Morven South Offshore Wind Array Project

Environmental Impact Assessment Report

Volume 3, Annex 9.1: Fish and Shellfish Ecology Shared Technical Report

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1 Introduction

1.1.1.1 The Morven North Offshore Wind Array Project (hereafter "Morven North") and the Morven South Offshore Wind Array Project (hereafter "Morven South") are both located within the Morven Option Lease Agreement Site (hereafter "Morven Site") in Scottish offshore waters (Figure 1.1). Morven North is located approximately 61.2km from the Aberdeenshire coast (at its closest point) and Morven South is located approximately 86.1km from the Aberdeenshire coast (at its closest point). Each project will comprise wind turbines, Offshore Substation Platforms (OSPs), associated foundations, inter-array and interconnector cables and cable protection. Consent for the export cables for Morven North and Morven South will be sought separately.

1.1.1.2 As shown in Figure 1.1, Morven North is situated northwest of Morven South. The external boundaries of the projects correspond with the boundaries of the Morven Site.

1.1.1.3 This Morven North and Morven South Fish and Shellfish Ecology Shared Technical Report (hereafter referred to as the Fish and Shellfish Ecology Shared Technical Report) presents the baseline characterisation of fish and shellfish ecology for both Morven North and Morven South.

1.1.1.4 Consent for Morven North and Morven South will be sought separately, aided by the development of a separate Environmental Impact Assessment (EIA) and Habitats Regulations Assessment (HRA) for each project. However, the survey campaign and/or desk-based studies that support the impact assessments for Morven North and Morven South are based on the Morven Site, which accommodates both Morven North and Morven South. Given the comparability and consistency of information collected to inform the assessments for both projects, the baseline characterisation of fish and shellfish ecology for both Morven North and Morven South is reported in the Fish and Shellfish Ecology Shared Technical Report.

1.1.1.5 The information from this Fish and Shellfish Shared Technical Report provides the technical baseline to inform the assessment of the likely significant effects of Morven North and Morven South on fish and shellfish receptors. This report accompanies the EIA and HRA provided in Volume 2, Chapter 9 Fish and Shellfish Ecology of the EIA and within the Report to Inform Appropriate Assessment (RIAA) for Morven North or Morven South to support the respective consent applications.

1.1.1.6 The aim of this Fish and Shellfish Ecology Shared Technical Report is to:

- summarise the potential for fish and shellfish receptors to be encountered within the Regional Fish and Shellfish Study Area;
- identify known fish and shellfish, particularly those which are Important Ecological Features (IEFs) within the Regional Fish and Shellfish Study Area from available desktop data sources;
- present site specific fish and shellfish data from surveys across the Morven North Boundary and Morven South Boundary and characterise these data, integrating the results with the findings of the desk-based work described above;
- inform the EIA and HRA for fish and shellfish ecology to support the consent applications for Morven North and Morven South.

1.1.1.7 Data on fish and shellfish ecology receptors were collated through a desktop study of existing resources, and from relevant information drawn from site specific surveys. These data provide information on the habitats and species expected to be present within defined Fish and Shellfish Study Areas for both Morven North and Morven South (outlined within Section 2). IEFs were identified based upon conservation status and ecological and commercial importance and included consideration of relevant Priority Marine Features (PMFs).

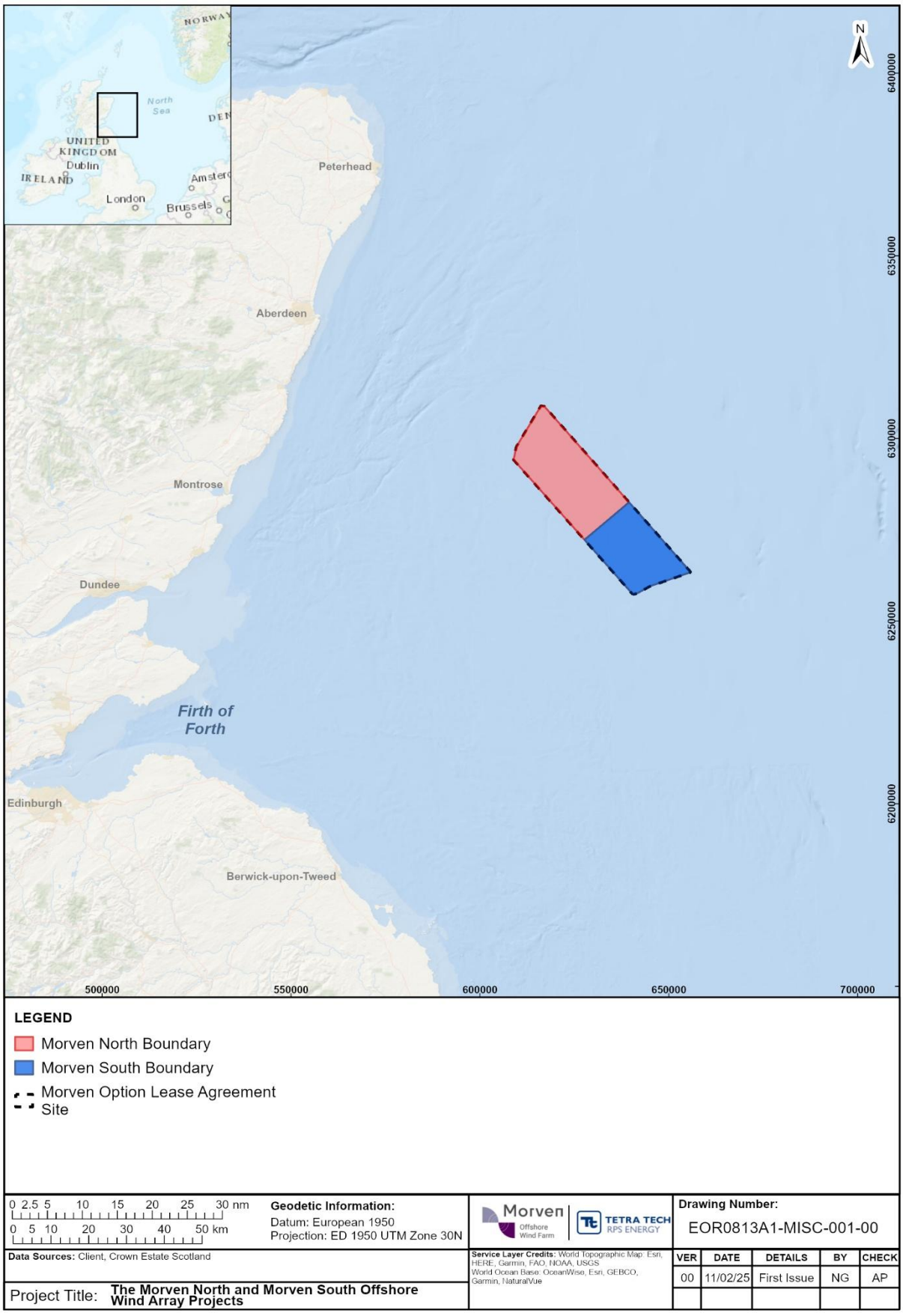

Figure 1.1: The boundaries of the Morven North and the Morven South within the Morven Option Lease Agreement Site

2 Study areas

2.1.1.1 Three study areas are defined for fish and shellfish ecology:

- the Morven North Fish and Shellfish Ecology Study Area;
- the Morven South Fish and Shellfish Ecology Study Area;
- the Regional Fish and Shellfish Ecology Study Area.

2.1.1.2 The study areas defined for fish and shellfish ecology are shown in Figure 2.1 and defined as follows:

- The Morven North Fish and Shellfish Ecology Study Area, which includes the Morven North Boundary plus a buffer extending from 5km to 14km. This buffer encompasses the area surveyed during the site specific benthic survey campaign, which has been used to inform the baseline within and in the immediate vicinity of the Morven North Boundary;
- The Morven South Fish and Shellfish Ecology Study Area, which includes the Morven South Boundary plus a buffer extending from 5km to 14km. This buffer encompasses the area surveyed during the site specific benthic survey campaign, which has been used to inform the baseline within and in the immediate vicinity of the Morven South Boundary;
- The Regional Fish and Shellfish Ecology Study Area is defined by a 100km buffer zone around Morven North and Morven South. This 100km buffer zone was the predominant, defining factor for the Regional Fish and Shellfish Ecology Study Area to encompass any direct and indirect impacts (including underwater sound from piling) and to characterise the fish and shellfish ecology baseline. This buffer zone also encompasses the Forth and Tay Scottish Marine Region (SMR) waters; desk-based data collated within this region has been used to inform coastal receptors such as diadromous fish;

2.1.1.3 In the Scoping Report produced for the Morven Site (MvOWL, 2023), the Regional Fish and Shellfish Ecology Study Area extended to the boundary of the Charting Progress 2 Northern North Sea region. Since Scoping, this Regional Fish and Shellfish Ecology Study Area has been refined, based upon Tetra Tech RPS Energy's expert opinion and experience of consenting in this region, and to align with the ranges modelled for underwater sound effects (i.e. behavioural, injury and mortality; see Volume 3, Annex 10.2: Underwater Sound Shared Technical Report) and the potential for interactions with migratory species. This was supported by NatureScot in a consultation letter dated 27th March 2024.

2.1.1.4 The Regional Fish and Shellfish Ecology Study Area enables the wider context required for the highly mobile fish and shellfish receptors. This includes diadromous fish species along the Scottish coastline, for which Special Area of Conservation (SACs) have been designated. This information has been used to assessments of any impacts affecting fish and shellfish ecology receptors, including both direct and indirect impacts.

2.1.1.5 Whilst the Morven North Fish and Shellfish Ecology Study Area and Morven South Fish and Shellfish Ecology Study Area provide spatial context to site specific surveys undertaken, the highly mobile and migratory life histories of many fish and shellfish species is better captured by the Regional Fish and Shellfish Ecology Study Area. This is therefore used largely throughout the baseline characterisation presented in this chapter and is applicable and relevant to both Morven North and Morven South.

2.1.1.6 The Fish and Shellfish Ecology Study Areas for fish and shellfish ecology for the Morven Site were presented to and agreed during the scoping process for the Morven Site[1]. The underlying principles used to define the Fish and Shellfish Ecology Study Area(s) for Morven North and Morven South have not changed, other than the limits have been applied relative to each project, rather than the Morven

[1] The Regional Fish and Shellfish Ecology Study Area for the Morven Site was presented to the Marine Directorate Licencing Operations Team (MD-LOT) and NatureScot in a letter dated 1 March 2024 and agreed in a return letter from NatureScot dated 27 March 24.

Site. The Fish and Shellfish Ecology Study Areas for Morven North and Morven South for fish and shellfish ecology were presented to the Marine Directorate Licencing Operations Team (MD-LOT) via a “Targeted Consultation Exercise” undertaken in Quarter 1, 2025.

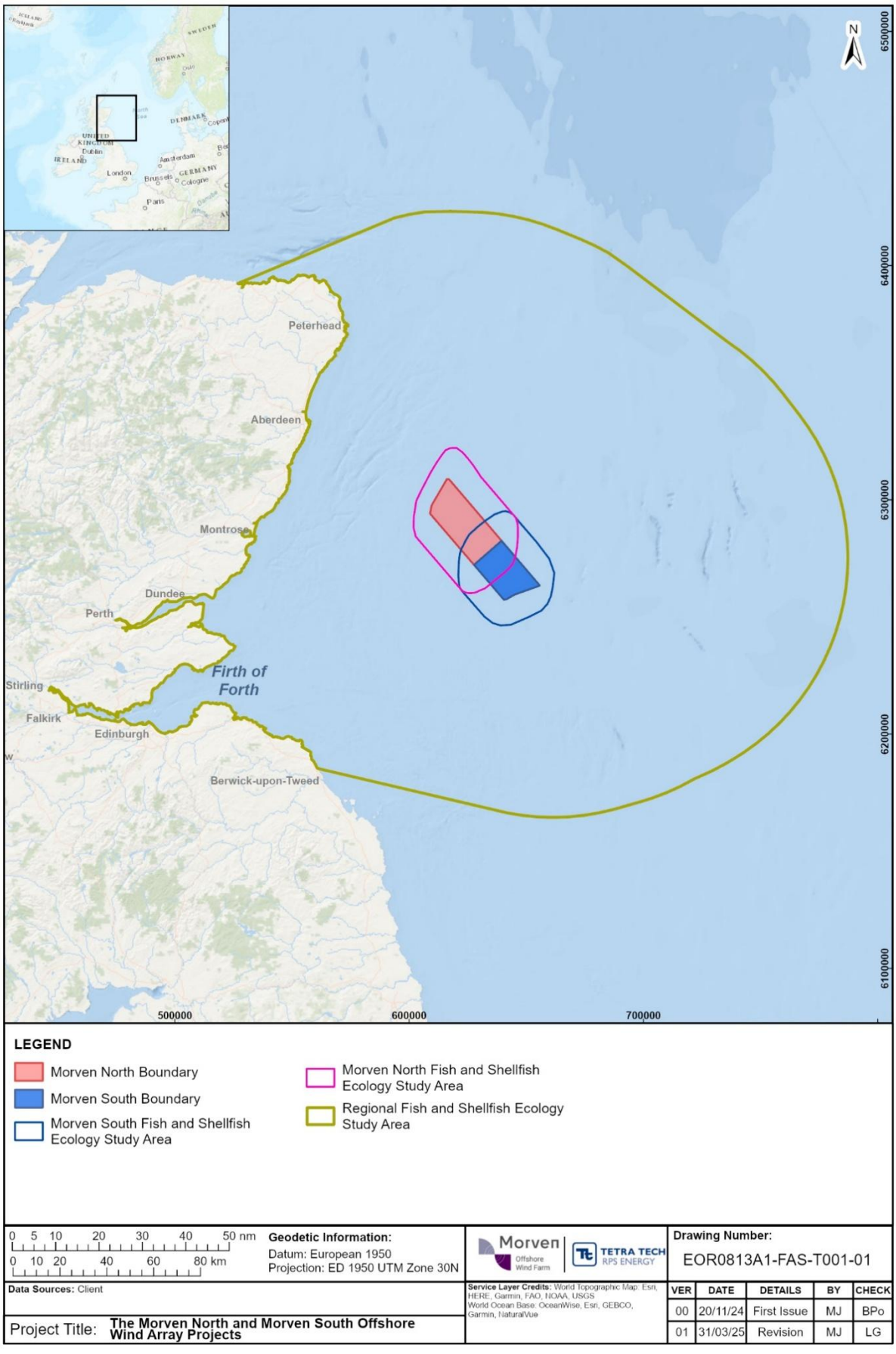

Figure 2.1: Fish and Shellfish Ecology Study Area for Morven North and Morven South

3 Methodology

3.1 Desktop Study

3.1.1.1 Information on fish and shellfish ecology within the Regional Fish and Shellfish Ecology Study Area was collected through a detailed desktop review of existing studies and datasets, which are summarised in Table 3.1.

Table 3.1: Summary of key desktop datasets and reports for Fish and Shellfish Ecology

Title	Source	Year	Author
Survey data/reports available through ICES, including, International Bottom Trawl Survey (IBTS) (North Sea).	ICES	2022	ICES.
Berwick Bank Offshore Wind Farm (OWF) EIA Report.	SSER	2022	SSER.
Rod catch data.	Scottish Government	2022	Marine Directorate.
Berwick Bank OWF Scoping Report.	SSER	2021	SSER.
Distribution model for lesser sandeel.	Marine Scotland Science (MSS) (Now Marine Directorate – Science, Evidence, Digital and Data (MD-SEDD))	2021	Langton *et al.*
JNCC Marine Protected Area (MPA) Mapper.	JNCC	2020	JNCC.
European Marine Observation and Data Network (EMODnet) broadscale seabed habitat map for Europe (EUSeaMap).	EMODnet – Seabed Habitats	2019	EMODnet – Seabed Habitats.
Seagreen Phase 1 (Seagreen Alpha and Seagreen Bravo): Natural Fish and Shellfish Resource Environmental Statement chapter for the optimised project.	Seagreen Wind Energy Ltd.	2018	Seagreen Wind Energy Ltd.
Natural Fish and Shellfish Resource Environmental Statement section for the optimised project.	Seagreen Environmental Impact Assessment Report: Volume 1, chapter 9	2018	Seagreen.
Updating fisheries sensitivity maps in British waters.	Marine Scotland	2014	Aires *et al.*
Spawning and nursery grounds of selected fish species in UK waters.	Centre for Environment, Fisheries, and Aquaculture (Cefas)	2012	Ellis *et al.*
Fisheries Sensitivity Maps.	Cefas	1998	Coull *et al.*

3.2 Site Specific Surveys

3.2.1.1 No direct site specific surveys were proposed for fish, although a site- specific benthic ecology characterisation survey was undertaken from April to August in 2022, which encompassed the Morven Site, therefore covered both the Morven North Boundary and Morven South Boundary. Particle Size Analysis (PSA), macrofaunal and environmental Deoxyribonucleic Acid (eDNA) sampling (including specific sampling for fish eDNA), and underwater imagery records were collected from this survey (Gardline, 2023). Sample locations are presented in Figure 3.1, showing where various data collection techniques were employed during the site specific survey, including the collection of eDNA samples from seabed sediments and the water column, drop down-down video and seabed sampling using sediment grab samplers. This information is used to support characterisation of the fish and shellfish receptors in the Morven North Fish and Shellfish Ecology Study Area and the Morven South Fish and Shellfish Ecology Study Area.

3.2.1.2 eDNA metabarcoding was used to support characterisation of the baseline fish and shellfish ecology community. Sediment eDNA shows greater longevity than eDNA within the water column, therefore, may contain eDNA material from organisms that were present some time ago, depending upon the depositional regime at the seabed. This eDNA can, therefore, be used to provide a broader characterisation in terms of timescales. Seawater eDNA, however, is typically considered to be representative of occurrence within the current or preceding tidal cycle, as material can be quickly degraded and dispersed when free-floating. Comparison between the two datasets, and with desktop data sources, can increase confidence in the sedimentary results and the characteristic species.

3.2.1.3 Sediment eDNA samples were collected from sediment grab samples using sterile tools, with fish eDNA analysed at 17 stations. Sediment material was frozen in sealed containers immediately and transferred to the laboratory for processing. Seawater eDNA samples were collected using Niskin bottles at 20 stations; seawater was collected at two depths per station within the water column and combined into a single sample through filtering over a laboratory-supplied filter to provide a collated sample per station, representing key areas of the water column. The eDNA samples from the seabed sediments were collected and analysed for sediment bacteria, invertebrates and fish, and seawater eDNA samples were collected and analysed for fish elasmobranchs and marine mammals. Note the elasmobranch assay is a technique still undergoing research and development and yielded few results. The draft survey scope of work was shared with NatureScot in October 2021; the results were discussed with NatureScot and the Marine Directorate at the scoping workshop on 18 April 2023.

3.2.1.4 Analysis of eDNA samples was undertaken by Naturemetrics Ltd, with sediment eDNA extracted from 10g of each sample per analytical assay (with the fish and invertebrate/metazoan assays considered most applicable to fish and shellfish ecology) and amplified using triplicate polymerase chain reactions. Invertebrate subsample sequence data was processed for quality filtering and taxonomic assignment, with each taxonomic unit assigned by being compared to two reference databases. Minimum similarity thresholds of 98%, 95%, and 92% were required for species-, genus-, and higher-level assignments. Assignments were made to the lowest possible taxonomic level where there was consistency in the matches. Fish subsample operational taxonomic unit assignments were drawn from the National Centre for Biotechnology Information (GenBank) database. Assignments were made to the lowest possible taxonomic level where there was consistency in the matches. Conflicts were flagged and resolved manually. Minimum similarity thresholds of 99%, 97%, and 95% were required for species-, genus-, and higher-level assignments. In cases where there were equally good matches to multiple species, public records from the Ocean Biodiversity Information System were used to assess which were most likely to be present in the North Sea.

3.2.1.5 Monthly DAS were carried out by APEM from January 2021 with 33 consecutive months of data collected (APEM, 2024), to assess the spatiotemporal distribution and abundance of birds and marine megafauna in and around (a 4km buffer) of the Morven Site. These surveys were conducted at 400m flight altitude, along 30 survey lines spaced approximately 2km apart.

3.2.1.6 A summary of the site specific surveys undertaken for other topics, but which have been used to support the fish and shellfish baseline is provided in Table 3.2. The locations of other offshore wind developments with site specific data used to characterise the fish and shellfish ecology baseline within the Regional Fish and Shellfish Ecology Study Area are shown in Figure 3.2.

Table 3.2: Summary of surveys undertaken that are relevant to Fish and Shellfish Ecology

Title	Extent of survey	Overview of surveyor	Surveyor contractor	Date	Reference to further information
Environmental Baseline Survey and Habitat Assessment.	Morven Site plus a buffer of up to 14km.	Grab sampling, Drop Down Video (DDV), and sediment and seawater eDNA sampling.	Gardline.	April to August 2022.	Gardline, 2023.
Ornithology and marine megafauna Digital Aerial Surveys (DAS).	Morven Site plus a 4km buffer.	Monthly DAS undertaken to assess the ornithology and marine mammal baselines.	APEM.	January 2021 to September 2023.	APEM, 2024.
Environmental Baseline Survey and Habitat Assessment.	Morven Site plus a buffer of up to 14km.	Grab sampling, DDV, and sediment and seawater eDNA sampling.	Gardline.	April to August 2022.	Gardline, 2023.

