sand, and gravelly Sand, with marginal habitat classified as sandy Gravel.

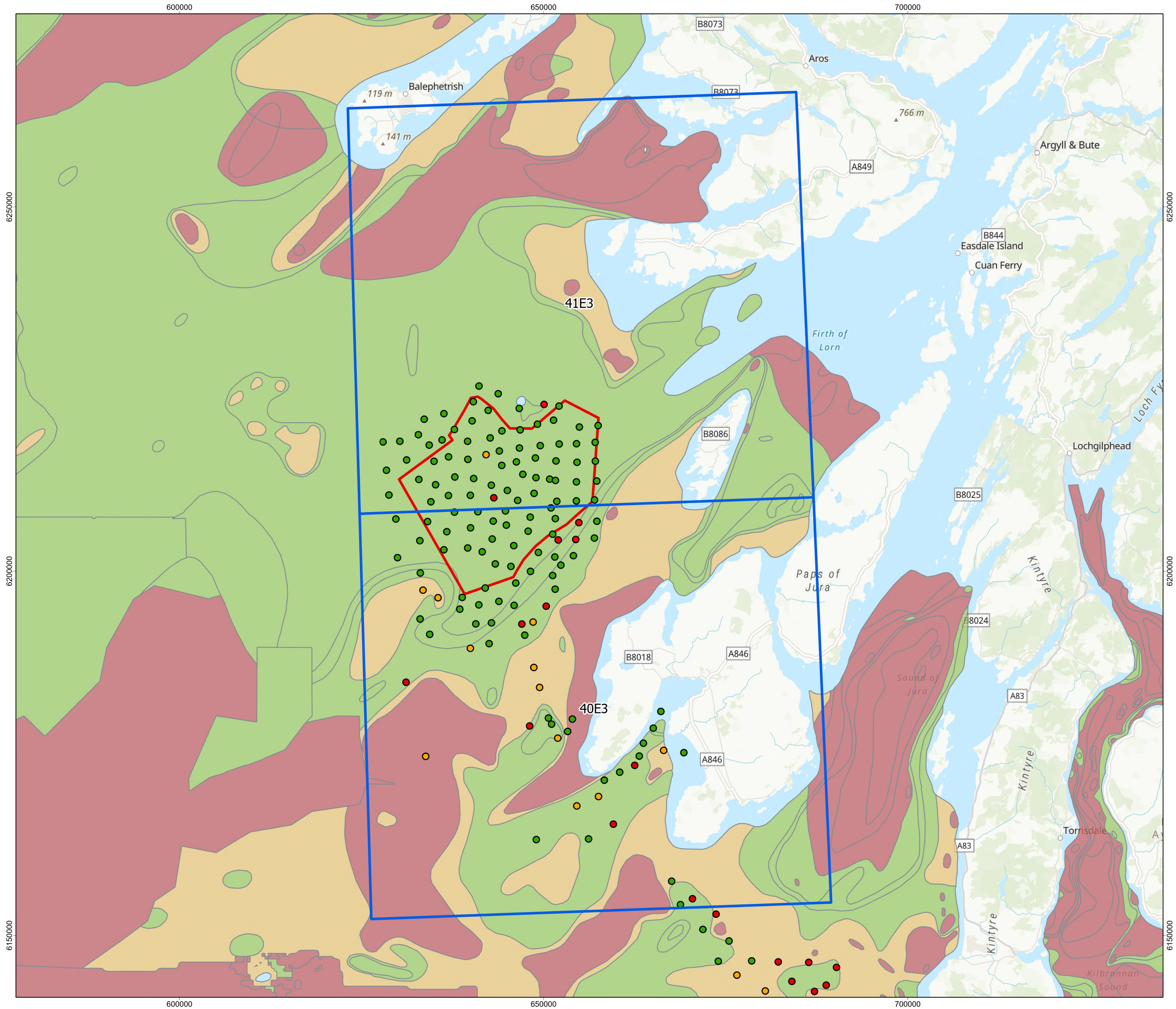
48. A sandeel habitat assessment based on Folk (1954) was undertaken for the Project using third-party data. Of the 76 PSD samples collected within the OAA, 71 were classified as 'Preferred', two as 'Marginal', and three as 'Unsuitable' (**Appendix B of the Scoping Report;**). Similarly, Table 4.3 of **Appendix D of the Scoping Report** indicates that within the OAA, 53 samples were classified as 'Sand', two as 'gravelly Sand', one as 'muddy Sand', one as 'sandy Gravel', and one as 'Gravel'. Based on Folk's classification, 55 stations can be considered 'Preferred' sandeel habitat, one as 'Marginal', and two as 'Unsuitable'.

