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APPENDIX 13-A FISH AND SHELLFISH ECOLOGY TECHNICAL REPORT

ABERDEEN HARBOUR EXPANSION PROJECT

FISH AND SHELLFISH ECOLOGY TECHNICAL STUDY

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AMENDMENTS PAGE

This table contains a record of amendments.

Issue Number	Amendment Number	Section/Paragraph	Date	Authoriser's Signature
1	1	Section 6 – Atlantic salmon. Addition of commercial netting catch data for Dee district.	15/06/15	[redacted]
2	2	Section 6 Atlantic salmon. Addition of monthly rod and line catch data for Dee District	10/07/15	[redacted]

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1. INTRODUCTION

1.1 Study Background

Aberdeen Harbour Board have proposed the design and construction of a new harbour facility at Nigg Bay, immediately south of the existing harbour. The purpose of the new facility is to complement and expand the capabilities of the existing harbour, accommodate larger vessels, retain existing custom, and attract increased numbers of vessels and vessel types to Aberdeen.

The new harbour development shall include but is not limited to:

- Dredging the existing bay to accommodate vessels up to 9 m draft with additional dredge depth of 10.5 m to the east quay and entrance channel;
- Construction of new north and south breakwaters to form the harbour;
- Provision of approximately 1500 m of new quays and associated support infrastructure. The quay will be constructed with solid quay wall construction and suspended decks over open revetment;
- Construction of areas for development by others to facilitate the provision of fuel, bulk commodities and potable water;
- Land reclamation principally through using materials recovered from dredging operations and local sources, where possible;
- Provision of ancillary accommodation for the facility;
- Off-site highway works to the extent necessary to access the facility and to satisfy statutory obligations;
- Diversions and enabling works necessary to permit the development.

To achieve these development aims, a series of technical environmental studies were commissioned to support the necessary consent applications and associated Environmental Statement (ES).

Information derived from these studies will be used to inform the Environmental Impact Assessment (EIA), with respect to predicted effects of the construction, operation and decommissioning of the new port facilities and to assist in the development of mitigation measures where agreed and appropriate. This will aid in the development of the ES in support of the consent application.

To address these aspects, Fugro EMU Limited (Fugro EMU) was commissioned to undertake a desk based review of the fish and shellfish ecology of the development area and local surrounds. Accordingly this document presents the data collected and provides a characterisation of the fish and shellfish ecological conditions within and around the harbour proposals. These have been presented in terms of the spatial and temporal distributions of the typical assemblages, the locations and extents of any critical fish habitat and the occurrence and use of the area by important species.

1.2 Aims

This desk based study aims to provide a suitable baseline of the fish and shellfish ecology within and around the Aberdeen Harbour Expansion Project study area, to inform statutory EIA processes.

1.3 Scope of the Study

An initial scoping report (RPS, 2013) and subsequent stakeholder responses have defined the scope and terms of reference of this desk based study. In the scoping report it was recommended particular attention be given to UK priority species such as Atlantic salmon (salmon) *Salmo salar*, river lamprey *Lampetra fluviatilis* and sea lamprey *Petromyzon marinus* originating from the River Dee Special Area of Conservation (SAC). It also draws attention to the freshwater pearl mussel *Margaritifera margaritifera* owing to its close association to the salmon and sea trout *Salmon trutta* population of the Dee. Other ecologically important species recommended for discussion include sandeels Ammodytidae and basking shark *Cetorhinus maximus*.

Several fish species were recommended for assessment by RPS (2013) in their project scoping. Subsequent to this, Scottish Natural Heritage (SNH) and Marine Scotland Science (MSS) made recommendations for several additional fish and shellfish species, which are present on the Scottish list of Priority Marine Features (PMFs), to be considered. The final list of recommended species to be assessed in relation to the Aberdeen Harbour Expansion Project proposals are outlined in Table 1.1.

Brook lamprey *Lampetra planeri* have not been included in the assessment on the basis that they are regarded as non-migratory species. Consequently, the species will not encounter the Project or incur any direct / indirect effects as a consequence of the Project during their entire life history.

Table 1.1: Recommended Species for Assessment in Relation to the Aberdeen Harbour Expansion Project Proposals Identified Through Scoping

Scientific Name	Common Name
Teleosts	
Ammodytidae	Sandeel species
Clupea harengus	Herring
Gadus morhua	Cod
Lophius piscatorius	Monkfish / Anglerfish
Merlangius merlangus	Whiting
Molva molva	Ling
Pollachius virens	Saithe
Pomatoschistus minutus	Sand goby
Trisopterus esmarkii	Norway pout
Elasmobranchs	
Cetorhinus maximus	Basking shark
Dipturus batis	Common skate
Squalus acanthias	Spurdog

Table 1.1: Recommended Species for Assessment in Relation to the Aberdeen Harbour Expansion Project Proposals Identified Through Scoping, Continued

Scientific Name	Common Name
Migratory Fish	
Anguilla anguilla	European eel
Lampetra fluviatilis	River lamprey
Petromyzon marinus	Sea lamprey
Salmo salar	Atlantic salmon
Salmo trutta	Sea trout
Shellfish	
Arctica islandica	Ocean quahog
Atrina fragilis	Fan mussel
Cancer pagurus	Brown crab
Homarus gammarus	European lobster
Nephrops norvegicus	Norway lobster

During scoping SNH recommended that European smelt/sparling *Osmerus eperlanus* and European spiny lobster *Palinurus elephas* are not required to be considered in the EIA (scoped out) as this is not regarded as an important area for these species. SNH also stated that during environmental impact assessment, the sand goby *Pomatoschistus minutus* need only be considered at the cumulative level due to its ubiquitous nature, and that the likely effects on this species at this scale are unlikely to be of concern.

In their response to scoping, MSS highlighted a similar list of species for consideration to that of SNH. This also included brown crab *Cancer pagurus* and European lobster *Homarus gammarus* in light of potential effects on creel fisheries. In addition it was also recommended by MSS that the endangered common skate *Dipturus batis* should be considered.

The scoping report identified that the construction and operation of the proposals are anticipated to have a variety of direct and indirect effects on identified fish and shellfish receptors. Effects were also predicted on certain life-cycle aspects in addition to critical habitats, and particularly the following ecological aspects:

- Spawning grounds;
- Nursery grounds;
- Feeding grounds;
- Over-wintering grounds for crustaceans;
- Migration routes.

Direct effects of the proposed harbour development may include temporary seabed disturbances due to construction activities and loss of habitat due to placement of infrastructure on the seabed. Indirect effects which could occur locally and at distance from the proposed development may include temporary increased suspended sediment concentrations and sediment deposition due to

the generation of sediment plumes arising from marine construction activities as well as increased underwater noise from underwater blasting or piling operations.

2. METHODS

Information has been collated at various geographical scales, reflecting the mobility and range of characterising fish and shellfish species and the distributions of associated critical habitats. These geographical scales in turn encompass the spatial extents of the potential direct and indirect effects predicted to arise as a result of the construction and operation of the harbour proposals. Figure 2.1 shows the location of the proposals and the study area overlaid with the corresponding ICES statistical rectangles 43E7 and 43E8 for this desk based review.

Information on fish and shellfish species, such as cod *Gadus morhua* and whiting *Merlangius merlangus* have been described within a regional context reflecting their comparatively wider range movements. Information on such species has been collated from commercial fisheries landings data as well as from the most recent literature sources. Smaller species that are likely to be resident within the immediate study area throughout the year, or which have comparatively limited range of movement, such as gobies Gobiidae, dragonets Callionymidae, pogge *Agonus cataphractus*, crabs and molluscs, have also been described using the literature. This will be supplemented in the ES with site specific data drawn from 2 m beam trawl sampling surveys, which will form part of the benthic survey.

2.1 Overview of the Study Area

Nigg Bay is a shallow sediment filled, east facing embayment, bounded by two rocky headlands and located to the south of Aberdeen Harbour. The seabed is dominated by sand, mixed sand and gravel sediments, which become progressively more coarse and rocky towards its northern and southern margins. Rocky outcrops with variable topography occurred to the north and south of the bay at Girdle Ness and Greg Ness. Predicted seabed habitats included infralittoral fine sand distributed along nearshore areas, with circalittoral fine sand and deep circalittoral sand habitats dominating further offshore (JNCC, 2014a).

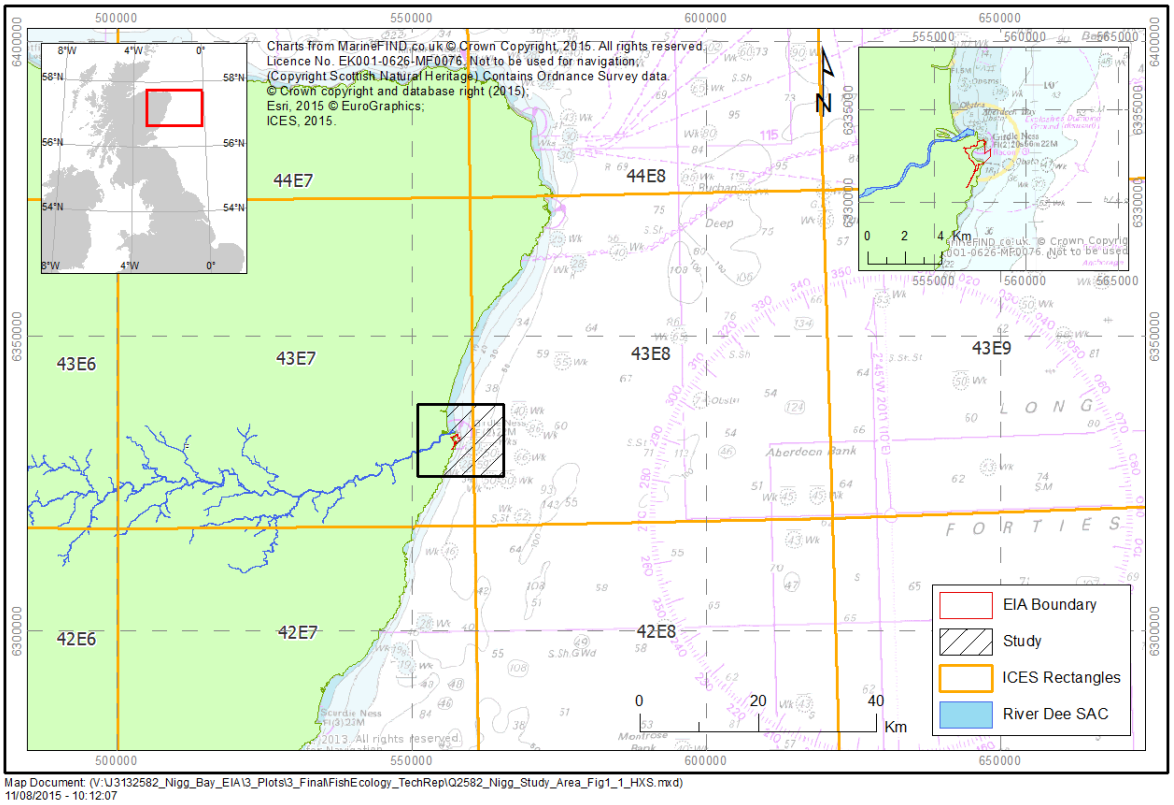


Figure 2.1: Fish and shellfish study area and location of ICES statistical rectangles

2.2 Data Availability

A review of the current literature was conducted, and was used to describe the fish and shellfish ecology of the study area, Nigg Bay and the surrounding region. The major data sources that were reviewed are summarised in Table 2.1. Further data sources used in the preparation of this document are credited within the text and full references are provided in the reference list at the end of the document.

Table 2.1 Summary of Major Data Sources Reviewed

Source	Area of research
Centre for Environmental, Fisheries and Aquaculture Science (Cefas)	Areas of sensitivity nursery and spawning grounds; Details on feeding and predation of key species; General fish and shellfish ecology and biology.
The Joint Nature Conservation Committee (JNCC)	Overview of River Dee SAC and qualifying species for site selection.
Scottish Natural Heritage (SNH)	Guide to Scottish species of interest particularly migratory species like salmon, lamprey and eel.
FishBase	Fish biology and ecology.
UK Marine Life Information Network (MarLIN)	Guidance to the likely distribution and assemblage of the fish and shellfish species within the east coast of Scotland.
Marine Scotland Science	General information on species found in Scottish waters.
Scottish Government	Commercial fish and shellfish landing data Salmonid catch and release data.
International Union for Conservation of Nature (IUCN)	Red List of Threatened Species.
Oslo and Paris (OSPAR) Commission for the Protection of the Marine Environment of the North-East Atlantic	Impact guidance and legislation; Fish biology and ecology.
Dee District Salmon Fishery Board (DDSFB)	Catch and release data; General ecology of the Dee catchment and associated migratory fish.
Other	Journals, PhD theses, white papers, research articles.

3. ECOLOGICAL REVIEW

3.1 General Overview

Most fish and shellfish species are mobile, inhabiting different geographical areas at various stages of their lifecycle. The composition and spatial distribution of fish and shellfish communities are dependent on a wide range of physical conditions such as water temperature, salinity, depth, prevailing currents and seabed topography. These are further influenced by complex biotic factors such as the availability of food, breeding opportunities and predator–prey relationships that exist across all trophic levels. Rogers and Stocks (2001) explained that some fish species exhibit similar annual and/or seasonal distribution patterns but other species can show a large degree of variability depending upon climate or prey availability. Similarly, certain aspects of fish and shellfish life-cycle behaviour, such as spawning areas and nursery grounds, are typically dynamic features and are rarely fixed in one location from year to year.

Seasonal variability in fish communities such as herring, sprat and cod is a natural phenomenon often driven by shifts in prey abundance, and/or the need to seek specific spawning and nursery grounds. These often result in a biannual peak around spring and autumn, which coincides with a change in the ambient water temperature. As temperatures rise in spring an inshore migration is triggered in pursuit of prey and reproduction. Falling temperatures in autumn triggers a net movement back into the offshore waters of the North Sea, again in the pursuit of prey, or to overwinter. This means that the species assemblages present within the study area are likely to be transient, with few truly resident species. Species that may be considered more resident are the smaller bodied species like goby, blennies and dragonets.

Fish assemblages can be broadly divided into three categories including demersal, benthopelagic and pelagic, depending upon their life-style.

Demersal species are mainly bottom feeders, which live on or near the seabed. Their distribution is often related to sediment type, hydrography, bathymetry, predator-prey interactions and competition for space. Characteristic demersal species of this part of the North Sea include cod, saithe, whiting, Norway pout, monkfish and plaice. Scientific demersal fishing surveys across the wider North Sea region (Callaway et al., 2002) found a typical community within the general region of the current study comprising whiting, haddock, dab, plaice and grey gurnard.

Pelagic species inhabit the water column, including the near surface where they feed on small zooplankton and other swimming animals. The spatial distributions of these fish are strongly influenced by hydrodynamic factors and may vary annually within the region. They can undergo extensive migrations, linked to spawning and foraging opportunities. Typical pelagic species occurring within the region include herring *Clupea harengus*, sprat *Sprattus sprattus* and mackerel *Scomber scombrus*.

Benthopelagic species live in close association with the seafloor, but mainly feed in mid-water. Such species include the lesser sandeel *Ammodytes marinus* and spurdog *Squalus acanthias*. These species often have very specific habitat requirements. Sandeel for example need tidally

active waters and a high proportion of medium to coarse grained sand where they can burrow and spawn.

Certain fish may also be described as diadromous (migratory) and include those species which move between fresh and marine water environments to spawn and forage. Diadromous species utilising rivers on the east coast of Scotland such as the Dee, Don, Tweed, Tay, Teith and Spey include salmon, sea trout, sea/river lamprey and European eel. Given the migratory behaviour of these species their potential range of movement is generally considered to be wide. This increases the connectivity between distant populations with regard to shared foraging areas. Information pertaining to the likely movements of diadromous species likely to be present within the study area is presented at a national and international level where relevant.

A wide range of shellfish (molluscs and crustaceans) is also typically encountered within the wider region and within specific seabed habitat types. Typical shellfish species associated with mud, sandy mud and coarser mixed sand and gravel sediments within the North Sea include Norway lobster *Nephrops norvegicus*, king scallop *Pecten maximus*, common whelk *Buccinum undatum* and pink shrimp *Pandalus borealis*. The European lobster *Hommarus gammarus*, velvet swimming crab *Necora puber* and mussel *Mytilus edulis* also occur commonly and are usually found in shallow rocky and boulder habitats. Brown crab *Cancer pagurus* inhabit inshore rocky areas although females undergo extensive annual spawning migrations, utilising clean sand and gravel substrates for over-wintering.

3.2 Commercial Catch Data

A broad overview of the regional fisheries communities of the study area has been completed from examination of local commercial catch data. Catch data from 2009 to 2013 for ICES statistical rectangles 43E7 and 43E8 have been collated from Marine Scotland (Scottish Government, 2014a) and reviewed (see also Commercial Fisheries Technical Report). Figure 2.1 above shows the area covered by these statistical rectangles. Rectangle 43E7 encompasses inshore areas within and around the study area. Rectangle 43E8 includes areas located comparatively further offshore from Nigg Bay.

Figure 3.1 and Figure 3.2 summarise annual commercial fish and shellfish catch respectively from within the inshore (ICES statistical rectangle 43E7) and offshore (ICES statistical rectangle 43E8) waters of the North Sea area surrounding Nigg Bay.

The inshore waters of ICES 43E7 were dominated by shellfish species including brown crab, scallops, squid, lobsters and velvet swimming crabs. Demersal fish species were also well represented in inshore waters including haddock, plaice, whiting, lemon sole, cod, turbot and saithe, although the quantities (weight) of these species caught in commercial catches were generally much lower than for shellfish. Pelagic fish were generally unrepresented in inshore areas in commercial catches with the exception of mackerel, which make seasonal inshore migrations. In total, 26 species of fish and shellfish were recorded in commercial catches from ICES 43E7 over the most recent 5 year period although the majority of these were only recorded in 2011.

Further offshore (ICES statistical rectangle 43E8), catches were generally dominated by the pelagic herring with other pelagic species such as mackerel and horse mackerel also present (Figure 3.1). Demersal species found offshore included haddock, whiting, plaice, lemon sole, hake, cod and Norway pout. Shellfish were also well represented offshore and particularly scallops and brown crab, which appeared to make up important components of the catches for each year.

It should be noted that whilst these data provide a potentially useful summary as to the presence and general distribution of characteristic fish and shellfish species, commercial catch data should be treated with a degree of caution since data is likely to be influenced by the targeted nature of the sampling (fishing) gear used, the broad area over which commercial catch data are collated and the actual distribution of fishing effort in relation to the study area in question. A full assessment of commercial fisheries will be undertaken and presented separately within the Aberdeen Harbour Expansion Project ES.

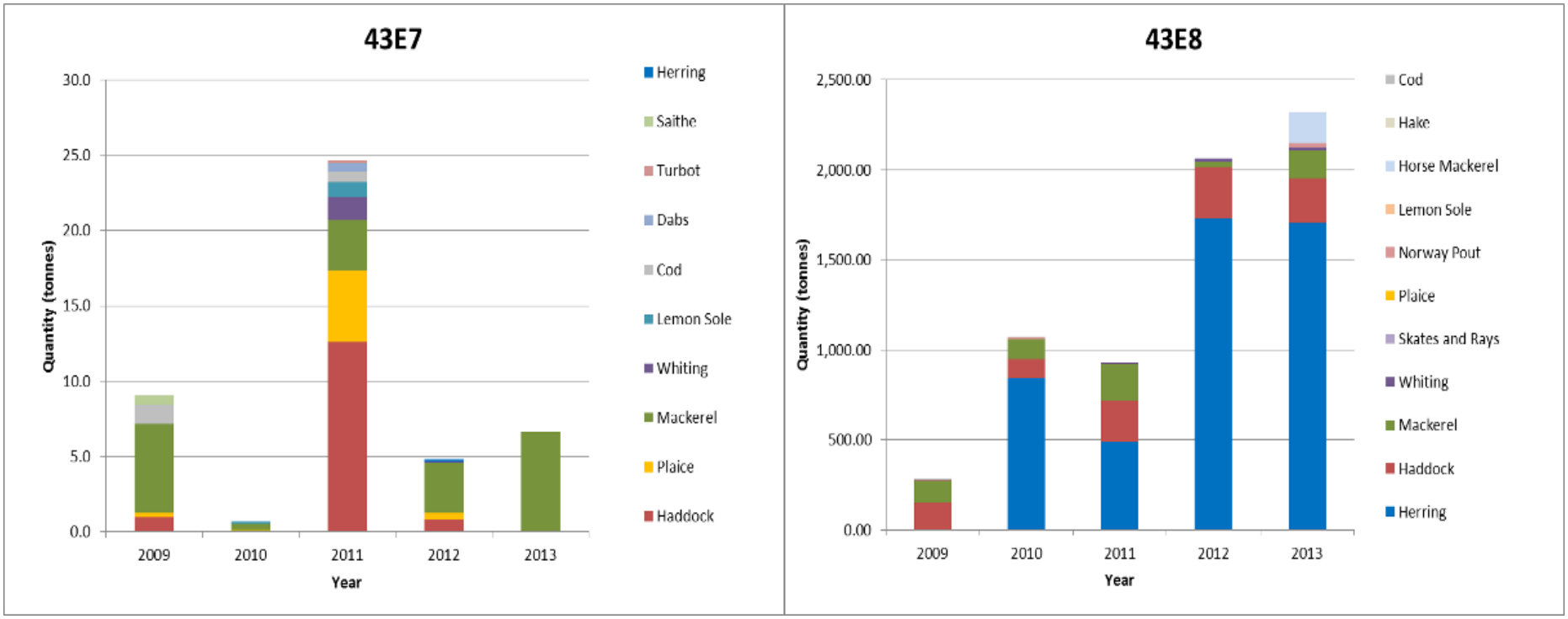


Figure 3.1: Quantity (tonnes) of fish caught in commercial catches within ICES 43E7 and 43E8 between 2009 to 2013 (top 99% of species by quantity shown) (Source: Scottish Government, 2014a)

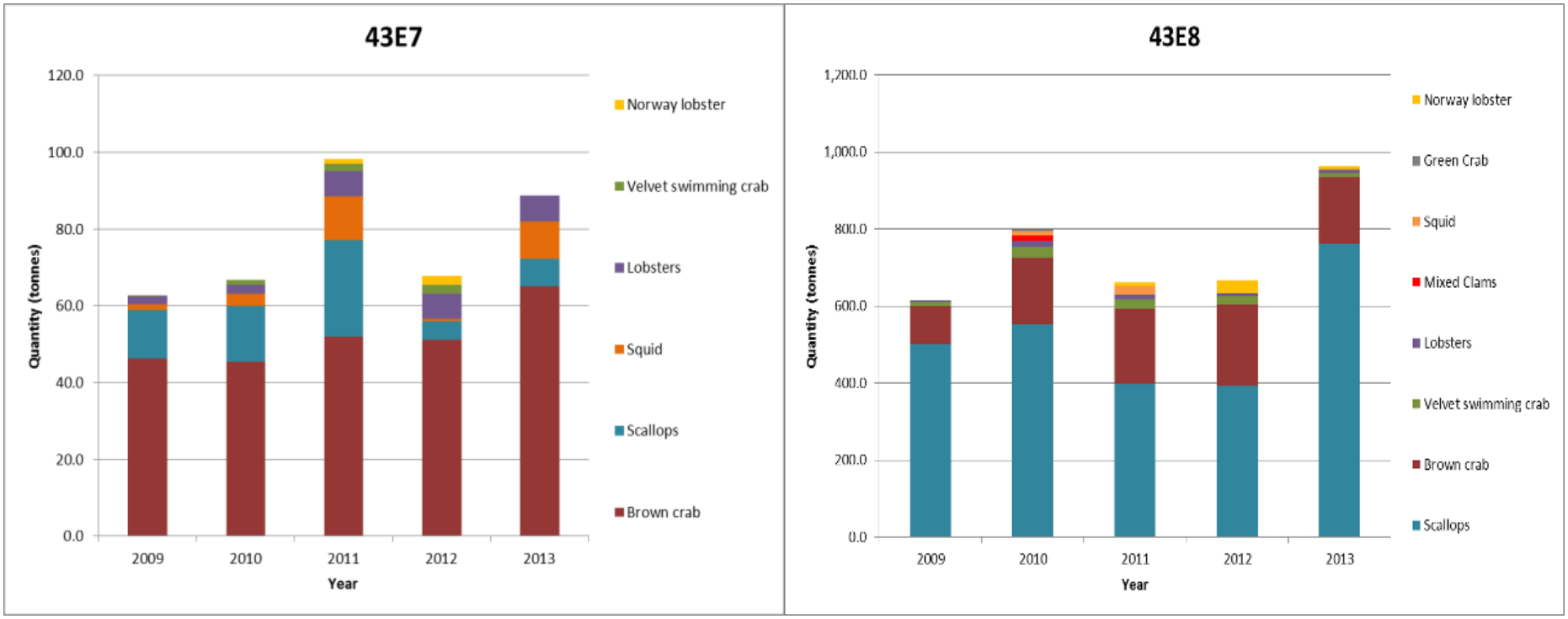


Figure 3.2: Quantity (tonnes) of shellfish caught in commercial catches within ICES 43E7 and 43E8 between 2009 to 2013 (top 99% of species by quantity shown) (Source: Scottish Government, 2014a)

3.3 Features of Conservation Importance

3.3.1 Legislative Framework

Although the UK Biodiversity Action Plan (BAP) partnership has ceased to operate, much of the mitigation developed under the UK BAP remains of use, particularly the priority marine species and habitats list. The list identifies Species of Conservation Concern considered to be threatened or listed as nationally or internationally important, for example cod, herring and ling *Molva molva*, which are exploited commercially within the region of the study area.