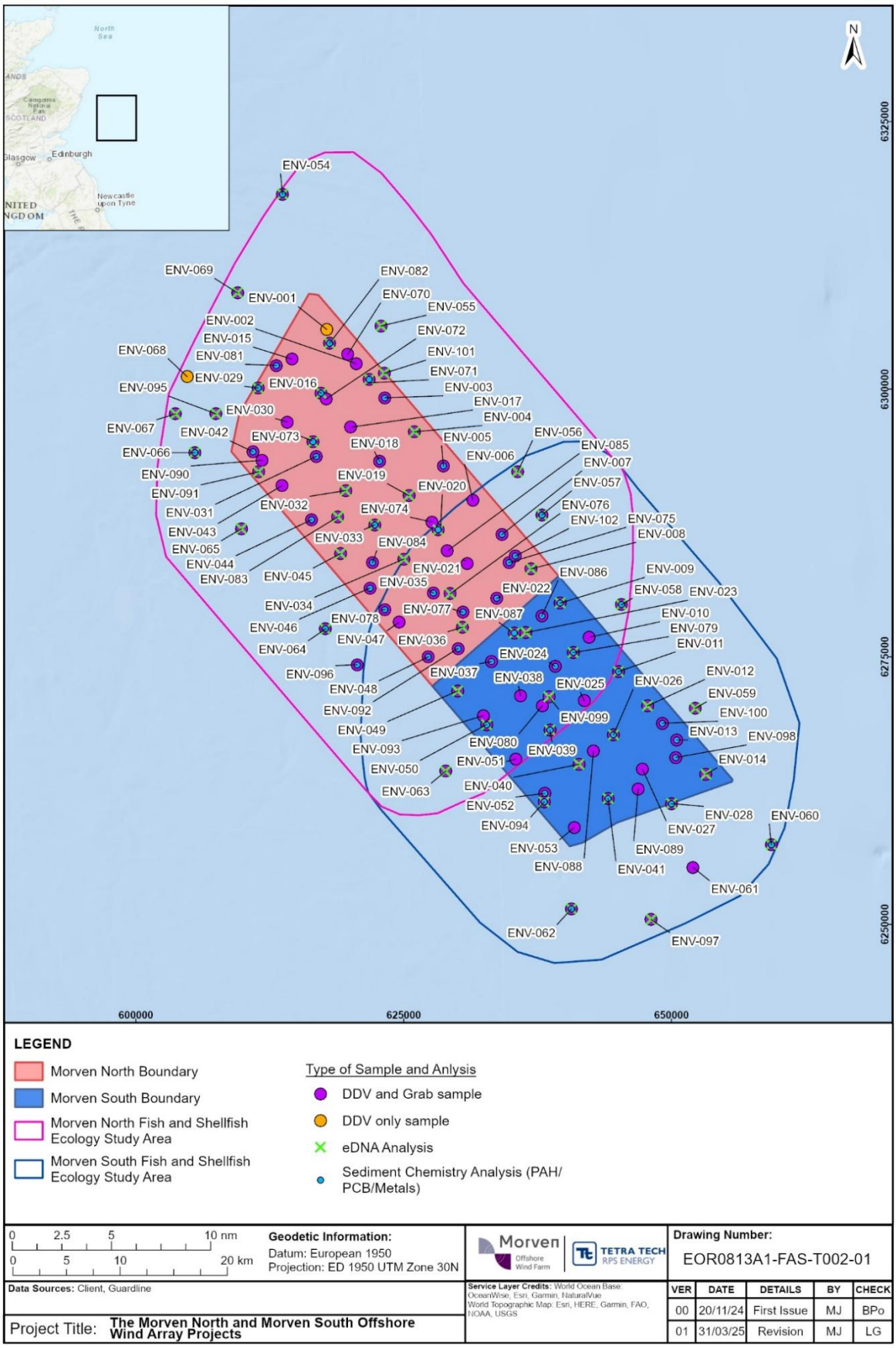

Figure 3.1: Site Specific Benthic Survey sampling locations within the Morven North Fish and Shellfish Ecology Study Area and the Morven South Fish and Shellfish Ecology Study Area

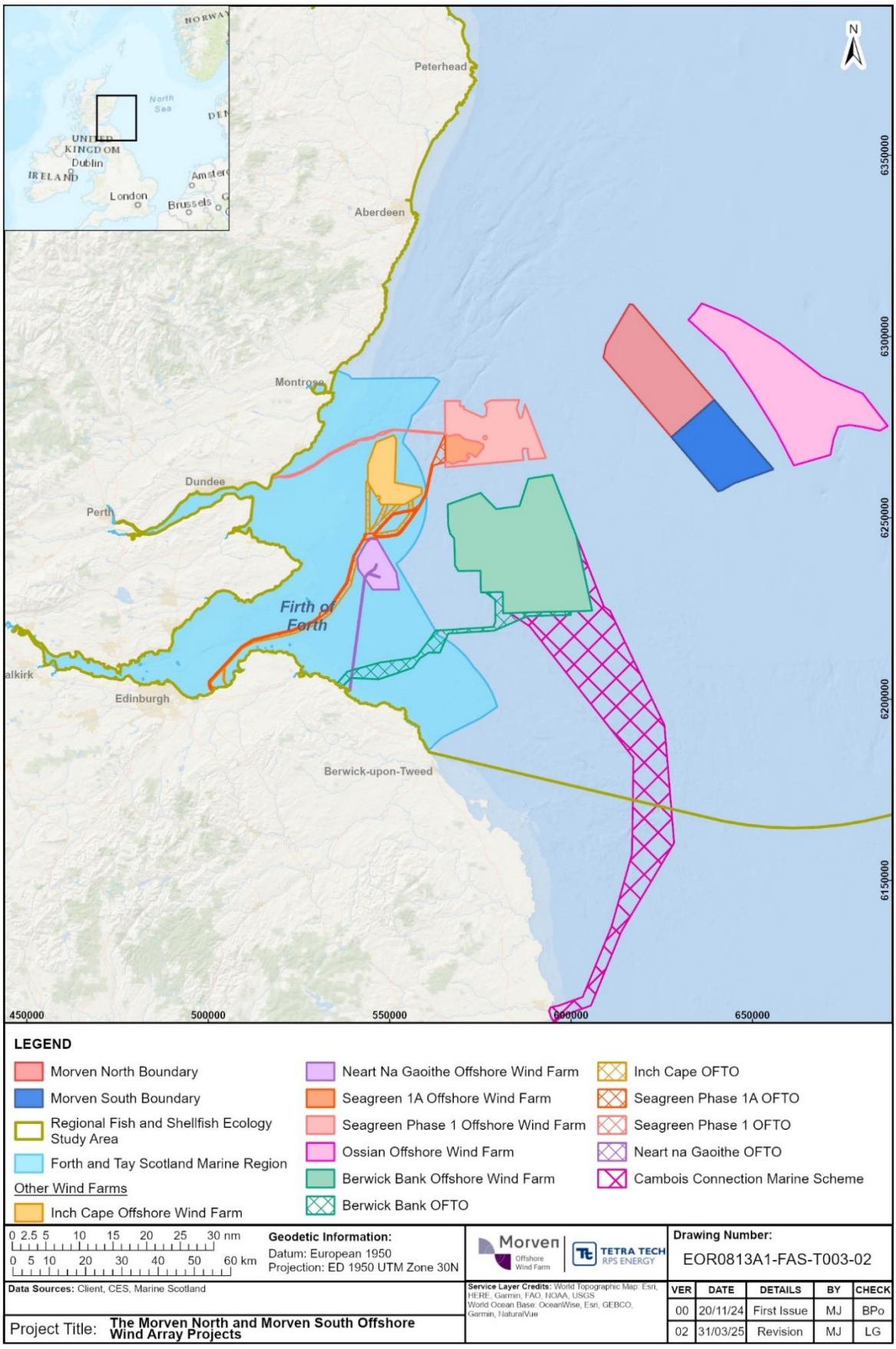

Figure 3.2: Location of Offshore Wind Developments with site specific data used to characterise the Fish and Shellfish Ecology Baseline within the Regional Fish and Shellfish Ecology Study Area

4 Baseline characterisation

4.1 Overview

4.1.1 Regional Fish and Shellfish Ecology Study Area

4.1.1.1 The results of desktop study for the Regional Fish and Shellfish Ecology Study Area (within which the Morven North Fish and Shellfish Ecology Study Area and the Morven South Fish and Shellfish Ecology Study Area are located) are described below. This provides a wider spatial coverage and, due to the wide-ranging nature of fish and shellfish species and habitats, is applicable to both the Morven North Fish and Shellfish Ecology Study Area and the Morven South Fish and Shellfish Ecology Study Area. These results include descriptions of marine fish assemblages and associated habitat types, diadromous fish species and their migration characteristics, and shellfish assemblages. This information has been used to inform the baseline characterisation and identification of fish and shellfish IEFs, against which potential impacts associated with Morven North and Morven South have been assessed.

Marine fish assemblage

4.1.1.2 A range of marine fish species comprise the fish assemblage with the Regional Fish and Shellfish Ecology Study Area. Marine fish can be further divided into teleost fish (i.e. bony fish) and elasmobranchs (i.e. fish with skeletons made of cartilage opposed to bone). The marine fish assemblage includes both commercial and non-commercial species. Demersal teleost species include sandeel (Family: Ammodytdiae), cod (*Gadus morhua*), whiting *(Merlangius merlangus*), lemon sole (*Microstomus kitt*), ling (*Molva molva*), saithe (*Pollachius virens*) and plaice (*Pleuronectes platessa*). Pelagic teleost species include herring (*Clupea harengus*), sprat (*Sprattus sprattus),* and mackerel (*Scomber scombrus*). Elasmobranch species, such as spotted ray (*Raja montagui*), thornback ray, tope shark (*Galeorhinus galeus*), small-spotted catshark (*Scyliorhinus canciula*), spurdog (*Squalus acanthias*), thorny skate (*Amblyraja radiata*) and cuckoo ray (*Leucoraja naevus*), among others, have been observed in the Regional Fish and Shellfish Ecology Study Area (Coull, *et al.,* 1998; Daan *et al.,* 2005; Baxter *et al.,* 2011; Ellis *et al.,* 2012). Several of these species (sandeel, cod, whiting, ling, saithe, mackerel, spurdog) are listed as Scottish PMFs (JNCC, 2012). These species are listed as a PMF if either a large proportion of their population occurs in Scotland's seas, if the species is under threat or in decline or due to the function role of the species.

4.1.1.3 Herring and sandeel are considered substrate-specific, as both rely on a particular sediment composition to support spawning and burrowing (sandeel). Substrata suitable for herring spawning is reported to comprise less than 5% mud content and greater than 10% gravel content (Reach *et al.*, 2013). Suitable substrate for sandeel inhabitation is reported as less than 10% mud content, over 50% sand and less than 80% gravel content, with a preference for areas comprising less than 4% mud content (prime and sub-prime) and over 70% sand (Holland *et al.*, 2005).

4.1.1.4 Between 2011 and 2020, epifaunal beam trawl surveys were undertaken across the Berwick Bank OWF, Seagreen 1 OWF and Seagreen 1A OWFs (between 25.2km to 51.8km away from the Morven North Boundary and Morven South Boundary). These surveys recorded a range of demersal species, such as dab (*Limanda limanda*), long rough dab (*Hippoglossoides platessoides*), lesser sandeel (*Ammodytes tobianus*), Raitt's sandeel (*Ammodytes marinus*), four-bearded rockling (*Enchelyopus cimbrius*), pogge (*Agonus cataphractus*), butterfish (*Pholis gunnellus*), Norwegian topknot (*Zeugopterus norvegicus*), reticulated dragonet (*Callionymus reticulatus*), common dragonet (*Callionymus lyra*), lemon sole, short-spined scorpion fish (*Myoxocephalus scorpius*) and goby species (Family: Gobiidae). Commercial species such as plaice, whiting, cod, and red gurnard (*Chelidonichthys cuculus*), were also recorded, as were smooth sandeel (*Gymnammodytes semisquamatus)* and greater sandeel (*Hyperoplus lanceolatus*), and one elasmobranch species; the cuckoo ray (Seagreen, 2012; Seagreen, 2018; SSER, 2022).

4.1.1.5 Within the Berwick Bank OWF, an epibenthic beam trawl survey was undertaken in 2020, by Ocean Ecology Ltd (SSER, 2022). Berwick Bank OWF is located 31.7km from the Morven North Boundary and 33.8km from the Morven South Boundary. The epibenthic survey revealed 553 teleost fish from 21 taxa, of which 167 were dab. Long rough dab, lesser sandeel, pogge and gobies were also in high abundances, whilst four-bearded rockling, anglerfish (*Lophius piscatorius*), plaice, lemon sole and cod were found in low abundances (SSER, 2022). For the Cambois Connection (the transmission assets of the Berwick Bank OWF), DDV sampling was undertaken in autumn 2022. A range of fish species were recorded in this survey, such as haddock (Melanogrammus aeglefinus), plaice, other flatfish species, gadoids, dragonets (Order: Callionymiformes), and gurnards (Family: Triglidae) (SSER, 2023).

4.1.1.6 Recently, an epifaunal trawl survey was undertaken in 2022 to characterise the benthic environment at Ossian (8.9km from Morven North and 5.6km from Morven South). There were 16 fish and shellfish species recorded, with long rough dab being the most common (Ossian Offshore Wind Farm Limited, 2024). This was followed by plaice, dab, Norway pout (*Trisopterus esmarkii*), Raitt's sandeel, lemon sole, and grey gurnard (*Eutrigla gurnardus*). Other species recorded in lower abundances were pogge, poor cod (*Trisopterus minutus*), haddock, cod, transparent goby (*Aphia minuta*), sand goby (*Pomatoschistus minutus*), scaldfish (*Arnoglossus laterna*), Lotidae spp. and Argentinidae spp (Ossian Offshore Wind Farm Limited, 2024).

Diadromous fish species

4.1.1.7 Diadromous fish (i.e. species that migrate between freshwater and the marine environment) migrate to and from rivers within the Regional Fish and Shellfish Ecology Study Area and, therefore, may migrate through the Morven North Boundary and/or Morven South Boundary during certain periods of the year (NBN Atlas, 2023).

4.1.1.8 Based on information on diadromous fish populations on the east coast of Scotland, the EIAs for Berwick Bank OWF, Seagreen 1 OWF and Seagreen 1A OWF identified eight diadromous fish species that have the potential to occur in offshore areas within the Regional Fish and Shellfish Ecology Study Area, including the coastal areas along the east of Scotland. These species were Atlantic salmon (*Salmo salar*), sea trout (Salmo trutta), sea lamprey (*Petromyzon marinus*), river lamprey (*Lampetra fluviatilis*), European eel (*Anguilla Anguilla*), allis shad (*Alosa alosa*), twaite shad (*Alosa fallax*), and European smelt (*Osmerus eperlanus*); (Seagreen, 2018; SSER, 2022). River lamprey and European smelt are primarily coastal species and, therefore, unlikely to interact with Morven North and Morven South. The species that are considered as having the greatest potential to be present within the Morven North Boundary and Morven South Boundary are Atlantic salmon, sea trout, European eel, sea lamprey, allis shad and twaite shad.

4.1.1.9 No site specific surveys are proposed to inform the diadromous fish impact assessment. For the intended purpose of this technical report, it will be assumed that the species referred to above are likely to be present within the Regional Fish and Shellfish Ecology Study Area during migration at key stages of their life cycles. This includes smolt migration from natal rivers and adult migration to spawning habitats. The aim of the impact assessment is to determine whether construction, Operations and Maintenance or decommissioning activities have the potential to disrupt the migration of these species. Therefore, migratory seasons is an important element of the baseline characterisation and has been collated through desktop data sources (Malcolm *et al.*, 2010; 2015; Hume, 2017; Newton *et al.*, 2017; Gardiner *et al.*, 2018; Seagreen, 2018). Migration timings for diadromous fish species relevant to Morven North and Morven South are provided in Table 4.1.

4.1.1.10 The River Dee SAC, River South Esk SAC, and River Spey SAC are designated for Atlantic salmon and the symbiotic freshwater pearl mussel (*Pinctada margaritifera*) as primary features. Although freshwater pearl mussel is not found in the offshore environment, the species depends on the Atlantic salmon smelting population during their parasitic larval stage (Taeubert and Geist, 2017). Therefore, freshwater pearl mussel populations may be indirectly affected if Atlantic salmon are adversely affected by Morven North and/or Morven South.

Table 4.1: Migration timings for key diadromous fish species

Species	Timing of downstream mitigation	Timing spent at sea before first return	Timing of upstream migration	Source	Species
Allis and twaite shad.	Autumn (juveniles).	2 years in estuaries and marine areas; do not return to fresh water until sexually mature.	April to June (to spawn in freshwater).	Maitland and Hatton-Ellis, 2003, ABPMer, 2019.	Allis and twaite shad.
Atlantic salmon.	April to June.	1 to 4 years.	All year; peaks in late summer/early autumn.	Malcolm *et al.*, 2010, 2015, ABPMer, 2019.	Atlantic salmon.
European eel.	June to November.	Most do not return to freshwater.	Varies spatially, typically arrives in coastal waters of eastern Scotland in December and may migrate upstream until June.	Malcolm *et al.*, 2010.	European eel.
River lamprey.	From late autumn onwards (to feed in estuaries).	Spends 1 to 2 years in estuaries.	Winter and spring when temperatures are <10°C.	NatureScot, 2022a, ABPMer, 2019.	River lamprey.
Sea lamprey.	From late autumn onwards (to open sea) (timing varies between rivers).	18 to 24 months.	April to May (to spawn in May to June).	NatureScot, 2022a, ABPMer, 2019.	Sea lamprey.
Sea trout.	Spring.	2 or more.	April to June.	Malcolm *et al.*, 2010.	Sea trout.
European smelt.	Not applicable (migration to estuaries only).	Spends time in estuaries.	February to April (to spawn in estuaries and large rivers).	NatureScot, 2022b.	European smelt.

Shellfish assemblage

4.1.1.11 The population structure of shellfish stocks around the UK is not well understood, with assessments largely based on previous fishing and landings data (Mesquita *et al.*, 2016). The shellfish industry in the UK is economically important; UK shellfish landings contributed to 45% (£313m) of fisheries landings (£691.8m) in 2021 (Marine Management Organisation (MMO), 2023). Fisheries landings data provides information which can be used as a principal overview of the species present within a certain area. Using fisheries catch and landings data alongside baseline data from other projects, we can build an overview of the species present within the Regional Fish and Shellfish Ecology Study Area. Landings data have been reviewed from the ICES Rectangles within the Regional Fish and

Shellfish Ecology Study Area to provide an overview of the key shellfish species and support characterisation of the shellfish assemblage.

4.1.1.12 Shellfish contribute significant value to the Scottish fishing industry. There are consistently high landings of Nephrops (Norway lobster; *Nephrops norvegicus*), and medium to low landings of European lobster (*Homarus gammarus*), edible crab (*Cancer pagurus*), velvet swimming crab (*Necora puber*), king scallop (*Pecten maximus*), whelk (*Buccinum undatum*), razor clam (Solen spp.), surf clam (Spisula spp.), clams (*Mya arenaria*), ommastrephid and loliginid squids, and octopus (*Eledone cirrhosa*; Mesquita *et al.*, 2016, 2017; Marine Scotland, 2021). Occasionally caught species include shore crab (*Carcinus maenas*), pink shrimp (*Pandalus montagui*) and queen scallop (*Aequipecten opercularis*; (Marine Scotland, 2021).

4.1.1.13 Epifaunal trawls conducted for the Seagreen OWF in 2011 observed several shellfish species including king and queen scallop in the samples, with queen scallop found to be one of the most frequently recorded species, present in 64% of the samples recovered (201 individuals, overall; Seagreen, 2018). The Seagreen OWF fish and shellfish ecology chapter (Seagreen, 2012) also refers to data supplied by Marine Scotland in 2012 demonstrating high abundances of Nephrops recorded through underwater imagery acquisition by Marine Scotland in the inshore waters and southern parts of Regional Fish and Shellfish Ecology Study Area.

4.1.2 Site specific surveys

4.1.2.1 No dedicated site specific surveys were undertaken to characterise fish and shellfish ecology, as sufficient desktop information was considered available (such as fisheries statistics and long-term time series studies) to conduct a robust baseline characterisation. However, ad-hoc data collected during the benthic survey campaign (e.g. underwater visual observations by DDV can provide insights into the species present within the Morven North Fish and Shellfish Ecology Study Area and the Morven South Fish and Shellfish Ecology Study Area). Further, eDNA metabarcoding was undertaken for both fish and invertebrate species, from sediment and seawater samples, which has been used to support the characterisation of the fish and shellfish assemblage. Finally, the results of DAS undertaken for ornithology and marine mammals have been investigated for the presence of any large fish species that would be visible in the aerial imagery.

4.1.2.2 Fish and shellfish species recorded during these site specific surveys are detailed, where relevant, throughout this baseline characterisation report.

4.2 Spawning and nursery grounds

4.2.1.1 Coull *et al.* (1998) identified the potential spawning and nursery areas in the North Sea for a range of species through a range of larvae, egg, and benthic habitat survey data. For some species, these data were reviewed by Ellis *et al.* (2012) to update the data with details of spatial distribution of high and low intensity spawning and nursery grounds. Spawning and nursery grounds for herring and sandeel were identified in the Berwick Bank OWF, which could suggest that similar sites may be present close to or within the Morven North Boundary and Morven South Boundary.

4.2.1.2 Essential fish habitat maps produced by the Franco *et al.*, (2023) reveal spawning aggregations of haddock (adult specimens in Q1) to be largely absent (to a higher confidence; based on numerous datasets/literature) around the Morven North Boundary and Morven South Boundary. The same was found for aggregations of anglerfish juveniles (0 and 1-group), aggregations of mackerel juveniles (0-group), aggregations of mackerel eggs, and aggregations of blue whiting (*Micromesistius poutassou*) juveniles (0-group). Sole aggregations (0 and 1-group) are also modelled to be absent, though to higher and lower (where datasets/literature are limited) confidences around the Morven North Boundary and Morven South Boundary (Franco *et al.*, 2023).

4.2.1.3 Species with known spawning and nursery grounds identified within the Regional Fish and Shellfish Ecology Study Area are summarised in Table 4.2 and presented in Figure 4.1 to Figure 4.5.