49. Site-specific data confirms sandeel presence within the Local Study Area. Third-party grab samples recorded Raitt's sandeel at three sites, lesser sandeel (*Ammodytes tobianus*) at 16 sites, smooth sandeel (*Gymnammodytes semisquamatus*) at three sites, and great sandeel (*Hyperoplus lanceolatus*) at one site. Abundance distributions for these species are shown in **Figure 34, Appendix B of the Scoping Report**. Additionally, sandeels were observed at two DDV stations in third-party data and at four stations during the Project's site investigation survey **Appendix D of the Scoping Report**. While photographic data cannot confirm species-level identification, two Raitt's sandeel individuals were recorded in macrofauna samples from stations MCW-C-ST42 and MCW-D-ST101.

50. These findings align with publicly available data sources. **Figure 1.12** indicates that the WDA and surrounding waters are likely to support sandeel populations. Coull et al. (1998) identifies areas north of Mull as sandeel spawning and nursery grounds, while Ellis et al. (2012) identifies ICES rectangles 41E3 and 40E3, which overlap with the WDA and make up the Local Study Area, as low-intensity nursery grounds (**Figure 1.3 - Figure 1.4**).

51. Sandeels typically occupy sloping edges of sandbanks (Wright et al., 1998; Greenstreet et al., 2010). **Appendix D of the Scoping Report** describes ripple, mega ripple, sandwave, and sand dune bedforms within the survey area (W1 OAA). The positions of larger sandwaves and dunes correspond with EMODnet (2022) data, suggesting minimal migration over time. Further characterisation of sandeel within the WDA would require intrusive seabed dredge surveys. However, such surveys are considered of limited value for baseline characterisation given that sandeel presence has already been confirmed through grab and video sampling. Abundance estimates from dredge surveys would be subject to inter-annual variability and patchy distribution, and surveying the entire WDA would not be practical for environmental or financial reasons.

52. In summary, site-specific and third-party data confirm the presence of suitable habitat and multiple sandeel species within the Local Study Area, supported by sediment analysis and national datasets. Given their strong habitat associations and site fidelity, maintaining these conditions is critical for sustaining local populations. While further intrusive surveys could provide abundance estimates, existing evidence demonstrates that sandeels are present and that the Local Study Area offers preferred habitat.




- Windfarm Development Area
- Local Study Area

**Sandeel Habitat Preference (Particle Size Analysis Data)**

- Preferred
- Marginal
- Unsuitable

**Sandeel Habitat Preference (EMODnet data)**

- Preferred
- Marginal
- Unsuitable

N

0 5 10 20 Kilometres


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**Figure 1.12: Sandeel Habitat Assessment**



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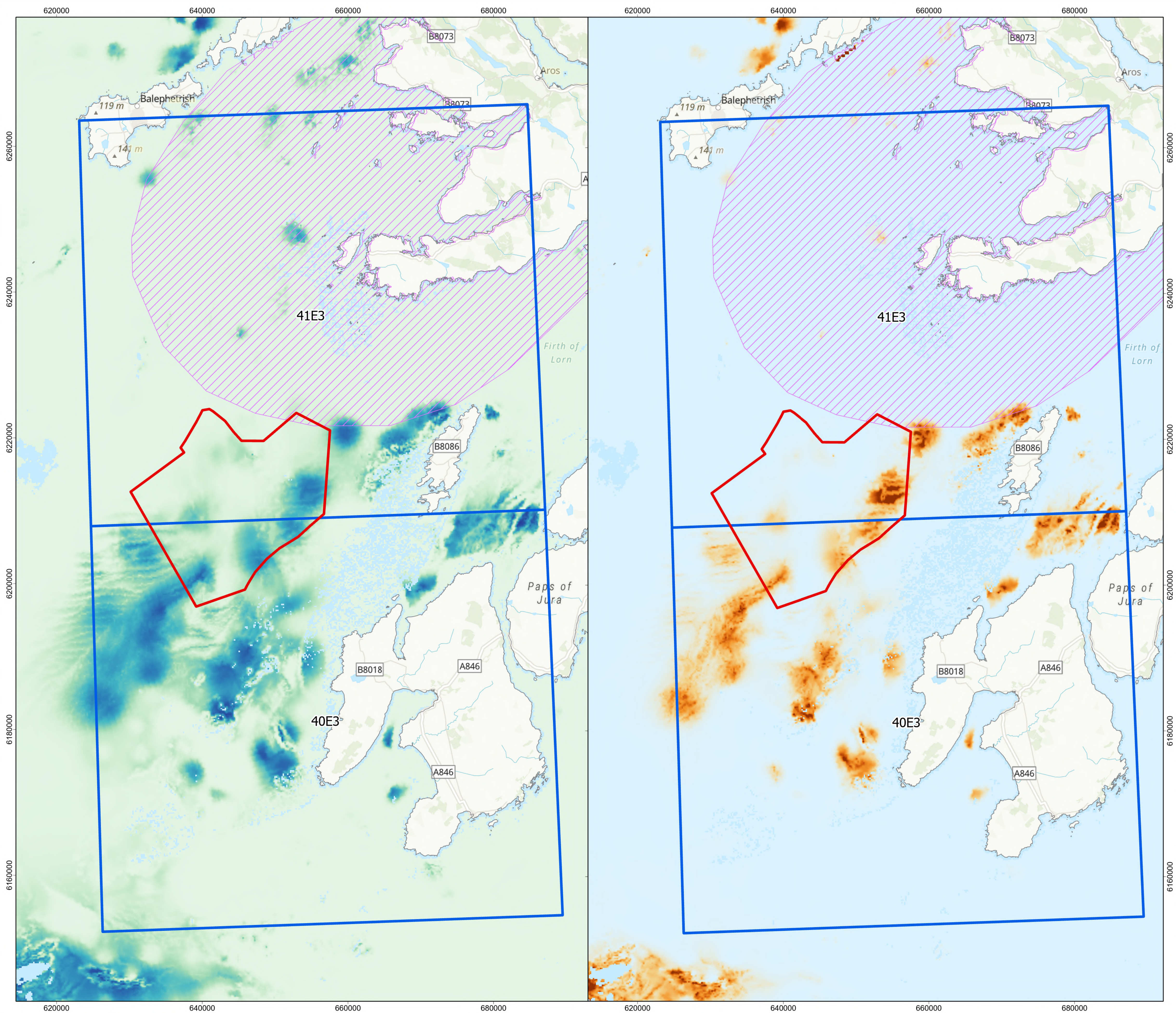


