Inch Cape Offshore Wind Farm

New Energy for Scotland

Offshore Environmental Statement:
VOLUME 2E
Appendix 13A: Natural Fish and Shellfish Survey Report

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Inch Cape Offshore Wind Farm

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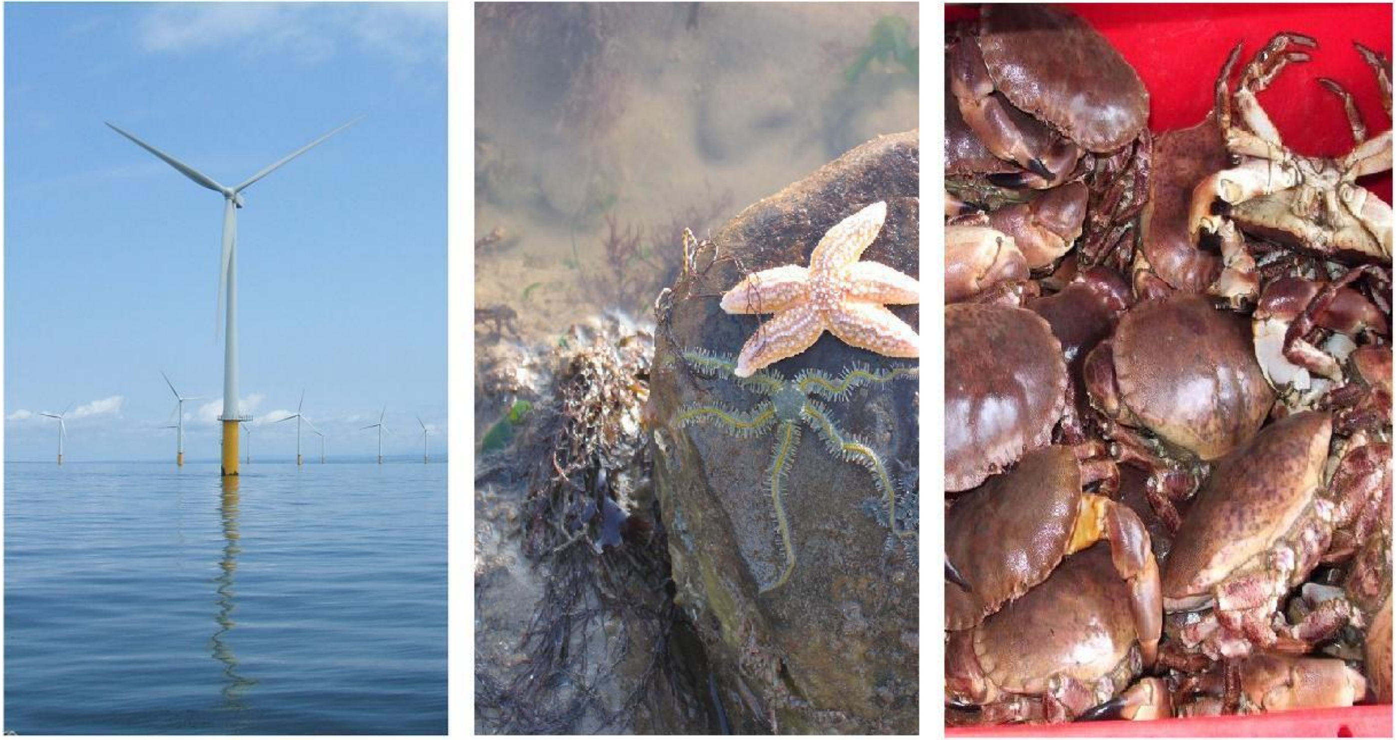

AMEC Environment & Infrastructure UK Limited

May 2013

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Inch Cape Offshore Wind Farm

Natural Fish and Shellfish Survey Report

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UK Limited

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13A.1. Introduction

Inch Cape Offshore Ltd (ICOL) are developing the Wind Farm and associated Offshore Transmission Works (OfTW). The project location can be seen in *Chapter 7: Description of the Development* Figure 7.1 and for assessment purposes is considered as two discrete locations, the Development Area and the Offshore Export Cable Corridor, collectively known as the Project. A description of the Project can also be found in *Chapter 7*. This report has been produced for the purpose of providing the results of the baseline fish surveys that will inform the Environmental Impact Assessment (EIA) for the Inch Cape Offshore Wind Farm and OfTW.

The results of the site specific survey have been considered in parallel with a number of other data sources including the reported distribution of spawning and nursery grounds of key marine fish species (refer to *Annex 13A.1*), diadromous migratory fish species (refer to *Annex 13A.2*) and the regional importance of the area for commercial fisheries (*Chapter 18: Commercial Fisheries*). These are combined in a single baseline for the Project in *Chapter 13: Natural Fish and Shellfish Section 13.4*.

The surveys were primarily carried out to characterise the Development Area as it was felt that that due to the temporary nature of habitat disturbance in the Offshore Export Cable Corridor the existing sources of data were sufficient to allow adequate assessment of the impacts. However, where relevant the Offshore Export Cable Corridor is discussed in context to the conclusions of the survey. Between January 2012 and October 2012 a series of otter trawl surveys were undertaken to determine the type and distribution of fish and shellfish species in and around the site of the Development Area. These otter trawl surveys were conducted within each season (winter, spring, summer and autumn) to gain information on fish distribution in the Development Area.

This report presents the data collected in summary form, and statistical analysis has been undertaken on survey data to evaluate whether any spatial or temporal patterns are present.

13A.2. Method

13A.2.1 Survey Planning

In order to assess fish presence and distribution in the Development Area, four separate trawl surveys were undertaken using a local fishing vessel deploying a commercial otter trawl. This is a method of trawling whereby a net is pulled along the seabed, while large rectangular “otter boards”, either side of the mouth, keep the net open and ‘herd’ individuals in front of the net until they tire and fall back into the net. This method is used commercially to target demersal fish and shellfish such as Norwegian lobsters (*Nephrops norvegicus* – from here on referred to as *Nephrops*). However, other benthic invertebrates and pelagic fish may also be captured as bycatch. This method of trawling is an effective way of surveying demersal fish, elasmobranchs and shellfish, particularly on softer sediment types. It is acknowledged that the otter trawl gear is not optimal for all species, specifically pelagic species such as herring (*Clupea harengus*) and for specific bottom dwelling molluscs i.e. scallops (*Aequipecten opercularis*). As a result the numbers of these species captured would be expected to be less than if optimised fishing method and gear for these species (i.e. pelagic net and scallops dredges) was employed. These methods would, however, provide much less information on other fish and shellfish species present. Otter trawling is a relatively non selective method of fishing, capturing a wide range of demersal species and as such can provide information on the abundance and distribution of fish which are often not recorded in fisheries data (i.e. bycatch). In addition, information on commercially important species such as herring and scallops is readily available from landing and catch statistics, therefore negating the need for specific surveys.

The survey methodology was agreed with Marine Scotland and their advisors Marine Scotland Science prior to the commencement of the January 2012 survey. Geophysical information was reviewed and 10 sample locations were decided upon to characterise the site and build upon desk-based information in relation to the following areas of interest regarding fish and shellfish:

- Spawning Grounds
- Nursery Grounds
- Feeding Grounds
- Refuge areas for crustaceans (e.g. lobster and crab) if appropriate, and
- Migration routes (non diadromous marine species only)

Trawl surveys were conducted quarterly over a 12 month period, in order to try and identify any broad-scale variation in species distribution and abundance in the Development Area. The four surveys were conducted in January (winter), May (spring), July (summer) and October (autumn). A summary of the survey plan is given in Table 13A.1.

Table 13A.1. Survey Programme

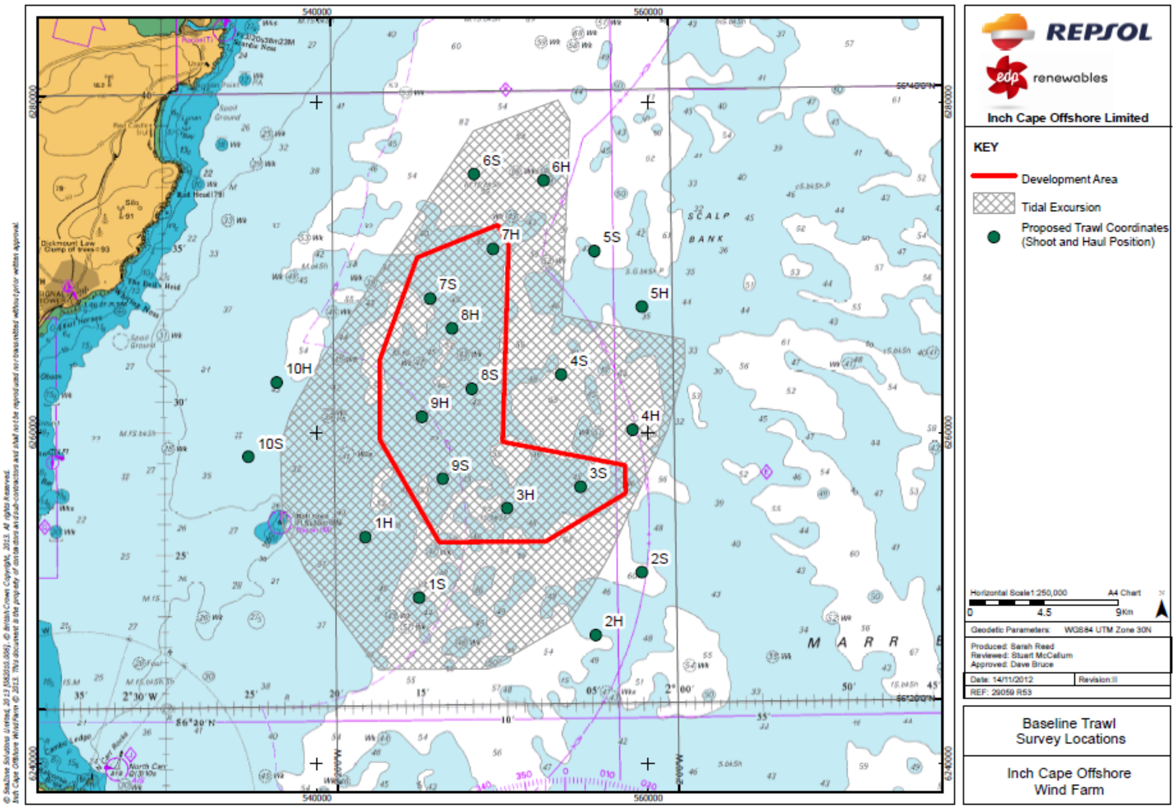
Survey	Method	Species Targeted	Frequency and Time of Year Surveys Undertaken	Details
Trawl surveys	Otter trawling	*Nephrops*, white fish (cod, lemon sole, haddock, whiting, plaice, ling, saithe turbot and brill)	Survey carried out quarterly - winter, spring, summer and autumn.	10 x 1 hour tows in and around the Development Area

Sampling locations were chosen within the Development Area and surrounding tidal ellipse (i.e. the area of tidal influence). Locations were specified to provide a representative, but not exhaustive, coverage of the different areas and ground conditions, as defined by geophysical survey data collected previously (Table 13A.2). Control stations outside of one tidal ellipse were also identified (Figure 13A.1).

Table 13A.2. Location of Otter Trawl Sampling Sites

Treatment Area	Sampling Station	Trawl Start Position	Trawl End Position	Average Depth (m)
Within Tidal Ellipse	1	56.4258, -2.3020	56.3926, -2.2503	50.56
Control Site	2	56.3711, -2.0777	56.4049, -2.0319	52.31
Within Development Area	3	56.4518, -2.0908	56.4407, -2.1628	47.52
Within Tidal Ellipse	4	56.4823, -2.0390	56.5129, -2.1083	60.01
Control Site	5	56.5492, -2.0284	56.5797, -2.0742	49.32
Within Tidal Ellipse	6	56.6185, -2.1235	56.6224, -2.1916	54.45
Within Development Area	7	56.5816, -2.1740	56.5550, -2.2362	49.43
Within Development Area	8	56.5388, -2.2151	56.5057, -2.1963	48.98
Within Development Area	9	56.4908, -2.2456	56.4570, -2.2257	47.86
Control Site	10	56.4700, -2.4159	56.5103, -2.3877	44.03

Figure 13A.1. Baseline Otter Trawl Survey Locations



13A.2.2 Survey Methodology

The vessel, *FV Crystal Tide* (Figure 13A.2) was used to conduct all four trawl surveys. The *Crystal Tide* regularly works in and around the Development Area, using gear representative of the local area (otter trawl). The vessel meets the MCA certification for work boats.

Figure 13A.2. FV Crystal Tide

The gear used was an 18 fathom otter trawl with 95mm nylon mesh, 8 - 10 inch rubber hoppers on the foot rope, and Dunbar B doors. The warp length used was three times that of the depth to ensure that the net was fishing the seabed correctly.

At each sampling station the gear was towed for 1 hour at a speed of 1-2 knots. The trawl track was recorded for each tow using GPS equipment (Garmin GPS Map78s with external antennae), backed up with the vessels on board positioning system. In addition the time, date and coordinates at which the trawl was deployed and recovered was recorded, as well as environmental data such as turbidity, salinity, sea water temperature, prevailing weather conditions, tidal state and sea state. Trawl surveys dates are provided in Table 13A.3, with full survey details shown in *Annex 13A.3.*

Table 13A.3. Survey Dates

Survey Season	Survey Dates
Winter	27/01/2012 – 28/01/2012
Spring	16/05/2012 – 17/05/2012
Summer	25/07/2012 – 26/07/2012
Autumn	04/10/2012 – 05/10/2012

13A.2.3 Treatment of Catch

At each sampling station once the gear was hauled the catch was sorted on board into individual species (Figure 13A.3). A photographic record was taken of the catch and of any species not easily identified on board. The numbers of all species of fish and macro-invertebrates were recorded. The number and size (total length[1]) of all fish (including electro-sensitive elasmobranch species and non-commercial species) was recorded. The number of all species of macro-invertebrate was also recorded as well as the carapace[2] length of all commercially important invertebrates, prior to being returned to the sea.

On a number of occasions during the trawl survey, the catch contained many hundreds of small fish such as haddock (*Melanogrammus aeglefinus*), or Norway pout (*Trisopterus esmarkii*). On these occasions a sub-sampling procedure was adopted using the method specified in Boyd *et al* (2006). Using this method the entire catch was sorted into separate species to ensure rare species are accounted for. Sub-sampling of abundant species whereby a known proportion of that species (by volume) were measured after the entire catch has been thoroughly sorted was undertaken. A note was made of the volume in which the initial count was determined and of the total volume of that species. Species were measured using the methods set out in EC Regulation 850/98 for the Conservation of Fisheries Resources through Technical Measures for the Protection of Juveniles of Marine Organisms.

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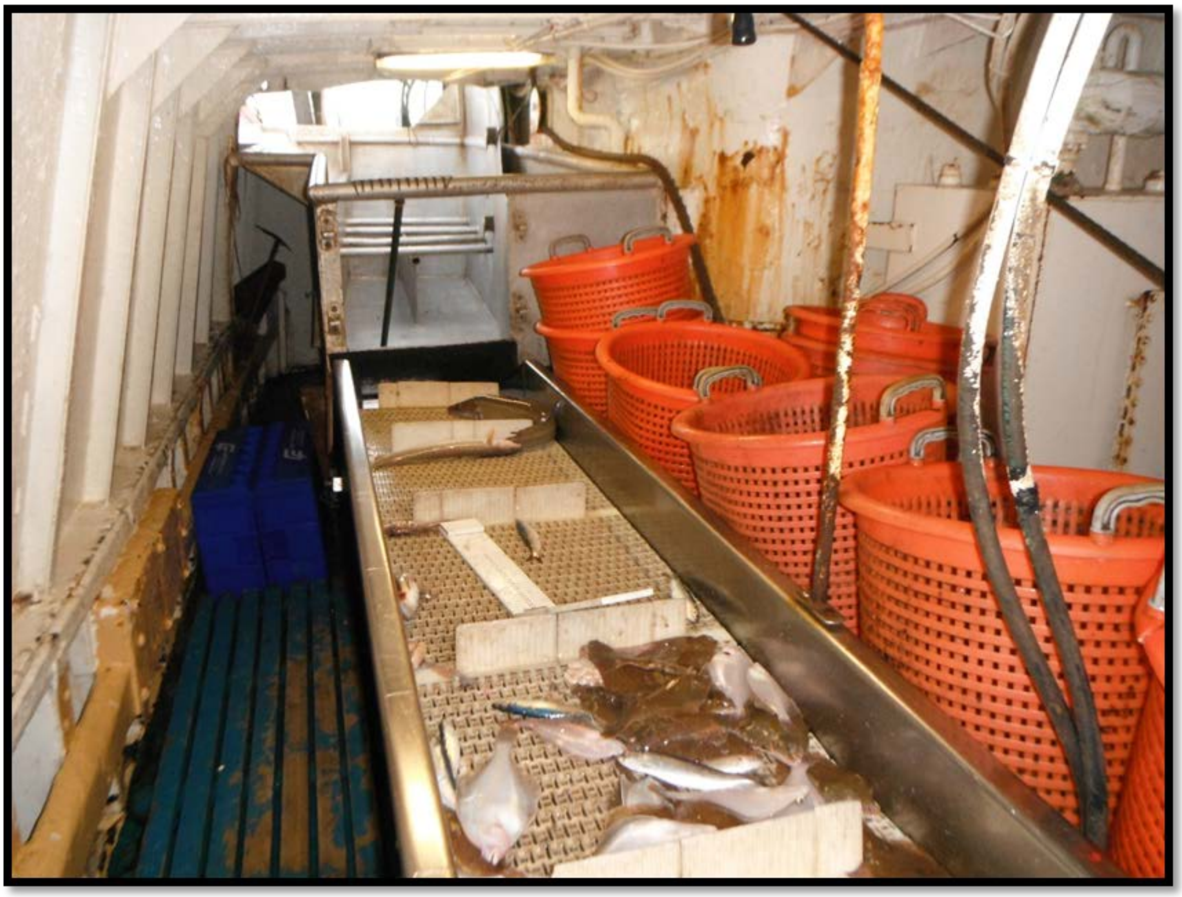
[1] Or wing width in the case of skates and rays.

[2] Carapace width for crabs.

Figure 13A.3. Sorting Bench on the Crystal Tide



13A.2.4 Data Handling

The physical details of the survey as well as the numbers and size of all the fish and invertebrates captured in each trawl were recorded in an Excel spreadsheet. Size data was recorded for all fish species but only for invertebrates of commercial importance.

For each sampling station the total number and size range (for all fish and invertebrates of commercial importance) was calculated. In addition, the number and proportion of each species of commercial importance over minimum landing size (MLS) was calculated. For some commercial species where there is no legal MLS the number and proportion of individuals over the minimum marketable size (MMS) was recorded (Table 13A.4).

Table 13A.4. Minimum Landing Sizes (MLS) and Minimum Marketable Size (MMS) for Commercial Species of Fish and Shellfish

Commercial Species	MLS (mm)	MMS (mm)
Cod	350*	
Haddock	300*	
Plaice	270*	
Whiting	270*	
Hake	270*	
Saithe	350*	
Mackerel	300*	
Herring	200*	
Ling	630*	
Lemon sole		250*
Dab		230*
Common lobster	87**	
Norwegian lobster	25**	
Edible crab	130***	
Velvet swimming crab	65***	

* total length, ** carapace length, *** carapace width

13A.2.5 Data Analysis

Analysis of the data was conducted using various visual and statistical methods. Fish and invertebrate catch data was analysed focusing on both geographic and seasonal patterns, with differences in diversity, size, total numbers of individuals and species diversity analysed between stations and between seasonal surveys.

Size frequency graphs and mean size values were used to test seasonal and geographical patterns in fish size whilst species presence/absence graphs and figures were used to determine geographical patterns in species distribution. Diversity and catch numbers were assessed in both a geographical and seasonal context through graphical representation of the data using GIS (Geographic Information System).

Statistical similarity and significance was tested using Primer v6 and accompanying ANOSIM functions. Cluster analysis was used to discern similarities within the data set which could then be illustrated through the use of Multi-Dimensional Scaling (MDS) plots. Subsequent analysis of the patterns of abundance and distribution was undertaken using ANOSIM analyses within PRIMER.

ANOSIM uses R values as a comparative value of the degree of separation between the test groups. R values range from -1 to +1, and when close to 0 indicate that there is no difference between the test groups. As the R value approaches 1 (or -1) the greater the degree of separation, and as such the greater the difference between the test groups.

13A.3. Results

13A.31 Survey Data

A total of 30 fish species and 20 macro-invertebrate species were captured during all four surveys with 19,309 and 6,127 individuals recorded respectively (Table 13A.5 and Table 13A.6). Full catch data for each survey is presented in *Annex 13A.4*.