Table 4.2: Species with spawning and nursery grounds within the Regional Fish and Shellfish Ecology Study Area (adapted from Coull *et al.*, 1998 and Ellis *et al.*, 2012)

Species	Spawning grounds	Spawning intensity	Nursery grounds	Nursery intensity	Species
Teleost Fish					
Anglerfish	×	-	✓	Low	Anglerfish
Blue whiting	×	-	✓	Low	Blue whiting
Cod	✓	Low	✓	High and low	Cod
European hake (*Merluccius merluccius*)	×	-	✓	Low	European hake
Haddock	×	-	✓	Unspecified	Haddock
Herring	✓	Undetermined	✓	High and low	Herring
Lemon sole	✓	Undetermined	✓	Unspecified	Lemon sole
Ling	×	-	✓	Low	Ling
Mackerel	×	-	✓	Low	Mackerel
Norway pout	✓	High and low	✓	Unspecified	Norway pout
Plaice	✓	Low	✓	Low	Plaice
Sandeel	✓	High and low	✓	Low	Sandeel
Saithe	×	-	✓	Unspecified	Saithe
Sprat	✓	Undetermined	✓	Unspecified	Sprat
Whiting	✓	Low	✓	High and low	Whiting
Elasmobranchs					
Common skate	×	-	✓	Low	Common skate
Spotted ray	×	-	✓	Low	Spotted ray
Spurdog	×	-	✓	Low	Spurdog
Tope shark	×	-	✓	Low	Tope shark
Shellfish					
Nephrops	✓	Undetermined	✓	Unspecified	Nephrops

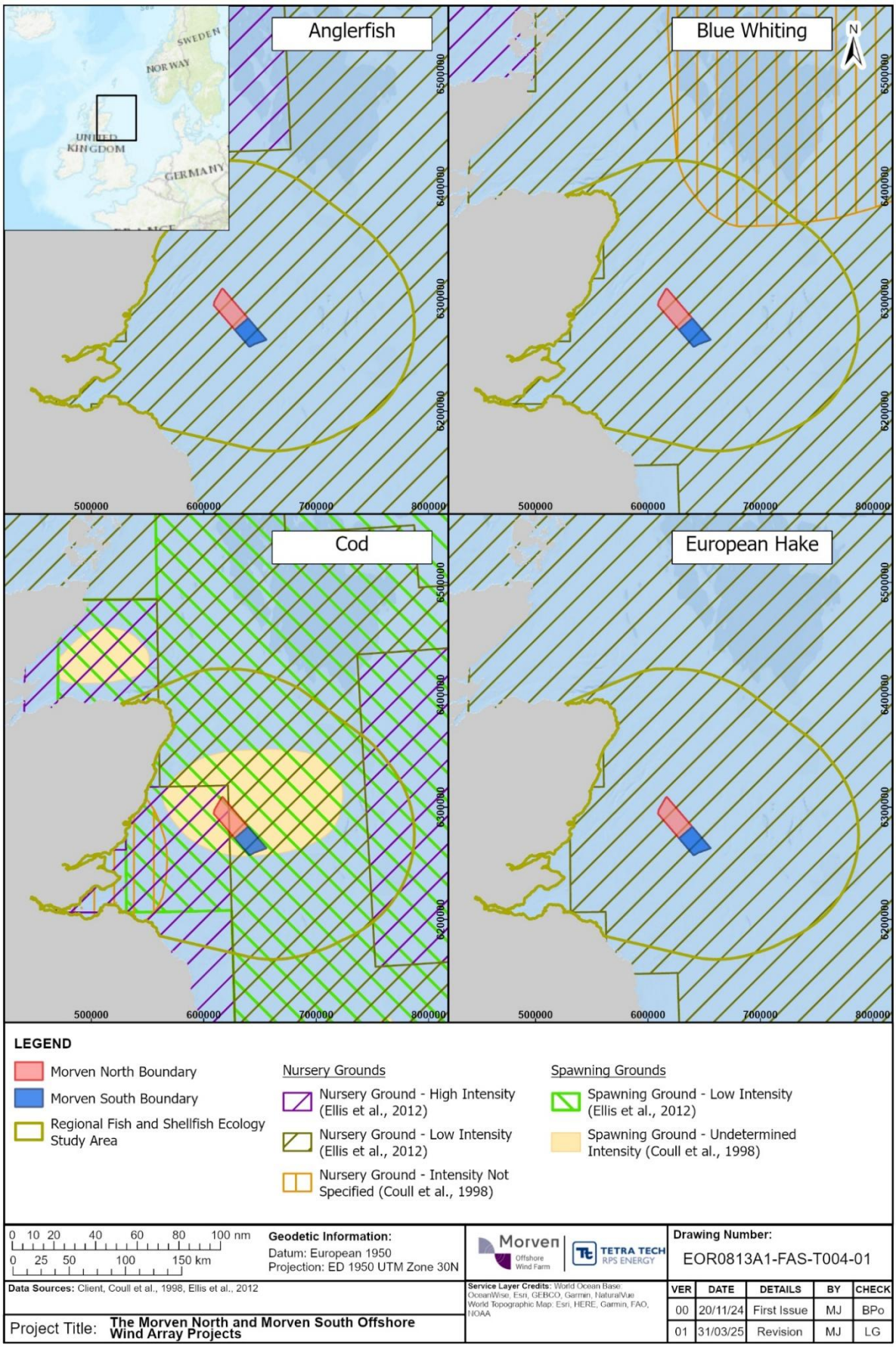

Figure 4.1: Spawning and nursery grounds of anglerfish, blue whiting, cod and European hake

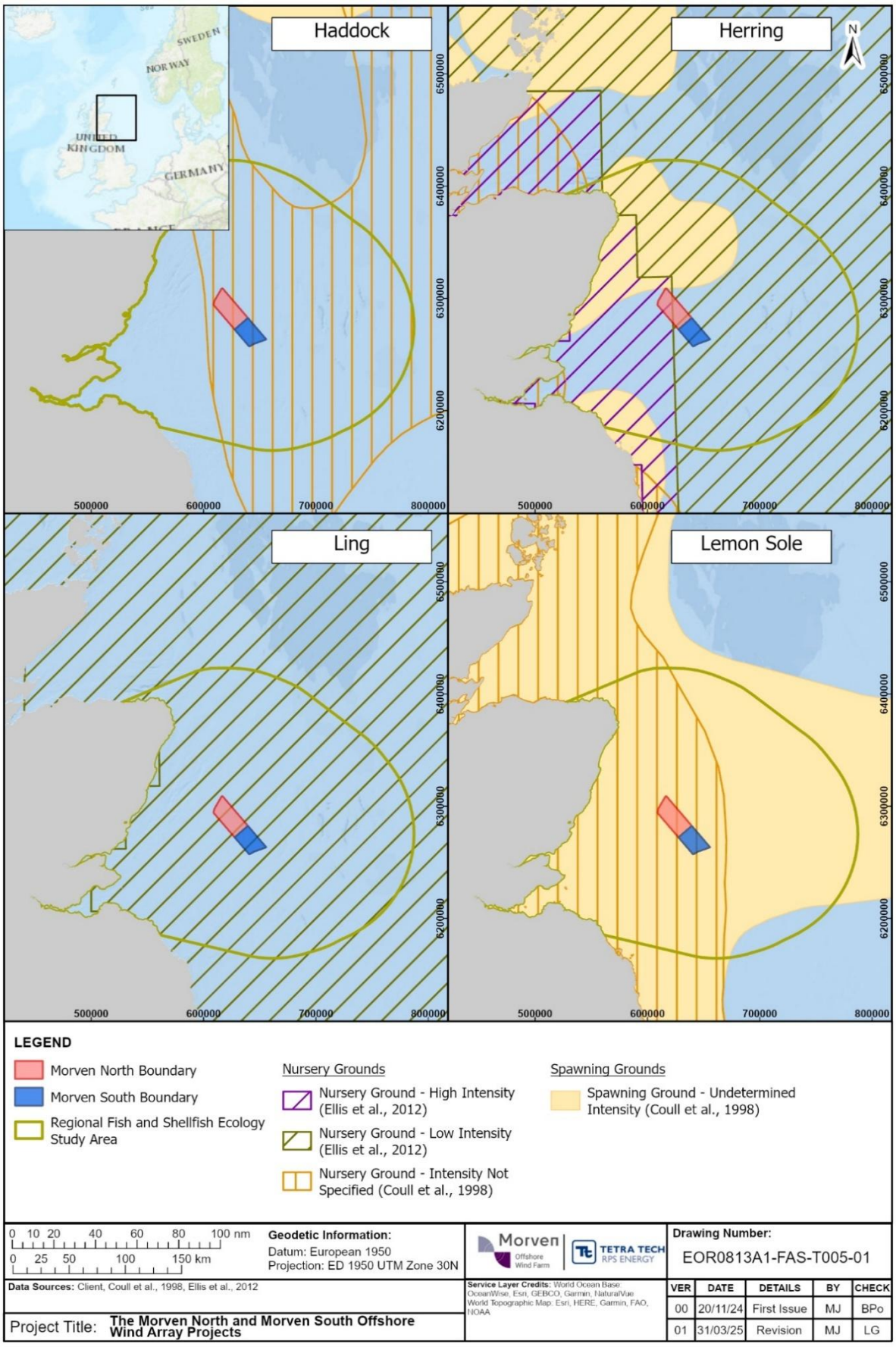

Figure 4.2: Spawning and nursery grounds of haddock, herring, ling and lemon sole

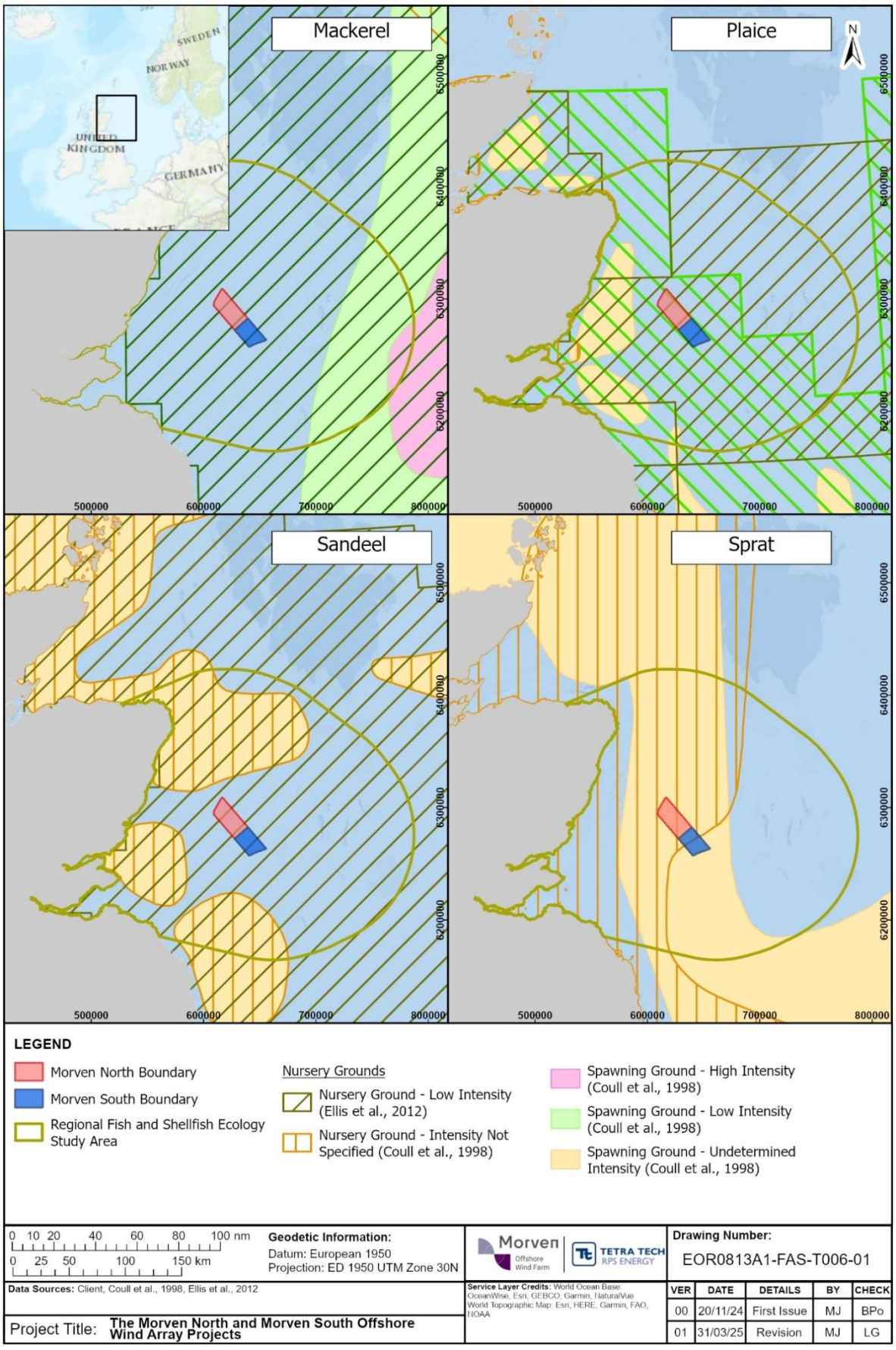

Figure 4.3: Spawning and nursery grounds of mackerel, plaice, sandeel and sprat

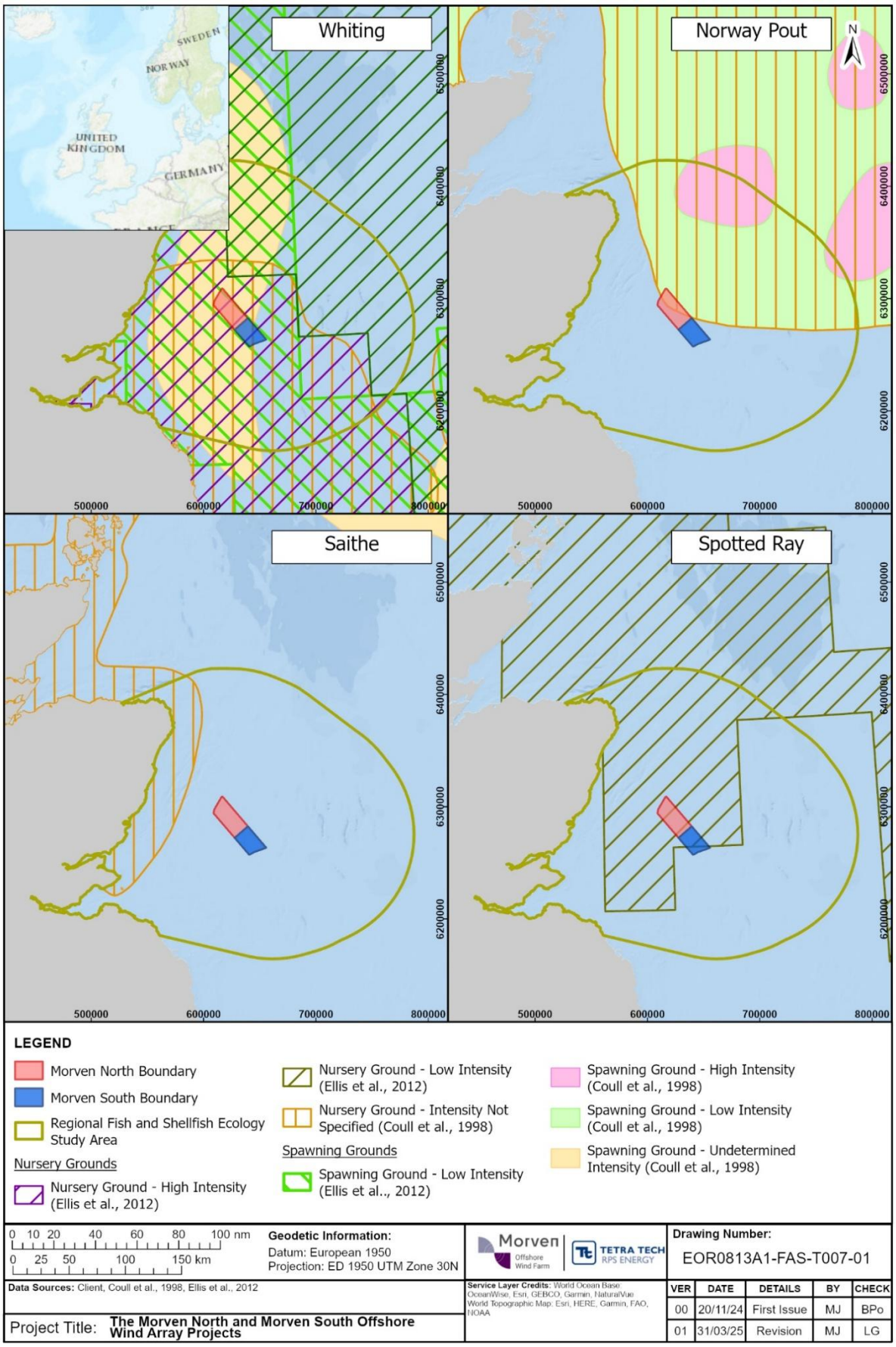

Figure 4.4: Spawning and nursery grounds of whiting, Norway pout, saithe and spotted ray

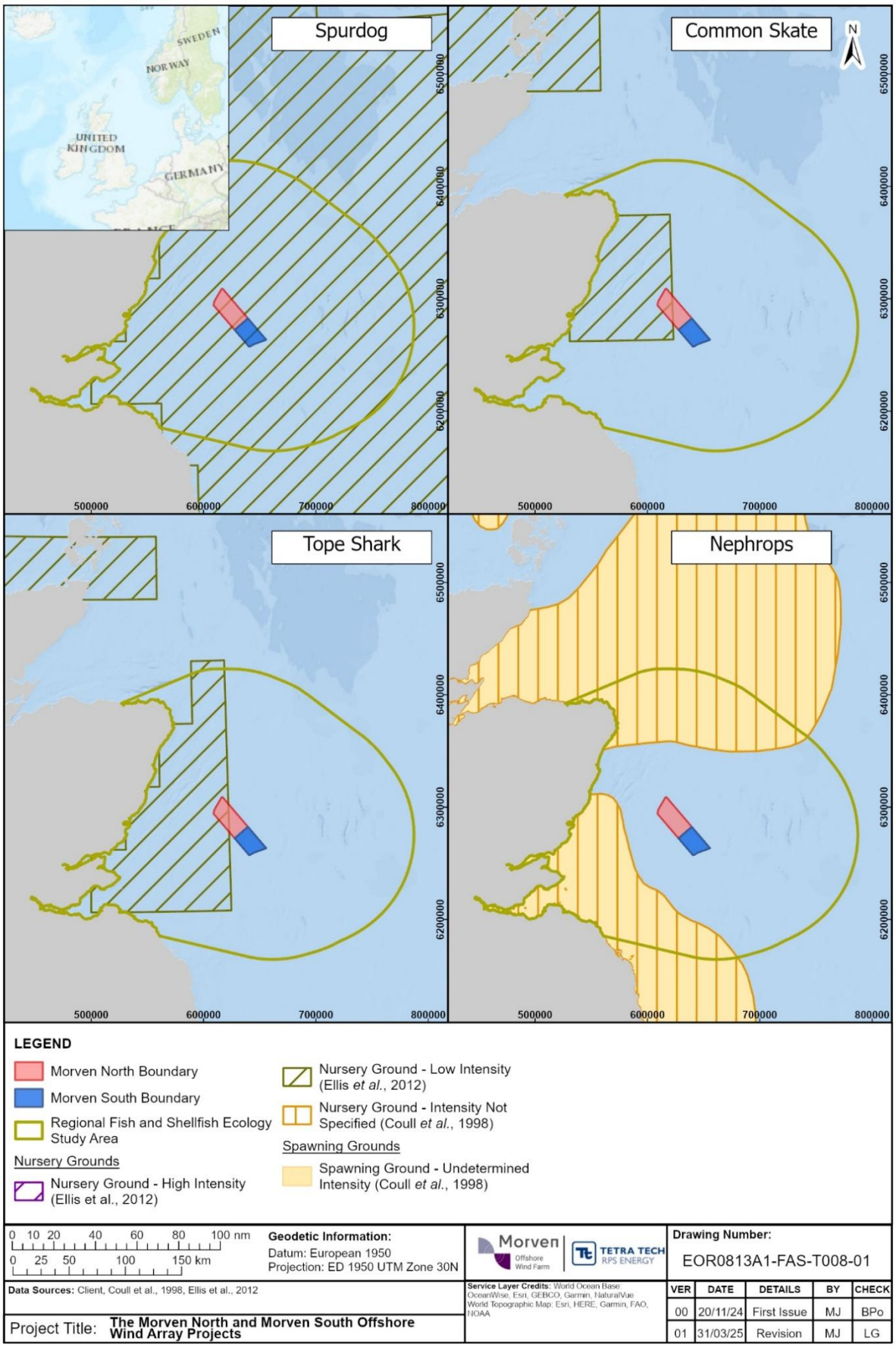

Figure 4.5: Spawning and nursery grounds of spurdog, common skate, tope shark and nephrops

4.2.1.4 High and low intensity nursery grounds of herring, a widespread and ubiquitous pelagic fish species, are present within the Regional Fish and Shellfish Ecology Study Area. The Morven North Boundary overlaps with high intensity nursery grounds, whilst the Morven South Boundary overlaps with those of low intensity (Figure 4.2). There are spawning grounds of unknown intensity adjacent to the northern tip of the Morven North Boundary, within the Regional Fish and Shellfish Ecology Study Area (Figure 4.2). Records collated by Ellis *et al.* (2012) reveal that herring larvae catches, albeit at relatively low levels, extend south into the Regional Fish and Shellfish Ecology Study Area. Section 4.3 presents further information on the spawning habitat suitability for herring within the Regional Fish and Shellfish Ecology Study, and within the Morven North Boundary and Morven South Boundary.

4.2.1.5 Both high and low intensity sandeel spawning grounds are present within the Regional Fish and Shellfish Ecology Study Area. High intensity spawning grounds were overlapping with the Morven North Boundary and low intensity spawning grounds with the Morven South Boundary (Figure 4.3). Low intensity nursery grounds were also present within the Regional Fish and Shellfish Ecology Study Area, overlapping with the Morven North Boundary and Morven South Boundary (Figure 4.3). Further, distribution models by Langton *et al.* (2021) predicted probabilities of occurrence and densities of sandeel within Regional Fish and Shellfish Ecology Study Area, though these probabilities were far greater in areas of the central North Sea that lie south of the Morven North Boundary and Morven South Boundary. There are five species of sandeel in UK waters that are widely distributed and abundant within suitable habitats. Sandbanks and other sandy substrates may be important habitats for these species. The assessment considers substrate suitability for sandeel spawning, based upon the site specific benthic survey sediment composition data, following the method outlined by Latto *et al.* (2013). Section 4.4 presents further information on the spawning habitat suitability for sandeel within the Regional Fish and Shellfish Ecology Study, and within the Morven North Boundary and Morven South Boundary.

4.2.1.6 Spawning periods for species which have spawning grounds overlapping or within close vicinity to the Morven North Boundary and/or Morven South Boundary are presented in Table 4.3.

Table 4.3: Main spawning periods for species with spawning grounds overlapping with the Morven North Boundary and/or Morven South Boundary (adapted from Coull *et al.*, 1998 and Ellis *et al.*, 2012)

Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Cod												
Herring*												
Lemon sole												
Plaice												
Norway pout[N]												
Sandeel												
Sprat												
Whiting												
Key		Spawning period						Key spawning period				

* Herring spawning grounds are present at the northernmost tip of the Morven North Boundary only

[N] Spawning grounds overlap with Morven North Boundary only

4.3 Herring

4.3.1 Desktop study for the Regional Fish and Shellfish Ecology Study Area

4.3.1.1 Herring are present throughout European waters, as well as around the eastern coasts of the United States of America (USA), Canada, and Greenland. IBTS data found herring to be in high abundances (thousands of specimens per hour trawled), with peaks in abundance at the end of the year.

4.3.1.2 As herring are on the Scottish Biodiversity List (SBL) and are a PMF, they are a high Priority Species for Scotland's conservation actions (Casini *et al.*, 2004). Herring are not only ecologically important, acting as prey species for fish, birds and marine mammals, but are also commercially important (Scottish Government, 2022). Historically, overfishing led to herring stock collapse in the 1970s, though it is believed stocks are now in recovery, largely due to the herring recovery plan for the North Sea, which saw a ban on discarding in pelagic fisheries from 2015. This ban incentivised fishers to work more selectively to avoid capturing small, juvenile fish which would otherwise have been discarded back to the sea.

4.3.1.3 Three herring stocks exist in the North Sea, based on their spawning seasons: the Southern Bight/Downs stock spawns in the English Channel during winter, the Banks/Dogger stock spawns in the central North Sea between August and October, and the Buchan/Shetlands stock spawns off the Shetlands and Scottish coasts during summer (August and September). The Buchan sub-stock is nearest to Morven North and Morven South and within the Regional Fish and Shellfish Ecology Study Area. This herring stock's spawning and nursery grounds are presented in Figure 4.2.

