FOREWIND

DOGGER BANK
TEESSIDE A & B

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2014

Environmental Statement Chapter 13 Appendix C Nearshore Fish and Shellfish Surveys

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Client: Forewind

Assessment of Fish and Shellfish in Relation to the Inshore Export Cable Corridor for Dogger Bank Teesside A & B – Autumn 2012

Date: 4th June 2013

Report ref: PMSL/FWD06/TS/06-13-F

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1. Introduction

Precision Marine Survey Limited (PMSL) have been commissioned by Forewind Limited to undertake an assessment of fish and shellfish assemblage within the inshore region of the proposed Dogger Bank Teesside A & B export cable corridor for the Dogger Bank Teesside A & B offshore wind farm developments. These surveys were carried out on in conjunction with offshore surveys within Tranche B and the offshore export cable corridors conducted by Brown and May Marine Limited (BMM).

Table 1. Fish and shellfish survey schedule for autumn 2012

Component	Period	Start Date	Completion Date
Shellfish Assessment (potting)	**Autumn 2012**	**15th September 2012**	**20th September 2012**
Fish Assessment (Gill Netting)	**Autumn 2012**	**17th September 2012**	**18th September 2012**
Fish Assessment (Otter Trawling)	**Autumn 2012**	**22nd September 2012**	**23rd September 2012**
Prawn & Fish Assessment (Otter Trawling)	**Autumn 2012**	**24th October**	**24th October**
Beam Trawl	**Autumn 2012**	**25th – 26th October**	**Postponed due to weather and hard ground conditions**

2. Methods

The following section describes the methods used to survey the faunal assemblage within 12 nautical miles (nm) in the vicinity of the Dogger Bank Export Cable Corridor. Due to the high degree of shellfish static gears and other static fin fish gears throughout the nearshore waters of the Cleveland coast, otter trawling is limited to specific grounds and the waters largely outside of 3nm. As a consequence, the survey utilised gears suited to the capture and retention of key target species and was similar to the type of finfish gears used by local fishermen.

The methodologies outlined follow standard industry guidance (i.e. Ware & Kenny (2011), Rees *et al.,* (1990) and Cooper & Rees (2002), and where such standard operating procedures are not clearly defined, the methods employed, such as gill netting followed those practices used by the local fishing sector, as recommended by Cefas (2004) and Potter & Pawson (1991).

2.1. Shellfish Survey

A local vessel (MFV Lucia - HL 1067) was used for the autumn survey.

Figure 1. Survey fishing vessels used during the shellfish, netting surveys - MFV Lucia (HL1067)

2.1.1. Shellfish Survey Method

Standard pots, pot distances and bait type were used throughout the survey. Five fine mesh pots (mesh size 10mm) were located randomly within the fleet of normal pots to sample juveniles. The fine mesh pots were positioned randomly within the fleet to account for pot bias and end effects'. Five fleets, each containing 20 pots, were positioned across the inshore Export Cable Corridor and within the main fishing grounds. Due to the level of trawling activity, it was not considered appropriate to deploy static gears on trawl grounds, nor in areas outside of the normal shellfish fishing grounds. Each fleet was baited identically with a combination of mackerel and dab in bait bags and left for a minimum soak time of 48 hours (Figure 2).

Figure 2. Deployment of 38" parlour pots during nearshore survey

The position of the fleet (lat. & long.), water depth, number of brown crabs, lobsters and velvet crabs per pot, their general condition (ecdysis), presence of berried females, density and diversity of the by-catch and percentage discards, sea state, wind speed and direction, percentage cloud cover and weather was recorded.

2.2. Fin Fish Assessment

2.2.1. Otter Trawl Method

The MFV Lucia used 5'6" V doors and worked 16" discs on the fishing line. The trawl was comprised of 120ft fishing line, with 110ft head line and a mesh size of 100mm as agreed with the MMO and the NEIFCA.

Figure 3. Recovery of otter trawl during inshore trawl survey

At each station, the otter trawl towed for 30 minutes at 2.5 -3.0 knots over the seabed. The start point for each trawl commenced when the winch was locked, and after 30 minutes the trawl was hauled. The total volume of the catch was measured and sorted with the fish species separated from the epifaunal invertebrates.

A survey log was maintained at all times, with any notable observations from individual trawls recorded in the log (high amount of shell, rocks, cobbles, weed and other debris, including total catch volume. The otter trawl survey was carried out over two days in conjunction with the shellfish and trammel net surveys in September.

2.2.2. *Nephrops* Trawl Method

The trawl used to characterise the *Nephrops* and fish assemblage was a dedicated *Nephrops* trawl comprising 100ft fishing line, with 90ft head line and a mesh size of 80mm. The vessel used 5'6" V doors and worked 4" discs and chain on the fishing line (figure 4).

Figure 4. Prawn trawl on net drum

A total of three trawl stations were identified for the characterisation of the local grounds. At each station, the Nephrops trawl was towed for a duration of 40 minutes at a towing speed of 2.5 -2.7 knots. The start point for each trawl commenced when the winch was locked, and after 40 minutes, the trawl was hauled and the sample recovered. The total volume of the catch was measured and sorted to separate fish species and epifaunal invertebrates. A survey log was maintained at all times, with any notable observations (e.g. high amount of shell, rocks, cobbles, weed and other debris) from individual trawls recorded.

2.2.3. Trammel Netting Method

Six fleets in total were deployed, with one fleet positioned close to the shore along each of the proposed cable routes, a second was laid along the mid section of the inshore cable route, to account for varying depth and habitat, and two fleets positioned randomly within the central nearshore region, but within comparable water depths, to act as a controls (figure 5).

In order to replicate current fishing practices, trammel nets with a minimum mesh size of 100mm were deployed in order to account for the smaller size classes using the inshore area. The nets were comprised of two panels of differing mesh sizes, with an inner mesh of 100mm and an outer mesh of 645mm.

Figure 5. Hauling a fleet of trammel nets into net bin during nearshore survey

Each monofilament trammel net was 100m in length with a depth of 10ft (30 meshes Anchors secured each end of the net to the seabed with a surface with a surface marker buoy at each end. The nets were deployed during a medium to neap tidal cycle to fish either side of a slack water period. The nets were then recovered following a suitable 'soak time' (6 - 12 hours).

Following the recovery of each fleet, the fish were removed from the net and placed into fish boxes, live fish were placed into a container filled with aerated seawater. Fish were measured for length, weight and sex (where possible) and released, except for those retained for gonad analysis. Nets were redeployed to provide data over a 24hr period (two survey days), with assessments carried out during both daylight hours and periods of darkness in order to obtain representative samples of diurnal and nocturnal fish species.

The trammel net fleets were located in close proximity to the shellfish pots to minimise travelling times and were fished for a complete tidal cycle.

2.2.4. Two Metre Scientific Beam Trawl (Juvenile Fish and Epifauna)

The number and location of sampling stations within the study area for the cable route in to Teesside and out to the 12nm limit depended to a large extent on local knowledge of fishermen and the crews of the MFV Lucia and MFV Stella Maris in particular. A survey with 12 stations each for the juvenile fish and epifauna was determined, with the sampling stations being parallel to the main otter trawl stations.

The fish and epifaunal surveys were scheduled for October to coincide with the recruitment of juvenile fish, especially flatfish species such as Dover sole, dab *Limanda limanda* and plaice which are abundant in Tees Bay during the late summer/early autumn.

2.2.4.1. Two Metre Beam Trawl Method

At each station a 2m scientific beam trawl with 10mm mesh and 5mm cod end liner was towed for 10 minutes. Each trawl commenced when the winch was locked and after 10 minutes, the trawl was hauled and the sample recovered. The total volume of the catch was measured and sorted with the fish species separated from the epifaunal invertebrates.

A survey log was maintained at all times. Any notable observations from individual trawls were recorded on the survey log (high amount of shell, rocks, cobbles, weed and other debris, including total catch volume).

Dispensation to catch and retain undersized fish and shellfish was gained from the North Eastern Inshore Fisheries and Conservation Authority (NEIFCA) to deploy static nets from a local vessel within the jurisdiction of the authority. Additional dispensation was requested and given by the Marine Management Organisation (MMO) in Newcastle, with an endorsement from the regional office in Grimsby, particularly with regard to the retention of cod in a recovery zone and whilst using nets with a mesh of 100mm.

Following extensive and irreparable damage to three nets, the decision was taken to abandon the scientific beam trawl survey until a more robust system could be manufactured.

Figure 6. Damaged beam trawl net during the October 2012 inshore survey

2.2.4.2. Beam Trawl Modification

Using local knowledge and suggested modifications to the 2-m beam trawl, a new modified beam trawl was constructed, which included the following changes to the original;

- a heavier frame to reduce damage when snagging on boulders,
- the removal of chains and intermittent discs on the fishing line,
- the re-rigging the fishing line with 4” rubber discs on a stainless steel wire,
- a heavy Dyneema chafer on the belly of the main net and cod end,

- a chain mesh 'stone catcher' to prevent cobbles and boulders passing down into the belly/cod end of the net,
- a heavier chain bridle and
- the use of a trawl bridle as the initial towing warp.

The new 2-m beam trawl was successfully deployed in May 2013 and was used to complete the survey.

Figure 7. Modified 2-m beam trawl frame without net

Figure 8. Recovery of modified 2-m beam trawl during the spring 2013 inshore beam trawl survey

3. Results

3.1. Autumn 2012 Surveys

The surveys commenced in September 2012. A range of surveys were undertaken including;

- Otter trawls
- Shellfish potting
- Trammel netting
- *Nephrops* trawling and,
- 2m scientific beam trawl (juvenile fish & epifauna).

3.2. Otter Trawl Survey

The otter trawl survey took place on 22nd and 23rd September, with each trawl run lasting approximately 30 minutes (figure 9 & table 2).

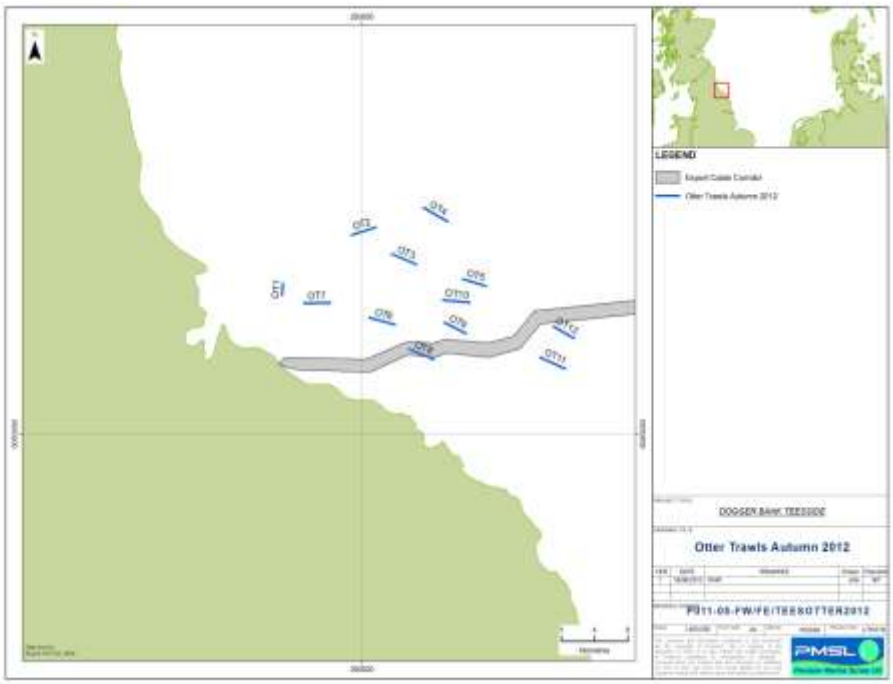

Figure 9. Distribution of otter trawl locations along the Dogger Bank Teesside A & B export cable corridor

Table 2. Otter Trawling Positional Data

		Fleet Start WGS 84				Fleet End WGS 84				
Station	Date	Deployment Time (GMT)	Latitude	Longitude	Depth (m)	Recovery Time (End)	Latitude	Longitude	Depth (m)	Duration (mm:ss)
OT1	22/09/2012	13:29:54	54.41.027N	001.01.641W	27.6	14.00.09	54.40.310N	001.01.641W	29.1	30:15
OT2	22/09/2012	15:11:09	54.44.230N	000.54.234W	50.3	15:41:26	54.44.790N	000.51.557W	53.9	30:17

OT3	22/09/2012	16:28:24	54.43.224N	000.49.610W	51	16:58:33	54.42.663N	000.46.759W	53.6	30:09
OT4	22/09/2012	17:55:27	54.46.158N	000.46.308W	58.5	18:28:38	54.45.378N	000.43.533W	59.4	33:11
OT5	23/09/2012	15:27:51	54.41.606N	000.38.884W	54.9	15:58:33	54.41.938N	000.41.510W	55.6	30:42
OT6	23/09/2012	07:18:22	54.39.259N	000.51.764W	46.6	07:48:29	54.38.924N	000.48.812W	49.9	30:07
OT7	23/09/2012	06:11:58	54.39.904N	000.59.131W	35.9	06:42:09	54.40.033N	000.56.197W	43.9	30:11
OT8	23/09/2012	08:20:06	54.37.494N	000.47.113W	47.9	08:50:29	54.36.939N	000.44.294W	48.3	30:23
OT9	23/09/2012	09:37:52	54.38.642N	000.40.828W	54.1	10:08:03	54.39.211N	000.43.316W	54.1	30:11
OT10	23/09/2012	10:46:29	54.40.594N	000.43.617W	54.9	11:16:44	54.40.525N	000.40.596W	56.9	30:15
OT11	23/09/2012	12:51:02	54.37.419N	000.32.397W	55.6	12:21:56	54.36.808N	000.29.551W	53.9	30:54
OT12	23/09/2012	13:47:16	54.38.703N	000.28.703W	59.4	14:18:22	54.39.351N	000.31.072W	54.5	31:06

3.2.1. Species Density and Diversity

Figure 10 illustrates the species retained at all sampling stations. In total, 14 species of fish were recorded. The most abundant species recorded was whiting, representing 37% of the total catch.

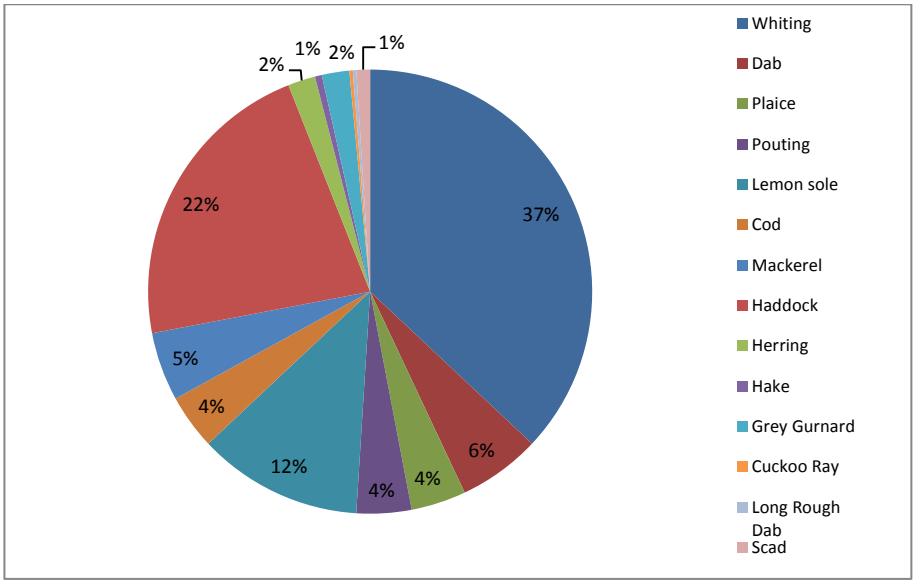

Figure 10. Overall abundance of fish species for all sampling stations

Figure 11 provides information on the relative abundance of key species retained at all sampling stations and the contribution they made towards the total abundance recorded.

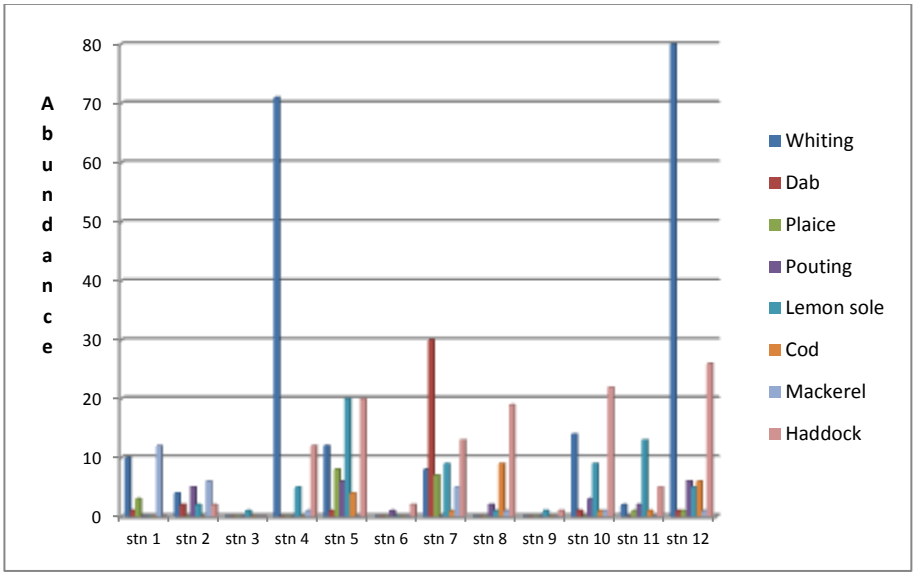

Figure 11. Abundance of key species for individual fleets

In addition to the fish species captured, four species of mobile invertebrate were also recorded, as well as the sedentary Cnidarian species commonly referred to as dead man's fingers *Alcyonium digitatum.* The four mobile invertebrates captured were the European squid *Loligo vulgaris* with one individual captured at stations 4 and 7 each, a solitary *Nephrops* was recorded at station 7, whilst six queen scallops *Aequipecten opercularis* were recorded from the trawl at station 11.

The sea urchin *Echinus esculentus* was the commonest invertebrate species observed, albeit in low abundance (12 in total), urchins are more usually an indicator of particularly hard ground and the species was recorded at four stations (5, 6, 8 & 9).

Table 3 gives total catch for fish and invertebrates and the species diversity for all sampling stations.

Table 3. Species Diversity and Abundance from the Otter Trawl Survey.

Species (Common name)	Species (Latin name)	stn 1	stn 2	stn 3	stn 4	stn 5	stn 6	stn 7	stn 8	stn 9	stn 10	stn 11	stn 12	Total
Whiting	*Merlangius merlangus*	10	4	0	71	12	0	8	0	0	14	2	80	**201**
Dab	*Limanda limanda*	1	2	0	0	1	0	30	0	0	1	0	1	**36**
Plaice	*Pleuronectes platessa*	3	0	0	0	8	0	7	0	0	0	1	1	**20**
Pouting	*Trisopterus luscus*	0	5	0	0	6	1	0	2	0	3	2	6	**25**
Lemon sole	*Microstomus kitt*	0	2	1	5	20	0	9	1	1	9	13	5	**66**
Cod	*Gadus morhua*	0	0	0	0	4	0	1	9	0	1	1	6	**22**
Mackerel	*Scomber scombrus*	12	6	0	1	0	0	5	1	0	1	0	1	**27**
Haddock	*Melanogrammus aeglefinus*	0	2	0	12	20	2	13	19	1	22	5	26	**122**
Herring	*Clupea harengus*	0	7	0	0	0	0	0	0	1	0	0	1	**9**
European squid	*Loligo vulgaris*	0	0	0	1	0	0	1	0	0	0	0	0	**2**
Hake	*Merluccius merluccius*	0	0	0	0	1	0	0	0	0	1	0	0	**2**
Grey Gurnard	*Eutrigla gurnardus*	0	0	0	0	1	0	5	0	0	0	0	3	**9**
Cuckoo Ray	*Raja naevus*	0	0	0	0	1	0	0	0	0	0	0	0	**1**
Long Rough Dab	*Hippoglossoides platessoides*	0	0	0	0	0	1	0	0	0	0	0	0	**1**
Scad	*Trachurus trachurus*	0	0	0	0	0	1	0	1	0	1	1	0	**4**
Prawn	*Nephrops norvegicus*	0	0	0	0	0	0	1	0	0	0	0	0	**1**
Alcyonium	*Alcyonium digitatum*	0	0	0	0	0	0	0	P	0	0	0	0	**0**
Queen Scallop	*Aequipecten opercularis*	0	0	0	0	0	0	0	0	0	0	6	0	**6**
Sea Urchin	*Echinus esculentus*	0	0	0	0	3	1	0	6	2	0	0	0	**12**
Total abundance		**26**	**28**	**1**	**90**	**77**	**6**	**80**	**39**	**5**	**53**	**31**	**130**	**566**
Total diversity		**4**	**7**	**1**	**5**	**11**	**5**	**10**	**8**	**4**	**9**	**8**	**10**	**19**

3.2.2. Individual Sampling Station Composition

3.2.1.1. Station 1

Mackerel represents 46% of the total catch at station 1 and Whiting contributed 38% (figure 12).

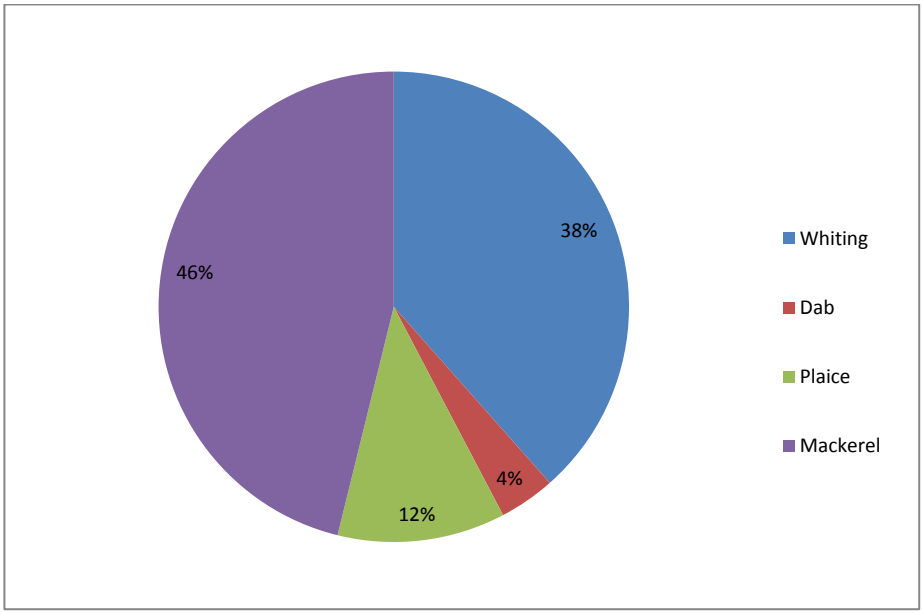

Figure 12. Percentage composition of species at station 1

3.2.1.2. Station 2

Herring represents 25% of the total catch and mackerel contributes 22% (figure 13).

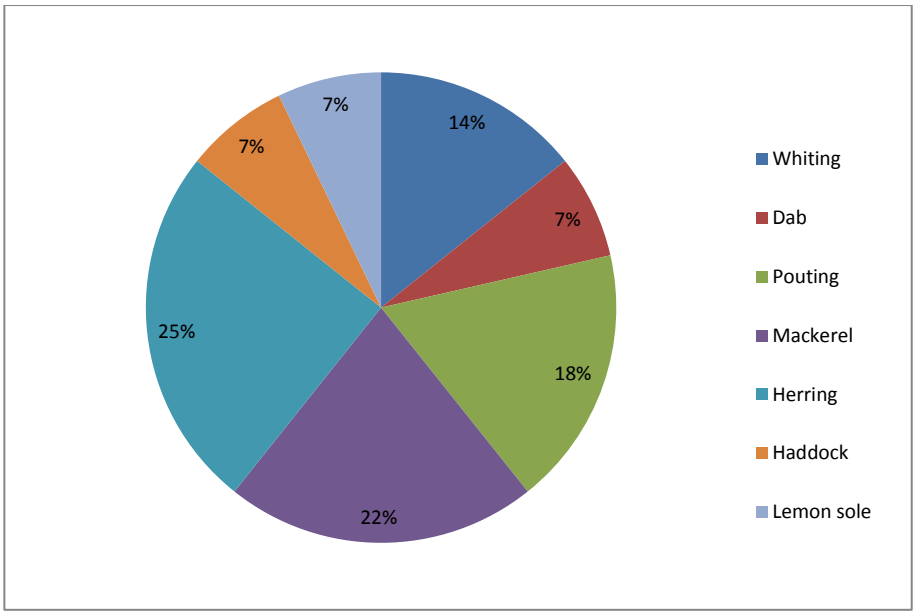

Figure 13. Percentage composition of species in station 2

3.2.1.3. Station 3

At station 3, one lemon sole was recorded.

3.2.1.4. Station 4

Whiting contributed 79% of the total abundance recorded at station 4 and haddock contributed 13% (Figure 14). A high abundance was observed at station 4, however species diversity was low.

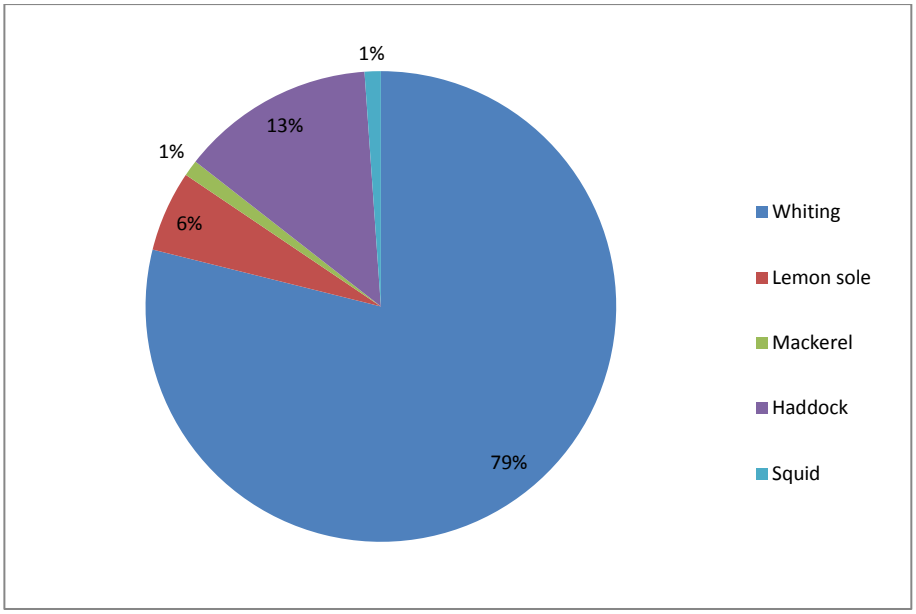

Figure 14. Percentage composition of species in station 4

3.2.1.5. Station 5

High species diversity was recorded at station 5. Haddock and lemon sole were the most abundant species at station 5, each contributing 26% towards the total catch (Figure 15).

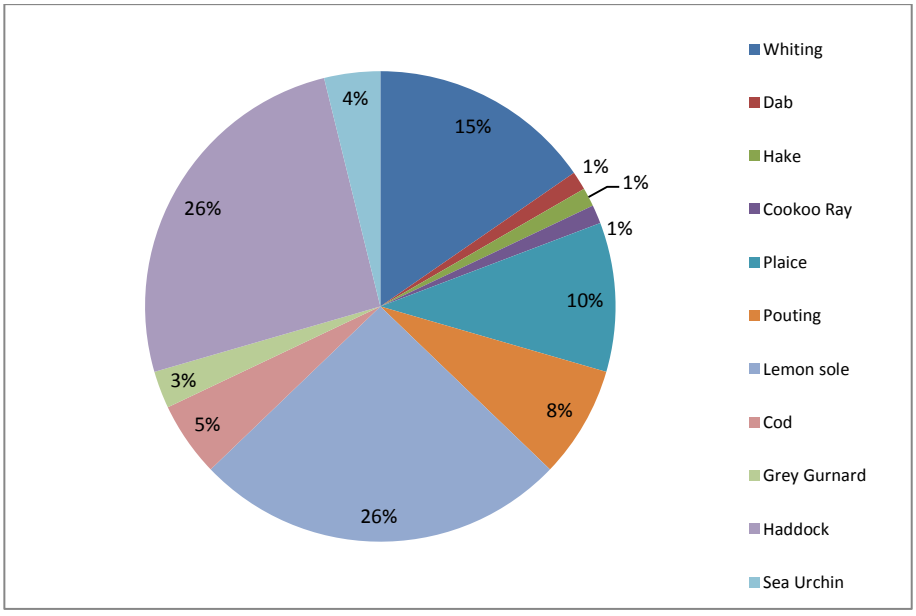

Figure 15. Percentage composition of species at station 5

3.2.1.6. Station 6

station 6 recorded a very low abundance and species diversity, with haddock contributing 33% of the total catch (Figure 16).

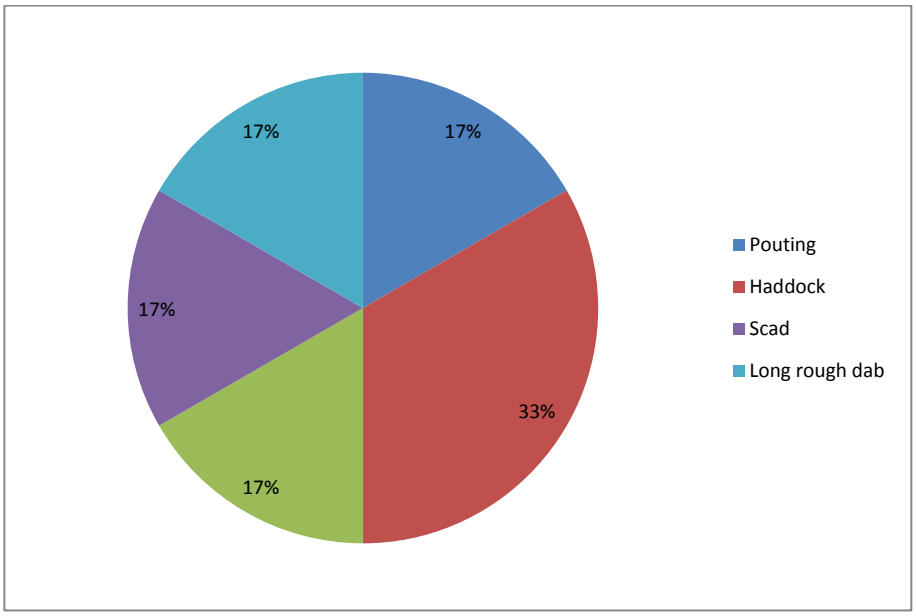

Figure 16. Percentage composition of species in station 6

3.2.1.7. Station 7

Dab represents 40% of the total catch at station 7, and haddock was the second most abundant species with 17%.

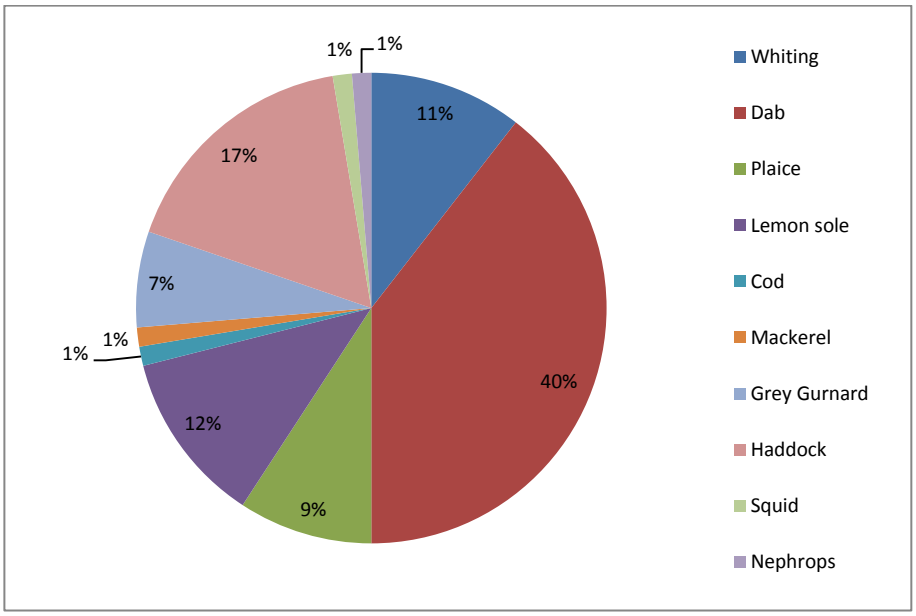

Figure 17. Percentage composition of species in station 7

3.2.1.8. Station 8

Haddock represents 49% of the total catch at station 8, cod represents 23%, and the sea urchin contributed 15% of the total abundance (figure 18).

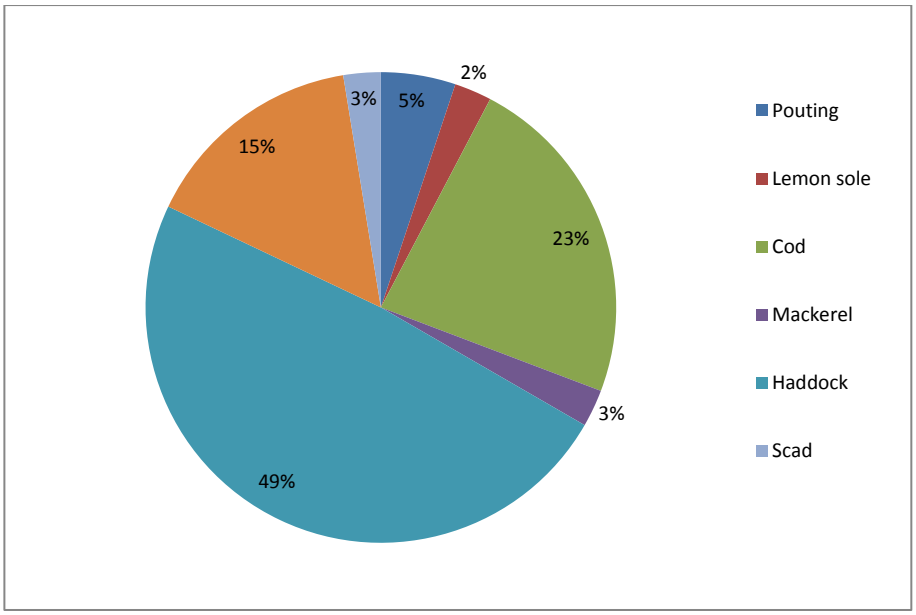

Figure 18. Percentage composition of species in station 8

3.2.1.9. Station 9

Four species were recorded at station 9, of which the sea urchin contributed 40% (figure 19).