The Scottish priority marine features (PMFs) list contains species that have been chosen by Scottish Ministers because they are considered to be of principal importance for biodiversity in Scotland. The list can be used by public bodies to determine those species and habitats most at risk when undertaking their Biodiversity Duty.

Further legislative protection for fish and shellfish species is given by the Oslo and Paris (OSPAR) Commission for the Protection of the Marine Environment of the North-East Atlantic, which aims to raise awareness and promote fisheries management through international or national authorities. The scheme incorporates commercially exploited species such as cod and other ecologically vulnerable species such as spurdog, European eel and sea lamprey. These species may be found within the region of the study area but should not be considered as resident populations due to their mobile nature.

The Wildlife and Countryside Act 1981 incorporates existing legislation to implement the Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention) and Council Directive 79/409/EEC on the conservation of wild birds (Birds Directive) in Great Britain. Both salmon and sea lamprey feature in Annex II of the Habitats Directive, and salmon is also contained in Annex V.

The International Union for Conservation of Nature (IUCN) is used as a global evaluation tool to catalogue and highlight those taxa that are facing a higher risk of global extinction (IUCN, 2012). Taxon cited under ‘Low Risk’ have been evaluated, but do not qualify for the higher risk categories; they are, however, separated into three subcategories:

- Conservation Dependent;
- Near Threatened;
- Least Concern.

Species such as salmon, small-spotted catshark *Scyliorhinus canicula* and sea lamprey are cited as ‘Low Risk/Least Concern’ and not currently considered to be threatened. European eels are classed as ‘critically endangered’ by the IUCN and are further protected by the Biodiversity Framework and OSPAR regulations. In addition the European Commission has initiated an Eel Recovery Plan (Council Regulation No.1100/2007), which aims to return the European eel stock to more sustainable levels of abundance (Defra, 2010). This is being achieved through the establishment of national Eel Management Plans to ensure the long-term viability of the stock. Coastal and transitional waters in Scotland are exempt from the plan as there are no known fisheries for eels operating within these waters. However, the Scottish river basin district (RBD) is

covered and this includes the River Dee. As European eels will migrate through or close to the study area it is important that they are considered within this assessment.

Minimal legislative conservation exists to cover shellfish within UK waters. Those that are referenced and can be found within the study area are in relation to European lobster and Norway lobster. Both species have been evaluated as low risk least concern and are not currently considered to be threatened under the IUCN Red List of Threatened Species, owing to their broad geographic range and sustained commercial yield over several years.

3.3.2 Protected Species

A summary of the current nature conservation status of a characteristic assemblage of fish and shellfish species found within and around the study area is presented in Table 3.1.

Table 3.1: Current Conservation Designations of Species Known to Occur Within and Around the Study Area

Scientific Name	Common Name	Conservation Designations					
		National Biodiversity Framework	Scottish PMF	IUCN Red List	OSPAR	EC Directive	Bern Convention
Teleosts							
Ammodytes marinus	Raitt's sandeel	✓	✓				
Clupea harengus	Herring	✓	✓ (priority to juveniles and spawning adults)	LR/LC			
Gadus morhua	Cod	✓	✓	VU	✓		
Lophius piscatorius	Monkfish / anglerfish	✓	✓ (priority to juveniles)				
Merlangius merlangus	Whiting	✓	✓ (priority to juveniles)				
Merluccius merluccius	Hake	✓					
Molva molva	Ling	✓	✓				
Pleuronectes platessa	Plaice	✓		LR/LC			
Pollachius virens	Saithe		✓				
Pomatoschistus minuts	Sand goby		✓	LR/LC			
Scomber scombrus	Mackerel	✓	✓	LR/LC			
Trachurus trachurus	Horse mackerel /Scad	✓					
Trisopterus esmarkii	Norway pout		✓				

Source: JNCC, 2012; IUCN, 2012; OSPAR, 2008, 2012; Wildlife and Countryside Act, 1981

Key:

CR = Critically Endangered VU = Vulnerable LR = Low risk

Associated Subcategories: LC = Least Concern NT= Near Threatened

II and IV= Annex II and IV of the Habitats Directive ✓= Features under specific designation

Table 3.1: Current Conservation Designations of Species Known to Occur Within and Around the Study Area, Continued

Scientific Name	Common Name	Conservation Designations					
		National Biodiversity Framework	Scottish PMF	IUCN Red List	OSPAR	EC Directive	Bern Convention
Elasmobranchs							
Cetorhinus maximus	Basking shark	✓	✓	VU	✓	V	
Dipturus batis	Common skate	✓	✓	CR	✓		
Galeorhinus galeus	Tope	✓		VU			
Scyliorhinus canicula	Small-spotted catshark			LR/LC			
Squalus acanthias	Spurdog	✓	✓	VU	✓		
Migratory Fish							
Alosa alosa	Allis shad	✓		LR/LC	✓	II and V	✓
Alosa fallax	Twaite shad	✓		LR/LC		II & V	✓
Anguilla anguilla	European eel	✓	✓ (marine part of life-cycle only)	CR	✓		
Lampetra fluviatilis	River lamprey	✓	✓ (marine part of life-cycle only)	LR/LC		II and V	✓
Petromyzon marinus	Sea lamprey	✓	✓ (marine part of life-cycle only)	LR/LC	✓	II	✓
Salmo salar	Atlantic salmon	✓	✓ (marine part of life-cycle only)	LR/LC	✓	II and V	✓
Salmo trutta	Sea trout	✓	✓ (marine part of life-cycle only)	LR/LC			
Shellfish							
Homarus gammarus	European lobster			LR/LC			
Nephrops norvegicus	Norway lobster			LR/LC			

Source: JNCC, 2012; IUCN, 2012; OSPAR, 2008, 2012; Wildlife and Countryside Act, 1981

Key:

CR = Critically Endangered VU = Vulnerable LR = Low risk

Associated Subcategories: LC = Least Concern NT= Near Threatened

II and IV= Annex II and IV of the Habitats Directive ✓= Features under specific designation

3.3.3 Special Area of Conservation (SAC)

Natura 2000 is a European Union (EU) Nature and Biodiversity policy for the protection of Europe's natural areas. It was established under the EC Habitats Directive and aims to assure the long-term survival of Europe's most valuable and threatened species and habitats. It comprises Special

Areas of Conservation (SAC), as designated by Member States under the Habitats Directive, and also incorporates Special Protection Areas (SPAs), as designated under European Council Directive 2009/147/EC on the conservation of wild birds ('the Birds Directive'). Government policy as outlined in the addendum to PPS 9 (ODPM, 2005) is that Wetlands of international importance designated under the Ramsar Convention (Ramsar sites) should also be subject to the provisions of the Habitats Regulations and their qualifying features.

The study area does not directly coincide with any Natura 2000 sites, but may lie along the migratory pathway of species listed under Annex II of the Habitats Directive and for which, Natura 2000 sites have been designated. There are six rivers on the Scottish east coast designated as SACs for their migratory fish populations as presented in Table 3.2. Of the species listed in Table 3.2 only salmon and sea lamprey are likely to encounter the development due to the fact that they migrate over tens of kilometres. River lamprey are not thought to leave their natal estuaries and will not therefore encounter the development. The River Dee SAC is designated for salmon, as well as freshwater pearl mussel and otter, and is located immediately to the north of the development such that salmon entering and leaving the River. Dee SAC from the south will at some stage pass through the study area. Other migratory species, such as the sea trout and European eel *Anguilla anguilla* are also known to inhabit the Dee and surrounding catchments such as the rivers Don and Ugie, and are similarly considered likely to utilise the study area for passage during their migrations.

It should also be noted that the freshwater pearl mussel *Magaritifera margaritifera* is cited as a primary species for selection for the rivers Spey, Dee and South Esk as SACs. As adults the freshwater pearl mussel only inhabit riverine environments, but during their early development (glochidial stage), they depend on migrating anadromous salmonids for dispersal. They do this by parasitising on their gills before the salmon migrate out to sea. This means that any influences on the River Dee, Spey or South Esk salmonid populations (salmon / sea trout) may directly affect the respective freshwater pearl populations.

Table 3.2: Scottish East Coast SACs Designated for Annex II Migratory Fish

Scientific Name	Common Name	Natura 2000 SAC Site					
		R. Spey	R. Dee	R. South Esk	R. Tay	R. Teith	R. Tweed
Lampetra fluviatilis	River lamprey	×	×	×	*✓	✓	*✓
Petromyzon marinus	Sea lamprey	✓	×	×	*✓	✓	*✓
Salmo salar	Atlantic salmon	**✓	**✓	**✓	✓	*✓	✓
Magaritifera margaritifera	Freshwater pearl mussel	✓	✓	✓			
Approx. distance (km) and direction from development		87 (NW)	1 (N)	53 (S)	87 (SW)	157 (SW)	152 (S)

Source: JNCC, (2014b)

Key:

✓/× = Features under designation N = north NW = north-west S = south SW = south-west

Notes:

* Annex II species present as qualifying feature, but not a primary reason for site selection

** Cites freshwater pearl mussel as primary species for qualification

4. KEY SPECIES ACCOUNTS

The following section provides an account of the species recommended for assessment during scoping and consultation, see Section 1.3. Information on migratory species, including salmon, sea trout, European eel and sea lamprey is provided in Section 6 below.

4.1 Sandeel Species Ammodytidae

4.1.1 Ecology

Sandeel are small eel like fishes that congregate in large shoals. There are five commonly occurring species in UK waters; these are the Raitt's *Ammodytes marinus*, lesser *A. tobianus*, smooth *Gymnammodytes semisquamatus*, greater *Hyperoplus lanceolatus* and Corbin's *H. immaculatus* sandeel. The Raitt's sandeel is the most abundant sandeel species in the North Sea often comprising 90% of the commercial catch (Scottish Government, 2014b). As a commercial species sandeels once represented the largest fishery in North Sea, with annual landings in excess of 800,000 tonnes between 1994 and 2003, however in recent years numbers have declined to 290,000 tonnes per year (JNCC, 2014c). A commercial fishing ban was introduced for sandeel off eastern Scotland and north-east England in 2000 to safeguard the sandeel population (JNCC, 2014c).

The local distribution of sandeel is very much dependant on the substrate characteristics of the area (Lancaster et al., 2014). This is because sandeel are closely associated with specific sandy substrates in which they create burrows to live. During the colder months, September through to March, sandeel rarely leave their burrows except to spawn between December and January. After this over-wintering period has ended the sandeel emerge from their burrows to begin feeding. Feeding takes place during the day, between April and September (Scottish Government, 2014b). Refuge is sought back in the burrow at night or whenever a predator may be present.

Eggs are deposited in the sediment where they hatch between February and March (Lancaster et al., 2014). The larvae then become planktonic drifting with the prevailing currents before settling back on to the seabed. These new settlements may be a considerable distance away from where they hatched, however they are still governed by the availability of suitable sandy substrates.

After hatching it usually takes around one to three years to reach maturity. Sandeels found in Scotland, for example in the Firth of Forth and Shetland, tend to be slower growing than those found further south and only reproduce after three years (Scottish Government, 2014b). This is thought to be a factor of the colder water temperatures found in northern latitudes.

Sandeels ecological value is exceptionally high because of the role they play as a keystone species in many marine food webs. A host of top predators including larger commercial fish species such as cod, whiting and spurdog predate on sandeel as well as a variety of seabirds and marine mammals.

4.1.2 Conservation Status

Both the smooth and greater sandeel are classified by the IUCN as 'Least Concern' for species that are not at risk of becoming endangered at present. The Raitt's sandeel is cited on both the National Biodiversity Framework and the Scottish PMF list for species of principal importance for biodiversity in Scotland.

4.1.3 Occurrence in study area

Much of the east coast of Scotland, incorporating the Aberdeen Harbour Expansion Project study area, is regarded as spawning and nursery habitat for sandeel (Appendix A and Appendix B) (Coull et al., 1998; Ellis et al., 2012). However, the distribution and abundance of sandeel within the study area is subject to the availability of suitable sandy habitats. A peak in water activity takes place between December and January when they emerge from the seabed to spawn and during the feeding season between April and September.

4.2 Basking Shark *Cetorhinus maximus*

4.2.1 Ecology

Basking sharks *Cetorhinus maximus* are widely distributed within temperate waters around the world. They are highly mobile and undertake annual migrations of many hundreds of kilometres (Lancaster et al., 2014). In the UK they are present as seasonal visitors typically arriving in the south-west of England in April/May and migrating up the west coasts of England and Scotland during the subsequent spring and summer months before moving away into deeper waters during late autumn. Figure 4.1 shows the seasonal variation in basking shark abundance in Scotland and highlights the occurrence of peak numbers in June, July, August and September.

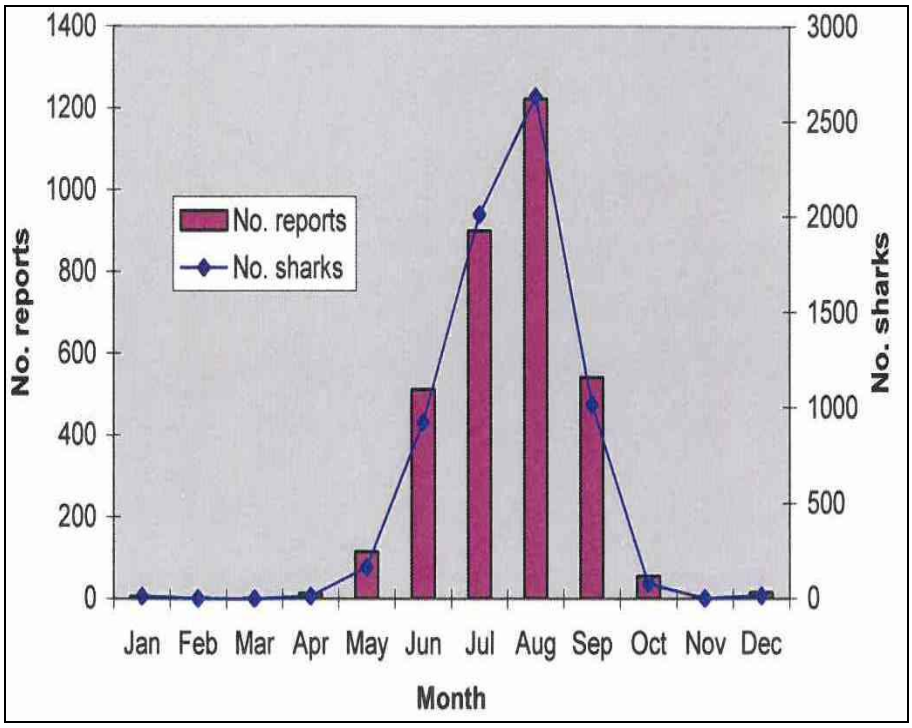


Figure 4.1: Seasonal variation in basking shark abundance in Scotland (1987 to 2006) (Source: Bloomfield and Solandt, undated)

Basking sharks are filter feeders feeding preferentially on zoo-planktonic crustaceans (copepods), but also on crustacean and fish eggs and larvae, within the uppermost surface water layers with feeding individuals generally congregating at fronts between different inshore water bodies where the highest concentrations of plankton occur. Speedie et al., (2009) and Lancaster et al., (2014) explain the clear relationship that exists between basking shark abundance and areas of high plankton productivity in shelf sea areas and headland fronts and where water bodies meet. Lancaster et al., (2014) further explain that the surface feeding and courtship behaviours of basking sharks makes them comparatively vulnerable to physical damage in shelf waters and that collisions with vessels can be fatal.

4.2.2 Conservation Status

In UK waters basking shark are protected under Schedule 5 of the Wildlife & Country Act, 1981 (as amended). They are listed on Appendix II of the Convention on the Trade of Endangered Species (CITES) and are included on the OSPAR list of threatened or declining species. In addition, the IUCN assess the global status of the Basking Shark as Vulnerable but classify this species as Endangered within the north Pacific and northeast Atlantic stocks (Fowler 2009), which have been subject to target fisheries. Basking sharks are also subject to a UK Biodiversity Action Pan (UKBAP), as part of the Scottish Biodiversity Strategy, and are included as a priority species in the Scottish Marine Wildlife Watching Code (SMWWC).

4.2.3 Occurrence in Study Area

Sightings of basking shark within the current study area appear to be uncommon in comparison to sightings from the west coasts of England and Scotland and Hebrides. This is demonstrated in Figure 4.2 and Figure 4.3 below which shows very low densities of observations of basking shark around the current Aberdeen Harbour Expansion Project study area relative to numbers of sightings elsewhere in Scotland. Small numbers of sightings at Fife Ness and around the outer Firth of Forth suggest that some individuals may transit through the study area although any transit appears to be highly infrequent and only involve one or a few individuals in any one season. For instance, no basking sharks were recorded during site specific marine mammal observations at Nigg Bay in 2014 (please see the Marine Mammal Technical Report). Also, volunteer observations recorded by the Shark Trust (www.sharktrust.org) recorded just one individual at Fife Ness in late August 2013, and just 3 individuals were recorded by the Shark Trust at Sandend and Dunbar in July and September 2012 respectively.

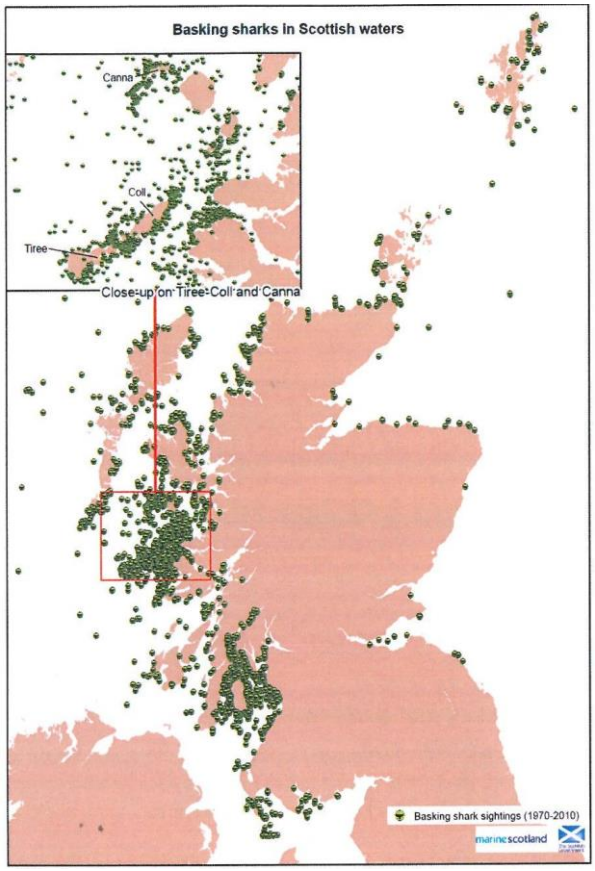


Figure 4.2: Distribution of basking shark sightings between 1970 and 2010 (Source: Drewery, 2012)

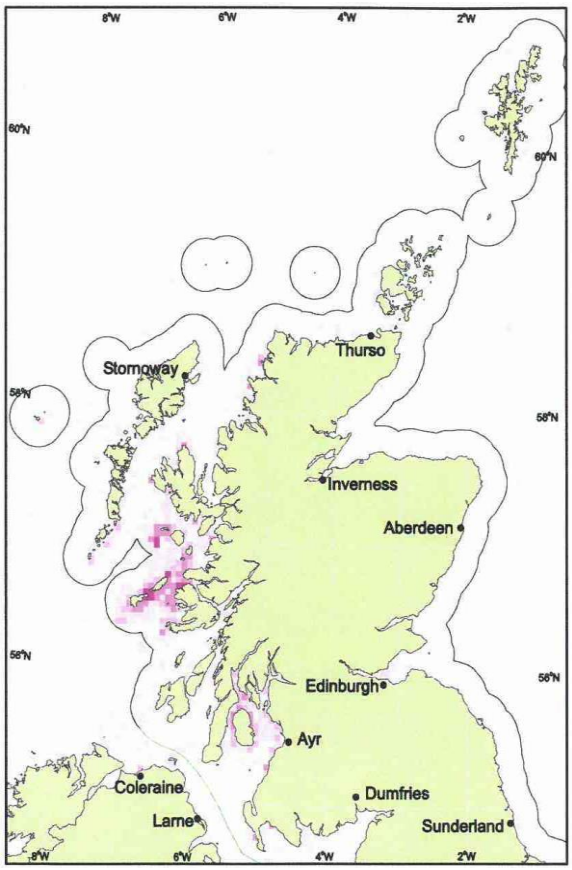


Figure 4.3: Numbers of basking shark sightings by 5km2 cell (lightest shades are 1-10 sightings; then 11-50; 51-100; the darkest squares represent densities of 100+ sightings) (Source: Bloomfield and Solandt, undated)

4.3 Herring *Clupea harengus*

4.3.1 Ecology

Herring are widely distributed throughout the north-west and north-east Atlantic and occur throughout the North Sea. They are primarily a pelagic species with distributions based on various hydrographical conditions such as water temperature, degree of mixing and presence of frontal systems as well as the distribution of zooplankton prey.

They generally form large shoals, staying close to the bottom in depths of around 200 m during the day but rising up through the water column at dusk (Barreto and Bailey, 2013) presumably in response to the diurnal vertical migration of their prey items. Herring play an important ecosystem function as important prey for many predators, including cod and other large gadoids, dogfish and sharks, marine mammals and sea birds (ICES, 2006a).

Four distinct spawning populations are known in the North Sea including the Buchan population, which spawn off the Scottish east coast during September/October (Payne, 2010). Herring are demersal spawners and deposit their eggs on the seabed by adhering them to coarse sand, gravel, shells and small stones in relatively shallow water approximately 15 m to 40 m deep. Natural

variability in the timing of spawning is to be expected (Payne, 2010), owing to year to year changes of environmental conditions at the time of egg development and larval hatch, as well as changes in the timing of emergence of eggs and larvae or a combination of both (Wieland et al., 2000).

Eggs hatch after around 2 weeks, depending on sea temperature, after which the larvae drift to shallow water inshore nursery grounds. Nursery grounds are known in the Moray Firth and Firth of Forth. As they grow over the subsequent 2 years, the juvenile herring gradually move offshore to eventually join the adult populations.

4.3.2 Conservation Status

Herring are classified by the IUCN as 'Least Concern' for species that are considered to be widespread and relatively abundant thus not at risk of becoming endangered at present. In addition herring are also cited on both the National Biodiversity Framework and the Scottish PMF list for species of principal importance for biodiversity in Scotland.