Windfarm Development Area
Local Study Area
Spawning Grounds *(Coul et al, 1998)*

**Lesser Sandeel (Ammodytes marinus) – Celtic Seas - Probability of presence of buried sandeel**

0 (Less Probable)
0.25
0.5
0.75
1 (More Probable)

**Lesser Sandeel (Ammodytes marinus) - Celtic Seas - Predicted density of buried sandeels (number per m²)**

0 per sq m
30 per sq m
60 per sq m
90 per sq m
120 per sq m or greater

0 5 10 20 Kilometres


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**Figure 1.13: Marine Directorate NMPi model outputs showing predicted probability of presence of sandeel (left) and predicted density of buried sandeels (number per m²) (right) around Islay. Pink hatch is Coull et al. (1998) sandeel spawning and nursery ground in relation to the Local Study Area**



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### 1.4.4 Basking Shark

53. Basking shark is listed as 'Endangered' on the IUCN Red List and is an OSPAR threatened or declining species having undergone widespread historic exploitation in the northeast Atlantic (Witt et al., 2012). Basking sharks are also formally recognised as PMFs in Scottish waters. The species is highly migratory and inhabits a very wide geographical area with seasonal aggregations of basking shark often occurring in the temperate continental shelf waters of the Atlantic, Pacific and Indian Oceans for feeding and presumed reproduction purposes (Witt et al, 2016). Basking shark is the world's second largest fish and one of three species of shark known to filter seawater for food. It has a unique feeding strategy which strongly influences its ecology and life history (Sims, 2008).

#### *1.4.4.1 Distribution Information and Sightings Data*

54. Within UK waters, there is a marked seasonality in basking shark sightings, with peak sightings between May and September (Pikesley et al., 2024). The vast majority of surface sightings occur in western Scotland (including the Sea of the Hebrides NCMPA), the Isle of Man and southwest England (Witt et al., 2012). **Plate 1.5** (Pikesley et al., 2024) shows basking shark density estimates for the UK based on public sightings data from 2014-2020. A density estimate of 0-0.01 basking shark / $km^2$ is estimated for the area which overlaps the WDA.

55. In the west coast of Scotland, areas to the west of Coll, north of Tiree and Hyskeir are known to be seasonal hotspots for basking shark with peak occurrence from July to the end of September (Speedie et al., 2009, Witt et al., 2016). In December 2020, the Sea of the Hebrides NCMPA (approximately 4.4 km north of the WDA) came into force with the conservation objective to conserve the favourable condition of the basking shark feature (NatureScot, 2020a) (see **Section 1.4.5** for more details on this MPA).

56. In the summer months, basking sharks spend a greater proportion of time in coastal areas and at the sea surface where they feed on the correspondingly high abundances of zooplankton. During the summer period in the Study Areas, they are associated with shallow waters overlaying rock and reef seabed substratum with low to moderate tidal speeds (Witt et al., 2016). Basking sharks appear to move to deeper waters in autumn (with gathered data suggesting basking sharks likely depart coastal waters of Scotland in October and November). Basking sharks disperse either into the north-east Atlantic Ocean or through the Irish Sea into the Celtic Sea and Bay of Biscay. Varying overall patterns of dispersal have been observed i.e. with some moving to the west of Ireland, the Bay of Biscay, Iberian Peninsula and North Africa (Witt et al., 2016) with at least some individuals returning each year. Some sharks however remain relatively close to Scotland throughout the winter (Witt et al., 2016) although there is little evidence to show significant northerly migration, despite basking sharks being present in Norway (Compagno 2001).