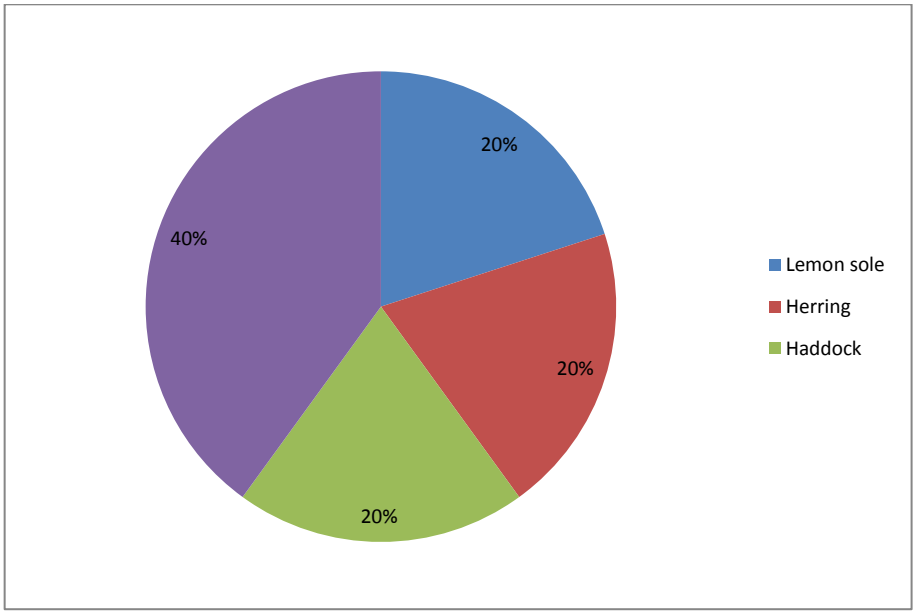

Figure 19. Percentage composition of species in station 9

3.2.1.10. Station 10

Haddock dominated the catch at station 10 representing 41% of the total catch. Whiting was the second most abundant species at this station with 26%. Lemon sole contributed 17%, pouting 6%, with the remaining species each contributing 2% towards the total catch. Station 10 recorded the third highest species diversity (9 spp.).

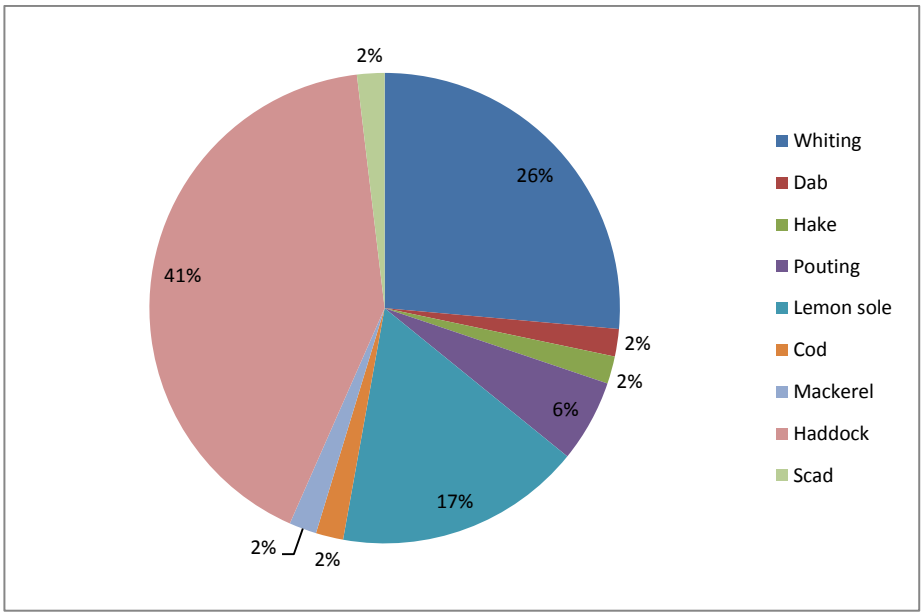

Figure 20. Percentage composition of species in station 10

3.2.1.11. Station 11

At station 11, the lemon sole represents 42% of the total catch. Haddock contributed 16%, with pouting and whiting each representing 7% (Figure 21).

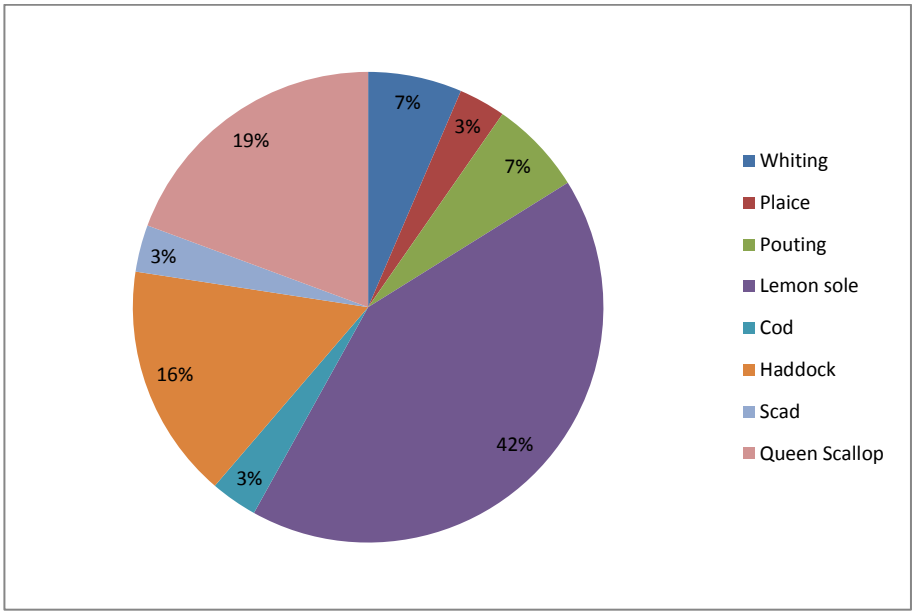

Figure 21. Percentage composition of species in station 11

3.2.1.12. Station 12

The catch at station 12 was dominated by whiting (61%), with haddock contributing 20%, whilst cod represented 5%, with pouting and lemon sole each contributing 4%. The grey gurnard represented 2% of the total abundance, whilst all remaining species each contributed 1%. The largest abundance (130) was recorded at station 12 and the second highest species diversity (10 spp.).

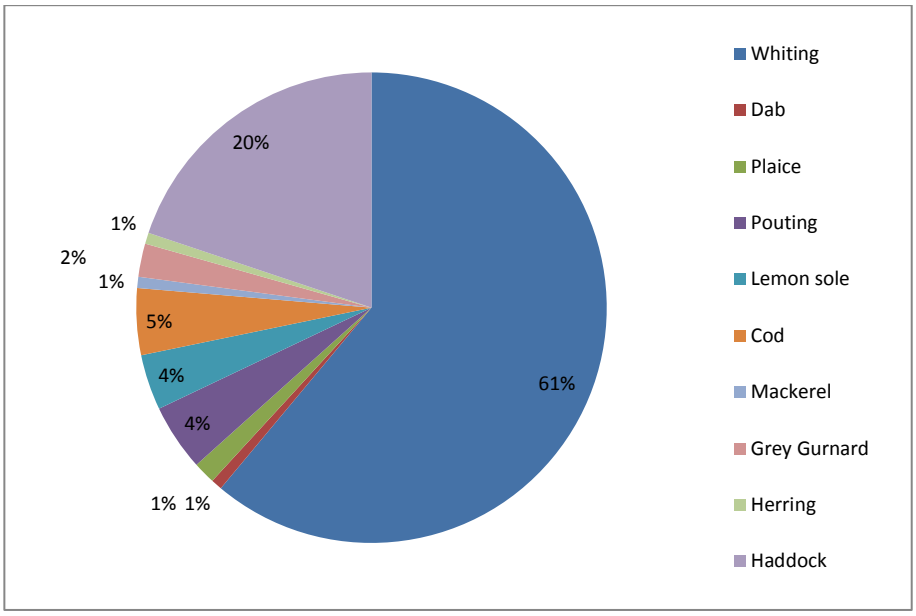

Figure 22. Percentage composition of species at station 12

3.2.2. Length Frequency Analysis

Due to a low abundance of species within the dataset for the otter trawling survey, length frequency charts could only be compiled for whiting, dab, pouting, lemon sole and haddock.

3.2.2.1. Whiting

The most abundant length frequency group recorded for whiting was the 220 - 229mm which is below the minimum landing size (MLS) of 270 mm. Wheeler (1969) states that growth rates for whiting vary by population; however as a general rule for the current survey, the most abundant length class identified (220 – 229mm), appear to be Intermediate two to three year old fish, with no whiting of a smaller size retained. This is likely a function of the mesh size used in the net i.e. 100mm, and that whiting below 220mm will have been lost through the meshes. It should be noted that 60% of the whiting landed throughout the otter trawl survey were above the MLS.

Figure 23 indicates the distribution of size classes by frequency.

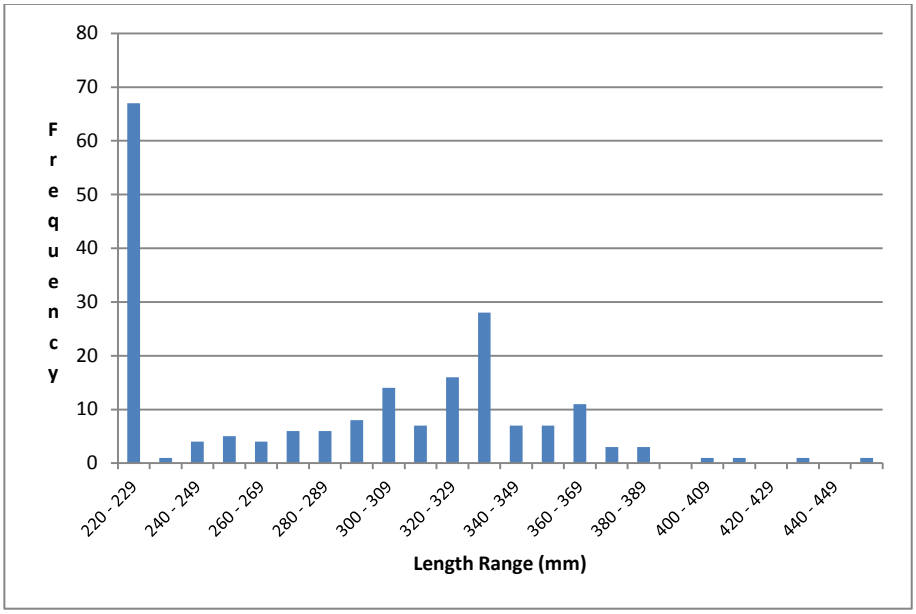

Figure 23. Whiting length frequency data

3.2.2.2. Dab

The largest length range frequency for dab was observed at the 220 – 229 mm length range (7), with a few dab recorded at length ranges above 250mm. Dab are typically slow growing; long lived species of flatfish. The larger numbers of dab were recorded at the lower size ranges as seen in figure 24, however the majority of these fish are adolescents and mature adults, very few juveniles were retained as a result of the mesh size of the net.

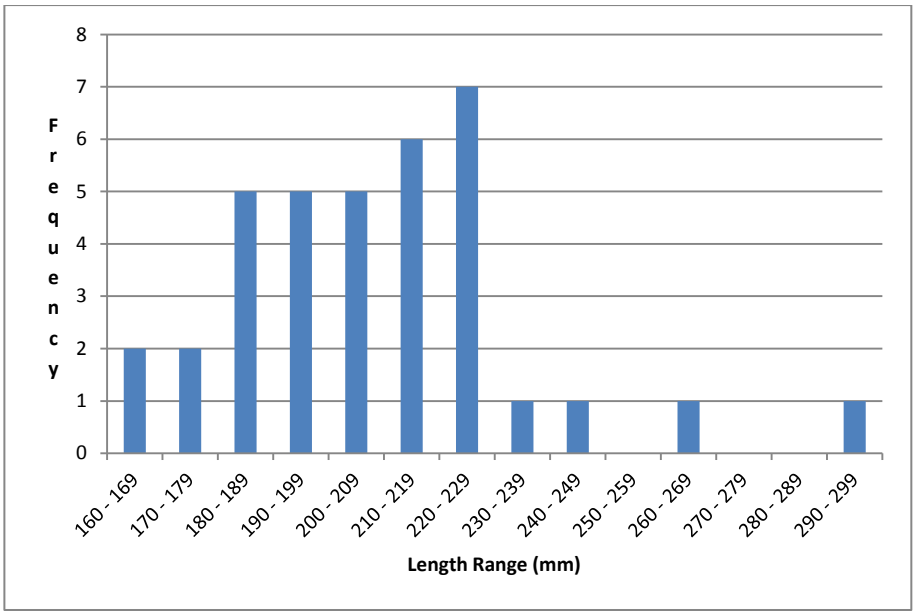

Figure 24. Dab length frequency data

3.2.2.3. Pouting

The largest abundance length frequency for pouting was 220 – 229 mm, whilst the smallest size class was the 110 and 119mm length range (Figure 25).

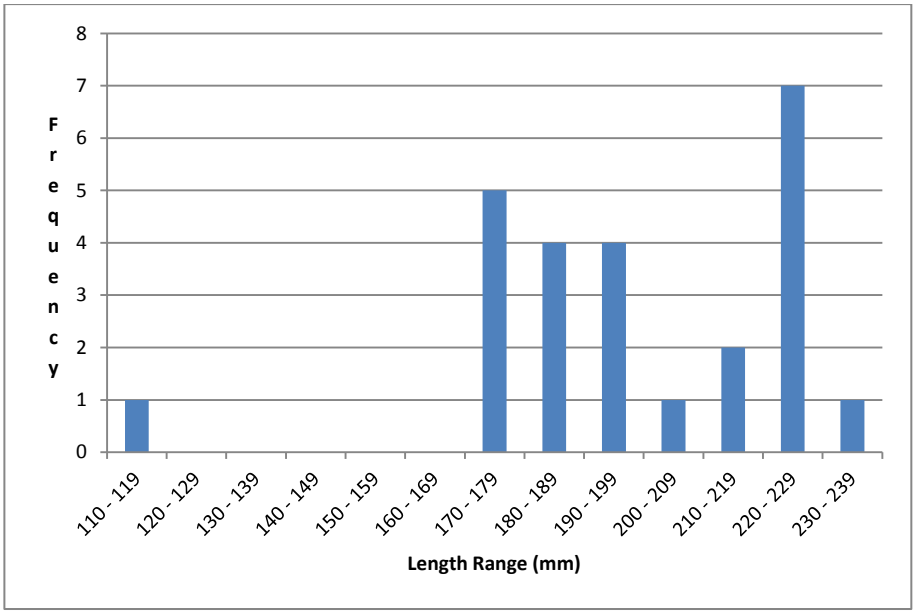

Figure 25. Pouting length frequency data

3.2.2.4. Lemon sole

The length frequency data for lemon sole show that a wide range of sizes were encountered during the otter trawl survey, although the smaller size classes were not well represented. Wheeler (1969) observes that there is considerable variation in length by age for lemon sole and there is considerable variation from ground to ground.

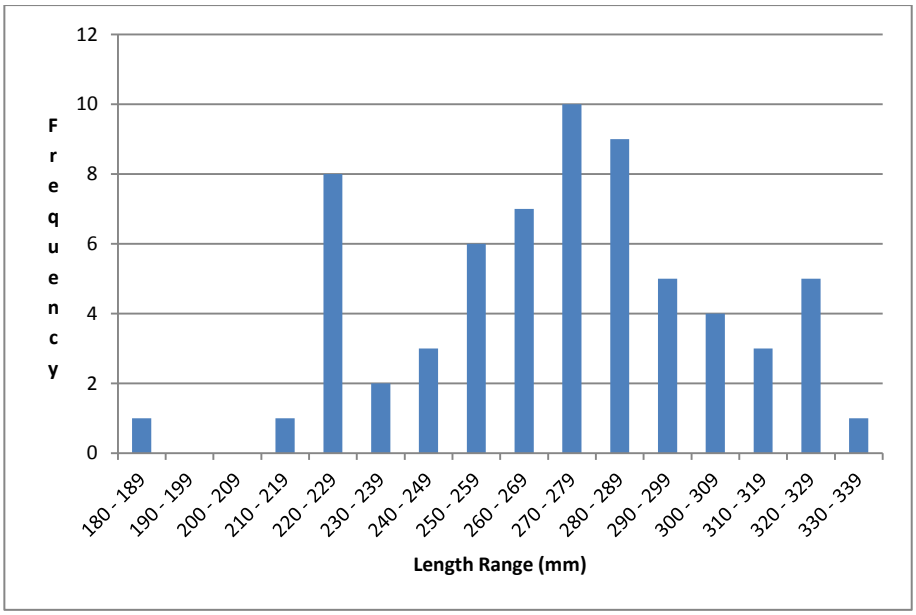

Figure 26. Lemon sole length frequency data

3.2.2.5. Haddock

The most abundant size class identified within haddock length frequency data was the 330-339mm size range, although all haddock captured in the otter trawl survey were above the MLS of 300 mm. As seen previously in the length frequency data, the mesh size used in the trawl is directly linked to the range of lengths recorded, with juvenile fish being either absent or in low abundance; this is also the case with the haddock length frequency data, which show no size classes below 320mm.

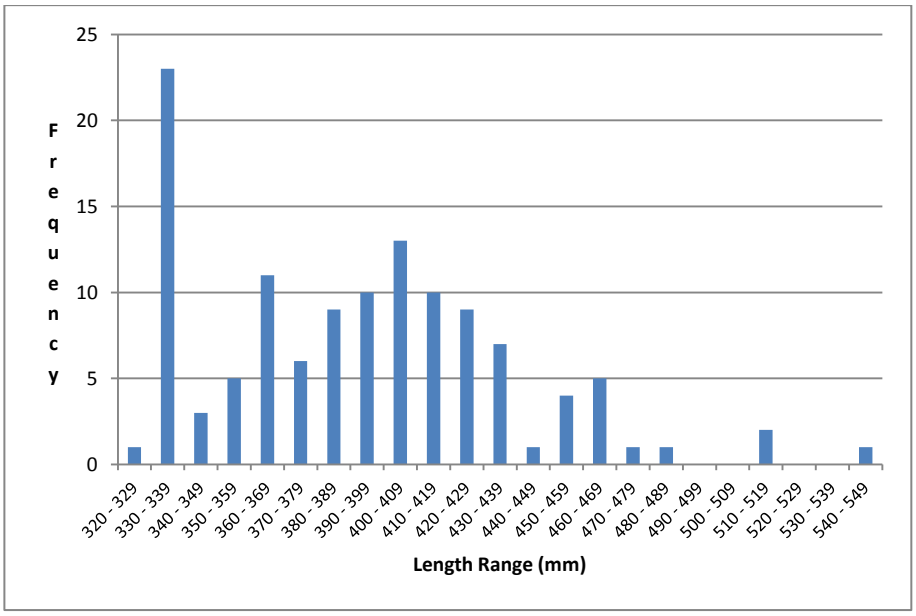

Figure 27. Haddock length frequency data

3.2.3. Sex Ratios and Spawning Potential

An analysis of the ratio of males to females was undertaken on a range of abundant species and or species of commercial importance, in addition the sex of elasmobranch species was also noted, although for the summer/autumn otter trawl survey the incidence of elasmobranches was observed to be particularly low, with just one species, a male cuckoo ray recorded. Figure 28 indicates the percentage composition of males and females. This shows that in general terms, females of most species are more abundant than males, with the exception of hake (all males) and herring (all females).

The female:male ratio was approximately 4:1 for cod, whiting and mackerel 3:1 for haddock, plaice and lemon sole and 2:1 for dab.

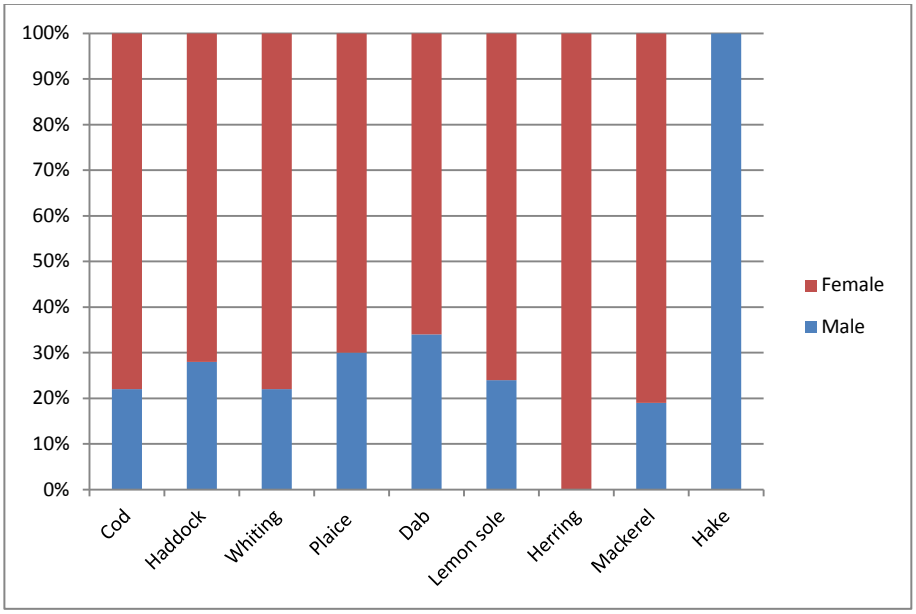

Figure 28. Percentage composition of females to males

With the exception of herring and mackerel, there was no evidence of maturing gonads in any of the fish examined. In the case of the herring, approximately 50% were considered to be 'running' when light pressure was applied to the body, the remainder appeared spent indicating that they had recently spawned. The mackerel were considered to be maturing were not running ripe.

3.2.4. Statistical Analysis of Otter Trawl Data

Simple multivariate analysis was used to examine patterns in similarity between the survey fish data collected during September 2012 and May 2013. Classification (cluster analysis) of the data was undertaken using the Bray-Curtis similarity coefficient and grouped average (UPGMA) clustering technique followed by a non-metric MDS (multi dimensional scaling) ordination in PRIMER. Cluster analysis is used to display graphically the similarity between sites based upon their species composition. Similarity between sites is expressed using the Bray-Curtis similarity coefficient (0% indicating no species in common and 100% indicating an identical community).

These values are used in a dendrogram to link groupings of sites with similar species composition at a predefined level of similarity.

Non metric MDS graphically displays the (rank) similarity between sites as a 2 dimensional plot in which the distances between sites indicates the level of similarity between them. The stress value associated with an MDS plot indicates how faithful the plot is in representing the similarity between sites with low values (below 0.2) generally indicating a good fit. The SIMPROF test within PRIMER was used to identify groups of sites that differed significantly in terms of species composition.

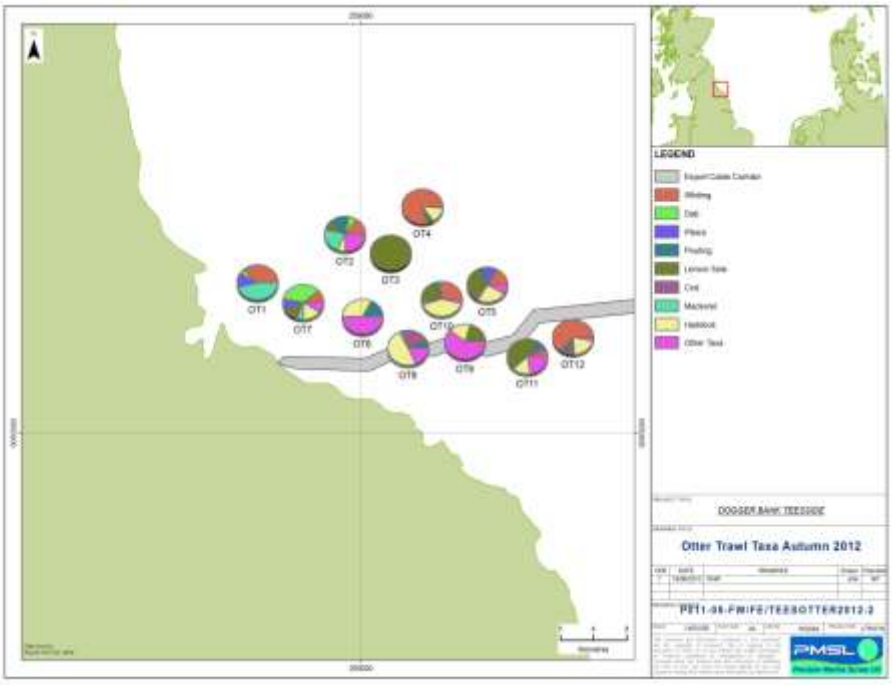

Figure 29. Distribution of taxa groups for the otter trawl survey along the Dogger Bank Teesside A & B export cable corridor

Figure 29 illustrates the range of key and abundant species present at each otter trawl station. Table 4 provides information on fish assemblage groups according to similarity. This analysis shows that in the otter trawls dataset , there are three cluster groups (Figure 30).From these analyses, Group A is defined by a single species (lemon sole) at station OT3, Group B includes sampling stations OT6 and OT9 gives with an average similarity of 40.70% and, Group C comprises the remaining sampling stations (OT1, 2, 4, 5, 7, 8, 10, 11 & 12) withan average similarity of 47.06%.

Table 4. Cluster analysis and group identification

Cluster Groups Species Contributions (SIMPER)			
	Group a (OT 3)		
Species	Abundance (per hr)		
Lemon sole	0.50		
	Group b (OT6, 9)		
	Average similarity: 40.70		
Species	Av.Abund (per hr)	% of Stations	Cum.% Contribution
Haddock	0.75	100	50.03
Sea Urchin	0.75	100	100
	Group c (OT1, 2, 4, 5, 7, 8, 10, 11, 12)		
	Average similarity: 47.06		
Species	Av.Abund (per hr)	% of Stations	Cum.% Contribution
Haddock	6.80	88.89	25.02
Whiting	11.78	88.89	48.99
Lemon sole	3.65	88.89	65.64
Mackerel	1.52	77.78	74.57
Pouting	1.36	66.67	82.48
Cod	1.25	66.67	87.83
Dab	2.02	66.67	92.67

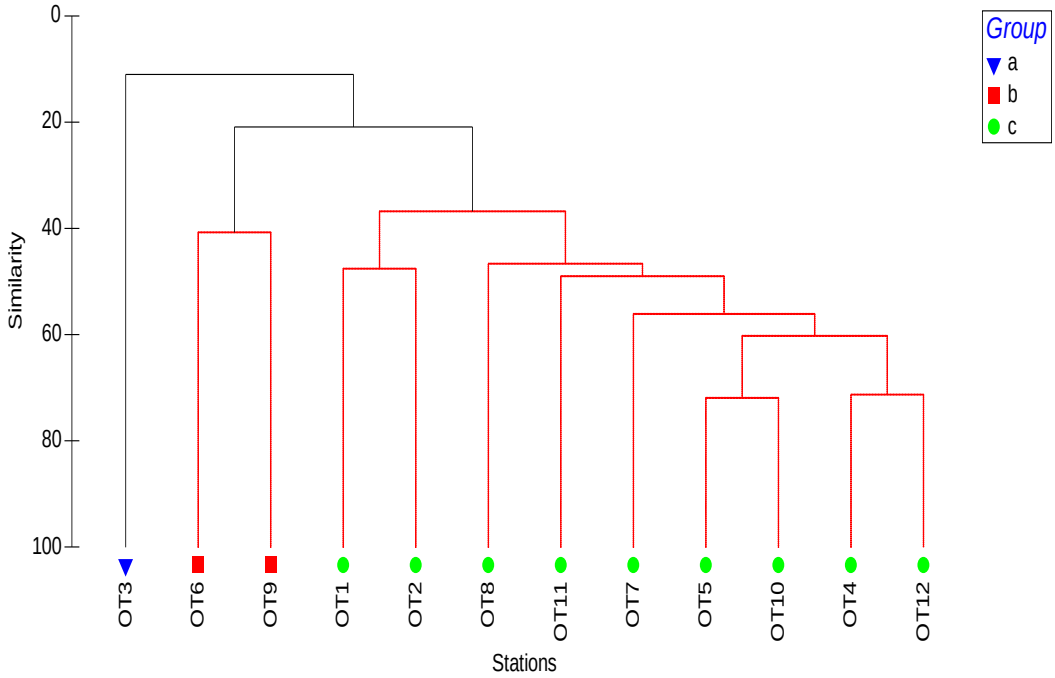

Figure 30. Dendrogram showing otter trawl cluster groups

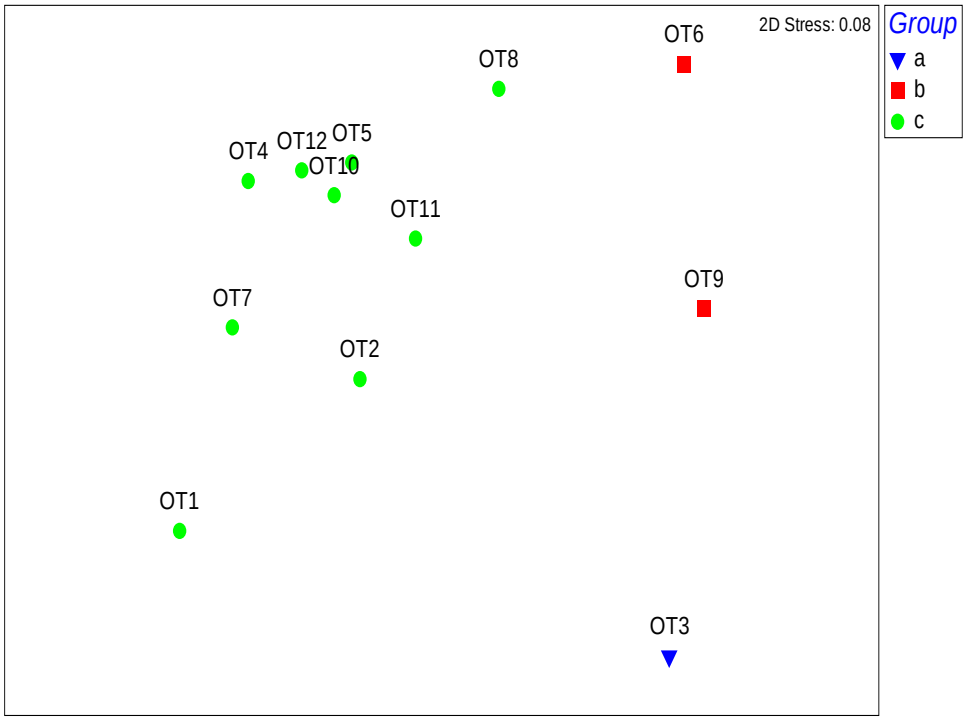

Figure 31. MDS plot of cluster groups

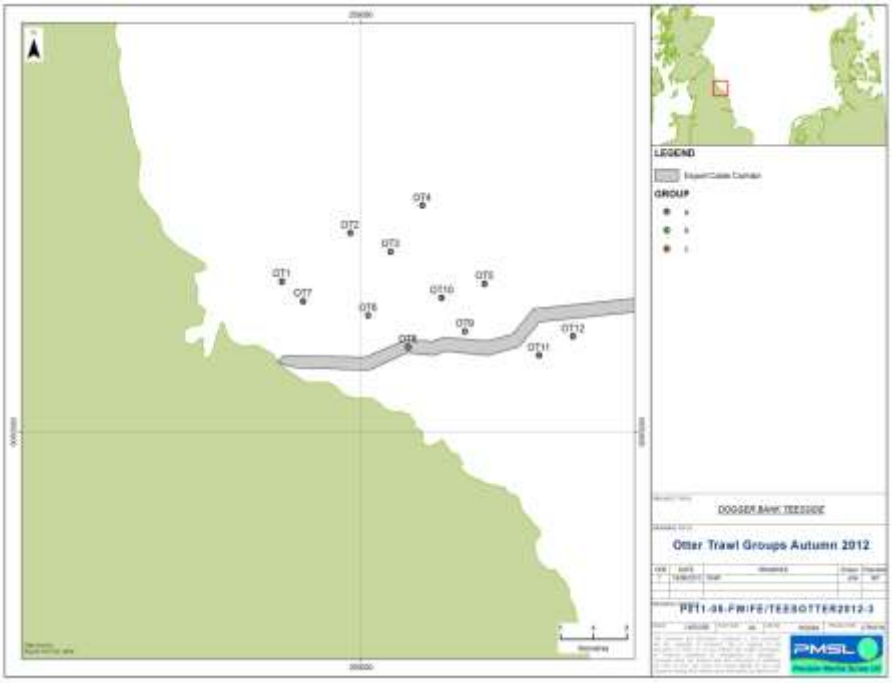

Figure 32. Distribution of cluster groups for the otter trawl survey along Dogger Bank Teesside A & B export cable corridor

Table 5. Total catch summary per hour

Species	Total	Average	% of Stations	Total Number per hour
Whiting	201	16.75	66.67	32.80
Dab	36	3.00	50.00	5.87
Plaice	20	1.67	41.67	3.26
Pouting	25	2.08	58.33	4.08
Lemon sole	66	5.50	83.33	10.77
Cod	22	1.83	50.00	3.59
Mackerel	27	2.25	58.33	4.41
Haddock	122	10.17	83.33	19.91
Herring	9	0.75	25.00	1.47
European squid	2	0.17	16.67	0.33
Hake	2	0.17	16.67	0.33
Grey Gurnard	9	0.75	25.00	1.47
Cuckoo Ray	1	0.08	8.33	0.16
Sea Urchin	12	1.00	33.33	1.96
Long Rough Dab	1	0.08	8.33	0.16
Scad	4	0.33	33.33	0.65
Prawn	1	0.08	8.33	0.16
Alcyonium	P	P	8.33	P
Queen Scallop	6	0.50	8.33	0.98

3.3. Trammel Netting

The Trammel net survey was carried out over a two day period beginning 17th September; giving soak periods of up to 19 hours (figure 29).