4.3.1.4 Herring nursery grounds exist across the whole North Sea and western Scotland, albeit with higher intensity grounds found in the shallower, coastal waters (Ellis *et al.*, 2012). Herring are reliant on particular seabed types for spawning, as they attach adhesive eggs to aquatic vegetation of coarse substrates, which can include coarse sand, shingly, small rocks and gravel, or even broken mollusc shells (Frost and Diele, 2022). Herring spawning usually occurs between 15m and 40m depth. A single batch of eggs is laid per year per female; egg numbers, sizes, and weight tend to differ between stocks. For example, a Buchan/Shetlands stock female of 28cm fork length might produce approximately 67,000 eggs, whereas a 28cm FL female in the Southern Bight/Downs stock could produce 42,000 eggs (Barreto and Bailey, 2014; Fishbase, 2023c). For between one and three weeks from hatching, autumn-spawned herring larvae become planktonic, drifting from the western to eastern North Sea, during which time they take on a generalist diet, feeding on fish eggs, euphausiids, juvenile sandeel and copepods (Dragesund *et al.*, 1980; Last, 1989). As herring develop, they migrate offshore until reaching sexual maturity.

4.3.1.5 Habitat modelling by Franco *et al.* (2023) produced a low score (low habitat suitability, low confidence in the model's performance) for suitable herring spawning grounds south of the Morven South Boundary. The area to the north was not assessed within this study.

4.3.1.6 The IHLS monitors herring larvae throughout the North Sea and around the UK coastline. The IHLS counts larvae by size per m^2; it is assumed that larvae <10 mm long are recently hatched (ICES, 2022b). Herring larvae in high abundances imply recent spawning activities close to the sample locations. These data are shown for the years 2007-2010 (Figure 4.6), 2011-2014 (Figure 4.7) and 2015 to 2016 (Figure 4.8). As data from years 2017 and 2018 are lacking, together with a change in reporting since 2019, recent years are not available for reporting, though ICES (2021) report that records during these years in the Buchan (east Scotland) area were like previous years. Spatial variability can exist due to data collection timings, combined with oceanographic properties, such as tidal speeds and direction.

4.3.1.7 Cumulative data between 2007 and 2016 (Figure 4.9) presents the locations of areas with the highest cumulative larval abundances (indicative of spawning grounds). These are located in the northwest Regional Fish and Shellfish Ecology Study Area. From Figure 4.6 to Figure 4.9, the core spawning grounds for the Buchan herring spawning stock can be seen through the darker red patches which are located directly north of the Morven North Boundary. A core spawning location also exists to the

southwest of the Regional Fish and Shellfish Ecology Study Area, as also shown throughout these figures.

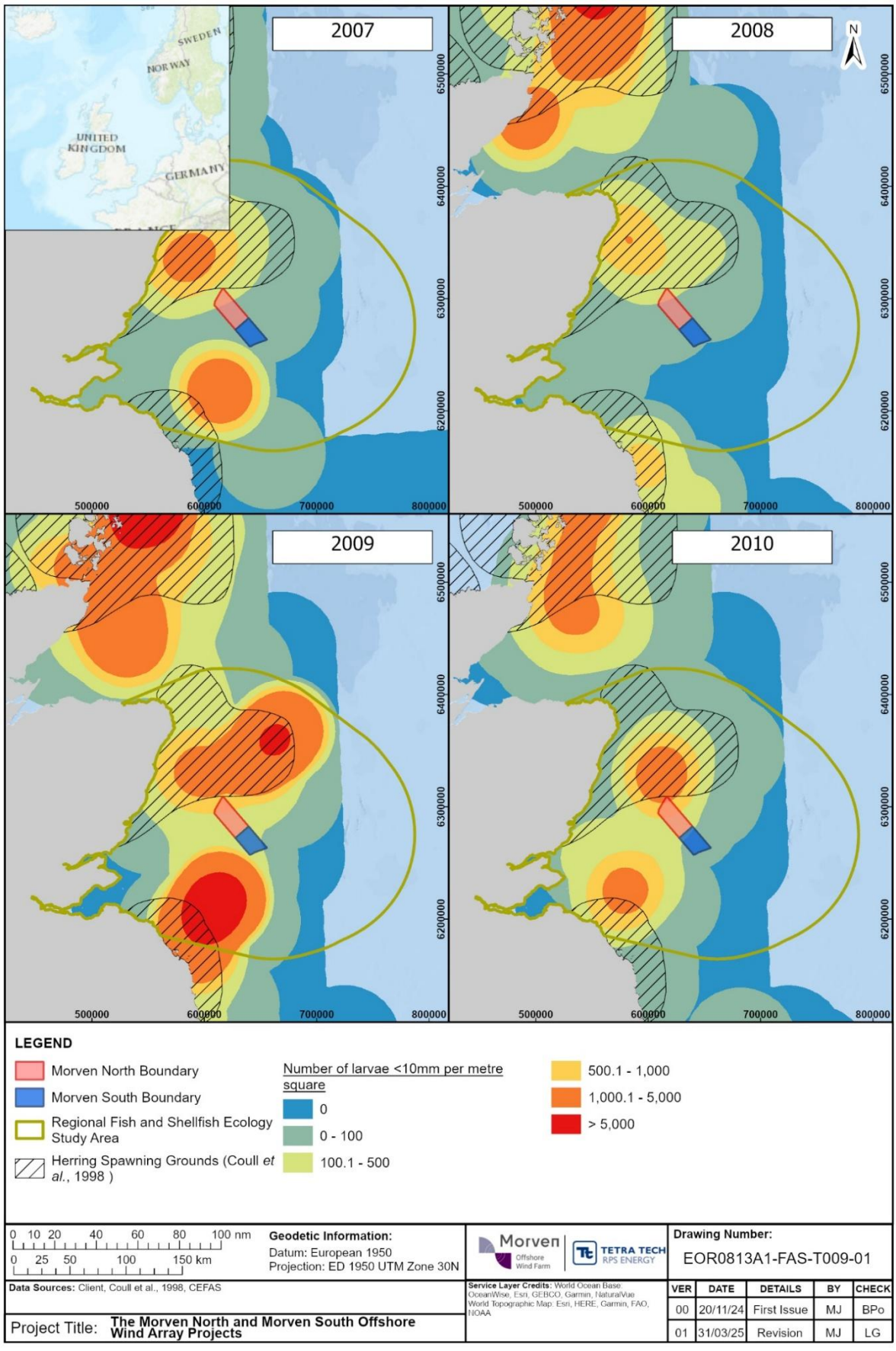

Figure 4.6: Herring larval density from IHLS datasets (2007 to 2010)

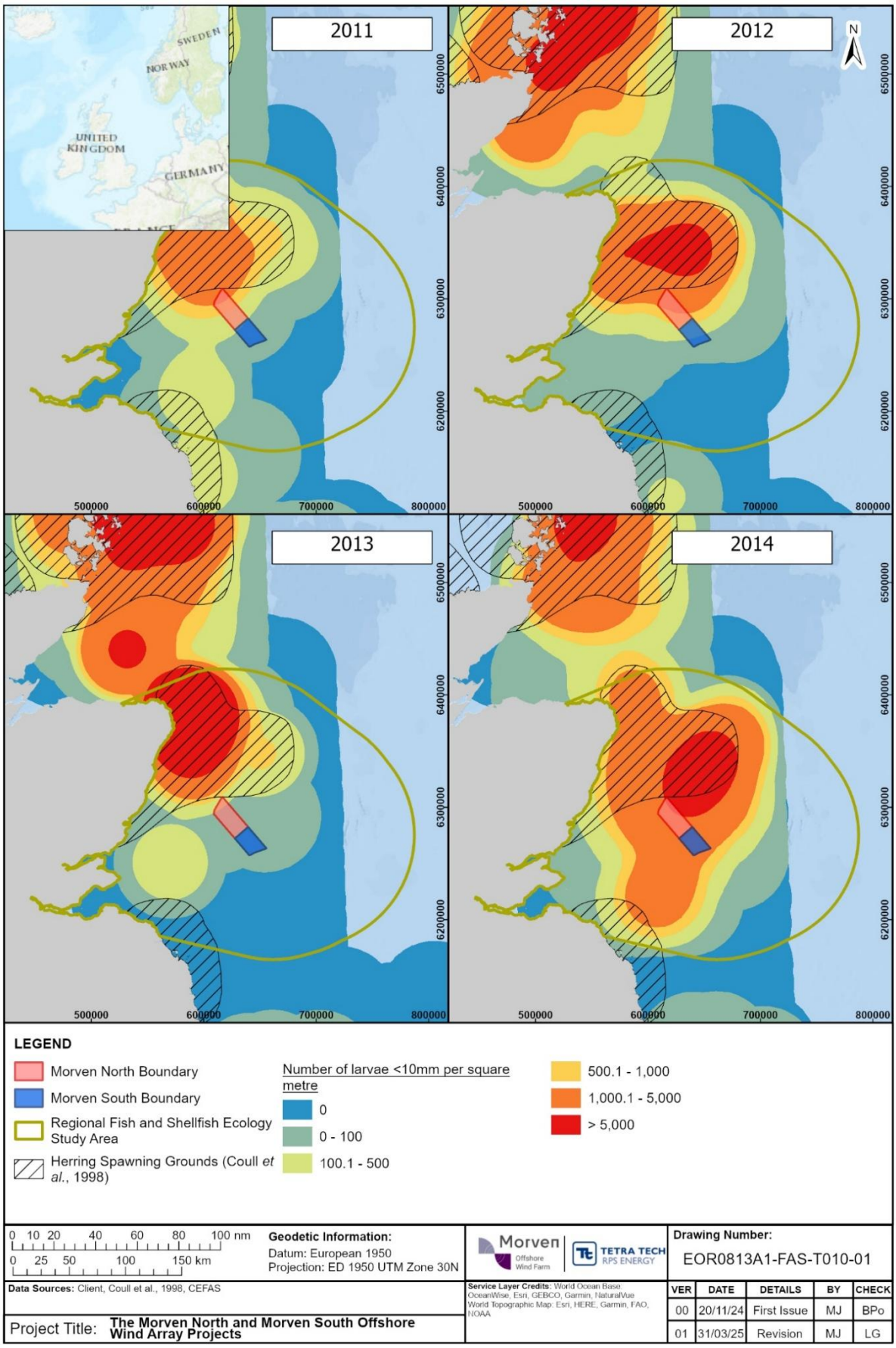

Figure 4.7: Herring larval density from IHLS datasets (2011 to 2014)

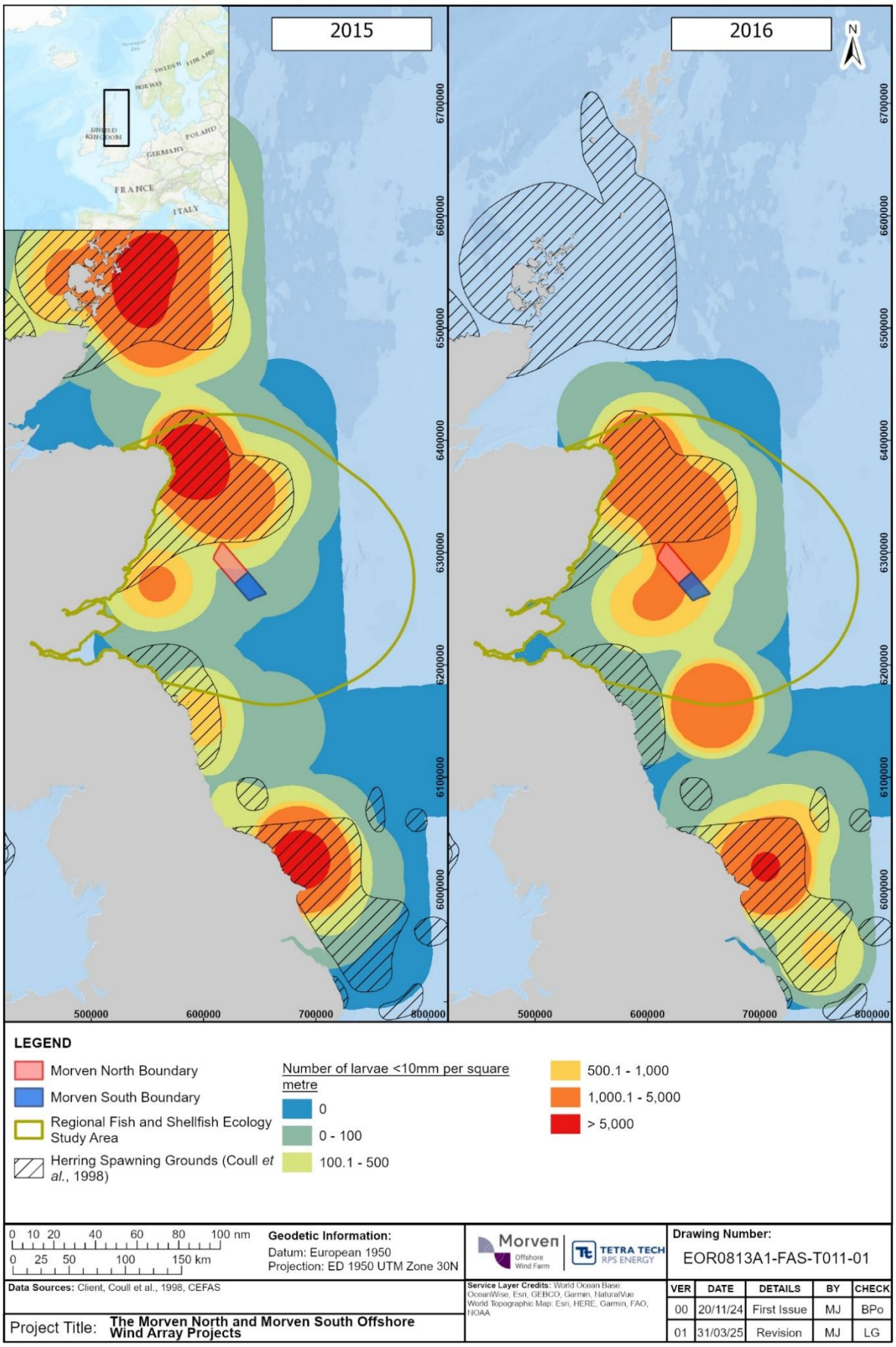

Figure 4.8: Herring larval density from IHLS datasets (2015 and 2016)

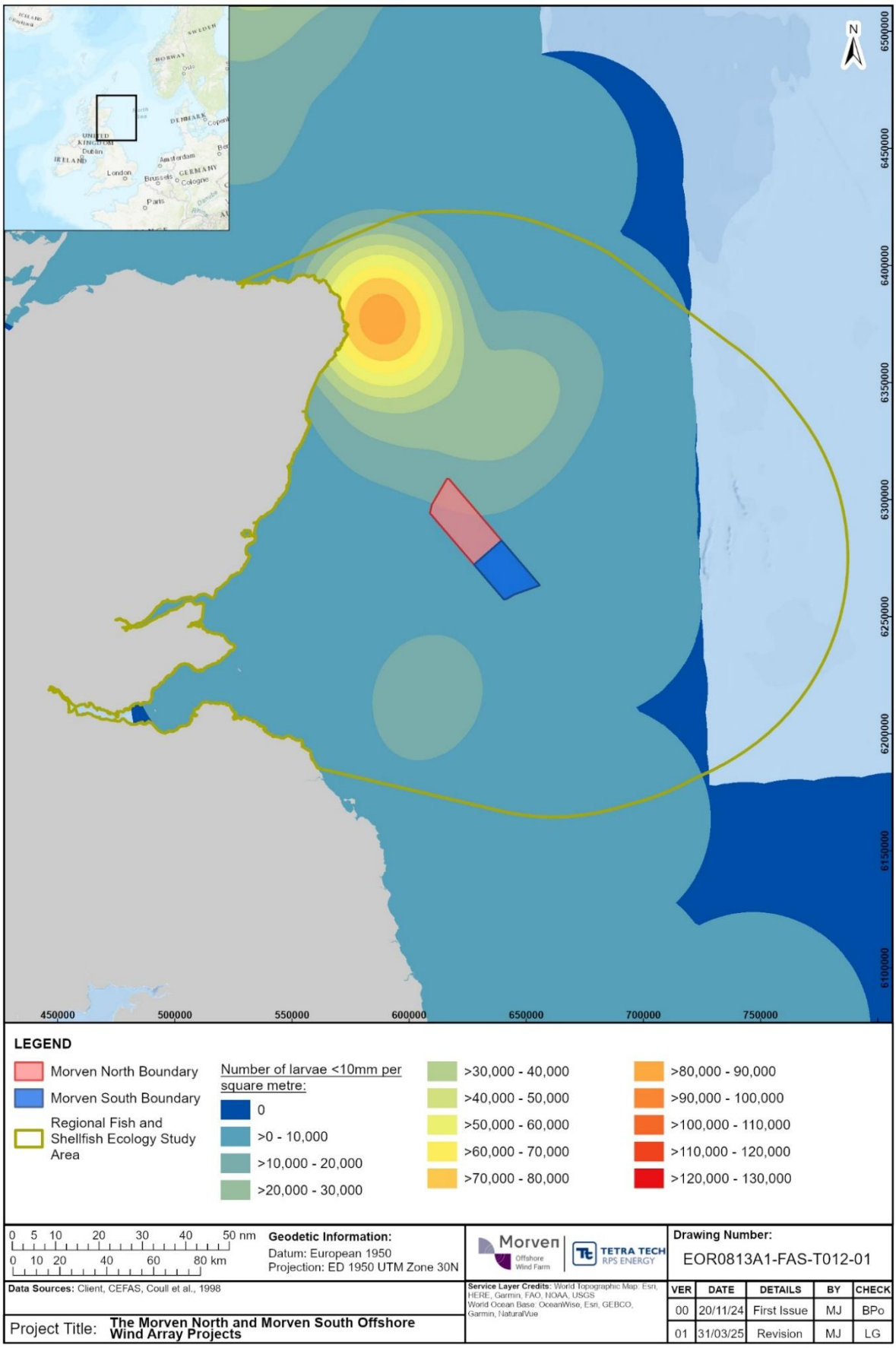

Figure 4.9: Cumulative herring larval density from IHLS datasets (2007 to 2016)

4.3.2 Site specific survey results

4.3.2.1 To characterise herring spawning habitats within the Morven North Fish and Shellfish Ecology Study Area and Morven South Fish and Shellfish Ecology Study Area, PSA and DNA metabarcoding data from the site specific benthic survey have been used to determine area of suitable substrate to support herring spawning activities.

4.3.2.2 PSA samples were collected at 100 stations in 2022 during the site specific benthic survey. Sample data were analysed to assign substrate suitability classifications for each station, for herring spawning. The potential spawning habitat sediment classifications for herring are given in Table 4.4 (from Reach *et al.*, 2013). Originally, these classifications were created for the marine aggregates industry, following Greenstreet *et al.*, (2010a), who examined the spatial interactions between herring spawning habitat and aggregate application areas.

Table 4.4: Herring spawning habitat sediment classifications (Reach *et al.*, 2013)

% Contribution (mud = <63µm)	Habitat sediment preference (adapted from Reach *et al.*, 2013)	Habitat sediment classification (adapted from Reach *et al.*, 2013)
<5% mud, >50% gravel	Prime	Preferred
<5% mud, >25% gravel	Sub-prime	Preferred
<5% mud, >10% gravel	Suitable	Marginal
>5% mud, <10% gravel	Unsuitable	Unsuitable

Morven North Fish and Shellfish Ecology Study Area

4.3.2.3 The substrate suitability criteria developed by Reach *et al.*, (2013) have been applied to inform the presence of substrates suitable for herring spawning within the Morven North Fish and Shellfish Ecology Study Area. The PSA data from all sampling stations across the Morven North Fish and Shellfish Ecology Study Area represented substrates that were classified as 'unsuitable' for herring spawning (as per Table 4.4) (Figure 4.10).

4.3.2.4 Seabed substrate data from EMODnet were used alongside the site specific survey data to provide further insight into herring spawning habitat suitability within the Morven North Fish and Shellfish Ecology Study Area. Areas of 'potential' and 'marginal' herring spawning habitat preference (sandy gravel, gravel, and gravelly sand) from the EMODnet dataset are presented in Figure 4.10. The Morven North Fish and Shellfish Ecology Study Area overlaps with some small areas of "marginal" spawning habitat from the EMODnet seabed substrate data. However, the broadscale EMODnet seabed substrate data tend to be less accurate than the site specific survey data, due to the lower data resolution of the former.

4.3.2.5 Site specific seawater and sediment eDNA metabarcoding detected the presence of herring in a total of six of the 38 eDNA samples from within the Morven North Fish and Shellfish Ecology Study Area (Gardline, 2023).

Morven South Fish and Shellfish Ecology Study Area

4.3.2.6 The substrate suitability criteria developed by Reach *et al.*, (2013) have been applied to inform the presence of substrates suitable for herring spawning within the Morven South Fish and Shellfish Ecology Study Area. The PSA data from all sampling stations across the Morven South Fish and Shellfish Ecology Study Area represented substrates that were classified as 'unsuitable' for herring spawning (as per Table 4.4) (Figure 4.10).

4.3.2.7 Seabed substrate data from EMODnet were used alongside the site specific survey data to provide further insight into herring spawning habitat suitability within the Morven South Fish and Shellfish

Ecology Study Area. The Morven South Fish and Shellfish Ecology Study Area overlaps with some small areas of 'marginal' spawning habitat from the EMODnet seabed substrate data (Figure 4.10). However, the broadscale EMODnet seabed substrate data tend to be less accurate than the site specific survey data, due to the lower data resolution of the former.

4.3.2.8 Site specific seawater and sediment eDNA metabarcoding detected the presence of herring in a total of three of the 29 eDNA samples from within the Morven South Fish and Shellfish Ecology Study Area (Gardline, 2023).

Regional Fish and Shellfish Ecology Study Area

4.3.2.9 These site specific PSA data were expanded upon at a regional scale using data obtained from the Cefas OneBenthic data portal. OneBenthic is a freely accessible, online repository where benthic data from, for example, Cefas, Oil and Gas UK, the JNCC, Marine Directorate, Natural England, and Environment Agency are standardised and amalgamated. The same criteria from Reach *et al.* (2013) (Figure 4.10) were applied to the PSA data extracted from OneBenthic.

4.3.2.10 These OneBenthic data are presented alongside site specific data in Figure 4.11 and illustrate that areas in the south of the Regional Fish and Shellfish Ecology Study Area were predominantly unsuitable for herring spawning. There were 'preferred' and 'marginal' spawning habitat classifications identified from grab samples in the north of the Regional Fish and Shellfish Ecology Study Area. These were located wholly within the herring spawning ground mapped by Coull *et al.* (1998), therefore the substrate composition supports the assumption of herring spawning potential (Figure 4.11).

4.3.2.11 Seabed substrate data from EMODnet were used alongside the OneBenthic data to provide further insight into herring spawning habitat suitability within the Regional Fish and Shellfish Ecology Study Area (Figure 4.11). The OneBenthic data, when amalgamated with EMODnet data, demonstrated patches of unsuitable herring spawning sediment throughout the Regional Fish and Shellfish Ecology Study Area, and areas of "potential" and "marginal" EMODnet seabed sediments broadly corresponded to the spawning grounds presented by Coull *et al.* (1998) (Figure 4.11).