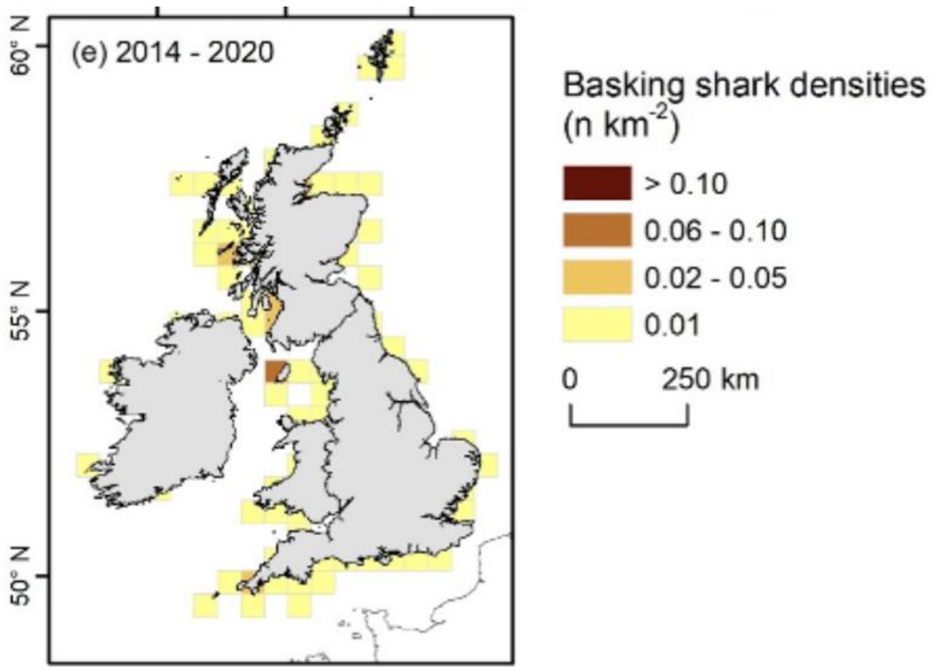



*Plate 1.5 Basking Shark Density Estimates Based on Public Sightings Data From the Marine Conservation Society and the Shark Trust for 2014-2020*

57. Summer movements of basking shark described in Witt et al. (2016) indicate potential movement patterns through the WDA on transit to favoured grounds around Coll and Tiree within the Sea of the Hebrides MPA.

58. Recent HWDT visual survey data (2018-2024) (**Appendix 10.3 Analysis of Hebridean Whale & Dolphin Trust Visual and Passive Acoustic Survey Data**) indicates that basking shark presence in Scottish west coast waters remains highly seasonal, with sightings concentrated between May and September and peaking in July and August. While the Sea of the Hebrides continues to be a key aggregation area, detections within a 30 km buffer zone around the WDA were rare. This data highlighted a reduction in sightings, with only one positive observation recorded in 2023, which is in line with the site-specific survey data undertaken for the Project (**Section 1.4.4.2**). It should be noted that since basking sharks do not need to surface for respiration, visual detection is likely negatively biased, and their actual presence may be greater than recorded.

#### *1.4.4.2 Site-Specific Survey Data*

59. Thirty months of DAS have been undertaken for the Project. Although these surveys were primarily designed to inform marine mammal and offshore ornithology assessments basking sharks were also recorded. Only very small numbers were observed: two individuals in April 2021, a single additional record in November 2021, one in April 2022, and four in April 2023. Third-party survey data (see **Table 1.2** in **Section 1.3.3**), gathered over a 16 month period recorded seven basking sharks in May 2021. No basking sharks were sighted during the Project's geophysical surveys in 2023 (August – November) and 2025 (April – June).

60. The DAS results therefore indicate that the WDA is not likely to be an area where a large number of basking sharks are present and it can be expected that if any feeding or courtship behaviour occurs, it is at low levels. Concentrations of the species occur further to the north in the Sea of the Hebrides NCMPA with small numbers of basking shark likely to transit through the WDA whilst transiting to favoured grounds in the MPA.

61. Whilst the DAS data indicates low abundances of basking shark within the WDA, caution must be applied when interpreting this data because basking sharks may not have been visible within surface waters to enable them to be recorded. DAS data is effective to characterise marine mammal abundances because they need to surface regularly to breathe. Basking shark however have no need to do so. The amount of time basking sharks spend at the surface will have a direct effect on the probability of sightings made by DAS. Research (Witt et al. 2016 and Doherty et al. 2019) indicates that the time spent at the surface by basking sharks depends largely on the minimum abundance of prey in the surface layer, time of year / season and the time of day.

62. Basking sharks exhibit seasonality in vertical space use, revealing repeated 'yo-yo' movement behaviour with periods of occupancy at depths greater than 1,000 m in late winter/early spring (Witt et al., 2016; Doherty et al., 2019). This behaviour is relatively ubiquitous, is common in a wide range of shark species and is generally attributed to foraging. It is also possible that this behaviour may be linked to thermoregulation or in aiding energy conservation (Klimley et al., 2002). Gathered depth data, including from within the Study Areas, indicates that basking sharks predominantly occupy the epipelagic zone (i.e. just below the surface to up to 100m deep), but have the capacity to undertake extensive vertical movements over short periods of time (days) (Witt et al, 2016).