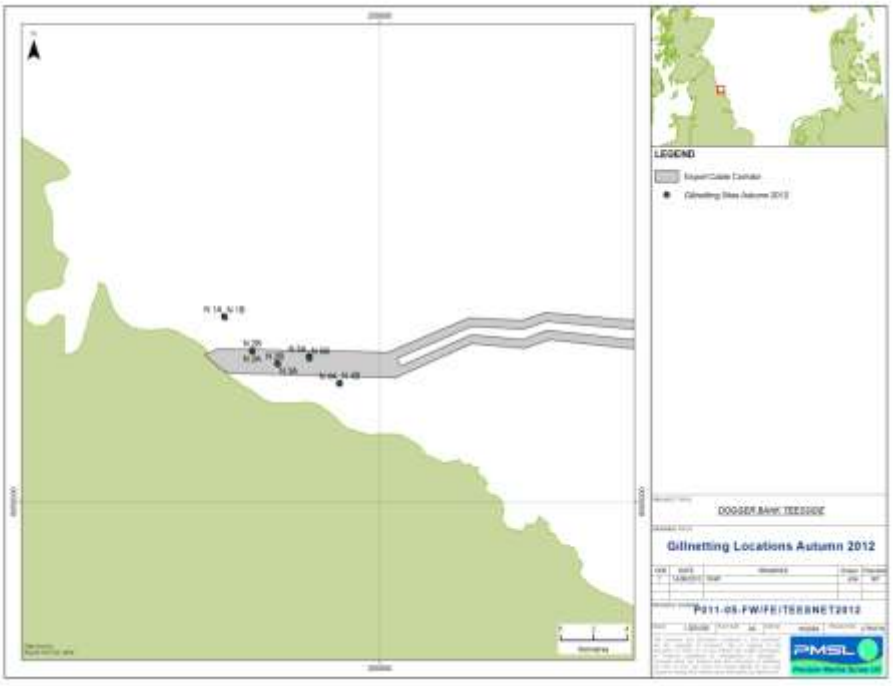

Figure 33. Distribution of survey trammel nets fleets along the Dogger Bank Teesside A & B export cable corridor

Table 4. Trammel Netting Positional Data Schedule

Station	Date	Fleet Start Deployment Time (GMT)	Fleet Start WGS 84 Latitude	Fleet Start WGS 84 Longitude	Depth (m)	Recovery Date (End)	Recovery Time (End)	Fleet End WGS 84 Latitude	Fleet End WGS 84 Longitude	Soak time (hh:mm)
N 1A	17/09/2012	07:10:00	54.37.505N	001.01.115W	7.9	17/09/2012	19:38:00	54.37.489N	001.01.074W	12:28
N 1B	17/09/2012	20:07:00	54.37.489N	001.01.089W	8.3	18/09/2012	07:51:00	54.37.509N	001.01.077W	10:44
N 2A	17/09/2012	07:56:00	54.36.506N	000.59.429W	6.6	17/09/2012	17:31:00	54.36.511N	000.59.448W	09:35
N 2B	17/09/2012	17:24:00	54.36.518N	000.59.460W	6.7	18/09/2012	09:29:00	54.36.528N	000.59.488W	16:05
N 3A	17/09/2012	08:54:00	54.36.172N	000.57.998W	5.3	17/09/2012	16:45:00	54.36.171N	000.57.986W	07:51
N 3B	17/09/2012	17:01:00	54.36.169N	000.57.981W	5.6	18/09/2012	12:25:00	54.36.166N	000.57.978W	17:24
N 4A	17/09/2012	10:17:00	54.35.675N	000.54.470W	19.3	17/09/2012	17:23:00	54.35.694N	000.54.503W	07:06
N 4B	17/09/2012	17:45:00	54.35.696N	000.54.456W	18.9	18/09/2012	12:50:00	54.35.688N	000.54.427W	19:05
N 5A	17/09/2012	12:00:00	54.36.453N	000.56.255W	16.7	17/09/2012	17:58:00	54.36.443N	000.56.251W	05:58
N 5B	17/09/2012	18:35:00	54.36.396N	000.56.231W	16.3	18/09/2012	07:08:00	54.36.433N	000.56.231W	12:33

3.3.1. Species Density and Diversity

In total, twelve species of fish and three species of crustacea were recorded from the five fleets during the trammel netting survey following two deployments of the gear. The most abundant species recorded was the brown crab, which represented 74% of the total catch. Dab was the most abundant species of fish contributing 11% of the total catch, but representing 54% of the total fish recorded.

Whiting, Dover sole, cod and dab accounted for 84% of the total fish abundance Plaice, pouting and the lesser spotted dogfish were present in lower numbers and the remaining species were recorded on just a single occasion. Figure 34 illustrates the range of key species retained in the sampling nets and the percentage contribution they made towards the total abundance recorded.

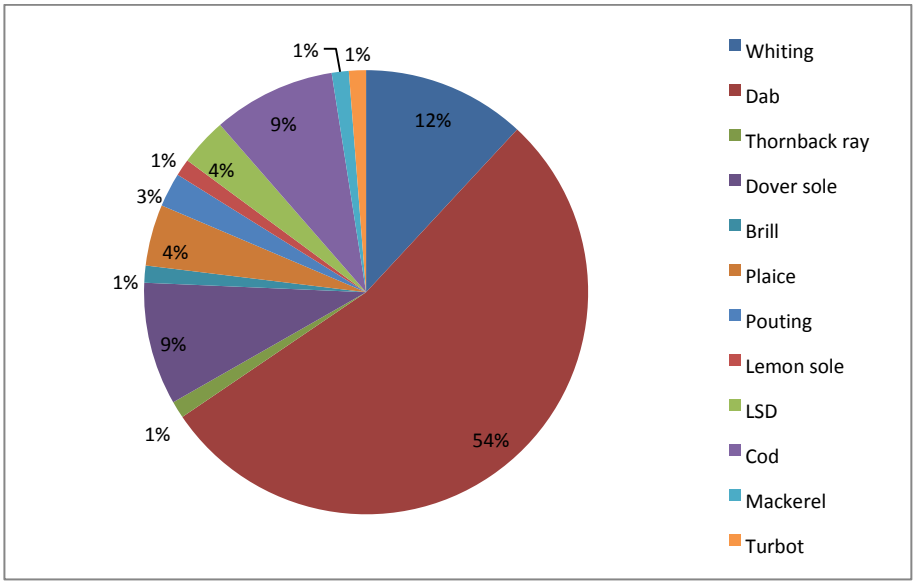

Figure 34. Abundance of key fish species within individual sampling fleets

Figure 34. Overall abundance of key fish species for all trammel net fleets

As outlined previously, crustacean shellfish, in particular the brown crab, were abundant in trammel nets and represented approximately 92% of all shellfish captured. Female brown crab outnumbered males by a factor of 2:1.. Table 5 gives absolute catch densities and the diversity for individual sampling stations.

Table 5. Species diversity and abundance from the autumn 2012 trammel net survey.

Species (Common Name)	Species (Latin Name)	stn 1	stn 2	stn 3	stn 4	stn 5	Total
Whiting	*Merlangius merlangus*	3	6	1	0	0	10
Dab	*Limanda limanda*	19	12	14	2	0	47
Thornback ray	*Raja clavata*	0	1	0	0	0	1
Dover sole	*Solea solea*	1	4	2	0	1	8
Brill	*Scophthalmus rhombus*	0	0	0	1	0	1
Plaice	*Pleuronectes platessa*	2	1	1	0	0	4
Pouting	*Trisopterus luscus*	0	1	0	0	1	2
Lemon sole	*Microstomus kitt*	0	1	0	0	0	1
LSD	*Scyliorhinus canicula*	2	0	1	0	0	3
Cod	*Gadus morhua*	1	3	0	3	1	8
Mackerel	*Scomber scombrus*	0	0	1	0	0	1
Turbot	*Psetta maxima*	0	2	0	0	0	2
Brown crab	*Cancer pagurus*	14	120	178	0	3	315
Lobster	*Homarus gammarus*	1	7	4	2	0	14
Velvet crab	*Necora puber*	1	1	0	10	0	12
Total abundance		44	159	202	18	6	429
Total diversity		9	12	8	5	4	15

It should be noted that no species was present at all of the sampling stations, with the lowest abundance recorded at sampling station 5 (6 individuals), which also produced the lowest species diversity (4 spp.). The highest sample abundance was recorded at station 3 (202 individuals), whilst station 2 was also comparably high in abundance; the greatest diversity (12 spp.) was also recorded at station 2. The data in table 5 show that the increased abundance at these stations was primarily due to the presence of brown crab.

Figure 31 illustrates the key fish species retained in the sampling nets and the total abundance recorded.

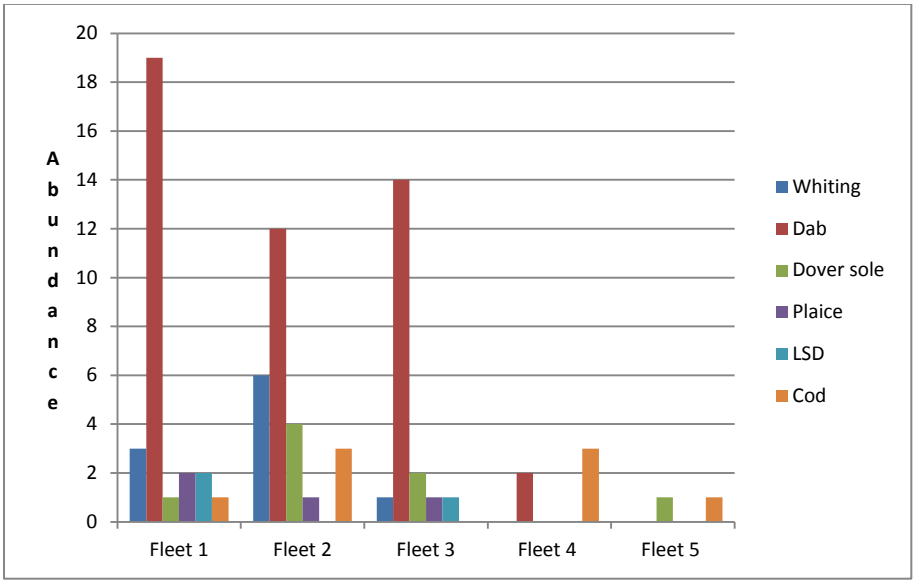

Figure 35. Abundance of key fish species within individual sampling fleets

3.3.2. Individual Sampling Station Composition

3.3.2.1. Station 1

The catch composition of station 1 was dominated by the dab, representing 43% of the total catch, whilst the brown crab contributed 32%, the whiting was recorded at 7%, with lesser spotted dogfish (LSD) and plaice at 5% each.

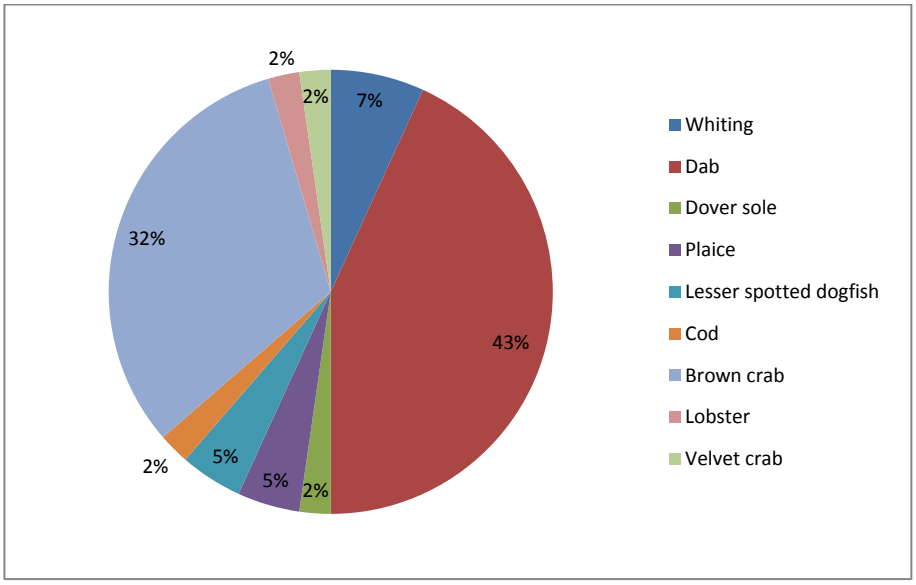

Figure 36. Percentage composition of species at station 1

3.3.2.2. Station 2

The brown crab dominated the catch composition of station 2 representing 76% of the total catch; dab contributed 7%, with lobster and whiting both contributing 4%. The remaining species contributed between 1% and 3%. Station 2 produced the highest species diversity (12 spp.).

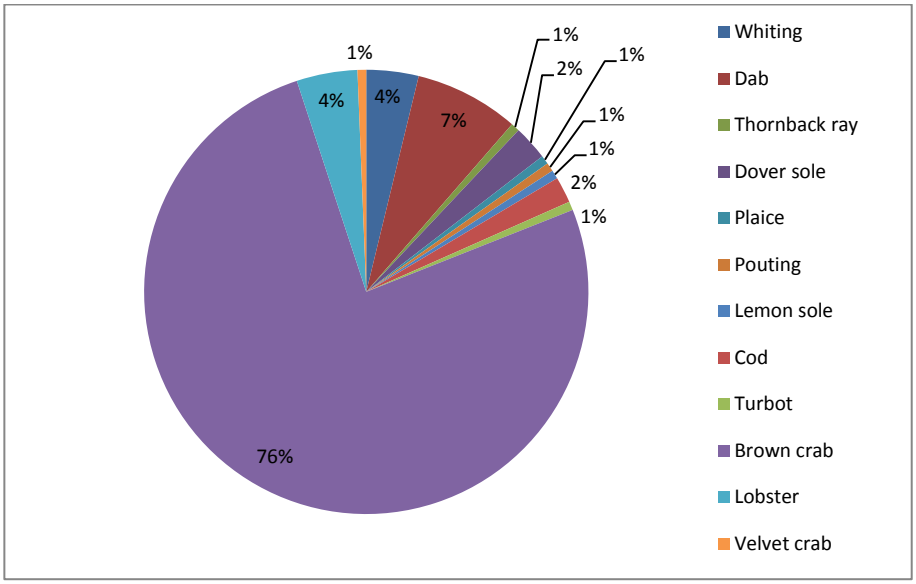

Figure 37. Percentage composition of species at station 2

3.3.2.3. Station 3

Station 3 recorded the highest abundance (202) with brown crab contributing 88% (Figure 38).

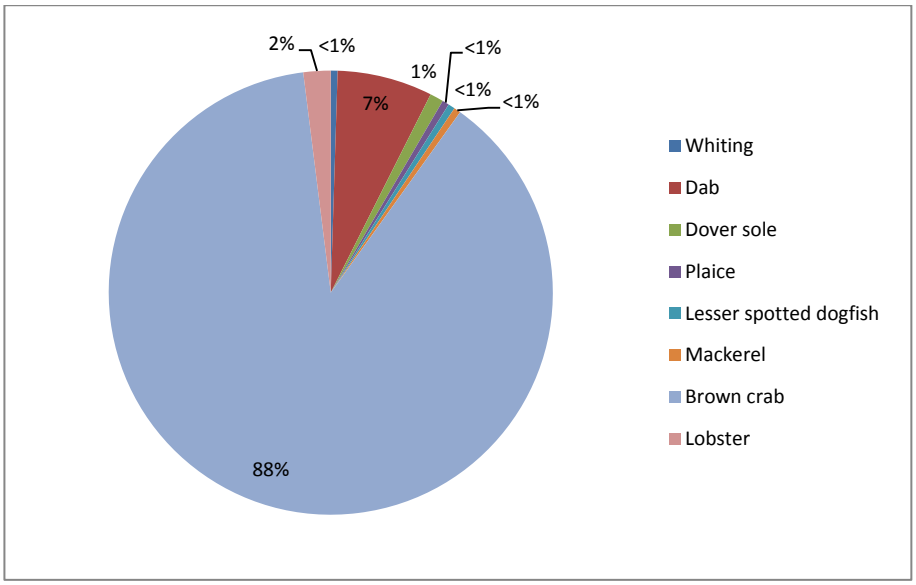

Figure 38. Percentage composition of species at station 3

3.3.2.4. Station 4

The catch composition of station 4 was dominated by the velvet crab, representing 56% of the total abundance, whilst cod contributed 17% (figure 39).

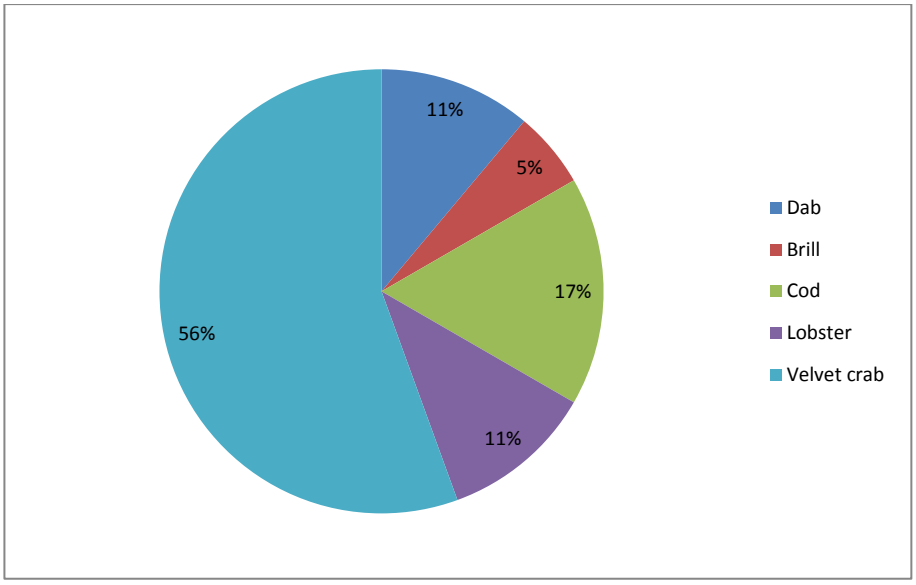

Figure 39. Percentage composition of species at station 4

3.3.2.5. Station 5

Brown crab was the most abundant species at station 5 representing 50% of the total catch, whilst pouting, Dover sole and cod each represented less than 17%. Station 5 produced the lowest abundance (6), and lowest species diversity (4 spp.).

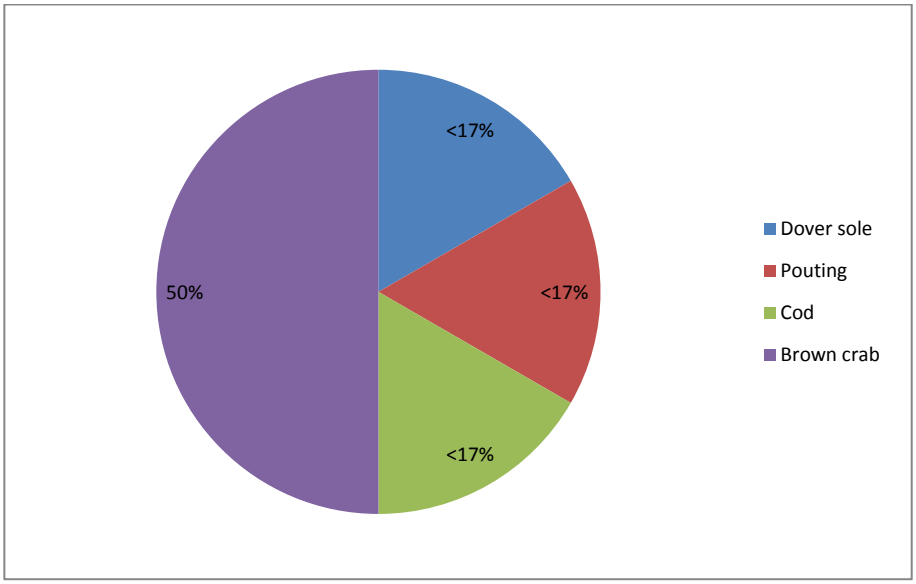

Figure 40. Percentage composition of species at station 5

3.3.3. Length Frequency Analysis

Due to a low abundance of species within the gill/trammel netting survey, length frequency charts were only able to be compiled for dab and male and female brown crab.

3.3.3.1. Dab

Figure 41 shows that the largest length frequency recorded for dab was the 250 - 259mm class.

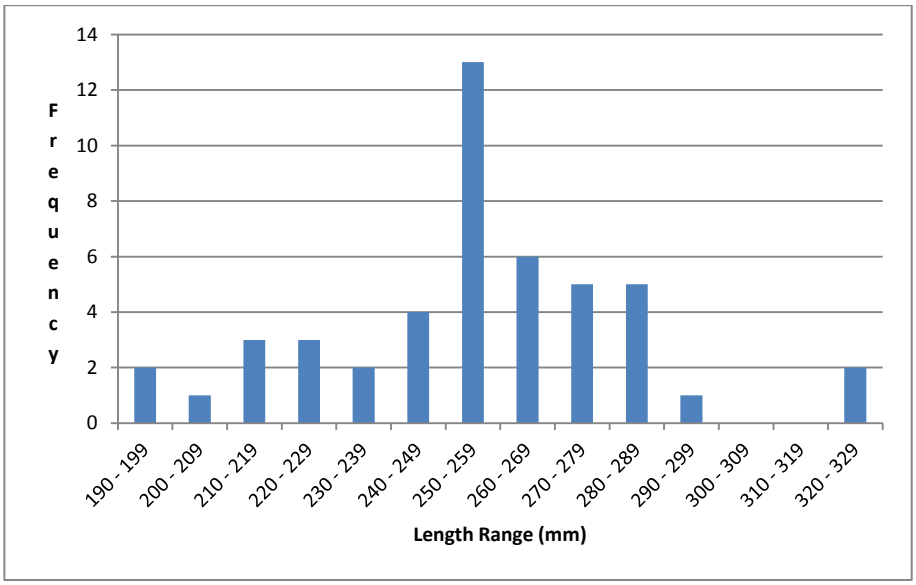

Figure 41. Dab length frequency data

3.3.3.2. Brown Crab

Figure 38 shows that a large proportion of male (77%) and female brown crab (68%) are below the MLS of 130 mm. Females are more abundant in size classes above 100mm.

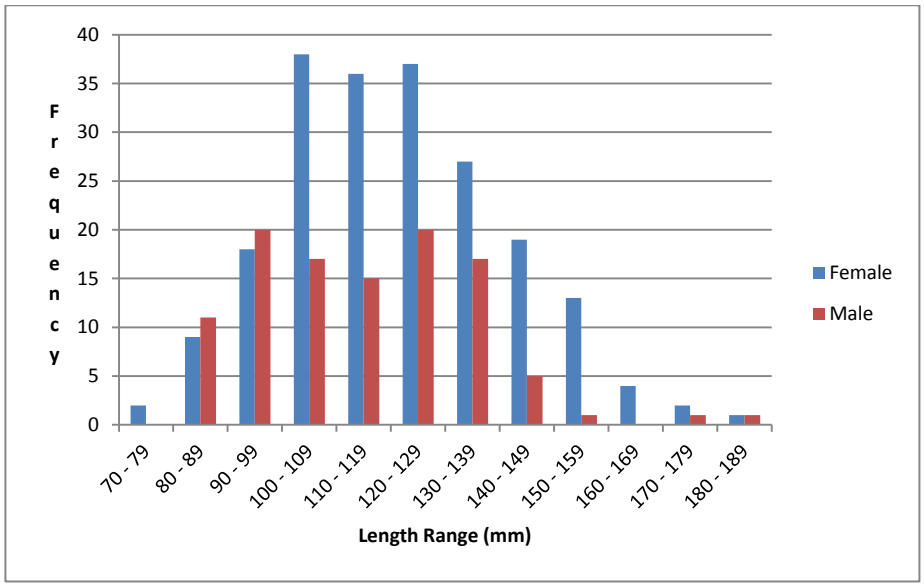

Figure 42. Male and Female Brown Crab length frequency data

3.3.4. Sex ratios and Spawning Condition

The ratio of males to females for all species was recorded for all fleets during the survey, with data collated by sex and length for individuals, in addition all egg carrying or bearing females were noted. Sex ratios could not be included in this section for the velvet crab as no females were landed in this survey.

3.3.4.1. Brown crab

An equal distribution of male to female brown crabs was observed at station 2. The male: female ratio was 1:3 at station 3 and 0:3 at station 5. No egg carrying female brown crabs were recorded at any of the sampling stations.

3.3.4.2. Lobster

The male:female ratio was 1:1 at station 4. Station 3 recorded a female dominance in sex exhibiting a ratio of 1 male to every 3 females, whilst stations 1 and 2 exhibited a 1:0 and 5:2 male bias respectively. No lobsters were recorded at station 5. Collectively, there was a 4:3 bias of male lobster.

3.3.4.3. Dover sole

Station 2 recorded a 3:1 bias of males, whilst station 3 exhibited an equal distribution in the ratio of males to females (1:1). Stations 1 and 5, both exhibited a 0:1 female bias.

3.3.4.4. Cod

Given the low number of cod caught during the trammel net survey, a very small sample size was available; these data show that all cod caught were female.

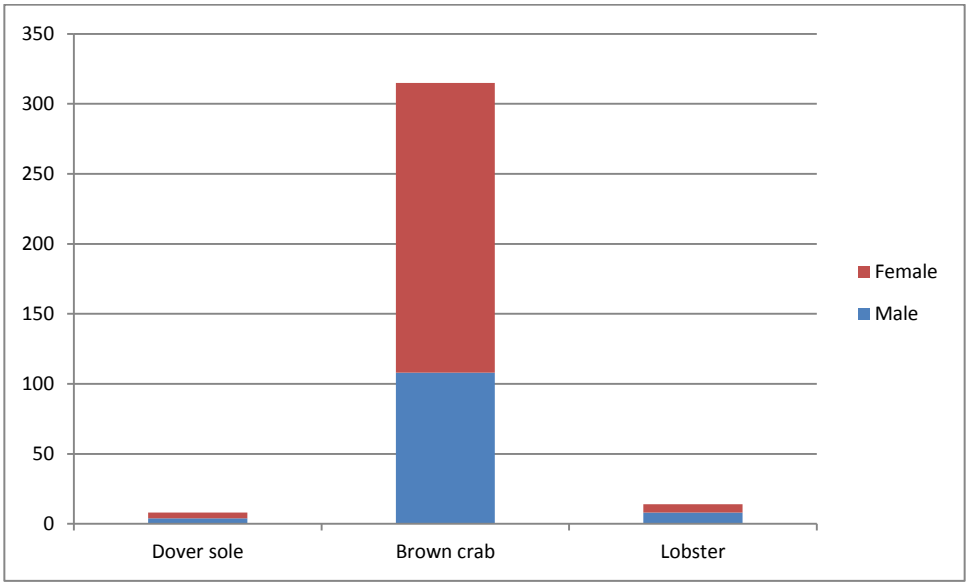

Figure 43. Distribution of sex ratios for the Dover sole, brown crab and lobster

3.4. Shellfish Survey

The data collected for the shellfish survey are represented in the following section. The survey was scheduled to commence on the 15th of September, the timing of which was based on appropriate tides, suitable weather window and vessel availability. The survey was carried out over a five day period; giving a soak period of between 96 and 121 hours (figure 37).

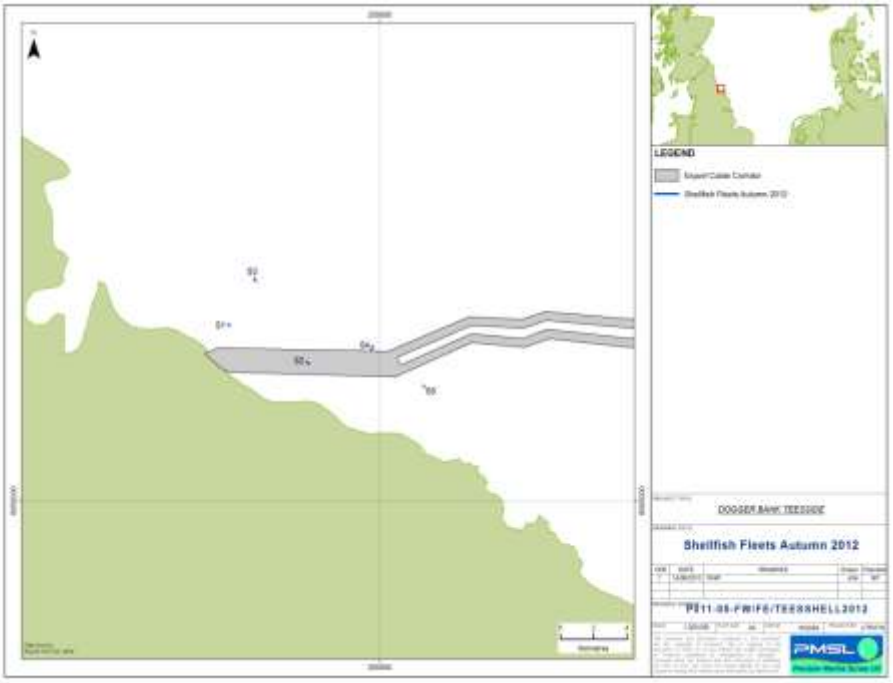

Figure 44. Distribution of survey fleets of pots along the Dogger Bank Teesside A & B export cable corridor

Table 6. Shellfish Positional Data Schedule

Station	Date	Deployment Time (GMT)	Recovery Date	Pot fleet Start Time (GMT)	WGS 84		Depth (m)	WGS 84		Soak time (days)
					Latitude	Longitude		Latitude	Longitude	
S1	15/09/2012	13:55:00	20/09/2012	16:24:00	54.37.242N	001.00.891W	11.9	54.37.218N	001.00.771W	5.1
S2	15/09/2012	13:26:00	20/09/2012	11:30:00	54.36.198N	000.56.230W	16.1	54.36.251N	000.56.375W	4.94
S3	16/09/2012	11:25:00	20/09/2012	15:35:00	54.38.610N	000.59.468W	31.3	54.38.704N	000.59.541W	4.17
S4	15/09/2012	09:46:00	20/09/2012	10:55:00	54.36.751N	000.52.762W	32.4	54.36.852N	000.52.713W	5.05
S5	15/09/2012	09:15:00	20/09/2012	09:55:00	54.35.742N	000.49.757W	32.7	54.35.706N	000.49.723W	5.02

3.4.1. Species Density and Diversity

In total, 8 species were recorded from the 5 stations during the survey, with the brown crab recorded as the most abundant species representing 74% of the total catch. Figure 41 demonstrates the range of species retained in the sampling pots and the contribution towards the total abundance.

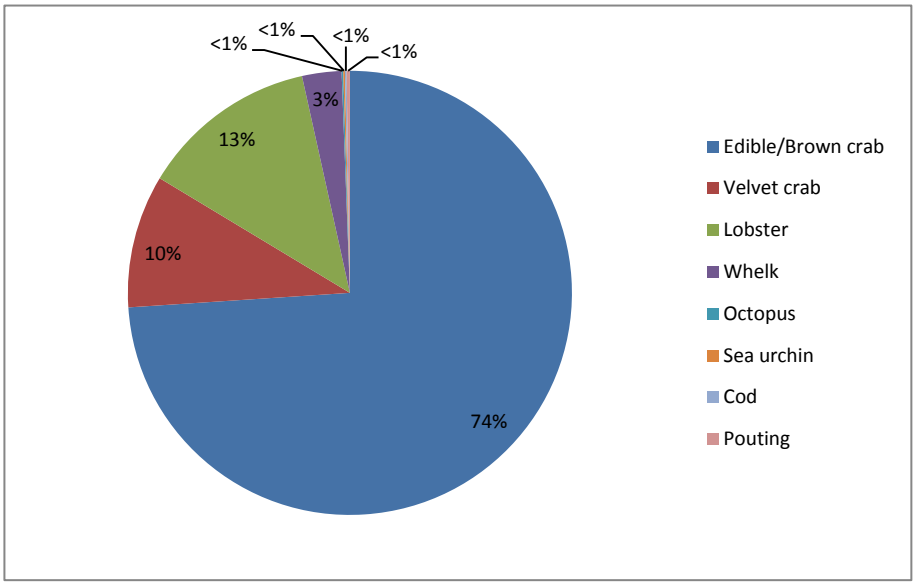

Figure 45. Overall abundance of species for all fleets

The brown crab, velvet crab and lobster were present throughout all sampling stations. Table 7 gives absolute catch densities and the diversity for individual sampling stations.

Table 7. Species diversity and abundance from the autumn shellfish survey.

Species (Common name)	Species (Latin name)	Fleet 1	Fleet 2	Fleet 3	Fleet 4	Fleet 5	Total
Brown crab	*Cancer pagurus*	48	433	115	16	7	**619**
Velvet crab	*Necora puber*	28	4	12	16	21	**81**
Lobster	*Homarus gammarus*	30	11	4	31	32	**108**
Whelk	*Buccinum undatum*	0	0	11	2	11	**24**
Octopus	*Octopus vulgaris*	0	0	0	0	1	**1**
Sea urchin	*Echinus esculentus*	0	0	0	1	0	**1**
Cod	*Gadus morhua*	0	1	0	0	0	**1**
Pouting	*Trisopterus luscus*	0	0	0	0	2	**2**
Density		**106**	**449**	**142**	**66**	**74**	**837**
Diversity		**3**	**4**	**4**	**5**	**6**	**22**

The brown crab was the most abundant species at all sampling stations, with the exception of station 5. Lobster was the second most abundant species in the catch with catch frequencies ranging between 4 (fleet 3) and 32 individual's (fleet 5). The velvet crab was the third most abundant species ranging from 4 in fleet 2 to 28 individuals (fleet 1). As described in table 7, the lowest abundance was recorded in fleet 4 (66), whilst the lowest species diversity was recorded in fleet 1 (3 spp.). Fleet 2 recorded the highest sample abundance (449), although 96% of this was brown crab. The largest species diversity was recorded in fleet 5 (6 spp.).

Figure 46 illustrates the abundance of key species retained in the pots and the percentage contribution they made towards the total abundance recorded.