4.3.3 Occurrence in Study Area

Broad scale sensitivity maps, shown in Appendix A and Appendix B, identify the study area as being a potential spawning ground for herring (Coull et al., 1998). Most of the eastern Scottish coast extending north from Whitby to Peterhead is regarded as high intensity nursery for herring (Ellis et al., 2012). It is therefore reasonable to assume that Nigg Bay and the surrounding inshore waters of the North Sea are being used by juvenile herring after spawning, which takes place throughout October and November (Payne, 2010). Evidence to support the wider regions importance to herring is seen in the commercial landing data, which show herring to be the most abundantly landed species (by weight) from ICES 43E8; refer to Section 3.2.

4.4 Common Skate *Dipturus batis*

4.4.1 Ecology

The common skate *Dipturus batis* was once found throughout the northeast Atlantic and Mediterranean, however due to fishing pressures its range has been greatly reduced (Shark Trust, 2009). Its current UK distribution is limited to northwest Scotland and the Celtic Sea where it can be found in shallow coastal waters down to a depth of 600 m (Dulvy et al., 2006). However, it is most commonly found at a depth of approximately 200 m (Dulvy et al., 2006).

It is a large and long-lived species with females reaching a maximum of 285 cm and living for between 50 years to 100 years (Shark Trust, 2009). Typical to most elasmobranchs the species is slow growing and late to mature only reaching sexual maturity after 11 years and breeding once in every two years (Shark Trust, 2009). Mating takes place in spring followed by egg laying in summer. Up to 40 eggs are deposited directly into soft sandy/muddy seabed where they hatch after approximately 2 months to 5 months (Dulvy et al., 2006; Neal et al., 2008; Shark Trust, 2009).

The common skate is a bottom dwelling species and is capable of feeding on a wide variety of prey including shellfish such as crab and lobster and demersal fish such as catshark and monkfish. They are also capable of taking mid-water species like herring, mackerel and squid (Shark Trust, 2009).

4.4.2 Conservation Status

The IUCN assess the global status of the common skate as 'Critically Endangered' for species considered to be facing an extremely high risk of extinction in the wild. The common skate is cited on both the National Biodiversity Framework and the Scottish PMF list for species of principal importance for biodiversity. In addition common skate are included on the OSPAR list of threatened and/or declining species in the northeast Atlantic.

4.4.3 Occurrence in Study Area

The National Biological Network (NBN) Gateway does not hold any record of common skate within or around the study area and nor does the Marine Life Information Network (MarLIN). The study area is regarded as being a low intensity nursery ground for common skate (Ellis et al., 2012). However, due to the study areas shallow depth and the lack of recorded distribution it is unlikely that the species will occur in any abundance within the study area.

4.5 Cod *Gadus morhua*

4.5.1 Ecology

Cod occur throughout the coastal and deeper offshore waters of the northern and central North Sea (Maitland and Herdson, 2009). Juveniles tend to be concentrated in shallow coastal waters of the eastern North Sea whereas adults are generally found in the deeper offshore waters (Maitland and Herdson, 2009). Adult cod are usually found in shoals although it is not uncommon to find solitary individuals.

Cod generally grow quickly reaching a length of 80 cm after a period of four years which coincides with maturity. Spawning activity takes place in offshore waters occurring between January and April peaking in February (Scottish Government, 2014b). Concentrated spawning aggregations can be found in the northern North Sea and the coastal waters of east Scotland. To reach these spawning grounds cod can undertake seasonal migrations although in many areas spawning movements are limited.

Like most Gadoids, cod are active predators with a varied diet consisting of crustaceans such as Norway lobster, shrimps, amphipods and other benthic organisms. Cod also feed on a wide variety of fish including herring, sandeels, Norway pout, whiting, haddock and smaller cod (Rogers and Stock, 2001).

4.5.2 Conservation Status

The IUCN assess the global status of the cod as 'Vulnerable' for species considered to be facing a high risk of extinction in the wild. Cod are also cited on both the National Biodiversity Framework and the Scottish PMF list for species of principal importance for biodiversity. In addition cod are included on the OSPAR list of threatened and/or declining species in the northeast Atlantic.

4.5.3 Occurrence in Study Area

Nigg Bay and its surrounding waters are used by cod for low intensity spawning and nursery (Appendix A and Appendix B) (Ellis et al., 2012). The study area is likely to have a higher proportion of juveniles because of their association with inshore waters when young. It is therefore

considered that juvenile cod will be present within the study area throughout the year and that adult cod may on occasion visit the area for spawning and foraging activities.

4.6 Monkfish *Lophius piscatorius*

4.6.1 Ecology

There are two species of monkfish, also called anglerfish, which occur in Scottish waters. These are the black-bellied monkfish *Lophius budegassa* and the monkfish *L. piscatorius.* Of the two the latter is more common. The biology of the two species is very similar with both occurring in a wide range of water depths from shallow inshore waters down to and beyond 1,000 m (Scottish Government, 2014b). Smaller individuals are more regularly caught in shallower waters with congregations of larger individuals often being found in deeper waters. This is thought to be a factor of fishing pressures as the monkfish are slow growing and late to mature with females taking around seven years to reach maturity (Scottish Government, 2014b).

Spawning takes place in deep waters over a prolonged period between January and June (Maitland and Herdson, 2009). The eggs are unusual in that they are released in a continuous gelatinous ribbon that floats to the surface for dispersal by ocean currents. Young monkfish spend the first three to four months of life in mid-water before settling on the seabed usually in shallow waters. Monkfish are opportunistic predators that use a modified dorsal fin ray with a 'lure' attached to the end to attract a range of prey that includes various fish and shellfish species (Scottish Government, 2014b).

4.6.2 Conservation Status

Neither species of monkfish have been evaluated by the IUCN. *L. piscatorius* is cited on both the National Biodiversity Framework and the Scottish PMF list for species of principal importance for biodiversity in Scotland.

4.6.3 Occurrence in Study Area

Adult monkfish may on occasion be present within the study area but for reasons discussed above they are unlikely to be present in any significant abundance. However, the inshore waters south of Fraserburgh, including Nigg Bay, are considered low intensity monkfish nursery (Appendix B) (Ellis et al., 2012). It is therefore likely that juvenile monkfish will be present within the study area throughout the year.

4.7 Whiting *Merlangius merlangus*

4.7.1 Ecology

Whiting is a member of the cod (Gadoid) family and can be found throughout the inshore and offshore regions of the North Sea (Maitland and Herdson, 2009). Its inshore distribution tends to be associated with smaller individuals that are thought to be using the shallows as nurseries prior to recruitment (Maitland and Herdson, 2009). Juveniles grow quickly for the first 12 months after which growth slows.

Once maturity has been reached, which occurs on average after 2 years, a prolonged spawning season takes places throughout the first half of the year (Scottish Government, 2014b). Spawning

generally peaks in spring, however, this is variable and can be later in colder northern North Sea waters. There are three main spawning areas in the North Sea with the northern most being located off the east coast of Scotland.

Whiting is an active predator with young fish mainly eating crustaceans while the adults eat a variety of fish including Norway pout, sandeel, haddock and cod as well as other whiting (Scottish Government, 2014b). Conversely the species itself is an important prey species for larger fish, seabirds and marine mammals. It is also a commercially important species and is often targeted in mixed demersal trawls or is retained as by-catch.

4.7.2 Conservation Status

IUCN has not evaluated whiting however the species is cited on both the National Biodiversity Framework and the Scottish PMF list for species of principal importance for biodiversity in Scotland.

4.7.3 Occurrence in Study Area

Broad scale sensitivity maps identify a large area of low intensity spawning and high intensity nursery situated along the east coast of England and Scotland (Appendix A and Appendix B) (Ellis et al., 2012). Nigg Bay and the study area are therefore considered to be utilised by whiting for spawning and nursery purposes. Given the northern location of the study area, peak spawning activity is likely to occur in late spring, followed by an inshore migration of juveniles throughout summer.

4.8 Ling *Molva Molva*

4.8.1 Ecology

Ling is a large species most often found in waters between 100 m and 400 m deep but can be found in shallower coastal areas over suitable rocky grounds or wrecks (Maitland and Herdson, 2009). Like all members of the cod family ling is an active predator with a diet consisting of fish such as Norway pout, cod and blue whiting *Micromesistius poutassou* as well as numerous crustacean species such as brown crab, Norway lobster and pink shrimp. Spawning takes place between March and July in the North Sea, however most spawning grounds are situated to the west of Scotland (Maitland and Herdson, 2009). Ling is an important commercial species with landings exceeding 30,000 tonnes per annum since 2000 (Seafish, 2014).

4.8.2 Conservation Status

IUCN has not evaluated ling however the species is cited on both the National Biodiversity Framework and the Scottish PMF list for species of principal importance for biodiversity in Scotland.

4.8.3 Occurrence in Study Area

Ling are unlikely to be present within the study area in any significant abundance as they are more associated with deeper offshore waters. However, the inshore regions surrounding Nigg Bay are considered as a low intensity nursery area (Appendix B) (Ellis et al., 2012). This means that there is the possibility for juvenile ling to be present throughout the year.

4.9 Saithe *Pollachius virens*

4.9.1 Ecology

Saithe *Pollachius virens* are widespread within the north-east Atlantic, distributed from the Barents Sea in the north to the Bay of Biscay in south, also around Iceland and east Greenland (Homrum et al., 2013). Adults are found in most areas of the North Sea but occur mainly around the 200 m depth contour (Barreto and Bailey, 2013).

They reach maturity at around age 4 years to 6 years and achieve a total length of around 55 cm in length by this stage. Spawning takes place between January and April with peak spawning activity occurring between January and February. Spawning takes place in offshore areas near to the edge of the continental shelf to the north and west of the Outer Hebrides (Barreto and Bailey, 2013).

Following spawning, young fish live near the surface and by mid-summer can be found close inshore, in bays and harbours which they utilise as nursery areas. In late summer and autumn, juveniles can be found in large numbers within Scottish coastal waters close inshore. Juvenile saithe reside in inshore waters the first 2 years to 4 years before moving into deeper offshore waters.

Although regarded as a demersal species, saithe also exhibit pelagic behaviour in pursuit of its main prey items which include pelagic crustaceans such as copepods, euphausiids, and amphipods as well as fishes such as Norway pout, blue whiting *Micromesistius poutassou*, herring, sandeel and capelin *Mallotus villosus* (Homrum et al, 2013). During the first 2 years of their life in inshore coastal waters saithe feed mainly on plankton like appendicularians and crustaceans.

Trawl surveys conducted in relation to the Inch Cape offshore wind farm located 15 km to 22 km east of the Angus coastline, within 40 m to 57 m depths of water found saithe in low abundance during autumn (October) and winter (January) (total 7 individuals) (AMEC, 2013). The individuals found ranged between 15 to 36 mm in length suggesting that they are juveniles (Frose and Pauly, 2012). Saithe were absent from spring (May) and summer (July) trawl sampling campaigns at the Inch Cape wind farm suggesting a seasonal distribution pattern in the area around the outer Tay.

4.9.2 Conservation Status

IUCN has not evaluated saithe however the species is cited on the Scottish PMF list for species of principal importance for biodiversity in Scotland.

4.9.3 Occurrence in Study Area

Saithe form part of the demersal catch of the wider region surrounding the study area. However, the occurrence of saithe within the study area is likely to be associated with juveniles, which are known to use the inshore regions of the east coast of Scotland for nursery purposes throughout the summer and autumn. Adults feed and spawn offshore and so are unlikely to be found within the vicinity of the study area.

4.10 Sand goby *Pomatoschistus minutus*

4.10.1 Ecology

The sand goby is distributed throughout shallow coastal waters of the UK. It is a relatively small fish, growing up to 10 cm in length. It lives on shallow sandy or muddy seabed substrates in coastal areas, estuaries and marine bays usually to a depth of 20 m but can occur at depths of 60 m to 70 m (Riley, 2007).

It is a relatively short lived species living up to around 15 months to 18 months. The sand goby becomes sexually mature after 7 months to 12 months of age after which it spawns between February and May (Riley, 2007). It is polygamous and during the breeding season the female can lay successive batches of eggs of the nests of different males. Eggs are laid in nests on the seabed which are dug by the males under suitable bivalve shells, small stones or pieces of wood. These nest sites are subsequently guarded by the male until hatching. The usual breeding sites of sand gobies are shallow sandy seabed areas but Lehtonen and Lindström, (2004) report the occurrence of nest sites on rocky bottoms on the Finnish coast of the Baltic Sea although strong preference for a sand habitat was demonstrated during laboratory observations.

The sand goby feeds on a range of benthic invertebrates and zooplankton including sedentary polychaete worms, juvenile brown shrimps, mysid shrimps, amphipods, bivalve siphons and planktonic crustaceans (Hamerlynck and Cattrijsse, 1994) and are themselves prey for larger species of fish such as cod, whiting and saithe.

4.10.2 Conservation Status

Sand goby is listed on the recommended list of Priority Marine Features (PMF) in Scottish territorial waters and is also included in Appendix 3 of the Convention on the Conservation and European Wildlife and Natural Habitats (BERN Convention).

4.10.3 Occurrence in Study Area

The NBN Gateway holds no record of the occurrence of sand goby within the study area. However, the shallow sand seabed habitat within the Nigg Bay embayment indicates that suitable spawning habitat may be available and it may therefore be possible that sandy goby are present in the area.

4.11 Spurdog *Squalus acanthias*

4.11.1 Ecology

Spurdog, also called spiny dogfish, is distributed throughout the North Sea and the North Atlantic (Shark Trust, 2010). It is a highly migratory species which is not known to associate with any particular habitat although it is usually found in water depths between 10 m and 200 m (Fordham et al., 2006). Typical of elasmobranchs (sharks, skates and rays) the species is long lived, slow growing and late to mature with populations in the north-east Atlantic only maturing after 15 years. Slow growth and late maturity makes the species particularly vulnerable to over fishing.

The spurdog is a shoaling species that can often be found in single sex aggregations that may be further segregated by size. Males and females only mix during mating in offshore aggregations. Development is ovoviviparous (producing young by means of eggs that hatch internally) with

relatively long gestation periods of between 18 months to 24 months (Shark Trust, 2010). Females give birth to between 1 and 22 pups every 2 years (Shark Trust, 2010).

Diet is varied consisting mainly of mid-water shoaling fish like herring, sprat and pilchard but the spurdog is also known to predate upon sandeel and other bottom dwelling fish such as whiting, Norway pout and poor cod. Crustaceans and molluscs also form a large part of the diet of smaller individuals (Shark Trust, 2010).

4.11.2 Conservation Status

The IUCN assess the global status of the spurdog as 'Vulnerable' for species considered to be facing a high risk of extinction in the wild. Spurdog are also cited on both the National Biodiversity Framework and the Scottish PMF list for species of principal importance for biodiversity in Scotland. In addition spurdog are included on the OSPAR list of threatened and/or declining species in the northeast Atlantic.

4.11.3 Occurrence in Study Area

Broad-scale sensitivity maps identify much of the northern and central North Sea as low intensity nursery for spurdog (Appendix B) (Ellis et al., 2012). However, due to its migratory nature and the fact that they do not associate with particular habitat, the species may be considered an occasional visitor to the study area for feeding, spawning or nursery purposes.

4.12 Norway pout *Trisopterus esmarkii*

4.12.1 Ecology

Norway pout *Trisopterus esmarkii* is a small (generally around 20 cm) boreal fish species belonging to the cod family, occurring generally between the North Sea and Barents Sea in depths of around 50 m to 300 m (Nash et al., 2012). It has a benthopelagic life style, living in extensive shoals in the open sea, frequently in mid-water (ICES 2006b). It is relatively short lived (4 years to 5 years) and typically matures at 2 years of age (Nash et al, 2012).

Norway pout spawn from January to March (Nash et al., 2012) off north and north-west Scotland, Faeroes, Iceland and Norwegian coasts (Sweet, 2009) in deep water areas (>100 m). There are no apparent discrete nursery grounds as juvenile and adult distributions overlap. Figure 4.2 (a) below shows the distribution of adults of spawning age (age 2+) during the spawning season and indicates potential presence of spawning ground within the vicinity of the current study area although the distribution of early stage eggs (Figure 4.2 b) suggests that the deeper, offshore waters to the east are more important in this respect.

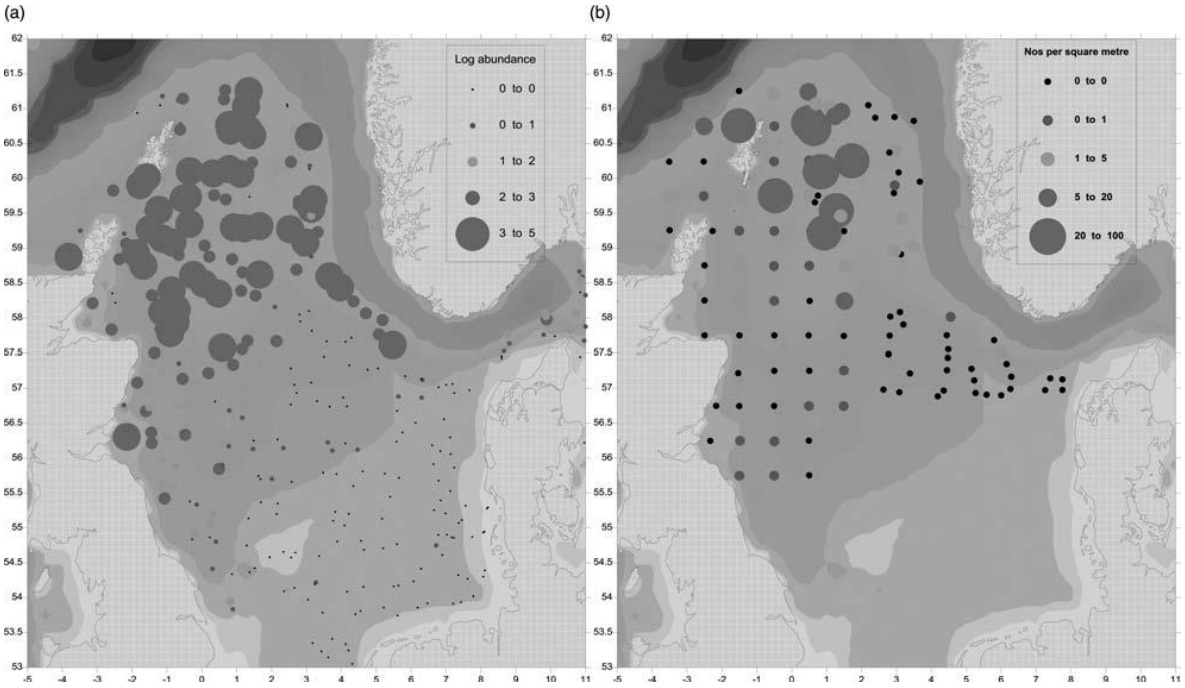


Figure 4.4: Distribution of Norway pout Trisopterus esmarkii (a) adults (age 2+) and (b) early stage eggs in January/March 2009 (taken from Nash et al, 2012) (black dots denote no eggs found)

Juvenile Norway pout feed mainly on copepods and appendicularians whilst larger specimens have been found to feed upon small crustaceans and small fish, mainly gobies during a study in Norway. Feeding appears to be more intense at night than during the day (Albert, 1994). In turn, it forms an important source of food for many species and nearly all predatory fish such as cod, hake, whiting, pollack, coalfish, monkfish and ling will eat Norway pout. As such, they may be regarded as very important within the food chain. In addition, they are commercially important and are targeted with the use of fine mesh demersal trawls nets for processing into fishmeal (Revill et al., 2004).

4.12.2 Conservation Status

IUCN has not evaluated Norway pout however the species is cited on the Scottish PMF list for species of principal importance for biodiversity in Scotland.

4.12.3 Occurrence in the Study Area

Norway pout are unlikely to be found within the study area because they are typically associated with offshore waters between 80 m and 200 m (Maitland and Herdson, 2009). However, spawning may be occurring between January and March within the vicinity based on the distribution of early stage eggs (as described above). If the study area is being used for spawning it is not likely to be high intensity due to the low abundance of eggs found inshore. The study area is therefore likely to be of low ecological importance to Norway pout.

4.13 Brown crab *Cancer pagurus*

4.13.1 Ecology

Brown crab is found all around the UK coast down to a depth of approximately 100 m. Inshore it inhabits rocky reefs and mixed coarse grounds and when encountered offshore it is often

associated with soft sediments (muddy sand) (Marine Scotland, 2011). Females can undertake large scale (100s km) migrations in autumn to reach offshore spawning and overwintering grounds. Males undertake limited, small scale movements and do not undergo migration. Spawning is annual or bi-annual and reproduction takes place during the summer. Preferred spawning ground is thought to comprise clean coarse sediment within which egg-bearing females bury themselves in order to over-winter prior to releasing larvae in the following spring.

The larvae are pelagic before settling to the seabed in summer or autumn depending on latitude and water temperature (Marine Scotland, 2011). Juvenile crabs are commonly found in shallow inshore nursery waters. Growth rate varies between areas and animals will typically reach minimum landing size, (140 mm carapace width) at around four to six years old (Marine Scotland, 2011).

4.13.2 Conservation Status

There is no legislative conservation on brown crab in the UK apart from a minimum landing size in Scotland of 140 mm.

4.13.3 Occurrence in Study Area

Brown crab are one of the most heavily targeted shellfish species within the inshore waters of the study area, see Section 3.2. This demonstrates that the species is utilising the study area and will be present throughout the year. Juveniles are more likely to be using the study area as nursery whereas adults, particularly females, may be migrating through en route to spawn.

4.14 European lobster *Homarus gammarus*

4.14.1 Ecology

Common around the UK coast, the European lobster is usually found on coarse rocky grounds at water depths of between 5 m and 150 m (Marine Scotland, 2011). European lobsters do not undertake migrations associated with spawning, instead they only tend to move a few miles throughout their life, which can be over 40 years (Marine Scotland, 2011). Growth rates vary depending on a number of variables like temperature, degree of exposure and food availability. Individuals reaching the minimum landing size of 87 mm carapace width in Scotland may be between 4 years and 12 years old (Marine Scotland, 2011).

Mating tends to occur between June and July at the time of moulting (Marine Scotland, 2011). This is because the females shell is soft and penetrable by the male sex organs. After mating females carry their fertilized eggs between their walking legs giving them a ‘berried’ appearance for up to 11 months. The eggs then hatch and the larvae become planktonic. Settlement occurs after three weeks but very little is known about where the juveniles settle or how they behave.

Their diet mainly consists of benthic species invertebrates such as crabs, molluscs, sea urchins, polychaete worms and starfish and may on occasion include fish.

4.14.2 Conservation Status

Little legislative conservation exists to cover shellfish within UK waters. The European lobster has been evaluated as low risk least concern and are not currently considered to be threatened under the IUCN Red List of Threatened Species. This is due to their broad geographic range and sustained commercial yield over several years.

4.14.3 Occurrence in Study Area

Given the distribution of commercial fishing effort (see Figure 4.3 below) European lobster is likely to be present within the study area and to the south of Nigg Bay. This species will be present throughout the year based on the non-migratory nature or small range movement of the species (Smith et al., 2001).