63. Diel vertical migration (DVM), the process of vertical daily migration, has been observed in planktivorous megamouth shark, whale sharks, and basking sharks. Migration may be towards the surface during the nighttime (DVM), or towards the surface during the daytime (reverse DVM) and both patterns have been observed in basking sharks (Shepard et al., 2006). This flexibility in migration strategy allows basking sharks to take advantage of the varying conditions in their environment. Depth use data collected in the Witt et al. (2016) study suggest that basking sharks, when within areas of the Sea of the Hebrides NCMPA, exhibit both DVM and reverse DVM behaviour, most likely adopting a strategy appropriate to the water column they encounter which would also be the case for any basking shark present within or transiting through the WDA. Furthermore, according to Sims et al. (2005) these changes in depth use behaviour are likely to occur as the sharks move from shallow areas of frontal activity to deeper, more stratified, waters.

64. The WDA is approximately 12.4 km from shore at its closest point (Colonsay). Water depths in the WDA range from 21.6 to 81.7 m. Given the timing of migrations through the WDA and correspondingly higher concentrations of phytoplankton in surface waters, it is more likely that basking sharks would be within surface waters and would therefore have been identified by the DAS. This supports the conclusion that basking shark abundance within the WDA is low with recorded individuals likely transiting towards or away from their preferred grounds to the north. However, it should be noted that the absence of sightings of basking sharks at the surface does not guarantee the absence of sharks from the area.

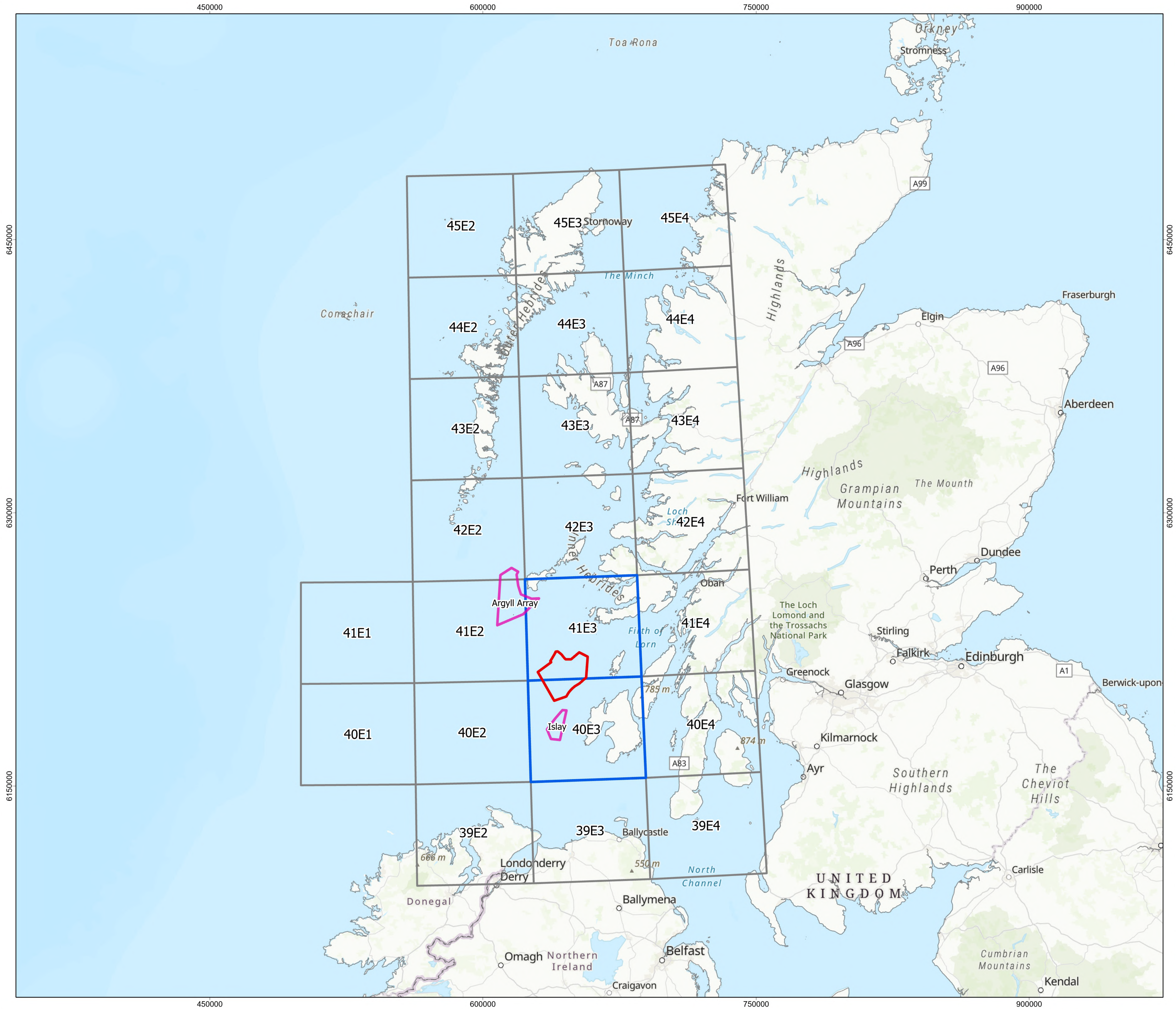
#### *1.4.4.3 Argyll Array and Islay Offshore Windfarm Surveys*

65. The Argyll Array Offshore Wind Farm, proposed off the west coast of Tiree and later cancelled was located approximately 27 km north of the WDA. They collected 27 months of boat-based survey data between September 2009 and August 2012 (**Figure 1.14**).