Table 13A.5. Total Number and Size Range of Fish Captured During the Trawl Surveys

English Name	Latin Name	Number Captured	Size Range (mm)	No. Over MLS or MMS*	% Over MLS or MMS
Norway Pout	*Trisopterus esmarkii*	8414	80-200		
Whiting	*Merlangius merlangus*	3395	100-420	206	6
Haddock	*Melanogrammus aeglefinus*	2828	80-430	67	2
Bib	*Trisopterus luscus*	1816	90-230		
Sprat	*Sprattus sprattus*	1194	70-170		
Dab	*Limanda limanda*	523	80-300	97	18
Sandeel	*Ammodytes tobianus*	449	90-180		
Mackerel	*Scomber scombrus*	168	280-380	86	50
Herring	*Clupea harengus*	161	100-300	34	7
Red gurnard	*Aspitriglia cuculus*	59	140-260		
Plaice	*Pleuronectes platessa*	56	170-370	16	29
Long Rough Dab	*Hippoglossoides platessoides*	50	130-260		
Lemon sole	*Microstomus kitt*	37	170-320	16	42
Pollack	*Pollachius pollachius.*	32	80-90		
Grey gurnard	*Eutrigla gurnardus*	32	150-370		
Long-spined Sea Scorpion	*Taurulus bubalis*	18	190-280		
Small spotted catshark	*Scyliorhinus canicula*	18	310-670		
Cod	*Gadus morhua*	15	120-490	5	34
Flounder	*Platichthys flesus*	10	180-300		
Bull rout	*Myoxocephalus scorpius*	9	180-300		
Saithe	*Pollachius virens*	6	150-360	2	33
Greater Sand eel	*Hyperoplus lanceolatus*	3	280-320		
John Dory	*Zeus faber*	3	260-270		
Ling	*Molva molva*	3	320-540	1	29
Cuckoo ray	*Raja naevus*	3	150-340		
Pogge	*Agonus cataphractus*	2	100-110		

English Name	Latin Name	Number Captured	Size Range (mm)	No. Over MLS or MMS*	% Over MLS or MMS
Dragonet	*Callionymus lyra*	2	190-240		
Hake	*Merluccius merluccius*	1	170	0	0
Red mullet	*Mullus surmuletus*	1	220		
Scad	*Trachurus trachurus*	1	200		

* commercial species only

Norway pout (*T. esmarkii*) was the most numerous species captured, contributing 43% to the overall catch. Other numerically important species were whiting (*Merlangius merlangus*; 17% of overall catch), haddock (*M. aeglefinus*; 15%), bib (*Trisopterus luscus*; 9%) and sprat (*Sprattus sprattus* 6%). The remaining 10% of the catch was made up of a further 25 species.

In total 19 species of commercially important fish were captured over the four surveys. Of these, individuals from 10 species were captured that were above their respective MLS or MMS.

Whiting (*M. merlangus*), dab (*Limanda limanda*), mackerel (*Scomber scombrus*), and haddock (*M. aeglefinus*) had the highest proportion of individuals over their MLS/MMS, however with the exception of mackerel, of which 50% of individuals were above MLS, the proportion of individuals over the MLS/MMS was still relatively low (between 2 and 18% in all species). Lemon sole (*Microstomus kitt*), cod (*Gadhus morhua*), saithe (*Pollachius virens*), ling (*Molva molva*) and plaice (*Pleuronectess. platessa*) had relatively high proportions of individuals over the MLS/MMS (29-42%) but the number of individuals caught from these species was low. In total, the number of marketable fish from all species was 530, representing less than 2.75% of the overall catch.

Table 13A.6. Species and Number of Invertebrates Captured During the Trawl Surveys

English Name	Latin Name	Number Captured	Size Range (mm)	No. Over MLS or MMS*	% Over MLS or MMS
European squid	*Loligo forbesii*	4472			
Moon jellyfish	*Aurelia aurita*	1337			
Pink shrimp	*Pandalus montagui*	104			
Lion's mane jellyfish	*Cyanea capitella*	77			
Common lobster	*Homarus Gammarus*	38	**65-141**	**30**	**79%**
Dead Man's fingers	*Alcyonium digitatum*	17			
Plumose anemone	*Metridium senile*	15			
Blue jellyfish	*Cyanea lamarckii*	14			
Harbour crabs	*Liocarcinus depurator*	12			
Sea urchin	*Echinus esculentus*	10			
Squid	*Alloteuthis subulata*	10			
Brown Crab	*Cancer pagurus*	6	**120-137**	**1**	**17%**

English Name	**Latin Name**	**Number Captured**	**Size Range (mm)**	**No. Over MLS or MMS***	**% Over MLS or MMS**
Queen Scallop	*Aequipecten opercularis*	6			
Sun star	*Crossaster papposus*	2			
Brittle stars	*Ophiothrix fragilis*	2			
Norwegian Lobster	*Nephrops norvegicus*	1	**38**	**1**	**100%**
Starfish	*Asteras rubens*	1			
Squat lobster	*Munida rugosa*	1			
Curled Octopus	*Eledone cirrhosa*	1			
Hermit crabs	*Pagurus bernhardus*	1			

* commercial species only

In total, 6127 individual invertebrates were captured during the four surveys. European squid (*Loligo forbesii*) was the most commonly caught species contributing 73% to the overall catch, moon jellyfish (*Aurelia aurita*) was the second most commonly captured species making up 22% of the total catch. The remaining 5% was made up of 13 species with pink shrimp (*Pandalus montagui*), lion's mane jellyfish (*Cyaena capitella*) and common lobster (*Homarus gammarus*) representing the following three most commonly captured species.

Five commercially targeted species were caught, European squid (*L. forbesii*), common lobster (*H.gammarus*), brown crab (*Cancer pagurus*), queen scallop (*Aequipecten opercularis*) and Norwegian lobster *(Nephrops norvegicus)*. European squid has no minimum landing size attached to it and made up the greatest proportion of the total catch, the proportion of common lobster captured over the MLS was 79% but the total number of lobsters captured was low (38 individuals, 0.6% of the overall catch). The numbers of brown crab and queen scallop were low, with only six individuals of each species captured during all surveys; the proportion of brown crab over the MLS was 17%. Only a single Norwegian lobster was captured with this individual over the MLS.

13A.3.2 Data Analysis

Geographic Distributions

Fish

No clear spatial pattern was observed in the distribution of the fish catch across the Development Area. The largest numbers of fish were captured at stations 6, 8 and 10 (Figure 13A.4), although this is largely due to the abundance of Norway pout (*T. esmarki*) and haddock (*M. aeglefinus*) at these stations in the summer and autumn surveys. The stations to the south east of the Development Area (2 and 3) had the lowest total number of individuals recorded. Total catch figures at station 4 were higher in the spring survey than at other stations but generally low during the other three surveys. No clear pattern is evident in the geographical distribution when looking at the total numbers of fish caught per station per season (Figure 13A.5).

Figure 13A.4. Total Fish Caught at Each Trawling Station for All Surveys

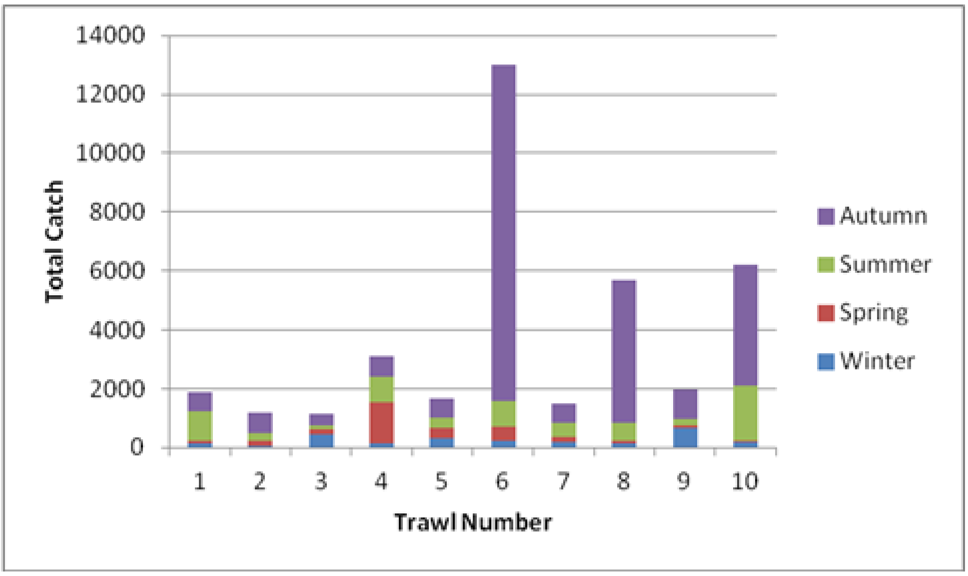
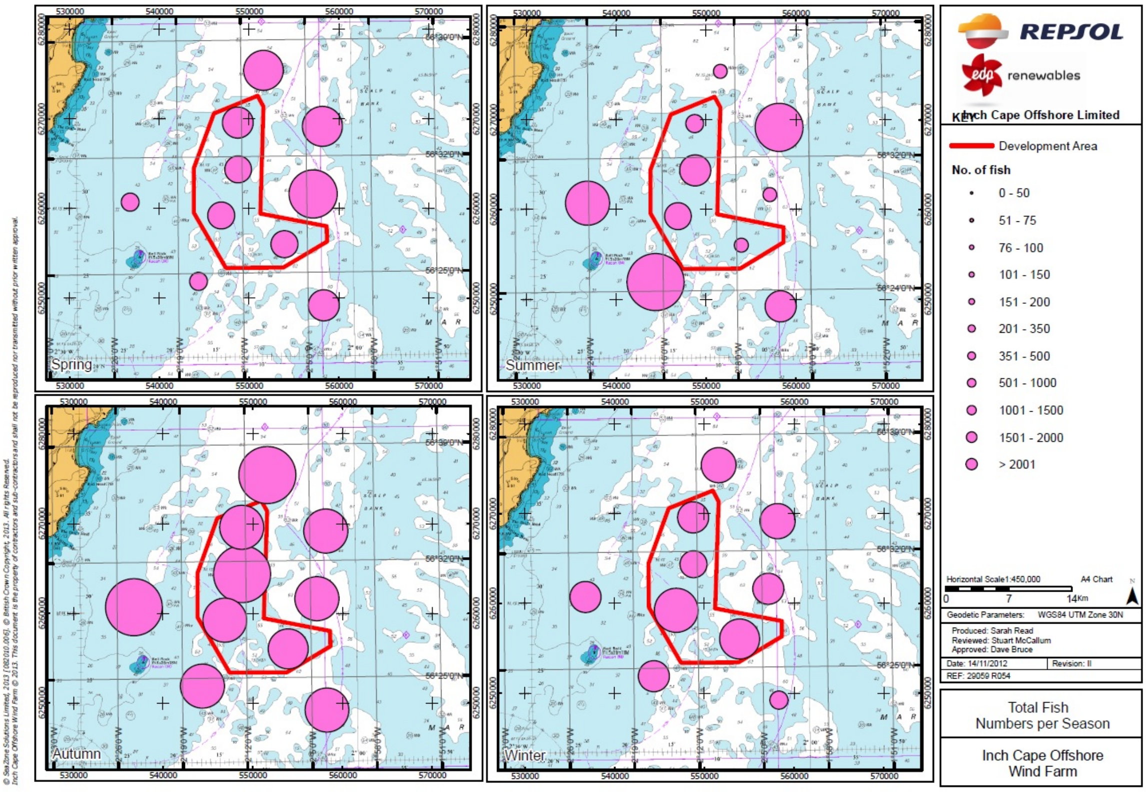
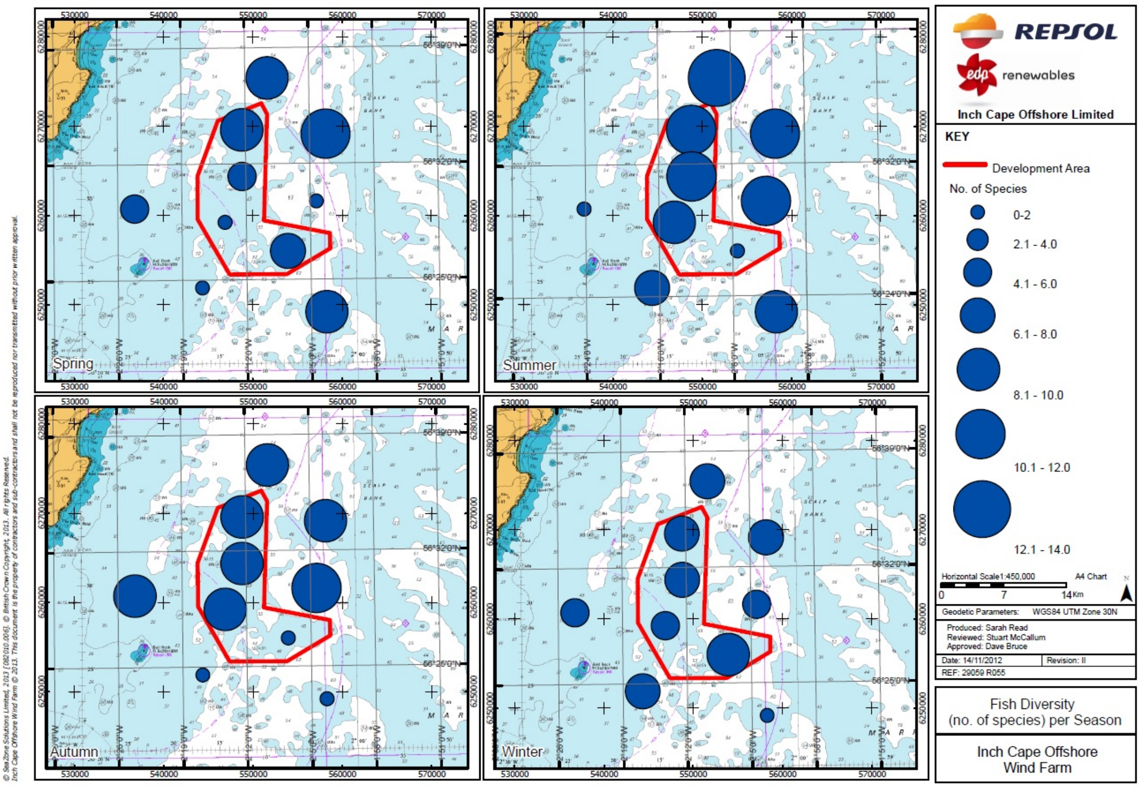


Figure 13A.5. Total Fish Numbers Per Season



Distribution patterns for flatfish such as dab (*L. limanda*) and lemon sole (*M. kitt*) showed that higher catches tended to be made in inshore areas in all four surveys, however these species were caught at most stations throughout the surveys, the exception being station 4 where no lemon sole (*M. kitt*) were caught during any of the 4 surveys. Whiting (*M. merlangus*) was absent from station 1 in the spring survey but was otherwise captured at all stations during the four surveys. Catch numbers increased in summer and autumn with the greatest increases seen at the inshore stations, and those within the Development Area. No pattern was observed in the number of species caught at each sampling station per season (Figure 13A.6).

Figure 13A.6. Fish Diversity (no. of species) Per Season



Invertebrates

The data shows that invertebrate communities in the area are sparse with the exception of the large increase in European squid (*L. forbesii*) and jellyfish during the summer and autumn survey results. The number of individuals captured was particularly low in winter and spring, with a large increase in summer due to the increases in squid (*L. forbesii*) and moon jellyfish (*A. aurita*) (Figure 13A.7). As with the fish species, no pattern was observed in the number of species caught at each sampling station per season (Figure 13A.8).

Figure 13A.7. Total Invert Numbers per Season

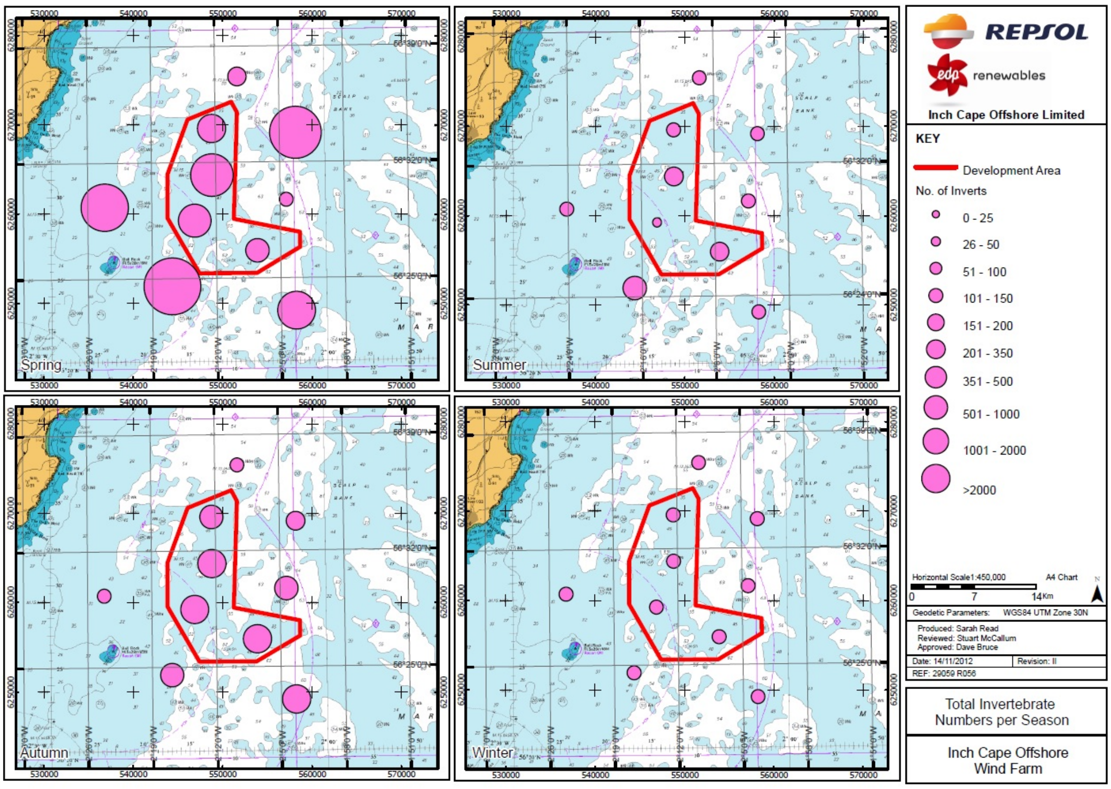
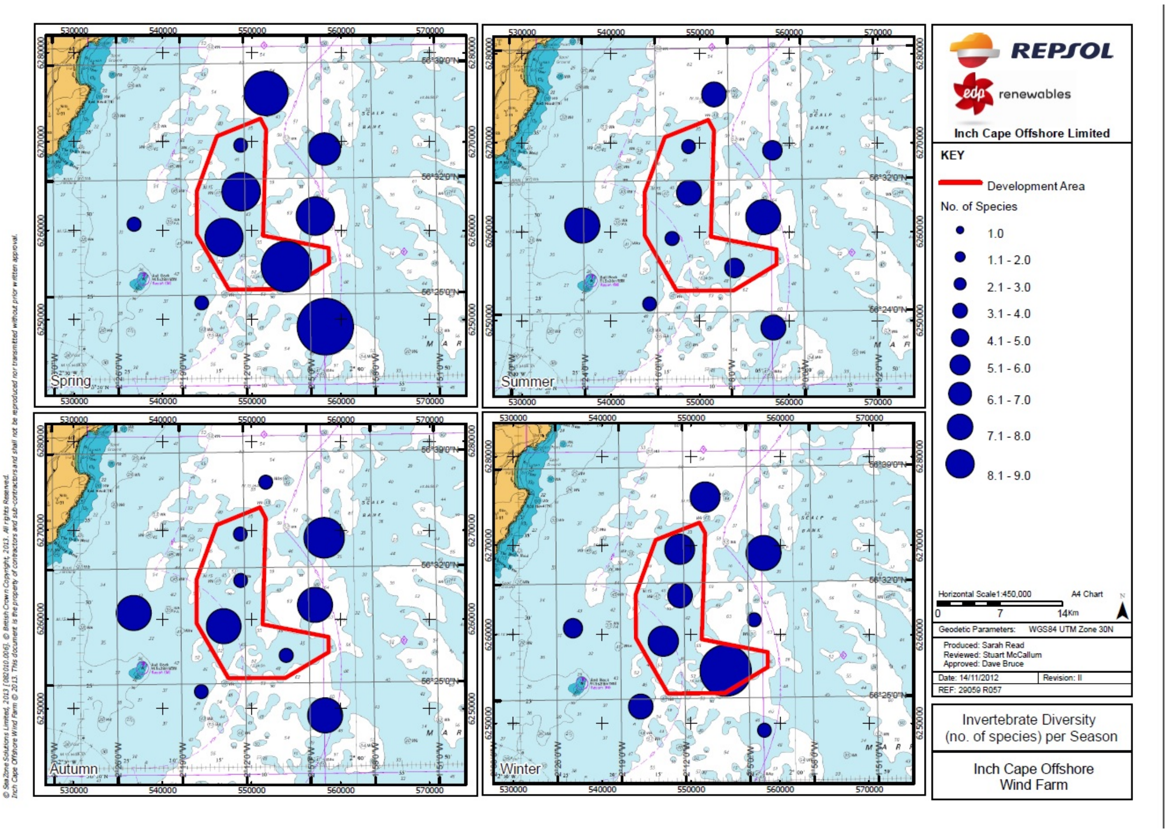


Figure 13A.8. Invert Diversity (no. of species) per Season



Seasonal Distributions

Fish

Clear seasonal differences in the total numbers of fish captured were seen (Figure 13A.9) and ANOSIM pairwise testing (Table 13A.7) shows significant differences between the numbers of individuals caught in each survey (Global R= 0.635; sig = 0.1%). Of the total catch, 65% of individuals recorded were caught during the autumn survey, 20% during the summer survey, 8% during the spring survey and 7% during the winter.