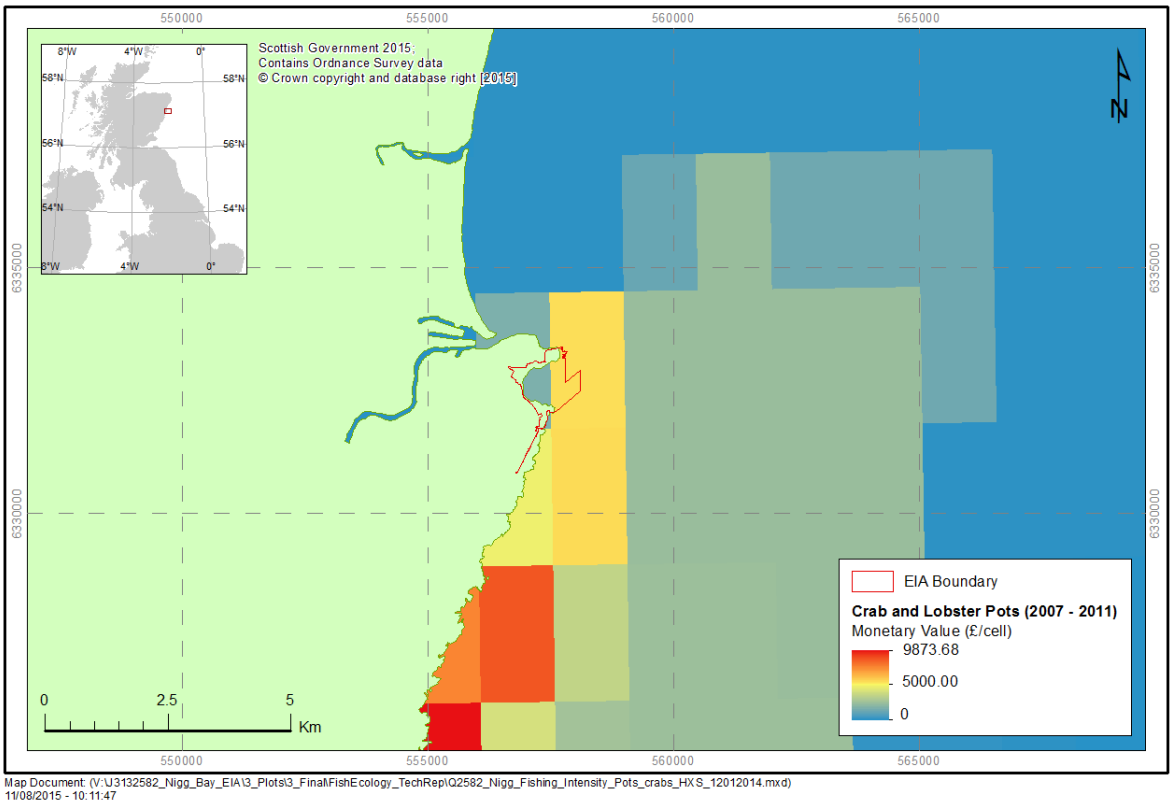


Figure 4.5: Distribution of crab and lobster fishing effort as value (from ScotMap)

4.15 Norway Lobster *Nephrops norvegicus*

4.15.1 Ecology

Norway lobster is common around the British coast with the apparent exception of the English Channel and Bristol Channel where it has not been recorded. At the European level it ranges from Iceland to the Mediterranean. It lives in shallow burrows which are constructed in suitable cohesive muddy sediments in a wide range of water depths from around 20 m to 800 m (Sabatini and Hill, 2008). It grows up to 25 cm in length although most adults are 18 cm to 20 cm in size. It is an opportunistic predator feeding on a variety of invertebrates such as crustaceans, molluscs, polychaetes and echinoderms. Norway lobsters remain in their burrows for most of the day emerging at dawn or dusk to forage for food. Emergence behaviour is dependent on depth. Individuals remaining within their burrows by day and emerge at sunset to forage at night but in

deeper waters this activity is reversed and individuals are more active by day. Emergence is thought to be linked to light availability and other external factors. Nephrops are important prey for various fish species including rays, dogfish and cod. Spawning occurs in late summer or early autumn and ovigerous (egg bearing) females remain in their burrows until the eggs hatch in late winter or early spring (Bell, 2013).

4.15.2 Conservation Status

Norway lobsters are an important commercial species and are targeted by deep demersal trawling gears. It is indicative of the 'deep burrowing mud' PMF habitat. They are classified as of 'least concern' by IUCN.

4.15.3 Occurrence in Study Area

The NBN Gateway does not hold any records of Norway lobster in Nigg Bay. Site specific investigation including seabed video surveillance will be undertaken within and around Nigg Bay to characterise the habitats and associated communities as part of the EIA investigations.

4.16 Fan Mussel *Atrina fragilis*

4.16.1 Ecology

In the UK, the fan mussel is found mostly in the south-west of England and in western and northern Scotland. It is a large triangular shaped benthic bivalve which lives partially buried within seabed sediments with only its outer shell edge (posterior end) and siphons emerging from a prominent gape at the sediment surface for filter feeding. It also uses byssus threads, to anchor itself to stones or shell fragments. It is regarded as one of the largest growing bivalves in the UK growing up to 50 cm.

The fan mussel lives in areas of soft seabed, including mud, sand or gravel and can be found from the low water mark on sheltered coasts to depths of 400 m. Seabed video surveillance at the Sound of Canna, found fan mussels as scattered individuals and as small clumps that supported a range of other species, considerably increasing the diversity of the biotope (Howson et al., 2012). The increased diversity associated with fan mussels is likely to relate to the byssal threads used to anchor the shells within the seabed. These stabilise sediment substrate which subsequently supports colonisation by disturbance sensitive species. In addition, the surfaces of the mussels themselves support growth of additional epifaunal species such as sponges and hydroids. Howson et al., (2012) report that the structure offered by clumps of fan mussels is comparable with horse mussel beds supporting a low density of *Modiolus modiolus*.

The shell of the fan mussel is particularly fragile and its protruding position within the seabed means that it is vulnerable to demersal fishing gears and industrial activity. Historically, fan mussels occurred in beds containing large numbers of the animals, but recent records only report them singly or in small groups and from fewer locations. Currently, it is scarce and is considered to be one of the most endangered animals of its kind in UK waters.

4.16.2 Conservation Status

The Fan mussel is a Scottish PMF and is a protected feature of Marine Protected Areas. It is also protected under Schedule 5 of the Wildlife and Countryside Act 1981 and is subject to a UK species action plan as part of the Scottish Government Scottish Biodiversity Strategy.

4.16.3 Occurrence in Study Area

The National Biodiversity Network does not hold any records of fan mussel in Nigg Bay. Site specific investigation including seabed video surveillance will be undertaken within and around Nigg Bay to characterise the habitats and associated communities as part of the EIA investigations.

4.17 Ocean Quahog *Arctica islandica*

4.17.1 Ecology

Ocean quahogs *Arctica islandica* are widely distributed throughout British coasts and in offshore water and in Europe its range extends from Norway to the Bay of Biscay. It is a large (up to 13 cm in width), thick shelled and long-lived bivalve which lives in marine sand and muddy sand sediment from the shallow sublittoral to around 500 m depth. It lives buried in the sediment with only its siphon exposed at the sediment surface for respiration and feeding. Following settlement, growth of this species is rapid over the first years, but then growth slows down after it reaches sexual maturity at the age of about 15 years to 20 years and at the size of 6 cm to 7 cm. Ocean quahogs are very long-lived and can achieve ages of 100 years. Adults occur in dense beds over level bottoms. They are capable of repositioning within the sediment, can survive periods of low oxygen and can burrow down and respire anaerobically for up to 1 week.

They are filter feeders, feeding on phytoplankton which is siphoned from the overlying water column. They are themselves predated upon by crab, haddock, cod and boring snails.

4.17.2 Conservation Status

The species is included on the OSPAR list of threatened and/or declining species and habitats and is listed on the Scottish list of Priority Marine Features (PMF).

4.17.3 Occurrence in Study Area

The NBN Gateway does not hold any records of ocean quahog in Nigg Bay. Site specific investigation including seabed video surveillance will be undertaken within and around Nigg Bay to characterise the habitats and associated communities as part of the EIA investigations.

5. CRITICAL HABITAT

5.1 Spawning Areas

Most marine fish aggregate to spawn, often in extensive offshore spawning areas (Ellis et al., 2012). These areas are not usually spatially distinct and may vary year on year from environmental cues like temperature and current direction (Ellis et al., 2012). During these aggregations the most common spawning technique used involves a process known as broadcast spawning. Broadcast spawning involves the release of spawn into the water column en-mass and is used by many of species including cod, plaice and sprat *Sprattus sprattus*. Broadcast spawning usually takes place in deeper offshore waters where currents can disperse spawn over vast areas. For this reason it is unlikely that the study area will be extensively used by broadcast spawning species.

A relatively common alternative strategy to broadcast spawning involves the deposition of eggs directly on to the seabed. This process is more dependent on spatially distinct spawning areas, relating to preferred seabed substrates types, and usually takes place in shallower waters (Ellis et al., 2012). Species that employ this technique include herring and sandeel as well as many of the oviparous (egg laying) elasmobranchs such as the thornback ray, small-spotted catshark and the common skate.

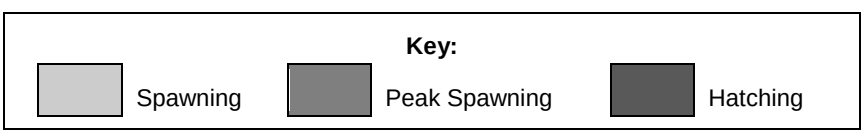
Broad scale fish sensitivity maps developed to assist assessment of marine activities (Coull et al., 1998; Ellis et al., 2012) on fisheries identify 6 fish species that spawn within the region of the study area. The species identified are whiting, plaice, lemon sole and cod as well as herring and sandeel. Appendix A presents the extents of these spawning areas in relation to the development. Only one species, sandeel, is regarded as having high intensity spawning areas that overlap with the study area. The other species are considered to have low intensity spawning in the study area.

Commercially targeted shellfish species that occur within the surrounding waters of the study area such as the European lobster, common whelk, Norway lobster and king scallop are thought to spawn wherever they occur.

Fish and shellfish spawning generally takes place during winter and early spring although periods may be extended in a number of species. A summary of seasonal spawning and hatching periods for selected species is presented in Table 5.1.

Table 5.1: Spawning Activity Guide for Fish and Shellfish Species Present Within the Region of the Study Area

Scientific Name	Common Name	Seasonal Spawning Activity											
		J	F	M	A	M	J	J	A	S	O	N	D
Teleost													
Ammodytidae	Sandeel spp.												
Callionymus lyra	Common dragonet												
Clupea harengus	Herring												
Gadus morhua	Cod												
Lophius piscatorius	Monkfish / angler fish												
Merlangius merlangus	Whiting												
Microstomus kitt	Lemon sole												
Molva molva	Ling												
Pleuronectes platessa	Plaice												
Pollachius virens	Saithe												
Pomatoschistus minutus	Sand goby												
Scomber scombrus	Mackerel												
Sprattus sprattus	Sprat												
Trisopterus esmarkii	Norway pout												
Elasmobranchs													
Galeorhinus galeus	Tope	*Viviparous species (can be found gravid year round)*											
Raja clavata	Thornback ray												
Scyliorhinus canicula	Small-spotted catshark												
Squalus acanthias	Spurdog	*Viviparous species (can be found gravid year round)*											
Shellfish													
Cancer pagurus	Brown crab												
Hommarus gammarus	European lobster												
Nephrops norvegicus	Norway lobster												
Pecten maximus	King scallop												



Peak brown crab spawning activity takes place between November and December (Thompson et al., 1995) after which female berried brown crab 'over winter' by burying themselves in coarse sediments or sheltering under rocks.

5.2 Nursery Areas

Shallow, sheltered inshore regions, such as Nigg Bay, are often utilised as nursery areas where juveniles congregate to maximise growth because of a readily available food supply and a low

abundance of predators. For example, studies in Stonehaven Bay, located approximately 20 km south of the current development have identified a number of species which use the local shallow waters as a nursery area including cod, haddock and whiting. The young of these species start to appear in the pelagic zone here from late April to around mid-May and settle to the seabed during July or August where they feed and grow (Bastrikin et al., 2014). Following settlement, these species then move offshore to recruit into the adult stock.

Review of fisheries sensitivity maps (Ellis et al., 2012 and Coull et al., 1998) identified 16 species as having nursery areas close to or directly within the Aberdeen Harbour Expansion Project study area. The extents of the nursery areas in relation to the proposed development are presented in Appendix B.

The majority of these nursery areas are regarded as 'low intensity' usage areas by Ellis et al., (2012) with only herring and whiting being regarded as having 'high intensity' nursery areas directly within the study area. Table 5.2 further describes and contextualises the study area in terms of its likely nursery usage.

Table 5.2: Species Identified from the Coull et al. (1998) and Ellis et al. (2012) Sensitivity Maps as Having Nursery Areas within or around the Study Area

Scientific Name	Common Name	Intensity of Nursery Usage (Low/High) as Defined by Ellis et al. (2012)	Description of Nursery Usage
Ammodytes spp.	Sandeel spp.	Low	Much of the coastal and offshore areas surrounding and incorporating the study area are considered sandeel nursery (Appendix B).
Clupea harengus	Herring	High	The study area is included within a large swathe of inshore herring nursery, extending north from Whitby to Peterhead (Appendix B). Juvenile herring move inshore during late winter / early spring to feed on algal blooms and other planktonic organisms. They are active swimmers and form large mid-water shoals.
Dipturus batis	Common skate	Low	The study area and its surrounding regions are regarded as nursery areas (Appendix B) for common skate. However, the area is not considered important to the common skate by SNH (Ref. SNH scoping).
Gadus morhua	Cod	Low	The study area does not directly overlap with any of the cod nursery areas identified by Coull et al. (1998) or Ellis et al. (2012) (Appendix B). However, the proximity of Nigg Bay to these nursery areas (within 5 km) and the fact that cod use shallow sheltered inshore regions for nursery purposes, means Nigg Bay can be regarded as a potential cod nursery.

Table5.2: Species Identified from the Coull et al. (1998) and Ellis et al. (2012) Sensitivity Maps as Having Nursery Areas within or around the Study Area, Continued

Scientific Name	Common Name	Intensity of Nursery Usage (Low/High) as Defined by Ellis et al. (2012)	Description of Nursery Usage
Galeorhinus galeus	Tope	Low	The area immediately offshore from the study area is regarded as nursery for tope (Ellis et al., 2012) (Appendix B). Females give birth in shallow bays where the young remain for their first two years (Walker et al., 2006). Tope are strong swimmers and highly mobile even at a young age. It is therefore likely that Nigg Bay will on occasion be used by tope for nursery purposes.
Lophius piscatorius	Monkfish	Low	Inshore waters south of Fraserburgh, including Nigg Bay, are considered monkfish nursery (Appendix B) (Ellis et al., 2012). Juvenile monkfish should be considered present within the study area throughout the year.
Merlangius merlangus	Whiting	High	Much of the UK coast, including Nigg Bay, is considered whiting nursery (Appendix B) (Ellis et al., 2012). Nigg Bay is therefore considered to be utilised by whiting for nursery purposes.
Merluccius merluccius	Hake	Low	Hake is an offshore species which inhabits the middle and lower continental shelf as an adult but juveniles are known to enter shallow waters during summertime (Maitland and Herdson, 2009). The study area is not considered ecologically important to hake as a nursery, although the offshore regions of the study area are regarded as hake nursery (Appendix B) (Ellis et al., 2012).
Micromesistius poutassou	Blue whiting	Low	Blue Whiting live mainly in mid-water over the edge of the continental shelf (Maitland and Herdson, 2009). It is occasionally captured in shallow inshore waters. The study area is not therefore considered to be an important nursery area for blue whiting although much of the surrounding offshore areas are regarded as blue whiting nursery (Appendix B) (Ellis et al., 2012).
Microstomus kitt	Lemon sole	None prescribed	Lemon sole are a widespread species which inhabit a range of bottoms including mud, sand, gravel and coarse rocky grounds (Maitland and Herdson, 2009). Nursery areas are identified within the study area and throughout much of the surrounding region (Appendix B) (Ellis et al., 2012).
Molva molva	Ling	Low	Much of the inshore and surrounding regions of the North Sea are considered as a ling nursery (Appendix B) (Ellis et al., 2012). The study area does not directly overlap with these nursery areas, however it is likely that juvenile ling will on occasion be present within the study area.

Table5.2: Species Identified from the Coull et al. (1998) and Ellis et al. (2012) Sensitivity Maps as Having Nursery Areas within or around the Study Area, Continued

Scientific Name	Common Name	Intensity of Nursery Usage (Low/High) as Defined by Ellis et al. (2012)	Description of Nursery Usage
Pollachius virens	Saithe	None prescribed	Juveniles are known to use the inshore regions of the east coast of Scotland for nursery purposes throughout the summer and autumn. Much of the east coast of Scotland, incorporating the study area, is regarded as saithe nursery (Appendix B) (Coull et al., 1998).
Raja montagui	Spotted ray	Low	The study area does not directly overlap with any of the spotted ray nursery areas identified by Ellis et al. (2012) (Appendix B). However, the proximity of Nigg Bay to these nursery areas (within 5 km) means Nigg Bay can be regarded as a potential spotted ray nursery.
Scomber scombrus	Mackerel	Low	Juvenile mackerel are found inshore during the summer months in large mid-water shoals (Maitland and Herdson, 2009). Almost all of the North Sea, Irish Sea and parts of the North Atlantic are considered nursery for mackerel (Appendix B) (Coull et al., 1998; Ellis et al., 2012).
Sprattus sprattus	Sprat	None prescribed	Sprat is a widespread pelagic species that have nursery grounds covering much of the North Sea, (Appendix B) (Coull et al., 1998).
Squalus acanthias	Spurdog	Low	Much of the northern and central North Sea is regarded as nursery for spurdog (Appendix B) (Ellis et al., 2012). For reasons explained in Section 4.11 spurdog are considered vagrants to the study area. For this reason the study area is not considered ecologically important in terms of its nursery function to spurdog.

5.3 Feeding

The proximity of the study to the entrance to the River Dee makes it likely that the area is utilised as a feeding ground. This is because feeding grounds are often associated with areas of high productivity, which in turn are related to physical features such as sand banks, estuaries and oceanic fronts. These areas may be used by different species at different times of year, sprat, herring and sandeel species, for example, may gather in large shoals during summer to feed upon the annual plankton bloom. These species would be preyed upon by other commercially important species, such as cod, rays and whiting, as well as marine mammals and sea birds.

Crustaceans, such as brown shrimp, prawns and small crabs are important prey species for many fish including thornback ray, cod and monkfish (Pinnegar and Platts, 2011). Benthic communities are likely to be a key factor in the distribution of demersal fish species within Nigg Bay.

6. MIGRATORY FISH REVIEW

6.1 Spawning and Migration

The timing and migration of diadromous species between the marine and freshwater environment taking place along the eastern Scottish coast is presented in Table 6.1. These timings are based on environmental cues, such as temperature and water flow, that may vary year on year. It is therefore suggested that these timings be used as a guide for when migratory fish are most likely to be present within the region of the study area. The European smelt as well as the allis and twaite shad have been omitted from Table 6.1 on the basis that neither species is thought to be present within the River Dee.

Table 6.1: Spawning and Migration Timings for Diadromous Fish Found with the River Dee and Surrounding Area

Scientific Name	Common Name	Life History Stage	Seasonal Spawning Activity											
			J	F	M	A	M	J	J	A	S	O	N	D
Anguilla anguilla	European eel	Silver eel						↓	↓	↓	↓	↓	↓	
		Glass eels/ elvers	↑	↑	↑					↑	↑	↑	↑	↑
Lampetra fluviatilis	River lamprey	Adult										↑	↑	↑
		Transformer							↓	↓	↓			
Petromyzon marinus	Sea lamprey	Adult				↑	↑							
		Transformer							↓	↓	↓			
Salmo salar	Atlantic salmon	MSW		↑	↑	↑	↑	↑	↑					
		Grilse							↑	↑	↑	↑		
		Smolt				↓	↓	↓						
Salmo trutta	Sea trout	Adult	↓	↑	↑	↑	↑	↑	↑	↑	↑	↑		↓
		Smolt						↓	↓					

Key:
Spawning ↑ Upstream migration ↓ Downstream migration

6.2 Atlantic Salmon *Salmo salar*

6.2.1 Ecology

Salmon are widely distributed throughout the north Atlantic ranging from Portugal to Scandinavia. They are an anadromous species meaning that adults migrate between marine and freshwater environments to feed and breed. Eggs are laid in shallow depressions in gravel sediments of shallow, fast flowing and well oxygenated rivers from which young fish emerge (Hendry and Cragg-Hine, 2003). The young fish spend up to 4 years within the rivers before migrating downstream to the sea during spring/early summer. At this stage, the young salmon become known as smolts and undergo a physiological transformation to allow them to survive at sea. The smolts spend between one and three years at sea where they grow rapidly into adults. Salmon can travel considerable distances to reach their feeding grounds situated in subarctic areas including Faroe Islands, Iceland and Greenland (Martin and Mitchell, 1985) before returning to their natal (home) rivers as

grilse (salmon that have spent one year at sea) or multi-sea winter (MSW) salmon (salmon that have spent >1 year at sea) to spawn (MacKenzie et al., 2012).

Malcolm et al., (2010) explains that once in the sea, little is known about the dispersion and migration of salmon to their distant feeding grounds, particularly for those salmon emerging into the North Sea from rivers on the east coasts of Scotland. Observations from Canada and Norway show that smolts undergo rapid and active migration towards open marine areas within the uppermost surface waters. For example, young salmon have been observed to travel 9 km away from their river of origin in an average time of just 28 hours and up to 77 km from the river in an average time of 83 hours. Martin and Mitchell (1985) describe the capture of post smolts tagged in Scottish rivers in the Faroese fishery within 6 months of leaving freshwater. Other studies have replicated these findings and further confirm the active and rapid migration of post-smolts once in the marine environment (Malcolm et al, 2010). These studies also showed that in general, the fish did not follow nearby shores closely although Malcolm et al., (2010) caveats this by suggesting that this may occur in areas of strong coastal currents.

Salmon probably spend most of their time at sea at or near the surface of the water feeding on pelagic animals such as fish, crustaceans and squid (Jacobsen and Hansen, 2001). Photoperiod and sea temperature have been shown to be relevant factors the growth and maturation of Icelandic salmon (Martin and Mitchell). Salmon in lower sea temperatures grow more slowly and mature later and feeding appears to be curtailed in cold conditions as observed in hatchery salmon and the west Greenland fishery where salon catches declined when sea temperature approached 3 ºC.

Salmon return to Scottish rivers to spawn throughout the year although periods of peak activity are apparent. For example, the majority of grilse return in late summer/early autumn whilst MSW salmon return in largest numbers during spring (Hawkins and Smith, 1986). Returning adult salmon are thought to approach Scottish coasts across a broad front but appear to originate mostly from the north and west coinciding with the dominant feeding areas around west Greenland and Faroes (Malcolm et al., 2010). Once at the coast, review and analysis of tag data from various studies suggest that within the broader region of the current study area, returning adult salmon undergo a predominantly northward migration from Northumberland to Aberdeenshire (south shore of the Moray Firth).

Upon arrival, entry into the natal river may be very quick. For example, Hawkins et al., (1979) observed one tagged salmon at the mouth of the River North Esk, which made the transition from fully marine conditions to full fresh water in less than 30 hours suggesting rapid adaptation or tolerance to changes in osmotic pressures. However, it is not known whether this observation is typical of returning adult salmon on the east coast of Scotland. Other tagging studies in the River Dee (Hawkins and Smith, 1986) showed rapid movement of adult salmon through the estuary and lower reaches of the river. Once entered into the estuary of the River Dee, initial upstream progress was typically above 10 km per day with movements of 20 km per day being commonly observed. Peak movement of returning salmon in the river occurred at night.

The numbers of salmon returning to Scottish rivers has generally increased over recent years although variations in trends occur in certain components of the population in certain regions and at certain run times (MSS, 2014). At a national level, however, the spring salmon stock warrant management attention. Rod catch data within the River Dee over the period 1952 to 2010, for example, shows a decline and this is particularly prominent in the spring catch (see further below). Catch and release has been used as a management tool in the Aberdeenshire Dee rod and line fishery since around the mid 1990's to improve survival of salmon.

Small fish, such as 0-group blue whiting, herring, sandeel and capelin, are important in the diet of post smolts in coastal waters whilst amphipods are important food items in offshore waters in the north west and north east Atlantic (Haugland *et al.*, 2006 and Malcolm *et al*., 2012). Analysis of the gut contents of salmon caught within a Faroese long line fishery (Jacobsen and Hansen, 2001) identified predominately pelagic amphipods and euphasiids (small shrimp like organisms) and shrimps as important food items during the autumn whilst meso-pelagic fish were important food sources in winter. Prey that is higher in the food chain becomes more important as salmon mature and grow. Larger salmon preyed upon more fish compared to smaller salmon (Jacobsen and Hansen, 2001). Adult Atlantic salmon tend to stop feeding on their return to natal rivers and fast during pre-spawning[1]. This is thought to relate to salmon adjusting to a target body size at return to optimise predation mortality rate at sea (Lindberg, 2011). Gut content analysis of returning salmon (Greenhalgh, 2005) support the view that in general returning salmon curtail feeding but may take food if available. For example off the west coast of Scotland, just 13% of salmon stomachs were found to contain food (mainly sandeels) in spring but in July their stomachs were empty. Salmon returning to an Icelandic river in September had empty stomachs but in another Icelandic study, 30% had food in their stomachs (mainly herring and sandeel). In the 1890's up to 48% of returning salmon had food (mostly herring) in their stomachs. Other observations have recorded 0%, 14% and 86% of returning salmon stomachs containing food (mostly amphipod crustaceans, sandeel and capelin).