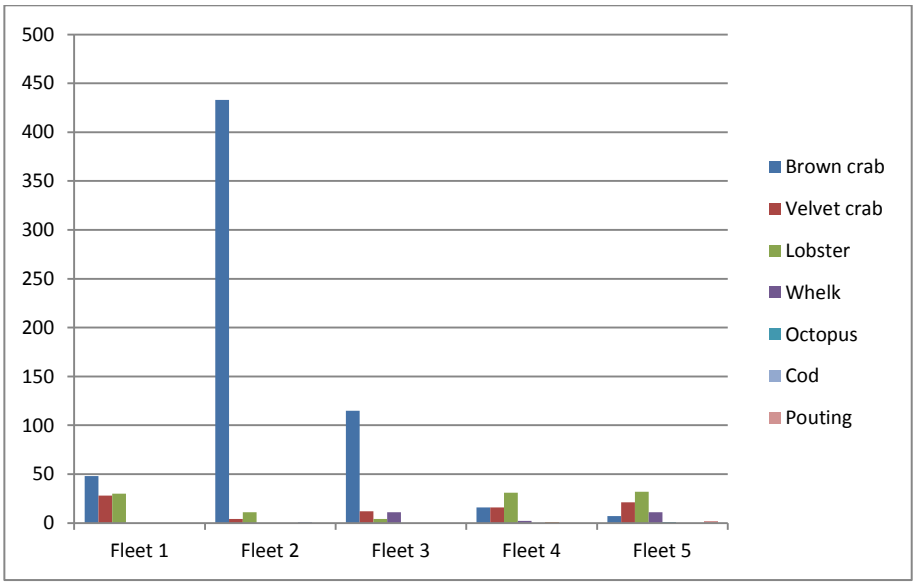

Figure 46. Abundance of key species for individual fleets

3.4.2. Individual Fleet Composition

3.4.2.1. Fleet 1

Station 1 recorded the lowest species diversity, with the most abundant species recorded in fleet 1 was the brown crab, contributing 45% of the total catch (Figure 47).

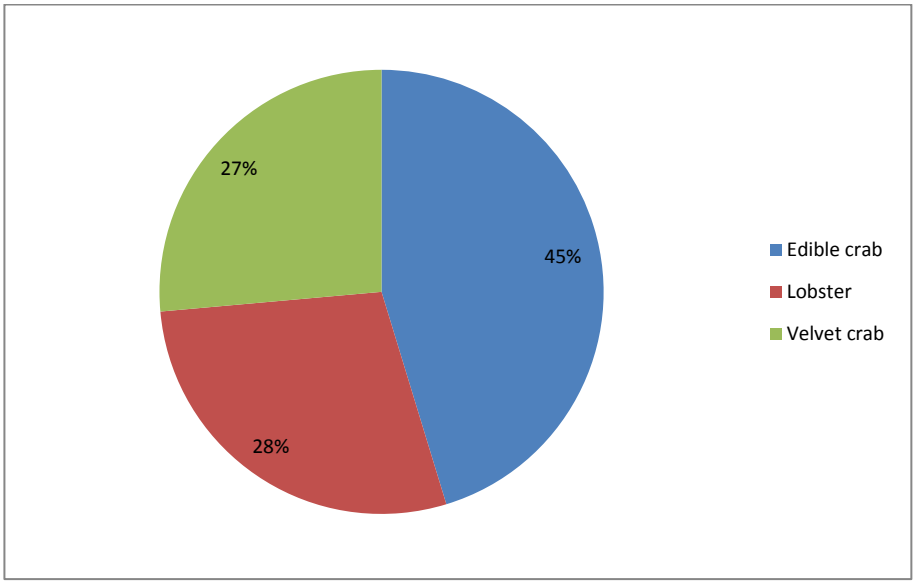

Figure 47. Percentage composition of species in fleet 1

3.4.2.2. Fleet 2

Brown crab represents 96% of the total catch at station 2 (Figure 48).

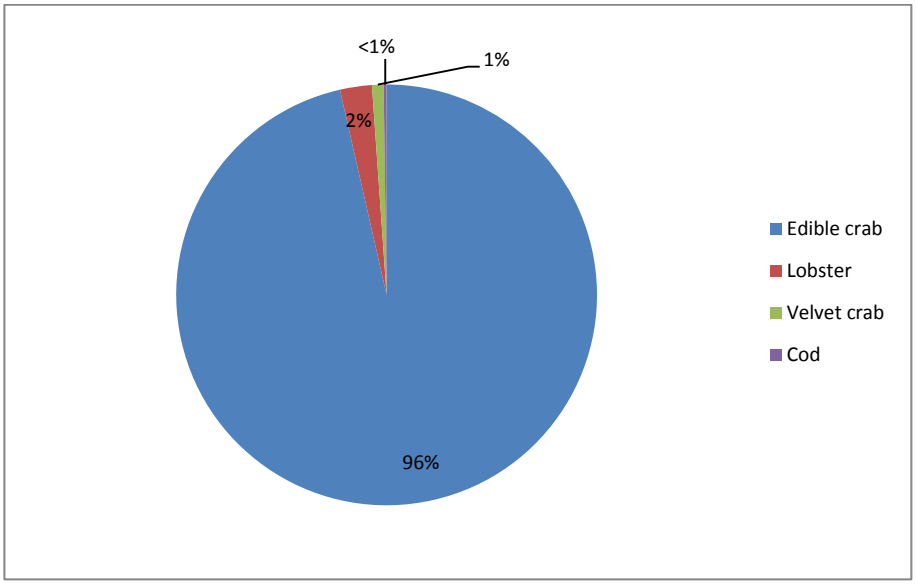

Figure 48. Percentage composition of species in fleet 2

3.4.2.3. Fleet 3

The catch composition of fleet 3 was similar to fleet 2 in that it was dominated by the brown crab, which represented 81% of the total catch. The velvet crab and the whelks each contributed 8% of the total catch whilst lobster contributed just 3%.

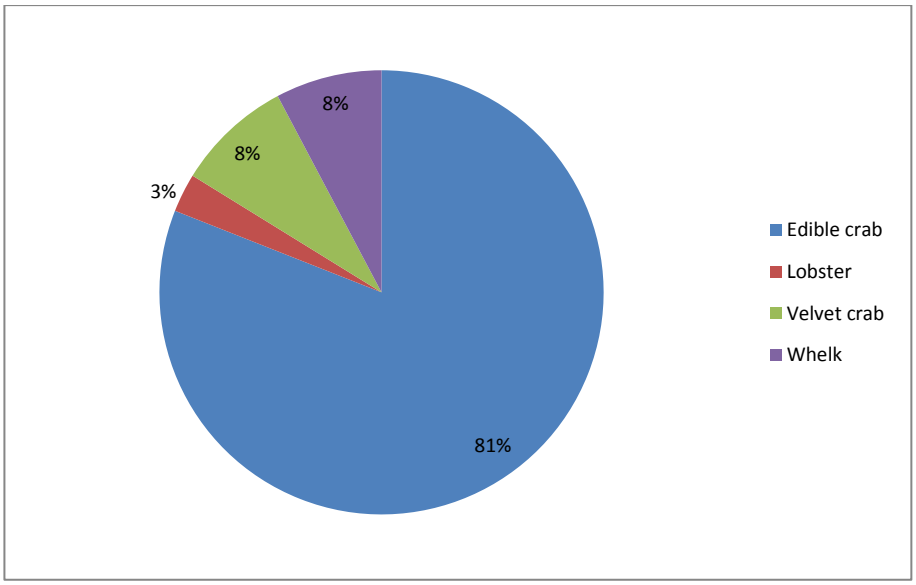

Figure 49. Percentage composition of species in fleet 3

3.4.2.4. Fleet 4

Station 4 recorded the lowest abundance with lobster representing 47%, whilst the edible crab and the velvet crab each contributed 24%.

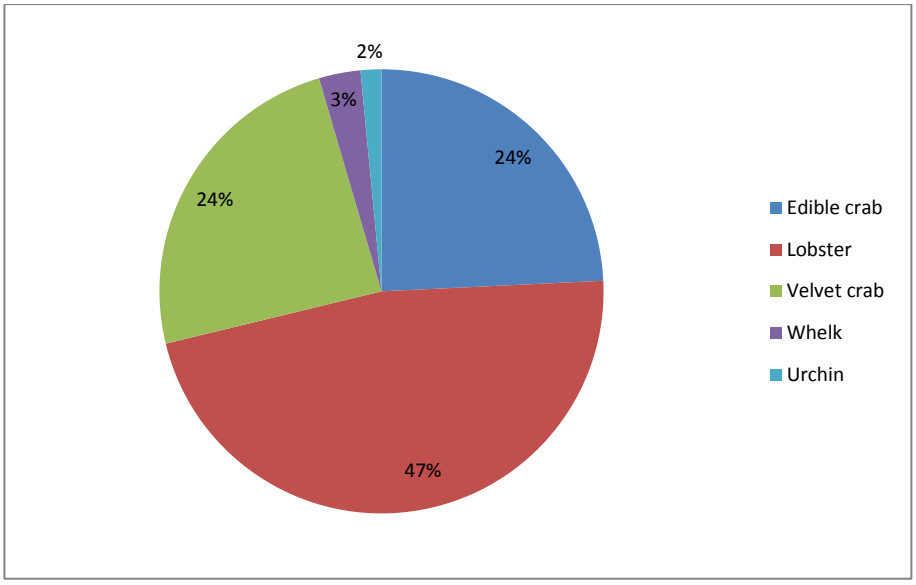

Figure 50. Percentage composition of species in fleet 4

3.4.2.5. Fleet 5

Lobster dominated the catch composition at station 5, representing 43%. o Station 5 produced the highest species diversity.

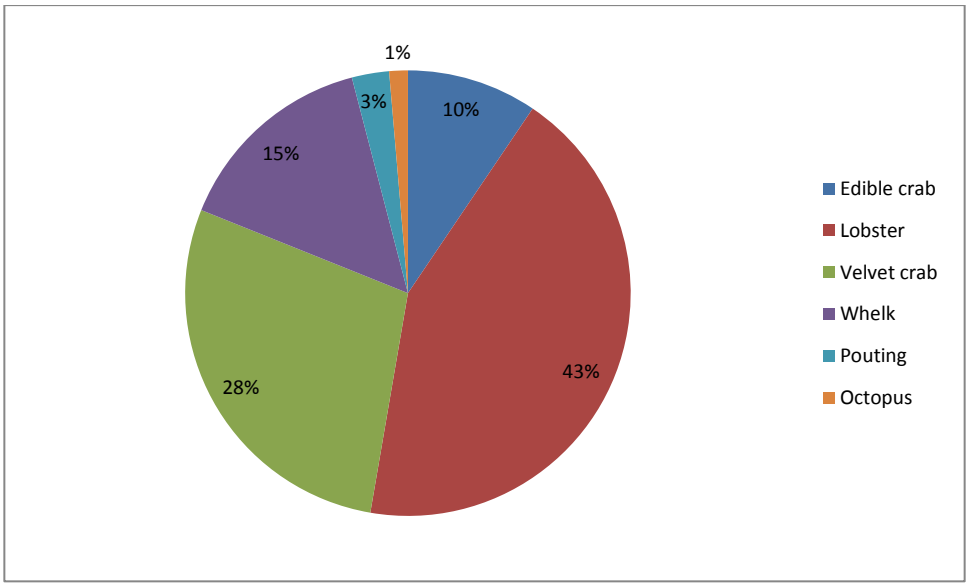

Figure 51. Percentage composition of species in fleet 5

3.4.3. Fine Mesh Pots

The percentage of catches in the fine mesh pots can be observed in figure 52. The velvet crab was consistently present in the fine mesh pots, whilst the particularly low abundance of brown crab in fleets 4 and 5 could explain their absence in the fine mesh pots for these fleets.

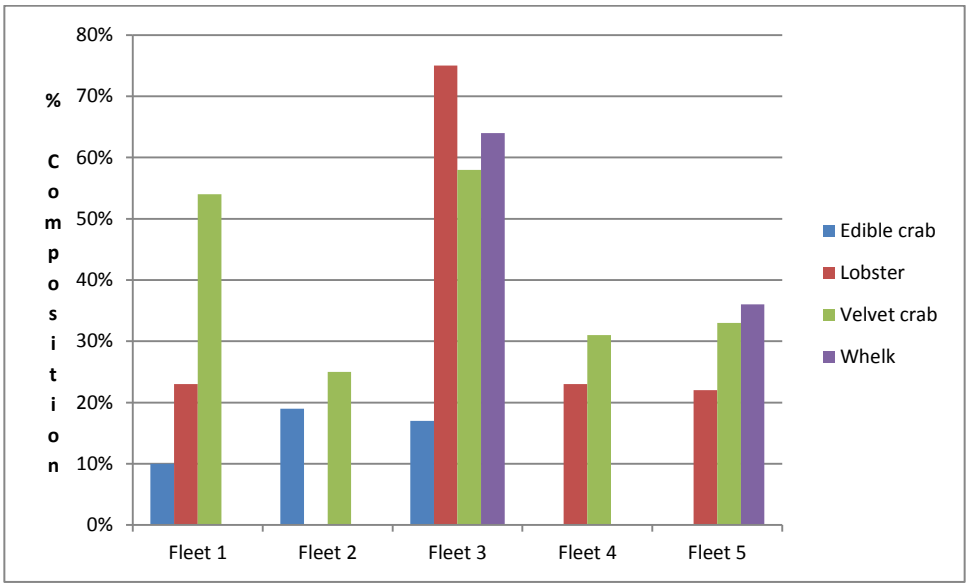

Figure 52. Percentage of key species caught in the fine mesh pots

3.4.4. Length Frequency Analysis

The following figures depict the length measurements taken for those abundant species and have been separated, to demonstrate any variation according to sex. Whilst length frequency figures have been produced by fleet for the brown crab (with the exceptions of fleets 4 and 5), there was insufficient data/individuals to produce a similar range of figures for both the lobster and velvet crab; as a consequence, combined figures for all fleet data are presented in the relevant sections.

3.4.4.1. Brown Crab

The length frequency data show a larger number of smaller males and a greater number of larger females in station 1. A large percentage of both the male (82%) and female (50%) brown crab is below the MLS. The most abundant length frequency class recorded for males was the 115 – 119mm whilst for females it was the 135 – 139mm (figure 53).

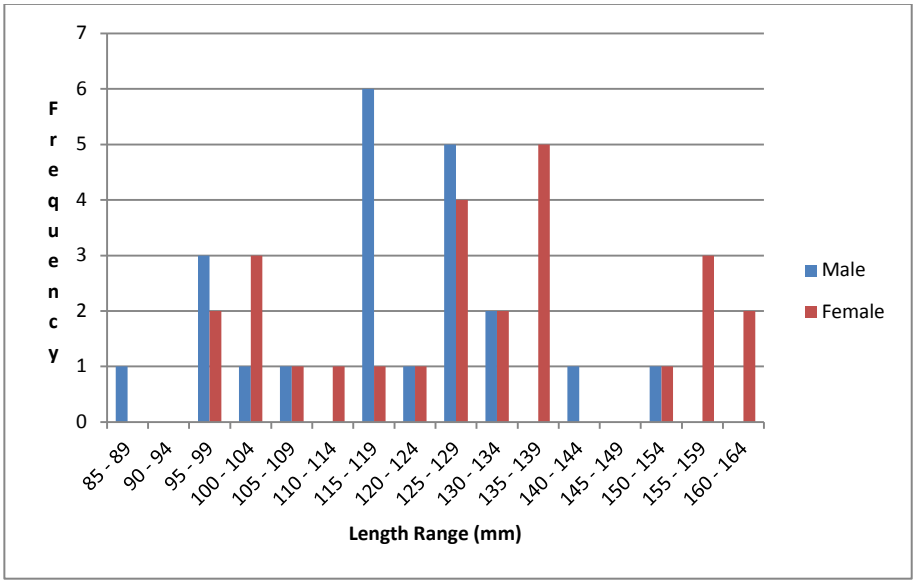

Figure 53. Brown crab length frequency data for fleet 1

For fleet 2, the distribution of male and female size ranges was similar to that observed in fleet 1, whereby a larger number of smaller males and a greater number larger females was recorded. A large proportion of the catch, both male (93%) and female (79%) brown crab were below the MLS. The highest length range frequency for males was 100 – 104 mm (21) and 120 – 124 mm for females (14).

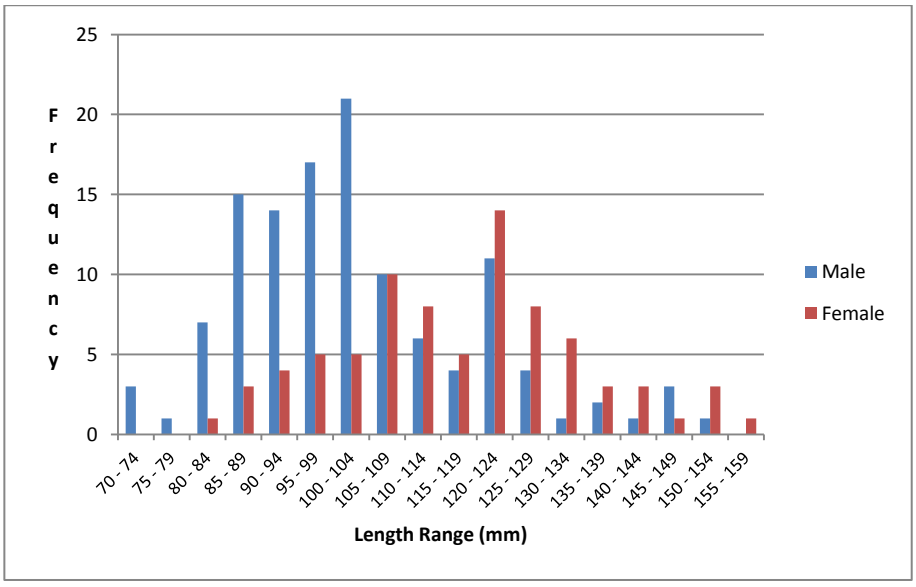

Figure 54. Brown crab length frequency data for fleet 2

At station 3, 43% and 36% respectively, both of which are markedly lower values than that were observed in fleets 1 and 2. Within fleet 3 there is a larger percentage of brown crab above the minimum landing size of 130mm, particularly the females. The most abundant length frequency recorded for males was the 110 – 114 mm class whereas the 160 – 164mm class for females showed the largest abundance (Figure 55).

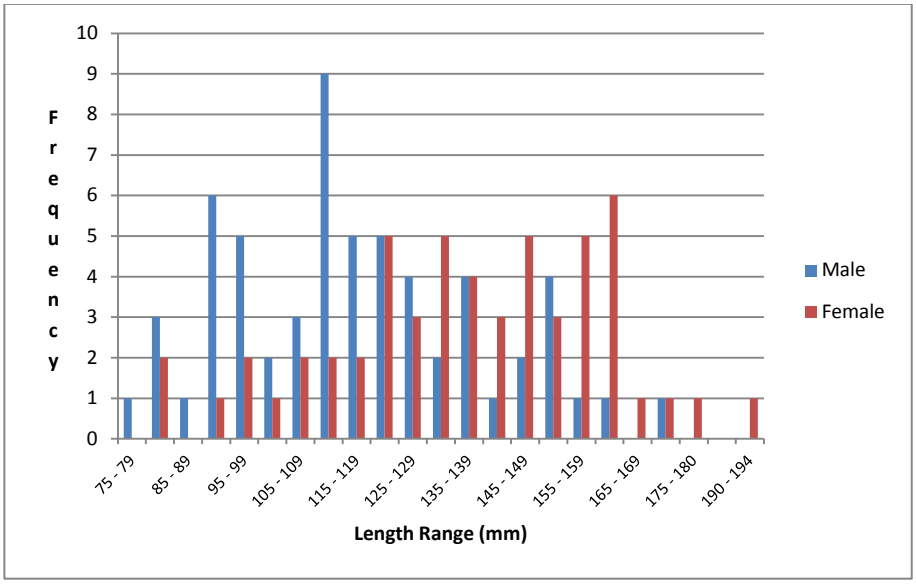

Figure 55. Brown crab length range frequency data for fleet 3

The overall combined length frequency data for male and female brown crab (figure 56) clearly illustrates how males predominate in the small size ranges and particularly the sub-legal size classes. The female assemblage occupies most of the larger size ranges, with both male and females occupying almost all size ranges. However, careful consideration should be made with regard to the total landings, as more males (219) were caught than females (167). Although 80% of males were below the MLS of 130 mm, females provide relatively equal distribution both above and below the MLS, with 42% and 58% respectively. The most abundant length frequency recorded for the male brown crab was the 95 – 99 mm size class, whilst for female brown crab it was 120 – 124mm.

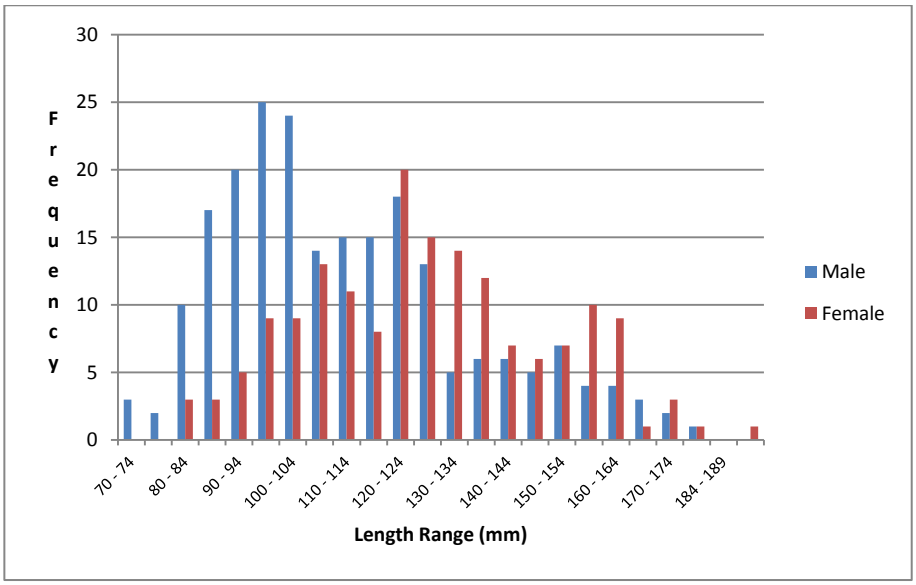

Figure 56. Combined brown crab length frequency data for all fleets

The mean carapace width for males at the nearshore stations was 116mm (fleet 1), 101mm (fleet 2) and 115mm in fleet 3 all of which are below the MLS. Stations further offshore e.g. fleet 4 (154mm) and fleet 5 (133mm), generally produced an increased mean carapace width in both male and female

brown crab (figure 50), all of which were above the MLS. It should however, be noted that these stations produced the lowest number of brown crab and as a consequence these data relate to a small sample size. The mean carapace width for females was below the MLS at sampling stations 1 (127mm) and 2 (110mm), whereas the remaining fleets all recorded a mean carapace width for females above the MLS i.e. 135mm (fleet 3), 151mm (fleet 4) and 170mm in fleet 5.

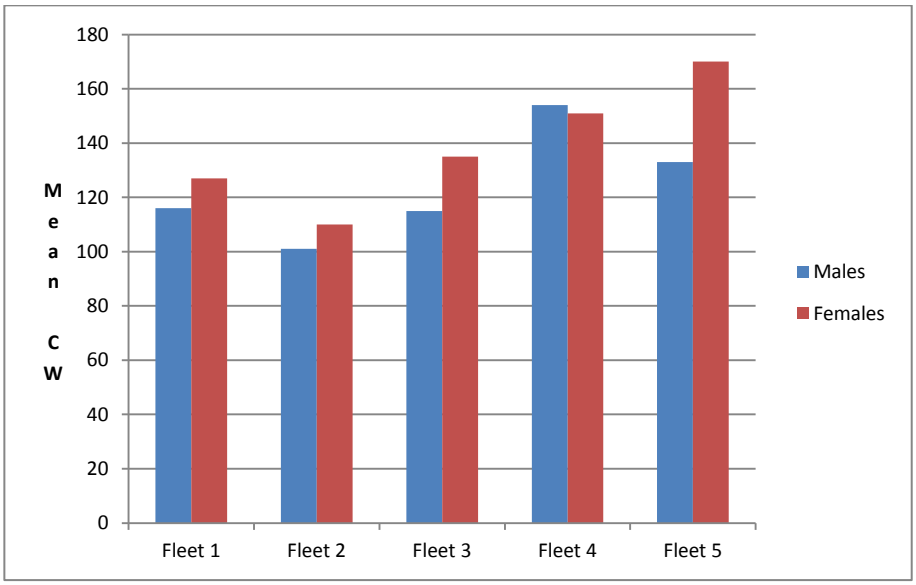

Figure 57. Brown crab mean carapace width for individual fleets

3.4.4.2. Lobster

The distribution of data in figure 51 show that male lobsters are more prominent in the sub-legal size ranges, whilst there appears to more of an abundance of females at or around the MLS. Both males and females predominate in the size ranges below the MLS, with a comparable number of males (36%) and females (46%) above the MLS. The most abundant size for males was the 79 – 80mm class, whilst females were most abundant in the 87 – 88mm class, which is at the MLS for lobster (87mm). The largest lobsters caught were males (132mm), as were the smallest at 59mm.

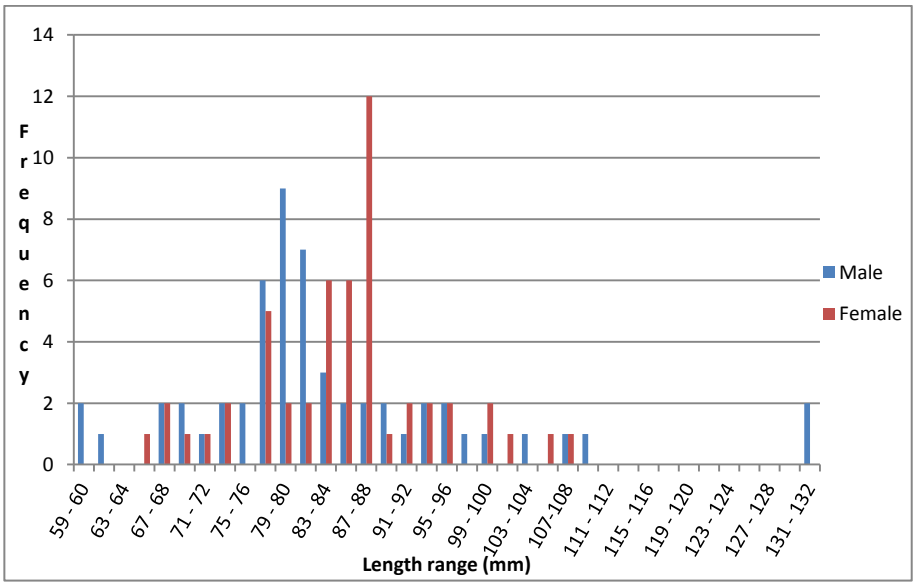

Figure 58. Combined lobster length range frequency data for all fleets

The mean carapace length for male and female lobster above the MLS of 87mm was only observed at station 3, with sampling stations 1, 4 and 5 producing a mean carapace lengths of between 83mm and 86mm. The values for both male and female were considerably lower at station 2 i.e. 72mm for males and 76mm for females.

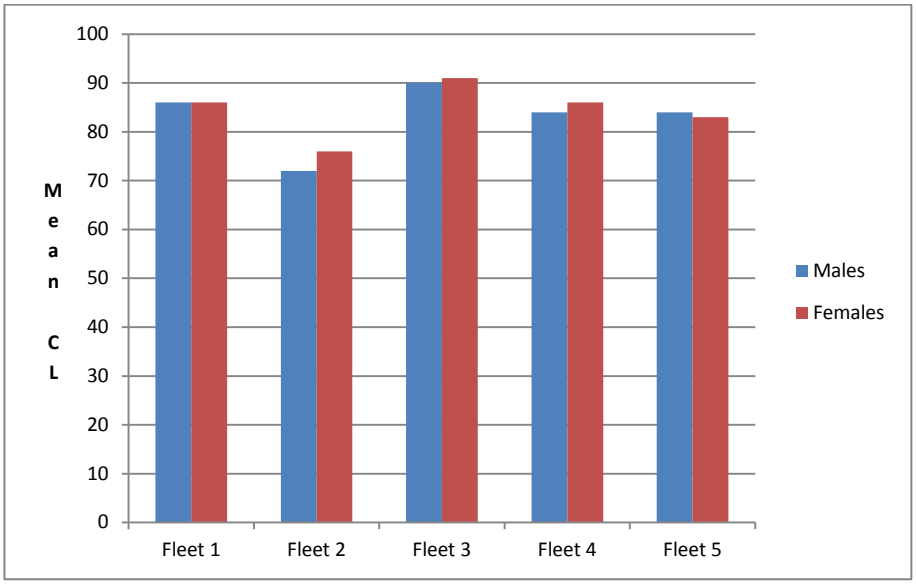

Figure 59. Lobster mean carapace width for all fleets

3.4.4.3. Velvet Crab

The distribution of data show that the male velvet crab occupy almost all of the size ranges observed, whilst there appears to be a series of size ranges clusters for females. This is likely related to the small sample size of females (13) compared to that recorded for males (70). The data shows that males dominate the overall assemblage with 93% of the total catch above the MLS (65mm), whereas 69% of females were above the MLS of 65mm.

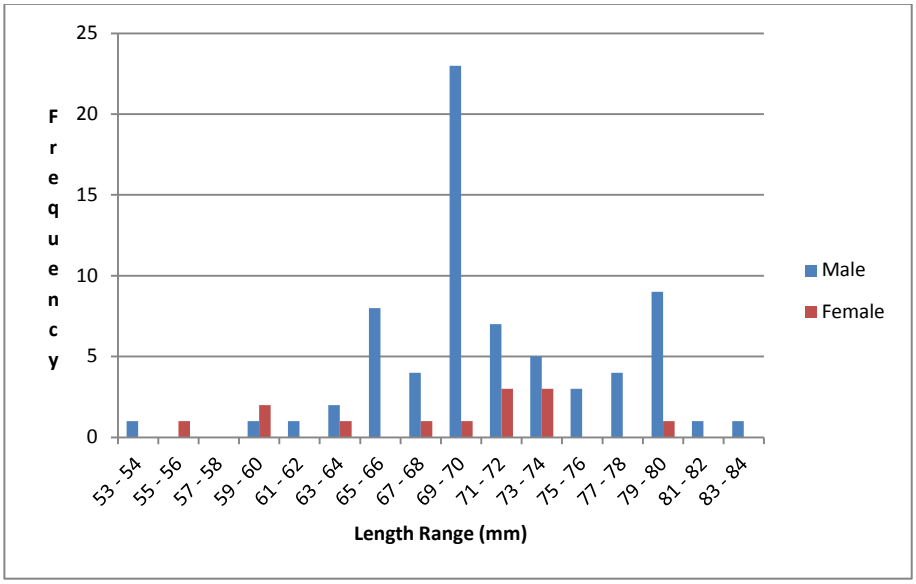

Figure 60. Combined velvet crab length frequency data for all fleets

All mean carapace lengths recorded for the velvet crab were above the MLS, although the trend for mean carapace width for velvet crab (figure 54) was less clear than for the other key commercial target species, mainly as females were not recorded at stations 2 and 4. However, smaller mean carapace lengths were observed for both males and females at the inshore stations.

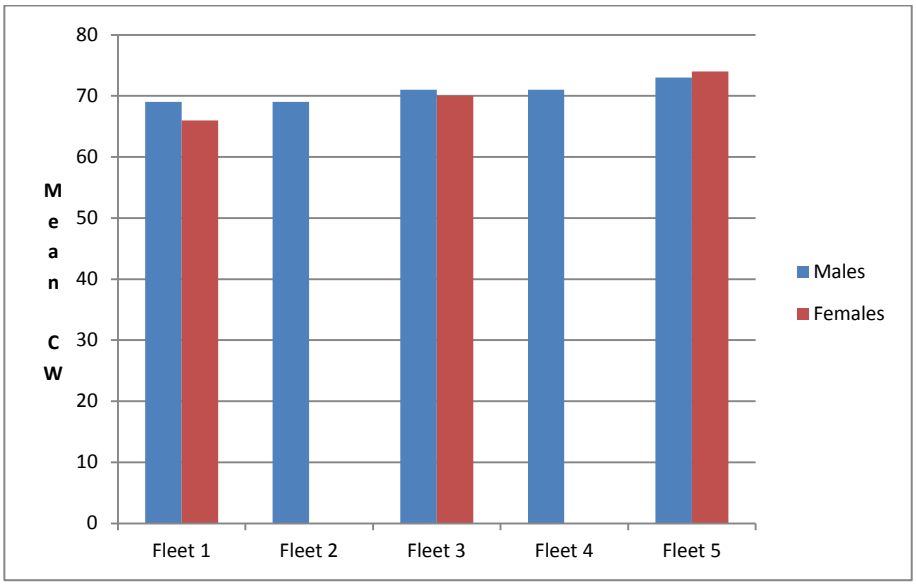

Figure 61. Velvet crab mean carapace width for all fleets

3.4.5. Sex Ratios and Spawning Condition

The ratio of males to females for all species was recorded for all fleets during the survey, with data collated by sex and length for individuals, in addition all egg carrying or bearing females were noted.

3.4.5.1. Brown crab

The only instance where the female brown crab exhibited dominance over males was in fleet 1, with four males to every five females. Males exhibited dominance in sampling stations 2 (3:2), station 4 (2:1) and station 5 (6:1). The furthest offshore station exhibited an almost equal distribution of males to females (1:1). Collectively, combined fleets observed a 4:3 bias of males over females due to the significantly larger sample of males (219) than females (167).

As anticipated no egg carrying female brown crabs were recorded at any of the sampling stations.

3.4.5.2. Lobster

A more equal distribution in the ratio of males to females was observed within the lobster dataset, with fleets 2, 3 and 4 exhibiting a ratio of 1:1. Fleet 1 exhibited a female bias (3:2), whilst fleet 5 conversely exhibited a male dominance with five males to every four females. All fleets recorded egg carrying female lobsters (figure 55). Combined data of all fleets produced an almost equal distribution of male to female lobsters during the autumn 2012 shellfish survey.

Fifty three female lobsters where captured from the five fleets of pots, of these, twelve were recorded as berried, which equates to approximately 23%, although the number of berried lobster varied widely between fleets i.e. 7% in fleet 4 and 50% in fleet 3 (figure 58). The range in size of berried lobsters was 86mm to 105mm.