Figure 13A.9. Total Number of Individual Fish Caught per Season

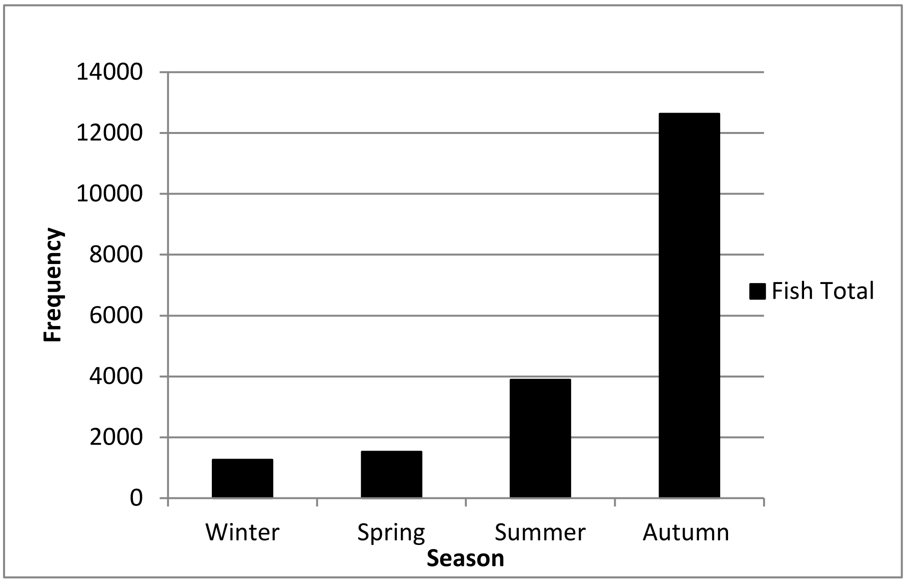
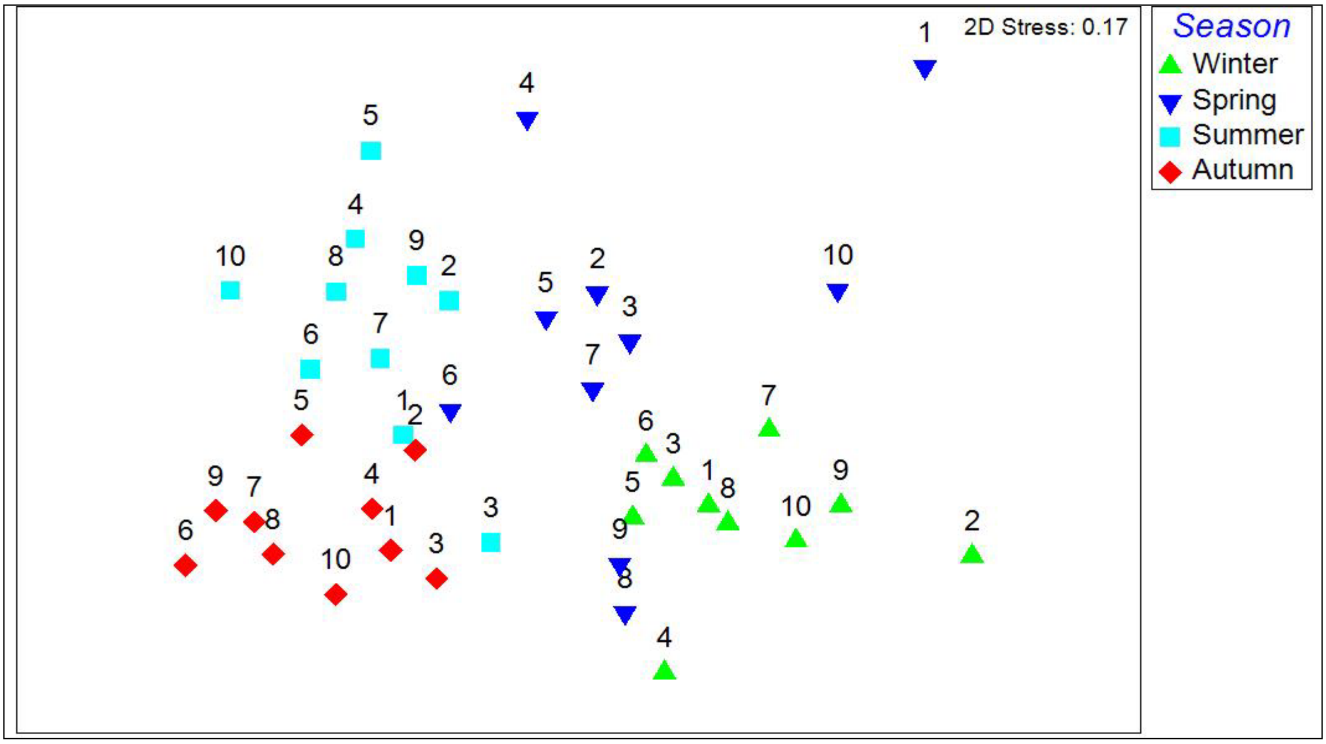


Table 13A.7 Pairwise Test Results from ANOSIM Comparing Seasonal Compositions of Fish Catch

Pairwise Test of Seasonal Variance	R Value	Significance Level
Winter, Spring	0.461	0.1
Winter, Summer	0.801	0.1
Winter, Autumn	0.728	0.1
Spring, Summer	0.418	0.1
Spring, Autumn	0.69	0.1
Summer, Autumn	0.847	0.1
Winter, Spring	0.461	0.1
Winter, Summer	0.801	0.1
Winter, Autumn	0.728	0.1

The data set did not lend itself to meaningful univariate testing due to the large differences (in some cases serveral orders of magnitude) between testing groups. Cluster analysis of the data using PRIMER shows the statistical separation between sites and seasons visually as an MDS (multi-dimensional scaling) plot (Figure 13A.10). Very distinct seasonal groupings were evident with stations sampled being closely grouped according to season rather than location. Stations from the spring survey have a less defined cluster pattern with stations 1, 4 and 10 shown as distinct from other stations. Stations 6, 8, and 9 show similarities with stations in the summer (station 6) and winter (stations 9 and 10) surveys.

Figure 13A.10. MDS Plot of Fish Catch Data



A large increase in the numbers of Norway pout (*T. esmarkii)*, haddock (*M. aeglefinus*), mackerel (*S. scombrus*) and bib (*T. luscus*) was seen during the autumn survey (Table 13A.8). Few individuals from these species were caught during the other surveys. Many species (e.g. whiting (*M. merlangius*), sprat (*S. sprattus*), and dab (L. *limanda*)) show some increase in catch numbers during the summer and autumn surveys but are present during other seasons also. Herring (*C. harengus*) catch data show that the highest numbers are present during winter and spring surveys with numbers decreasing through the summer and autumn. Numbers of sandeels (*Ammodytes tobianus*) were greatest in the summer surveys.

Table 13A.8. Species Total Catches for Each Seasonal Survey

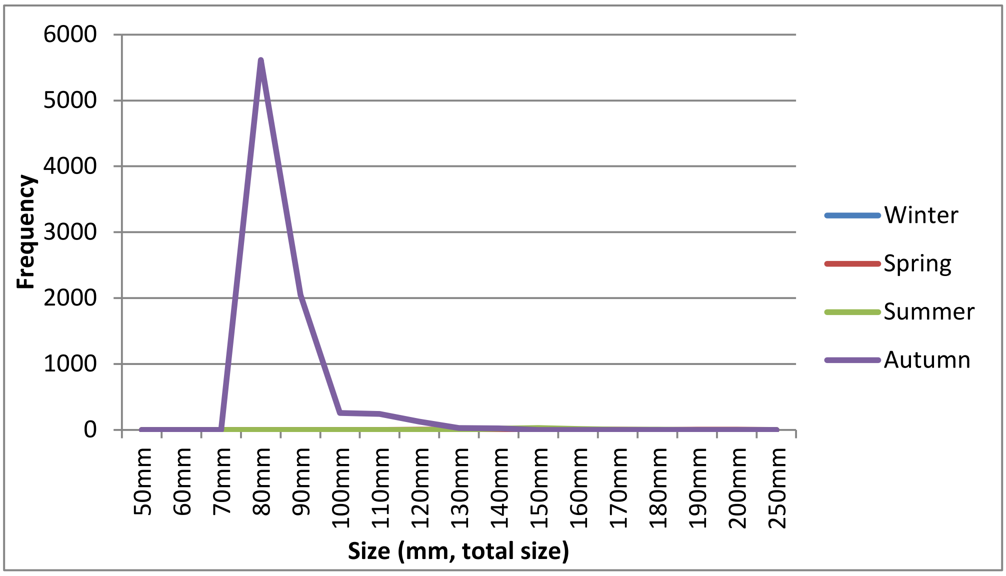
English Name	Latin Name	Winter	Spring	Summer	Autumn
Norway Pout	*Trisopterus esmarkii*	0	17	68	8329
Whiting	*Merlangius merlangus*	882	525	818	1170
Haddock	*Melanogrammus aeglefinus*	92	49	1461	1225
Bib	*Trisopterus luscus*	0	1	216	1599
Sprat	*Sprattus sprattus*	0	665	518	11
Dab	*Limanda limanda*	137	110	152	123
Sand eel	*Ammodytes tobianus*	0	16	432	1
Mackerel	*Scomber scombrus*	0	18	64	86

English Name	Latin Name	Winter	Spring	Summer	Autumn
Herring	*Clupea harengus*	77	61	5	19
Red gurnard	*Aspitriglia cuculus*	4	14	37	5
Plaice	*Pleuronectes platessa*	32	12	8	4
Long Rough Dab	*Hippoglossoides platessoides*	0	0	20	31
Lemon sole	*Microstomus kitt*	9	11	7	10
Pollack	*Pollachius pollachius*	0	0	32	0
Grey gurnard	*Eutrigla gurnardus*	0	4	25	2
Long-spined Sea Scorpion	*Taurulus bubalis*	7	0	2	9
Lesser spotted dogfish	*Scyliorhinus canicula*	0	4	10	4
Cod	*Gadus morhua*	7	2	4	2
Flounder	*Platichthys flesus*	0	3	7	0
Bull rout	*Myoxocephalus scorpius*	0	9	0	0
Saithe	*Pollachius virens*	0	0	3	4
Greater Sand eel	*Hyperoplus lanceolatus*	0	0	3	0
John Dory	*Zeus faber*	0	1	2	0
Ling	*Molva molva*	3	0	0	0
Cuckoo ray	*Raja naevus*	3	0	0	0
Pogge	*Agonus cataphractus*	0	0	0	2
Dragonet	*Callionymus lyra*	2	0	0	0
Hake	*Merluccius merluccius*	1	0	0	0
Red mullet	*Mullus surmuletus*	0	0	0	1
Scad	*Trachurus trachurus*	0	0	0	1

* commercial species only

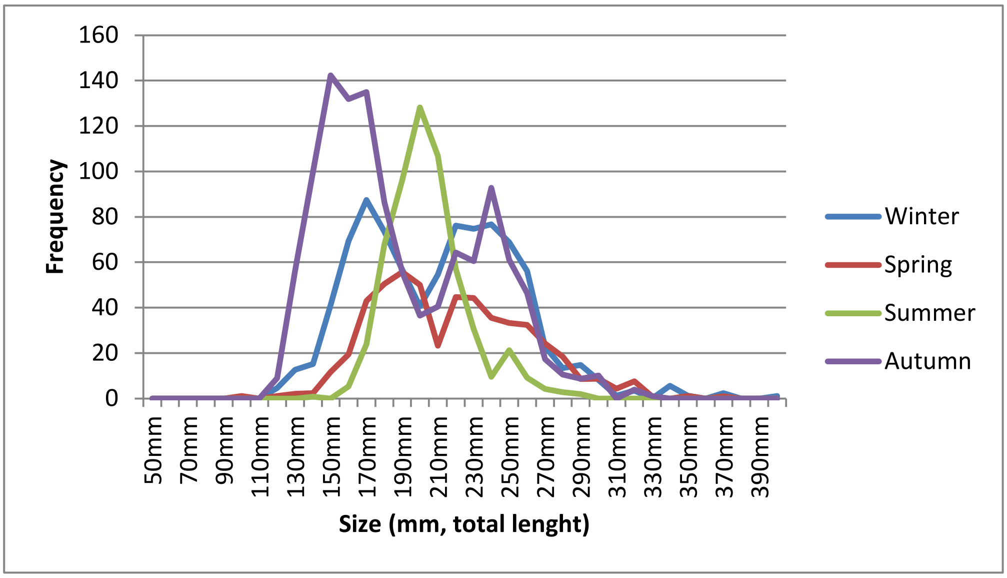
Size frequency graphs of the most abundant species show that there are differences in the average size of individuals between seasons. Norway pout (*T. esmarkii*), the most abundant species caught was most prominent in the autumn survey with very few comparative individuals caught in summer, spring and winter (Figure 13A.11).

Figure 13A.11. Seasonal Differences in Norway Pout Size Frequency



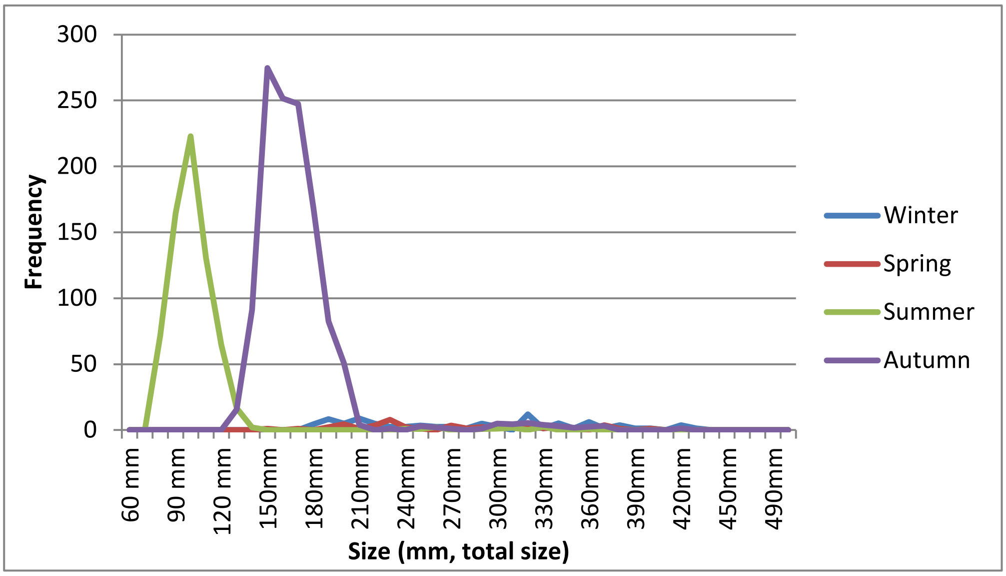
Whiting is present all year round in substantial numbers; the smallest catch recorded was 525, however greater numbers of individuals were caught in summer (818) and autumn (1170). Whiting mean size was also fairly consistent throughout the year (190-218 mm), with the mean size in autumn being the smallest (190 mm). In the winter, spring and summer survey data there was a double peak in the size frequency graph (Figure 13A.12) with peaks at the large and small ends of the size range.

Figure 13A.12. Seasonal Differences in Whiting Size Frequency



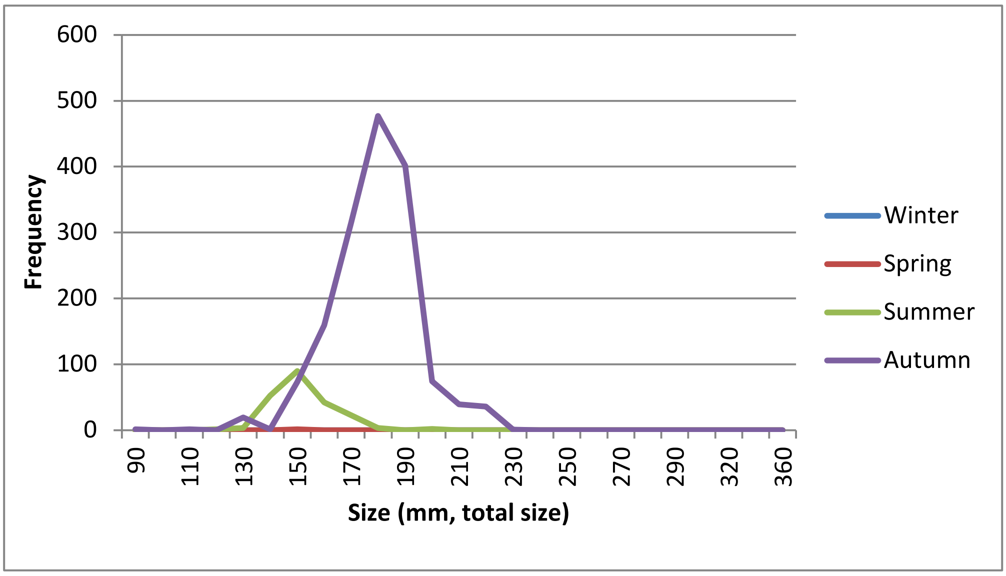
An increase in the mean size of haddock (*M. aeglefinus*) was seen throughout the summer and autumn surveys with few individuals being caught in winter and spring (Figure 13A.13). The data shows a trend of increasing mean size from summer to autumn with the mean size of individuals in the summer survey being 104 mm, increasing to 170 mm in the autumn survey. During the summer survey 98% of individuals captured were between 80 mm and 140 mm with the absolute range between 80 mm and 360 mm. In autumn 96% of haddock captured were between 130 mm and 200 mm with an absolute range of 130 mm-420 mm.

Figure 13A.13. Seasonal Differences in Haddock Size Frequency



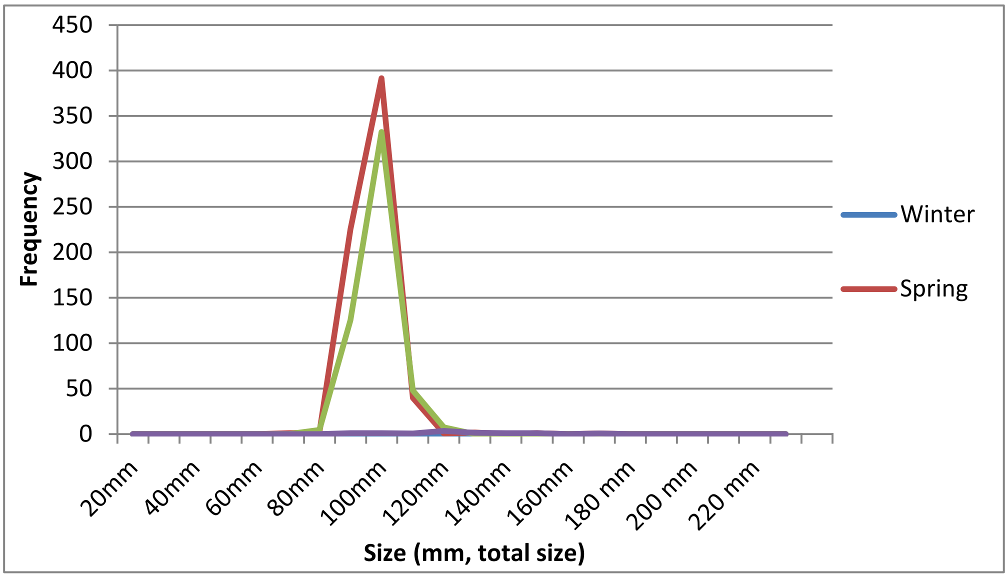
The mean size of bib (*T. luscus*) caught in the summer survey (152 mm) was smaller than that of the autumn survey (179 mm), with very few individuals caught within winter and spring (Figure 13A.14).