Depending on the life stage, the principal predators of salmon are goosanders and red-breasted mergansers, cormorants, gulls, pike, pollack, cod, sharks, seals and otters[2]. Predation by seals is more common as the fish get closer to the coast (Lindberg, 2011).

The North Atlantic Salmon Conservation Organisation (NASCO) maintains a salmon rivers database, which classifies the salmon stock for each river. In this instance, NASCO classified the River Dee stock as 'not threatened with loss', which means that natural salmon stocks are not considered to be in decline.

In Scotland, it is the role of District Salmon Fisheries Boards to manage and improve stocks of salmon within their districts. The closest salmon district to the current proposals is the River Dee District although there are a number of other districts in the wider region including Ythan, Don, Ugie, and Esk. The Dee District Salmon Fishery Board (DDSFB) is the appropriate statutory organisation responsible for the protection and enhancement of salmonid stocks within an around

[1] http://www.npafc.org/new/publications/Technical%20Report/TR4/page%2073-75(Cairns).pdf

[2] http://www.atlanticsalmontrust.org/salmon-and-sea-trout-facts/what-are-the-salmons-natural-enemies.html

the study area and is a competent authority on developments that may impact upon Atlantic salmon.

Long-term salmon rod and line catch statistics for the River Dee are maintained by the Dee District Salmon Fishery Board (DDSFB, 2014) and provide a useful indication of population trends over the last 62 years (see Figure 6.1 below). These show that whilst initially quite variable, there has been an overall decline in the catch of spring salmon between the 1960's and 1990's, followed by a period of comparative stabilisation to 2012. Summer and autumn catches, primarily of grilse, on the other hand, have followed an improving trend since 2000 but have declined sharply in 2013 (DDSFB ,2014; Rivers and Fisheries Trusts of Scotland, 2014). DDSFB (2014) note that declines in spring salmon catches were attributed to reductions in marine survival with the numbers of smolts surviving as returning adults dropping from approximately 40 % in the 1960's to 6.4 % in 2008. It is also worth drawing attention to the fact that salmon within the River Dee also face negative population pressures from agricultural activities, forestry operations, freshwater aquaculture and construction activities as highlighted by Rivers and Fisheries Trusts of Scotland (2014).

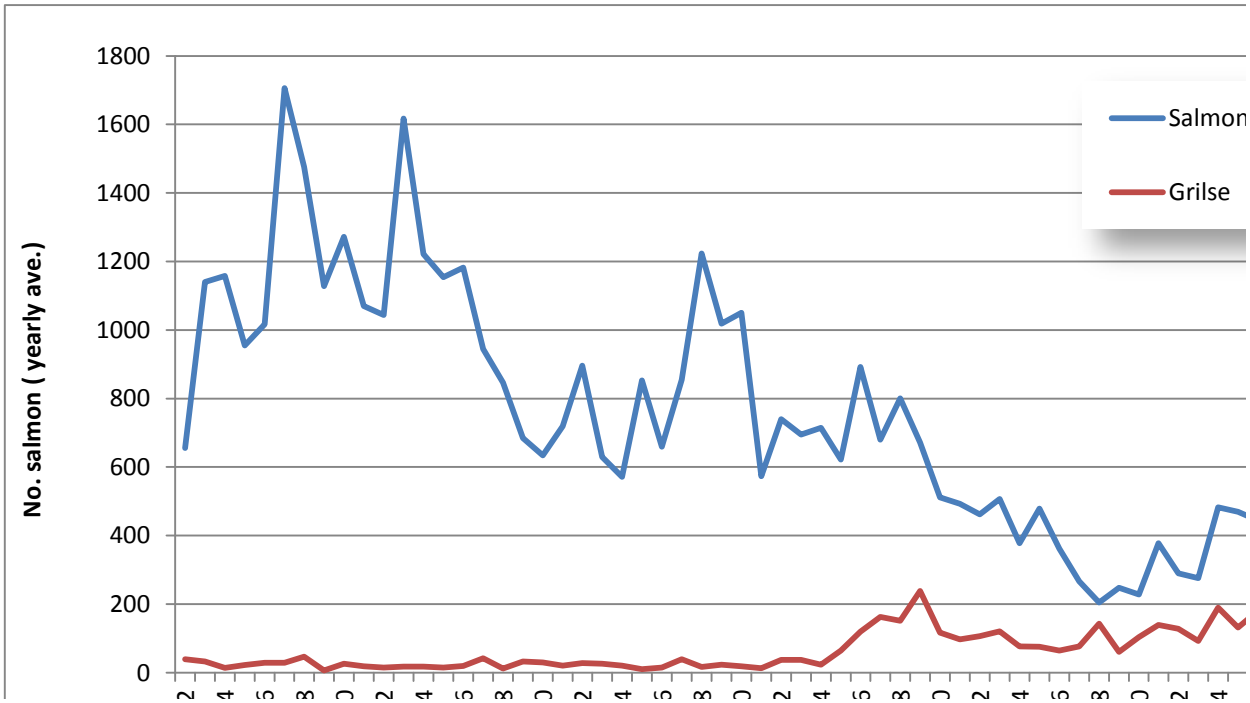


Figure 6.1: Average annual Dee District Atlantic salmon rod catches from (1952 to 2012) (Source: Crown copyright Marine Scotland Science DDSFB, 2014)

Current salmon fishery trends are indicated on the Fish Dee website[3] and show a decrease in salmon catches for 2014 and 2015 compared to the 5 year average (see Figure 6.2 below). It is estimated that current (2015) catches of salmon are 33% of the 5 year average for the River Dee (*pers comm*. River Dee Trust). The reason(s) for the apparent decline in salmon abundance is unclear.

[3] http://www.fishpal.com/Scotland/Dee/SeasonSoFar.asp?dom=Dee

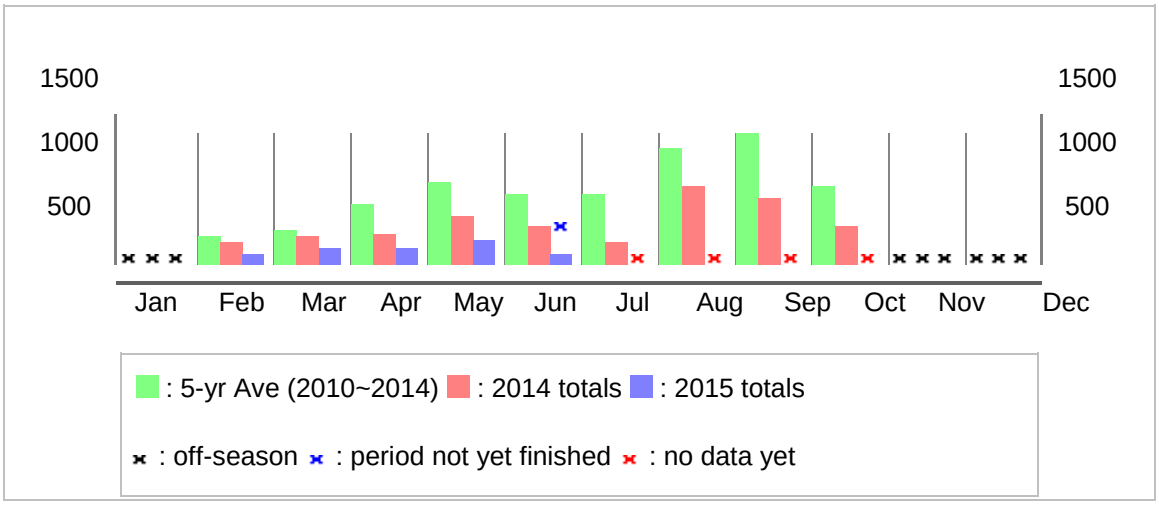


Figure 6.2: River Dee salmon catches for 2014 and 2015 (to June) showing an apparent decline in numbers compared to the 5 year average (Source: www.fishpal.com/Scotland/Dee/SeasonSoFar.asp?dom=Dee)

6.2.2 Conservation Status

Salmon are listed on Appendix III of the Bern Convention and Annex II and V of the EC Habitats & Species Directive. The Rivers Dee, Spey, South Esk, Tay and Tweed all cite Atlantic salmon as a primary species for SAC selection. Conservation assessment of the River Dee suggests that juvenile populations should be in favorable conservation status within the boundary of the SAC (Rivers & Fisheries Trusts of Scotland, 2014). Salmon are listed on the National Biodiversity Framework and OSPAR list. In addition, the marine part of their life-cycle is included on the Scottish list of PMFs.

6.2.3 Occurrence in Study Area

Important salmon populations occur in the River Dee, which enters the North Sea immediately north of Nigg Bay. The river is regarded as representing a significant proportion of the Scottish salmon resource, contributing an estimated 4% to 5% of all salmon that have been caught in Scotland in recent years (JNCC, 2014d). The importance of the River Dee within the wider region is illustrated in Figure 6.3 which compares recent (2013) catches of salmon for the River Dee with catches from other salmon fishery districts in north east Scotland (Scottish Government, 2014c).

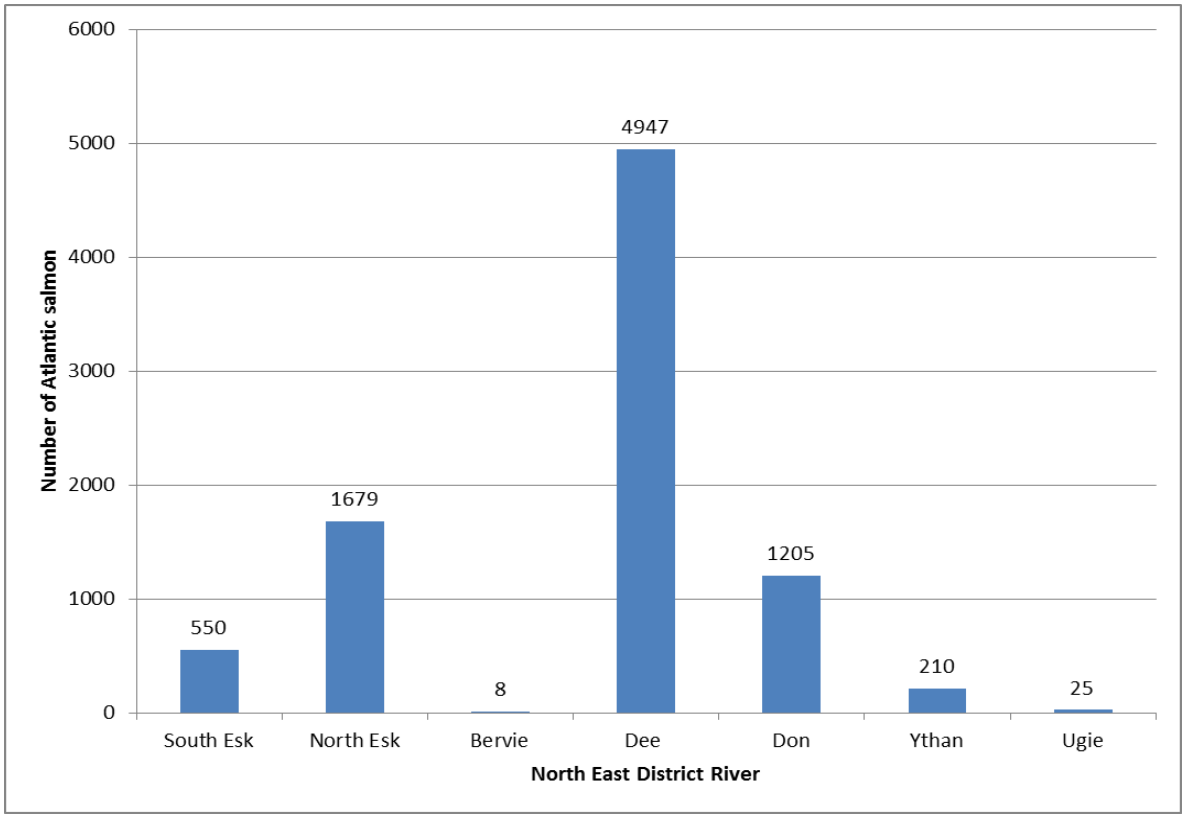


Figure 6.3: Total salmon caught using rod and line within north-east Scotland Salmon Fishery District for 2013 (Source: Scottish Government, 2014c)

Smolts emerging from the river in spring will occur within the study area close to the boundaries of the harbour proposals. Their use of the local area prior to their migration is not known, however, given their apparent rapid dispersal in marine waters, individuals are likely to pass through and disperse quickly into the wider marine environment.

Smolt, generally migrate downstream between April and June (Hendry and Cragg-Hine, 2003). Malcom et al, (2015) further refines the smolt migration window as occurring between day 103 and 145. This period is characteristic of a national window of sensitivity for coastal developments in relation to smolt migration (Malcolm et al., 2015).

Adult salmon are expected to return to the River Dee through the coastal waters from the south. Consequently they are likely to traverse the study area, including Nigg Bay from south to north prior to entry to the river mouth. Adult salmon, as grilse or MSW salmon, may return at any time during the year so that there is no defined period of entry into the River Dee.

Two long time series data sets have been reviewed to provide a picture of the temporal distribution of salmon and the likely timing of their 'runs' within the vicinity of the proposals. The first data set comprises monthly rod and line salmon catch data for the River Dee covering the period 1952 to 2014. These data are shown in Figure 6.4 and represent the average numbers of salmon and grilse per month over the 64 year period Dee (Aberdeenshire) District. Records of both retained and released salmon have been used. Note that these data are not effort corrected. Grilse error has not been corrected for.

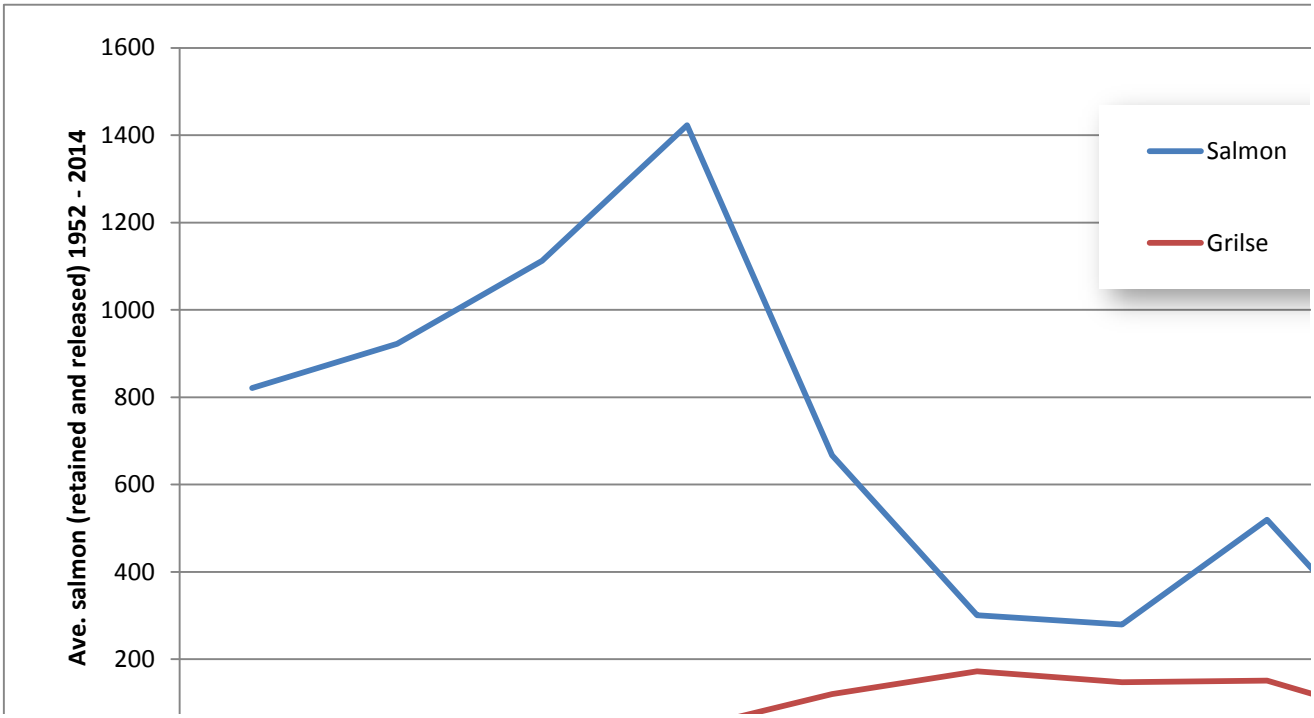


Figure 6.4: Average abundance of salmon and grilse retained and released with rod and line for the River Dee District
(Source: Crown Copyright Marine Scotland Science)

The data show a biannual peak in the number of returning salmon. The first, and largest, peak occurs in May and can be attributed to returning MSW salmon, whilst the second smaller peak occurs in September, which can be attributed to the arrival of grilse (Scottish Government, 2014c). Martin and Mitchell (1985) explain that the vast majority of MSW salmon arrive at the mouth of the River Dee before the end of May at about the time of the commencement of the grilse run.

The second dataset reviewed comprises aggregated salmon (and sea trout) monthly (February – August) catch statistics for 13 coastal netting stations for the period 1986 to 1999. Figure 6.5 summarises these data and presents the monthly average of aggregated numbers wild salmon and wild grilse captured. The 13 netting stations from which catch data were collated are shown in Figure 6.6. Data are effort corrected on the basis of the maximum number of traps used each month.

The coastal fishery data reveal a slightly different picture of salmon occurrence than the rod and line data. For example, the spring peak is not apparent in the coastal fishery which is instead characterised by a peak abundance of grilse in July. This apparent discrepancy may reflect the selective nature of the two different fisheries as well as variations in the seasonal distribution of catch effort and imposed management measures.

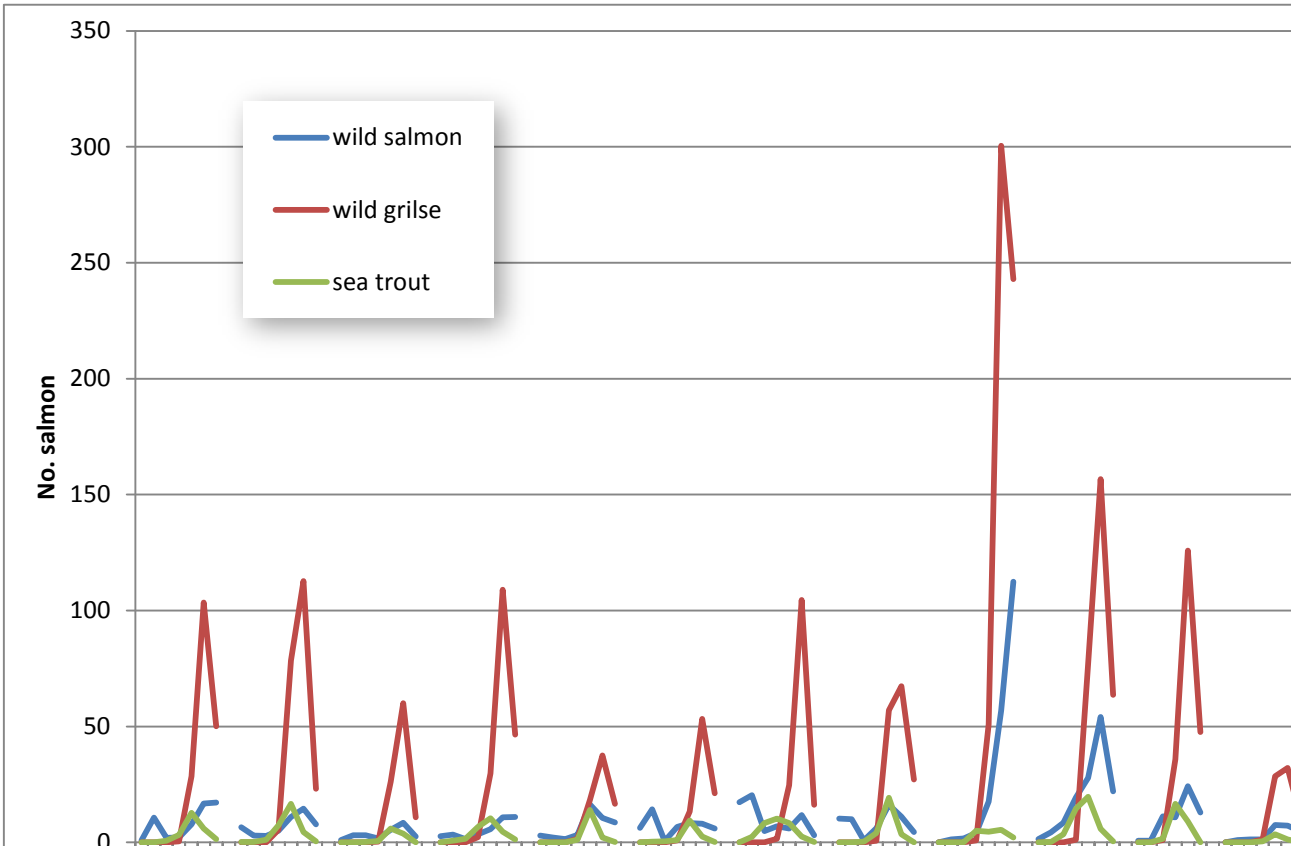


Figure 6.5: Abundance of salmon and grilse per month caught in the coastal net fishery within the vicinity of Nigg Bay during 1986 - 1999. Data are aggregated over 13 coastal netting stations (see Figure 6.5)
(Source: Crown Copyright Marine Scotland Science courtesy of The River Dee Trust)

As part of ongoing salmon conservation efforts, the Dee District Salmon Fishery Board (DDSFB) and Atlantic Salmon Conservation Trust (ASCT) have purchased a number of inshore (marine) salmon netting stations from commercial operators. This includes the 13 stations used in this review (see Figure 6.5 above and Figure 6.6 below). There is currently no commercial salmon netting undertaken in the region. Therefore the apparent declines in the numbers of fish caught during the latter stages of the coastal netting data series is a result of the increasing acquisition of the netting stations by the Salmon Boards and the consequent reduction of total fishing activity in line with salmon conservation objectives.

Greenhalgh (2005) provides a useful summary of the timing of salmon 'runs' in UK rivers and identifies three distinct seasonal periods. The spring run mainly comprises 2SW salmon and often begins in early winter (November onwards) and lasts until the end of April or May. It is this component of the Aberdeenshire Dee that has declined (see Figure 6.1 above). The summer run consists of grilse with a few larger 2SW salmon and peaks through June and July. The final run period is the autumn run. This comprises salmon of mixed ages including grilse and MSW salmon. It peaks in September and lasts until the end of the season in October.