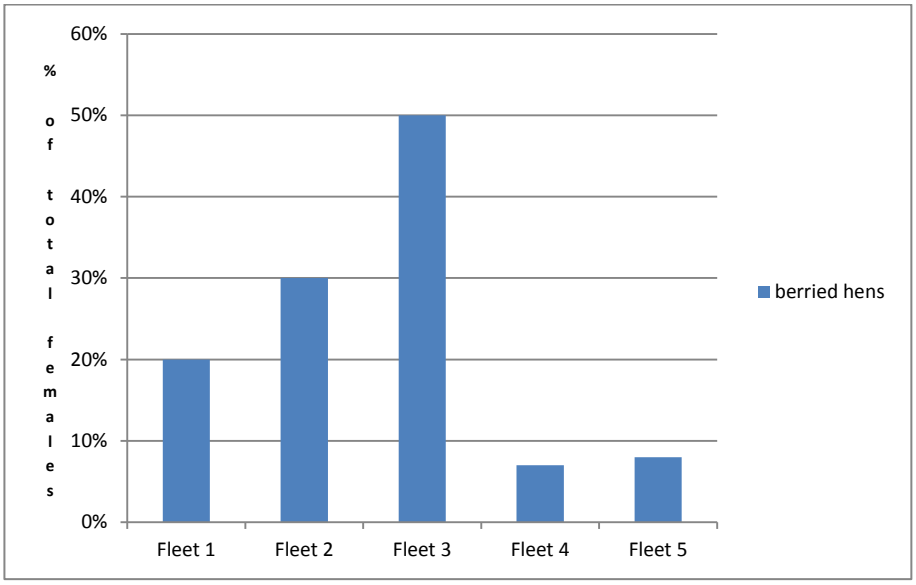

Figure 62. Percentage composition of berried lobsters within all fleets

3.4.5.3. Velvet crab

Similarly to the data recorded for the brown crab, male velvet crabs were more abundant than females at all sampling stations. A male bias was observed in fleets 2 and 4 producing sex ratios of 16:0 and 4:0 respectively. Fleet 1 produced a ratio of 2 males to every 1 female; fleet 3 exhibited a ratio of 5 males to every 1 female, whilst fleet 5 recorded 9 males to every 1 female. Combined data of all fleets produced a 5:1 ratio of male to female velvet crabs within this survey. No egg carrying female velvet crabs were recorded at any of the sampling stations.

3.4.6. Biomass and Landings Value

Typically for the time of year in which the surveys were undertaken, there is a significant component of brown crabs which are undergoing ecdysis and as a consequence produce a low flesh yield. This is reflected in lower landings in comparison to the actual legally sized catch.

3.5. Prawn Trawling

The data collected for the prawn trawling survey are represented in the following section. The survey was scheduled to commence on the 24th of October, the timing of which was based on appropriate tides, suitable weather window and vessel availability. The survey was carried out in one day; providing trawl times of 40 minutes duration (figure 63), additional time was given following the deployment to allow the trawl and doors to settle and operate efficiently on the softer ground and shallower water.

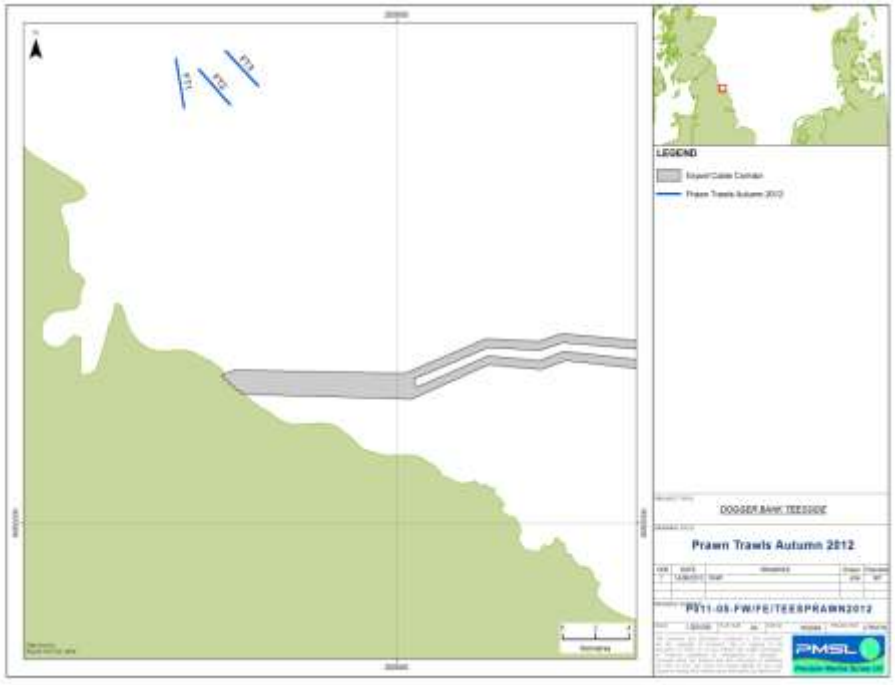

Figure 63. Distribution of Prawn trawl sites in proximity to the Dogger Bank Teesside A & B export cable corridor

Table 11. Prawn Trawling Positional Data Schedule

Station	Date	Fleet Start				Fleet End				
		Deployment Time (GMT)	WGS 84		Depth (m)	Recovery Time (End)	WGS 84		Depth (m)	Duration (mm:ss)
			Latitude	Longitude			Latitude	Longitude		
FT1	24/10/2012	06:46:31	54.44.401N	001.04.987W	43.2	07:27:49	54.45.880N	001.05.600W	44.3	41:18
FT2	24/10/2012	09:22:15	54.45.596N	001.04.277W	43.9	10:03:10	54.44.579N	001.02.421W	49.4	40:55
FT3	24/10/2012	11:14:22	54.45.201N	001.00.901W	46.8	11:55:56	54.46.204N	001.02.835W	47.4	41:34

3.5.1. Species Density and Diversity

In total, 29 species of fish and 9 species of invertebrate were recorded from the three *Nephrops* trawls during the October survey. The total number of *Nephrops* captured during this survey was 2394, which accounting for all size ranges, amounts to approximately 125kg in total biomass. Figure 64 illustrates the range of fish species caught in the prawn trawl and the percentage contribution they made towards the total fish abundance recorded.

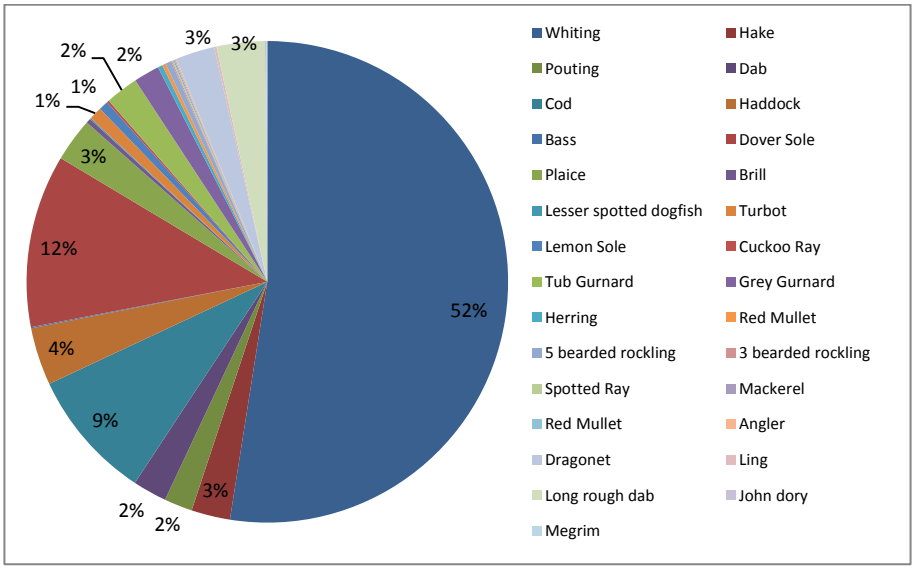

Figure 64. Overall abundance of fish species for all prawn trawls

Whiting was the most abundant species at all sampling stations ranging in abundance from one hundred and fifty three (station 3) to three hundred and two individuals at station 1. The Dover sole was the second most abundant species in the catch at all sampling stations with catch frequencies ranging between twenty seven (stations 2 and 3) and ninety three individual's (station 1). Cod was the third most abundant species ranging from sixteen at station 2 to forty nine individuals at station 1. Table 12 gives absolute catch densities and the diversity for individual sampling stations. The lowest abundance was recorded at sample station 2 (524), whilst the lowest species diversity was also recorded at this station (27 spp.). Site 1 recorded the highest sample abundance (2,187), whilst site 3 recorded the largest species diversity (30 spp.).

Table 12. Species diversity and abundance from the prawn trawl survey.

Species (common name)	*Species (Latin name)*	Site 1	Site 2	Site 3	Total
Whiting	***Merlangius merlangus***	302	210	143	**665**
Hake	***Merluccius merluccius***	16	8	9	**33**
Pouting	***Trisopterus luscus***	23	4	1	**24**
Dab	***Limanda limanda***	16	3	10	**29**
Cod	***Gadus morhua***	49	16	46	**111**
Haddock	***Melanogrammus aeglefinus***	31	9	9	**49**
Bass	***Dicentrarchus labrax***	1	0	0	**1**
Dover Sole	***Solea solea***	93	27	27	**147**
Plaice	***Pleuronectes platessa***	23	8	6	**37**

Species (common name)	*Species (Latin name)*	Site 1	Site 2	Site 3	Total
Brill	***Scophthalmus rhombus***	2	1	1	**4**
Lesser spotted dogfish	***Scyliorhinus canicula***	1	0	0	**1**
Turbot	***Psetta maxima***	2	5	4	**11**
Lemon Sole	***Microstomus kitt***	6	1	1	**8**
Cuckoo Ray	***Raja naevus***	1	1	0	**2**
Tub Gurnard	***Trigla lucerna***	13	6	9	**28**
Grey Gurnard	***Eutrigla gurnardus***	18	1	3	**22**
Herring	***Clupea harengus***	1	1	2	**4**
Red Mullet	***Mullus surmuletus***	2	0	1	**3**
5 bearded rockling	***Ciliata mustelus***	3	1	1	**5**
3 bearded rockling	***Gaidropsarus vulgaris***	0	0	1	**1**
Spotted Ray	***Raja montagui***	0	1	0	**1**
Mackerel	***Scomber scombrus***	0	1	0	**1**
Mullet	***Mullus surmuletus***	0	1	0	**1**
Angler	***Lophius piscatorius***	0	0	1	**1**
Dragonet	***Callionymus lyra***	21	8	4	**33**
Ling	***Molva molva***	0	0	2	**2**
Long rough dab	***Hippoglossoides platessoides***	15	9	17	**41**
John dory	***Zeus faber***	0	0	1	**1**
Megrim	***Lepidorhombus whiffiagonis***	0	0	1	**1**
Squid	***Loligo vulgaris***	5	3	0	**8**
Little cuttlefish	***Sepiola atlantica***	7	5	1	**13**
Brown crab	***Cancer pagurus***	6	2	3	**11**
Lobster	***Homarus gammarus***	2	0	0	**1**
Prawn	***Nephrops norvegicus***	1520	190	684	2394
Harbour crab	***Liocarcinus depurator***	6	4	1	**11**
Livid swimming crab	***Liocarcinus holsatus***	2	2	3	**7**
Angular crab	***Goneplax rhomboides***	0	0	1	**1**
Edible clam	***Arctica islandica***	0	0	2	**2**
Density		**2187**	**524**	**1005**	**3716**
Diversity		28	27	30	**37**

Figure 61 illustrates the abundance of key species retained in the prawn trawl.

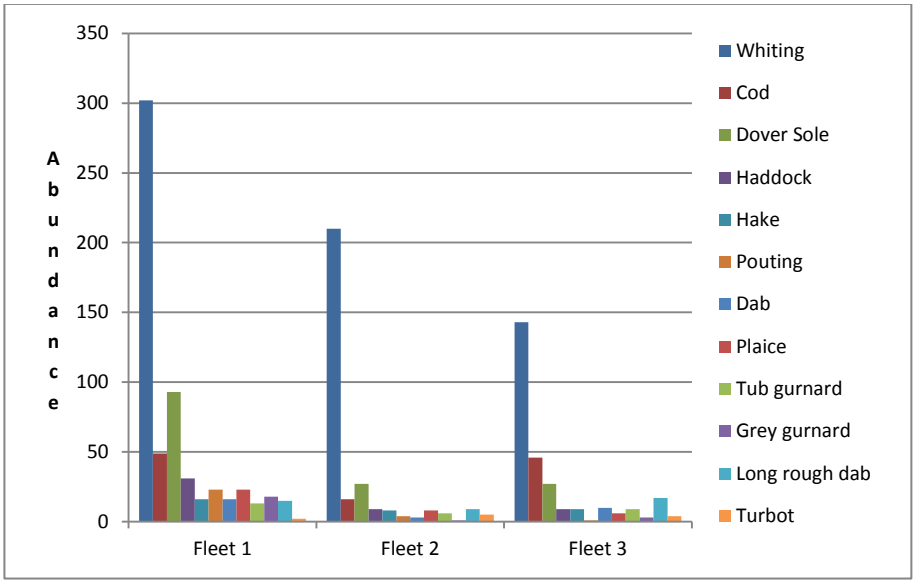

Figure 65. Abundance of key species for individual trawls

3.5.2. Individual Trawl Composition

In all trawls, prawns were the dominant component in terms of abundance, as a consequence this tends to skew the fish data, and therefore the following figures for each prawn trawl represent the combination of prawns, invertebrates and fish, with separate figures for just the catch of fish.

The abundance of prawns was derived from a volumetric analysis, whereby a known number of prawns are equivalent to a specific volume measurement i.e. 19 prawns equate to one litre, this volumetric counting process is undertaken at least ten times to account for size variation and the mean of the ten counts is taken. The number of buckets filled by the prawns is then multiplied by 19 to produce.

3.5.2.1. Trawl 1

The catch composition for prawn trawl station 1 was largely dominated by *Nephrops* and which represented 70% of the total catch; an estimated 1,520 *Nephrops* with an approximate biomass of 80kg were caught.

Whiting was the second most abundant species contributing 14% of the total abundance, whilst Dover sole represented 4% and cod 2%, the remaining species contributed 1% or less of the overall catch at station 1 (figure 66).

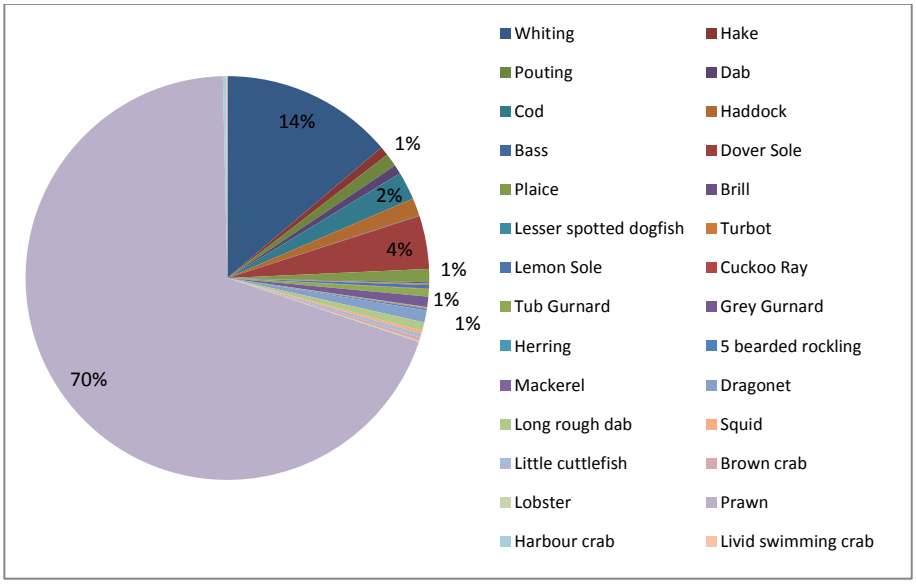

Figure 66. Percentage composition of all species at prawn trawl station 1

By omitting the invertebrate data and concentrating on the fish dataset, it is clear that the whiting is the most abundant fish species, representing 47% of the total catch of fish. The Dover sole was the second most abundant species contributing 15%, whilst cod represented 8%, haddock 5%, plaice and pouting each contributed 4%, with the grey gurnard, dab and hake each representing 3% of the total catch.

The tub gurnard *Trigla lucerna* represented 2% of the total catch, whilst the remaining species each contributed no more than 1% (figure 67).

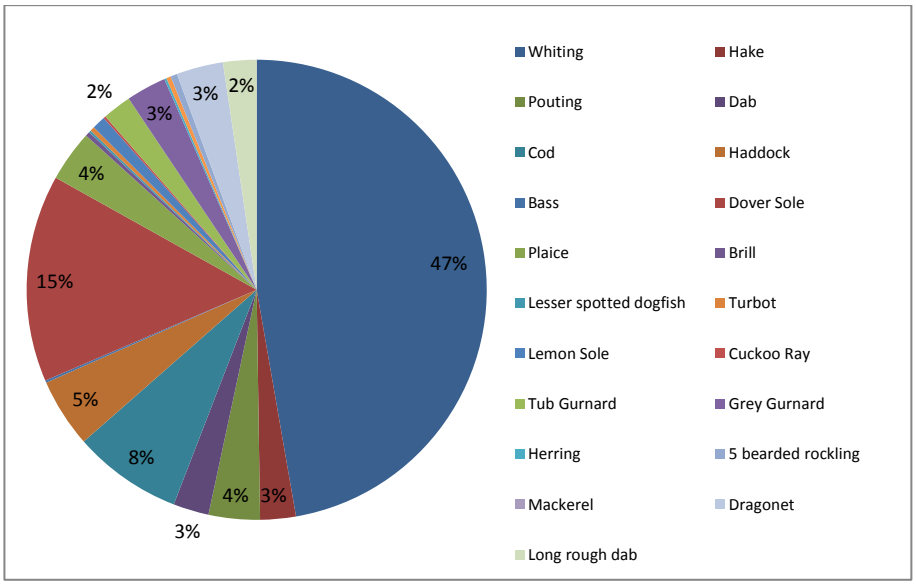

Figure 67. Percentage composition of fish species at prawn trawl station 1

3.5.2.2. Trawl 2

Whiting and *Nephrops* dominated the catch composition in trawl 2, representing 40% and 36% respectively of the total catch. Dover sole contributed 5%, whilst cod represented 3%. All other species did not exceed 2% of the total catch which included the invertebrate species. The abundance of *Nephrops* was recorded at 190 individuals which was the lowest density recorded for

the species from the three prawn trawls, the total wet weight biomass for *Nephrops* was recorded as approximately 10 kg.

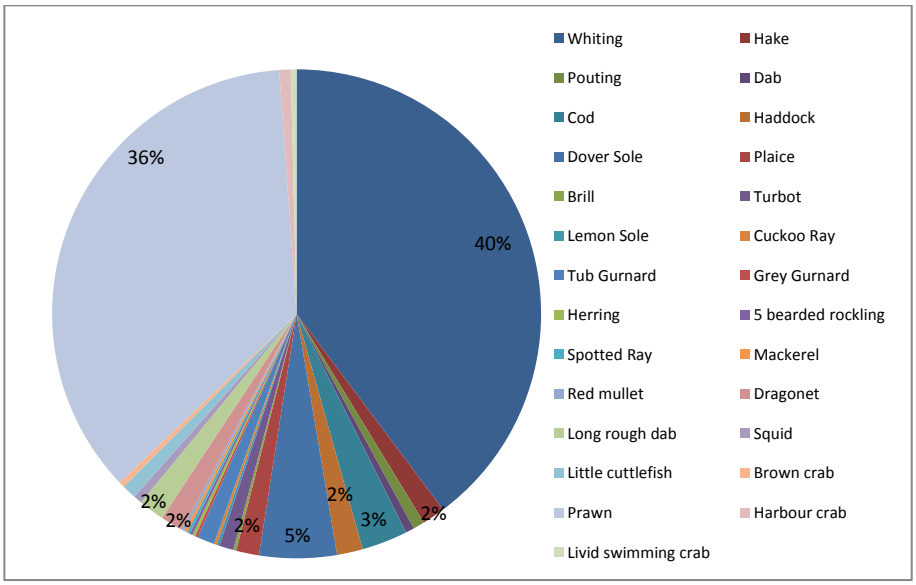

Figure 68. Percentage composition of all species at prawn trawl station 2

In respect to the fish assemblage, whiting significantly dominated the catch composition in trawl 2, representing 65% of the total catch. Dover sole was the second most abundant species contributing 8%, with cod representing 5%, and haddock and long rough dab each contributing 3%. Plaice, turbot *Psetta maxima*, dragonet *Callionymus lyra*, tub gurnard and hake each contributed 2% of the total catch, whilst each of the remaining species did not exceed 1% of the total catch.

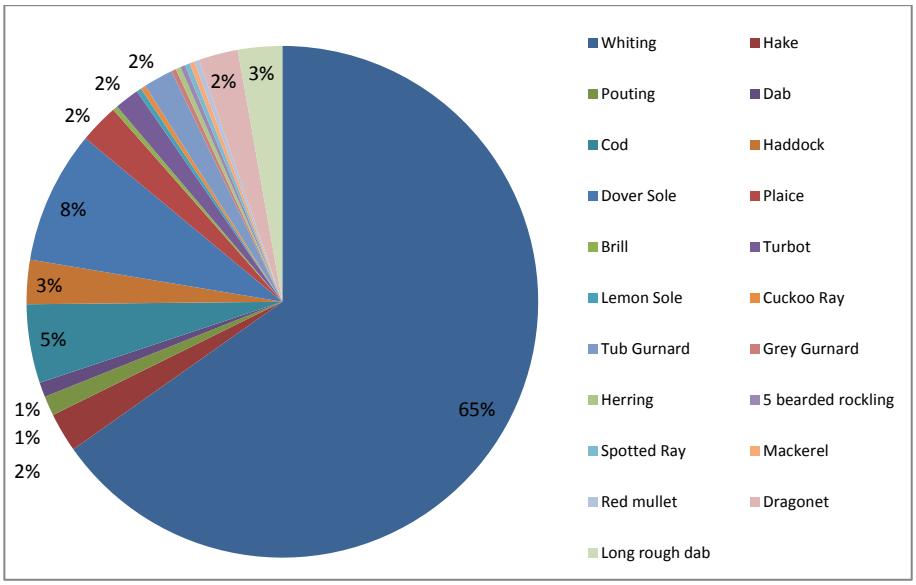

Figure 69. Percentage composition of fish species at prawn trawl station 2

3.5.2.3. Trawl 3

Nephrops contributes 69% of the total catch at station 3, which relates to 684 individuals with a biomass of 36kg. The most abundant fish species, the whiting represented 14%, whilst cod was the second most abundant fish species representing 5% with Dover sole contributing 3%.

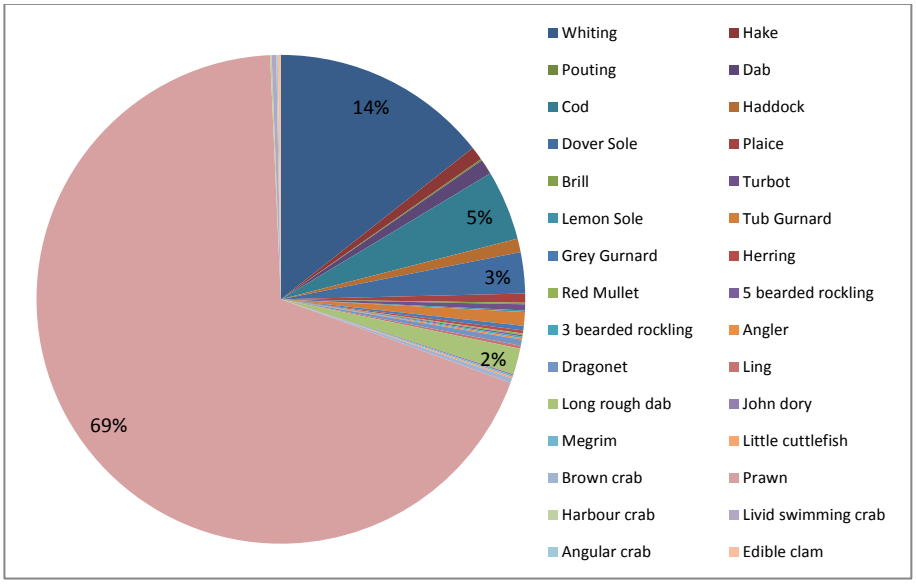

Figure 70. Percentage composition of all species at prawn trawl station 3

In respect to the fish assemblage, as indicated above, whiting significantly dominated the catch composition of trawl 3 contributing 48% of the total catch. Whilst, cod was the second most abundant species in this catch representing 15% and Dover sole contributing 9%. There was a greater increase in the abundance of long rough dab in this fleet which represented 6% of the total catch of fish, whilst the tub gurnard, haddock, dab and hake each contributed 3% to the total catch. Plaice contributed 2% towards the total catch; with the remaining species each contributed no more than 1% of the total catch.

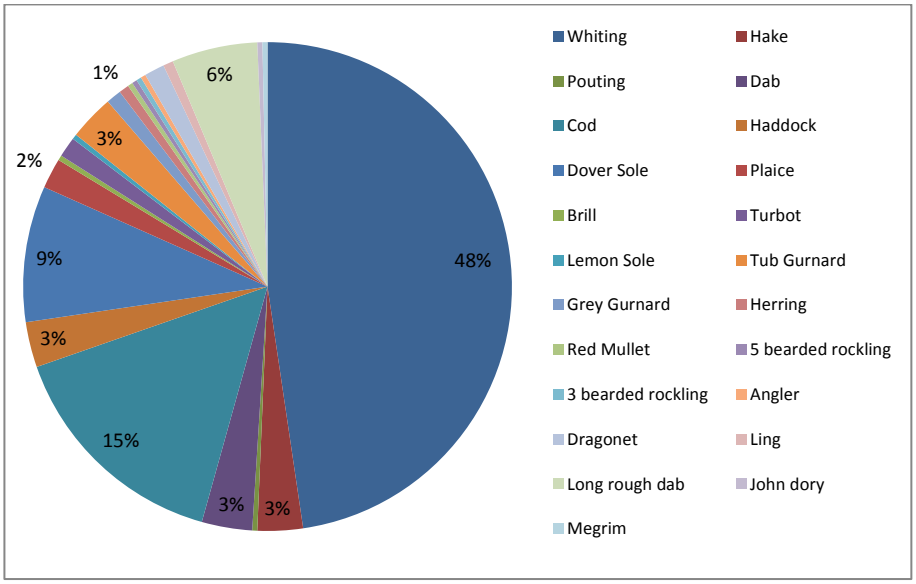

Figure 71. Percentage composition of fish species at prawn trawl station 3

3.5.3. Length Frequency Analysis

The following figures depict the size length of those abundant species recorded from the prawn trawls. Whilst length frequency figures have been produced for whiting, dab, Dover sole, haddock

and *Nephrops*, there was insufficient data/individuals to produce a similar range of figures for other species.

3.5.3.1. Whiting

The most abundant length frequency size class recorded for whiting was 270mm - 279mm, the lower value (27cm) of which is the MLS for the species in the North Sea. The length frequency data show the majority of whiting captured were between 230mm to 330 mm, it is considered that this covers intermediate 3-gp and 4-gp fish.

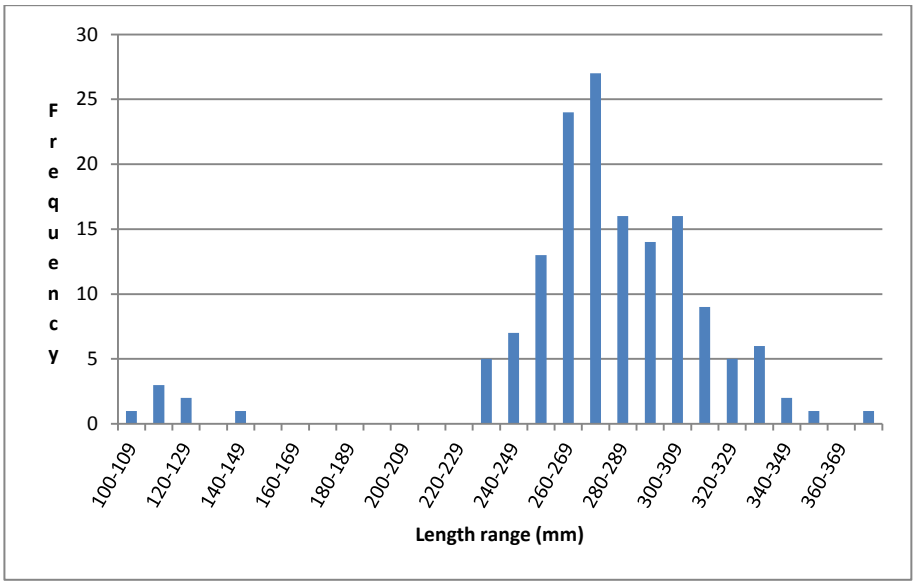

Figure 72. Whiting length range frequency data

3.5.3.2. *Dover sole*

All of the Dover sole recorded in the prawn trawl survey were above the MLS of 24cm. The most abundant length frequency class was observed at 260mm – 269 mm, although the relatively low abundance observed may not be fully representative. The data indicate three possible age groups and based on Pawson (1995) it is thought that these fish in the lower classes are likely three and four year old fish, whilst the upper length class may be intermediate five to six year old fish.

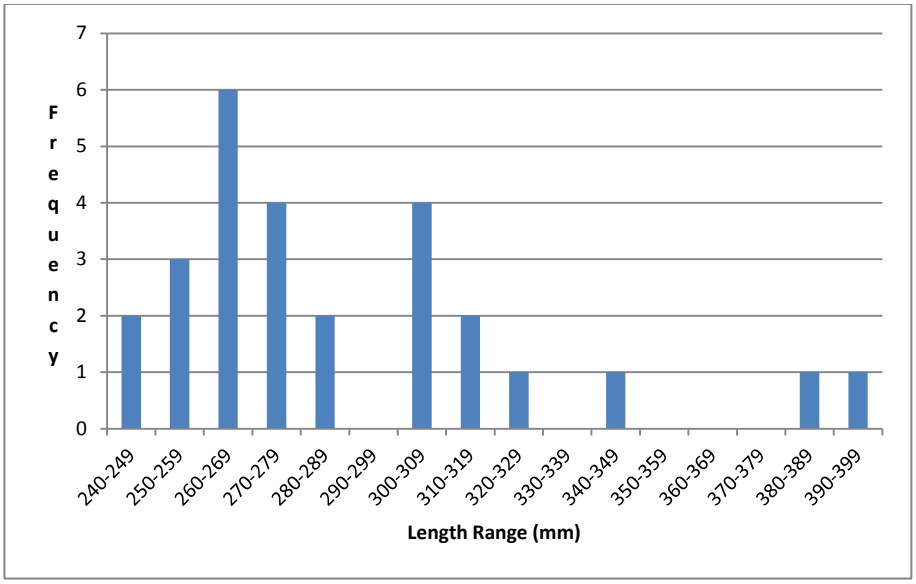

Figure 73. Dover sole length range frequency data

3.5.3.3. Haddock

The relative low abundance of haddock recorded during the survey meant a full evaluation of size classes was difficult to present, however the data collated are shown in figure 70.

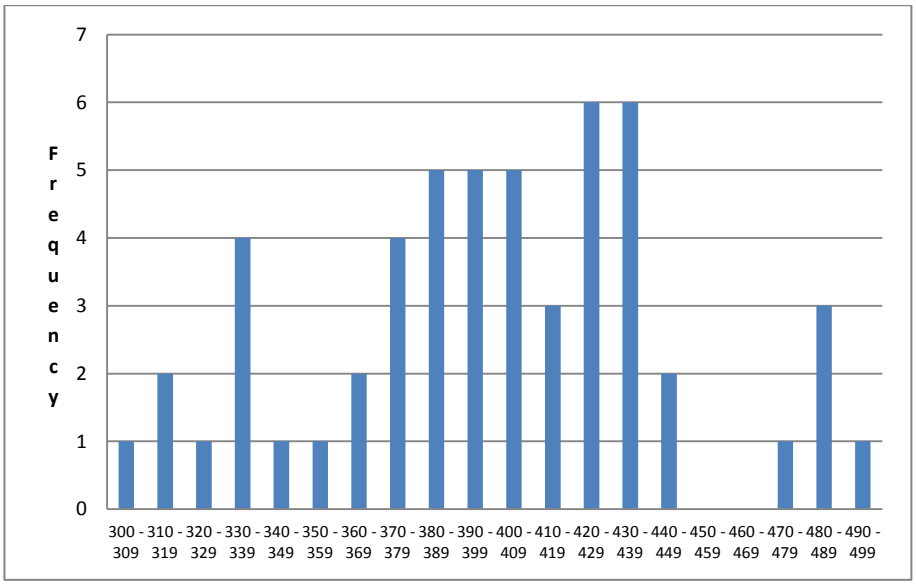

Figure 74. Haddock length range frequency data

3.5.3.4. Nephrops

Twenty percent of the prawn catch was sampled for length frequency measurement. The highest length range frequency was observed between 25 – 26 mm (49), whilst the lowest length range was frequency was observed between 33 – 34 mm (1). Figure 71 demonstrates a noticeable increase

towards the peak length range followed by a rapid decline; suggesting a series of size clusters for this species. Furthermore, 91% of the *Nephrops* landed in this survey were above the MLS of (20 mm).