Figure 13A.14. Seasonal Differences in Bib Size Frequency



Over the 4 survey periods sprat (*S. sprattus*) were predominately found in spring and summer with very few individuals caught in Autumn and zero caught in winter. The mean size of sprat in spring and summer were similar with the majority (94%) ranging between 80 mm and 120 mm (Figure 13A.15).

Figure 13A.15. Seasonal Differences in Sprat Size Frequency

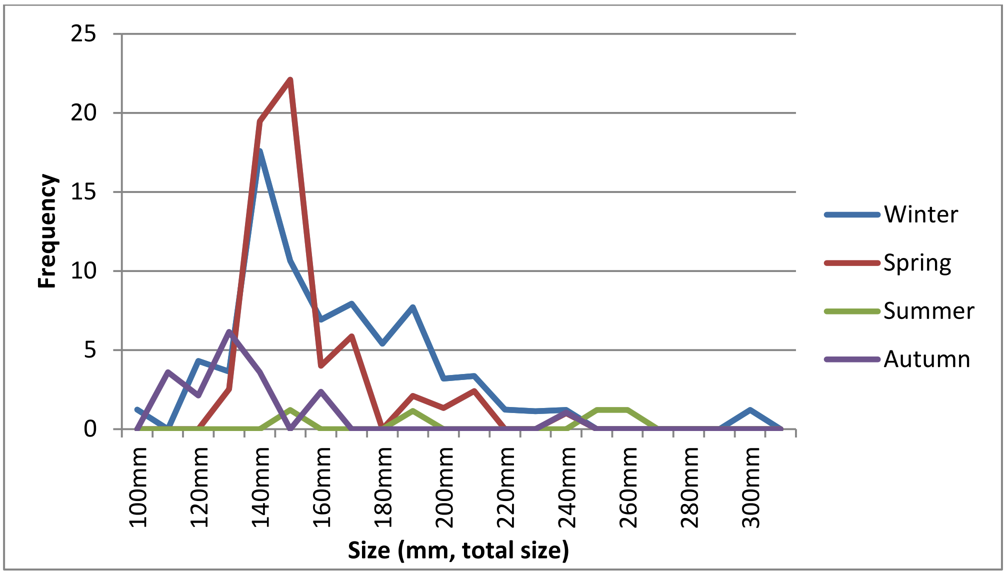


Mackerel size frequency (Figure 13A.16) shows an increase in the numbers of individuals captured in the summer and particularly the autumn survey. The mean size of mackerel in the autumn survey (334 mm) is smaller than in summer and spring surveys (341 mm for both surveys), however, there is a greater size range in autumn with fish ranging from 230 mm-380 mm.

Figure 13A.16. Seasonal Differences in Mackerel Size Frequency

In contrast to other species the number of herring (*C. harengus*) captured (Figure 13A.17) was highest in the winter survey, decreasing through the summer. The size range is varied and the mean size is similar in winter and spring surveys (166 mm and 161 mm respectively), in the autumn surveys the catch size was lower and the mean size of fish was smaller (144 mm).

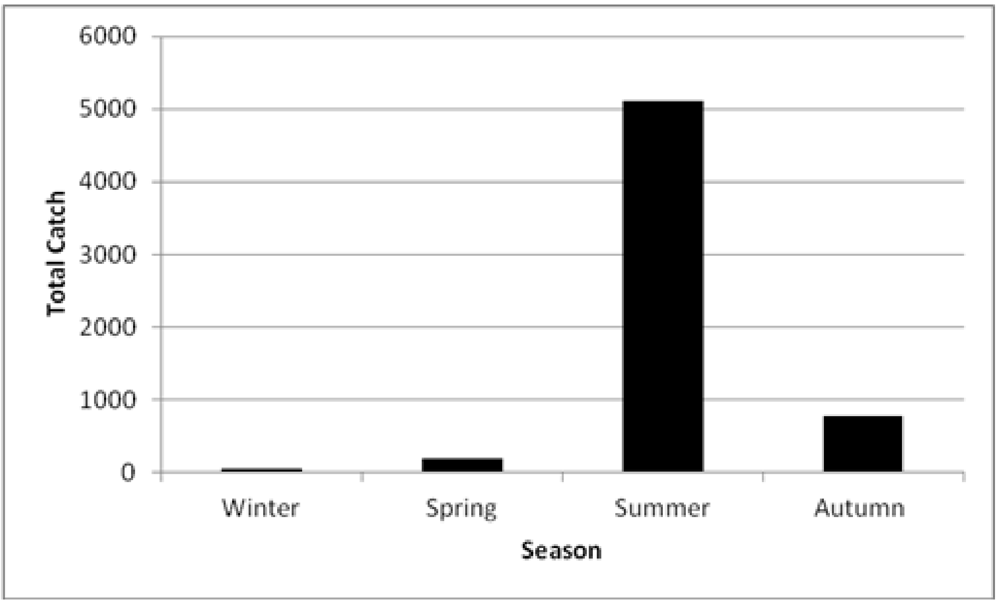
Figure 13A.17. Seasonal Differences in Herring Size Frequency and Abundance



Invertebrates

The large increases in invertebrate numbers seen in the summer surveys were from pelagic invertebrates and major seasonal patterns in the data are shown by a large increase of European squid (*L. forbesii*) and jellyfish (*A. aurita* and *C. capitella*) during the summer survey. Pink shrimp (*P. montagui*) were more abundant in the autumn survey with 94% of all individuals recorded being captured during this survey. All other species recorded had low numbers with no clear seasonal trends being apparent. Low numbers of commercial shellfish species were recorded throughout all surveys, however, 79% of the common lobsters caught were above the MLS (Table 13A.6). Of the total catch, 84% of individuals recorded were caught during the summer survey, 13% during the autumn survey, 3% during the spring survey and 1% during the winter (Figure 13A.18).

Figure 13A.18. Total Number of Individual Invertebrates Caught per Season



As with fish, the invertebrate data did not lend itself to univariate analysis due to very high variance between groups. Multivariate analysis shows similar seasonal results to the fish data with close seasonal similarities between stations (Figure 13A.19). Stations 6 and 9 from the spring survey show a greater degree of dissimilarity from the other spring stations but in general the spring data shows clear clustering. ANOSIM pairwise testing shows that there is significant dissimilarities between seasonal results (Global R = 0.615, sig.= 01) , the greatest dissimilarity between surveys was between summer and autumn surveys with an R value of 0.847 (Table 13A.9).

Figure 13A.19. MDS plot of Invertebrate Catch Data

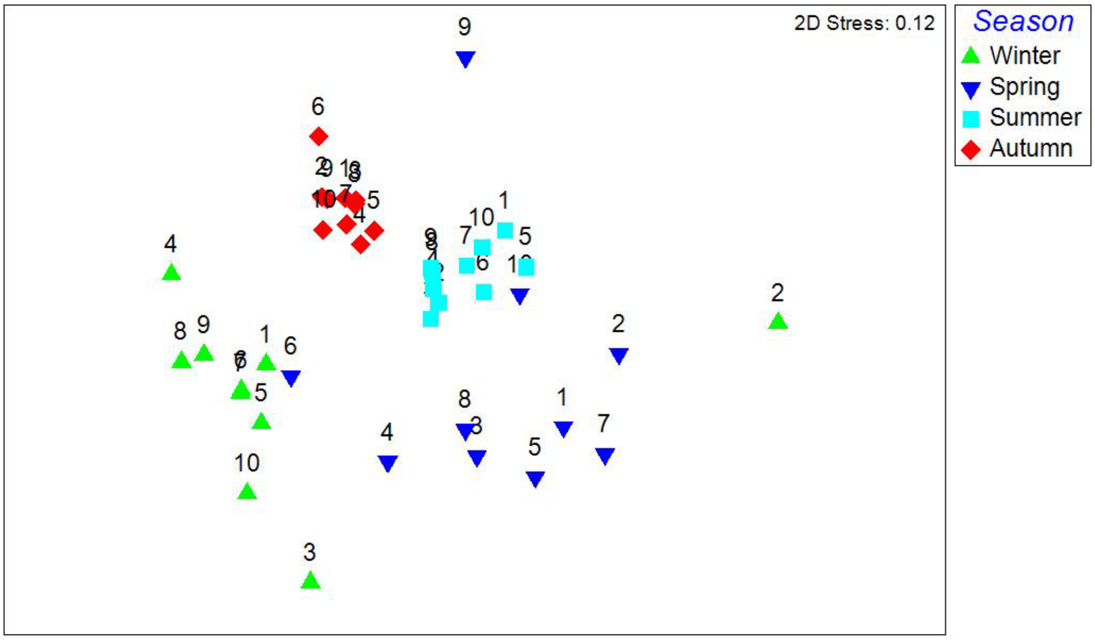


Table 13A.9. Pairwise Test Results from ANOSIM Comparing Seasonal Compositions of Invertebrates

Pairwise Test of Seasonal Variance	R Value	Significance Level
Winter, Spring	0.461	0.1
Winter, Summer	0.801	0.1
Winter, Autumn	0.728	0.1
Spring, Summer	0.418	0.1
Spring, Autumn	0.69	0.1
Summer, Autumn	0.847	0.1
Winter, Spring	0.461	0.1
Winter, Summer	0.801	0.1
Winter, Autumn	0.728	0.1

13A.4. Discussion

During the four trawl surveys of the Development Area a total of 30 fish species and 20 macro-invertebrate species were captured with 19,309 and 6127 individuals recorded respectively.

The catch data collected from the surveys was generally sparse for both fish and invertebrate with catch figures being heavily influenced by large numbers of Norway pout (*T. esmarkii*), bib (*T. luscus*), haddock (*M. aeglefinus*), European squid (*L. forbesii*) and moon jellyfish (*A. aurita*) during the summer and autumn surveys.

In total, 19 fish species and five invertebrate species of commercial importance were recorded. Marketable sized fish, i.e., those over their MLS or MMS, were recorded from ten species of fish and three species of invertebrate, however marketable sized fish only represented 2.75% of the total fish catch and 0.5% of invertebrate catch. It should be noted that some species, such as gurnard (Triglidae) and European squid (*L. forbesii*), are commercial species although they do not have an associated MLS/MMS. As previously stated otter trawling gear is not optimal for pelagic species such as herring (*C. harengus*) and for specific bottom dwelling molluscs i.e. scallops (*A. opercularis*). As a result the numbers of these species found in these surveys is less than would have been expected if optimum fishing methods for these species (i.e. pelagic nets and scallops dredges) had been employed.

Commercially important species of white fish were found during the survey; haddock (*M. aeglefinus*), whiting (*M. merlangus*), cod (*G. morhua*), pollock (*Pollachius pollachius*), hake (*M. merluccius*), ling (*M. molva*) and saithe (*P. virens*) were all recorded during the surveys, however, the proportion of individuals over the MLS was generally low (e.g. 2% for haddock (*M. aeglefinus*), 6% for whiting (*M. merlangus*) or based on very few individuals (e.g. cod (*G. morhua*), hake (*M. merluccius*), and saithe (*Pollachius virens*). Dab (*L. limanda*), plaice (*P. platessa*), flounder (*Platichthys flesus*) and lemon sole (*M. kitt*) were also found during the survey, 18% of dab (*L. limanda*), 29% of plaice (*P. platessa*) and 42% of lemon sole (*M. kitt*) were over the MMS, and there is no MLS/MMS for flounder (*P. flesus*).Herring (*C. harengus*) and mackerel (*S. scombrus*) make up the pelagic species of commercial importance found during the four surveys, herring is not noted as being landed from the area, however, mackerel is landed and is the most valuable fishery in the area. The proportion of herring over the MLS was 50% but only 168 individuals were caught, while otter trawling is not the optimum gear for the capture this pelagic species, these results are indicative of the size range of these species in the area at different times of year.

13A.4.1 Geographic Patterns

Fish

There was no clear evidence suggesting that individual fish species have distinct geographical preferences in the Development Area. Abundance changed seasonally, but did not tend to conform to a regular pattern between stations. Haddock (*M. aeglefinus*) seemed to show a loose affinity for the more offshore stations during the winter/spring, whilst during the summer and autumn surveys catches of haddock (*M. aeglefinus*) were much higher at stations further inshore. However, this is a loose trend as some haddock (*M. aeglefinus*) were caught at all stations throughout the year.

On the whole there seems to be a loose correlation between station depth and abundance, with the inshore stations showing the greatest increase in catch during the warmer months, which is fairly typical of coastal zonation patterns. At the Development Area this is likely to be confused by the presence of a sand back on the eastern boundary and the non-uniform nature of depth across the Area. The Development Area has a relatively large depth range (between 35-63m) with much of the site being 40-57 m, however, the depth increase is not uniform across the site i.e. it does not get deeper uniformly moving away from the coast.

The lack of a clear pattern in the distribution in fish presence across the Development Area suggests that the site is largely homogeneous in terms of biological distribution. Inshore and shallower stations tended to yield larger and more diverse catches, particularly in summer, but species presence was not restricted to these inshore sites. Size of a given individual caught did not appear to be affected by geographical distribution, suggesting that age cohorts within the Development Area are not separated. Results also reflect the fact that the completed surveys only represent a small snapshot of fish ecology in the area and are unlikely to identify clear patterns in distribution.

Invertebrates

The number of macro-invertebrates, excluding European squid (*L. forbesii*) and moon jelly fish (*A. aurita*), was low throughout the four surveys. The overwhelming contribution to the total catch was made by European squid (*L. forbesii*) and moon jellyfish (*A. aurita*) during the summer and autumn survey. The lack of macro-fauna is surprising as previous benthic surveys in the area have suggested a relatively rich infaunal benthic community (*Appendix 12A – Benthic Ecology Baseline Development Area*); however a sparse macro-faunal community is fairly common in areas with strong hydrological currents and sandy/coarse substrate.

13A.4.2 Seasonal Patterns

Fish

There are clear seasonal patterns affecting the abundance and distribution of some species on the Development Area. An increase in the abundance of Norway pout (*T. esmarkii*), bib (*T. luscus*), and haddock (*M. aeglefinus*) in summer and autumn surveys is clear. Norway pout (*T. esmarkii*) and bib (*T. luscus*) were largely absent during the winter and spring surveys but present in relatively large numbers in summer and autumn. This is also true for haddock (*M. aeglefinus*) and whiting (*M. merlangus*), which although at most stations were present throughout all surveys, their abundance notably increased in the summer and autumn surveys.

Seasonal changes in the mean size of bib (*T. luscus*) and haddock (*M. aeglefinus*) show a trend of increasing size throughout the summer and autumn. Most individuals captured throughout all surveys were juveniles and this is apparent by the low percentages of fish over the MLS. Seasonal increases in certain species are likely to be attributable to either nearby spawning grounds for those species or juvenile migration into the area.

In contrast, herring numbers were highest in winter and spring, dropping off in summer; this suggests that herring move away from the Development Area during the summer months. In the winter and spring months, when herring were more abundant (an increase of around 60 individuals), the average size was also greater.

Invertebrates

As with the fish catch data, there are clear seasonal differences in abundance for some invertebrate species. European squid (*L. forbesii*) and moon jellyfish (*A. aurita*) increase substantially in summer, reflecting a likely increase in biomass by spring/summer phytoplankton blooms and the associated increase in food availability. Station 1 and 10, both located outwith the Development Area, were the most abundant stations for European squid.

13A.4.3 Spawning/Nursery Grounds

Several Cefas data sources have been used to determine the usage of the Development Area and Offshore Export Cable Corridor in terms of Spawning or Nursery Grounds (e.g. Coull *et al.*, 1998; Ellis *et al.*, 2010; *Annex 13A.1*) It is predicted that spawning areas exist for cod (*G. morhua*), plaice (*P. platessa*), whiting (*M. merlangus*), lemon sole (*M. kitt*) , sandeels (*A. tobianus* & *Hyperoplus lanceolatus*) and Norwegian lobster (*N. norvegicus*), with nursery areas for plaice (*P. platessa*), cod (*G. morhua*), whiting (*M. merlangus*), blue whiting (*Micromesistius poutassou*), hake (*Merluccius merluccius*), herring (*C. harengus*), sprat (*S. sprattus*) , lemon sole (*M.kitt*), haddock (*M. aeglefinus*), ling (*M. molva*), mackerel (*S. scombrus*), saithe (*P. virens*), monkfish (*Lophius piscatorius*), spurdog (*Squalus acanthius*), tope (*Galeorhinus galeus*) and Norwegian lobster (*N. norvegicus*) within the Development Area and Offshore Export Cable Corridor.

Juveniles of all fish species except blue whiting (*M. poutassou*) monkfish (*L. piscatorius*), spurdog (*S. acanthius*) and tope (*G. galeus*) were recorded during the baseline surveys, and only a single Norwegian lobster was captured indicating that the Development Area and surrounding area are not an important area for Norwegian lobster. The vast majority of individuals caught from all species were smaller than their described length of maturity, and the proportion of commercial fish over their MLS was low for all species except mackerel. This suggests that this area is used primarily by juveniles as nursery grounds. However, the numbers of individuals caught was generally low except for bib (*T. luscus*), haddock (*M. aeglefinus*), whiting (*M. merlangus*) and Norway pout (*T. esmarkii*). Ellis *et al.* (2010) does not describe the Development Area as spawning or nursery grounds for Norway pout (*T. esmarkii*) or bib (*T. luscus*), but does suggest that it is a nursery area for haddock (*M. aeglefinus*), and a spawning and nursery area for whiting (*M. merlangus*). The data from the baseline survey would appear to confirm the Cefas data, suggesting a nursery or spawning ground for haddock (*M. aeglefinus*) and whiting (*M. merlangus*), although would also suggest that this area is also used by juvenile bib (*T. luscus*) and Norway pout (*T. esmarkii*).

As discussed above, juvenile herring were found in all survey seasons, with 98% of all herring caught occurring in a size category suggesting ages below 2 years. Given that around 20% reach maturity below 2 years (although no notes of the reproductive status of herring were made during the survey), and that the greatest abundance of herring did not occur in autumn (when herring are reported to spawn on the east coast of Scotland), the fish surveys do not provide evidence that herring are using the Development Area to spawn. Further, spawning areas identified by Coull *et al.* (1998), are not located within the Development Area boundary (Herring spawning areas identified to be 5km to the north) and the benthic survey shows that the area within the Development Area boundary is predominantly fine and medium sand, with few areas dominated by the course sand and gravel which is suitable for herring spawning. This combined evidence does not suggest significant herring spawning activity in the direct vicinity of the Development Area.

Sandeels (*A. tobianus*) were also captured during the summer survey. The implications of this are not discussed further within this report as a separate sandeel study can be found in *Appendix 13B Sandeel Habitat Mapping* and is summarised in *Chapter 13 Section 13.4*. This includes catch data alongside a review of the suitable habitat present in the area.

Migratory Species

No migratory species were recorded in any of the seasonal surveys undertaken as part of the baseline assessment, however these species are rarely captured in trawl surveys, therefore this does not indicate that they do not migrate through the site.

13A.4.4 Elasmobranchs

The *Electromagnetic Field Assessment (Appendix 13C)* identified four species of elasmobranch as present in the Development Area, spurdog (*S. acanthias*), small lesser spotted dogfish (*Scyliorhinus canicula*), thornback ray (*Raja clavata*) and cuckoo ray (*Raja naevus*). During the baseline fish surveys, only the lesser spotted dogfish and cuckoo ray were captured. In total eighteen lesser spotted dogfish were captured, ten of which were during the summer survey, along with three cuckoo rays.

13A.5. Conclusion

The results from the Natural Fish and Shellfish surveys suggests that the proposed Development Area holds generally low numbers of both fish and invertebrate species with few species dominating catch in the summer months. Numbers of Norway pout (*T. esmarkii*), haddock (*M. aeglefinus*), bib (*T. luscus*) and whiting (*M. merlangus*) were relatively high in comparison to the other species of fish, with whiting (*M. merlangus*) being the only species found in substantial numbers all year round.

A large increase in European squid (*L. forbesii*) and moon jellyfish (*A. aurita*) numbers dominated invertebrate catch records with most other species (except jellyfish) generally being present in small numbers throughout the year.

Commercial species caught during the survey were mostly undersized juveniles with a small proportion of the catch being commercially marketable. Whiting and haddock were the commercial fish species caught in the greatest numbers with European squid (*L. forbesii*) and common lobster (*H. gammarus*) being the most abundant commercial invertebrate species.

Very few elasmobranch species were caught during the survey with only the lesser spotted dogfish (*Scyliorhinus canicula*) and cuckoo ray (*Raja naevus*) captured, both in low numbers. No species of migrating fish were captured during the baseline surveys, as would be expected as trawling rarely captures migratory fish offshore.

The results of these surveys are discussed in relation to other data sources (from fisheries statistics, long term trawl surveys and academic research) within *Chapter 13 Section 13.4*.