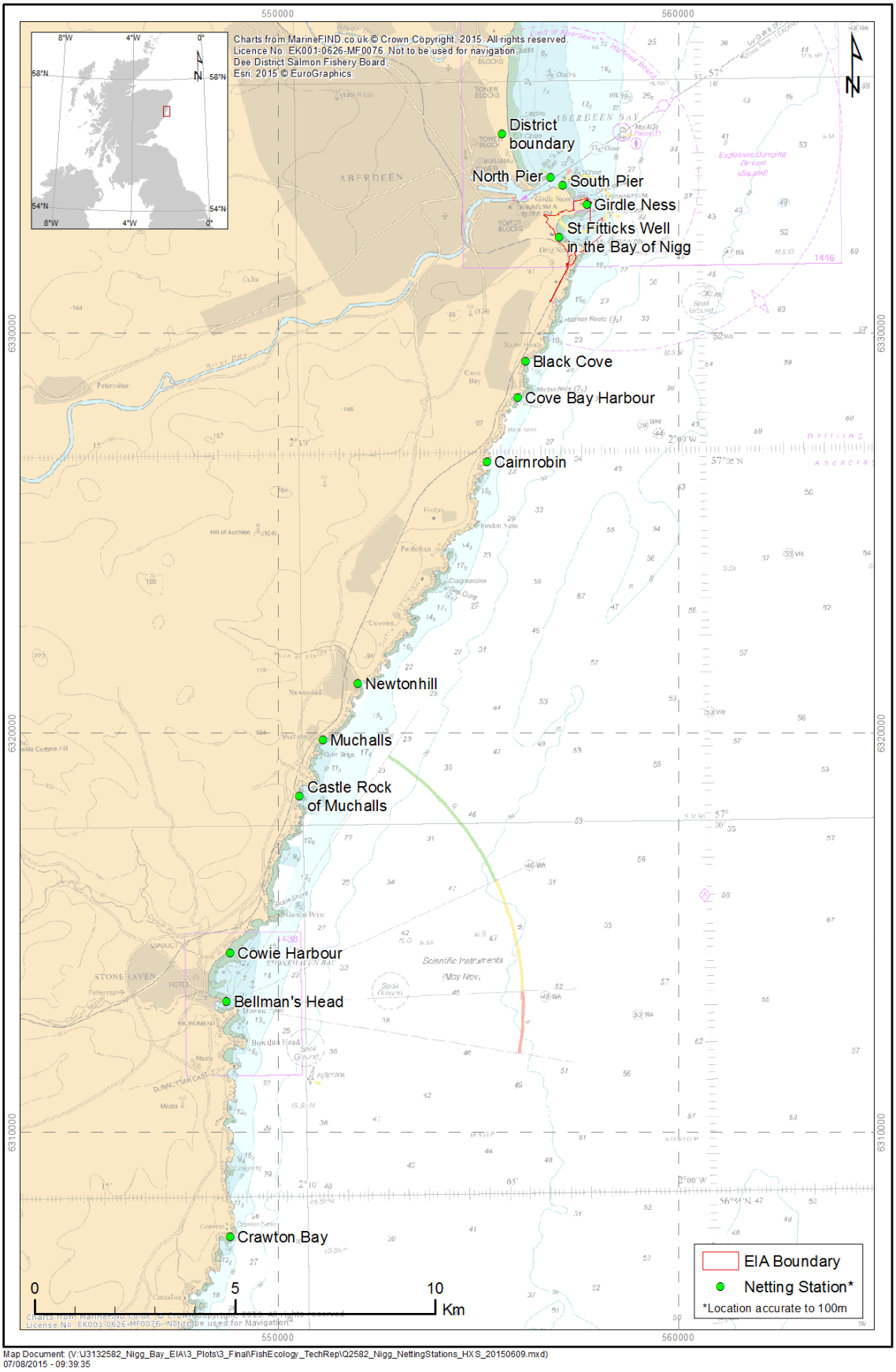


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Figure 6.6: Locations of inshore commercial salmon netting stations for which historic (1986 – 1999) catch statistics have been provided and aggregated
(Source: Crown copyright Marine Scotland Science, courtesy of The Dee River Trust)

6.3 Sea Trout *Salmo trutta*

6.3.1 Ecology

Sea trout are the anadromous variant of the widely distributed freshwater brown trout. The mechanisms that drive this alternative life-history are not fully understood but it is thought to be related to environmental cues and a genetic predisposition (De Laak, 2012). Sea trout shares much of its life-history with salmon, spawning in upland rivers before migrating downstream in June and July into estuaries, sea lochs and the open sea to feed and mature.

Tracking studies undertaken on the west coast of Scotland suggest that young sea trout, known as smolts, disperse slowly and remain inshore often swimming in surface waters at a depth of <10 m (Malcolm et al., 2010). Although few studies have taken place there is some evidence to suggest that smolts originating from the east coast may range over a wide area. Studies from the North Esk found individuals to have travelled to neighbouring catchments such as the South Esk, Spey and Tweed (Malcolm et al., 2010).

Once in the marine environment, the smolts begin to grow and mature into adult sea trout. Feeding is thought to take place predominantly in estuaries and coastal areas although some adult sea trout have been caught in offshore waters. After a period of feeding some sea trout will return to the river in the autumn of the same year but only a few will actively participate in spawning. Most that migrate to the sea will remain in the marine environment for between 1 year and 3 years before migrating back into the riverine environment to spawn between August and September.

There is a reasonable degree of understanding for the movement of adult sea trout originating from the east coast of Scotland. Tracking studies reveal a variable pattern of migration with some adults being recaptured close to their natal rivers while others disperse over considerable distances (ca. 150 miles) (Malcolm et al., 2010). There have been no studies of swimming depth used by adult sea trout in Scottish waters, however, Norwegian studies suggest shallow swimming of <3 m depth with occasional dives to ca. 30 m (Malcolm et al., 2010).

After spawning, a proportion of the adults will succumb to the energetic costs involved, however some will survive and may go on to spawn again. These will return to the sea to regain strength and take part in the subsequent year(s) spawning migration (De Laak, 2012). The relatively high post spawning survival rate of sea trout (>10%) is a key difference to that of salmon. This has aided the recovery of sea trout after a severe population decline in the 1980's that affected both sea trout and salmon.

The abundance of sea trout caught using rod and line for the River Dee in 2013 was second only to that of the River Ythan (Figure 6.7). The comparatively high abundance of sea trout in the River Dee in comparison to other catches in Scotland's north east salmonid fishery district highlights the regional importance of the River Dee for sea trout.

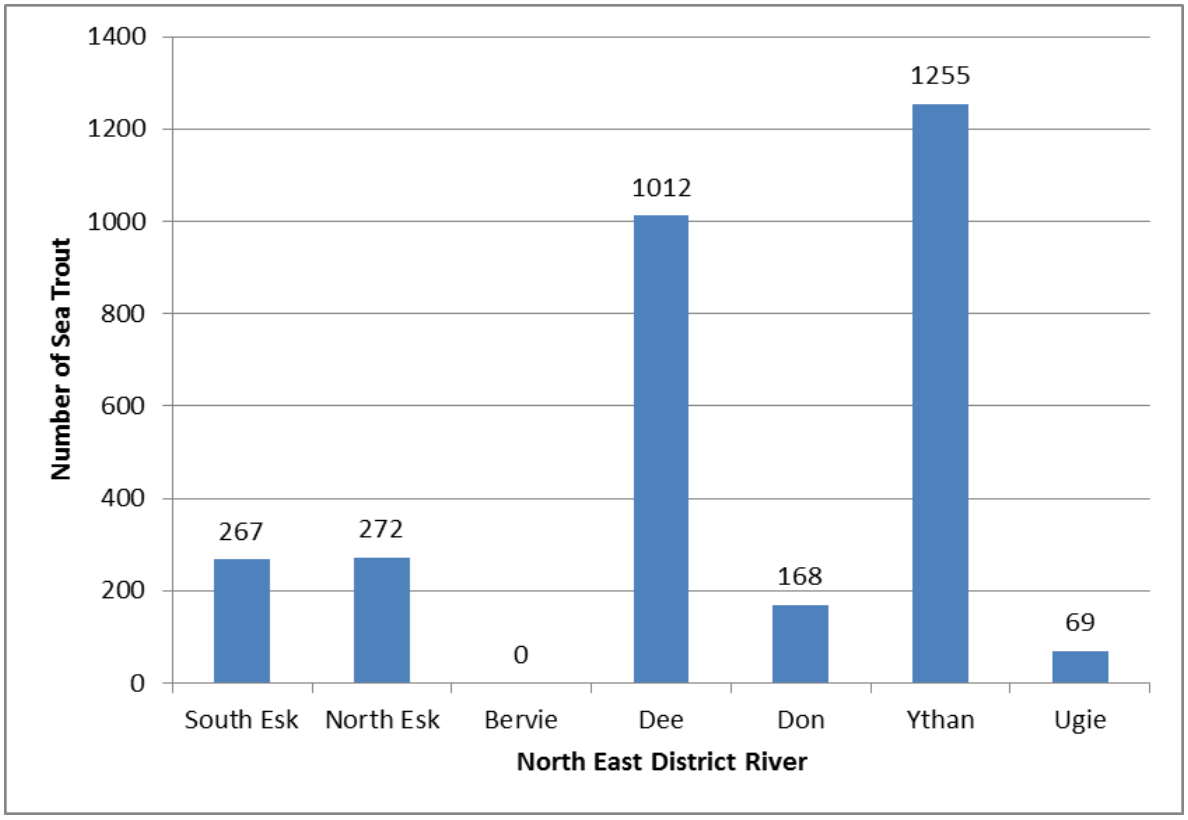

Figure 6.7: Total sea trout caught using rod and line within North East Scotland salmon fishery district for 2013
(Source: Scottish Government, 2014c)

Long-term sea trout rod and line catch statistics are maintained by the Dee District Salmon Fishery Board (DDSB, 2014) and provide a useful indication of population trends over the last 60 years (Figure 6.8). Overall there has been an increase in sea trout catches since the 1980s but the population shows a high degree of annual variability (DDSB, 2014).

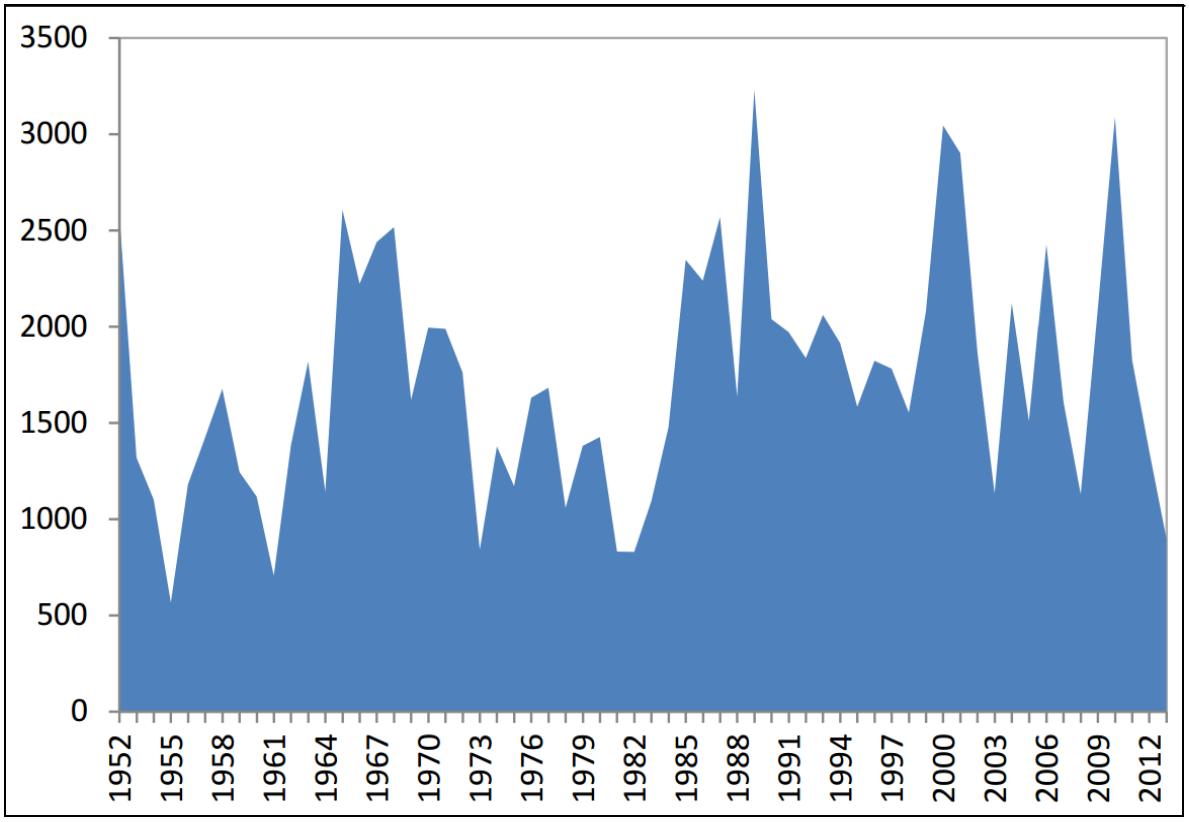

Figure 6.8: River Dee Sea trout rod catches from 1952 to 2012
(Source: DDSFB, 2014)

6.3.2 Conservation Status

Sea trout is included in the National Biodiversity Framework list and the marine part of the species life-cycle is included on the Scottish list of PMFs.

6.3.3 Occurrence in Study Area

Sea trout emerging from and entering the River Dee are likely to use the current study area for passage during their migration. Marine bound smolts emerging from the River Dee will be present between June and July with the returning adults present between February and October and again between December and January, when they make their return journey to the sea after spawning. Although return to the river may occur at almost any time of the year, review of the 2013 rod and line catch data for the River Dee shows peak abundance for returning sea trout occurring in June (Figure 6.9). This concurs with catch data from the inshore salmon fisheries (Figure 6.5 above) which shows greatest catches of sea trout in June. June is therefore likely to represent the peak migratory movement of sea trout through the study area with important numbers migrating during the period between July and October.

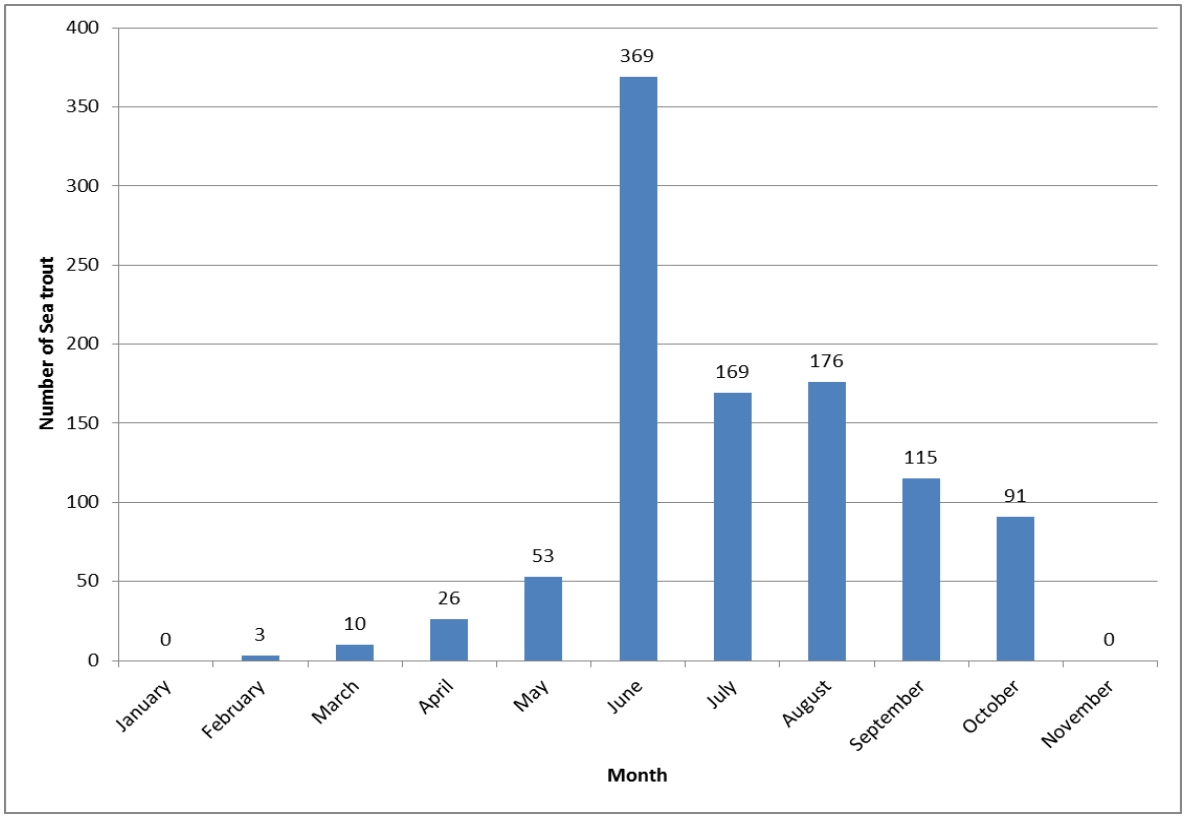

Figure 6.9: Monthly rod and line sea trout catch in River Dee (Aberdeenshire) for 2013 (Source: Scottish Government, 2014c). (no salmonid angling took place in December)

The tendency to utilise shallow inshore waters combined with a slow dispersal rate and a comparatively limited foraging range suggests that sea trout may be exposed to the effects of the development at some point during their marine migration. It is also feasible that Nigg Bay will be utilised by neighbouring sea trout populations from the rivers Don, Tweed, South and North Esk as tracking studies on the east coast show a tendency toward a wide range of dispersal. However, it is not possible to fully describe the migratory routes taken by sea trout due to a lack of scientific data.

6.4 European Eel *Anguilla anguilla*

6.4.1 Ecology

The European eel has a complex life history and may live for more than 50 years (OSPAR, 2010). Unlike anadromous species, such as salmon and sea trout described above, the European eel is catadromous, which means they reproduce in the marine environment and mature in freshwater (Cefas, 2011).

Adults, known as ‘yellow eel’, feed and grow in freshwater before reaching maturity where they metamorphose into the sexually mature phase known as ‘silver eel’. Silver eels migrate downstream generally on a flood tide or following heavy rain in late summer/autumn (McCleave and Arnold, 1999). Males will migrate after six years of age and females even older (NE, 2013). Once in the marine environment the European eel undertakes a long spawning migration across the Atlantic Ocean, where they are believed to travel in excess of 5,000 km to reach their spawning grounds in Sargasso Sea in the central Atlantic (Munk et al., 2010).

Newly hatched larvae, called leptocephali, undertake a passive drift migration using the Gulf Stream and the North Atlantic Current back to continental Europe and North Africa (OSPAR, 2010 and Malcolm et al., 2010). The journey can take up to 3 years whereupon reaching the shallow continental waters of Europe and Africa the leptocephali metamorphose into a transparent stage and become known as 'glass eel'. As the glass eels move into the shallow coastal waters of Europe they begin to develop pigment on the body and become known as 'elvers'. As young elvers, the European eel enters inshore waters and estuaries, living under rocks, in crevices, or in the mud of estuaries, coastal lagoons, rivers, lakes and ponds (Wang and Tzeng, 2000; OSPAR, 2010; NE, 2013).

Some elvers may stay in salt or brackish water along the coast, others will start the journey into rivers pushing upstream to feed and grow into yellow eel (Laffaille et al., 2005). This can take up to 25 years or more before the yellow eel reaches the maturation phase. Once ready for reproduction, silver eels migrate downstream and out to sea to make the return journey back to the Sargasso Sea to spawn. The spent adults then succumb to the energetic cost of spawning (OSPAR, 2010).

6.4.2 Conservation Status

European eel is included in the National Biodiversity Framework and OSPAR list. The marine part of the eel's life-cycle is included on the Scottish list of PMFs and it is considered to be critically endangered by the IUCN. The presence of European eel in the River Dee has resulted in the inclusion of the catchment within the national Eel Management Plan (EMP)[4]. The Scottish Government has introduced legislation for the protection of eels through the prohibition of unlicensed eel fishing (The Freshwater Fish Conservation (Prohibition on Fishing for Eels) (Scotland) Regulations 2008).

6.4.3 Occurrence in Study Area

The presence of European eel within the study area is likely to coincide with the outward spawning migration of the adults and the inbound migration of juveniles.

Monitoring studies on the River Dee show adult eel begin to leave the river in June, peaking in August or September and continue on into October/November (Malcolm et al., 2010). Once in the marine environment there is some evidence to suggest that adult eel undergo a residency period in the immediate coastal area before heading off on their spawning migration (Malcolm et al., 2010). The duration and purpose of this residency period is unknown although it is likely to be associated with acclimatisation to the marine environment.

Little is known about the sea phase migration of adult eel or the direction in which they are likely to take after leaving the River Dee. East coast eel populations have two choices, either turn north and head against the prevailing current around the top of Scotland or turn south with the current and enter the North Atlantic via the English Channel. There are no direct accounts of larval migration routes although it is likely they will approach the River Dee from the north given the southerly direction of the prevailing Fair Isle current. Juvenile eel are most likely to be present within the study area between June and October.

[4] http://www.gov.scot/Resource/Doc/295194/0118349.pdf

6.5 Sea Lamprey *Petromyzon marinus*

6.5.1 Ecology

Sea lamprey is an anadromous species, spawning in freshwater and growing in the ocean. The species is present along most of the Atlantic coast of western and northern Europe (Maitland, 2003).

Spawning usually occurs in late May or June, when the water temperature reaches 15°C. After hatching the larvae, known as ammocoetes, drift downstream to reach suitable silty substrates in which they bury themselves. Here they spend several years feeding, until metamorphosis into the adult stage begins; usually around mid-to late summer. Morphological changes are evident with functional eyes appearing and the mouth becoming sucker like (known as the oral disc) with teeth; this stage is called 'macrophthalmia'. This metamorphosis takes place between July and September and lasts for a few weeks (Gardiner, 2003; Maitland, 2003).

Young adult sea lamprey will then migrate downstream and out into the marine environment where they will feed and mature. Little information is available about the adult life stage at sea although they have been found in both shallow coastal regions and deep offshore waters (Maitland, 2003). When in the marine environment the adults become an exoparasite of a variety of large fish including basking shark, cod and salmon (Maitland, 2003; Wilkie et al., 2004). Adults will return to freshwater between April and May in Europe to spawn (Maitland, 2003).

6.5.2 Conservation Status

Sea lamprey is listed on Appendix III of the Bern Convention and Annex II of the EC Habitats & Species Directive. They are a primary reason for the selection of the river Teith and Spey SAC and are a qualifying feature for the designation as SAC of the River Tay. In addition sea lamprey are cited on the National Biodiversity Framework and OSPAR list as well as having the marine part of their life-cycle included on the Scottish list of PMFs.

6.5.3 Occurrence in Study Area

Juvenile sea lampreys migrate into the marine environment between July and September. Adult sea lampreys migrate into freshwater to spawn between April and May. Very little is known about the marine phase of sea lamprey however, as they feed on larger fish species such as cod, basking shark and salmon, it is likely that they will move into deeper offshore waters where they are more likely to encounter their prey. None of these prey species are particularly abundant within the proposed study area. However, it is possible that sea lamprey may be more abundant within Nigg Bay during their migratory periods.

6.6 River Lamprey *Lampetra fluviatilis*

6.6.1 Ecology

River lamprey is an anadromous species that has a similar life history to that of the larger sea lamprey, described above. Numbers have declined in Britain but they remain widely distributed throughout most of Scotland.

Upstream migration of adults into freshwater spawning grounds occurs between October and December (Maitland, 2003). After hatching the larvae spend between 3 years and 5 years in the river, until metamorphosis occurs and they migrate downstream and into the marine environment as young adults. This tends to take place between July and September (Maitland, 2003). Once in the marine environment river lampreys undergo highly localised migrations staying within their local estuary and surrounding coastal areas. Here they feed on a variety of fish, particularly herring, sprat and flounder (Maitland, 2003). After a period of one or two years the adults stop feeding and return to the river to breed.

6.6.2 Conservation Status

River lamprey is listed on Appendix III of the Bern Convention and Annex II and V of the EC Habitats & Species Directive. They are a primary reason for the selection of the River Teith SAC and are a qualifying feature for designation as SAC of the rivers Tay and Tweed. In addition river lamprey is cited on the National Biodiversity Framework and has the marine part of their life-cycle included on the Scottish list of PMFs.

6.6.3 Occurrence in Study Area

The River Dee is known to contain river lamprey. This makes it likely that there will be a year round presence of river lamprey within the study area and the surrounding coastal regions of the River Dee. However, abundance is likely to be a factor of prey availability and the study area is not regarded as being particularly important for any of the river lamprey's prey species.

6.7 Allis & Twaite Shad *Alosa alosa* & *A. fallax*

6.7.1 Ecology

Allis *Alosa alosa* and twaite *A. fallax* shad are the only members of the herring family (Clupeidae) that can be found in UK fresh waters (Maitland and Hatton-Ellis, 2003). Shad, like the salmon and sea lamprey, are anadromous living in coastal waters and spawning in fresh water systems (Maitland and Hatton-Ellis, 2003; Reeve, 2005; Barnes, 2008; JNCC, 2013a,b).