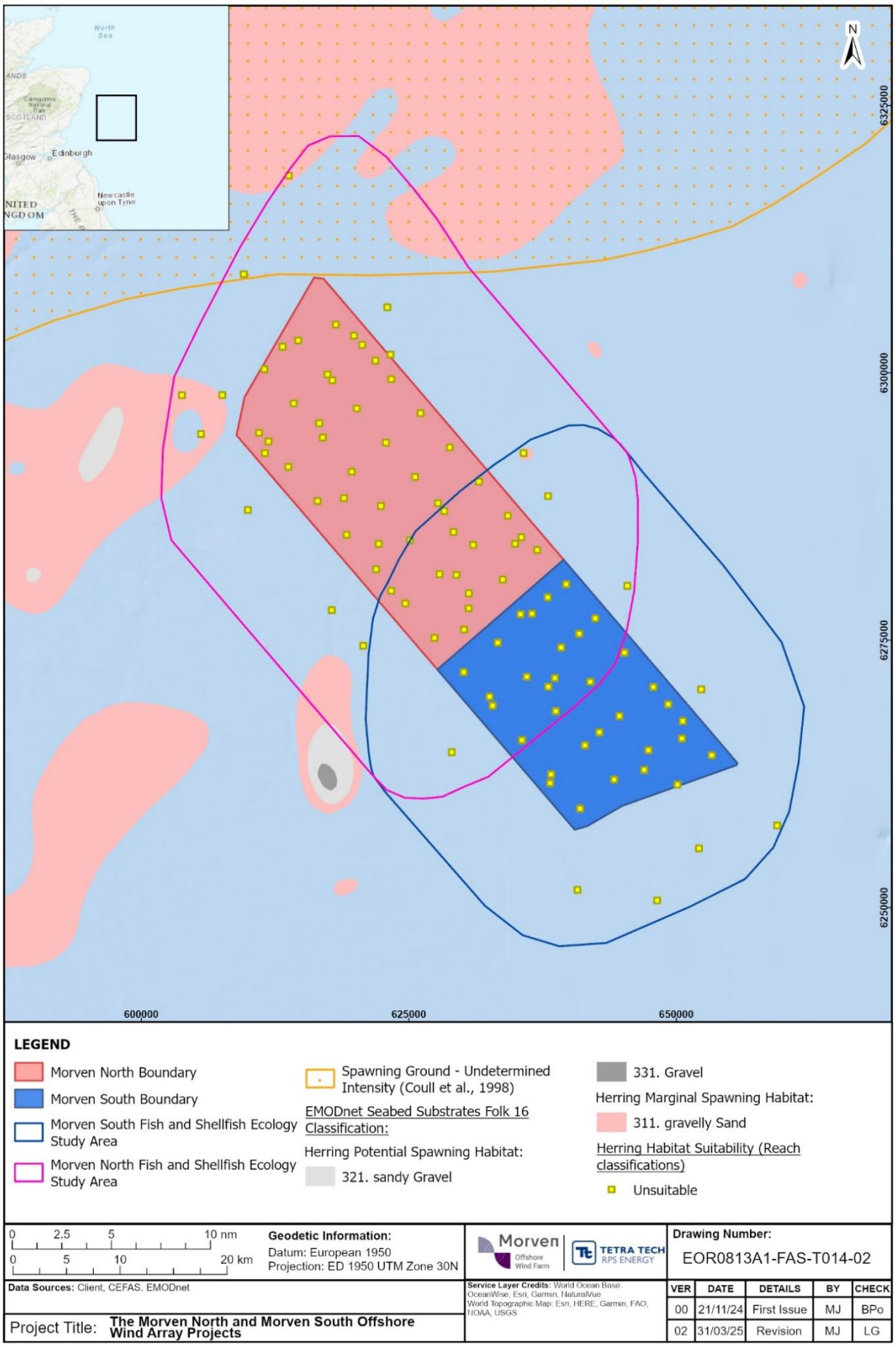

Figure 4.10: Herring spawning habitat suitability from site specific data, alongside EMODnet substrate data

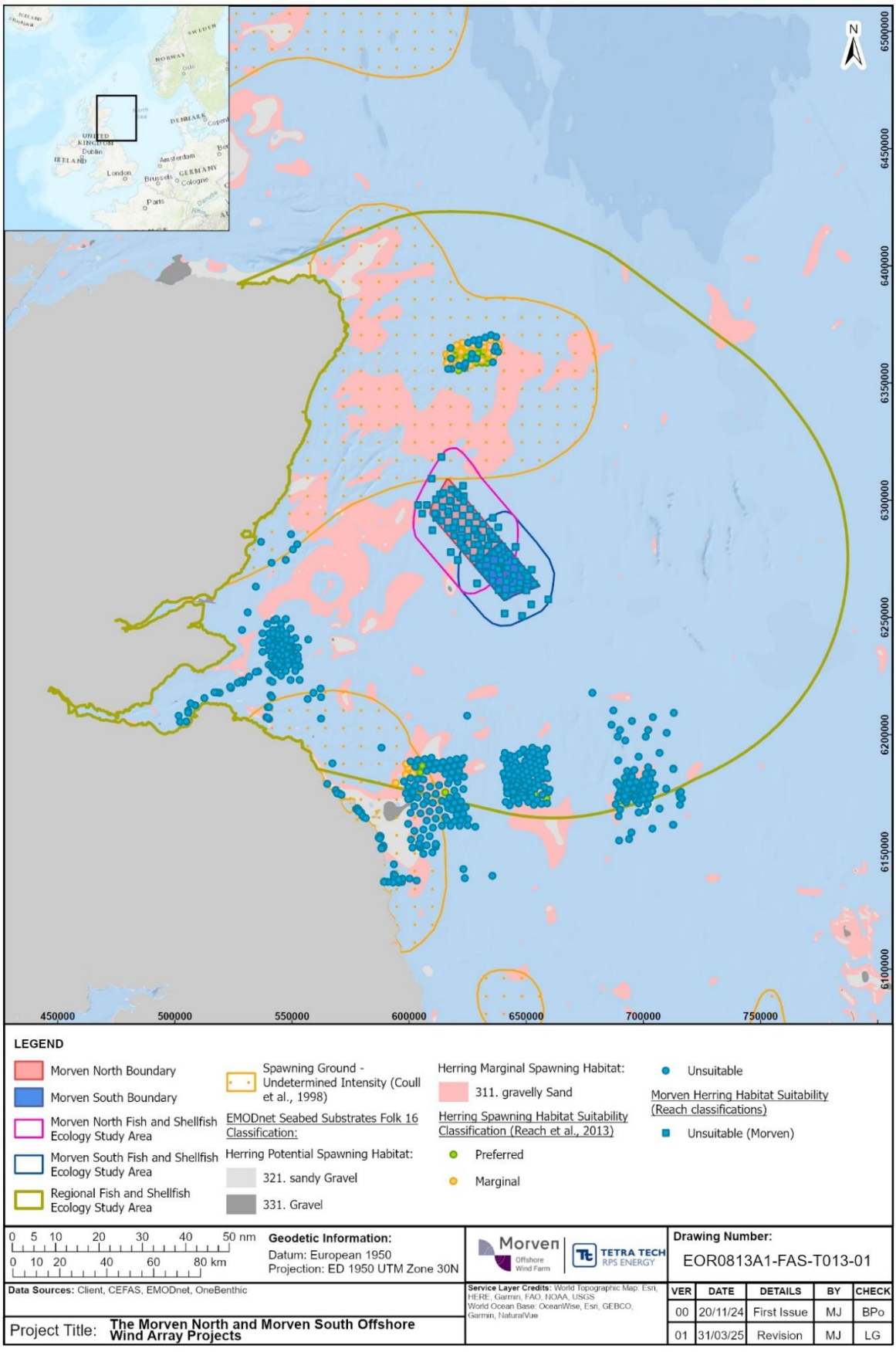

Figure 4.11: Herring spawning habitat suitability from site specific data (squares) and OneBenthic (circles), alongside EMODnet substrate data

4.4 Sandeel

4.4.1 Desktop study for the Regional Fish and Shellfish Ecology Study Area

4.4.1.1 Sandeel are ecologically important as they act as forage fish for many other marine and avian species. In the North Sea, sandeel were reported to account for approximately 25% of fish biomass by Christensen *et al.* (2013). Five sandeel species exist in the North Sea, with Raitt's sandeel being the most abundant; Raitt's sandeel was among the top ten species recorded from IBTS between 2019 and 2022. Raitt's sandeel, along with the lesser sandeel, are PMFs, although this section refers to all five species generally as Ammodytidae spp. Sandeel are present throughout European waters, as well as around Iceland and the Baltic. Maturity is reached at around 13cm total length. Sandeel swim in schools and are usually found in inshore waters. Sandeel tend to consume diatoms and zooplankton, and winter is spent in hibernation, buried in sand (Fishbase, 2023e). Within the Regional Fish and Shellfish Ecology Study Area, the Forth and Tay SMR has played an important role in supporting sandeel populations; the primary concentration of this population is centred around the Wee Bankie region. Nevertheless, sandeel are found throughout the wider North Sea, and during the early 1900s, there was a commercial sandeel fishery operating on the Wee Bankie, Marr Bank, and Berwick Bank sandbanks. By 1993, more than 100,000 tonnes were caught from these areas (Greenstreet *et al.*, 2010b). Due to fishing pressures, in 2000, the sandeel fishery was closed within the Forth and Tay SMR. During the initial closure, there was an upsurge in sandeel biomass on the Wee Bankie sandbank; this abrupt increase was attributed to a combination of robust recruitment and the absence of any substantial fishing activity (Greenstreet *et al.*, 2010b).

4.4.1.2 Between 2001 and 2010, sandeel biomass gradually declined, likely due to the absence of consistent recruitment considering heavy predation and natural mortality (Greenstreet *et al.*, 2010b). Since, there has been a recovery in sandeel stocks, leading to increased sandeel fishing near the previously closed area. Nevertheless, according to ICES (2022a), it was recently noted that the "escapement strategy" for sandeel stock management is not sustainable for short-lived species unless coupled with a limit on fishing mortality. Sandeel play a pivotal role as an umbrella species, connecting primary productivity to higher trophic levels, and any disturbances to sandeel populations can have cascading effects throughout the food chain. They primarily feed on phytoplankton and zooplankton in the water column during daylight hours, serving as a crucial prey item for various fish, seabirds, and marine mammals (Freeman *et al.*, 2004; Engelhard *et al.*, 2008). At night and during winter months, sandeel burrow into sediment, exhibiting high site fidelity and vulnerability to habitat loss (Jensen *et al.*, 2011; Latto *et al.*, 2013). This behaviour restricts their habitat to specific sediment particle sizes that allow penetration into the sediment.

4.4.1.3 During spring and summer months, sandeel tend to feed in schools within a 10km radius of their burrowing sites as an energy-saving adaptation to avoid predation (Wright *et al.*, 2019). They remain buried in the seabed from September to February, with sporadic emergence between December and February for spawning, during which they deposit a single batch of demersal eggs on the seabed (van der Kooij *et al.*, 2008). Larvae hatch between February and April and drift as plankton with currents for ten weeks (Wright and Bailey, 1996; Régnier *et al.*, 2017; Proctor *et al.*, 1998; Wright *et al.*, 2019). After metamorphosis, juveniles return to the demersal environment in search of suitable sandy areas to inhabit. There is evidence suggesting that the survival of sandeel larvae is closely linked to the availability of copepod prey in early spring, particularly Calanus finmarchicus, and that shifts in Calanus species composition due to climate change can disrupt the timing of food availability and the early life stages of lesser sandeel (Wright and Bailey, 1996; van Deurs *et al.*, 2009).

4.4.1.4 Further research by Langton *et al.* (2021) involved the development of a predictive distribution model for sandeel, estimating density and the probability of occurrence for sandeel along the British coastline. This modelling relied on the dependence of sandeel on specific habitat types, with the primary explanatory variables being silt, depth, sand, and slope, and it was supported by sandeel fisheries data (e.g., data from Jensen *et al.*, 2011). The results were mapped, highlighting significant sandeel population areas in the North Sea, including within the Regional Fish and Shellfish Ecology Study Area, to the southwest of the Morven North Boundary and Morven South Boundary (Figure

4.12). These areas align with previous studies where marine mammals and birds are known to congregate and feed on sandeel (Langton *et al.*, 2021).

4.4.1.5 Further, sandeel aggregation modelling (from frequencies of occurrence in years 2010 to 2020 surveys) were conducted by Franco *et al.* (2023). This study reported a high confidence of Raitt's sandeel absence regarding the potential for aggregations throughout the east Scottish coast from Q4 surveys between 2010 and 2020.

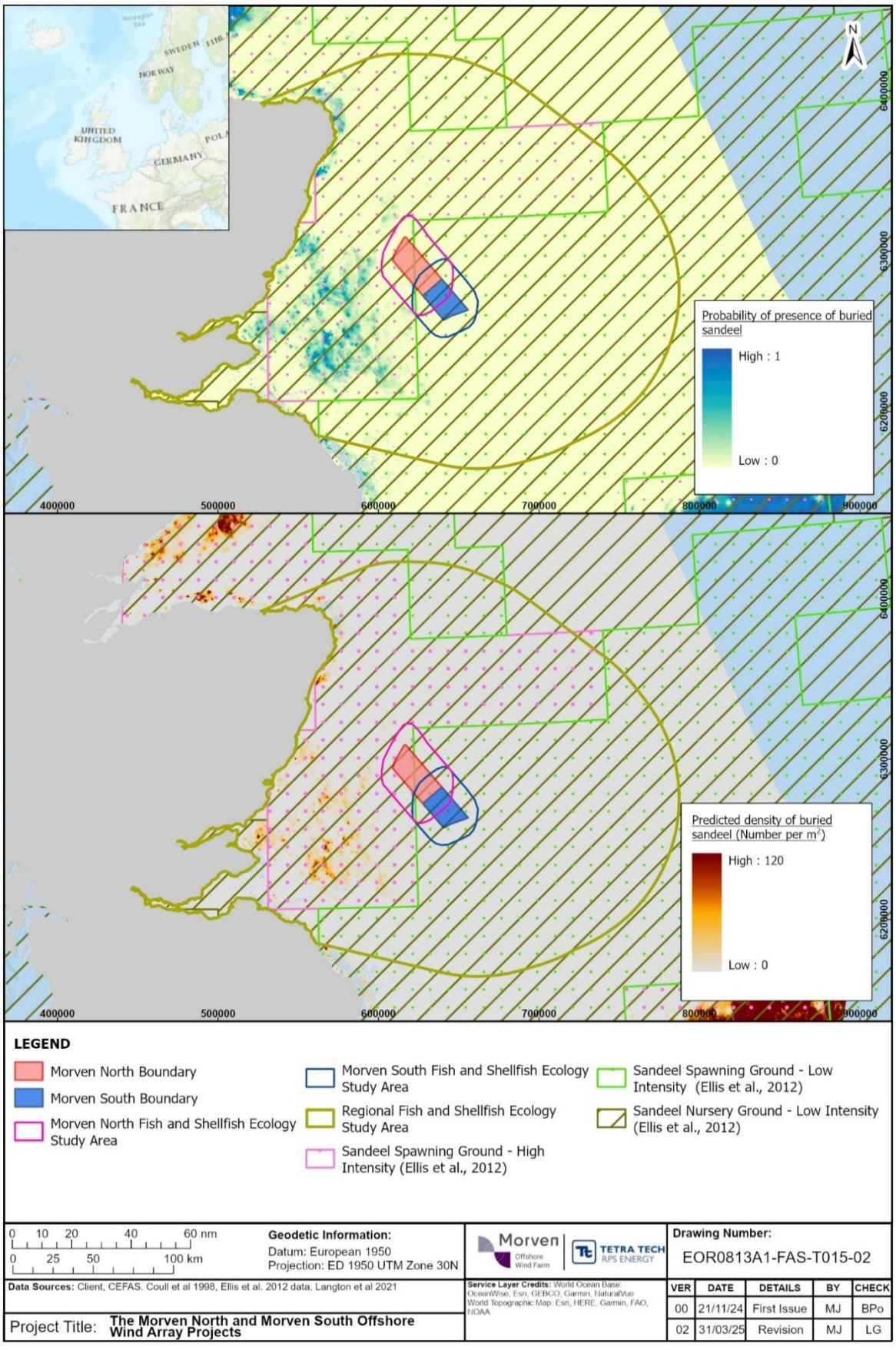

Figure 4.12: Model derived predictions of density and probability of sandeel presence within the Regional Fish and Shellfish Ecology Study Area

4.4.2 Site specific survey results

4.4.2.1 Site specific survey data were gathered and analysed in conjunction with desktop research to evaluate the extent of suitable sandeel habitat within the vicinity both Morven North Fish and Shellfish Ecology Study Area and Morven South Fish and Shellfish Ecology Study Area. Sediment grab samples were collected during 2022, with the PSA data used to assess sandeel spawning habitat suitability. This analysis enabled the classification of sediment types in accordance with the methodology outlined by Latto *et al.* (2013) (Table 4.5). As with herring, these classifications were initially formulated for the marine aggregates sector, building upon research by Greenstreet *et al.* (2010a) and Holland *et al.* (2005), to explore the spatial relationships between areas designated for aggregate applications and sandeel habitat.

4.4.2.2 Greenstreet *et al.* (2010a) defined four sandeel sediment preference categories, combining fine sand, three silt grades, and two coarser sand grades into two particle size classes: silt and fine sand, and coarse sand. They then examined the combined impact of these two sediment particle size grades on the percentage of grab samples containing sandeel. Latto *et al.* (2013) utilised this research to establish four sandeel sediment preference categories, as shown in Table 4.5. Comparatively, the EMODnet seabed substrate data (Folk, 1954) is less accurate than the site specific survey data, due to EMODnet's lower data resolution, though remains valuable for providing a broadscale overview of the surrounding substrate.

Table 4.5: Sandeel spawning habitat sediment classifications (Latto *et al.*, 2013)

% Contribution (mud = <63µm)	Habitat sediment preference (adapted from Latto *et al.*, 2013)	Habitat sediment classification (adapted from Latto *et al.*, 2013)
<1% mud, >85% sand	Prime	Preferred
<4% mud, >70% sand	Sub-prime	Preferred
<10% mud, >50% sand	Suitable	Marginal
>10% mud, <50% sand	Unsuitable	Unsuitable

Morven North Fish and Shellfish Ecology Study Area

4.4.2.3 The substrate suitability criteria developed by Latto *et al.*, (2013) have been applied to inform the presence of substrates suitable for sandeel spawning within the Morven North Fish and Shellfish Ecology Study Area (Figure 4.13). This figure shows that the Morven North Fish and Shellfish Ecology Study Area overlaps with high intensity spawning grounds (Ellis *et al.*, 2012) in the northwest. Low intensity spawning habitat is also present within the Morven North Fish and Shellfish Ecology Study Area (Figure 4.13). Within the Morven North Fish and Shellfish Ecology Study Area, "marginal" habitat suitability was most commonly recorded using the site specific PSA data. There was one sample station assigned as "preferred" spawning habitat suitability based on the PSA data, in the northwest, outside of the Morven North Boundary itself. Several sampling stations were assigned as "unsuitable" (Figure 4.13).

4.4.2.4 Using the seabed substrate data layer from EMODnet, "preferred" sandeel habitat sediment classifications were present across the Morven North Fish and Shellfish Ecology Study Area (Figure 4.13). The broadscale EMODnet seabed substrate data (Folk, 1954) tends to be less accurate than the site specific survey data, due to EMODnet's lower data resolution, though remains valuable for providing a broadscale overview of the surrounding substrate.

4.4.2.5 Site specific survey findings obtained throughout the Morven North Fish and Shellfish Ecology Study Area have incidentally provided data regarding the presence of sandeel within it. For example, in the underwater imagery collected, sandeel were observed free-swimming and buried within the sediment at two sample stations within the Morven North Fish and Shellfish Ecology Study Area. Seawater and sediment eDNA metabarcoding also detected the presence of sandeel within a total of 42 samples within Morven North Fish and Shellfish Ecology Study Area. Finally, one individual sandeel was

recorded in a grab sample within the Morven North Fish and Shellfish Ecology Study Area (Gardline, 2023). However, as grab sampling is not specifically designed to target sandeel, these results should be viewed as incidental and opportunistic in nature. The absence or low abundances of sandeel in samples and imagery should not be taken as an absence of sandeel from the area, or that the area is of low importance to this species group.

Morven South Fish and Shellfish Ecology Study Area

4.4.2.6 The substrate suitability criteria developed by Latto *et al.*, (2013) have been applied to inform the presence of substrates suitable for sandeel spawning within the Morven South Fish and Shellfish Ecology Study Area (Figure 4.13). This figure shows that the Morven South Fish and Shellfish Ecology Study Area largely overlaps with low intensity spawning grounds (Ellis *et al.*, 2012). Within the Morven South Fish and Shellfish Ecology Study Area, "marginal" habitat suitability was most commonly recorded using the PSA data. There was one sample station assigned as "preferred" spawning habitat suitability based on the PSA data, with several assigned as "unsuitable" (Figure 4.13).

4.4.2.7 Using the seabed substrate data layer from EMODnet, "preferred" sandeel habitat sediment classifications were present across the Morven South Fish and Shellfish Ecology Study Area (Figure 4.13). The broadscale EMODnet seabed substrate data (Folk, 1954) tends to be less accurate than the site specific survey data, due to EMODnet's lower data resolution, though remains valuable for providing a broadscale overview of the surrounding substrate.

4.4.2.8 Site specific survey findings obtained throughout the Morven South Fish and Shellfish Ecology Study Area have incidentally provided data regarding the presence of sandeel within it. In the underwater imagery collected, sandeel were observed free-swimming and buried within the sediment at one sample station within the Morven South Fish and Shellfish Ecology Study Area. Seawater and sediment eDNA metabarcoding also detected the presence of sandeel within a total of 30 samples within the Morven South Fish and Shellfish Ecology Study Area. There were no sandeel present in any grab samples collected within the Morven South Fish and Shellfish Ecology Study Area (Gardline, 2023). However, as grab sampling is not specifically designed to target sandeel, these results should be viewed as incidental and opportunistic in nature. The absence or low abundances of sandeel in samples and imagery should not be taken as an absence of sandeel from the area, or that the area is of low importance to this species group.

Regional Fish and Shellfish Ecology Study Area

4.4.2.9 As above in Section 4.3 for herring, PSA data from the OneBenthic portal have been assessed to provide further information on spawning habitat suitability of sandeel within the Regional Fish and Shellfish Ecology Study Area (Figure 4.14). These PSA data were assessed for spawning habitat suitability using the classifications provided in Latto *et al.*, (2013) (Table 4.5). These data demonstrated that substrates near the Firth of Forth were largely unsuitable for sandeel spawning, whilst those at the south of the Regional Fish and Shellfish Ecology Study Area were more variable, with some "marginal" and "preferred" data points (Figure 4.14). A patch of OneBenthic PSA datapoints from the north of the Regional Fish and Shellfish Ecology Study Area were mostly assigned to the 'preferred' and 'marginal' spawning classifications (Figure 4.14). These data points correspond to the Turbot Bank MPA, which is designated for sandeel, highlighting the importance of these northern areas of the Fish and Shellfish Ecology Study Area (see Section 4.9 for more information on designated sites).