66. The survey recorded 1,844 basking sharks in total, including a peak of 950 individuals in August 2012 (Booth et al., 2013). The survey observations suggest that the area may remain an important seasonal habitat, with individuals transiting to and from the area. The survey data shows that large numbers of basking sharks were recorded in the Coll and Tiree area during the survey period. However, limitations in the methodology means the results cannot be used to infer consistently higher

numbers or population density. As the data was collected via boat-based surveys, there is the possibility that multiple counts of the same shark(s) were recorded within the dataset.

67. Another cancelled offshore windfarm project, Islay Offshore Windfarm, which directly overlaps with the WDA, as shown in **Figure 1.14**, did not record any basking sharks during a 24-month boat-based survey campaign between December 2009 and November 2010 and between October 2011 and September 2012. Only one individual was recorded in an ‘off-effort’ sighting which suggests that the waters around Islay are not likely to be of particular importance to the species relative to areas further north (AMEC, 2013).




- Windfarm Development Area
- Regional Study Area
- Local Study Area
- Withdrawn Windfarm Development Areas

N

0 25 50 Kilometres


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**Figure 1.14: Argyll Array and Islay Offshore Windfarm in relation to the Fish and Shellfish Regional Study Area**



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### 1.4.5 Designated Sites

68. The WDA does not intersect with any designated sites for fish or shellfish features but is about 4.4 km from the Sea of the Hebrides NCMPA at its closest point. Several UK riverine SACs are designated for diadromous fish species (**Section 1.4.2**), which undertake extensive marine migrations; therefore, sites within the Regional Study Area are considered. Additionally, sites where individuals from these populations may pass near the WDA during their lifecycle are included. MPAs designated for non-migratory fish and shellfish features are assessed if located within 88 km of the WDA to account for the worst-case UWN impacts (**Appendix 10.1 Underwater Noise Technical Report)**. These sites aim to protect species from development and other activities that could compromise their conservation objectives.

69. There is no direct overlap between designated sites and the WDA, and therefore no pathway for direct habitat impacts within site boundaries. For potential long-range effects such as UWN, the designated sites listed in **Table 1.6** fall within the Project's Fish and Shellfish Zone of Influence (ZoI), i.e. 88 km. Consequently, aside from these listed sites and their qualifying features, the EIA focusses on potential effects on qualifying fish species occurring outside designated sites.

70. **Table 1.6** provides details of designated sites relevant to fish and shellfish ecology in relation to the WDA.

*Table 1.6 Designated sites for Fish and Shellfish ecology features within the Fish and Shellfish ZoI (88 km)*

| Designated Site | Protected fish and shellfish ecology feature(s) | Closest approximate distance from the WDA (km) |
|---|---|---|
| **SACs** | | |
| Loch Creran SAC | Horse mussel *(Modiolus modiolus)* beds | 80.3 |
| **MPAs and NCMPAs** | | |
| Sea of the Hebrides NCMPA | Basking shark | 4.4 |
| Loch Sunart to the Sound of Jura NCMPA | Flapper skate | 44.9 |
| Loch Sween NCMPA | Native oyster *(Ostrea edulis)* | 47.9 |
| Loch Sunart NCMPA | Flame shell *(Limaria hians)* beds<br>Northern feather star aggregations (*Leptometra celtica*) on mixed substrata<br>Serpulid aggregations | 69.7 |
| Upper Loch Fyne and Loch Goil NCMPA | Flame shell beds<br>Horse mussel beds<br>Ocean quahog aggregations | 68.2 |
| Small Isles NCMPA | Fan mussel *(Atrina fragilis)* aggregations | 79.8 |
| Loch Creran NCMPA | Flame shell beds | 80.2 |

#### *1.4.5.1 Loch Creran SAC*

71. Loch Creran, located at the northern end of the Firth of Lorn on Scotland's west coast, is designated as a SAC under the Habitats Directive for its unique biogenic and bedrock reef habitats (Scottish Government, 2020b; JNCC, 2023). The site is internationally significant for its biogenic reefs formed by the horse mussel, which occur in the upper basin of the loch at depths of approximately 13 - 25 m (Argyll Marine SAC, 2023).