After spending most of their lives at sea, mature allis shad stop feeding and move into the estuaries of large rivers, migrating into fresh waters during late spring (Maitland and Hatton-Ellis, 2003). Adults aggregate in shoals within suitable pools, where nocturnal spawning occurs (Maitland and Hatton-Ellis, 2003). The majority of allis shad die after spawning, with any surviving individuals returning back downstream to the sea (Maitland and Hatton-Ellis, 2003).

The migration and spawning process of twaite shad is known to be similar to the allis shad, as detailed above, but with a slightly later estuary entry time of early summer, with upstream movement to spawning occurring from mid-May to mid-July (Maitland and Hatton-Ellis, 2003). Unlike allis shad, twaite shad may spawn multiple times (Maitland and Hatton-Ellis, 2003).

Juvenile shad remain in the lower parts of the rivers that are slow flowing before moving to estuarine and coastal waters and the open sea. This downstream migration takes around a year, (Maitland and Hatton-Ellis, 2003).

6.7.2 Conservation Status

Both the allis and twaite shad feature on the National Biodiversity Framework as well as being placed in Appendix III of the Bern Convention and Annex II and V of the EC Habitats & Species Directive. In addition, the allis shad is also cited on the OSPAR list.

6.7.3 Occurrence in Study Area

Pollution, over fishing and river obstructions has made both the allis and twaite shad rare over much of their range (western European coasts from southern Iceland/Norway to Spain) (Maitland and Hatton Ellis, 2003; Jolly et al., 2012). No current UK spawning grounds are known for allis shad, (Maitland and Hatton Ellis, 2003). The Solway Firth in south west Scotland is known to contain twaite shad but the species is not likely to be present within the River Dee. It is therefore highly unlikely that shad will be present within the study area although they might on occasion pass through.

6.8 Freshwater Pearl Mussel *Magaritifera margaritifera*

6.8.1 Ecology

The freshwater pearl mussel is found partially buried within coarse sand and gravel sediments of clean, fast flowing freshwater streams throughout north and Western Europe. Although once regarded as being widespread in Scotland, recent surveys have shown that it is extinct in most lowland areas and scarce in a few Highland rivers (Skinner et al., 2003). Despite these declines, Scotland is considered to be the last remaining stronghold in Europe.

It shares part of its life-cycle with young salmon and sea trout upon which it is reliant to aid dispersal of the species. Spawning of the mussel occurs in July to September as a release of larvae known as glochidia. These then attach onto the gills of young salmon or trout where they remain and encyst until the following spring when they drop off. Upon detachment from the gills and settlement on suitable clean sandy or gravelly substrate, the mussel starts to grow. Freshwater pearl mussels develop very slowly, taking around 15 years to mature, and may live up to 100 years, depending upon the prevailing physico-chemical conditions.

6.8.2 Conservation Status

In the UK, the freshwater pearl mussel is protected under Schedule 5 of the Wildlife and Countryside Act, 1981. It is also listed on Annex II of the EC Habitats Directive and is a primary qualifying feature for the River Dee SAC where populations appear to be recruiting strongly and may be one of the most important in the UK. It is listed as ‘vulnerable’ by IUCN.

6.8.3 Occurrence in Study Area

The freshwater pearl mussel does not occur in the study area as it is restricted to freshwater environments although its host fish (salmon or sea trout) may be present in the study area during migratory periods. The success and survival of the mussel is dependent upon the host availability and thus factors influencing salmon and sea trout populations are directly relevant to the consideration of the freshwater mussel.

7. CONCLUSIONS

This study forms one of a series of data strands that have been used to inform an assessment of the impacts of the construction and operation the proposed Aberdeen Harbour Development works on fish and shellfish ecology. It has primarily focused on the species deemed to be of commercial and ecological importance in response to statutory and non-statutory scoping. It also describes the study area in terms of its critical habitats and likely importance to the fish and shellfish community.

Species assemblages within the study area are deemed typical to those of the region. Few species will be truly 'resident' and the majority are likely to move between the inshore and offshore regions of the study area over the course of the year. Those that are deemed resident generally consist of the smaller bodied species like goby and dragonet which act as food for other larger species such as cod and monkfish and shellfish species such as the European lobster and common whelk which are not thought to migrate. Taking this into consideration the bulk of the fisheries community within the study area is likely to undergo a spatial and temporal shift in abundance and biodiversity. This means that careful consideration of the projects timings will be paid during the EIA process.

Consideration has been given to the temporal nature of Scotland's east coast migratory fish population and in particular to that of the River Dee. Migratory species will be present in peak numbers at different times of the year as they transit through the study area to their spawning/feeding grounds during seasonal 'runs' although for the River Dee, salmon and sea trout may enter the river at all times of the year.

During the assessment it will be important to consider the critical habitats of the study area. Spawning and nursery areas were identified for a number of species, some of which are regarded as 'high intensity' usage areas. However, it should be recognised that these habitats are not restricted to the study area; rather they form a small part of a much larger regional and often national spawning/nursery area.

A number of ecologically important species are shown to inhabit the study area, particularly sandeel which is a key food item within marine food webs. Any effects arising from the project to sandeel will be identified and discussed during the assessment with reference of the feeding of other species such as marine mammals, seabirds and other fish.

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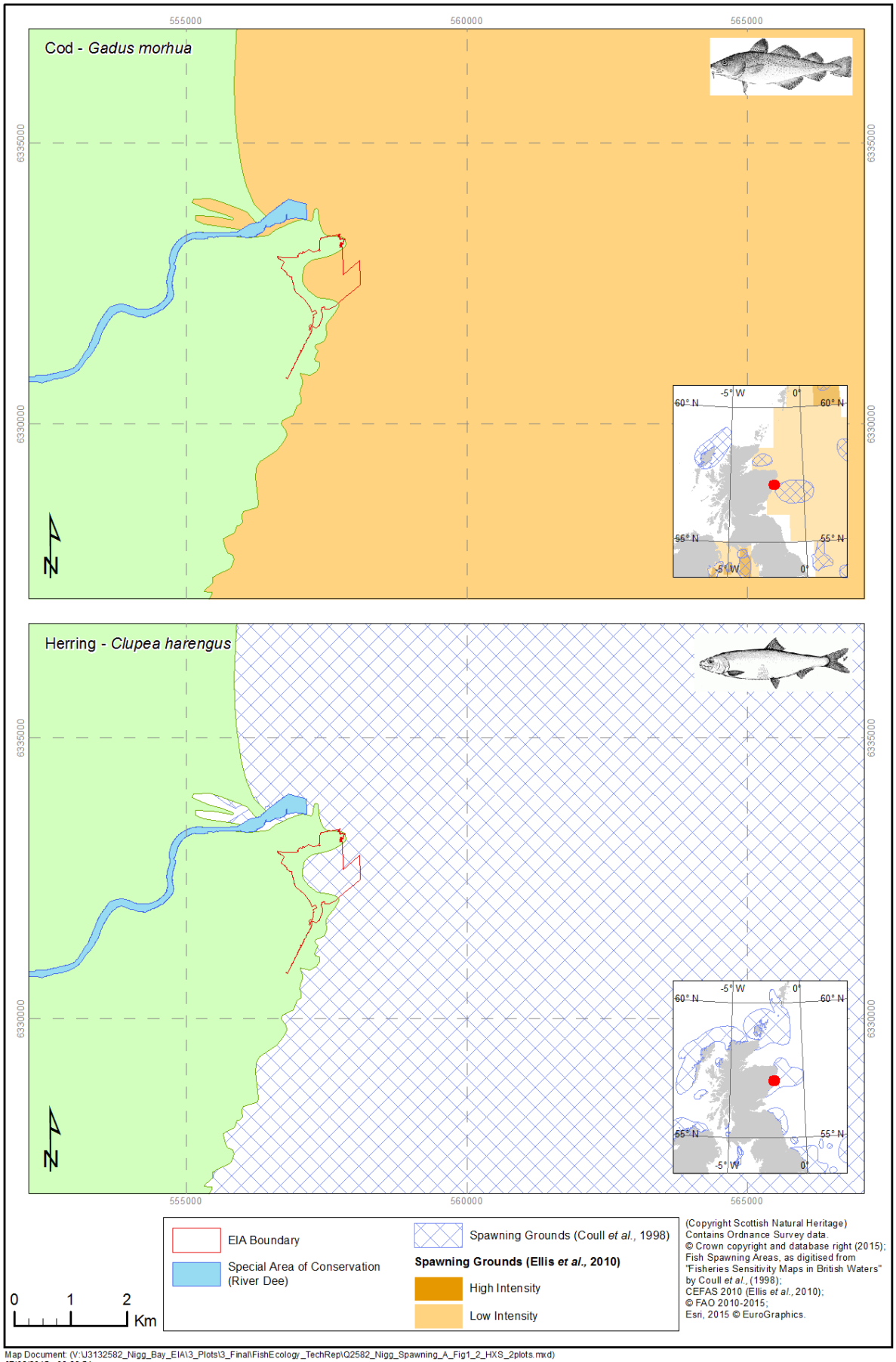
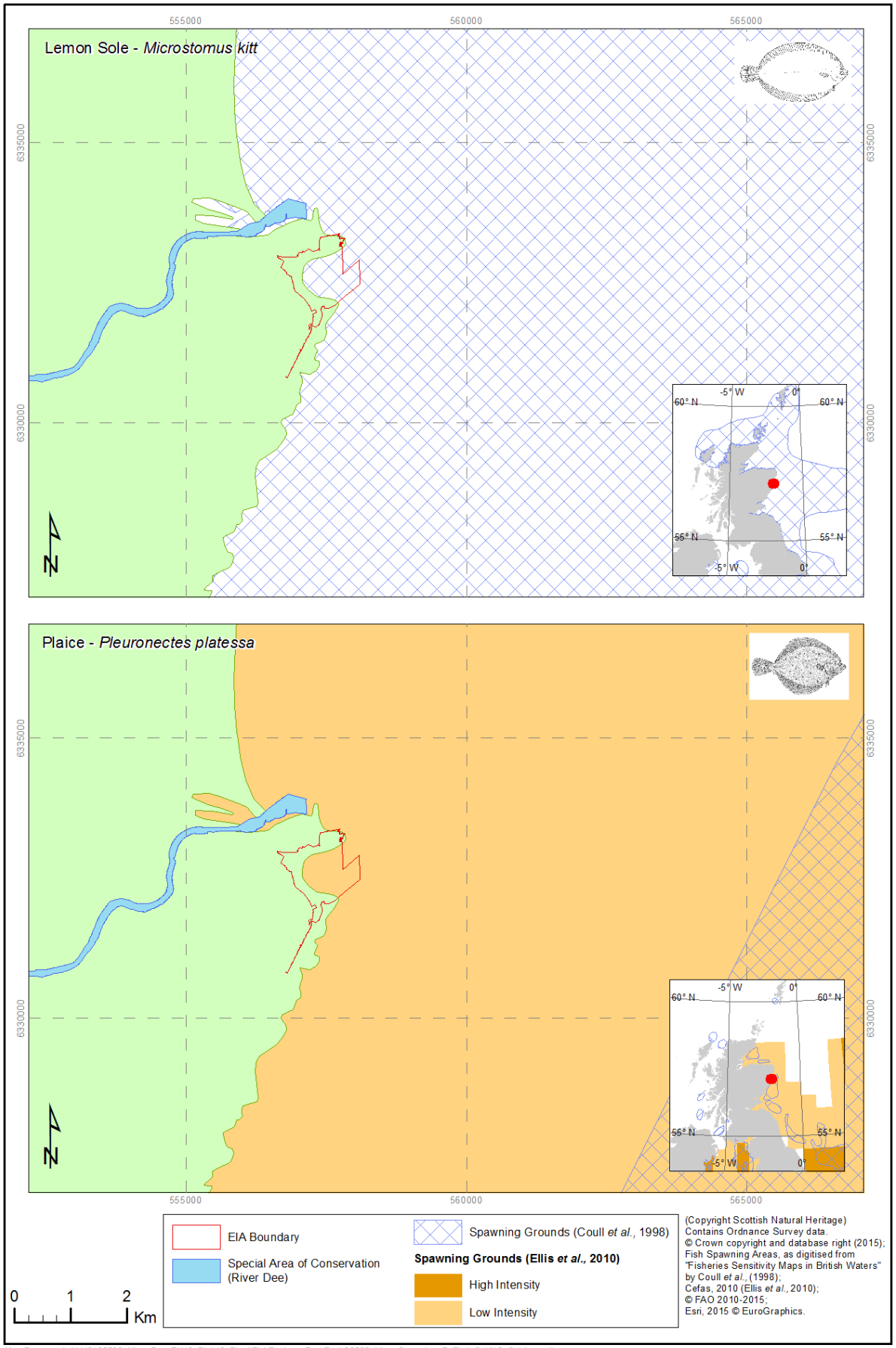
A. SPAWNING AREAS




Lemon Sole - Microstomus kitt
Plaice - Pleuronectes platessa
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EIA Boundary
Special Area of Conservation (River Dee)
Spawning Grounds (Coull et al., 1998)
Spawning Grounds (Ellis et al., 2010)
High Intensity
Low Intensity
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(Copyright Scottish Natural Heritage)
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Fish Spawning Areas, as digitised from "Fisheries Sensitivity Maps in British Waters" by Coull et al., (1998);
Cefas, 2010 (Ellis et al., 2010);
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Esri, 2015 © EuroGraphics.
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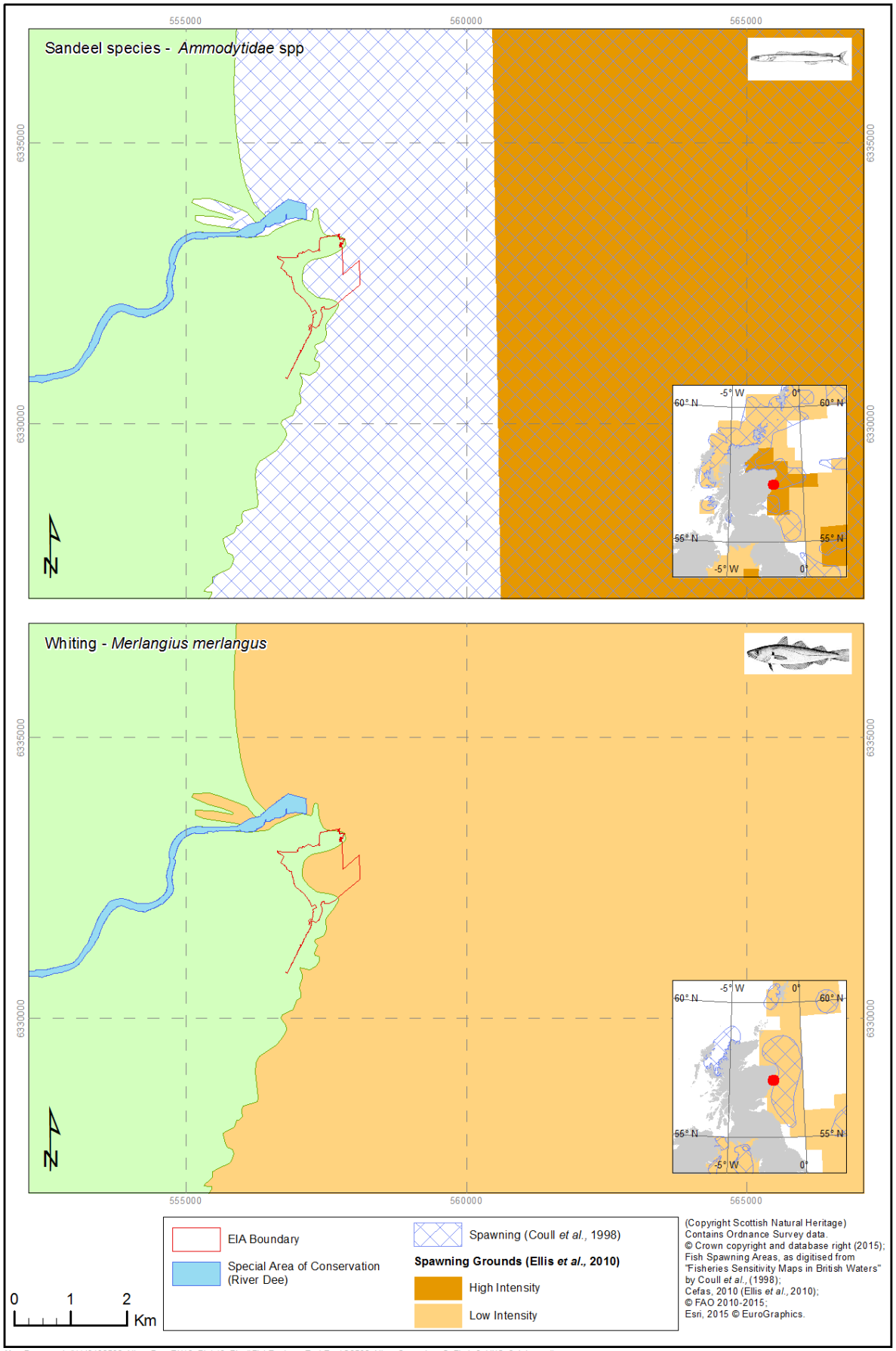

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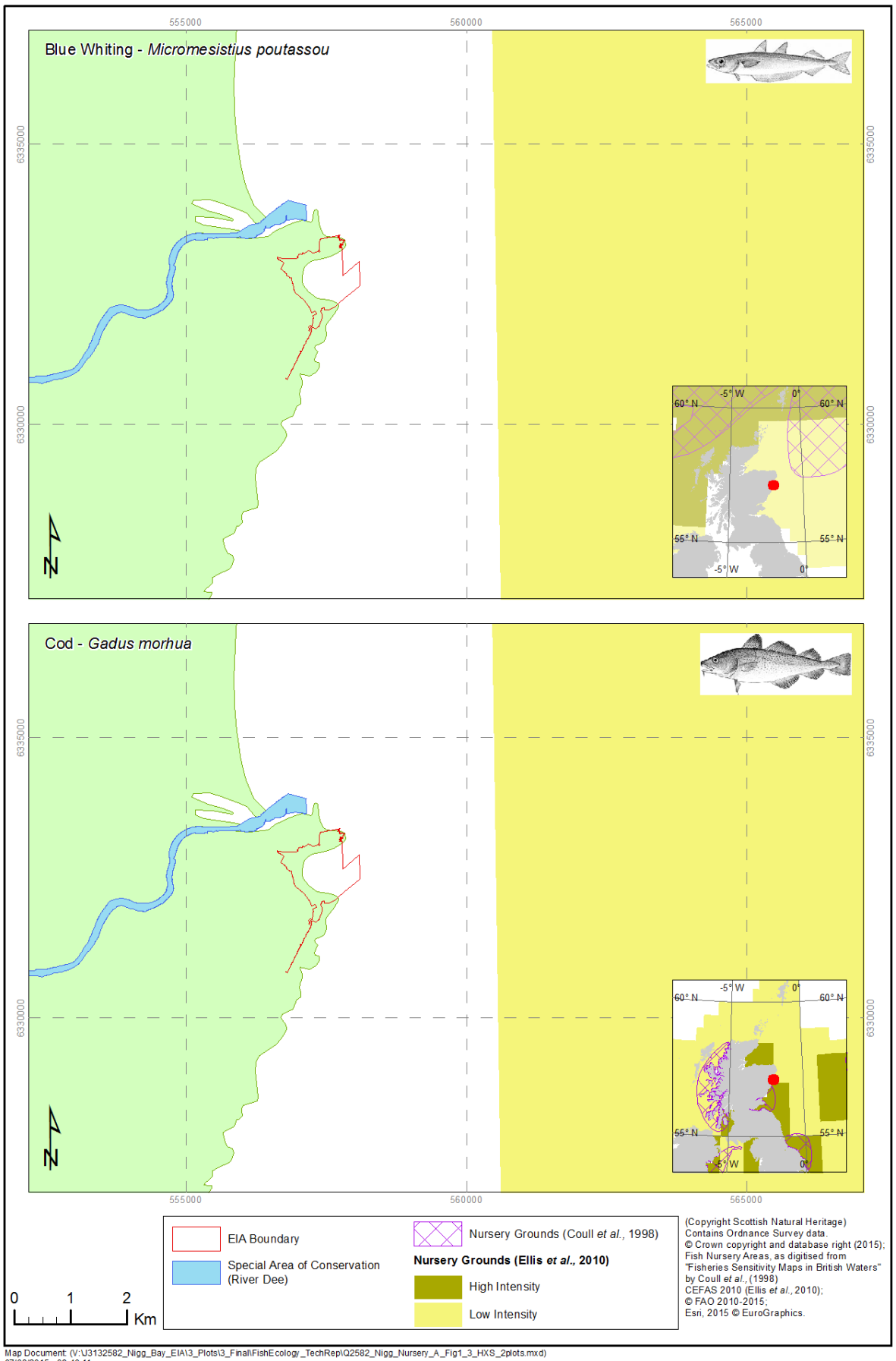

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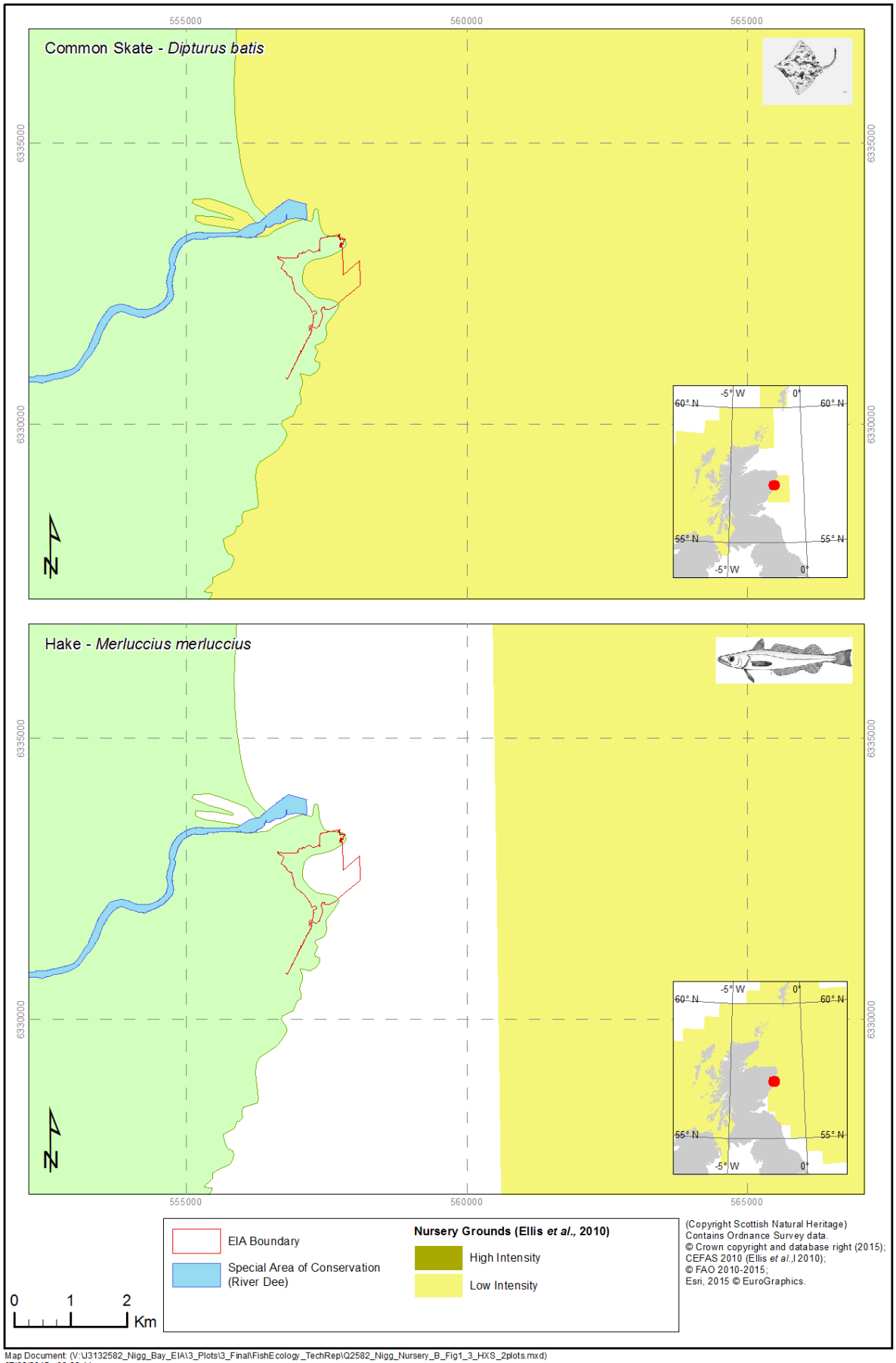