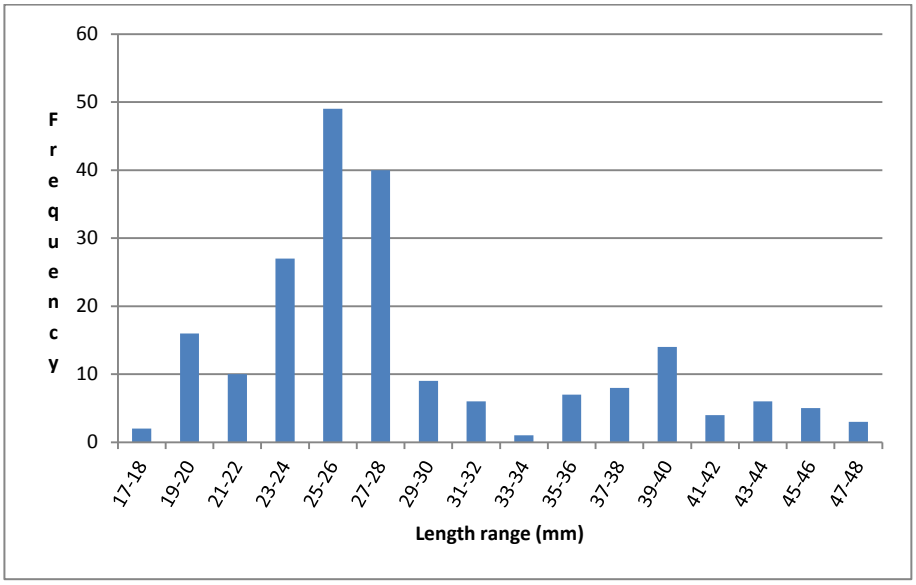

Figure 75. Prawn (Nephrops) length range frequency data

3.5.4. Statistical analysis of shellfish data

Given the low number of sampling stations and differences in mesh size, it is not considered that a statistical analysis of data collated from the three prawn trawl stations is warranted.

3.6. Combined Length Frequency Data for all Surveys

The length frequency data for species were there is adequate abundance have been pooled to provide a more defined view of likely length frequencies across the inshore waters of the Teesside export cable corridor study area. The evaluation of size classes of fish caught within the different survey's has to some extent been limited by gear type and in particular mesh size, pooling of length frequency data should provide a clearer view of the wider range of fish sizes, and as a consequence cohorts present throughout the inshore waters of the export cable corridor for the Dogger Bank Teesside projects.

3.6.1. Whiting

, Whiting were abundant in samples from the otter trawl and prawn trawl surveys. As expected, the smaller size ranges were largely retained by the prawn trawl which was comprised of 90mm mesh, as opposed to the otter trawl which utilised 100mm mesh.

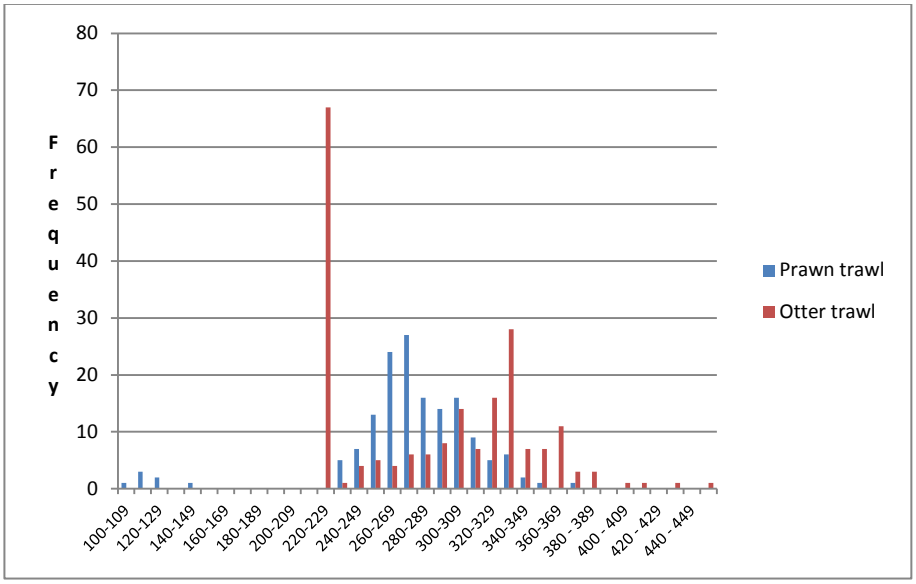

Figure 76. Combined length frequency data for whiting from the otter and prawn trawl surveys

3.6.2. Dab

Data produced for the dab in respect to pooled length frequency are derived from the otter trawl, prawn trawl and trammel net surveys.

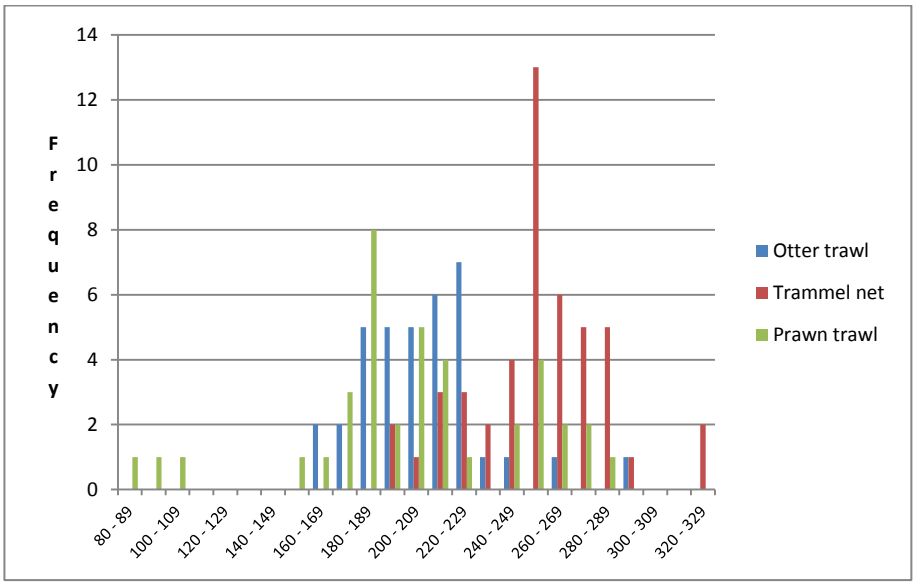

Figure 77. Combined length frequency data for dab from the trammel nets, otter and prawn trawl surveys

These data show a relatively distinct separation of sizes by gear which is directly linked to mesh size. In general terms, the smallest size of dab recorded were from the prawn trawl, which showed a relative distribution across most of the size ranges recorded (80mm to 289mm). Dab recorded in the otter trawls were largely within the mid range of sizes (160mm to 290mm), but more typically within the 160mm to 229mm range. The trammel netting survey produced dab in the 190mm to 329mm length ranges, although more typically between the length range of 240mm to 289mm.

As previously discussed in section 3.2.2.2., dab are typically a slow growing, but long lived species of flatfish and according to Wheeler (1969) may typically grow between 1cm – 2.5cm per year. The assembled data show that there are intermediate 1-gp present with the 2-gp absent. The length frequency data then suggest that all age groups from the 3-gp upwards are present in the inshore waters.

3.6.3. Cod

The length frequency data for cod have been combined from the otter trawl and prawn trawl surveys, these data, whilst relatively low in terms of overall abundance, provide detail on the size classes of cod present throughout the inshore waters of the study area. As expected smaller cod are largely retained in the prawn trawl, although the large percentage of cod captured are above the MLS (35cm). The length frequency data are not particularly clear in terms of define year classes, however, the data do indicate that that age groups ranging from 0-gp to 5-gp are present and that the 2-gp, 3-gp and 4g-gp are more abundant.

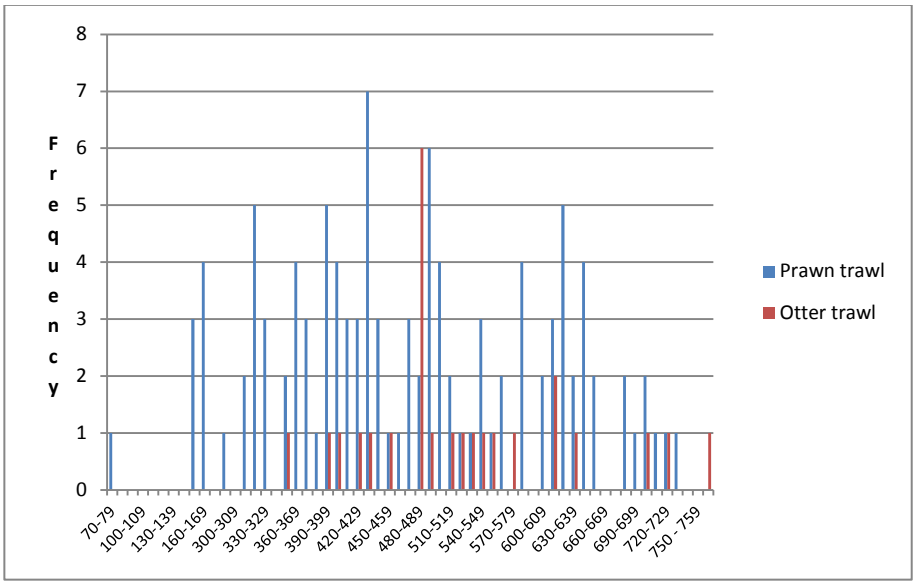

Figure 78. Combined length frequency data for cod from the otter and prawn trawl surveys

3.6.4. Haddock

The combined length frequency data produced for haddock have been derived from the otter trawl and prawn trawl surveys. These data, similar to the cod data are relatively low in terms of overall abundance, they do however, provide detail on the size classes of haddock throughout the inshore study area. The data show a general conformity between the prawn and otter trawls in that there is no significant difference between size range of haddock retained in each gear metier.

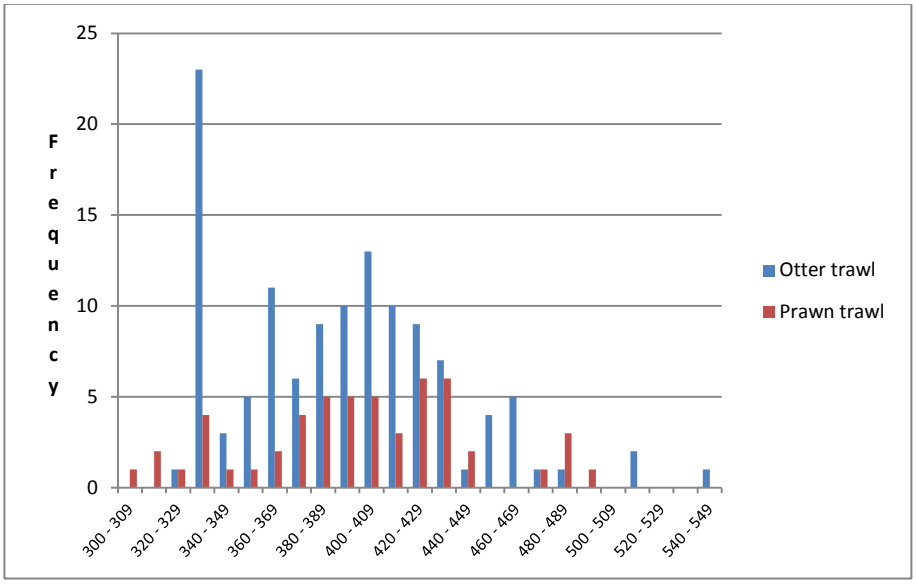

Figure 79. Combined length frequency data for haddock from the otter and prawn trawl surveys

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Wheeler

Client: Forewind

Assessment of Fish and Shellfish in Relation to the Inshore Export Cable Corridor for Dogger Bank Teesside A & B - Spring 2013

Date: 23rd June 2013

Report ref: PMSL/FWD07/TS/06-13-F

Report: Assessment of Fish and Shellfish in relation to the Inshore Export Cable Corridor for Dogger Bank Teesside A & B

Client Name: Forewind

Date: 23rd June 2013

Project ref: FWD/FETS/2012

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Author(s): Daniel Proctor, James Allen & Nigel Proctor

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Date:	16/06/2013	23/06/2013	23/06/2013

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1. Introduction

Precision Marine Survey Limited (PMSL) were commissioned by Forewind Limited to undertake an assessment of fish and shellfish assemblage within the inshore region of the proposed Dogger Bank Teesside A & B export cable corridors for the Dogger Bank Teesside A & B offshore wind farm developments. These surveys were carried out on in conjunction with offshore surveys within Tranche B and the offshore export cable corridors conducted by Brown and May Marine Limited (BMM).

Due to the range of differing fishing activities occurring within the 12 nautical miles (nm) limit, the methodology of the inshore and offshore surveys differed slightly. The offshore study used an otter trawl and 2 m scientific beam trawl. The inshore survey used an otter trawl, scientific beam trawl and static gears (nets and shellfish pots). The presence of shellfish pots and gill/trammel nets within the vicinity of the export cable corridors precluded the use of otter trawls due to the high risk of snagging static gears. In order to represent the same fishing practices as local fishermen, static gears were deployed within the 3nm limit and otter trawls were used outside of the 3nm limit to assess the fish assemblage. A key consideration throughout the survey design was the 'hard' nature of the seabed and following dialogue with local fishermen at Hartlepool, 16" rockhopper discs were used on the ground line to reduce the potential for snagging. As reported in the Teesside 2012 survey report (PMSL/FWL/T05-10/12/F – 29th October 2012) the hard ground caused problems during the deployment of the scientific beam trawl for the juvenile fish and epifaunal surveys. A new modified beam trawl was deployed in May 2013 and the survey was completed.

Table 1. Fish and shellfish survey schedule for autumn 2012 and spring 2013

Component	Period	Start Date	Completion Date
Shellfish Assessment (potting)	**Autumn 2012**	**15th September 2012**	**20th September 2012**
Fish Assessment (Gill Netting)	**Autumn 2012**	**17th September 2012**	**18th September 2012**
Fish Assessment (Otter Trawling)	**Autumn 2012**	**22nd September 2012**	**23rd September 2012**
Prawn & Fish Assessment (Otter Trawling)	**Autumn 2012**	**24th October**	**24th October**
Beam Trawl	**Autumn 2012**	**25th – 26th October**	**Postponed due to weather and hard ground conditions**
Prawn & Fish Assessment (Otter Trawling)	**Spring 2013**	**16th March 2013**	**16th March 2013**
Shellfish Assessment (potting)	**Spring 2013**	**22nd April 2013**	**25th April 2013**
Fish Assessment (Gill Netting)	**Spring 2013**	**23rd April 2013**	**25th April 2013**
Fish Assessment (Otter Trawling)	**Spring 2013**	**16th May 2013**	**16th May 2013**
Beam Trawl	**Spring 2013**	**19th May 2013**	**19th May 2013**

2. Methods

The following section describes the methods used to survey the fish and shellfish assemblage within the inshore arena (12 nm) in the proposed vicinity of the Dogger Bank Export Cable Corridor.

Due to the high degree of shellfish static gears and other static finfish gears throughout the nearshore waters of the Cleveland coast, otter trawling is limited to specific grounds and the waters beyond 3 nm. The survey methodology reflects the type of fishing gears used by local fishermen.

The methodologies outlined follow standard industry guidance (i.e. Ware & Kenny (2011), Rees *et al*., (1990) and Cooper & Rees (2002)), and where such standard operating procedures are not clearly defined, the methods employed, such as gill netting followed those practices used by the local fishing sector, as recommended by Cefas (2004) and Potter & Pawson (1991).

2.1. Shellfish Survey

A Bridlington based vessel (MFV Mirage II - H1075) was employed as the survey platform to ensure the gears were deployed in the same manner as the shellfish fishery (Figure 1). The Mirage II had been utilised previously for similar surveys along the inshore section of the Creyke Beck Projects export cable corridor.

Figure 1. Survey fishing vessel used during the shellfish, netting surveys - Mirage II (H1075)

2.1.1. Shellfish Survey Method

Standard pots, pot distances and bait type were used throughout the survey. Five fine mesh pots (mesh size 10mm) were located randomly within the fleet of normal pots to sample juveniles. The fine mesh pots were positioned randomly within the fleet to account for pot bias and end effects'. Five fleets, each containing 20 pots, were positioned across the inshore Export Cable Corridor and within the main fishing grounds. Due to the level of trawling activity, it was not considered appropriate to deploy static gears on trawl grounds, nor in areas outside of the normal shellfish fishing grounds. Each fleet was baited identically with a combination of mackerel and dab in bait bags and left for a minimum soak time of 48 hours (Figure 2).

Figure 2. Deployment of 38" parlour pots during nearshore survey

The position of the fleet (lat. & long.), water depth, number of brown crabs, lobsters and velvet crabs per pot, their general condition (ecdysis), presence of berried females, density and diversity of the by-catch and percentage discards as well as sea state, wind speed and direction, percentage cloud cover and weather was recorded upon retrieval of each fleet.

2.2. Finfish Survey

2.2.1. Otter Trawl Method

The MFV Stella Maris used 5'6" V doors and worked 16" discs on the fishing line. The trawl was comprised of 120ft fishing line, with 110ft head line and a mesh size of 100mm as agreed with the MMO and the NEIFCA.

Figure 3. Recovery of cod end from the otter trawl during inshore trawl survey

At each station, the otter trawl was towed for a duration of 30 minutes at a towing speed of 2.5 -3.0 knots. The start point for each trawl commenced when the winch was locked and after 30 minutes, the trawl was hauled to the surface and the sample recovered. The total volume of the catch was measured and sorted with the fish species separated from the epifaunal invertebrates. A survey log was maintained at all times. The total catch volume and any notable observations from individual trawls were recorded on the survey log (high amount of shell, rocks, cobbles, weed and other debris).

The otter trawl survey was carried out over two days in September and combined with the shellfish and trammel net surveys.

2.2.2. Prawn Trawl Method

Local fishermen indicated that the Dogger Bank Teesside C and D Export Cable Corridor option is in the vicinity of a *Nephrops* fishing ground.

The trawl used to characterise the *Nephrops* and fish assemblage was a dedicated *Nephrops* trawl comprising 100ft fishing line, with 90ft head line and a mesh size of 80mm. The vessel used 5'6" V doors and worked 4" discs and chain on the fishing line.

Figure 4. Release of trawl door during prawn trawl survey

A total of three trawl stations were selected for the characterisation of the local grounds. At each station, the *Nephrops* trawl was towed for a duration of 40 minutes at a towing speed of 2.5 -2.7 knots. The start point for each trawl commenced when the winch was locked, and after 40 minutes, the trawl was hauled and the sample recovered. The total volume of the catch was measured and sorted to separate fish species and epifaunal invertebrates. A survey log was maintained at all times, with any notable observations (e.g. high amount of shell, rocks, cobbles, weed and other debris) from individual trawls recorded.

The *Nephrops* trawl survey was carried out over a single day in March 2013. Poor weather caused the postponement of the 2m scientific beam trawl survey for juvenile fish and epifauna, otter trawl survey, potting survey and the trammel netting survey until May 2013.

2.2.3. Trammel Netting Method

Six fleets were deployed, with one fleet positioned close to the shore along each of the proposed cable routes, a second was laid along the mid-section of the inshore cable route, and two fleets positioned randomly within the central nearshore region (figure 5).

In order to replicate current fishing practices, trammel nets with a minimum mesh size of 100mm were deployed in order to account for the smaller size classes using the inshore area. The nets were comprised of two panels of differing mesh sizes, with an inner mesh of 100mm and an outer mesh of 645mm.

Figure 5. Clearing a fleet of trammel nets into net bin during nearshore survey

Each monofilament trammel net was 100m in length with a depth of 10ft (30 meshes Anchors secured each end of the net to the seabed with a surface with a surface marker buoy at each end. The nets were deployed during a medium to neap tidal cycle to fish either side of a slack water period. The nets were then recovered following a suitable 'soak time' (6 - 12 hours).

Following the recovery of each fleet, the fish were removed from the net and placed into fish boxes, live fish were placed into a container filled with aerated seawater. Fish were measured for length, weight and sex (where possible) and released, except for those retained for gonad analysis. Nets were redeployed to provide data over a 24hr period (two survey days), with assessments carried out during both daylight hours and periods of darkness in order to obtain representative samples of diurnal and nocturnal fish species.

The trammel net fleets were located in close proximity to the shellfish pots to minimise travelling times and were fished for a complete tidal cycle.

2.2.4. Two Metre Scientific Beam Trawl (Juvenile Fish and Epifauna)

Given the difficulties encountered during October in respect to the deployment of the 2m scientific beam trawl, a new modified beam trawl was developed. Modifications included;

- a heavier frame to reduce damage when snagging on boulders,
- the removal of chains and intermittent discs on the fishing line,
- the re-rigging the fishing line with 4" rubber discs on a stainless steel wire,
- a heavy Dyneema chafer on the belly of the main net and cod end,
- a chain mesh 'stone catcher' to prevent cobbles and boulders passing down into the belly/cod end of the net,
- a heavier chain bridle and
- the use of a trawl bridle as the initial towing warp.

The survey commenced on 19th May 2013. All stations were sampled however the presence of static gear and the close proximity to the Braer pipeline forced the abandonment of sampling at one station.

Twelve stations for the juvenile fish and twelve stations for the epifauna were determined, with the sampling stations being parallel to the main otter trawl stations.

2.2.4.1. Two Metre Beam Trawl Method

At each station a 2m scientific beam trawl with 10mm mesh and 5mm cod end liner was towed for 10 minutes. Each trawl commenced when the winch was locked and after 10 minutes, the trawl was hauled and the sample recovered. The total volume of the catch was measured and sorted with the fish species separated from the epifaunal invertebrates.

A survey log was maintained at all times. Any notable observations from individual trawls was recorded on the survey log (high amount of shell, rocks, cobbles, weed and other debris, including total catch volume)

Dispensation to catch and retain undersized fish and shellfish was provided by the North Eastern Inshore Fisheries and Conservation Authority (NEIFCA). Additional dispensation was requested and given by the Marine Management Organisation (MMO),particularly with regard to the retention of cod in a recovery zone and whilst using nets with a mesh of 100mm.

Figure 6. Recovery of modified 2-m beam trawl during the spring 2013 inshore beam trawl survey

3. Results – Spring Surveys

3.1. Otter Trawling

The otter trawl survey took place on 16th of May with each trawl lasting approximately 30 minutes (table 2). Figure 7 shows the sampling stations for the spring 2013 survey.

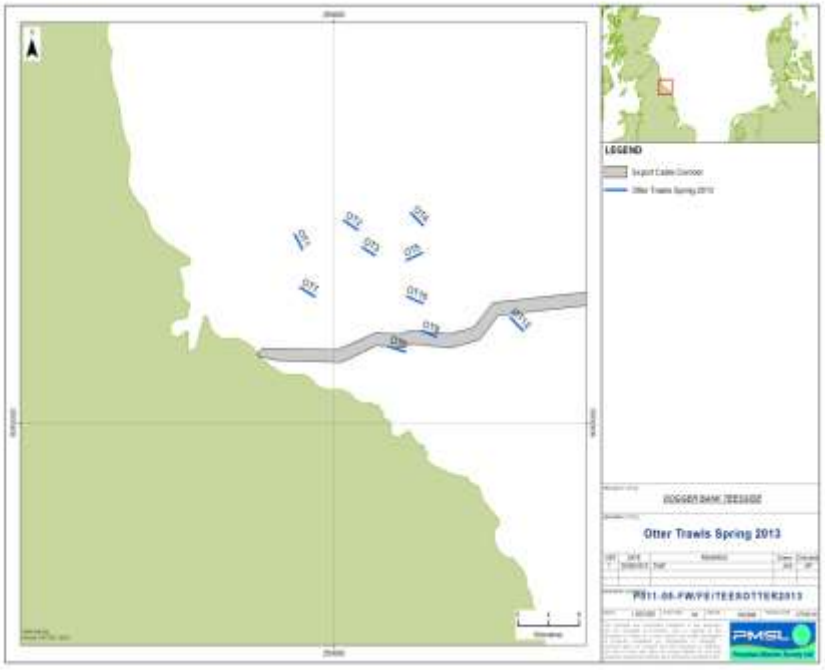

Figure 7. Otter trawl sampling stations for the spring 2013 survey

The presence of static gear and the close proximity to the Braer pipeline forced the abandonment of sampling at station 6. Sampling station 11 was also abandoned due the presence of static gear.

Table 2. Otter trawl positional data

		Fleet Start				Fleet End				
			WGS 84				WGS 84			
Station	Date	Deployment Time (GMT)	Latitude	Longitude	Depth (m)	Recovery Time (End)	Latitude	Longitude	Depth (m)	Duration (mm:ss)
OT1	16/05/2013	04:36:16	54.43.743N	000.57.786W	47.7	05:07:29	54.42.827N	000.56.721W	43.2	31:13
OT2	16/05/2013	20:45:53	54.44.271N	000.50.154W	53.9	21:17:22	54.44.800N	000.51.873W	55.4	31:29
OT3	16/05/2013	06:38:22	54.43.191N	000.49.451W	48.2	07:09:36	54.42.751N	000.47.904W	49.3	31:14
OT4	16/05/2013	07:56:00	54.45.500N	000.43.758W	57.5	08:27:16	54.44.789N	000.42.205W	56.9	31:16
OT5	16/05/2013	09:27:09	54.42.546N	000.44.035W	54.9	09:58:19	54.43.075N	000.42.140W	57.7	31:10
OT6	16/05/2013	19:50:00	Station abandoned after two failed attempts, on each occasion the trawl path was compromised by static gears, optional relocation placed the sample station too close to Braer pipeline							
OT7	16/05/2013	05:40:16	54.40.444N	000.56.800W	37.9	06:10:28	54.39.950N	000.54.952W	40.8	30:12
OT8	16/05/2013	17:33:06	54.36.841N	000.43.667W	47.2	18:05:01	54.37.125N	000.45.767W	46.5	31:55
OT9	16/05/2013	14:44:19	54.38.217N	000.41.763W	50.3	15:15:28	54.37.915N	000.39.987W	52.5	31:09
OT10	16/05/2013	16:06:13	54.39.941N	000.41.794W	48.9	16:36:33	54.40.298N	000.43.762W	47.6	30:20
OT11	16/05/2013	13:59:00	Station abandoned after three failed attempts, on each occasion the trawl path was compromised by static gears, optional relocation placed the sample station too far away to be an effective replicate of the Autumn 2012 station							
OT12	16/05/2013	12:03:43	54.39.371N	000.31.095W	55.2	12:34:34	54.38.594N	000.29.446W	51.6	30:51

3.1.1. Species Density and Diversity

Figure 8 illustrates the species composition during the otter trawl survey. In total, 16 species of fish and three macro-invertebrate species were recorded during the otter trawl survey.

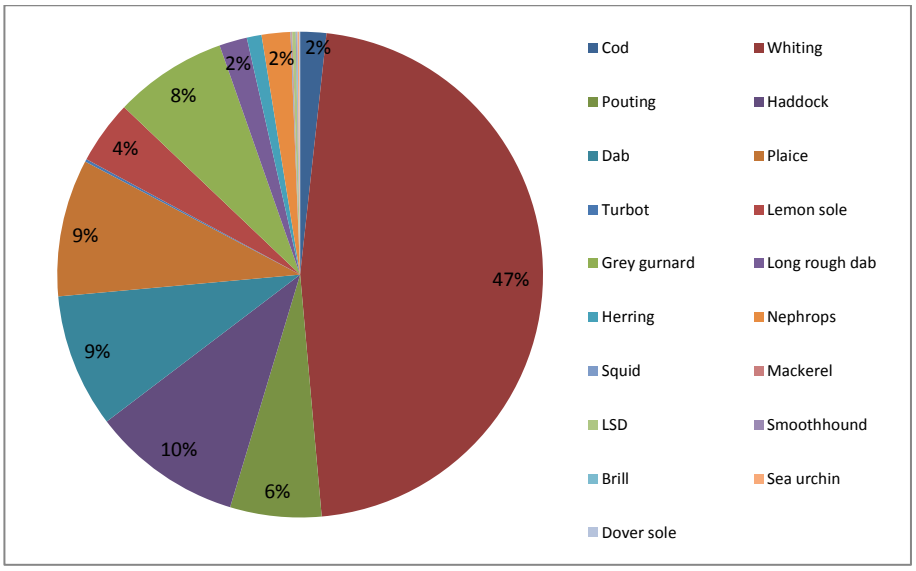

Figure 8. Overall Abundance of Species for all Sampling Stations

The most abundant species recorded was whiting, representing 47% of the total catch. Table 3 gives absolute catch densities and the diversity for individual sampling stations.

Table 3. Species diversity and abundance from the otter trawl survey.

Species	Latin name	stn 1	stn 2	stn 3	stn 4	stn 5	stn 7	stn 8	stn 9	stn 10	stn 12	Total
Cod	*Gadus morhua*	1	0	5	8	1	4	0	2	7	2	**30**
Whiting	*Merlangius merlangus*	90	228	28	240	9	184	1	14	7	9	**810**
Pouting	*Trisopterus luscus*	5	5	5	0	7	8	8	19	25	23	**105**
Haddock	*Melanogrammus aeglefinus*	13	55	7	35	3	55	2	2	0	1	**173**
Dab	*Limanda limanda*	7	9	6	10	12	36	8	19	15	32	**154**
Plaice	*Pleuronectes platessa*	6	12	6	6	16	39	4	6	7	56	**158**
Turbot	*Psetta maximus*	1	2	0	0	0	0	0	0	0	0	**3**
Lemon sole	*Microstomus kitt*	2	16	6	6	9	5	7	9	7	6	**73**
Grey gurnard	*Eutrigla gurnardus*	1	95	3	9	1	10	1	4	0	6	**130**
Long rough dab	*Hippoglossoides platessoides*	7	2	3	3	0	14	0	2	0	1	**32**
Herring	*Clupea harengus*	7	1	0	1	1	3	0	2	2	0	**17**
Mackerel	*Scomber scombrus*	0	0	0	1	0	0	0	0	0	0	**1**
Lesser spotted dogfish	*Scyliorhinus canicula*	0	0	0	4	0	0	0	0	0	0	**4**
Smoothhound	*Mustelus mustelus*	0	0	0	1	0	0	0	0	0	0	**1**
Brill	*Scophthalmus rhombus*	0	0	0	0	1	0	0	0	0	0	**1**
Dover sole	*Solea solea*	0	0	0	0	0	0	0	0	0	1	**1**
Prawn	*Nephrops norvegicus*	3	4	0	0	0	26	0	0	0	0	**33**
Squid	*Loligo vulgaris*	0	1	0	0	0	0	0	0	0	0	**1**
Sea urchin	*Echinus esculentus*	0	0	0	0	0	0	1	0	1	0	**2**
Total abundance		**143**	**430**	**69**	**324**	**60**	**384**	**32**	**79**	**71**	**137**	**1729**
Total diversity		**12**	**12**	**9**	**12**	**10**	**11**	**8**	**10**	**8**	**10**	**20**

Whiting, dab, plaice and lemon sole were present at all sampling stations during the survey (table 3). Whiting was the most abundant species throughout the survey, with up to 240 caught at one station (station 4). Haddock was the second most abundant species. These two species were also the most abundant species in the autumn surveys.

Thirty two individuals were caught at station 8, and stations 3 & 10 produced the lowest species diversity (8 species). Figure 9 illustrates the relative abundance of key species retained at all sampling stations and the contribution they made towards the total abundance recorded.

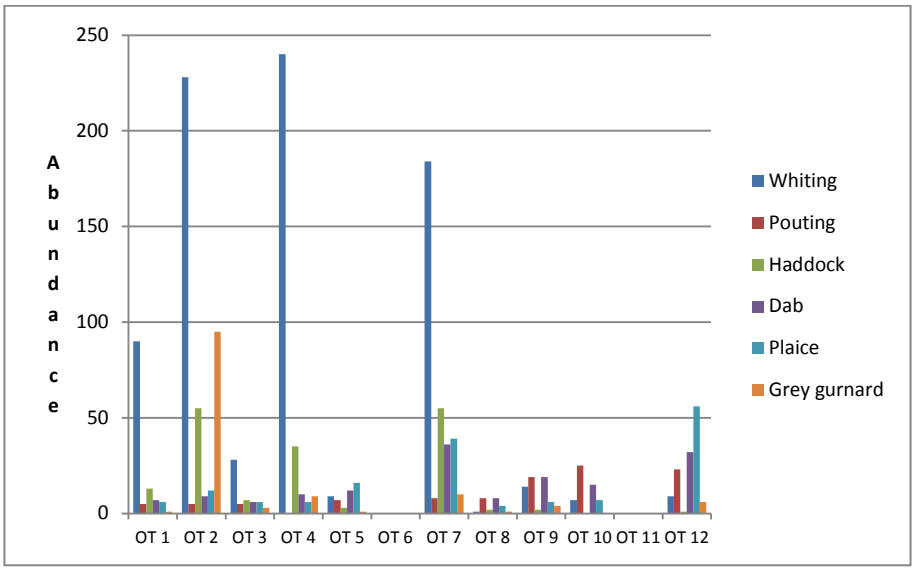

Figure 9. Abundance of key targets species for individual fleets

3.1.2. Individual Sampling Station Composition

3.1.2.1. Station 1

Whiting represented 63% of the catch at station 1. Figure 10 demonstrates the percentage composition of all species caught

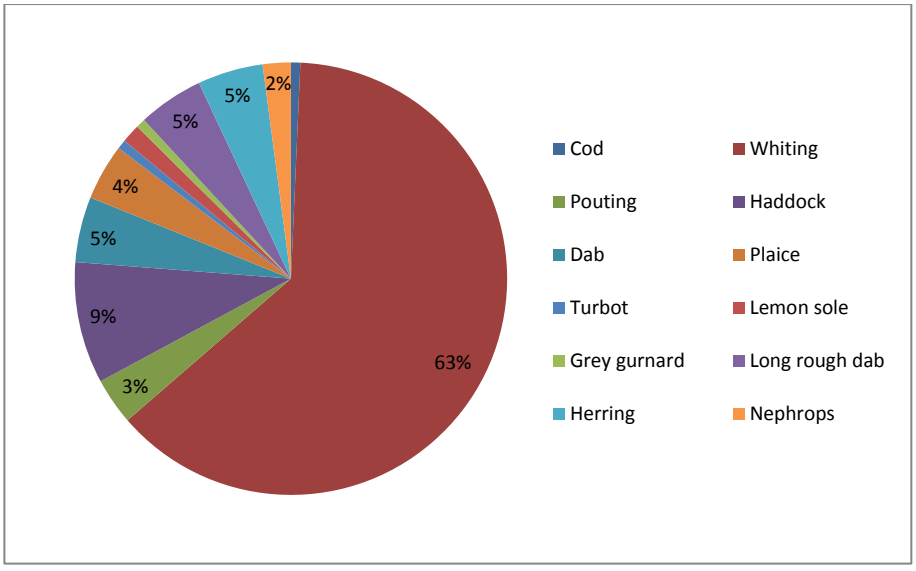

Figure 10. Percentage composition of species at station 1

3.1.2.2. Station 2

Whiting contributed 53% of the total catch at station 2. Grey gurnard represented 22% of the catch whilst haddock contributed 13%. Station 2 recorded the highest species abundance (430) and high species diversity with 12 species caught.