72. Horse mussel beds are relatively common along parts of the Scottish west coast but are rare in a European context, making Loch Creran an important conservation site (Loch Creran Management Plan, 2023). These reefs are created as mussels anchor themselves to stones and shells using strong byssal threads, forming dense aggregations that trap sediment and provide a stable platform for a diverse assemblage of marine life. Associated species include sponges, ascidians, bryozoans, sea squirts, and red algae, which colonize the hard substratum, while predators such as starfish and whelks feed on the mussels (Argyll Marine SAC, 2023). The structural complexity of horse mussel beds enhances biodiversity and supports ecosystem functioning by offering shelter and feeding grounds for numerous invertebrates and fish species.

73. Horse mussel reefs are highly sensitive to physical disturbance, particularly from activities such as dredging, anchoring, and mooring placement, which can damage the fragile structure and associated communities (Scottish Government, 2020b). Conservation objectives for Loch Creran SAC aim to maintain these habitats in favourable condition, ensuring their ecological integrity and resilience within the wider network of protected areas (Loch Creran Management Plan, 2023).

#### *1.4.5.2 Sea of the Hebrides NCMPA*

74. The Sea of the Hebrides NCMPA, designated in 2020 under the Marine (Scotland) Act 2010, covers approximately 10,039 km² off Scotland's west coast and plays a critical role in conserving biodiversity and geodiversity features (Scottish Government, 2020).

75. The area provides critical seasonal habitat for basking sharks, which aggregate here during summer months to feed on dense plankton blooms associated with oceanographic fronts and tidal mixing zones (NatureScot, 2025). These conditions create highly productive feeding grounds that support large numbers of sharks, making the NCMPA essential for maintaining population resilience. Basking sharks are listed as Endangered on the IUCN Red List and are protected under the Wildlife and Countryside Act 1981 and the Marine Strategy Framework Directive due to their vulnerability to anthropogenic pressures such as vessel strikes, entanglement, and disturbance from marine activities (IUCNb, 2023; Scottish Government, 2020). In addition to these protections, basking sharks are formally recognised as Priority Marine Features (PMFs) in Scottish waters, reflecting their conservation importance and the need for targeted management to address threats and support population recovery. The NCMPA's conservation objectives aim to maintain these habitats in favourable condition, ensuring the long-term survival of basking sharks and associated species while contributing to the wider Scottish MPA network (NatureScot, 2025a).

#### *1.4.5.3 Loch Sunart to the Sound of Jura NCMPA*

76. The Loch Sunart to the Sound of Jura NCMPA encompasses approximately 741 km² off Scotland's west coast. It includes the waters of Loch Sunart, Sound of Mull, Firth of Lorn, and Sound of Jura. This protected area was established specifically to conserve the Critically Endangered flapper skate, along with geodiversity features tied to deep glacial channels and shallow reef habitats (NatureScot, 2025b).

77. This area serves as a critical habitat and seasonal refuge for flapper skate, which exhibit strong site fidelity and residency patterns, as confirmed by acoustic tagging and archival studies (Neat et al., 2014). Given the species' slow growth, late maturity, and low fecundity, these protections are vital for population recovery and resilience. The MPA contributes to the wider Scottish MPA network, ensuring long-term survival of flapper skate and associated species (NatureScot, 2025b).

#### *1.4.5.4 Loch Sween NCMPA*

78. Loch Sween NCMPA, designated under the Marine (Scotland) Act 2010, is located on Scotland's west coast and covers approximately 45 km² of sheltered fjordic habitat. Loch Sween is ecologically significant for its role in supporting species such as native oysters, which are considered functionally extinct across much of their historic range but persist in small, fragmented populations within the loch (NatureScot, 2024; Scotlink, 2024). Native oysters act as ecosystem engineers, stabilizing sediments and improving water quality through filtration, while providing nursery habitat for juvenile fish and crustaceans.

79. The conservation objectives for Loch Sween NCMPA aim to maintain these habitats in favourable condition by minimizing physical disturbance and preventing activities that could damage fragile biogenic structures. Pressures include historic overexploitation, illegal shellfish gathering, disease outbreaks (e.g., *Bonamia ostreae*), and sedimentation, all of which threaten the integrity of these habitats (NatureScot, 2024). Management measures include restrictions on mobile demersal fishing gear and anchoring in sensitive areas, alongside restoration initiatives to enhance native oyster populations and improve habitat resilience (Scottish Government, 2024a). The NCMPA plays a key role in Scotland's MPA network by safeguarding rare and vulnerable habitats that underpin biodiversity and ecosystem functioning.

#### *1.4.5.5 Loch Sunart NCMPA*

80. Loch Sunart NCMPA on Scotland's west coast protects a suite of rare biogenic habitats that underpin high biodiversity. Among its most significant features are flame shell beds formed by *Limaria hians*, which create dense byssus-bound reefs stabilising sediments and providing habitat for hydroids, crustaceans, echinoderms, and algae (Tyler-Walters et al., 2004).