13A.6. References

Boyd, S.E., Coggan, R.A.,. Birchenough, S.N.R., Limpenny, D.S., Eastwood, P.E., Foster-Smith, R.L., Philpott , S., Meadows, W.J., James, J.W.C., Vanstaen, K., Soussi S., and Rogers, S., 2006. The role of seabed mapping techniques in environmental monitoring and management. Sci. Ser. Tech Rep., Cefas Lowestoft, 127: 170pp

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

Ellis, J. R., Milligan, S., Readdy, L., South, A., Taylor N., Brown, M., 2010. Project Title: Mapping spawning and nursery areas of species to be considered in Marine Protected Areas (Marine Conservation Zones). Available at: <http://randd.defra.gov.uk/Document.aspx?Document=MB5301_9578_FRP.pdf> [Accessed 04/01/2012]

Annex 13A.1 Key Marine Fish, Spawning and Nursery Grounds

Figure 13A.1.1: Spawning Grounds of Pelagic Species (Excluding Herring)

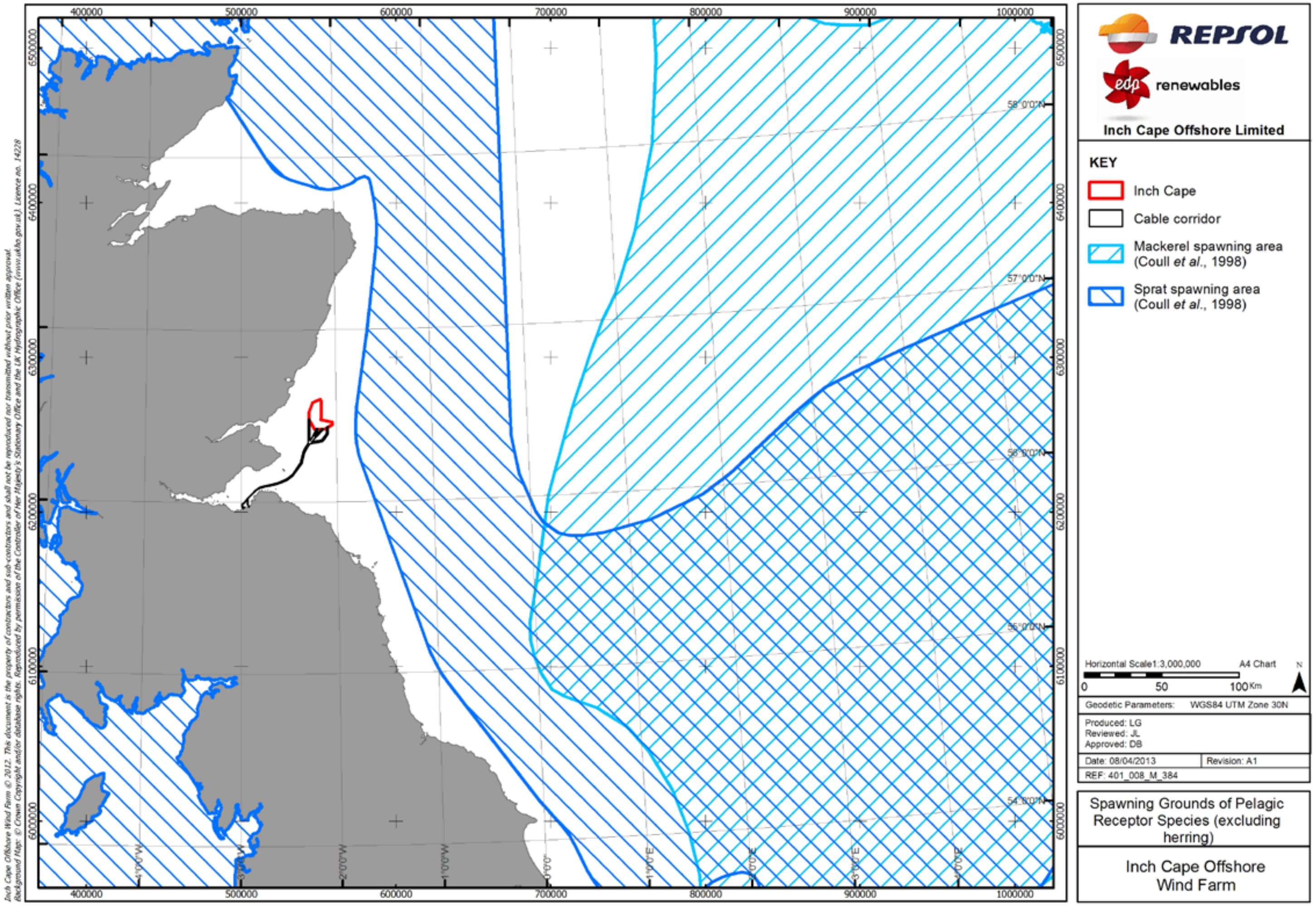


Figure 13A.1.2: Nursery Grounds of Pelagic Species (Excluding Herring)