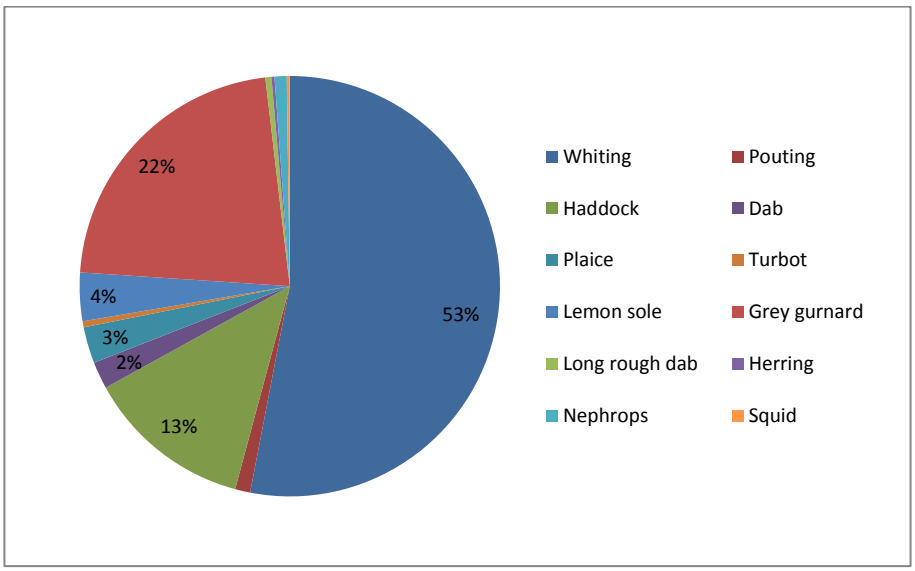

Figure 11. Percentage composition of species in station 2

3.1.2.3. Station 3

Whiting represents 41% of the catch at station 3. Haddock contributed 10% and dab, plaice and lemon sole made up 27%. There was a low species diversity at station 3.

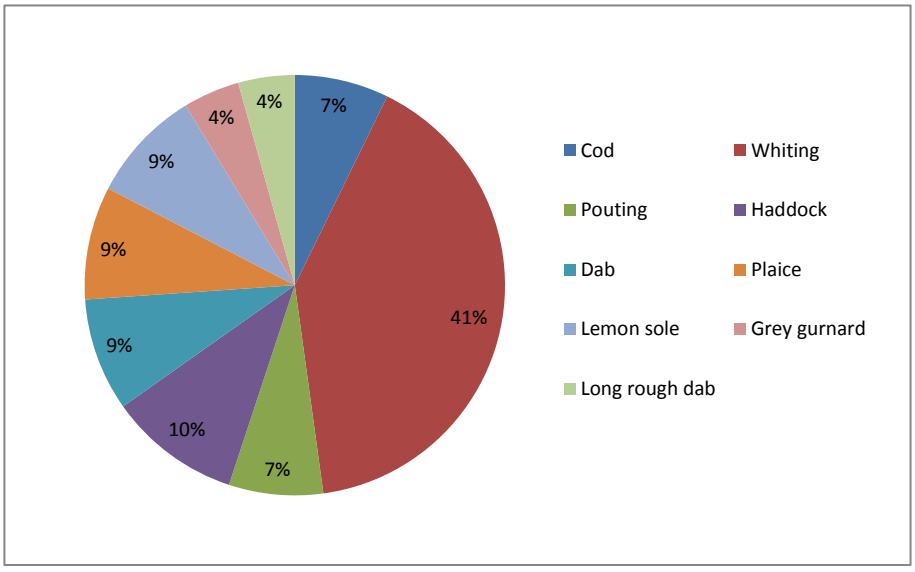

Figure 12. Percentage composition of species in station 3

3.1.2.4. Station 4

Values at station 4 were very similar in the spring and autumn surveys. Whiting and Haddock represented 74% and 11% of the catch, respectively.

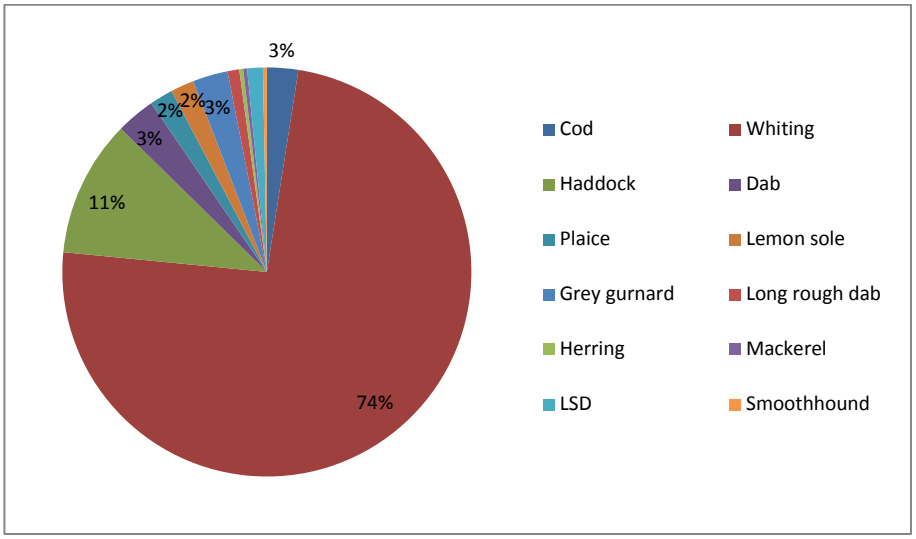

Figure 13. Percentage composition of species in station 4

3.1.2.5. Station 5

At station 5 plaice contributed 27% of the catch, dab 20% whilke whiting and lemon sole each represented 15%. Station 5 recorded the second lowest abundance of all sampling stations.

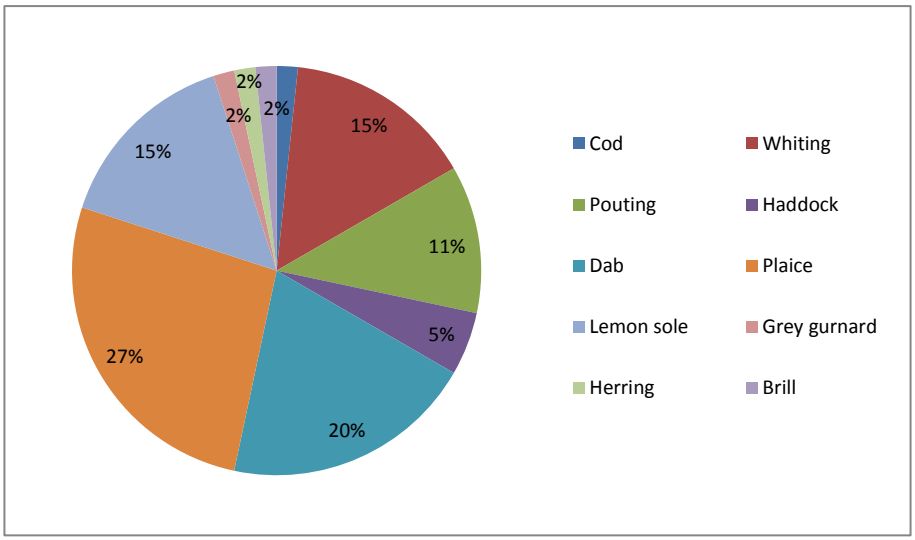

Figure 14. Percentage composition of species at station 5

3.1.2.6. Station 6

The presence of static gear and the close proximity to the Braer pipeline forced the abandonment of sampling at station 6 after two attempts.

3.1.2.7. Station 7

Whiting was the most dominat species at station 7 representing 48%, followed by haddock (14%). Station 7 recorded high species abundance and a relatively high species diversity.

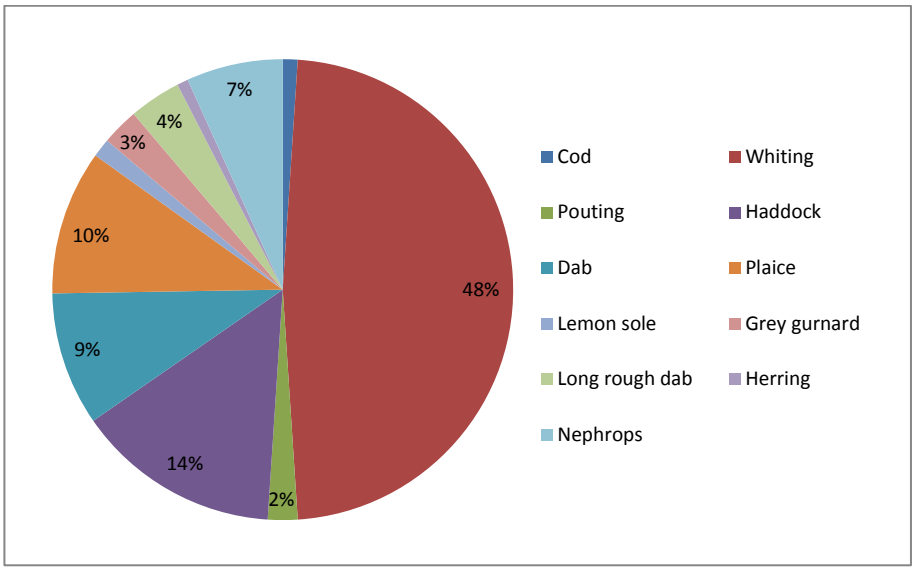

Figure 15. Percentage composition of species in station 7

3.1.2.8. Station 8

Station 8 recorded the lowest species abundance (32) and also low species diversity (8 species). Pouting and Dab represent 50% of the total catch, and lemon sole represent 22%.

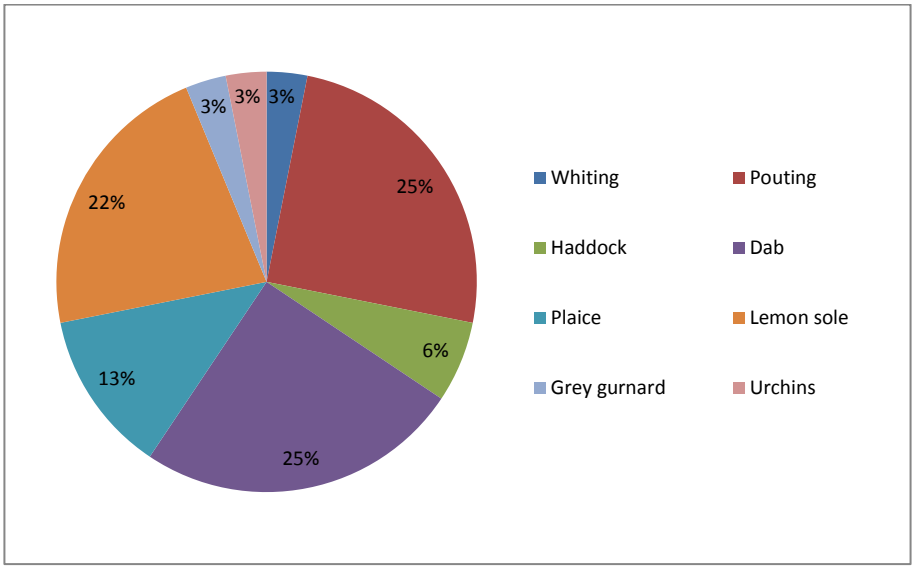

Figure 16. Percentage composition of species in station 8

3.1.2.9. Station 9

The species abundance at station 9 was low, with pouting and dab each contributing 24% of the catch.

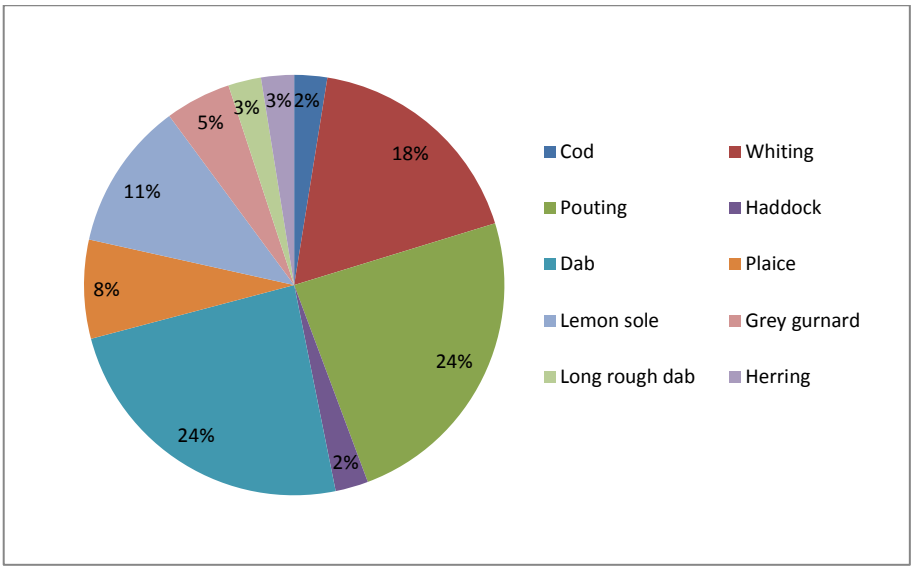

Figure 17. Percentage composition of species in station 9

3.1.2.10. Station 10

Species diversity at station 10 was the lowest of all 12 stations. Pouting and dab were the most dominant species, representing 56% of the catch.

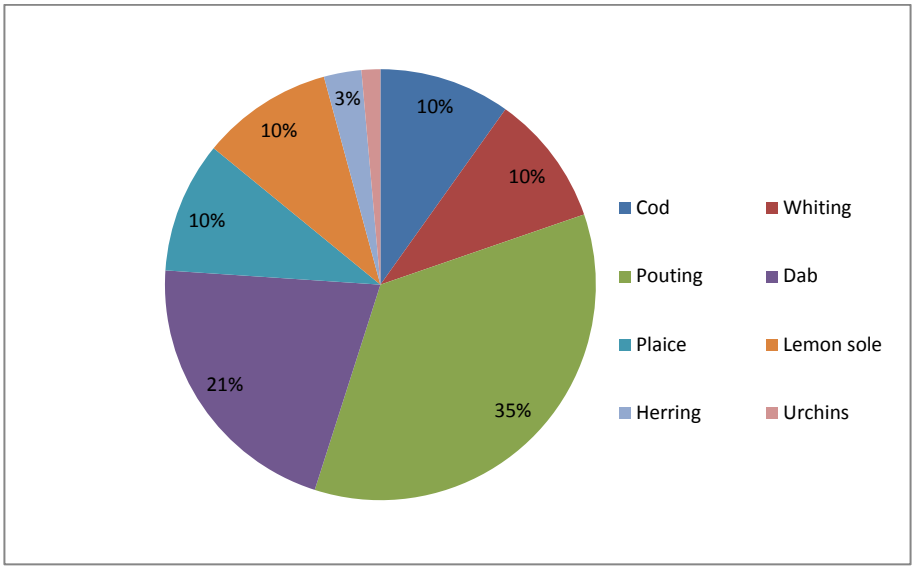

Figure 18. Percentage composition of species in station 10

3.1.2.11. Station 11

Sampling was abandoned at station 11after two attempts due to the amount of static gear in the close vicinity of the sampling station.

3.1.2.12. Station 12

Flatfish represented 64% of the catch at station 12 (plaice and dab).

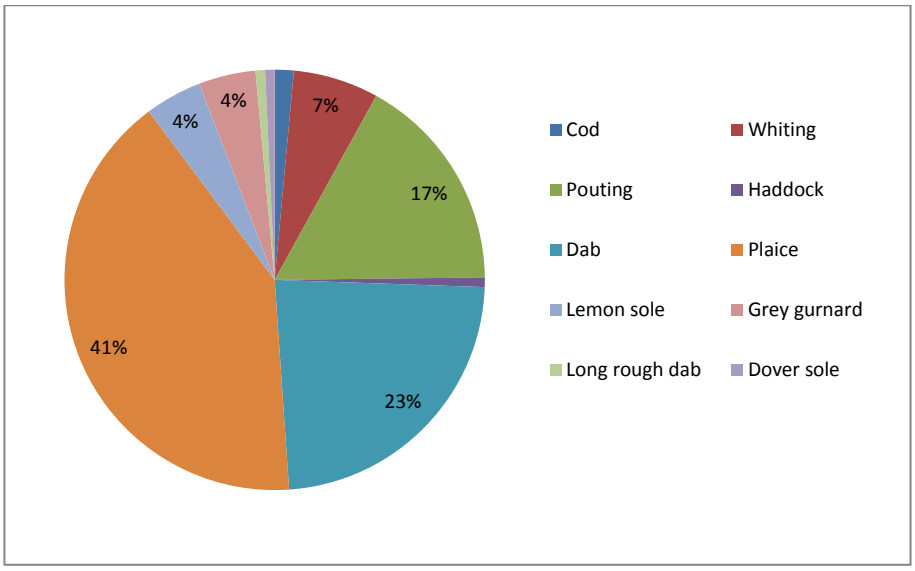

Figure 19. Percentage composition of species at station 12

3.1.3. Length Frequency Analysis

Due to a low abundance of species within the otter trawl survey, length frequency charts have only been produced for whiting, dab, pouting, plaice, haddock and grey gurnard.

3.1.3.1. Whiting

The largest length frequency class recorded for whiting was 280mm - 289mm, which is above the minimum landing size (MLS) of 27cm. There were very few whiting recorded in the small length ranges i.e. 140mm to 219mm, with frequency of length classes increasing from 220mm.

Figure 22 shows that 81% of the whiting landed during the otter trawl survey were above the MLS compared to a lower value of 60% caught in the autumn otter trawl survey.

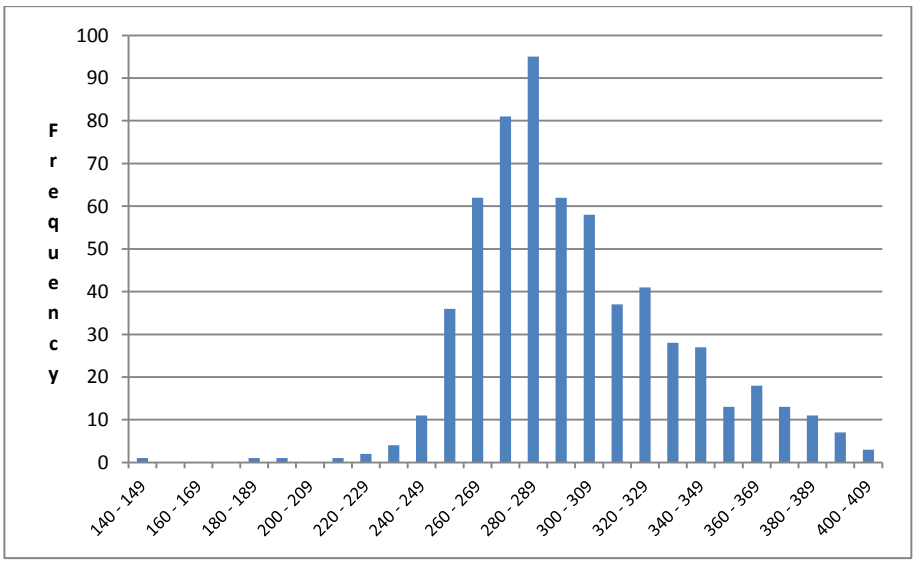

Figure 20. Whiting length frequency data

3.1.3.2. Dab

During the spring surveys, the most abundant length frequency range for dab was recorded in 220mm to 229 mm length range, the same observed in the autumn surveys, although there was a significantly lower abundance in comparison.

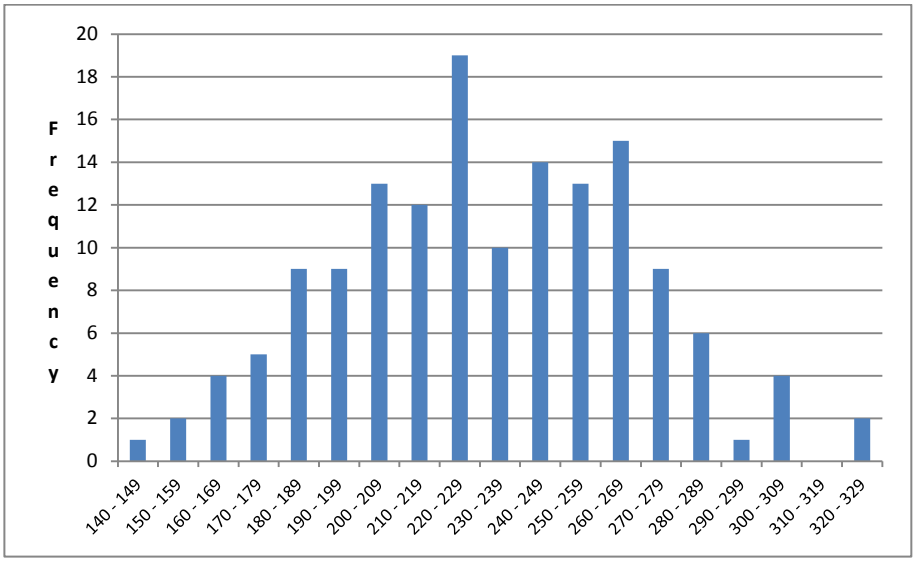

Figure 21. Dab length frequency data

Only 34% of dab caught in this survey were considered to be above the size of sexual maturity (25 cm).

3.1.3.3. Pouting

The length frequency data for pouting indicate that the assemblage is dominated by 1-gp and 2-gp fish, although there are a lesser number of 0-gp and 3-gp pouting present. The most abundant length class was the 210mm – 219mm, although a number of size classes around this were also relatively abundant.

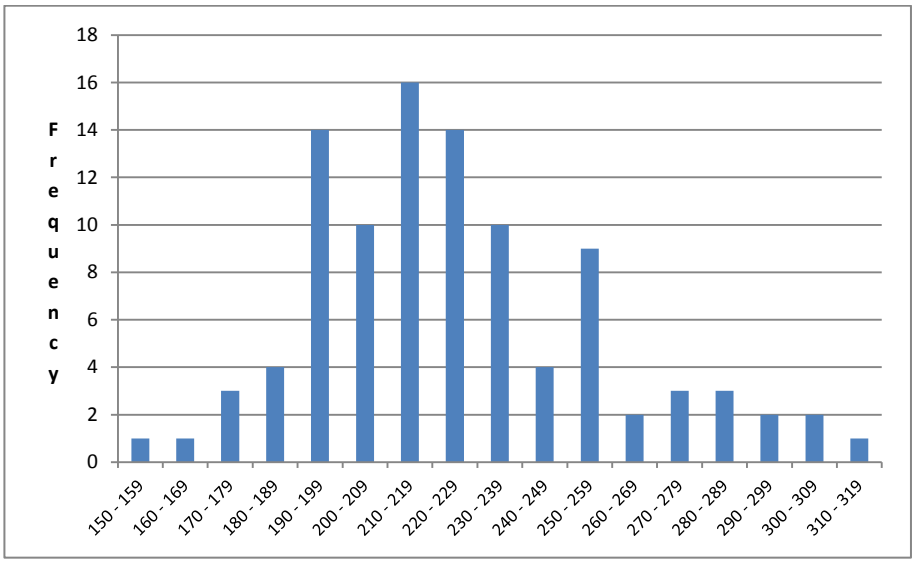

Figure 22. Pouting length frequency data

3.1.3.4. Plaice

Sixty percent of plaice caught during the otter trawl survey were above the MLS of 27cm.

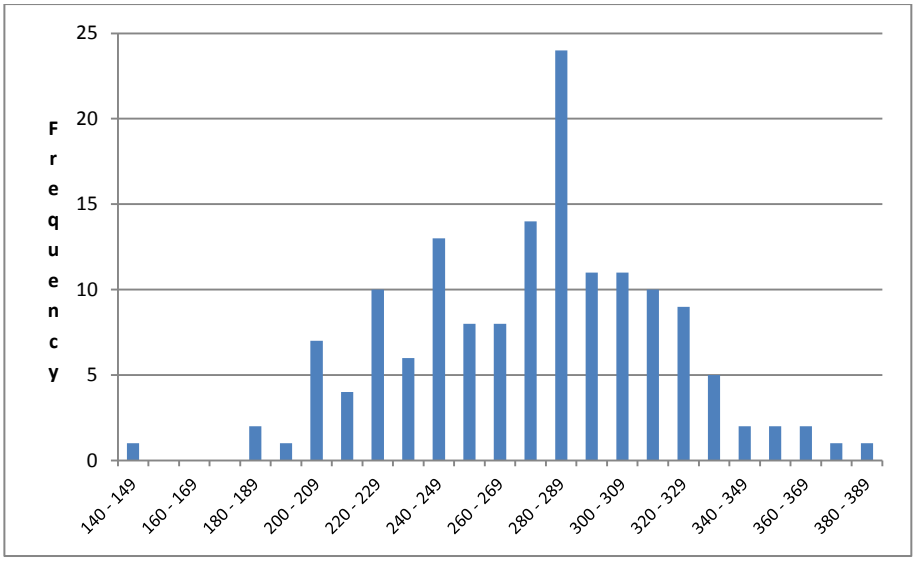

Figure 23. Plaice length frequency data

3.1.3.5. Haddock

The biggest length frequency class for haddock caught during the otter trawl survey was the 370mm to 379mm size class, which was higher than that seen in the autumn survey (330mm-339mm), although this is not unexpected given the average growth rates for the species.

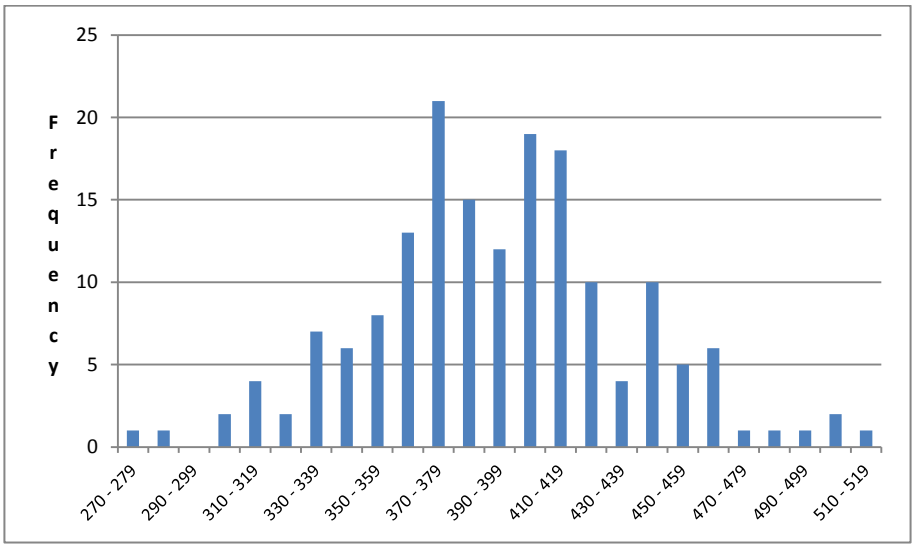

Figure 24. Haddock length frequency data

Ninety nine percent of the haddock retained during the spring otter trawl survey were above the MLS of 30cm.

3.1.3.6. Grey Gurnard

The most abundant length frequency class for the grey gurnard was 230 – 239 mm. Only 7% of grey gurnard caught in this survey were above the size of sexual maturity (25 cm).

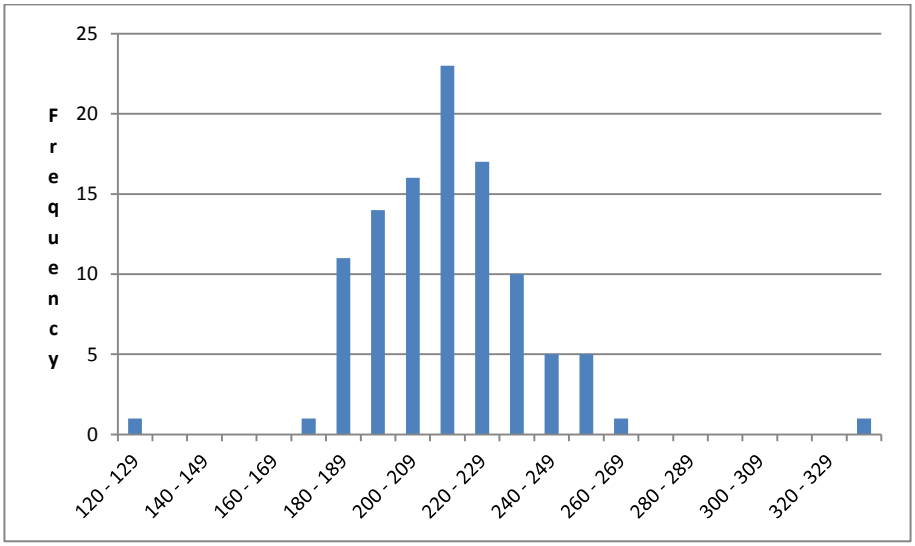

Figure 25. Grey Gurnard length range frequency data

3.1.4. Sex ratios

Sex ratios have been determined for key commercial species.

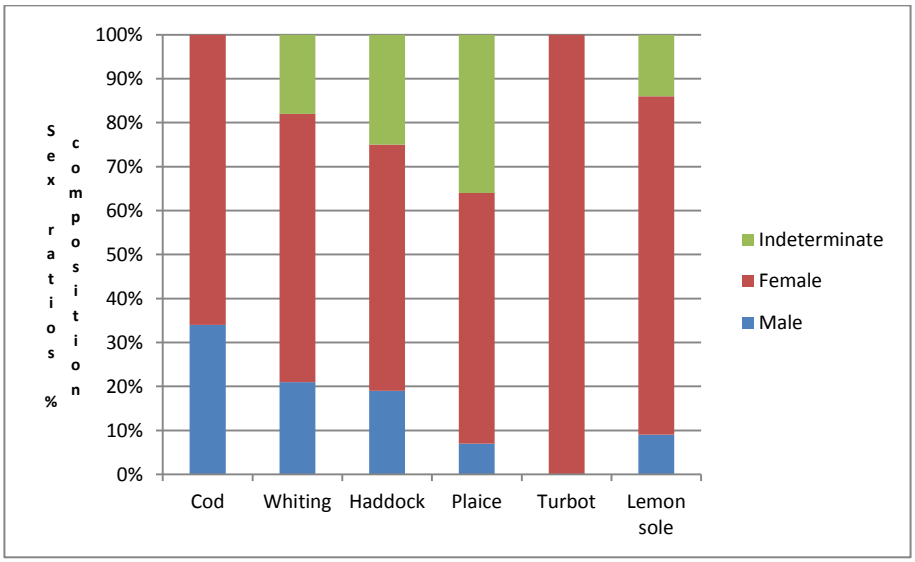

Figure 26. Percentage composition of sex ratios for key species

Figure 25 illustrates that females were more abundant than males; however sex could not be determined for almost 30% of plaice.

Males represented less than 10% of the catch for flatfish species, whereas females represented up to 77% of the catch. This produced a male to female ratio of 1:8 for plaice and 1:8.5 for lemon sole.

Whilst 25% of haddock and 18% of whiting could not be identified, females represented up to 66% of the gadoid species (cod). This produces a sex ratio of 1:3 for haddock and whiting, and 1:2 for cod.

Not included in figure 25 are data derived for the sex ratios of elasmobranch species captured during the otter trawl survey, this is due to the relatively low abundance for all elasmobranches. These data show that the spotted ray and starry ray had male to female ratios of 1:3, whilst the cuckoo ray ratio of male to female was 1:4. For the lesser spotted dogfish males outnumbered females by 2:1, whilst only a single female thornback ray was captured, as well as a single male starry smoothhound.

3.1.5. Spawning condition

Spawning condition was determined where possible. Figure 26 shows that turbot, all of which were females, gonads were maturing, but not yet ripe. For lemon sole,70% had ripe gonads, with approximately 15% maturing. For cod and haddock up to 55% of fish had empty gonads, having spawned previously, although 30% of haddock had maturing gonads, whilst 35% of cod contained ripe gonads.

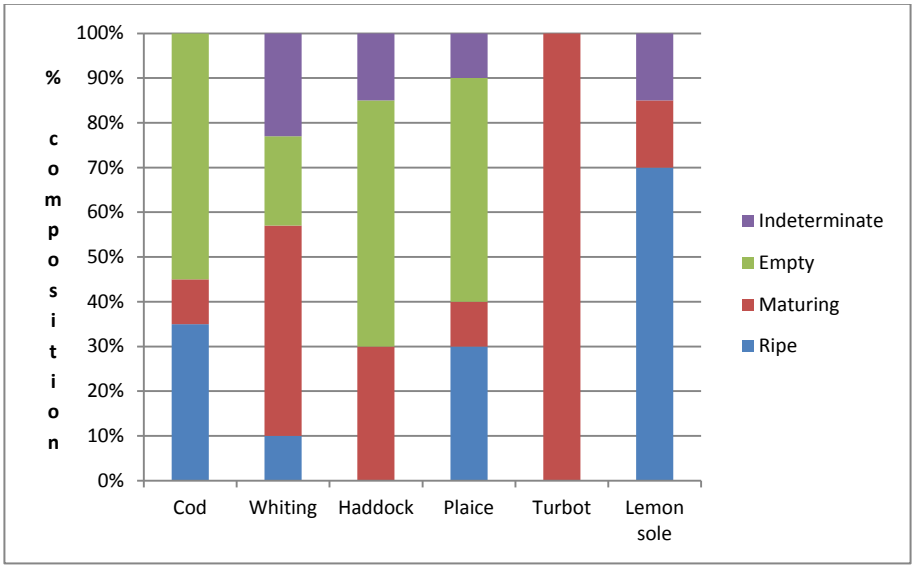

Figure 27. Percentage composition of sex ratios for key species

For 23% of whiting the gonad condition could not be determined, however 45% of gonads were maturing. For plaice, 30% had ripened gonads with 10% showing maturing gonads.