81. The loch also supports northern feather star aggregations on mixed substrata, where these suspension-feeding crinoids spread their arms in strong currents, forming dense carpets that enhance structural complexity and biodiversity (MarLIN, 2023; Moore, 2013). Additionally, serpulid aggregations of the tube worm *Serpula vermicularis* occur in sheltered arms such as Loch Teacuis, forming calcareous reefs that provide hard substrate for sponges, ascidians, and seaweeds, while offering refuge for crustaceans and fish (NatureScot, 2020b; Perry et al., 2020).

82. These habitats are highly sensitive to physical disturbance from dredging and anchoring, making their protection critical for Scotland's marine ecosystem resilience (European Commission, 2013; Moore et al., 2006).

#### *1.4.5.6 Upper Loch Fyne and Loch Goil NCMPA*

83. Upper Loch Fyne and Loch Goil NCMPA protects several important seabed habitats. One is the flame shell bed. The site also contains horse mussel beds, where large mussels form clumps or reefs on the seabed. These beds support sponges, sea squirts, and other invertebrates, and act as nursery grounds for fish (MarLIN, 2023; Moore, 2014).

84. In deeper muddy areas, ocean quahog aggregations occur and can live for centuries, helping maintain healthy sediment ecosystems (NatureScot, 2025; Moore, 2014). All these habitats are

sensitive to damage from dredging and trawling, so strong protection measures are needed to keep them healthy (Scottish Government, 2014).

#### *1.4.5.7 Small Isles NCMPA*

85. Small Isles NCMPA, located around Canna and Rum on Scotland's west coast, is home to the only known large aggregation of fan mussels in UK waters. Fan mussels are among Britain's largest and rarest bivalves, growing up to 48 cm long. They live partly buried in muddy sand or gravel, anchored by fine threads, with the upper shell exposed to filter food from the water (MarLIN, 2023; NatureScot, 2025).

86. These mussels often occur singly but in the Sound of Canna they form a dense bed covering nearly 4 km², making this site nationally important (Moore & Roberts, 2011; Scotlink, 2025). Fan mussels are very fragile and slow-growing, with lifespans of decades, so they are highly vulnerable to damage from bottom-towed fishing gear and sediment disturbance. Protecting this habitat is critical because recovery from damage can take many years (MMO, 2023; Scottish Government, 2024b).

#### *1.4.5.8 Loch Creran NCMPA*

87. Loch Creran NCMPA, located north of Oban, is one of Scotland's most important sites for rare biogenic habitats. Among its key features are flame shell beds. Flame shell beds in Loch Creran occur mainly in areas of strong tidal flow, such as the Eriska and Creagan Narrows, where they form vibrant, species-rich communities (Scotlink, 2025). These habitats are highly sensitive to physical disturbance from dredging and anchoring, making their protection essential for maintaining biodiversity (Marine Habitat Group, 2015; Scottish Government, 2013).

## 1.5 PREDICTED FUTURE BASELINE

88. Over time, natural processes and human activities are expected to gradually alter fish and shellfish communities within the marine environment. Consequently, some divergence from the current baseline conditions, as outlined in **Section 1.4**, is anticipated. This section evaluates the likely future baseline scenario, assuming the WDA is not developed.

89. Climate change is a major driver of changes in the distribution and abundance of fish and shellfish, primarily due to rising sea temperatures, ocean acidification, and shifts in salinity, oxygen levels, and primary productivity. Species respond differently to these pressures, with some experiencing changes in range, spawning and migration behaviours, and recruitment success (Perry et al., 2005; Pörtner et al., 2021). Shellfish species, including commercially valuable stocks such as Nephrops and king scallops, may also be affected, with growth, survival, and reproductive success influenced by changing oceanographic conditions (Capet et al., 2020).

90. Climate-induced changes in food availability and trophic interactions may further impact these communities. For instance, data from the Continuous Plankton Recorder has recorded changes in the planktonic communities in the North Atlantic Ocean such as shifts in the timing and distribution of plankton (Edwards et al., 2020). Such changes can result in mismatches between fish larvae and their prey, potentially reducing recruitment success for species dependent on seasonal food sources. Ocean acidification presents an additional challenge, particularly for shell-forming species like king scallops, as increased acidity can weaken shells, lower survival rates, and destabilise populations (Gazeau et al., 2013).

91. Alongside these climate-related pressures, other human activities such as fishing, pollution, and habitat alteration, may also influence fish and shellfish populations. Although the future scale of these impacts within the Study Areas is uncertain, activities like bottom trawling and seabed disturbance

could affect local populations through direct mortality, habitat degradation, or changes in community structure (Hiddink et al., 2017). Future shifts in fishing practices may also alter population dynamics, especially for commercially targeted species.

92. Overall, climate change is expected to drive significant changes in fish and shellfish populations along the whole west coast of Scotland, particularly in terms of species distribution, recruitment, and food web interactions. However, accurately predicting these changes is challenging due to the complex interplay of environmental and anthropogenic factors. While substrate type, a key factor in habitat suitability for demersal and benthic species, is unlikely to change substantially, broader ecological communities are likely to undergo gradual but noticeable shifts in the coming decades.

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