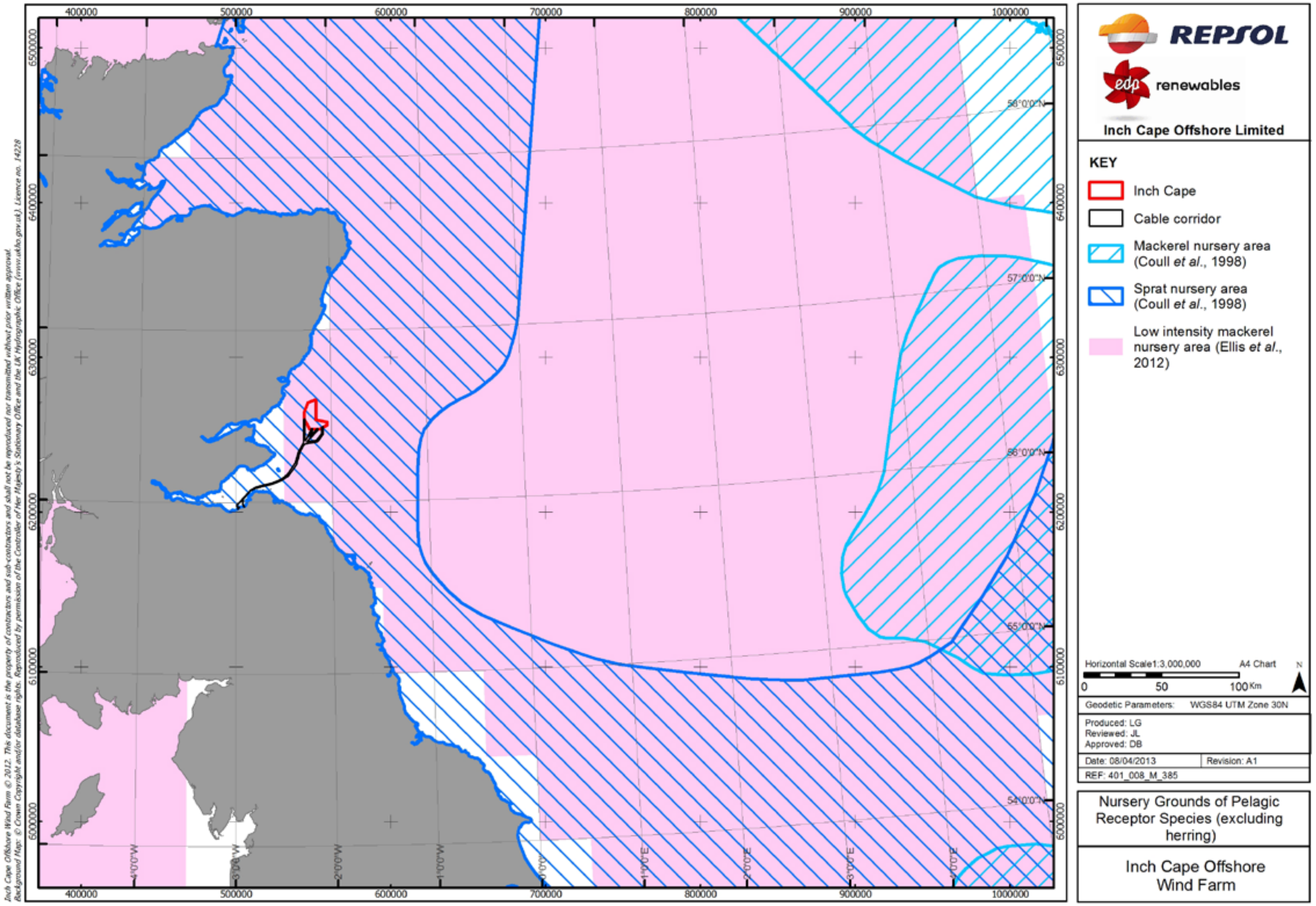


Figure 13A.1.3: Spawning Grounds of Herring

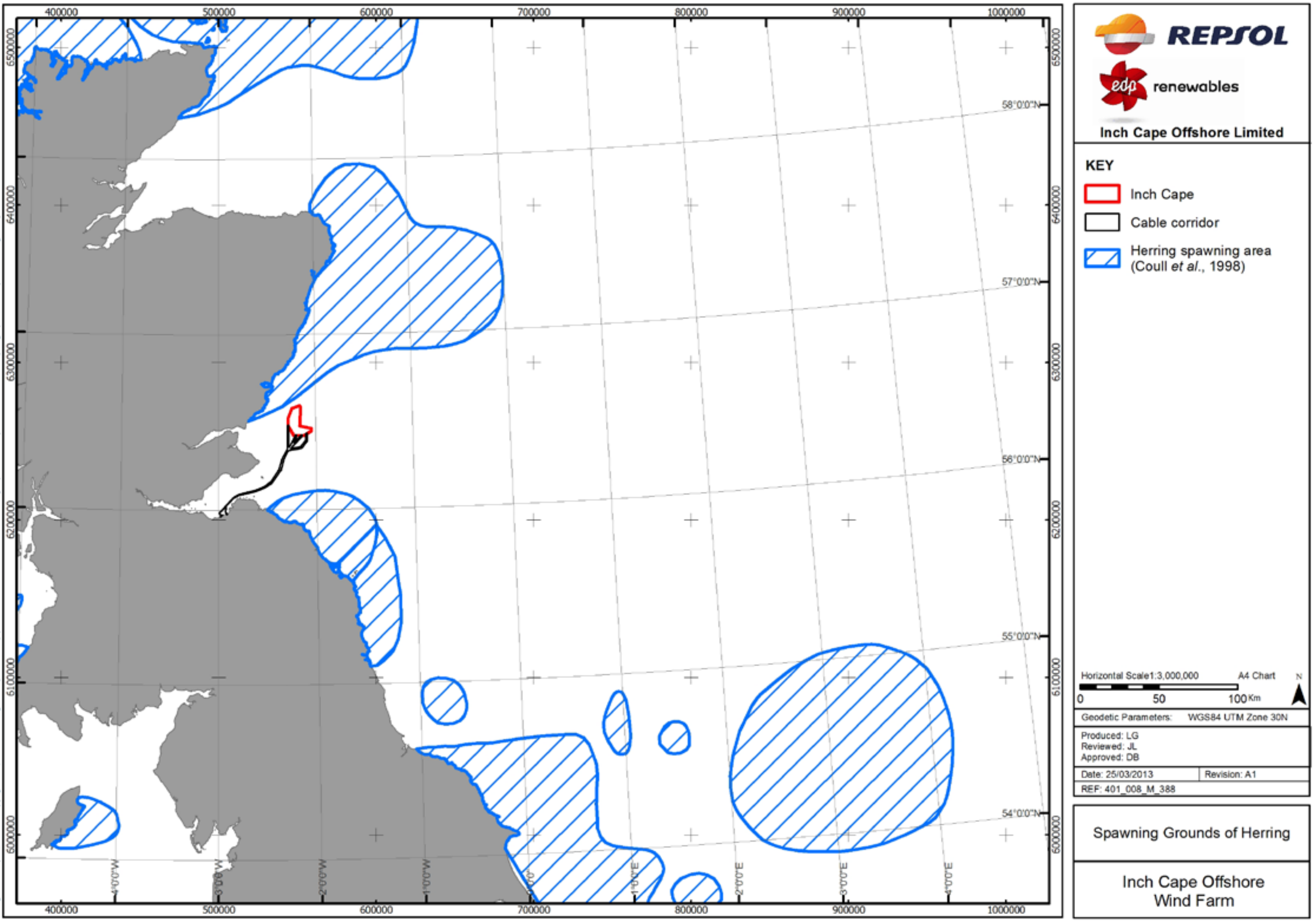


Figure 13A.1.4: Nursery Grounds of Herring

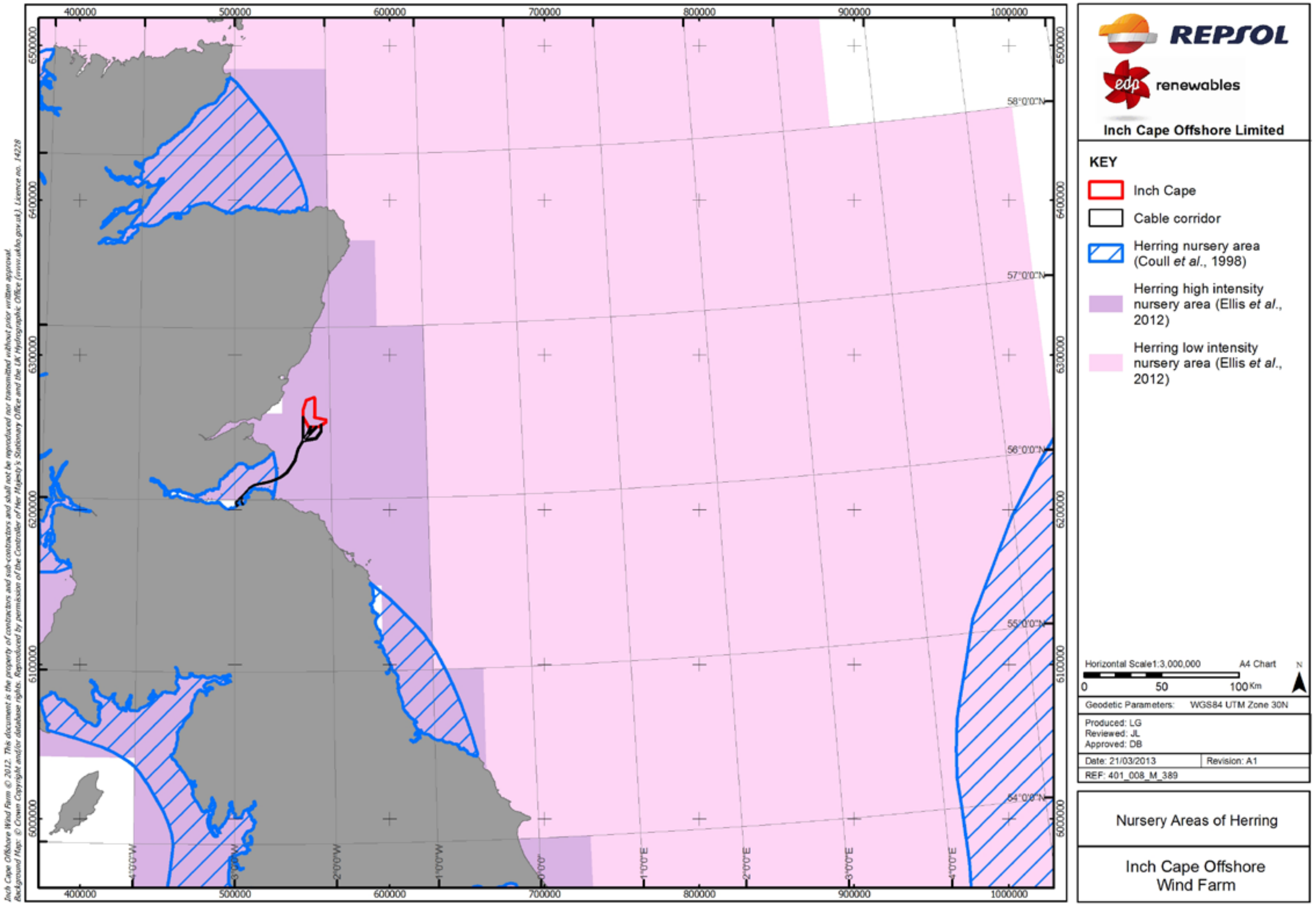


Figure 13A.1.5: Spawning Grounds for Demersal Flatfish

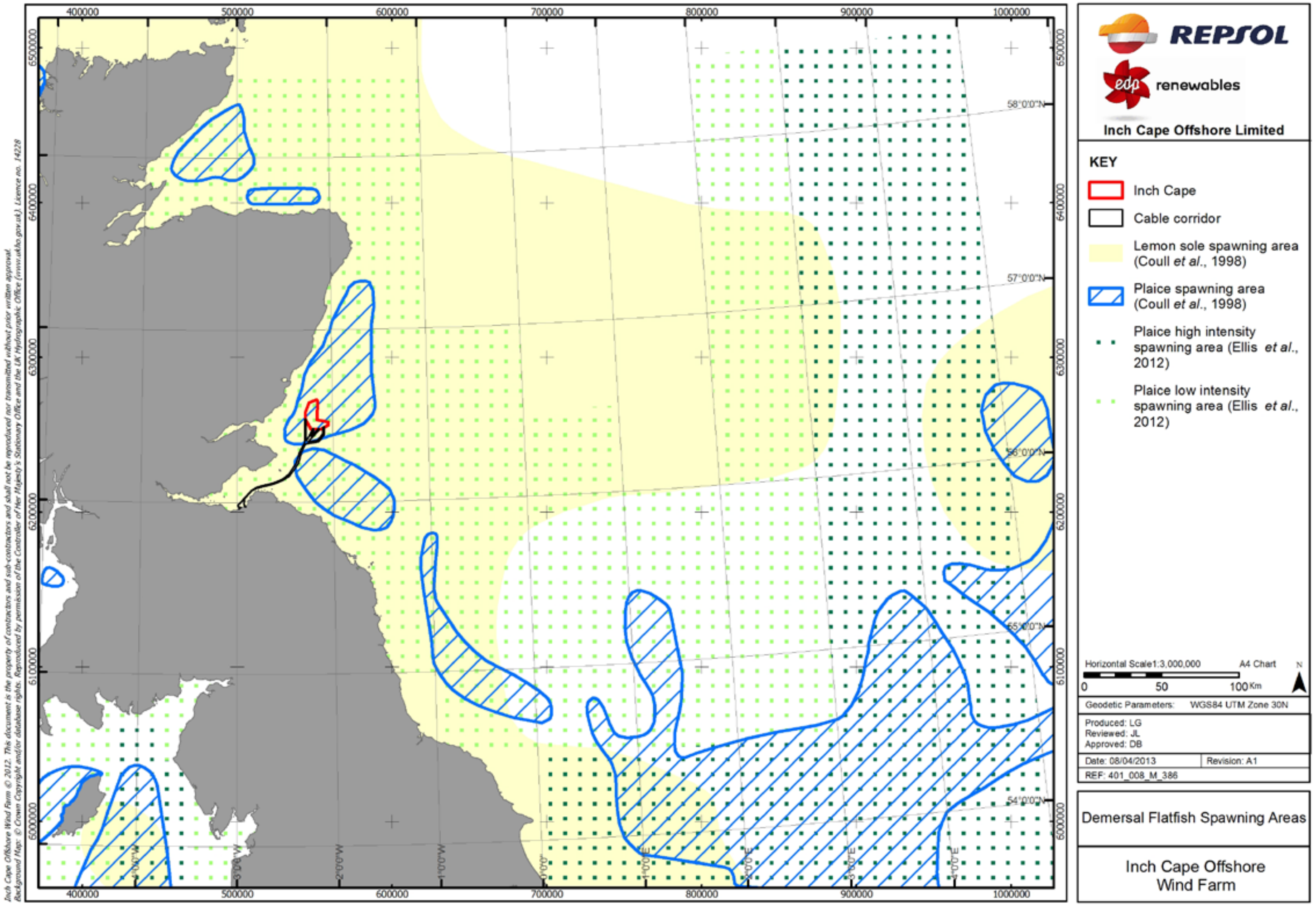


Figure 13A.1.6: Nursery Areas for Demersal Flatfish

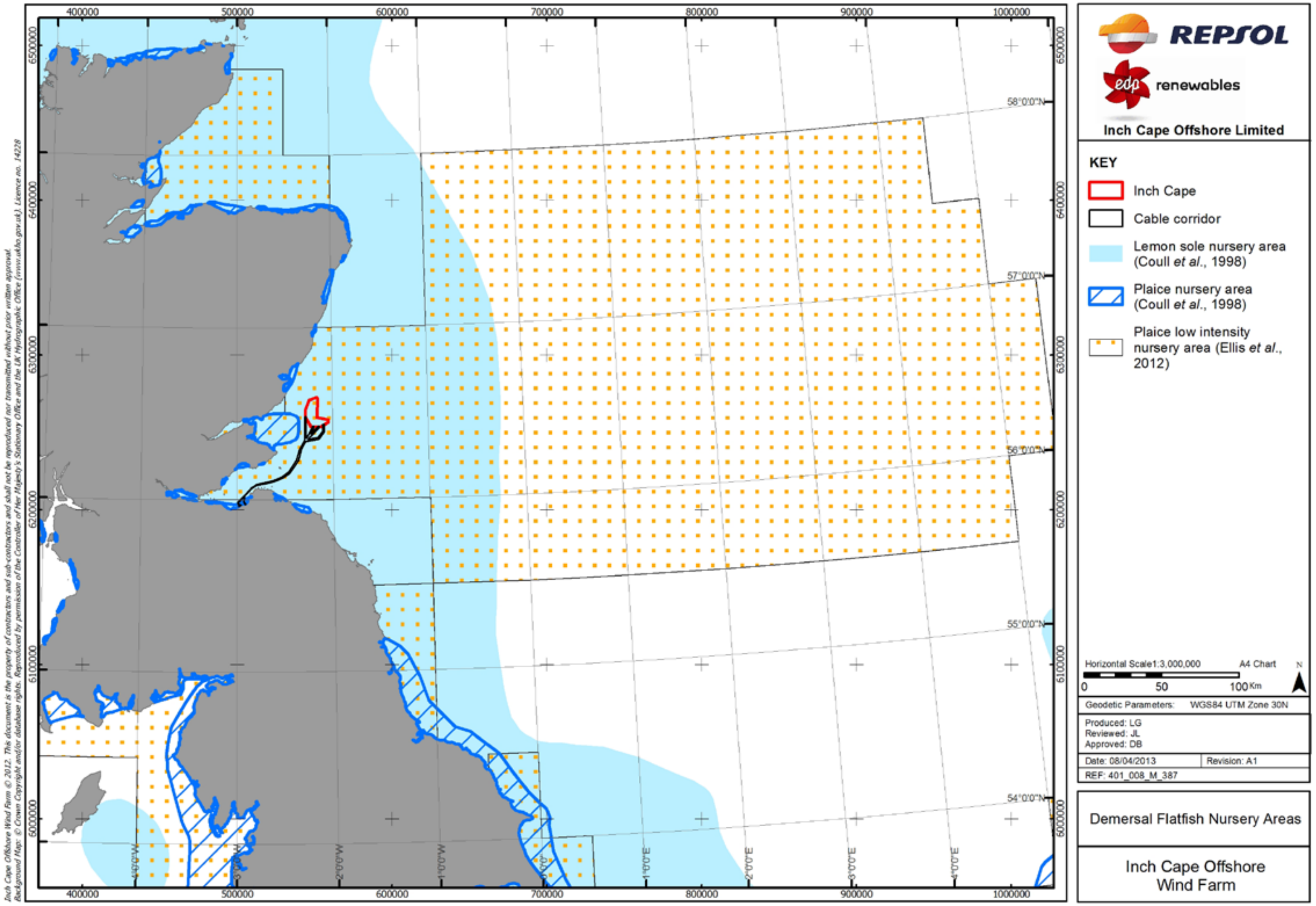


Figure 13A.1.7: Spawning Grounds for Demersal Round Fish

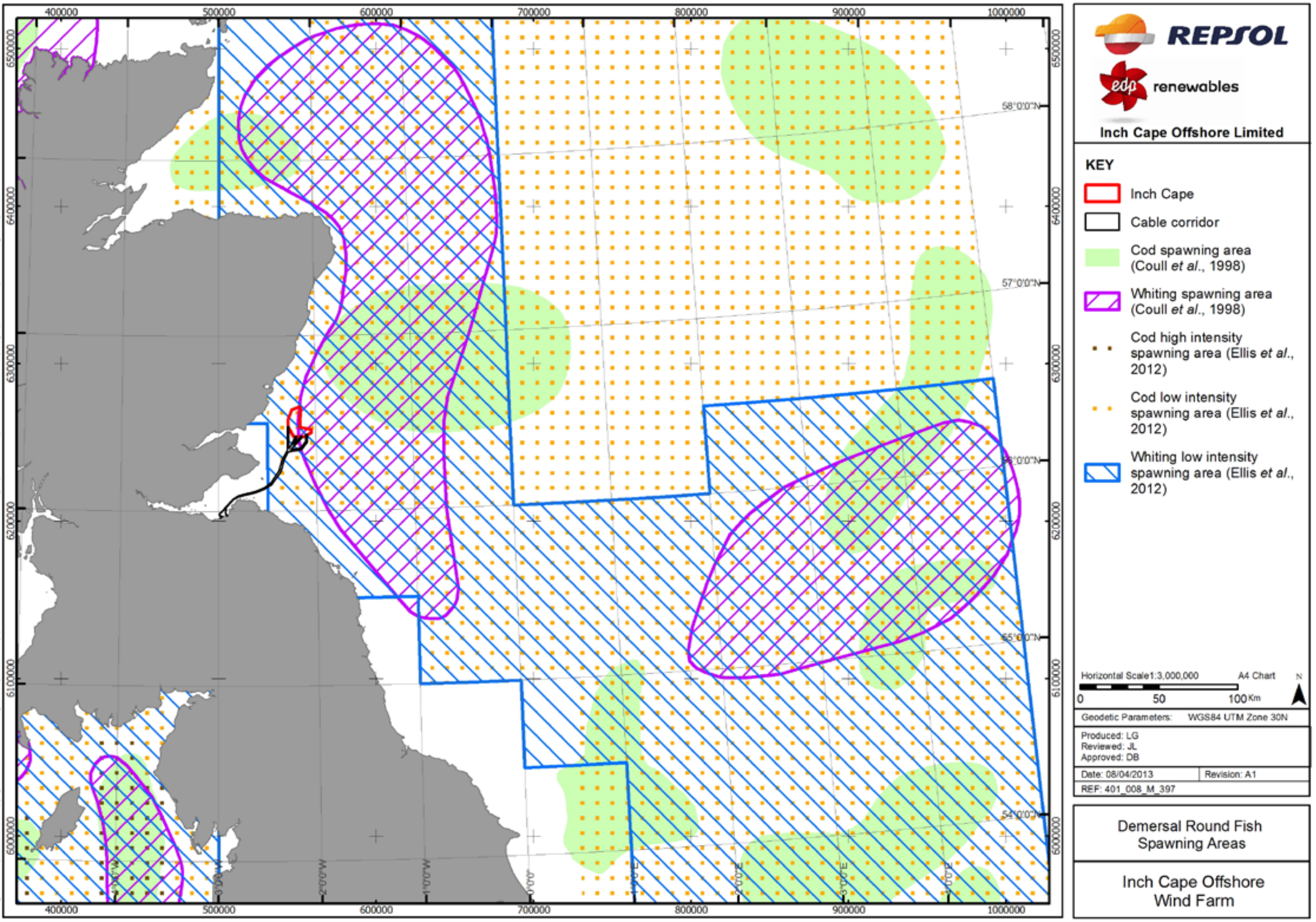


Figure 13A.1.8: Nursery Areas for Demersal Round Fish

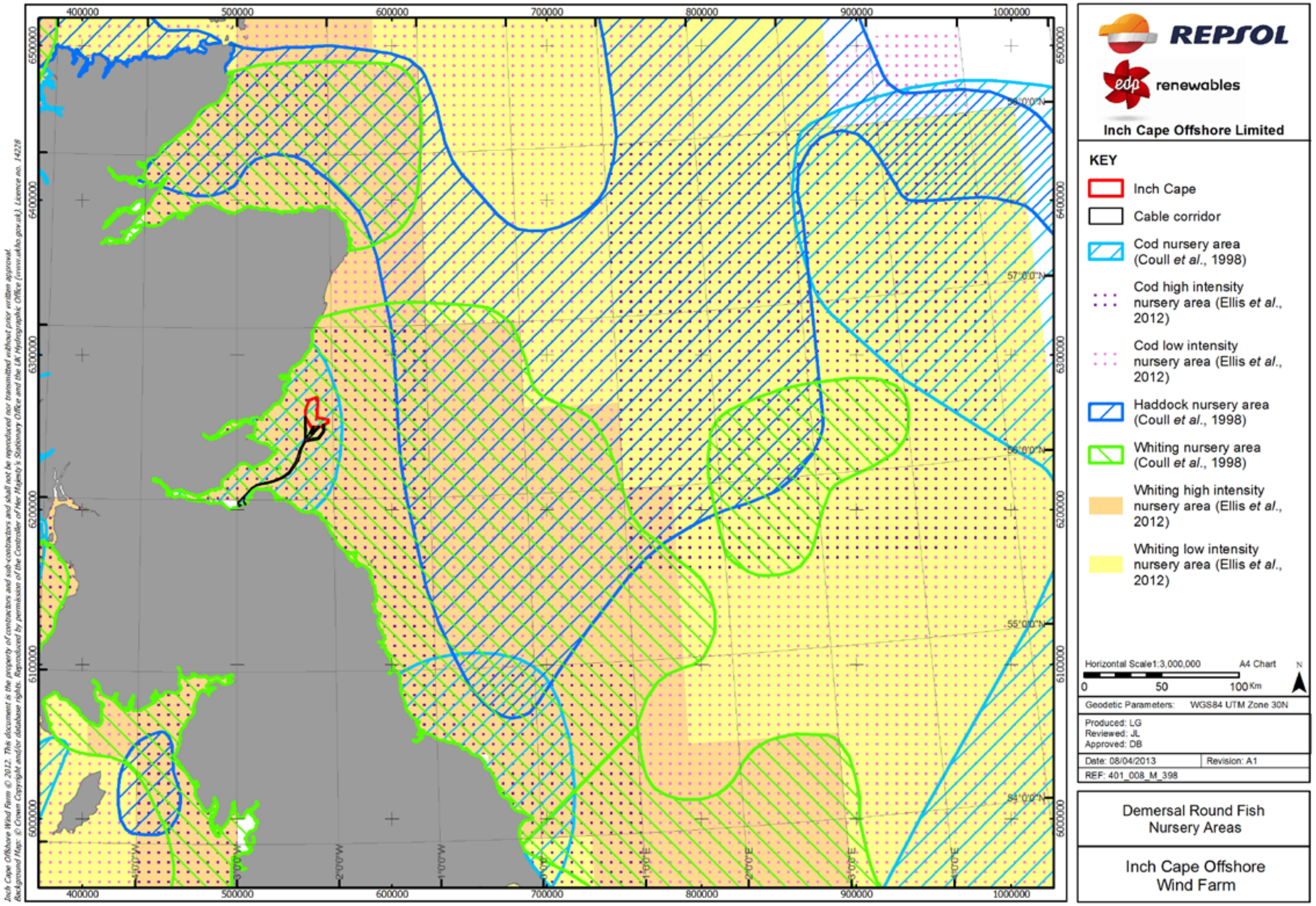


Figure 13A.1.9: Spawning & Nursery Grounds for *Nephrops*

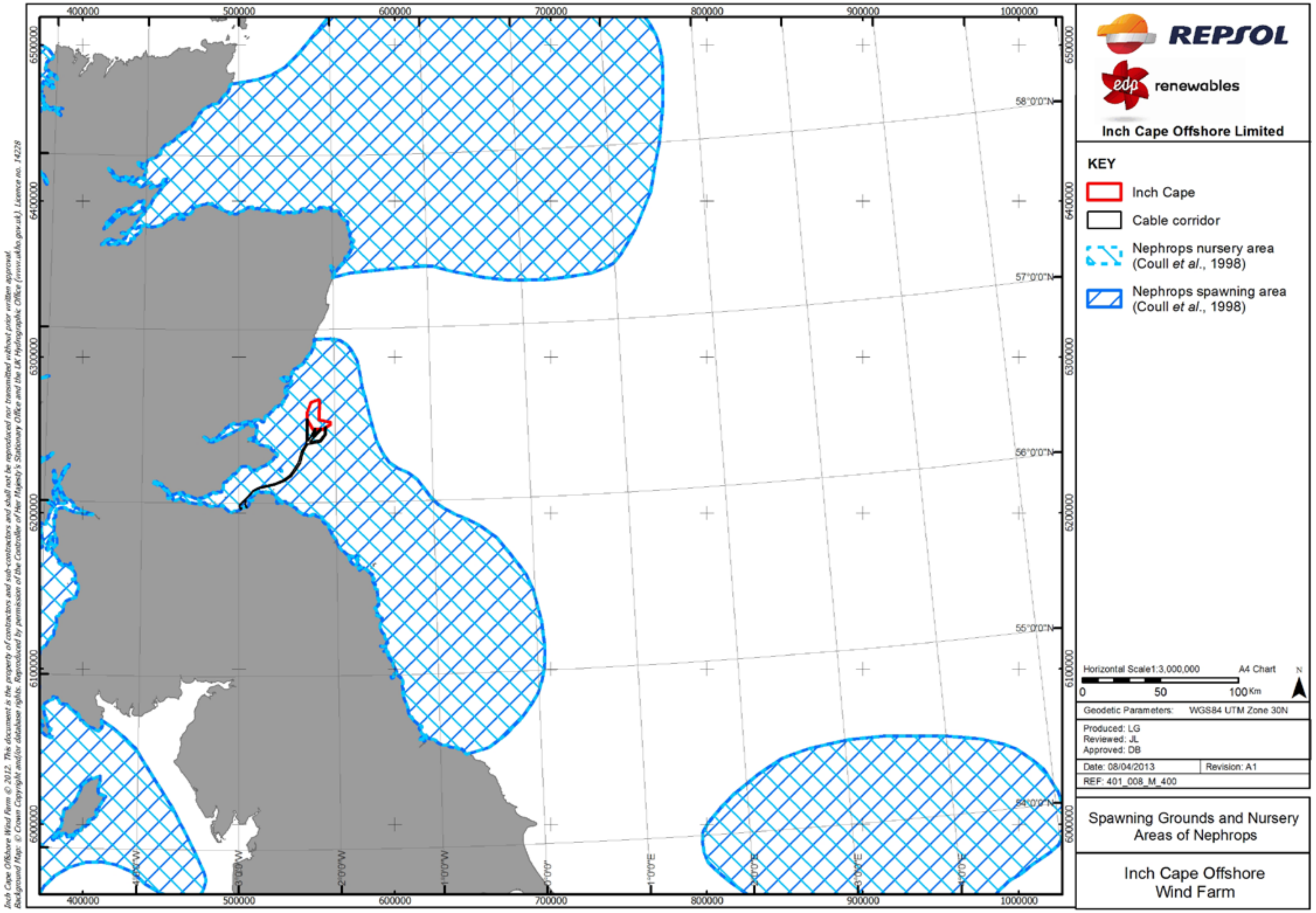


Figure 13A.1.10: **Spawning & Nursery Grounds for Sandeels**

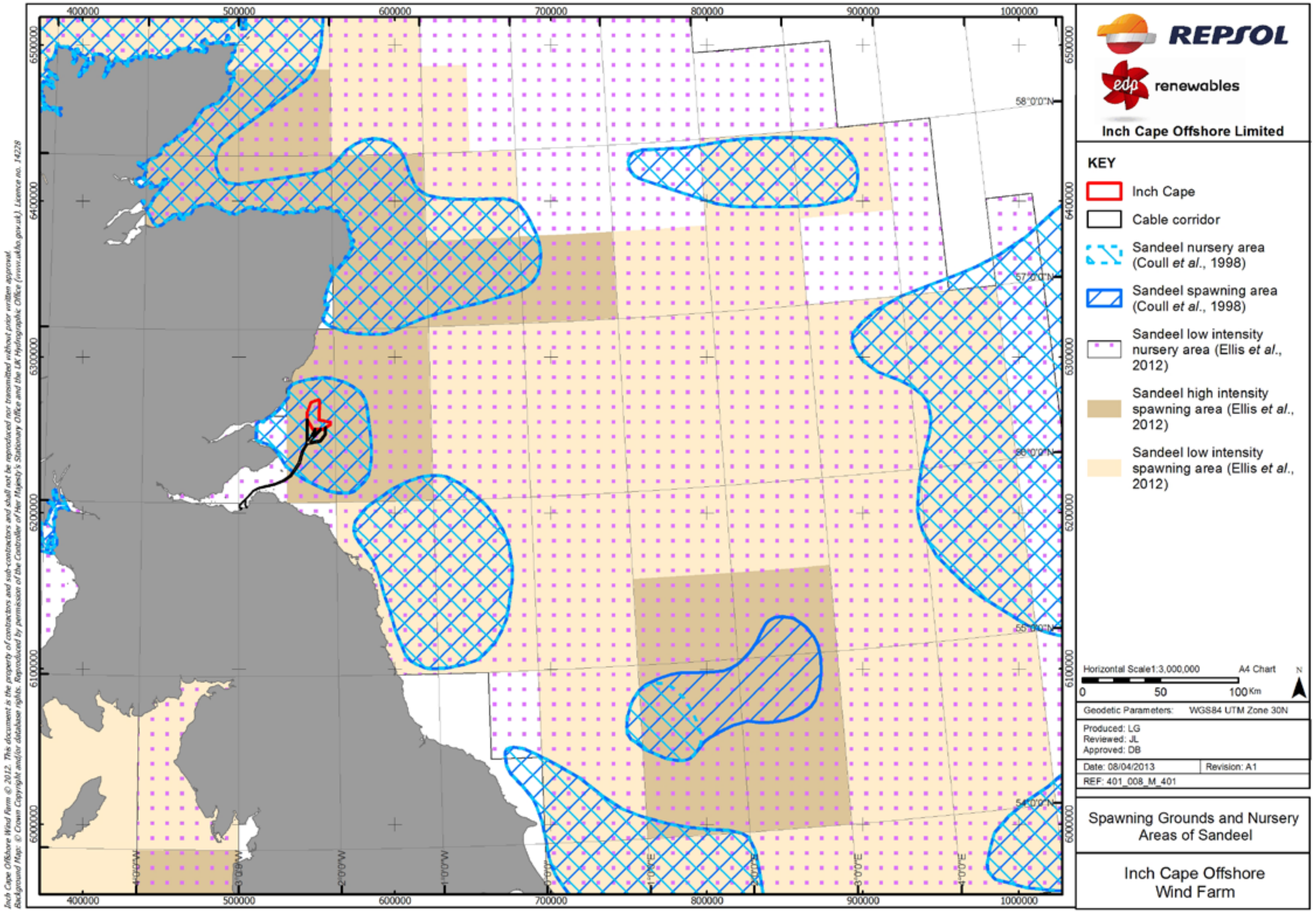
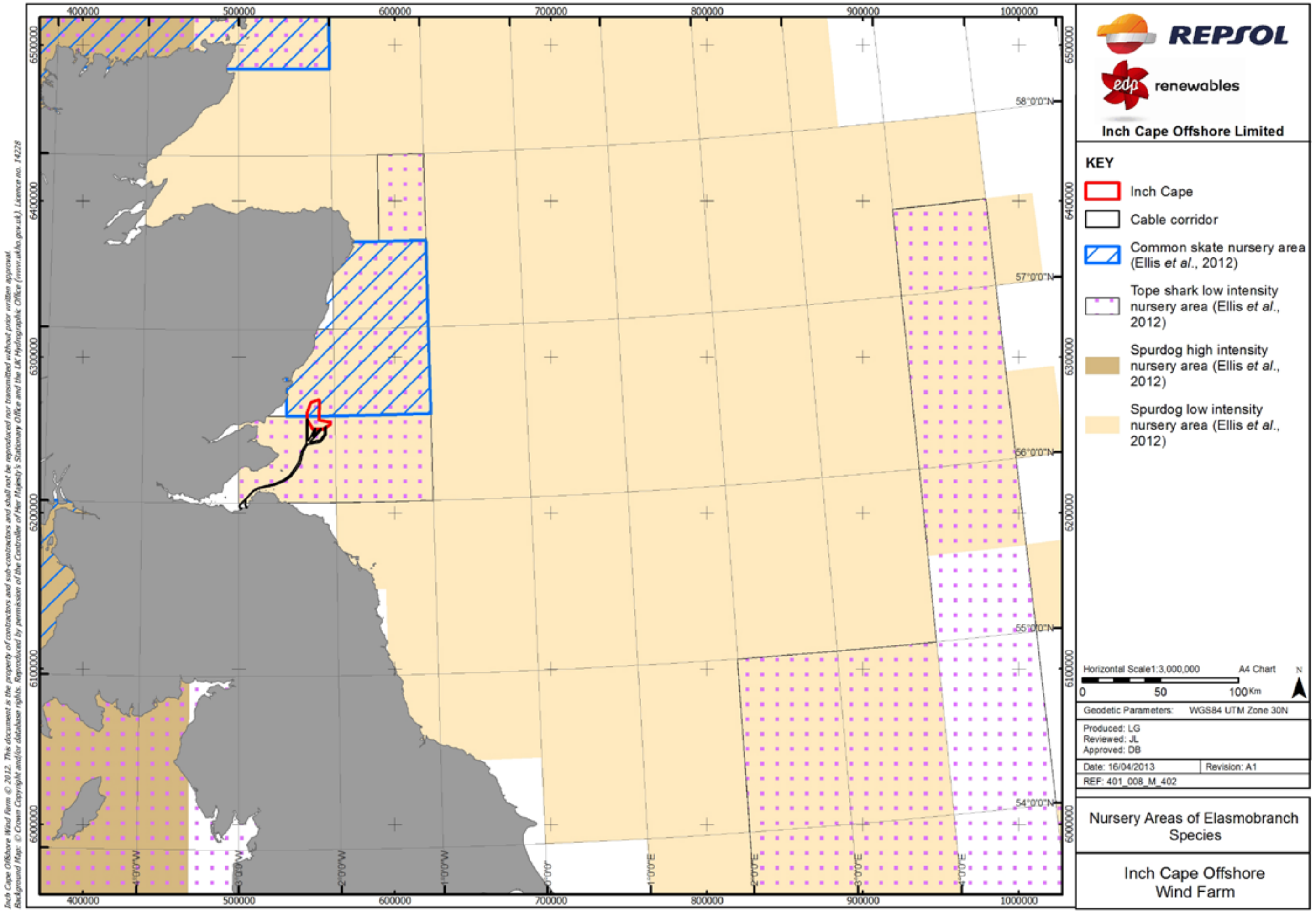


Figure 13A.1.11: Nursery Grounds for Elasmobranches Species



Annex 13A.2 Migratory Species

As information on migratory routes from Scottish East Coast Rivers is uncertain for many migratory species (Malcolm *et al*., 2010), information on their life history has been presented in order to provide some information on their distribution within the study area.