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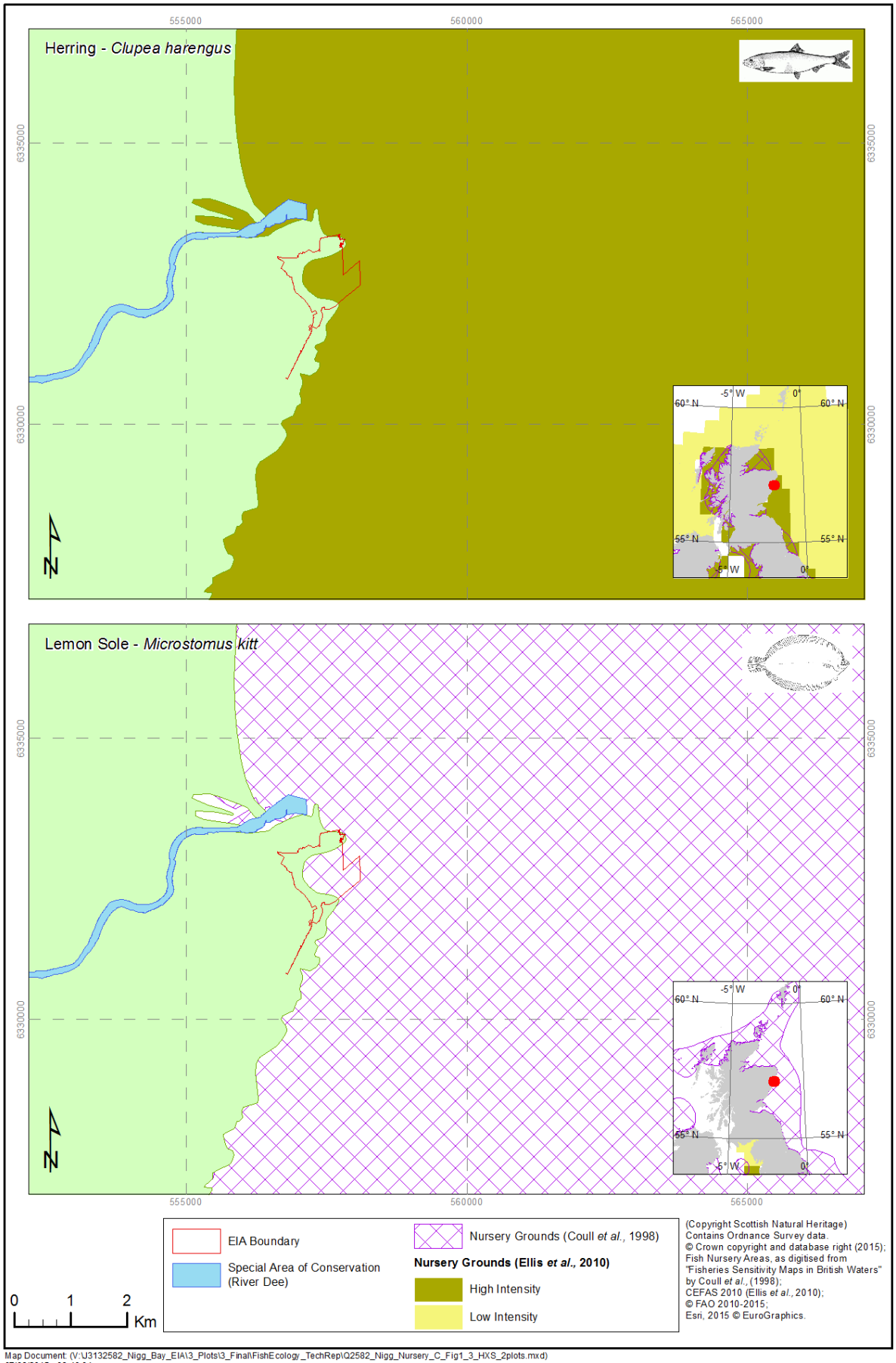

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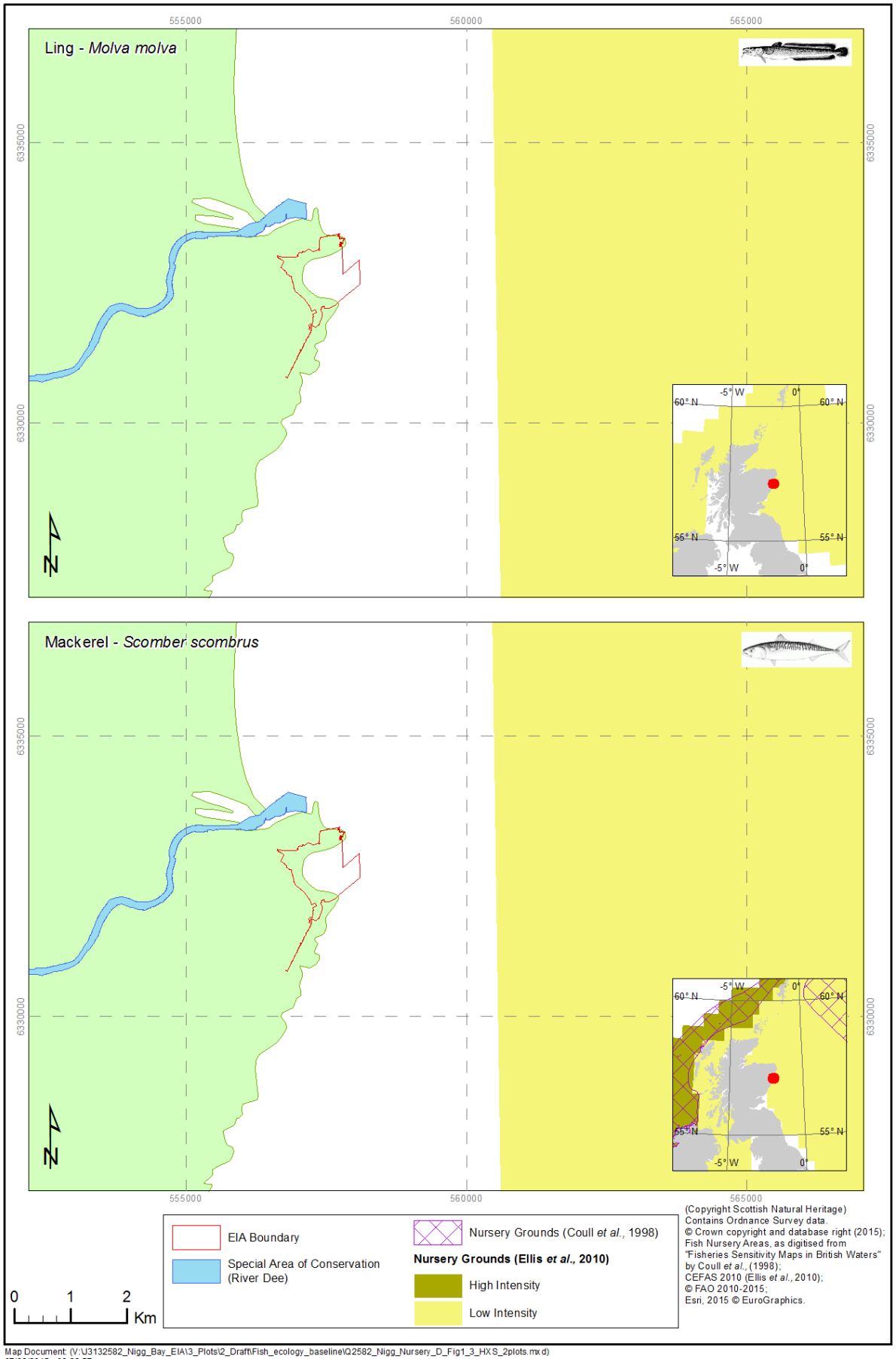

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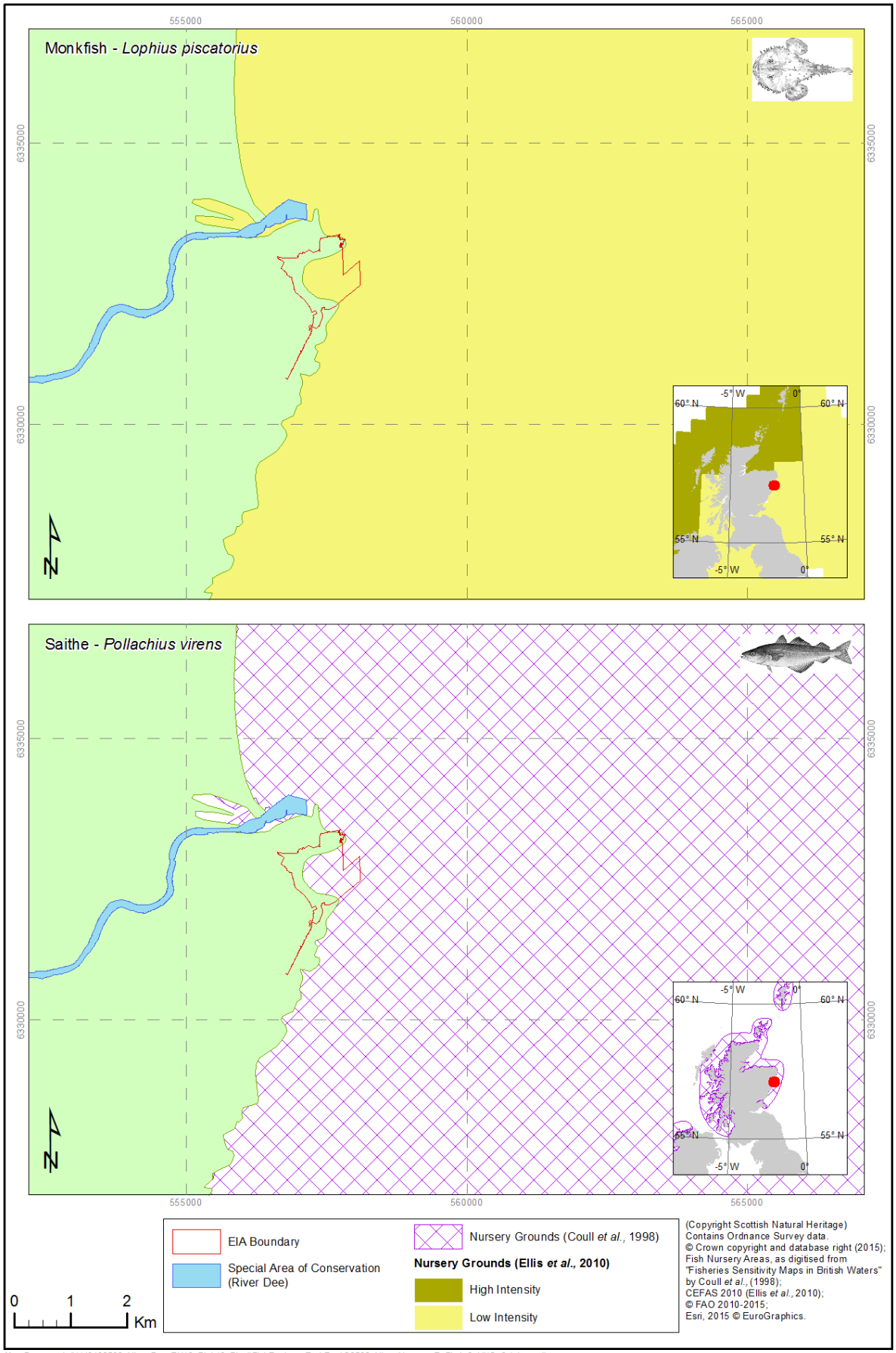

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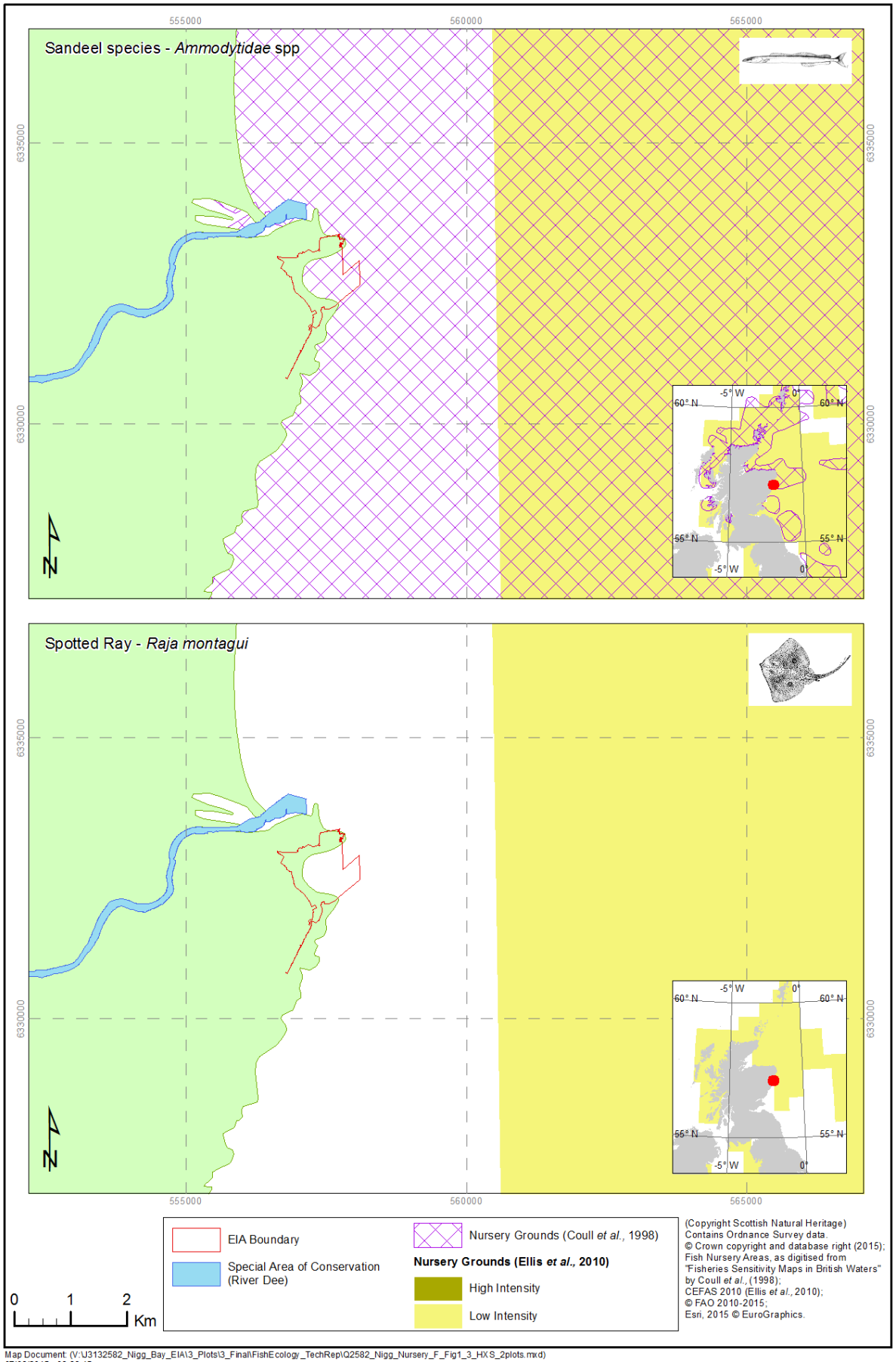
Sandeel species - Ammodytidae spp
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Special Area of Conservation (River Dee)
Nursery Grounds (Coull et al., 1998)
Nursery Grounds (Ellis et al., 2010)
High Intensity
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Fish Nursery Areas, as digitised from "Fisheries Sensitivity Maps in British Waters" by Coull et al., (1998);
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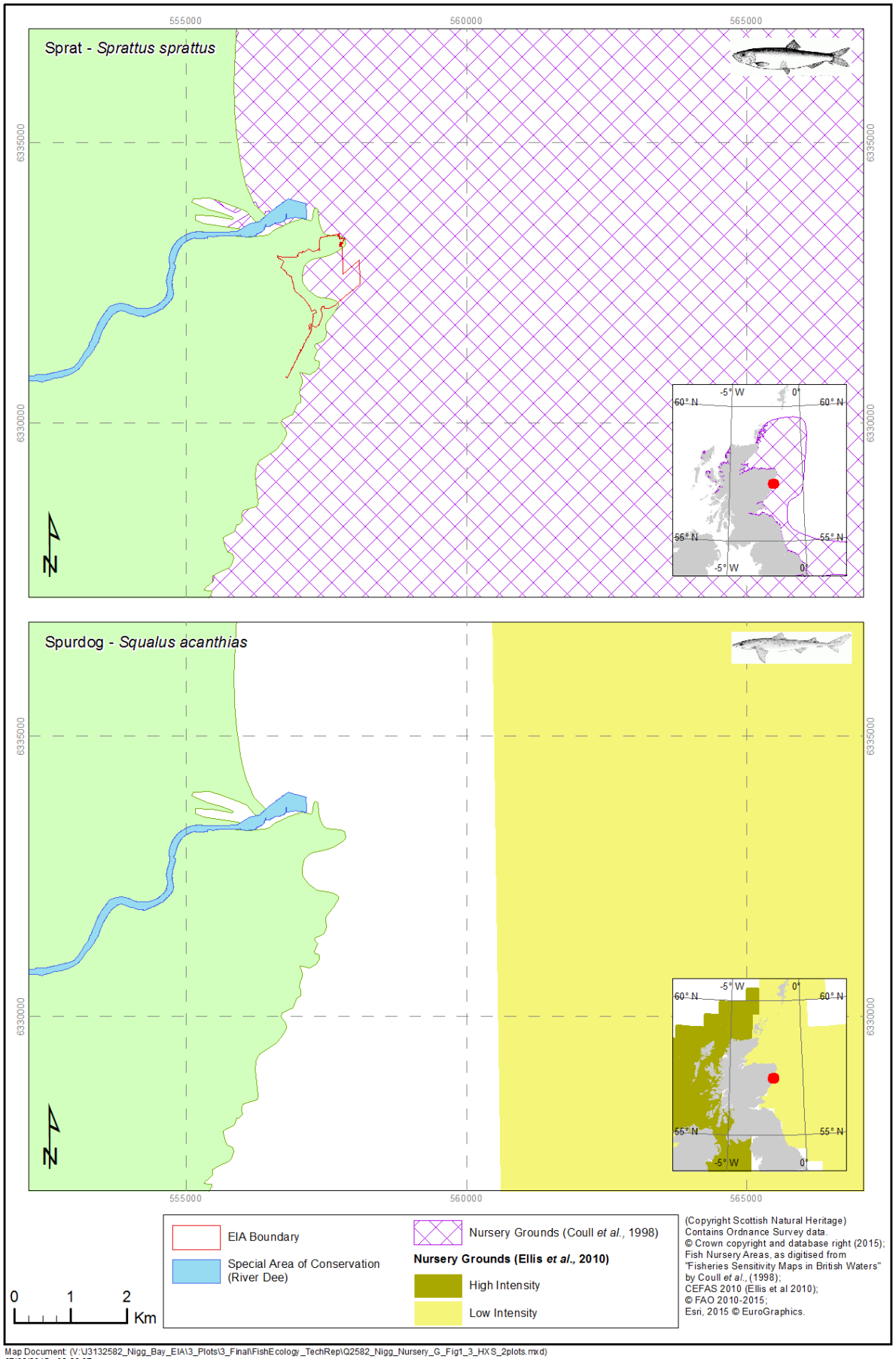
Sprat - Sprattus sprattus
Spurdog - Squalus acanthias
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Special Area of Conservation (River Dee)
Nursery Grounds (Coull et al., 1998)
Nursery Grounds (Ellis et al., 2010)
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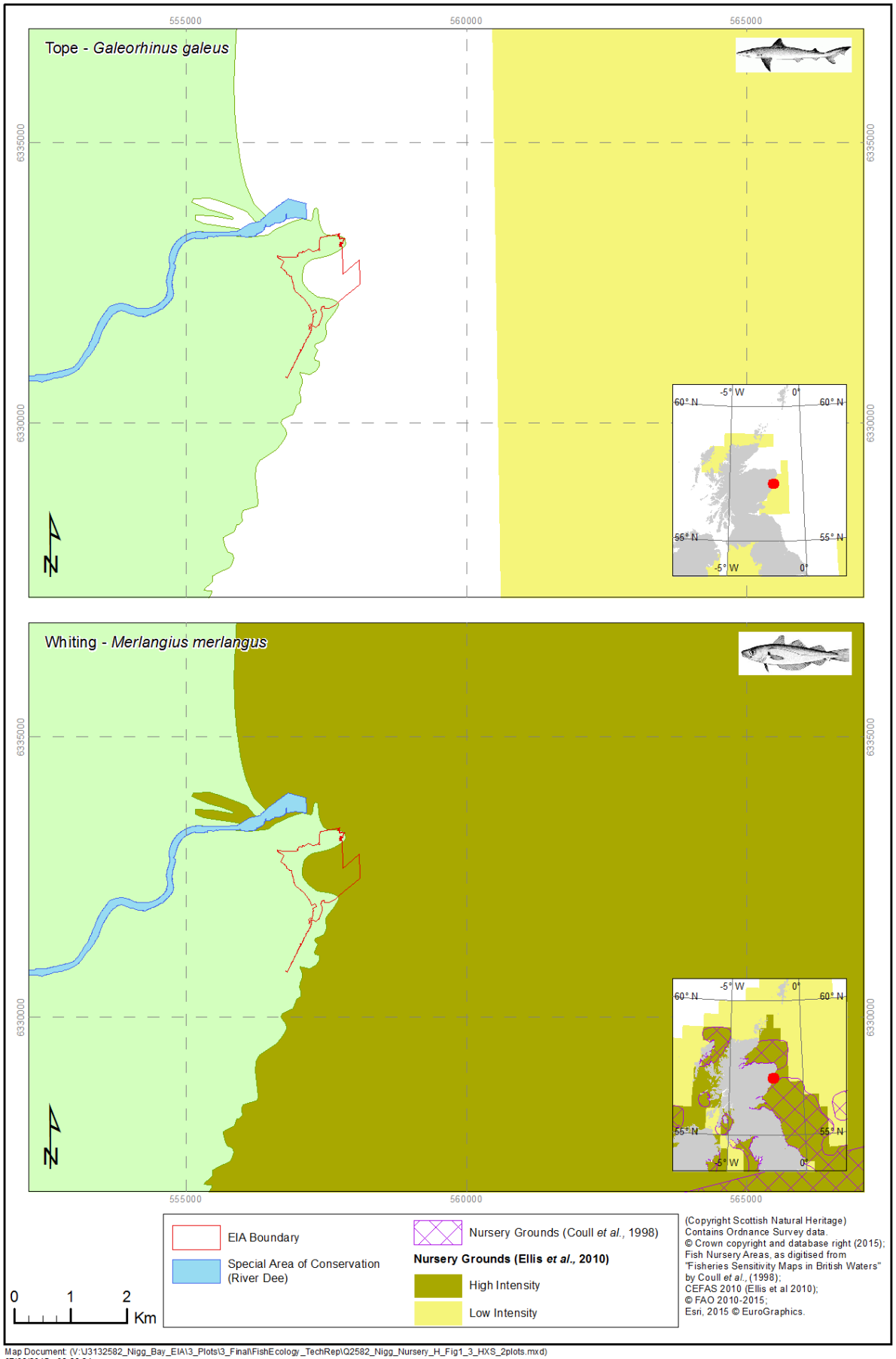
Tope - Galeorhinus galeus
Whiting - Merlangius merlangus
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