4.4.2.10 The PSA data from OneBenthic and the site specific benthic survey do not wholly correspond to the EMODnet seabed substrate data, which suggested that the majority of the Regional Fish and Shellfish Ecology Study Area comprised preferred substrates for sandeel, based upon the Folk (1954) classification. This highlights potential patchiness in the substrate composition throughout the Regional Fish and Shellfish Ecology Study Area, and the high degree of interpolation built into the EMODnet data.

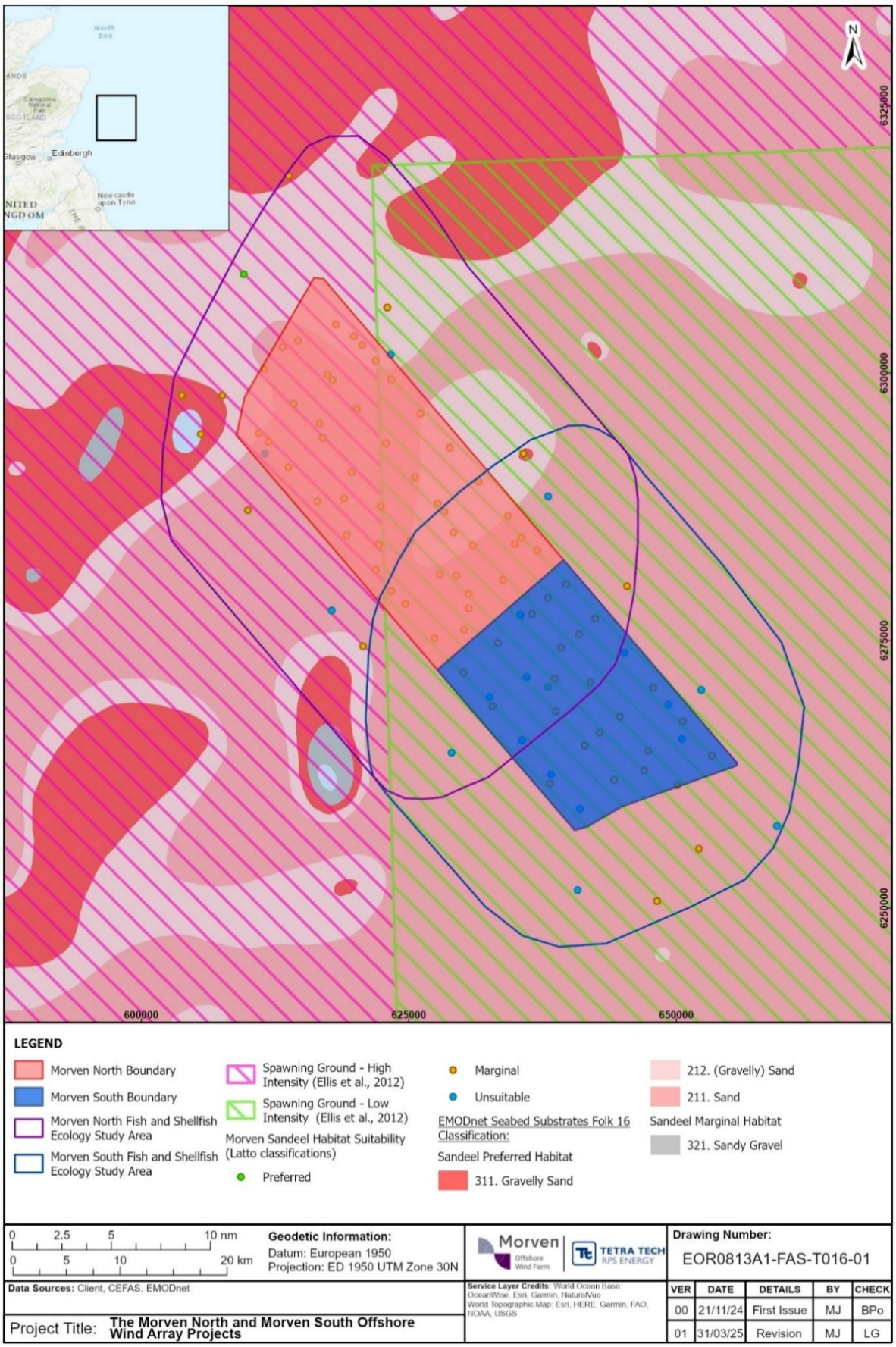

Figure 4.13: Sandeel Spawning Habitat Suitability from Site Specific Data, alongside EMODnet Substrate Data

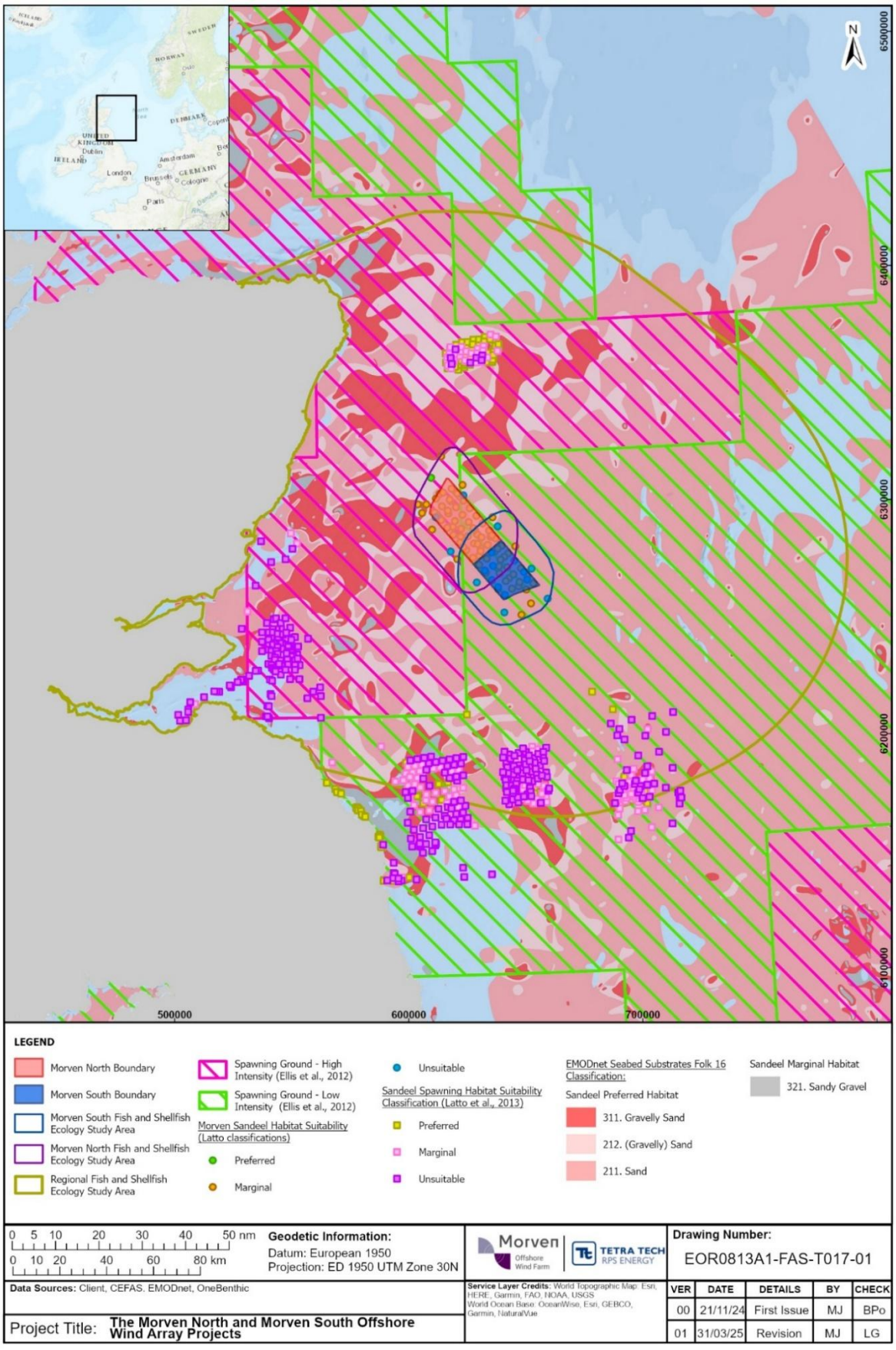

Figure 4.14: Sandeel spawning habitat suitability from site specific (circles) and OneBenthic (squares) data, alongside EMODnet substrate data

4.5 Other teleost fish

4.5.1 Regional Fish and Shellfish Ecology Study Area

4.5.1.1 Fish and shellfish spatiotemporal abundances and distributions are largely influenced by water temperature, salinity, depth, substrate type, and presence and abundances of prey and predators. Competition (both intraspecific and interspecific) for resources will also influence fish and shellfish population dynamics, as will anthropogenic pressures, such as the presence of marine and coastal infrastructure, and fishing activities. The Regional Fish and Shellfish Ecology Study Area is located within ICES area IVb where the dominant demersal teleost species include cod, haddock, lemon sole, ling, plaice, saithe, sandeel, and whiting. Dominant pelagic species include herring, mackerel, and sprat (Coull *et al.*, 1998; Baxter *et al.*, 2011; Ellis *et al.*, 2012).

4.5.1.2 Commercial fisheries for demersal and pelagic teleost fish exist in the northern North Sea. Further, the IBTS is carried out routinely to capture the population dynamics of the demersal species throughout the northeast Atlantic and Baltic Sea. IBTS trawl data between 2019 and 2023 have been used to ascertain the most recorded species within the Regional Fish and Shellfish Ecology Study Area and to identify any changes in population dynamics within the last five years (ICES, 2022b).

4.5.1.3 Between 2019 and 2023, IBTS data (from 712 hauls) found the most commonly recorded fish and shellfish were haddock, herring, whiting, dab, Norway pout, sprat, Raitt's sandeel, lesser sandeel, grey gurnard, European common squid (Alloteuthis ammarus) and long rough dab (ICES, 2022b). At least nine of the overall top ten aforementioned species comprised the top ten species within each survey year between 2019 and 2023. In 2022, mackerel replaced European common squid, and in 2023, Nephrops replaced Raitt's sandeel (ICES, 2022b). The consistency of the results implies a good indication of the characteristic species within the Regional Fish and Shellfish Ecology Study Area and wider northern North Sea. Details of key species are given below.

Cod

4.5.1.4 Cod are cosmopolitan in European waters and occupy depths from the surface (juveniles) to 600m (adults). Cod tend to reach maturity at 65.4cm total length and produce sounds to communicate during courtship and spawning, as well as to detect prey and avoid predators (Hawkins and Popper, 2020). As courtship sounds amongst cod are important for their reproduction (females are able to differentiate sounds from different males to assess desirability of mates), this trait tends to make cod sensitive to underwater sounds which might mask intraspecific communications (Engen and Folstad, 1998). Cod also tend to spawn in winter and during the beginning of spring. Fecundity is high for cod; females can produce from 2.5 million eggs, up to 9 million in some cases (Fishbase, 2023a). Spawning and nursery grounds for cod have been identified across the Regional Fish and Shellfish Ecology Study Area (Figure 4.1).

Plaice

4.5.1.5 Plaice are found in European waters in depths down to 300m. Plaice mature around 33cm total length and spawn in cool temperatures of around 6oC. As demersal species, plaice dwell on the seabed and are largely opportunistic in their diets (Fishbase, 2023b). The IBTS data from 2021, 2022 and 2023 also found plaice to be in low abundances. Like cod, plaice specimens were recorded as tens of specimens per hour trawled (ICES, 2022b), with no seasonal or age distributions apparent. Spawning and nursery grounds for plaice have been identified across the Regional Fish and Shellfish Ecology Study Area (Figure 4.3).

Mackerel

4.5.1.6 Mackerel are found throughout European waters, as well as around eastern USA, Canada, and Greenland. Mackerel tend to occupy water from the surface down to 1,000m. Mackerel swim in schools, usually close to the surface, though they occupy deeper waters during winter. Mackerel

primarily consume zooplankton and small fish and are a batch spawner which produce pelagic eggs (Fishbase, 2023d). IBTS data found mackerel to be in highest abundances at the end of the year in 2022, whereas in 2022 and 2023 at the beginning of the years, average abundances were lowest. These data imply northern North Sea mackerel are sporadic, with hauls catching no mackerel, up to >246,000 individuals (ICES, 2022b). There are nursery grounds for mackerel across the Regional Fish and Shellfish Ecology Study Area, with some areas of spawning ground to the east (Figure 4.3).

Sprat

4.5.1.7 Sprat mature at around 10cm fork length and often exhibit schooling in inshore waters. Sprat migrate between winter and summer (the summer being their spawning season) and spawn in depths of 10m to 20m, during which 6,000-14,000 eggs are produced, which are pelagic and are carried by currents (Fishbase, 2023f). There are spawning and nursery grounds for sprat within the centre of the Regional Fish and Shellfsih Ecology Study Area (overlapping with the Morven North Boundary and Morven South Boundary) (Figure 4.3). IBTS data show thousands of sprat per hour trawled, implying high abundances in the northern North Sea. Like mackerel, however, abundances appeared sporadic and in 2021 and 2022, there was a decrease in age five fish abundances (ICES, 2022b).

Whiting

4.5.1.8 Whiting tend to occupy waters in depths of 10m to 200m and reach maturity at 28.2cm fork length. Whiting have a generalist diet consisting of fish, crustaceans and molluscs. They have a relatively high fecundity with females producing up to 400,000 eggs during the January to September spawning months. Their eggs are pelagic and are carried by water currents (Fishbase, 2023g). IBTS data for whiting showed high abundances in the northern North Sea; for example, at the start of 2023, up to 8,000 specimens were captured per hour trawled. In start and end of year hauls, juvenile whiting (up to two years old) accounted for the highest abundances (ICES, 2022b). Spawning and nursery grounds for whiting are present across the Regional Fish and Shellfish Ecology Study Area (Figure 4.4).

4.5.2 Morven North Fish and Shellfish Ecology Study Area

4.5.2.1 Sediment eDNA metabarcoding was used to identify the presence of fish DNA, including clupeids (herring, sprat), gadoids (cod, haddock, Norway pout, and whiting), flatfish (dab, lemon sole, long rough dab, plaice, and witch (Glyptocephalus cynoglossus)), gurnards (Family: Triglidae), mackerel, and sandeel (Family: Ammodytidae) (Gardline, 2023). eDNA residence time in the sediment can potentially extend to years, therefore sediment eDNA may not be wholly representative of the current biological environment. Sedimentary eDNA can also be subject to resuspension and hydrodynamic transport away from the location where the eDNA material was shed, meaning spatial results should be interpreted with caution (Turner *et al.*, 2015).

4.5.2.2 Seawater eDNA metabarcoding revealed almost all the same fish as the sediment DNA (except witch), with the additions of Norwegian topknot, gobies (crystal goby (Crystallogobius linearis) and sand goby), northern rockling (Ciliata septentrionalis) and spotted dragonet (Gardline, 2023). eDNA fragments in seawater are considered relatively short-lived, degrading at a faster rate than those which become sediment bound and are therefore thought to be more reflective of the contemporary environment. eDNA fragments in seawater are considered to represent the local environment, with a maximum residence of approximately three days prior to degradation, although eDNA in offshore environments is reported to degrade at a slower rate than in inshore environments (Cristescu and Herbert, 2018). These data provide a snapshot of the species present at the time of sampling only, therefore only capture records of those species which have shed DNA at that time. eDNA can also be present in the form of excreted materials, or moribund organisms, therefore may not be fully representative of live individuals only (i.e. providing a “false positive” detection); as such, it is important to corroborate species lists generated using eDNA with desktop data and other observational information available (Roussel *et al.*, 2015).

4.5.2.3 Teleost fish species recorded from the underwater DDV imagery survey included sandeel, flatfish (dab, plaice, lemon sole, flounder, sole, witch), gadoids (cod, haddock), gurnards (red gurnard, grey gurnard, anglerfish, dragonets (Callionymus spp.) and gobies (Gardline, 2023).

4.5.2.4 There were no teleost fish species recorded during the DAS conducted for ornithology and marine mammals within the Morven North Fish and Shellfish Ecology Study Area (APEM, 2024).

4.5.3 Morven South Fish and Shellfish Ecology Study Area

4.5.3.1 The teleost fish assemblage recorded during eDNA and DDV surveys described in paragraphs 4.5.2.1 to 4.5.2.4 was also represented in the sample stations within the Morven South Fish and Shellfish Ecology Study Area and are equally relevant here.

4.5.3.2 There was one teleost fish species recorded during the DAS conducted for ornithology and marine mammals within the Morven South Fish and Shellfish Ecology Study Area. One Atlantic bluefin tuna *Thunnus thynnus* was observed in November 2022 (APEM, 2024).

4.6 Elasmobranchs

4.6.1 Regional Fish and Shellfish Ecology Study Area

4.6.1.1 Elasmobranchs are cartilaginous fish which include sharks, skates, and rays. Within the Regional Fish and Shellfish Ecology Study Area, basking shark (*Cetorhinus maximus*), spotted ray, thornback ray, tope shark, small-spotted catshark, spurdog, common skate (*Dipturis batis*), thorny skate and cuckoo ray may occur (Coull *et al.*, 1998; Daan *et al.*, 2005; Baxter *et al.*, 2011; Ellis *et al.*, 2012). Whilst no fisheries directly target these species, some have commercial value albeit not locally to Morven North or Morven South. Nursery grounds exist for some of these species within the Regional Fish and Shellfish Ecology Study Area (Ellis *et al.*, 2012) and are discussed in Section 4.2 above. Whilst this is not an exhaustive list, species accounts for key elasmobranchs in the Regional Fish and Shellfish Ecology Study Area are presented in the following sections.

Basking shark

4.6.1.2 Basking shark are large, ovoviviparous (they give birth to live young once females reach maturity at around 11 years old) filter feeders which migrate long distances. Whilst usually solitary, they sometimes aggregate when zooplankton (their prey) densities are high (Speedie, 1999; Sims and Quayle, 1998; Sims, 1999)).

4.6.1.3 Basking shark migrations have been documented from Scotland down to north Africa, and local (off Scotland and the Isle of Man) tagging of 28 basking sharks showed an average migration distance of 1,057km. Basking shark migrations appear to be influenced by environmental conditions, with predictors of presence being associated with high zooplankton densities (Sims and Quayle, 1998; Sims, 1999), where sea surface temperatures are between 15°C to 17.5°C (Skomal *et al.*, 2004; Cotton *et al.*, 2005), and where thermal fronts are present (Sims and Quayle, 1998; Jeewoonarain *et al.*, 2000). Basking shark are therefore vulnerable to environmental changes which may affect sea temperatures, thermal properties of water, and spatiotemporal abundances and distributions of zooplankton. As basking shark are slow growing and late to mature, recoverability from adverse environmental changes would be slow; therefore, basking shark are listed as “vulnerable” on the International Union for the Conservation of Nature (IUCN) Red List, and on “endangered” according to the European Red List for cartilaginous fish. Basking shark are also listed as PMFs in Scotland, among other conservation designations.

Common skate

4.6.1.4 Common skate are listed as “critically endangered” by the IUCN, are a slow growing species with late maturity and low fecundity. Common skate reach maturity at approximately 150cm total length for

males and 180cm total length for females; the females lay eggs onto seabed structures and substrate, with eggs hatching after two to five months. Common skate are also susceptible to overfishing (Griffiths *et al.*, 2010). Most recordings of common skate have been from the west coast of Scotland, Irish Sea, and English Channel (NBN Atlas, 2023), with two distinct populations (southern British Isles and Rockall, and the west coast of Scotland). Further, nursery grounds of common skate exist within the Regional Fish and Shellfish Ecology Study Area (Figure 4.5), implying common skate may be present there throughout spring and summer for spawning and egg hatching (FishBase, 2022).

Spotted ray

4.6.1.5 Spotted ray are listed as of 'least concern' on the IUCN Red List (Ellis *et al.*, 2015). Spotted ray mature at around 34cm to 40cm total length for males and 39cm to 42cm total length for females. The females produce 60 to 70 egg capsules annually, which attach to seabed structures and substrates before hatching. Juvenile specimens tend to occur on inshore sandy sediments, and adults appear on sand and coarse sand-gravel sediments further offshore. These habitat preferences are believed to be due to prey availability; juvenile spotted ray tend to predate on small crustaceans, whereas adults target larger crustaceans and fish (Ellis *et al.*, 2015). Low intensity nursery grounds are present within the Regional Fish and Shellfish Ecology Study Area (Figure 4.4) implying, like for common skate, spotted ray may be present.

Spurdog

4.6.1.6 Spurdog are listed as 'vulnerable' on the IUCN Red List (Finucci *et al.*, 2020) and are a PMF. Spurdog are slow growing, and females mature at around 15 years old. Once mature, they produce only a small litter of pups (between two to three pups). Spurdog are recorded all around the British Isles and occupy inshore and offshore waters down to 2,000m (Cox and Francis, 1997). Spurdog are often caught as bycatch in commercial and recreational fisheries. As with spotted ray, spurdog nursery grounds are located within the Regional Fish and Shellfish Ecology Study Area (Figure 4.5), implying spurdog may be present, particularly during winter months when pups are born (Pawson and Ellis, 2005).

Tope shark

4.6.1.7 Tope shark are listed as "critically endangered" on the IUCN Red List. Tope have low fecundity (litter sizes range from 10 to over 50) and mature late (around 10 years of age) and these factors, combined with fishing pressures from commercial and recreational fisheries, have led to significant stock reductions. In the northeast Atlantic, the tope shark subpopulation is believed to have reduced by 76% over 79 years (Walker *et al.*, 2020). Tope shark nursery grounds are present within the Regional Fish and Shellfish Ecology Study Area, implying this species may be present (Figure 4.5).

Other elasmobranchs

4.6.1.8 Angel shark (Squatina squatina) are listed as "critically endangered" on the IUCN Red List and have been observed in the Firth of Forth. However, it is likely that specimens in this area are transient, rather than resident in high abundances.

4.6.2 Morven North Fish and Shellfish Ecology Study Area

4.6.2.1 There were three elasmobranchs recorded during the DAS conducted for ornithology and marine mammals within the Morven North Fish and Shellfish Ecology Study Area. One blue shark Prionace glauca in November 2022, one basking shark Cetorhinus maximus in November 2022, and one unidentified shark in May 2021 (APEM, 2024).

4.6.2.2 There were two unidentified rays (Order: Rajiformes) identified in the imagery from sample stations 25 and 99 (which are within the overlap between the Morven North Fish and Shellfish Ecology Study Area and Morven South Fish and Shellfish Ecology Study Area) (see Figure 3.1). Finally, there were

five cuckoo rays identified within the imagery in the Morven North Fish and Shellfish Ecology Study Area (it should be noted that two were from sample stations which overlap with Morven South Fish and Shellfish Ecology Study Area: 23 and 86) (Gardline, 2023).

4.6.2.3 There were no elasmobranchs recorded during the seawater or sediment eDNA sampling from stations within the Morven North Fish and Shellfish Ecology Study Area (Gardline, 2023).