Atlantic Salmon (Salmo salar)

Atlantic salmon is an Annex II species under the EU Habitat Directive and is widely distributed in Scotland, with populations recognised as being of both national and international importance. There are number of Special Areas of Conservation (SACs) on the east coast of Scotland which are designated for Atlantic salmon – namely the Rivers Tay, Teith, Tweed, South Esk and Dee.

Salmon and grilse account for the majority of the catch along the Scottish East Coast from Fraserburgh in the north to Berwick in the south, with the exception of the Ythan and Ugie districts in the north. Highest salmon catch numbers are recorded in the Tweed, Tay and Esk (including the North Esk, South Esk and Bervie) and, to a lesser extent, from the Dee (data averaged 2001-2010, *Chapter 18 : Commercial Fisheries*). The Forth and Teith (the River Teith is a tributary of the River Forth) has salmon and sea trout catch numbers less than a third of those recorded in the neighbouring Tay district. Annual catches and trends in catch of salmon and grilse vary between the rivers and catches have fluctuated during the ten year period, with no clear trends being apparent (*Section 18.4*).

There is a lack of detailed, evidence-based knowledge on the migration of Atlantic salmon smolt leaving Scottish east coast rivers, however they are likely to travel in a northerly and easterly direction en route to feeding grounds around Greenland (Malcolm *et al*., 2010). Smolt are believed to leave the rivers in late spring. Malcolm *et al*., (2010) found no evidence of coastal migration and it is postulated that smolt may migrate over a broad area unless there are areas of strong coastal currents. Findings in Norway and Canada were that post smolts were observed to migrate rapidly and actively towards open marine areas after leaving their source rivers (Malcolm *et al*., 2010).

Adult Atlantic salmon returning to rivers on the east coast of Scotland are predominately multi sea winter adults and are believed to enter east coast Scottish rivers from the south (migrating up the coast from Northumberland between October and January (Malcolm *et al.*, 2010)) although they are likely to migrate across a broad front. During this time adult salmon spend several weeks moving parallel to the coast in shallow waters. River flow is considered to play a primary role in stimulating migration (Crisp 1996; Hendry *et al.*, 2003). Data is again limited regarding repeat spawners; while it is believed their contribution is likely to be small (Malcolm *et al.*, 2010). The migration of kelts is unstudied in Scotland however international studies suggest rapid migration to the open sea at shallow depths (Halttunen *et al*., 2009, cited in Malcolm *et al*., 2010).

As no definitive migratory routes exist for Scottish east coast Atlantic salmon, the possibility is that individuals migrate through the Project en route to or from their natal rivers, however the availability of space for migration around the Project must also be noted.

Scotland's salmon runs are notably the most seasonally diverse of all the countries where salmon occur. Smolt-tagging studies have shown that run-timing is a genetic characteristic of populations

(Stewart *et al*., 2002) and the genetic contributions of different populations underpin the diversity in timing of Scottish salmon runs. Salmon fishing takes place in every month except December, and the timings of the various runs that make such an extended fishing season possible depend on the separate seasonal contributions of different populations (MSS, 2003). The characteristics of the populations from the Almond and Tummel tributaries of the River Tay, for example, differ markedly. Tummel fish return to the Tay earlier in the season than Almond fish, and in the case of 2-sea-winter salmon, the difference is very marked. The migration of grilse (1-sea- winter fish) takes place over a much shorter period. In spite of this, Tummel grilse still enter the Tay earlier than Almond grilse. The Tummel generates early-running salmon and grilse, while the Almond generates later-running fish of both groups (Stewart *et al*., 2002).

It is recognised that the seasonality of the fisheries will to some extent be influenced by the length of the open season in different districts and further seasonal voluntary or statutory restrictions in place for some methods. However the seasonality of the rod-and-line (including catch and release) and the net fisheries (separated into net-and-coble and fixed engines) by species and district provides an indication of the timings of river movement within each district. Further information on specific river timings can be found in *Appendix 18C: Salmon and Sea Trout Fisheries Baseline*. Rod-and-line salmon catches peak in September and October in most districts within the regional study area with the Tweed also recording high catches in November. Whilst relatively lower, salmon catches are also of importance from March to July, particularly in the Tay and Tweed, reflecting the diversity of salmon runs in the regional area. Grilse are principally caught from July to October with peak catches recorded from August to October in most districts. In the Tweed, as for salmon, relatively high grilse catches are also recorded in November.

Sea Trout (Salmo trutta)

Sea trout are a UK BAP species and native to Scotland. Typically adult sea trout mainly migrate into rivers between June and November peaking in October with river flow playing a primary role in stimulating migration (Crisp, 1996; Hendry *et al*., 2003). In common with salmon, sea trout may spend a variable number of years in fresh water before migrating to sea, where they reach maturity. In contrast to salmon, immature sea trout often return to fresh water to over-winter and sea trout post-smolts do not migrate rapidly out to sea from inshore coastal areas but use near shore sea loch and fjord areas where available. It is uncertain what happens to sea trout post-smolts on the east coast of Scotland, and the movement of sea trout after the initial few months in the marine environment for both the west and east coasts of Scotland are unclear. For adult sea trout, tagging data for the west coast suggest more local habitat use than for the east coast; however, this may simply reflect survey and local geographic differences (Malcolm *et al*., 2010). Adult sea trout have been caught by fishing vessels in Scotland (Nall, 1935, Watt, 2008) suggesting that offshore movement and migrations are also a feature of adult sea trout behaviour. How adults migrate and behave on the east coast of Scotland is complex, although it is clear that migrations are individually variable and far ranging (Malcolm *et al.*, 2010). In the districts along the Scottish east coast sea trout are principally caught from May to October, with highest catches being recorded in June, July and August. Further information on specific river timings can be found within the salmon and sea trout fisheries baseline produced by Brown and May Marine Ltd (*Appendix 18C*).

Lamprey

All three UK species of lamprey (brook lamprey, *Lampetra planeri*, river lamprey, *L. fluviatilis*, and sea lamprey, *Petromyzon marinus*) are Annex II species under the EU Habitat Directive. The Rivers Tay, Teith and Tweed SACs are designated for all three lamprey species, the status of which are classed as favourable maintained.

Sea lamprey may range widely following migration to sea and do not spend their entire life cycle in the marine environments. Little is known about the distribution of sea lamprey during the adult (marine) phase of their lifecycle, however they have been reported in shallow coastal waters and deep offshore waters suggesting they have a wide range and utilise a range of habitat types (Maitland, 2003). In the River Tay, the main areas for sea lamprey spawning and larval development are the main-stem of the river and the lower reaches of larger tributaries.

The River Teith is the most significant tributary of the River Forth and young sea lampreys have been recorded throughout the lower reaches of the main river

Research undertaken establishes some behavioural characteristics; that sea lampreys do not appear to home to their natal streams, instead they are thought to be attracted to spawning areas by chemical cues released by conspecific larvae (Li *et al*., 1995; Bjerselius *et al*., 2000; Vrieze & Sorensen, 2001, cited in Watt, 2008). As such the presence of larvae in the SACs should promote continuing adult migration into the rivers (and subsequent dispersal through the catchment).

River lamprey migrate downstream to estuaries during the adult phase of the lifecycle and spend the majority of their adult life in estuarine habitats with restricted movements to open sea (Maitland, 2003), rarely leaving estuarine habitats. Populations are concentrated on a relatively small area during spawning, and SNH (2011) focus conservation measures within river habitats. Brook lamprey spend their entire life cycle within the river environment, and do not migrate offshore.

European Eel (Anguilla anguilla)

The European Eel, a BAP species which is also recognised as critically endangered on a European scale, has also been recorded in coastal waters of Scotland, however there is little known regarding migratory movements of juveniles or adults on a small scale. More widely, spawning occurs in the Sargasso Sea. After a larval stage juveniles, known as glass eels, reach the European continental shelf where some migrate into European Rivers, or between fresh and marine waters, and others remain in the marine environment, all developing into yellow eels before metamorphosis into silver eels when they return to spawning grounds in the Sargasso Sea. As reviewed by Malcolm *et al.*, (2010), there is a lack of information on the numbers of eels present in coastal waters of Scotland, however the little data there is on migratory pathways suggest they are less likely to be encountered in the River Tay than in the north west of Scotland. Both juvenile and adult migrations are seasonal, however the timing of migration into Scottish waters is poorly recorded. Best estimates are that glass eels pass through Scottish waters principally from September to December, and glass eels destined for Scottish rivers remain in coastal regions until the river temperatures rise sufficiently for them to enter fresh water. The majority of the return silver eel migration may extend from September to January.

European Smelt (Osmerus eperlanus)

European smelt were previously known to occur in a number of Scottish rivers, including the Rivers Forth and Tay. However, they have now disappeared from almost all of these rivers, with a small number of rivers, including the Forth and Tay, being notable exceptions (SNH, scoping response). These are predominantly estuarine species. Marine Scotland have identified the sensitivity of smelt, to underwater noise and reports its abundance on the Scottish south east coast, inshore from the proposed Development Area at Bell Rock. It is an inshore diadromous fish most commonly found in estuaries and river mouths. European smelt are found in coastal waters and estuaries and migrate into large clean rivers to spawn, congregating near river mouths in winter and usually ascend the river between February and April and returning to the sea soon after spawning takes place.

Shad (Alosa alosa and Alosa fallax)

The allis and twaite shad are Annex II species under the EU Habitat Directive. They are Diadromous species, which spawn in freshwater and use the coastal shelf for nursery and migration.

Allis shad are rare in the UK and, although formerly known to spawn in several British river systems, the only recently-confirmed spawning site is in the Tamar Estuary (Plymouth Sound and Estuaries cSAC). There is probably a spawning population in the Solway Firth area (Maitland & Lyle, 2001), but rivers in the Severn catchment may no longer support viable breeding populations (Carstairs 2000).

In the UK, spawning stocks of twaite shad are known to occur in only a few rivers in Wales and on the England/Wales border, flowing into the Severn estuary (Carstairs, 2000); no spawning stocks are known north of this, although the species is present in south-west Scotland, in rivers flowing into the Solway Firth, where hybrids with Allis shad (*Alosa alosa)* have been reported (Maitland & Lyle, 2001).

In relation to Inch Cape the database for the Atlas of Freshwater Fishes (Davies *et al*., 2004) shows two records of the Twaite Shad in the Tay in 1978, and one record of the Allis shad off the coast of St. Andrews (date unknown).

References

Bjerselius, R., Li, W., Teeter, J.H., Seelye, J.G., Johnsen, P.B., Maniak, P.J., Grant, G.C., Polkingthorne, C.N. and Sorensen, P.W. 2000. Direct behavioural evidence that unique bile acids released by larval sea lamprey function as a migratory pheromone. Canadian Journal of Fisheries and Aquatic Science, 57, 557-569.

Brown & May Marine Ltd. 2011. Salmon and Sea Trout Fisheries Technical Report

Carstairs, M., 2000. The ecology and conservation of allis and twaite shad. British Wildlife, 11, 159-166

Crisp, D. T., 1996. Environmental requirements of common riverine European salmonid fish species in fresh water with particular reference to physical and chemical aspects. *Hydrobiologia* 323: 201-221.

Davies, C. E., Shelley, J., Harding, P. T., McLean, I. F. G., Gardiner, R. and Peirson, G., eds. 2004. Freshwater fishes in Britain - the species and their distribution. Colchester: Harley Books

Halttunen, E. Rikardsen, A.H. Davidsen, J.G. Thorstad, E.B. and Dempson, J.B. 2009. Survival, Migration Speed and Swimming Depth of Atlantic Salmon Kelts During Sea Entry and Fjord Migration In

Hendry, K., Cragg-Hine, D., O'Grady, M., Sambrook, H. & Stephen, A., 2003. Management of habitat for rehabilitation and enhancement of salmonids stocks. *Fisheries Research* 62: 171-192

Li, W., Sorensen, P.W. & Gallaher, D.G., 1995. The olfactory system of adult sea lamprey (Petromyzon marinus) is specially and acutely sensitive to unique bile acids released by conspecific larvae. *Journal of General Physiology* 105: 569-587

Malcolm, I.A., Godfrey, J., Youngson, A.F., 2010. Review of migratory routes and behaviour of Atlantic salmon, sea trout and European eel in Scotland’s coastal environment: implications for the development of marine renewable. *Scottish Marine and Freshwater Science* Vol 1 No 14.

Maitland P. S., 2003. Ecology of the River, Brook and Sea Lamprey. Conserving Natura 2000 Rivers Ecology Series No. 5. English Nature, Peterborough

Maitland, P. S. and Lyle, A. A., 2001. Shad and smelt in the Cree estuary, south west Scotland. Scottish Natural Heritage Research, Survey and Monitoring Report, No. 6

Marine Scotland Science (MSS) 2003. Fisheries Research Services - Local Populations Determine the Seasonal Characteristics of the Salmon Fisheries. Available online at: http://www.scotland.gov.uk/Uploads/Documents/Local%20pop%20v1.pdf

Nall, G. H., 1935. Sea-Trout of the Montrose District. Part III – The Migrations of Sea-Trout. Fisheries, Scotland, Salmon, Fish., 1935, No. III

Scottish Natural Heritage. 2011. River Tay Special Area of Conservation (SAC): Advice to developers when considering new projects which could affect the River Tay Special Area of Conservation. SNH advice available from: http://www.snh.gov.uk/publications-data-and-research/publications/search-the-catalogue/publication-detail/?id=1749

Stewart, D.C. Smith G.W. and Youngson A.F., 2002. Tributary-specific variation in run-timing of adult Atlantic salmon (Salmo salar) has a genetic component. Canadian Journal of Fisheries and Aquatic Sciences. 59: 276-281.

Tagging and Tracking of Marine Animals with Electronic Devices. Springer, Netherland DOI 10.1007/978-1-4020-9640-2.

Watt, J., Ravenscroft, N.O.M. & Seed, M. 2008. Site Condition Monitoring of Lamprey in the River Tay Special Area of Conservation. Scottish Natural Heritage Commissioned Report No. 292 (ROAME No. R07AC606).

Vrieze, L.A. and Sorensen, P.W. 2001. Laboratory assessment of the role of a larval pheromone and natural stream odor in spawning stream localisation by migratory sea lamprey (Petromyzon marinus). Canadian Journal of Fisheries and Aquatic Science, 58, 2374-2385.

Annex 13A.3 Trawl Details

	Shoot coordinates		Haul coordinates		Time		Depth (m)		
Date	Lat	Long	Lat	Long	Shot	Haul	Shoot	Haul	Weather
27/01/2012	56.42583	-2.30300	56.39200	-2.25067	07:37:00	08:37:00	48.6	52.2	S4
27/01/2012	56.36883	-2.07950	56.38000	-2.06333	09:36:00	10:36:00	48.6	52.2	SW3
27/01/2012	56.44833	-2.08883	56.44100	-2.15800	11:32:00	12:32:00	41.4	46.8	W3
27/01/2012	56.48283	-2.04550	56.50517	-2.09333	13:10:00	14:10:00	63.0	63.0	W3
27/01/2012	56.54883	-2.03400	56.57717	-2.06733	14:42:00	15:42:00	45.0	54.0	W3
27/01/2012	56.61633	-2.12783	56.62233	-2.19433	16:11:00	17:11:00	63.0	61.2	NW3
27/01/2012	56.58067	-2.17783	56.55417	-2.23783	07:55:00	08:55:00	46.8	52.2	W3
27/01/2012	56.53833	-2.21583	56.50567	-2.19567	09:24:00	10:24:00	48.6	48.6	W3
27/01/2012	56.48867	-2.24067	56.45533	-2.22850	10:46:00	11:46:00	43.2	46.8	W3
27/01/2012	56.48017	-2.41300	56.51083	-2.41200	12:38:00	13:38:00	41.4	43.2	W3
16/05/2012	56.42500	-2.30300	56.39200	-2.24867	11:15:00	12:15:00	50.4	52.2	SW3
16/05/2012	56.37183	-2.07917	56.41000	-2.04083	13:05:00	14:05:00	50.4	54.0	WSW2
16/05/2012	56.44300	-2.15600	56.45183	-2.08767	15:15:00	16:15:00	48.6	48.6	N3
16/05/2012	56.48300	-2.04000	56.51617	-2.11333	16:35:00	17:35:00	63.0	57.6	N2
16/05/2012	56.54367	-2.06117	56.57267	-2.11917	18:05:00	19:05:00	48.6	52.2	N2
16/05/2012	56.58117	-2.17317	56.55767	-2.22367	19:20:00	20:20:00	43.2	45.0	N1
17/05/2012	56.50217	-2.37500	56.52300	-2.34833	11:10:00	12:10:00	50.4	52.2	NE4
17/05/2012	56.54067	-2.34917	56.56667	-2.34833	12:15:00	13:15:00	57.6	52.2	NE4
17/05/2012	56.57717	-2.36517	56.55467	-2.41667	13:10:00	14:10:00	59.4	41.4	NE4
16/05/2012	56.50600	-2.38850	56.47183	-2.48000	09:45:00	10:45:00	46.8	39.6	SW3
25/07/2012	56.42500	-2.30167	56.39167	-2.24917	07:30:00	08:30:00	48.6	51.66	Calm SSE
25/07/2012	56.37167	-2.08017	56.40650	-2.03083	09:20:00	10:20:00	51.3	57.6	Calm NNW
25/07/2012	56.43983	-2.16367	56.45450	-2.09000	11:05:00	12:05:00	47.7	46.26	Calm NNW
25/07/2012	56.48533	-2.04083	56.51667	-2.11300	12:25:00	13:25:00	62.1	50.76	Calm NNW
25/07/2012	56.54967	-2.02783	56.58533	-2.08133	14:15:00	15:15:00	42.3	55.26	Calm NNW
25/07/2012	56.61850	-2.12567	56.62133	-2.19833	15:40:00	16:40:00	50.4	59.4	Calm NNW
25/07/2012	56.58017	-2.17683	56.55317	-2.24450	17:05:00	18:05:00	45.36	53.1	Calm NNW
26/07/2012	56.50867	-2.38800	56.46650	-2.41983	06:30:00	07:30:00	47.7	41.76	Calm East
26/07/2012	56.53750	-2.23000	56.50183	-2.22750	08:45:00	09:45:00	51.66	45	Calm East
26/07/2012	56.48817	-2.24400	56.45450	-2.22617	10:00:00	11:00:00	48.06	48.6	Calm East
04/10/2012	57.18333	-2.29983	56.39333	-2.25117	06:58:00	07:58:00	46.8	54.0	SW3
04/10/2012	56.37217	-2.07683	56.40750	-2.03050	08:43:00	09:43:00	48.6	55.8	SW3
04/10/2012	56.44050	-2.16033	56.44983	-2.08633	10:28:00	11:28:00	50.4	50.4	SW3
04/10/2012	56.48317	-2.03667	56.51333	-2.11200	11:50:00	12:50:00	63.0	57.6	SW3
04/10/2012	56.54883	-2.02817	56.58250	-2.07583	13:35:00	14:35:00	41.4	55.8	SW3
04/10/2012	56.61783	-2.12433	56.62233	-2.19650	15:05:00	16:05:00	52.2	61.2	SW3
05/10/2012	56.45383	-2.22967	56.49050	-2.24483	10:15:00	11:15:00	43.2	52.2	SW3
05/10/2012	56.50650	-2.19450	56.53933	-2.21450	09:00:00	10:00:00	48.6	46.8	SW3
05/10/2012	56.58233	-2.17350	56.55233	-2.23917	07:40:00	08:40:00	48.6	46.8	SW3
05/10/2012	56.51117	-2.38650	56.47000	-2.41767	12:23:00	13:23:00	46.8	37.8	SW3

Annex 13A.4 Catch Data

		Winter Survey 27/01/2012										
Common Name	**Scientific Name**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Total**
Dab	*Limanda limanda*	21	3	5	3	10	33	19	11	18	15	137
Plaice	*Pleuronectes platessa*	3	3	1	0	0	4	10	2	8	1	32
Lemon sole	*Microstomus kitt*	2	0	0	0	1	5	0	0	0	1	9
Flounder	*Platichthys flesus*	0	0	0	0	0	0	0	0	0	0	0
Whiting	*Merlangius merlangus*	42	20	181	6	121	67	51	41	292	61	882
Cod	*Gadus morhua*	1	0	4	0	0	0	0	2	0	0	7
Saithe	*Pollachius virens*	0	0	0	0	0	0	0	0	0	0	0
Pollack	*Pollachius virens juv.*	0	0	0	0	0	0	0	0	0	0	0
Hake	*Merluccius merluccius*	0	0	0	0	0	0	0	0	0	1	1
Haddock	*Melanogrammus aeglefinus*	2	0	22	51	6	9	1	2	0	0	92
Sprat	*Sprattus sprattus*	0	0	0	0	0	0	0	0	0	0	0
Herring	*Clupea harengus*	8	0	14	19	9	2	5	3	8	7	77
Pogge	*Agonus cataphractus*	0	0	0	0	0	0	0	0	0	0	0
Grey gurnard	*Eutrigla gurnardus*	0	0	0	0	0	0	0	0	0	0	0
Red gurnard	*Aspitriglia cuculus*	0	0	1	0	1	1	1	0	0	0	4
Dragonet	*Callionymus lyra*	0	0	0	0	0	0	1	0	1	0	2
Red mullet	*Mullus surmuletus*	0	0	0	0	0	0	0	0	0	0	0
Scad	*Trachurus trachurus*	0	0	0	0	0	0	0	0	0	0	0
John Dory	*Zeus faber*	0	0	0	0	0	0	0	0	0	0	0
Bull rout	*Myoxocephalus scorpius*	0	0	0	0	0	0	0	0	0	0	0
Long-spined Sea Scorpion	*Taurulus bubalis*	0	0	1	1	1	0	0	3	0	0	7
Cuckoo ray	*Raja naevus*	0	3	0	0	0	0	0	0	0	0	3
Lesser spotted dogfish	*Scyliorhinus canicula*	0	0	0	0	0	0	0	0	0	0	0
Sand eel	*Ammodytes tobianus*	0	0	0	0	0	0	0	0	0	0	0
Greater Sand eel	*Hyperoplus lanceolatus*	0	0	0	0	0	0	0	0	0	0	0
Bib	*Trisopterus luscus*	0	0	0	0	0	0	0	0	0	0	0

		Winter Survey 27/01/2012										
Common Name	**Scientific Name**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Total**
Ling	*Molva molva*	0	0	1	0	0	0	2	0	0	0	3
Mackerel	*Scomber scombrus*	0	0	0	0	0	0	0	0	0	0	0
Norway Pout	*Trisopterus esmarkii*	0	0	0	0	0	0	0	0	0	0	0
Long Rough Dab	*Hippoglossoides platessoides*	0	0	0	0	0	0	0	0	0	0	0
Nephrops	*Nephrops norvegicus*	0	0	0	0	0	0	0	0	0	0	0
Lobster	*Homarus Gammarus*	1	0	0	1	1	1	2	1	3	0	11
Brown Crab	*Cancer pagurus*	0	3	0	0	0	0	0	0	0	0	3
Harbour crabs	*Liocarcinus depurator*	0	0	0	0	2	2	2	0	0	0	6
Hermit crabs	*Pagurus bernhardus*	0	0	0	0	0	0	0	0	0	0	0
Squat lobster	*Munida rugosa*	0	0	0	0	0	0	0	0	0	0	0
Pink shrimp	*Pandalus montagui*	0	0	0	0	0	0	0	0	0	0	0
Queen Scallop	*Aequipecten opercularis*	0	0	0	0	0	0	0	0	0	0	0
Squid	*Alloteuthis subulata*	0	0	1	0	1	1	3	1	0	1	9
European squid	*Loligo forbesii*	0	0	0	0	0	0	0	0	0	0	0
Brittle stars	*Ophiothrix fragilis*	0	0	0	0	0	0	0	0	0	0	0
Starfish	*Asterias rubens*	0	0	0	0	0	0	0	0	1	0	1
Sea urchin	*Echinus esculentus*	0	0	5	0	1	0	0	0	0	0	6
Plumose anemone	*Metridium senile*	1	0	0	0	0	0	0	0	0	0	1
Dead Mans fingers	*Alcyonium digitatum*	1	0	0	0	3	1	1	0	1	1	9
Moon Jellyfish	*Aurelia aurita*	0	0	0	0	0	0	0	0	0	0	0
Blue jellyfish	*Cyanea lamarckii*	0	0	0	0	0	0	0	0	0	0	0
lions mane jellyfish	*Cyanea capitella*	0	0	0	0	0	0	0	0	0	0	0
Curled Octopus	*Eledone cirrhosa*	0	0	0	0	0	0	0	0	0	0	0
Sun star	*Crossaster papposus*	0	0	0	0	0	0	0	1	1	0	2

		Spring Survey 16/05/2012										
Common Name	**Scientific Name**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Total**
Dab	*Limanda limanda*	0	6	2	6	11	20	36	13	12	4	110
Plaice	*Pleuronectes platessa*	1	1	0	0	5	0	4	0	0	0	12
Lemon sole	*Microstomus kitt*	0	2	0	0	0	1	4	3	1	0	11
Flounder	*Platichthys flesus*	0	0	0	0	0	0	0	1	1	0	3
Whiting	*Merlangius merlangus*	0	46	40	61	109	187	29	9	32	12	525
Cod	*Gadus morhua*	0	0	0	0	0	2	0	0	0	0	2
Saithe	*Pollachius virens*	0	0	0	0	0	0	0	0	0	0	0
Pollack	*Pollachius virens juv.*	0	0	0	0	0	0	0	0	0	0	0
Hake	*Merluccius merluccius*	0	0	0	0	0	0	0	0	0	0	0
Haddock	*Melanogrammus aeglefinus*	1	0	6	0	34	3	1	3	1	0	49
Sprat	*Sprattus sprattus*	20	8	6	616	10	1	3	0	0	1	665
Herring	*Clupea harengus*	5	5	13	0	2	0	4	23	4	5	61
Pogge	*Agonus cataphractus*	0	0	0	0	0	0	0	0	0	0	0
Grey gurnard	*Eutrigla gurnardus*	0	3	0	0	1	0	0	0	0	0	4
Red gurnard	*Aspitriglia cuculus*	0	5	2	2	2	2	0	0	0	0	14
Dragonet	*Callionymus lyra*	0	0	0	0	0	0	0	0	0	0	0
Red mullet	*Mullus surmuletus*	0	0	0	0	0	0	0	0	0	0	0
Scad	*Trachurus trachurus*	0	0	0	0	0	0	0	0	0	0	0
John Dory	*Zeus faber*	0	0	0	0	1	0	0	0	0	0	1
Bull rout	*Myoxocephalus scorpius*	1	0	2	0	1	0	1	0	0	3	9
Long-spined Sea Scorpion	*Taurulus bubalis*	0	0	0	0	0	0	0	0	0	0	0
Cuckoo ray	*Raja naevus*	0	0	0	0	0	0	0	0	0	0	0
Lesser spotted dogfish	*Scyliorhinus canicula*	0	0	0	0	1	0	0	1	0	1	4
Sand eel	*Ammodytes tobianus*	0	1	0	6	0	8	1	0	0	0	16
Greater Sand eel	*Hyperoplus lanceolatus*	0	0	0	0	0	0	0	0	0	0	0
Bib	*Trisopterus luscus*	0	0	0	0	1	0	0	0	0	0	1
Ling	*Molva molva*	0	0	0	0	0	0	0	0	0	0	0
Mackerel	*Scomber scombrus*	0	2	1	2	0	7	1	1	4	0	18
Norway Pout	*Trisopterus esmarkii*	0	0	0	0	0	12	5	0	0	0	17
Long Rough Dab	*Hippoglossoides platessoides*	0	0	0	0	0	0	0	0	0	0	0

		Spring Survey 16/05/2012										
Common Name	**Scientific Name**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Total**
Nephrops	*Nephrops norvegicus*	0	0	0	0	0	0	0	0	0	1	1
Lobster	*Homarus Gammarus*	0	0	0	0	0	1	0	0	0	0	1
Brown Crab	*Cancer pagurus*	0	1	0	0	0	0	0	0	0	0	1
Harbour crabs	*Liocarcinus depurator*	0	0	0	0	0	0	0	0	0	0	0
Hermit crabs	*Pagurus bernhardus*	0	0	0	1	0	0	0	0	0	0	1
Squat lobster	*Munida rugosa*	0	0	0	0	0	0	0	0	0	0	0
Pink shrimp	*Pandalus montagui*	0	0	0	1	0	0	0	0	0	0	1
Queen Scallop	*Aequipecten opercularis*	0	0	0	0	0	0	0	0	0	0	0
Squid	*Alloteuthis subulata*	0	0	0	1	0	0	0	0	0	0	1
European squid	*Loligo forbesii*	0	0	0	0	0	0	0	0	1	3	4
Brittle stars	*Ophiothrix fragilis*	0	0	0	0	0	0	0	0	0	0	0
Starfish	*Asterias rubens*	0	0	0	0	0	0	0	0	0	0	0
Sea urchin	*Echinus esculentus*	0	0	0	0	2	0	0	0	0	0	2
Plumose anemone	*Metridium senile*	0	6	0	0	0	0	0	0	0	3	9
Dead Mans fingers	*Alcyonium digitatum*	0	0	4	0	0	1	0	1	0	0	6
Moon Jellyfish	*Aurelia aurita*	72	4	30	0	5	0	1	33	0	13	159
Blue jellyfish	*Cyanea lamarckii*	0	0	0	1	0	0	0	1	0	0	2
lions mane jellyfish	*Cyanea capitella*	0	0	0	1	0	1	0	0	0	1	3
Curled Octopus	*Eledone cirrhosa*	0	0	0	0	0	0	0	0	0	0	0
Sun star	*Crossaster papposus*	0	0	0	0	0	0	0	0	0	0	0

		Summer Survey 25/07/2012										
Common Name	**Scientific Name**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Total**
Dab	*Limanda limanda*	17	3	9	15	10	16	22	28	15	18	152
Plaice	*Pleuronectes platessa*	0	2	0	3	0	0	1	2	0	0	8
Lemon sole	*Microstomus kitt*	1	0	1	0	1	2	1	0	0	0	7
Flounder	*Platichthys flesus*	0	0	0	1	0	0	0	5	0	1	7
Whiting	*Merlangius merlangus*	110	41	10	47	4	113	86	40	31	336	818
Cod	*Gadus morhua*	0	0	0	0	4	0	0	0	0	0	4
Saithe	*Pollachius virens*	0	0	0	3	0	0	0	0	0	0	3
Pollack	*Pollachius virens juv.*	0	0	0	0	0	29	2	1	0	0	32
Hake	*Merluccius merluccius*	0	0	0	0	0	0	0	0	0	0	0
Haddock	*Melanogrammus aeglefinus*	60	29	13	44	88	151	41	115	32	888	1461
Sprat	*Sprattus sprattus*	265	35	16	10	1	6	52	57	4	71	518
Herring	*Clupea harengus*	1	0	0	0	0	4	0	0	0	0	5
Pogge	*Agonus cataphractus*	0	0	0	0	0	0	0	0	0	0	0
Grey gurnard	*Eutrigla gurnardus*	0	9	0	1	3	6	1	2	3	0	25
Red gurnard	*Aspitriglia cuculus*	2	11	0	4	7	6	1	2	3	0	37
Dragonet	*Callionymus lyra*	0	0	0	0	0	0	0	0	0	0	0
Red mullet	*Mullus surmuletus*	0	0	0	0	0	0	0	0	0	0	0
Scad	*Trachurus trachurus*	0	0	0	0	0	0	0	0	0	0	0
John Dory	*Zeus faber*	0	0	0	0	1	0	0	0	1	0	2
Bull rout	*Myoxocephalus scorpius*	0	0	0	0	0	0	0	0	0	0	0
Long-spined Sea Scorpion	*Taurulus bubalis*	0	0	0	0	0	1	1	0	0	0	2
Cuckoo ray	*Raja naevus*	0	0	0	0	0	0	0	0	0	0	0
Lesser spotted dogfish	*Scyliorhinus canicula*	0	1	0	1	2	5	0	1	0	0	10
Sand eel	*Ammodytes tobianus*	0	0	0	278	48	0	0	13	1	92	432
Greater Sand eel	*Hyperoplus lanceolatus*	0	0	0	0	1	2	0	0	0	0	3
Bib	*Trisopterus luscus*	0	0	0	91	0	49	26	0	8	42	216
Ling	*Molva molva*	0	0	0	0	0	0	0	0	0	0	0
Mackerel	*Scomber scombrus*	6	1	0	2	0	30	2	21	1	1	64
Norway Pout	*Trisopterus esmarkii*	46	9	12	0	0	0	0	1	0	0	68

		Summer Survey 25/07/2012										
Common Name	**Scientific Name**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Total**
Long Rough Dab	*Hippoglossoides platessoides*	1	0	0	0	0	12	1	2	0	3	20
Nephrops	*Nephrops norvegicus*	0	0	0	0	0	0	0	0	0	0	0
Lobster	*Homarus Gammarus*	0	1	0	1	0	0	0	1	1	0	4
Brown Crab	*Cancer pagurus*	0	1	0	0	0	1	0	0	0	0	2
Harbour crabs	*Liocarcinus depurator*	0	0	0	0	0	0	0	0	0	0	0
Hermit crabs	*Pagurus bernhardus*	0	0	0	0	0	0	0	0	0	0	0
Squat lobster	*Munida rugosa*	0	0	0	0	0	0	0	0	0	0	0
Pink shrimp	*Pandalus montagui*	0	0	3	0	1	1	0	0	0	0	6
Queen Scallop	*Aequipecten opercularis*	0	0	1	0	0	0	0	0	0	0	1
Squid	*Alloteuthis subulata*	0	0	0	0	0	0	0	0	0	0	0
European squid	*Loligo forbesii*	2596	129	28	7	8	12	44	127	79	810	3840
Brittle stars	*Ophiothrix fragilis*	0	2	0	0	0	0	0	0	0	0	2
Starfish	*Asterias rubens*	0	0	0	0	0	0	0	0	0	0	0
Sea urchin	*Echinus esculentus*	0	0	2	0	0	0	0	0	0	0	2
Plumose anemone	*Metridium senile*	0	0	0	0	0	0	0	0	0	0	0
Dead Mans fingers	*Alcyonium digitatum*	0	1	1	0	0	0	0	0	0	0	2
Moon Jellyfish	*Aurelia aurita*	7	7	1	5	1091	12	11	22	12	10	1177
Blue jellyfish	*Cyanea lamarckii*	0	1	1	1	0	1	0	4	3	0	11
lions mane jellyfish	*Cyanea capitella*	18	7	3	2	2	7	7	7	12	6	71
Curled Octopus	*Eledone cirrhosa*	0	1	0	0	0	0	0	0	0	0	1
Sun star	*Crossaster papposus*	0	0	0	0	0	0	0	0	0	0	0

		Autumn Survey 04/10/12										
Common Name	**Scientific Name**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Total**
Dab	*Limanda limanda*	61	15	2	13	5	1	7	6	7	5	123
Plaice	*Pleuronectes platessa*	0	0	0	2	0	1	0	0	0	1	4
Lemon sole	*Microstomus kitt*	0	5	0	0	0	2	1	2	0	1	10
Flounder	*Platichthys flesus*	0	0	0	0	0	0	0	0	0	0	0
Whiting	*Merlangius merlangus*	95	141	42	72	75	157	13	66	113	396	1170
Cod	*Gadus morhua*	1	0	0	0	0	0	1	0	0	0	2
Saithe	*Pollachius virens*	0	0	1	0	0	0	1	2	0	0	4
Pollack	*Pollachius virens juv.*	0	0	0	0	0	0	0	0	0	0	0
Hake	*Merluccius merluccius*	0	0	0	0	0	0	0	0	0	0	0
Haddock	*Melanogrammus aeglefinus*	11	168	13	115	180	282	63	116	101	177	1225
Sprat	*Sprattus sprattus*	0	5	1	1	2	0	1	2	0	0	11
Herring	*Clupea harengus*	12	0	2	1	0	0	0	2	0	2	19
Pogge	*Agonus cataphractus*	0	0	0	0	0	1	0	0	1	0	2
Grey gurnard	*Eutrigla gurnardus*	0	0	0	0	0	1	0	0	1	0	2
Red gurnard	*Aspitriglia cuculus*	1	2	0	0	0	0	0	0	0	0	4
Dragonet	*Callionymus lyra*	0	0	0	0	0	0	0	0	0	0	0
Red mullet	*Mullus surmuletus*	0	0	0	0	0	0	0	0	1	0	1
Scad	*Trachurus trachurus*	0	0	0	1	0	0	0	0	0	0	1
John Dory	*Zeus faber*	0	0	0	0	0	0	0	0	0	0	0
Bull rout	*Myoxocephalus scorpius*	0	0	0	0	0	0	0	0	0	0	0
Long-spined Sea Scorpion	*Taurulus bubalis*	0	3	1	1	1	0	0	0	0	2	9
Cuckoo ray	*Raja naevus*	0	0	0	0	0	0	0	0	0	0	0
Lesser spotted dogfish	*Scyliorhinus caniculus*	0	0	0	1	0	0	0	2	1	0	4
Sand eel	*Ammodytes tobianus*	0	0	0	0	1	0	0	0	0	0	1
Greater Sand eel	*Hyperoplus lanceolatus*	0	0	0	0	0	0	0	0	0	0	0
Bib	*Trisopterus luscus*	14	0	0	2	4	5	16	1548	5	4	1599
Ling	*Molva molva*	0	0	0	0	0	0	0	0	0	0	0
Mackerel	*Scomber scombrus*	2	3	5	8	10	7	24	9	10	7	86
Norway Pout	*Trisopterus esmarkii*	108	13	144	142	58	5263	211	684	254	1453	8329
Long Rough Dab	*Hippoglossoides platessoides*	13	0	0	1	2	4	1	0	4	6	31

		Autumn Survey 04/10/12										
Common Name	**Scientific Name**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Total**
Nephrops	*Nephrops norvegicus*	0	0	0	0	0	0	0	0	0	0	0
Lobster	*Homarus Gammarus*	2	1	1	2	2	0	2	6	2	3	22
Brown Crab	*Cancer pagurus*	0	0	0	0	0	0	0	0	0	0	0
Harbour crabs	*Liocarcinus depurator*	0	1	0	1	0	2	0	0	1	0	6
Hermit crabs	*Pagurus bernhardus*	0	0	0	0	0	0	0	0	0	0	0
Squat lobster	*Munida rugosa*	0	1	0	0	0	0	0	0	0	0	1
Pink shrimp	*Pandalus montagui*	48	0	28	0	13	0	0	8	0	1	98
Queen Scallop	*Aequipecten opercularis*	0	0	0	0	1	1	0	0	2	0	5
Squid	*Alloteuthis subulata*	0	0	0	0	0	0	0	0	0	0	0
European squid	*Loligo forbesii*	42	106	96	48	26	17	53	107	121	12	628
Brittle stars	*Ophiothrix fragilis*	0	0	0	0	0	0	0	0	0	0	0
Starfish	*Asterias rubens*	0	0	0	0	0	0	0	0	0	0	0
Sea urchin	*Echinus esculentus*	0	0	0	0	0	0	0	0	0	0	0
Plumose anemone	*Metridium senile*	0	0	0	0	0	0	1	0	0	4	5
Dead Mans fingers	*Alcyonium digitatum*	0	0	0	0	0	0	0	0	0	0	0
Moon Jellyfish	*Aurelia aurita*	0	0	0	0	0	0	0	0	0	0	0
Blue jellyfish	*Cyanea lamarckii*	0	0	0	0	0	0	0	0	0	0	0
lions mane jellyfish	*Cyanea capitella*	0	0	0	1	1	0	0	0	0	0	2
Curled Octopus	*Eledone cirrhosa*	0	0	0	0	0	0	0	0	0	0	0
Sun star	*Crossaster papposus*	0	0	0	0	0	0	0	0	0	0	0