4.6.3 Morven South Fish and Shellfish Ecology Study Area

4.6.3.1 There were no elasmobranchs recorded during the DAS conducted for ornithology and marine mammals within the Morven South Fish and Shellfish Ecology Study Area (APEM, 2024).

4.6.3.2 There was one thornback ray identified from imagery collected during the site specific benthic survey within the Morven South Fish and Shellfish Ecology Study Area (Gardline, 2023). There were two unidentified rays (Order: Rajiformes) identified in sample stations 25 and 99 (which are within the overlap between the Morven North Fish and Shellfish Ecology Study Area and Morven South Fish and Shellfish Ecology Study Area) (see Figure 3.1). Finally, there were two cuckoo rays identified within the imagery in the Morven South Fish and Shellfish Ecology Study Area (it should be noted that these were from sample stations which overlap with Morven North Fish and Shellfish Ecology Study Area: 23 and 86) (Gardline, 2023).

4.6.3.3 One record of thorny skate was identified in the seawater eDNA metabarcoding from a sample station within the Morven South Fish and Shellfish Ecology Study Area, but none from the sediment eDNA sampling (Gardine, 2023).

4.7 Shellfish

4.7.1 Regional Fish and Shellfish Ecology Study Area

4.7.1.1 Fisheries landing data presented in paragraphs 4.1.1.11 *et seq.* has been used to determine the shellfish assemblage within the Regional Fish and Shellfish Ecology Study Area. Commonly landed species include Nephrops, Eureopan lobster, edible crab, velvet swimming crab, whelk, loliginid and ommastrephid squids, and scallops (Mesquita *et al.*, 2016, 2017; Marine Scotland, 2021). For some species, such as European lobster and Nephrops, distributions tend to be influenced by habitat/substrate type. Accounts for key species within the Regional Fish and Shellfish Ecology Study Area are provided in the following sections.

Edible crab

4.7.1.2 Desktop data on edible crab within the Regional Fish and Shellfish Ecology Study Area are scarce, though edible crab are cosmopolitan to rocky and gravelly substrata around British coasts. Juveniles can sometimes be found in the intertidal zones, and adults down to depths of 100m. Following spawning in the summer, larvae is planktonic for 30 to 50 days, after which they settle to the seabed (Cefas, 2020b). As edible crab migrate long distances, stock boundaries are not well defined. Edible crab are commercially fished, mostly in inshore waters via pots.

European lobster

4.7.1.3 Desktop data on European lobster within the Regional Fish and Shellfish Ecology Study Area are scarce, though European lobster are cosmopolitan to rocky substrata around British coasts. Juveniles can sometimes be found in the intertidal zones, and adults down to depths of 60m. European lobster moult their shell in the summer, then reproduce. Once the eggs hatch, larvae is planktonic for up to four weeks before settling to the seabed (Cefas, 2020a). European lobster are commercially fished mostly in inshore waters via pots but also within the Morven North Boundary and Morven South Boundary.

King and queen scallop

4.7.1.4 Desktop data on scallops within the Regional Fish and Shellfish Ecology Study Area are scarce, though scallops are associated with clean and firm sand, fine or sandy gravel, and sometimes, muddy sand. The distribution of these species is patchy, but areas with the highest abundance of scallops are often those with minimal mud content and strong water currents.

4.7.1.5 King scallops reach maturity at three to five years of age and live for over 15 years. They occur most frequently in depths ranging from 20m to 70m (Howarth and Stewart, 2014; Salomonsen *et al.*, 2015; Cappell *et al.*, 2018). Queen scallop are typically found on sandy or gravelly substrates at depths up to 100m. Queen scallops have two curved shells whilst king scallops are generally larger in size and have one curved and one flat shell.

4.7.1.6 Around Scotland, scallops first spawn in the autumn of their second year, and thereafter, spawn annually in either the spring or autumn. Following settlement, scallops experience growth until their first winter, during which growth typically halts. Subsequently, growth resumes each spring and ceases during the winter, forming distinct growth rings on the external surface of their shells (Scottish Government, 2012).

4.7.1.7 Commercially, king scallops are harvested through dredge fisheries near the Morven North Boundary and Morven South Boundary, with most of this activity concentrated in the northwestern section of the Regional Fish and Shellfish Ecology Study Area.

Nephrops

4.7.1.8 Nephrops (also referred to as Norway lobster, Dublin Bay prawn, prawn, langoustine, or scampi) can grow up to 25cm in total length and are a commercially important species. They are associated with muddy seabed habitats, in which they burrow and hide whilst inactive during the day. Females tend to mature at three years of age and reproduce each year after. Like crabs and lobsters, females carry their eggs under their tails, until the eggs hatch as planktonic larvae. Nephrops larvae remains planktonic for six to eight weeks before settling to the seabed. (Coull *et al.*, 1998). Unspecified intensity nursery and spawning grounds exist for Nephrops within the north and southwest of the Regional Fish and Shellfish Ecology Study Area, although these do not overlap with the Morven North Boundary or Morven South Boundary (Figure 4.5).

Squids

4.7.1.9 Desktop data on squids within the Regional Fish and Shellfish Ecology Study Area are scarce, though squids are cosmopolitan around British coasts and are ecologically and commercially important. Regarding the latter, squids were worth £6.6 million to the UK, caught by UK vessels, in 2021. Squids are short-lived and semelparous, dying shortly after a single spawning event. Further, most squids live for one to two years (Guerra and Rocha, 1994). Loliginid (demersal) squid species tend to be found over sand and muddy bottoms (Wilson, 2006), whereas ommastrephid (pelagic) squids occupy the water column. Given their pelagic nature, they are often under-represented in trawl survey data and fisheries statistics. In Scottish waters, squid exhibit a seasonal migration pattern, travelling up to 500km from the west coast of Scotland to the east coast in the winter months (Hastie *et al.*, 2009). Commercial fisheries for squids tend to be within coastal waters and do not directly overlap with the Morven North Boundary and Morven South Boundary.

Velvet swimming crab

4.7.1.10 Desktop data on velvet swimming crab within the Regional Fish and Shellfish Ecology Study Area are scarce, though velvet swimming crab are cosmopolitan to rocky and stony substrata around British coasts. Juveniles can sometimes be found in the intertidal zones, and adults down to depths of 100m. Velvet swimming crab are commercially fished mostly in inshore waters via pots. As they tend to be caught alongside edible crab and European lobster, their commercial importance is difficult to quantify (landings tend to be recorded as “crabs” rather than individual species), though based on

recordings from the Berwick Bank OWF (SSER, 2022), they can be assumed to be present within the Regional Fish and Shellfish Ecology Study Area.

Whelk

4.7.1.11 Desktop data on whelk within the Regional Fish and Shellfish Ecology Study Area are scarce, though whelk are a carnivorous mollusc distributed throughout the north Atlantic Ocean. They tend to be found in the intertidal zone, and subtidally on substrates including gravel, sand, mud and rock (Haig *et al.*, 2015). Whelk are commercially exploited in UK waters, with the catch mostly exported. They are vulnerable to exploitation as they are slow growing and slow to reach sexual maturity (Eastern Inshore Fisheries and Conservation Authority (IFCA), 2020). Furthermore, recent studies have demonstrated that whelk show local differences in growth and maturity rates, suggesting that in some areas, they are caught and landed before reaching sexual maturity (McIntyre *et al.*, 2015).

4.7.2 Morven North Fish and Shellfish Ecology Study Area

4.7.2.1 Regarding the site specific surveys, the following shellfish species were recorded in low numbers in the imagery analysis from sample stations within the Morven North Fish and Shellfish Ecology Study Area: whelk, whelk eggs, edible crab, octopus (unable to be identified further), lobster (Homarus sp.), harbour crab (Liocarcinus depurator) and scallops (Family: Pectinidae) (Gardline, 2023).

4.7.2.2 There were no Nephrops recorded within the Morven North Fish and Shellfish Ecology Survey Area. Given that Nephrops inhabit muddy habitats, this was expected as the majority of the Morven South Fish and Shellfish Ecology Study Area was characterised by sandy substrata.

4.7.3 Morven South Fish and Shellfish Ecology Study Area

4.7.3.1 Regarding the site specific surveys, the following shellfish species were recorded in low numbers in the imagery analysis from sample stations within the Morven South Fish and Shellfish Ecology Study Area: whelk, octopus (unable to be identified further), and scallops (Family: Pectinidae) (Gardline, 2023).

4.7.3.2 There were no Nephrops recorded within the Morven South Fish and Shellfish Ecology Survey Area. Given that Nephrops inhabit muddy habitats, this was expected as the majority of the Morven South Fish and Shellfish Ecology Study Area was characterised by sandy substrata.

4.8 Diadromous Fish

4.8.1 Regional Fish and Shellfish Ecology Study Area

4.8.1.1 As detailed in Section 4.1, there are a range of diadromous fish species that could potentially occur within the Regional Fish and Shellfish Ecology Study Area. Species accounts are provided in the following sections.

Atlantic salmon

4.8.1.2 Atlantic salmon are an Annex II species under the Habitats Directive and afforded protection in Scotland under the Habitat Regulations as a designated qualifying feature of sites within the National Site Network, which includes the Regional Fish and Shellfish Ecology Study Area. These include the River Dee SAC and the River Tay SAC (see Section 4.9). Atlantic salmon are a PMF in Scotland for the marine life cycle, an Annex III species under the Bern Convention (for the freshwater life cycle), and on the SBL. The species have been in decline across Scotland during the last 25 years (Youngson *et al.*, 2022).

4.8.1.3 The life cycle of adult Atlantic salmon involves spawning in rivers. After eggs mature into fry, then parr, the young salmon (smolts) migrate to the sea. Following one to three years at sea, salmon

return as adults, typically, to their natal river. The return journey is guided by environmental cues, including the position of the sun, the Earth's magnetic field (Hansen and Quinn, 1998), tidal phase and time of day (Smith and Smith, 1997). Upstream migration near estuaries often occurs at night during ebb tides (Smith and Smith, 1997). Smolts migrating downstream tend to be more active at night, using daytime for prey detection and avoiding predators (Hedger *et al.*, 2008).

4.8.1.4 Smolt emigration timing across Scotland was assessed by Malcolm *et al.*, (2015), who concluded that most salmon tend to leave rivers from mid-April until the end of May, and that smolt emigration is occurring earlier (approximately 1.5 days earlier per decade over 50 years). An eastwards migration of Atlantic salmon smolts into the Moray Firth from the Cromarty Firth was determined by Glasgow University, for Beatrice Offshore Windfarm Ltd (BOWL, 2017). This study also showed that when migrating, smolts tended to occupy the upper 1m of the water column.

4.8.1.5 Furthermore, smolts were tracked off Aberdeen to help investigate the spatiotemporal distributions of juvenile Atlantic salmon migrating seawards from the Dee and Don rivers (Main *et al.*, 2023). This three-year study involved the tagging of 187 Dee salmon and 125 Don salmon. Results showed that salmon travelled at an average speed of 0.45ms-1 from Aberdeen Harbour to 4km offshore. From 4km to 20km offshore, speed reduced to 0.24ms-1 and specimens typically swam within 3m of the surface.

4.8.1.6 A recent review on diadromous fish in the context of Scottish Offshore Wind Plan Option Areas (POAs) (including Morven North and Morven South) concluded that Atlantic salmon are very likely to utilise these areas and are also likely to occur in the inshore waters (Honkanen *et al.*, 2024).

4.8.1.7 Data from recreational fishing in 2022 reported 42,204 Atlantic salmon individuals; an increase from the 35,693 recorded in 2021 across Scotland, though the fourth lowest record since recordings began in 1952 by Marine Scotland. Recreational fishing data (which captures returning adults to their natal rivers to spawn) from Scottish east coast rivers (Tweed, Teith, Tay, South Esk, and Dee) show that Atlantic salmon migrate to and from east coast Scottish rivers, and that migrating smolts or returning adults may therefore pass through the Morven North Boundary or Morven South Boundary during migration (Scottish Government, 2023). Rod catch data of Atlantic salmon between 2018 and 2022 is presented in Figure 4.15.

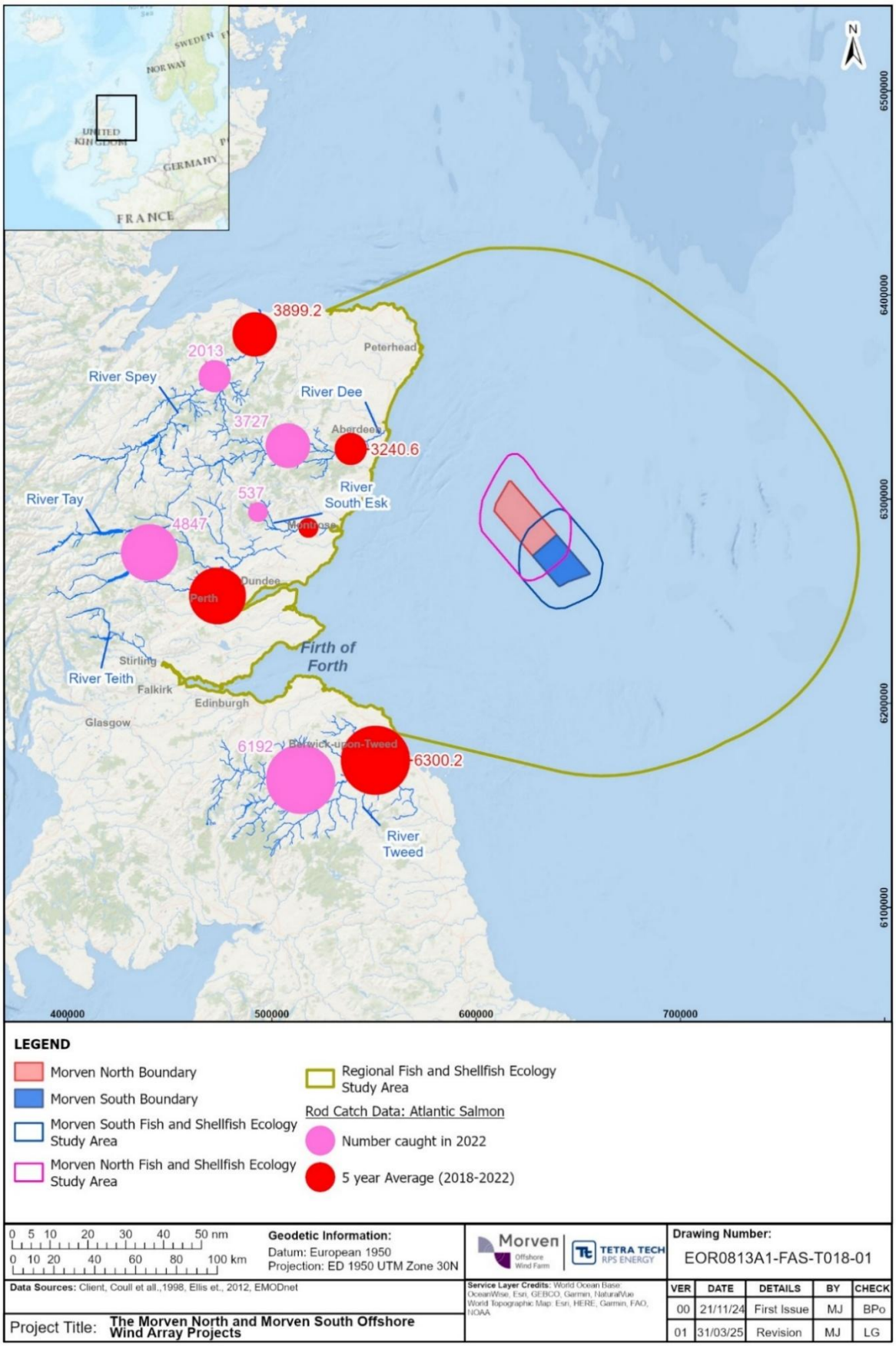

Figure 4.15: Marine Scotland rod catch data for Atlantic Salmon (Five year average from 2018 to 2022, and annual catches for 2022)

Sea trout

4.8.1.8 During the marine part of their life cycle, sea trout are listed as a PMF. Sea trout are often found in cold, freshwater, spawning where currents create downward movement into gravel beds (Fishbase, 2021).

4.8.1.9 Within the Regional Fish and Shellfish Ecology Study Area, sea trout smolts were tracked off the coast of Aberdeen to help investigate the spatiotemporal distributions of juveniles migrating seawards from the Dee River (Main *et al.*, 2023). This three-year study involved the tagging of 83 sea trout. Results showed that sea trout tended to remain nearshore, though some individuals showed variable migration behaviours; 18% showed only freshwater migration, 37% showed freshwater to estuarine migration, 45% showed freshwater to marine migration (Main *et al.*, 2023). Conclusions from Malcolm *et al.* (2010) also suggest that this species primarily occupies inshore and coastal waters, rather than taking extensive offshore migrations like Atlantic salmon. Most recently, this has been echoed by the results of a recent review on diadromous fish in the context of Scottish Offshore Wind POAs (including Morven North and Morven South), which highlighted that most research is focussed on nearshore habitat use (Honkanen *et al.*, 2024). However, Honkanen *et al.* (2024) concluded that sea trout are still likely to overlap with most, if not all, of the Scottish POAs (Honkanen *et al.*, 2024).

4.8.1.10 From recreational fishing records, 14,509 specimens of sea trout were recorded in 2022; this was the fourth lowest record since recording was initiated in 1952 by Marine Scotland (Scottish Government, 2023), though was an 11% increase from 2021 records. These data are from the rivers Dee, South Esk, Tay, and Tweed. Migrating smolts are therefore likely to migrate through the Morven North Boundary and Morven South Boundary. Rod catch data of sea trout from marine areas between 2016 and 2020 is presented in Figure 4.16.

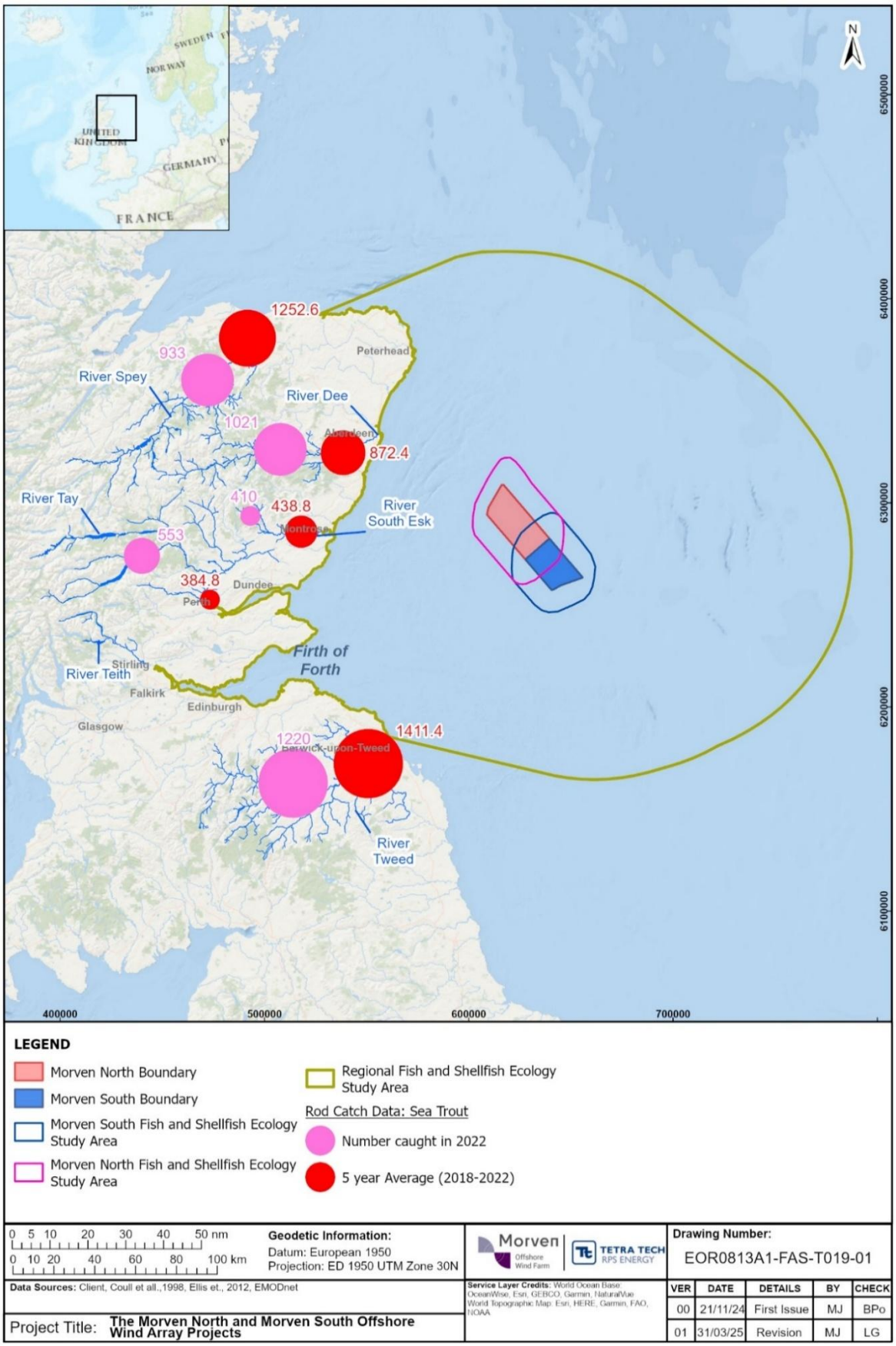

Figure 4.16: Marine Scotland rod catch data for sea trout (Five year average from 2018 to 2022, and annual catches for 2022)

European eel

4.8.1.11 European eel are a PMF during the marine part of their life cycle and are also considered "critically endangered" on the IUCN Red List (IUCN, 2023). European eel migrate to the Sargasso Sea to spawn. Their larvae are planktonic and are carried by the Gulf Stream. Larvae transform into glass eels, then elvers which reach Scottish coasts and migrate up estuaries and into rivers and lakes. When mature, European eel can migrate 5,000km to 6,000km to spawn and may be present within the Morven North Boundary and Morven South Boundary. As such, European eel are considered an IEF.

Sea lamprey

4.8.1.12 Sea lamprey are an Annex II species under the Habitats Directive and afforded protection in Scotland under the Habitat Regulations as a designated qualifying feature of sites within the National Site Network, which include the Regional Fish and Shellfish Ecology Study Area. Sea lamprey spawn in warm waters, in clean gravel with marginal silt or sand for juveniles to burrow, though they otherwise spend most of their time at sea. Spawning of sea lamprey is associated with the water spring temperatures in Scottish rivers. Sea lamprey are largely prevalent throughout UK rivers, their populations have declined due to pollution and migration barriers, such as dams and weirs (JNCC, 2021a). Sea lamprey may have migration routes which overlap the Morven North Boundary and/or Morven South Boundary, however there is limited data on the offshore distribution of this species (Honkanen *et al.*, 2024).

River lamprey

4.8.1.13 Like sea lamprey, river lamprey are an Annex II species under the Habitats Directive and a PMF during the marine part of their life cycle and are also of European conservation importance in the UK. River lamprey are morphologically similar to sea lamprey and are also impacted by pollution and barriers to migration. River lamprey are associated with hard substrates and also act as parasites on larger fish species, such as cod and herring. River lamprey are common to most UK rivers and have a northerly limit at the Great Glen, Scotland. It is unlikely river lamprey will occur within the Morven North Boundary or Morven South Boundary due to their residential status in estuaries and coastal waters. This is emphasised by the results of a recent review on diadromous fish in the context of Scottish Offshore Wind POAs (including Morven North and Morven South), which concluded that river lamprey are more likely to only overlap with export cable corridors in nearshore and estuarine waters and noted that there are limited data on the offshore presence of this species (Honkanen *et al.*, 2024).

Allis and Twaite shade

4.8.1.14 Allis and twaite shads are morphologically similar, albeit allis shad usually grows to a larger size and allis shad have more gill rakers than twaite shad (90 on the first gill arch for allis shad, 60 on the first gill arch for twaite shad).

4.8.1.15 Allis shad habitat requirements in freshwater are poorly understood, though they spawn in freshwater in spring. Twaite shad also spawn in freshwater, usually at night in deep pools. Most (75%) of adults die after spawning, which has been exacerbated by overfishing, pollution, and migration obstacles (JNCC, 2021b). Twaite shad spawning stocks have not been observed in Scotland.

4.8.1.16 As there is uncertainty around the life cycle phases of both shad species, they have been considered as IEFs as a precaution, though they are unlikely to be found in large numbers within either the Morven North Boundary or Morven South Boundary.

European smelt

4.8.1.17 European smelt are listed as Scottish PMFs during the marine phase of their life cycle. European smelt are known to inhabit estuaries and lakes, though spend most of their life in estuaries, and, for

short durations, the littoral zone. European smelt are associated with sandy and gravelly substrates when they enter rivers, more often in fast flowing waters. It is therefore unlikely that European smelt will be found within the offshore waters of the Regional Fish and Shellfish Ecology Study Area and interact with Morven North or Morven South.

Freshwater pearl mussel

4.8.1.18 The freshwater pearl mussel is fully protected under Schedule 5 of the Wildlife and Countryside Act 1981 (as amended), is listed on Annexes II and V of the Habitats Directive and Appendix III of the Bern Convention and as 'endangered' on the IUCN Red List. As freshwater pearl mussel relies on salmonids for a mechanism of locomotion (they attach to the gills of young Atlantic salmon or sea trout for their first year) they are included with diadromous fish as per standard EIA approach.

4.8.1.19 Freshwater pearl mussel is morphologically similar to blue mussel Mytilus edulis but grow up to 20cm length and can live for over 100 years (Skinner *et al.*, 2003). Freshwater mussels live in fast flowing rivers in clean water and usually buries into coarse sand or fine gravel.

4.8.2 Morven North Fish and Shellfish Ecology Study Area

4.8.2.1 There were no diadromous fish species recorded during any of the site specific surveys undertaken within the Morven North Fish and Shellfish Ecology Study Area. . However, it should be noted that these surveys were not designed to specifically assess diadromous fish presence, so their absence within the survey results does not indicate absence from the Morven North Fish and Shellfish Ecology Study Area in general. In addition, diadromous fish species are highly migratory and may be present throughout the Regional Fish and Shellfish Ecology Study Area during the marine phases of their life cycles. Therefore, the wider regional baseline presented in Section 4.8.1, is considered to be relevant at the smaller scale of the Morven North Fish and Shellfish Ecology Study Area.

4.8.3 Morven South Fish and Shellfish Ecology Study Area

4.8.3.1 There were no diadromous fish species recorded during any of the site specific surveys undertaken within the Morven South Fish and Shellfish Ecology Study Area. . However, it should be noted that these surveys were not designed to specifically assess diadromous fish presence, so their absence within the survey results does not indicate absence from the Morven South Fish and Shellfish Ecology Study Area in general. In addition, diadromous fish species are highly migratory and may be present throughout the Regional Fish and Shellfish Ecology Study Area during the marine phases of their life cycles. Therefore, the wider regional baseline presented in Section 4.8.1, is considered to be relevant at the smaller scale of the Morven South Fish and Shellfish Ecology Study Area.

4.9 Designated Sites

4.9.1.1 All the aforementioned diadromous fish, except for sea trout, European eel, and European smelt are Annex II qualifying features under the Habitats Directive (Council Directive 92/43/EEC). The Habitats Directive established a network of internationally important sites for EU Member States, designated for their ecological status. This Directive, through the designation of SACs, helps to ensure population and habitat maintenance and restoration. The obligations implemented under the Habitats Directive continue to apply in Scotland through the Conservation of Habitats and Species Amendment (EU Exit) Regulations 2019 to European sites in the UK that already existed on 31 December 2020 and now comprise part of the UK National Site Network. Atlantic salmon, river lamprey and sea lamprey are qualifying features of SACs within the Regional Fish and Shellfish Ecology Study Area, though other non-diadromous fish and shellfish have also been considered for further assessment (see Table 4.6and Figure 4.17).

Table 4.6: Designated Sites with fish and shellfish qualifying features within the Regional Fish and Shellfish Ecology Study Area

Designated site	Distance to Morven North (km)	Distance to Morven South (km)	Relevant qualifying features	Primary reason for the selection of the site
Turbot Bank MPA.	46.6	75.4	Sandeel (Raitt's sandeel and lesser sandeel).	Sandeel (Raitt's sandeel and lesser sandeel).
River Dee SAC.	63.8	93.6	Atlantic salmon Freshwater pearl mussel.	Atlantic salmon Freshwater pearl mussel.
River South Esk SAC.	75.5	101.1	Atlantic salmon Freshwater pearl mussel.	Atlantic salmon Freshwater pearl mussel.
River Tay SAC.	136.8	149.7	River lamprey Sea lamprey Atlantic salmon.	Atlantic salmon.
Tweed Estuary SAC.	111.8	108.5	River lamprey Sea lamprey.	-
River Tweed SAC and Site of Special Scientific Interest (SSSI).	116.5	113.2	River lamprey Sea lamprey Atlantic salmon.	Atlantic salmon.
River Teith SAC.	208.9	215.0	River lamprey Sea lamprey Atlantic salmon.	River lamprey Sea lamprey.
River Spey SAC.	172.6	207.3	Atlantic salmon Freshwater pearl mussel Sea lamprey.	Atlantic salmon Freshwater pearl mussel Sea lamprey.

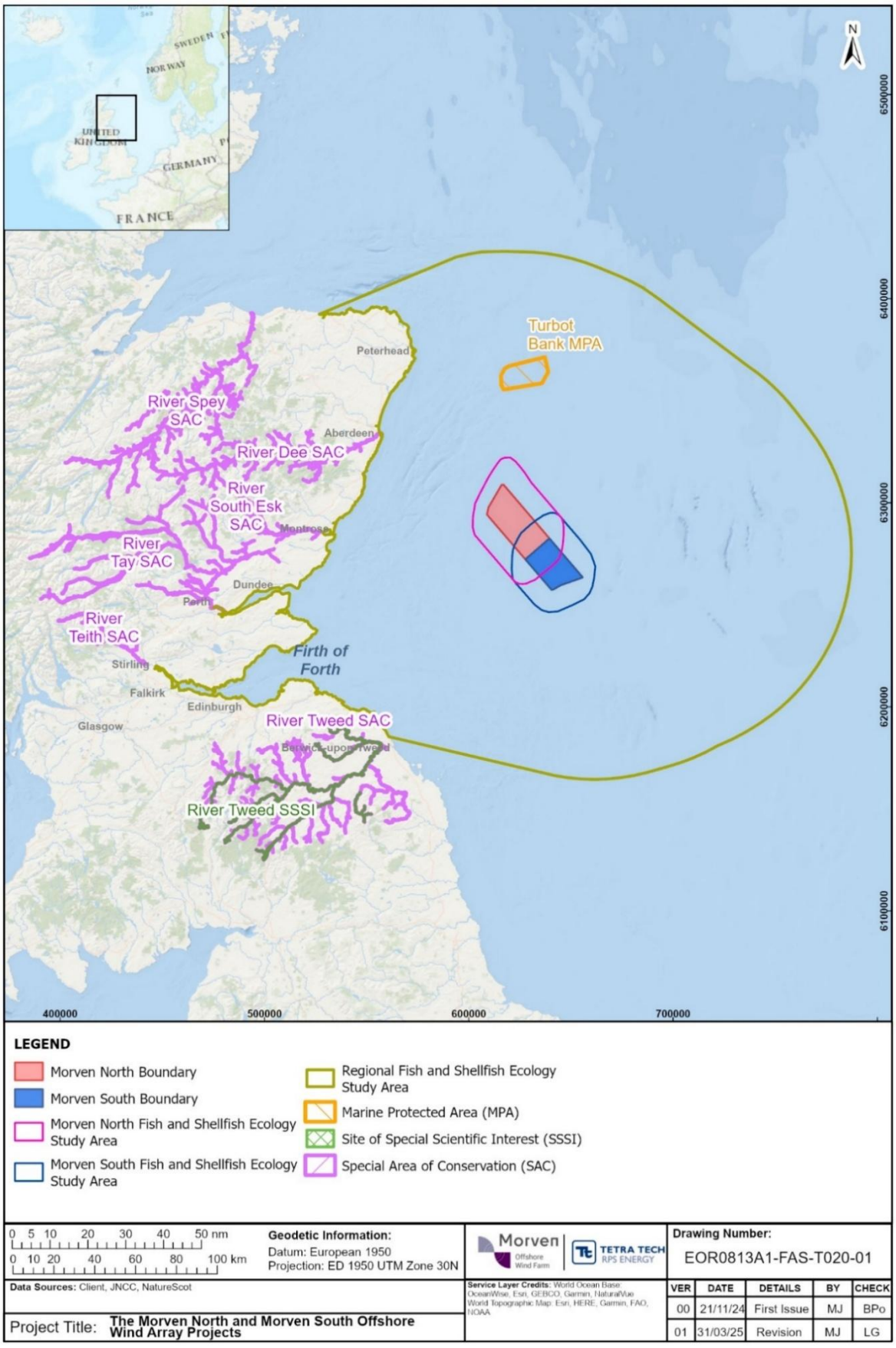

Figure 4.17: Designated Sites with fish and shellfish qualifying features within the Regional Fish and Shellfish Ecology Study Area summary

5 Summary

5.1 Overall baseline characterisation

5.1.1.1 The aforementioned records of fish and shellfish in the Regional Fish and Shellfish Ecology Study Area (and the Morven North Fish and Shellfish Ecology Study Area and Morven South Fish and Shellfish Ecology Study Area) represent a typical assemblage for the northern North Sea. The proximity of the Morven North Boundary and Morven South Boundary, alongside the mobile and wide-ranging nature of fish and shellfish species and habitats, means that the baseline presented for the Regional Fish and Shellfish Ecology Study Area is applicable to both Morven North and Morven South.

5.1.1.2 Within the Regional Fish and Shellfish Ecology Study Area, spawning and nursery grounds have been identified for 16 teleost fish species, four elasmobranch species, and Nephrops (Table 4.2). There was no favourable habitat for Nephrops identified within the Morven North Fish and Shellfish Ecology Study Area or Morven South Fish and Shellfish Ecology Study Area during the site specific benthic surveys by Gardline (2023). The site specific PSA data suggested that both the Morven North Fish and Shellfish Ecology Study Are and Morven South Fish and Shellfish Ecology Study Area were unsuitable for herring spawning. For sandeel, however, over half of the sample locations within both the Morven North Fish and Shellfish Ecology Study Area and Morven South Fish and Shellfish Ecology Study Area were assessed to be suitable ("marginal" and "preferred") for sandeel spawning.

5.1.1.3 Of the diadromous fish species, Atlantic salmon, sea trout, sea lamprey, European eel and allis and twaite shad were concluded to have the potential to occur within the Morven North Boundary or Morven South Boundary. Due to its obligate life history stage with salmonids, the freshwater pearl mussel is also considered, despite being a freshwater resident species. Within the Regional Fish and Shellfish Ecology Study Area, there were a range of SACs, one SSSI and one MPA which were designated for fish and shellfish features, including sandeel, Atlantic salmon, sea lamprey and freshwater pearl mussel (and river lamprey, however this species is not proposed to be considered within the assessment due to its limited presence in the offshore environment).

5.1.2 Important Ecological Features

5.1.2.1 IEFs are important habitats, species, and ecosystems, which could potentially be impacted by Morven North and/or Morven South. The Chartered Institute of Ecology and Environmental Management (CIEEM, 2022) guidance was used to define and assign importance to these IEFs. IEFs can either be defined as individual species (such as cod) or species groups (such as flatfish, which might include plaice and sole, for example). IEFs are then assigned an importance value based on their commercial, ecological or conservation (PMFs, SAC features, etc.) importance. PMFs, for example, are species which are most threatened, in greatest decline, or where Scotland has a significant proportion of the world's population, therefore they are considered marine nature conservation priorities. Table 5.1 details the IEF criteria, and Table 5.2 justifies the IEFs based on importance rankings.

Table 5.1: Defining criteria for IEFs

Value of IEF	Defining criteria
International	Internationally designated sites and protected species. Species protected under international law that are listed as a qualifying feature of an internationally designated site within the Regional Fish and Shellfish Ecology Study Area (e.g. Annex II species). Species protected under international law (including the Bonn Convention, the Bern Convention, or the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)).

Value of IEF	Defining criteria
National	Species protected under national law (e.g. listed on the SBL, species listed as qualifying features of MPAs, or under the Wildlife and Countryside Act 1981). Annex II species which are not listed as qualifying interests of SACs in the Regional Fish and Shellfish Ecology Study Area. OSPAR List of Threatened and/or Declining Species, and IUCN Red List species that have nationally important populations within the Regional Fish and Shellfish Ecology Study Area, particularly in the context of species/habitat that may be rare or threatened in Scottish waters. Species that are listed as PMFs as they have been deemed features characteristic of Scottish marine environment and are likely to be one of the characteristic species within the Regional Fish and Shellfish Ecology Study Area. Species that have spawning or nursery areas within or within close vicinity to the Morven North Boundary and/or Morven South Boundary that are important nationally (e.g. may be primary spawning/nursery area for that species).
Regional	OSPAR List of Threatened and/or Declining Species, and IUCN Red List species that have regionally important populations within the Regional Fish and Shellfish Ecology Study (i.e. are locally widespread and/or abundant). Species that are of commercial value to the fisheries which operate within the Regional Fish and Shellfish Ecology Study. Species that form an important prey item for other species of conservation or commercial value and that are key components of the fish and shellfish assemblages within the Regional Fish and Shellfish Ecology Study. Species that have spawning or nursery areas within or within close vicinity to the Morven North Boundary and/or Morven South Boundary that are important regionally (i.e. species may spawn in other parts of Scottish waters, but this is a key spawning/nursery area).
Local	Species that are of commercial importance but do not form a key component of the fish and shellfish assemblages within or within close vicinity to the Morven North Boundary and/or Morven South Boundary (e.g. they may be exploited in shallower/deeper waters outside of these areas). Species which are common throughout Scottish waters but forms a component of the fish assemblages in the Regional Fish and Shellfish Ecology Study Area.

Table 5.2: Fish and shellfish IEFs (Applicable to Morven North and/or Morven South)

IEF	Importance	Justification
Teleost fish		
Anglerfish	National	Nursery grounds are present throughout the Morven North Boundary and Morven South Boundary. Listed as a PMF.
Blue whiting	National	Nursery grounds are present throughout the Morven North Boundary and Morven South Boundary. Listed as a PMF. Listed on the SBL.
Cod	National	Listed as a PMF. Listed by OSPAR as threatened and/or declining and listed as Vulnerable on the IUCN Red List. Listed on the SBL. Spawning and nursery grounds are present within the Morven North Boundary and Morven South Boundary.
European hake	National	Nursery grounds are present throughout the Morven North Boundary and Morven South Boundary. Listed on the SBL.
Haddock	Regional	Nursery grounds are present throughout the Morven North Boundary and Morven South Boundary. Listed as Vulnerable on the IUCN Red List. An important commercial species, but not locally.
Herring	National	Important prey species for larger fish, birds and marine mammals. Nursery grounds are present throughout the Morven North Boundary and Morven South Boundary. Known to have spawning grounds within the Regional Fish and Shellfish Ecology Study Area, with core spawning habitats to the north and south of the Nursery grounds are present throughout the Morven North Boundary and Morven South Boundary. Listed as a PMF. Listed on the SBL.

IEF	Importance	Justification
Lemon sole	Regional	Spawning and nursery grounds are present throughout the Morven North Boundary and Morven South Boundary.
Ling	National	Nursery grounds are present throughout the Morven North Boundary and Morven South Boundary. Listed as a PMF. Listed on the SBL.
Mackerel	National	Important prey species for larger fish, birds and marine mammals. Nursery grounds are present throughout the Morven North Boundary and Morven South Boundary. Listed as a PMF. Listed on the SBL.
Norway pout	National	Spawning and nursery grounds are present within the Morven North Boundary and Morven South Boundary. Listed as a PMF. Listed on the SBL.
Plaice	National	Spawning and nursery grounds are present throughout the Morven North Boundary and Morven South Boundary. Listed on the SBL.
Sandeel	National	There are five species of sandeel found in Scottish waters lesser sandeel and greater sandeel being the most common. Important prey species for fish, birds and marine mammals. Spawning and nursery grounds are present throughout the Morven North Boundary and Morven South Boundary. Identified as likely to be present in the Morven North Boundary and Morven South Boundary based on historic data and habitat preference. Lesser sandeel and Raitt's sandeel are listed as PMFs and listed as protected features within the Turbot Bank MPA, which is within the Regional Fish and Shellfish Ecology Study Area. Listed on the SBL.
Saithe	National	Listed as a PMF. Nursery grounds present within the Regional Fish and Shellfish Ecology Study Area.

IEF	Importance	Justification
Sprat	Regional	Important prey species for larger fish, birds and marine mammals. Spawning and nursery grounds are present throughout the Morven North Boundary and Morven South Boundary.
Whiting	National	Spawning and nursery grounds are present throughout the Morven North Boundary and Morven South Boundary. Listed as a PMF. Listed on the SBL.
Other flatfish species	Local	Other flatfish species including dab and long rough dab are likely to occur within the Regional Fish and Shellfish Ecology Study Area.
Elasmobranchs		
Basking shark	International	Listed under Appendix II of the Bern Convention Protected under the Bonn Convention and CITES. Basking shark are also protected under the Wildlife and Countryside Act 1981. Listed on the OSPAR List of Threatened and/or Declining Species. Listed on the SBL. Listed as a PMF. This species has an IUCN Status of 'Endangered'.
Common skate	National	There are nursery grounds for this species overlapping and in the vicinity of the Morven North Boundary and Morven South Boundary. Listed on the SBL. Listed as a PMF. This species is also listed on the OSPAR List of Threatened and/or Declining Species.
Spurdog	International	Protected under the Bonn Convention. Listed on the SBL. Listed as a PMF. This species is also listed on the OSPAR List of Threatened and/or Declining Species and has an IUCN Status of 'Vulnerable'. There are nursery grounds for this species overlapping with the Morven North Boundary and Morven South Boundary.
Rays	Regional	Ray species including cuckoo ray, spotted ray and thornback ray. These species either have low intensity

IEF	Importance	Justification
		nursery grounds or no known nursery grounds overlapping with the Morven North Boundary and Morven South Boundary.
Small spotted catshark	Local	This species is common throughout Scottish waters but forms a component of the fish assemblages in the Regional Fish and Shellfish Ecology Study Area.
Thorny skate	Local	This species is common throughout Scottish waters but forms a component of the fish assemblages in the Regional Fish and Shellfish Ecology Study Area.
Tope shark	International	Protected under the Bonn Convention. Listed on the SBL. This species has an IUCN Status of 'Critically Endangered'. There are nursery grounds for this species overlapping and in the vicinity of the Morven North Boundary and Morven South Boundary.
Diadromous fish		
Allis and twaite shad	International	Listed under Annex II of the Habitats Regulations but not as a qualifying feature of any SACs within the Regional Fish and Shellfish Ecology Study Area. Appendix III of the Bern Convention. Protected under national legislation, such as the Salmon and Freshwater Fisheries (Consolidation) (Scotland) Act 2003 and the Wildlife and Countryside Act 1981. Listed on the SBL.
Atlantic salmon	International	Listed under Annex II of the Habitats Regulations and as a qualifying feature of SACs within the Regional Fish and Shellfish Ecology Study Area. Appendix III of the Bern Convention. Protected under the Salmon and Freshwater Fisheries (Consolidation) (Scotland) Act 2003. Listed on the SBL. Listed as a PMF.
European eel	International	Listed under Appendix II of CITES and the Bonn Convention. Protected under the Salmon and Freshwater Fisheries (Consolidation) (Scotland) Act 2003. Listed on the SBL. Listed as a PMF. This species has an IUCN status of 'Critically Endangered'.

IEF	Importance	Justification
Freshwater pearl mussel	International	Listed under Annex II of the Habitats Regulations and as a qualifying feature of SACs within the Regional Fish and Shellfish Ecology Study Area. Freshwater pearl mussel are also listed under Appendix III of the Bern Convention and under the Wildlife and Countryside Act 1981. Listed on the SBL. This species has an IUCN status of 'Critically Endangered'.
Sea lamprey	International	Listed under Annex II of the Habitats Regulations and as a qualifying feature of SACs within the Regional Fish and Shellfish Ecology Study Area. Listed under Appendix III of the Bern Convention. Protected under the Salmon and Freshwater Fisheries (Consolidation) (Scotland) Act 2003. Listed on the SBL. Listed as a PMF. Listed on the OSPAR list of Threatened and/or Declining Species.
Sea trout	National	Protected under the Salmon and Freshwater Fisheries (Consolidation) (Scotland) Act 2003. Listed on the SBL. Listed as a PMF.
Shellfish		
Edible crab	Regional	Commercially important species. Identified as being likely to be present within the Morven North Boundary and Morven South Boundary.
European lobster	Regional	Commercially important species. Identified as being likely to be present within the Morven North Boundary and Morven South Boundary.
King scallop	Regional	Commercially important species. Identified as being likely to be present within the Morven North Boundary and Morven South Boundary.
Nephrops	Regional	Commercially important species. Identified as unlikely to be present in the Morven North Boundary and Morven South Boundary based on habitat preference. Spawning and nursery grounds present throughout the Regional Fish and Shellfish Ecology Study Area but not overlapping within the Morven North Boundary or Morven South Boundary.

IEF	Importance	Justification
Queen scallop	Regional	Commercially important species. Identified as being likely to be present within the Morven North Boundary and Morven South Boundary.
Velvet swimming crab	Regional	Commercially important species. Identified as being likely to be present within the Morven North Boundary and Morven South Boundary.
Other shellfish	Local	Other shellfish including shrimps, whelk, razor clams, and cephalopods have been identified as being likely to occur within the Morven North Boundary and Morven South Boundary. Within the Regional Fish and Shellfish Ecology Study Area, these species are of relatively low commercial importance when compared to species such as Nephrops.

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