3.1.6. Statistical Analysis of Otter Trawl Data

Classification (cluster analysis) of the data was undertaken using the Bray-Curtis similarity coefficient and grouped average (UPGMA) clustering technique followed by a non metric MDS (multi dimensional scaling) ordination in PRIMER. Cluster analysis identifies the similarity between sites according to species composition based on the Bray-Curtis similarity coefficient (0% indicating no species in common and 100% indicating an identical community). These values are then used to plot a dendrogram to identify groups of sites with similar species composition at a predefined level of similarity.

Non metric MDS graphically displays the (rank) similarity between sites as a 2 dimensional plot in which the distances between sites indicates the level of similarity between them. The stress value associated with an MDS plot indicates how faithful the plot is in representing the similarity between sites with low values (below 0.2) generally indicating a good fit. The SIMPROF test within PRIMER was used to derive the presence of any groups of sites that differed significantly in terms of similarity between species.

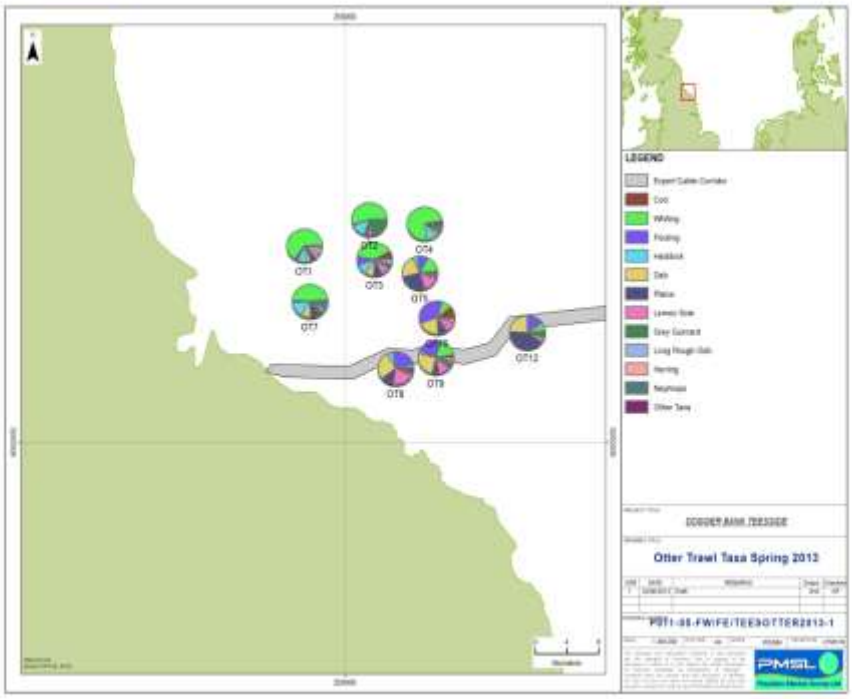

Figure 28. Distribution of taxa groups for the otter trawl survey along the Dogger Bank Teesside A & B export cable corridor

Figure 27 illustrates the range of key and abundant species present at each otter trawl station. Table 4 shows the SIMPER results linking groups with similar species' composition.

The analysis of the otter trawl data shows that there are two distinct clusters (Figure 28), which are based on the similarity of abundance (per hr), presence at sampling stations and cumulative percentage contribution to the total abundance.

Table 4. Cluster analysis and group identification

Cluster Groups Species Contributions (SIMPER)			
	Group a (OT 5, 8, 9, 10, 12)		
	Average similarity: 71.66		
Species	Av. Abundance	% of Stations	Cum.% Contribution
Dab	33.33	100.00	20.59
Pouting	31.86	100.00	40.35
Lemon sole	14.67	100.00	56.58
Plaice	34.53	100.00	71.56
Whiting	15.50	100.00	83.93
Haddock	3.07	80.00	88.47
Grey gurnard	4.64	80.00	92.65
	Group b (OT 1, 2, 3, 4, 7)		

	Average similarity: 67.41		
Species	Av. Abundance	% of Stations	Cum.% Contribution
Whiting	297.48	100.00	32.62
Haddock	63.94	100.00	47.01
Dab	26.57	100.00	57
Plaice	26.98	100.00	66.51
Lemon sole	13.46	100.00	73.88
Grey gurnard	45.17	100.00	80.41
Long rough dab	11.32	100.00	86.82
Pouting	8.93	80.00	91.93

From these analyses, Group a is derived as a result of the dominance of flatfish species within the trawls and stations OT5, OT8, OT9, OT10 and OT 12, which have an average similarity of 71.66%.

Group b gives an average similarity of 67.41% and is largely defined as a result of the significant abundance of whiting, although haddock are moderately abundant (63.93) in comparison to the average abundance identified in Group a (3.07). Group b includes sampling stations OT1, OT2, OT3, OT4 and OT7.

There is a relatively distinct north south divide between the sampling stations (Figure 27), with Group a cluster groups being largely located at and or in close proximity to the export cable for the Dogger Bank Teesside Projects A & B. Whereas the Group b cluster are all located north of the Export Cable Corridor.

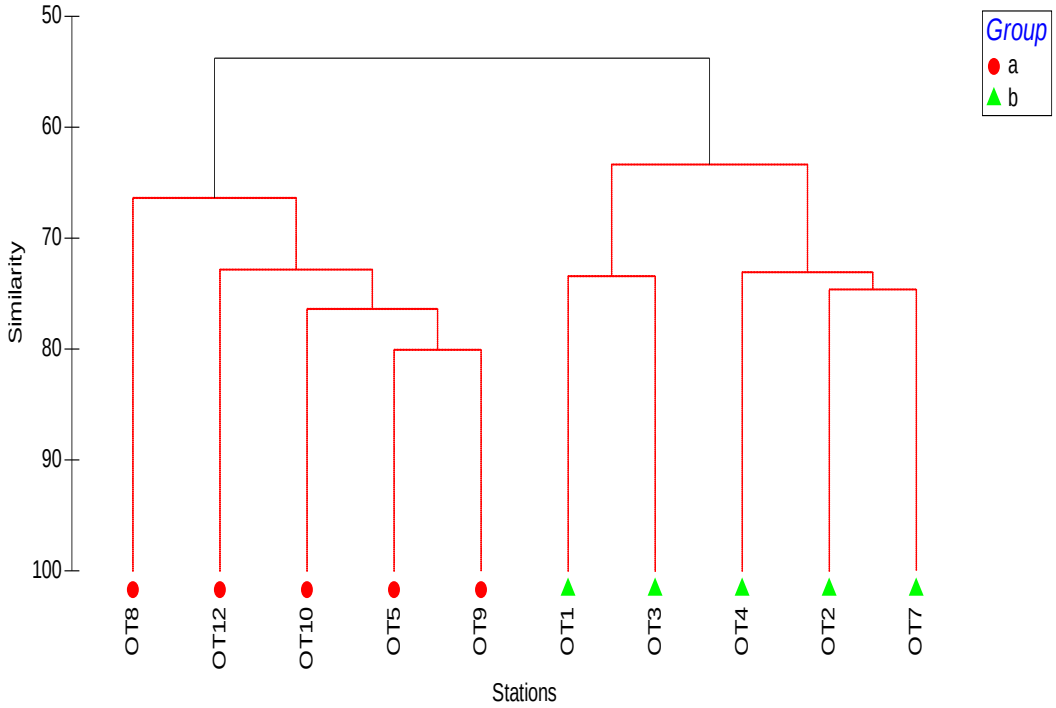

Figure 29. Dendrogram showing otter trawl cluster analysis

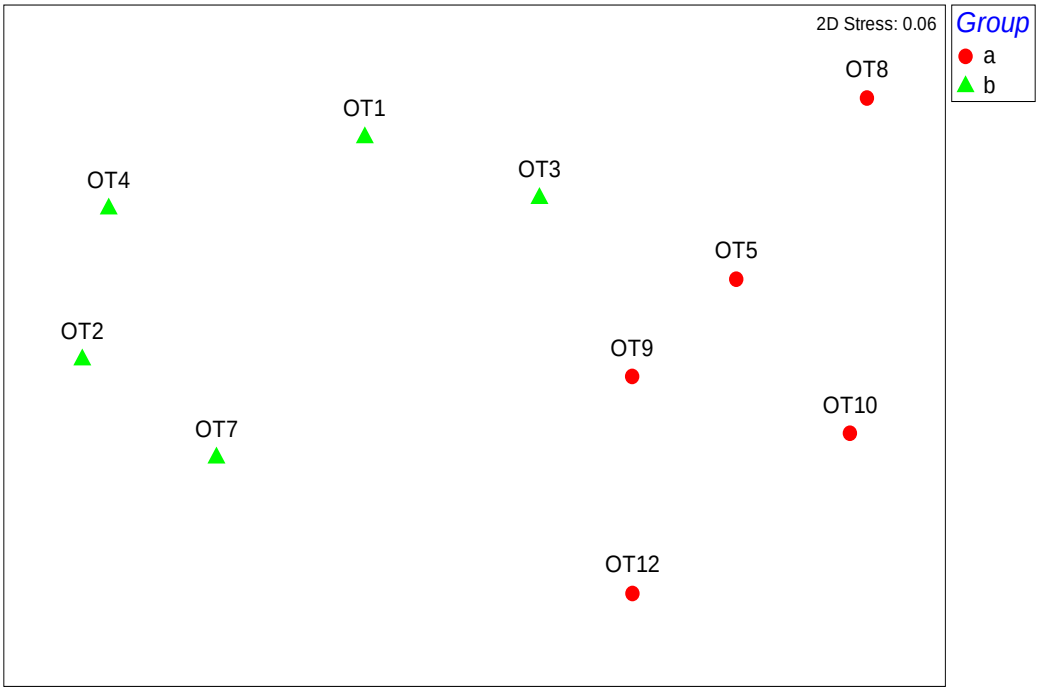

Figure 30. MDS plot of cluster groups

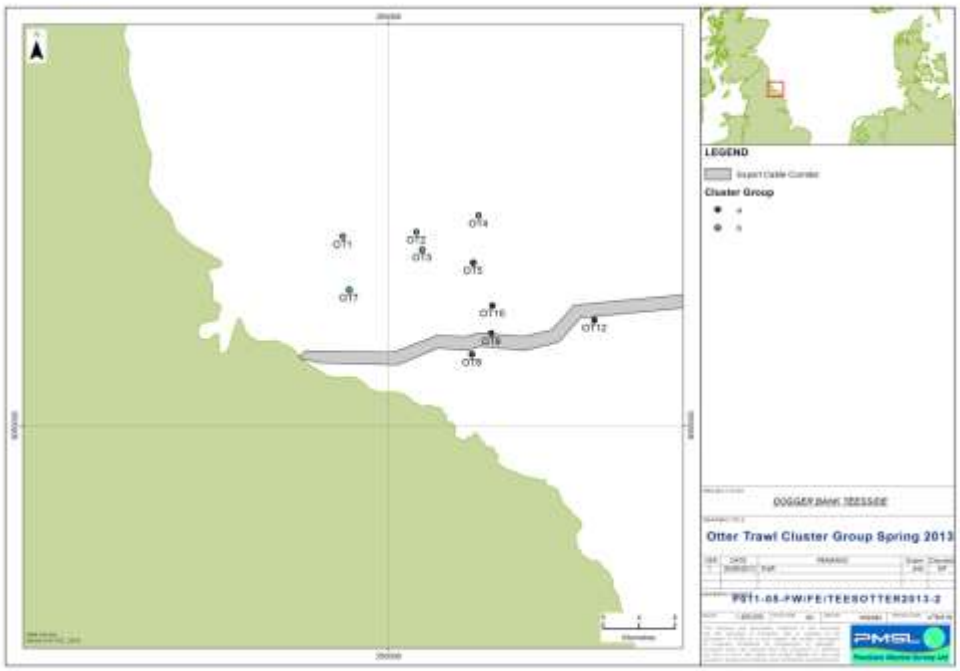

Figure 31. Dendrogram showing otter trawl cluster groups

Table 5. Total catch summary per hour

Species	Total	Average	% of sites	Total Number per hour
Cod	30	3	80	5.79
Whiting	810	81	100	156.36
Pouting	105	10.5	90	20.27
Haddock	173	17.3	90	33.40
Dab	154	15.4	100	29.73
Plaice	158	15.8	100	30.50
Turbot	3	0.3	20	0.58
Lemon sole	73	7.3	100	14.09
Grey gurnard	130	13	90	25.10
Long rough dab	32	3.2	70	6.18
Herring	17	1.7	70	3.28
Nephrops	33	3.3	30	6.37
Squid	1	0.1	10	0.19
Mackerel	1	0.1	10	0.19
LSD	4	0.4	10	0.77
Smoothhound	1	0.1	10	0.19
Brill	1	0.1	10	0.19
Sea urchins	2	0.2	20	0.39
Dover sole	1	0.1	10	0.19

3.2. Trammel Netting

The trammel net survey was carried out over two days; giving soak periods of between 17 ½ and 20 ¾ hours (table 5).

Table 6. Trammel netting positional data

						Fleet Start WGS 84		Fleet End WGS 84		
Station	**Deployment Date**	**Deployment Time (GMT)**	**Recovery Date (End)**	**Recovery Time (End)**	**Depth (m)**	**Latitude**	**Longitude**	**Latitude**	**Longitude**	**Soak time (hh:mm)**
N 1A	23/04/2013	16:44:00	24/04/2013	10:15:00	15.4	54.37.545N	001.01.087W	54.37.508N	001.00.944W	17:31
N 1B	24/04/2013	14:27:00	25/04/2013	09:33:00	15.1	54.37.539N	001.00.987W	54.37.490N	001.00.878W	19:06
N 2A	23/04/2013	16:25:00	24/04/2013	10:50:00	13.2	54.36.530N	000.59.427W	54.36.490N	000.59.311W	18:25
N 2B	24/04/2013	14:13:00	25/04/2013	10:06:00	13.4	54.36.526N	000.59.328W	54.36.487N	000.59.211W	19:53
N 3A	23/04/2013	16:11:00	24/04/2013	19:19:00	13	54.36.184N	000.57.996W	54.36.149N	000.57.900W	19:19
N 3B	24/04/2013	14:02:00	25/04/2013	10:29:00	12.7	54.36.175N	000.57.824W	54.36.141N	000.57.703W	20:27
N 4A	23/04/2013	15:47:00	24/04/2013	12:31:00	8.6	54.35.624N	000.54.433W	54.35.582N	000.54.351W	20:44
N 4B	24/04/2013	15:22:00	25/04/2013	11:22:00	8.7	54.35.704N	000.54.414W	54.35.664N	000.54.320W	20:00
N 5A	23/04/2013	15:25:00	24/04/2013	09:11:00	15.3	54.38.011N	000.57.887W	54.37.954N	000.57.752W	17:39
N 5B	24/04/2013	14:41:00	25/04/2013	09:07:00	14.7	54.38.075N	000.58.034W	54.38.017N	000.57.910W	18:33

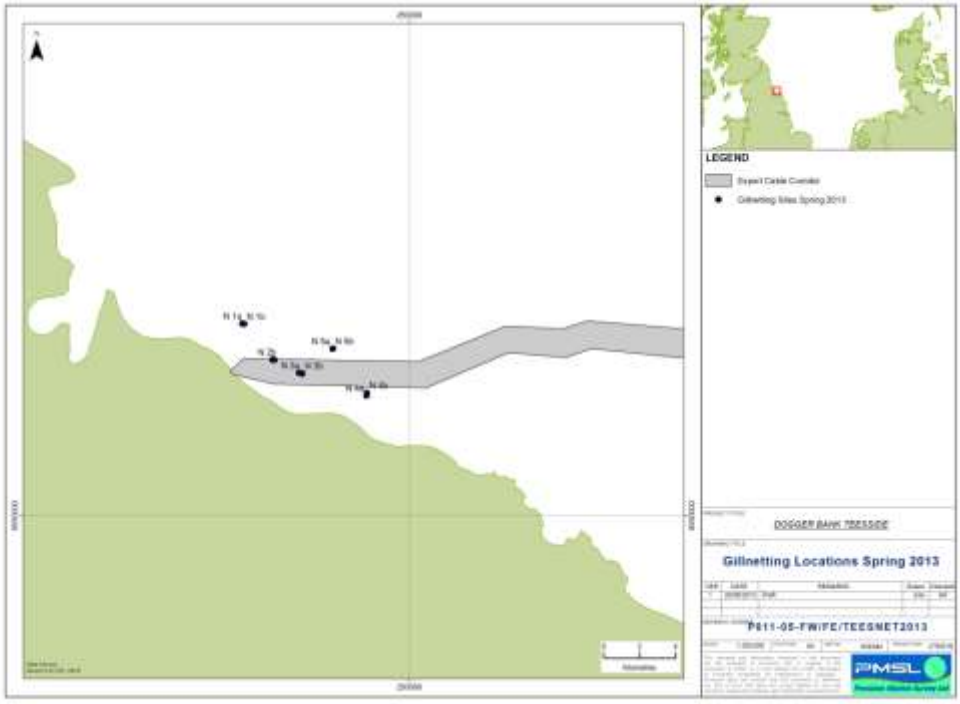

Figure 32. Positions of individual fleets of nets

3.2.1. Species density and diversity

In total, 18 species of fish and 6 macro-invertebrate species were caught. The most abundant species recorded was the brown crab. Dab and brown crab were present at all stations representing 68% of the total abundance (Figure33).

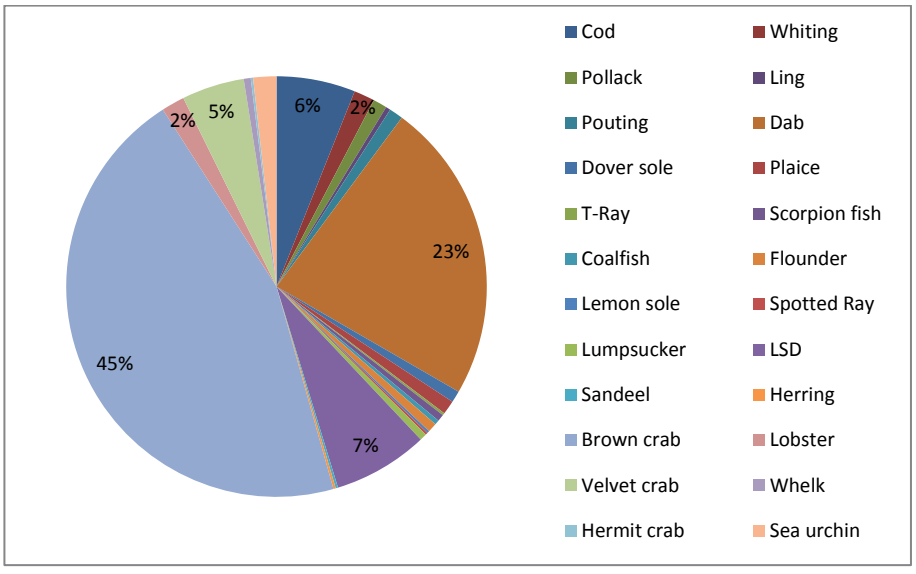

Figure 33. Overall abundance of key species for all fleets

Table 7 provides catch densities for individual sampling stations.

Table 7. Species diversity and abundance from the spring 2013 trammel netting survey.

Species (Common name)	*Latin name*	Station 1	Station 2	Station 3	Station 4	Station 5	Total
Cod	*Gadus morhua*	0	3	0	19	12	34
Whiting	***Merlangius merlangus***	3	4	2	0	0	9
Pollack	***Pollachius pollachius***	0	0	0	5	1	6
Ling	***Molva molva***	0	0	0	1	1	2
Pouting	***Trisopterus luscus***	1	0	0	1	4	6
Dab	***Limanda limanda***	32	40	50	3	5	130
Dover sole	***Solea solea***	1	2	0	1	1	5
Plaice	***Pleuronectes platessa***	4	1	1	0	0	6
Thornback Ray	***Raja clavata***	0	1	0	0	0	1
Scorpion fish	***Taurulus bubalis***	0	1	0	1	1	3
Coalfish	***Pollachius virens***	0	0	0	1	1	2
Flounder	***Platichthys flesus***	1	0	2	1	0	4
Lemon sole	***Microstomus kitt***	0	0	0	1	0	1
Spotted Ray	***Raja montagui***	1	0	0	0	0	**1**
Lumpsucker	***Cyclopterus lumpus***	0	2	1	0	0	3
LSD	***Scyliorhinus canicula***	3	3	7	24	4	41
Sandeel	***Ammodytes tobianus***	0	0	0	1	0	1
Herring	***Clupea harengus***	1	0	0	0	0	1
Brown crab	***Cancer pagurus***	43	28	117	37	29	254
Lobster	***Homarus gammarus***	0	0	2	6	2	10
Velvet crab	***Necora puber***	1	0	0	24	2	27
Whelk	***Buccinum undatum***	0	0	0	0	3	3
Hermit crab	***Pagurus bernhardus***	0	0	0	0	1	1
Sea urchin	***Echinus esculentus***	0	0	0	7	3	10
Total abundance		**91**	**85**	**182**	**133**	**70**	**561**
Total diversity		**11**	**10**	**8**	**16**	**15**	**24**

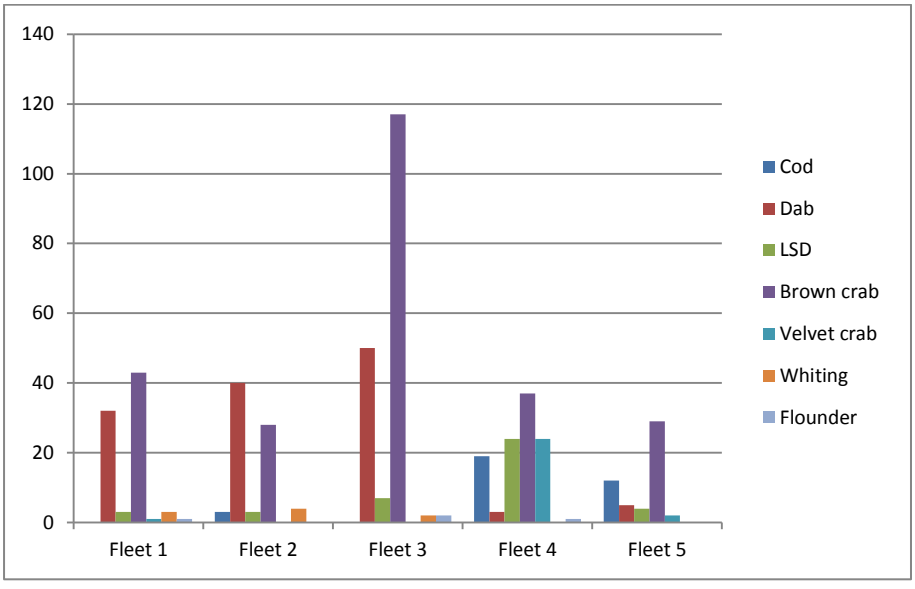

Figure 34. Abundance of key species within individual sampling fleets

3.2.2. Individual Sampling Station Composition

3.2.2.1. Station 1

Brown crab represents 47% of the total catch and dab contributed 35%.Station 3 had relatively high species abundance and diversity.

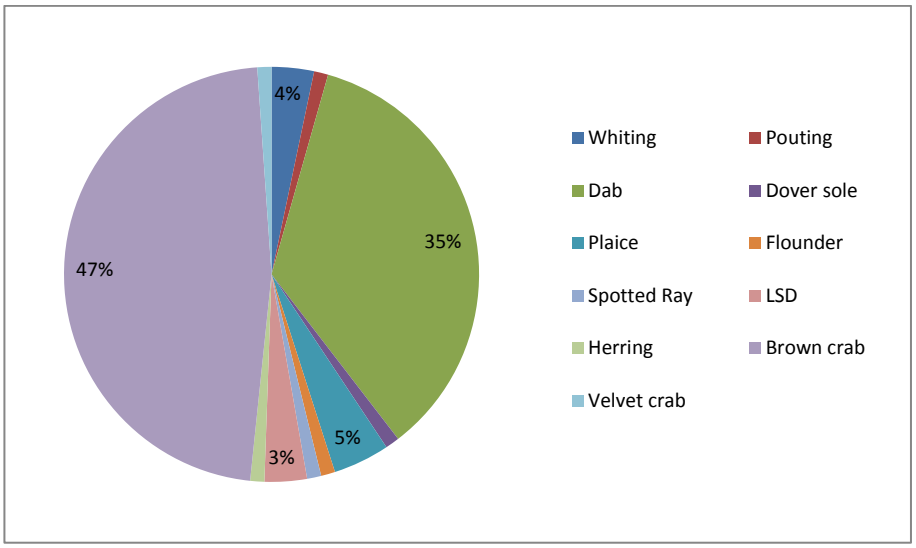

Figure 35. Percentage composition of species at station 1

3.2.2.2. Station 2

Dab contributed 47% of the total catch and brown crab represented 33%.Station 2 had a low species abundance and diversity.

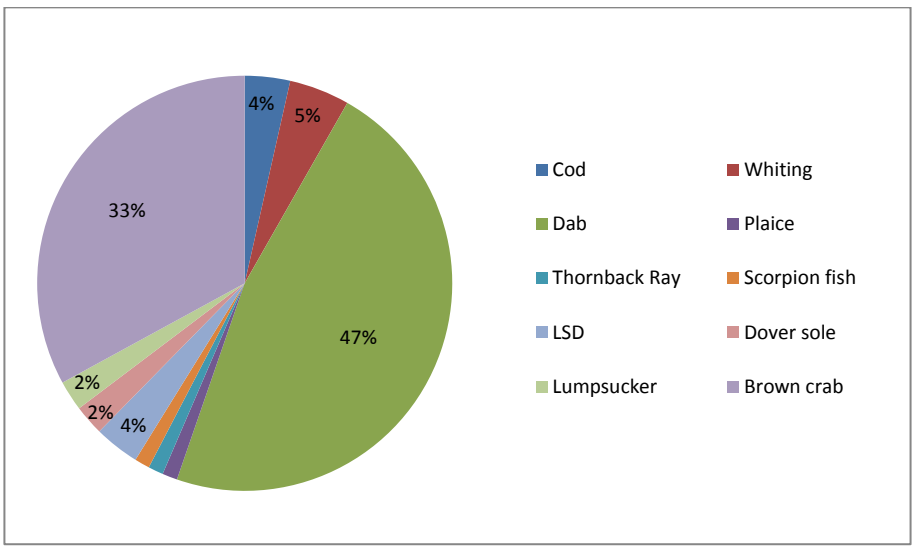

Figure 36. Percentage composition of species at station 2

3.2.2.3. Station 3

Brown crab and dab represent 91% of the total catch. Station 3 had high species abundance and the lowest species diversity.

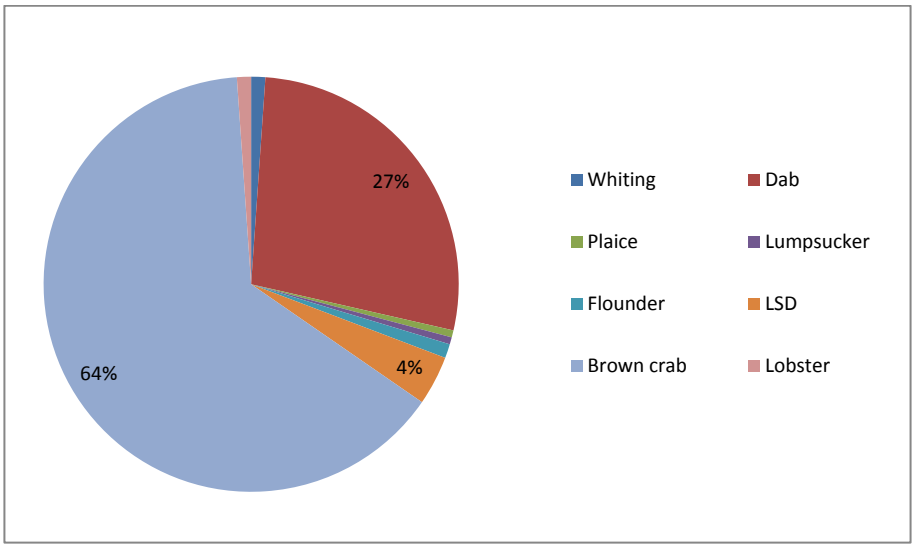

Figure 37. Percentage composition of species at station 3

3.2.2.4. Station 4

Station 4 records the highest species diversity with brown crab represents 28%.

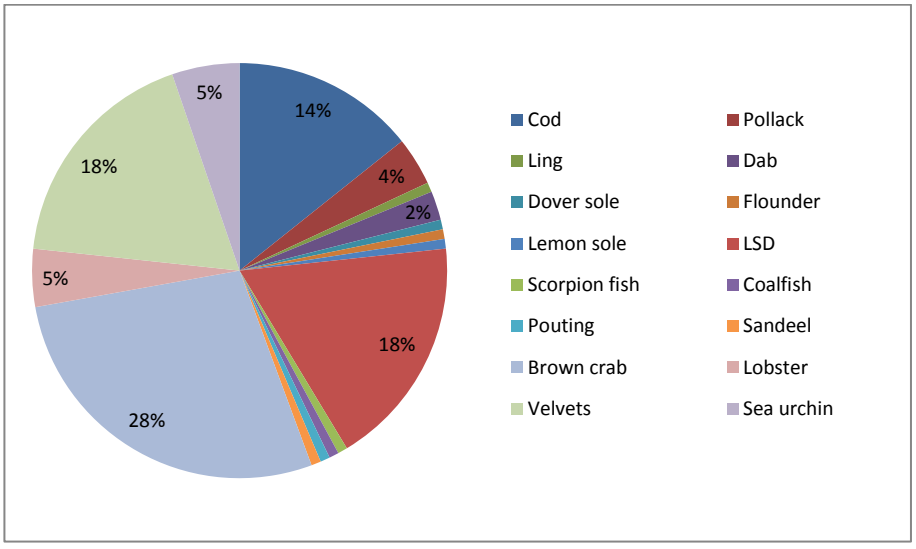

Figure 38. Percentage composition of species at station 4

3.2.2.5. Station 5

Station 5 recorded high diversity but low abundance. Brown crab and cod represent 43% and 18% of the abundance, respectively.

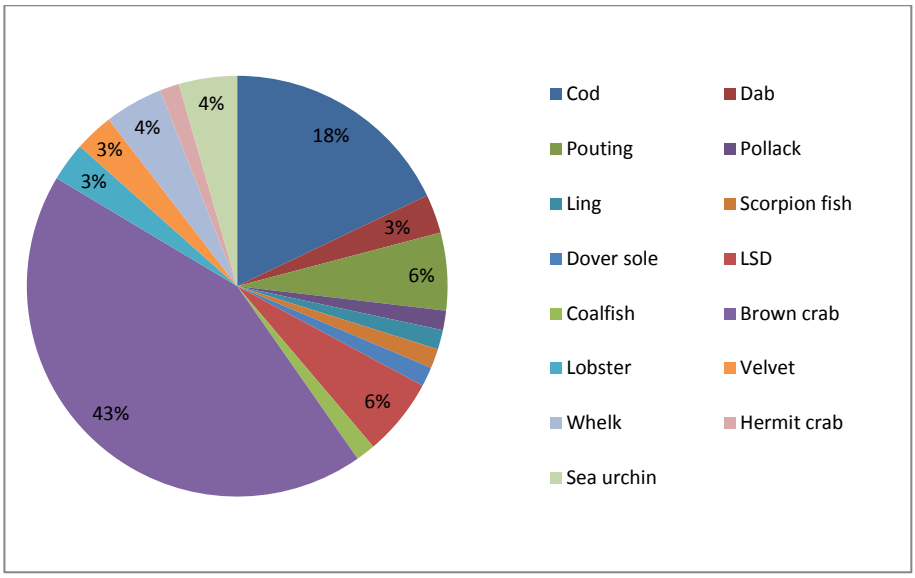

Figure 39. Percentage composition of species at station 5

3.2.3. Length Frequency Analysis

3.2.3.1. Dab

The most abundant length frequency classes recorded for the dab were the 220-229mm, 230-239mm and the 270-279mm, all of which produced identical frequency counts. The length frequency data indicate a number of age groups are present, and whilst the spring 2013 data are broadly comparable to that collected during the autumn 2012 trammel netting survey, there are a larger range of size classes present in the 2013 dataset.

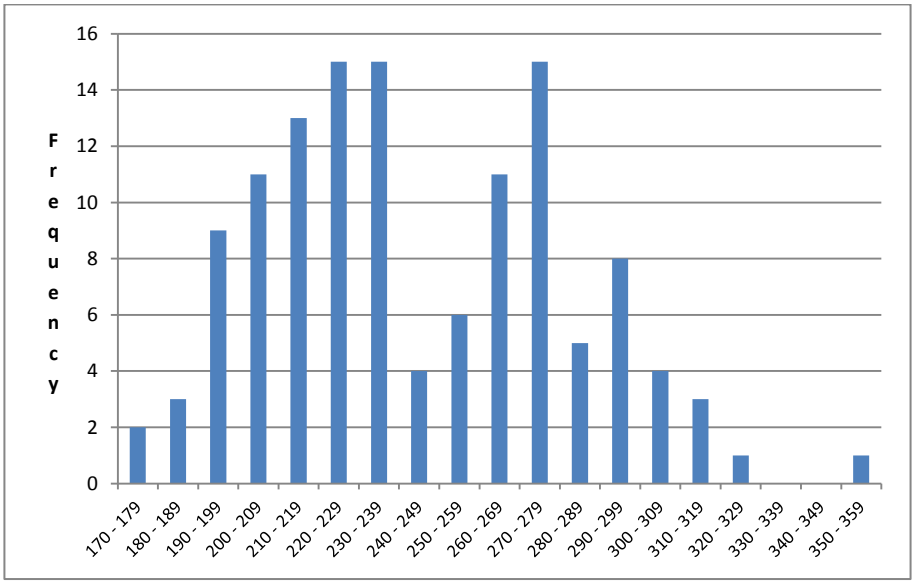

Figure 40. Length frequency data for dab

3.2.3.2. Combined Male and Female Brown Crab

The largest length frequency classes recorded for the brown crab are shown to be female crab in the 150mm – 159mm, 160mm – 169mm and the 170mm – 179mm length range, with very few male crabs present in this range. Male brown crab were particularly abundant in the size classes below the MLS of 130 mm with 83% of male crab caught being below the MLS. In comparison, female crab occupied both the sub-legal and legal sizes, with 65% above the MLS.

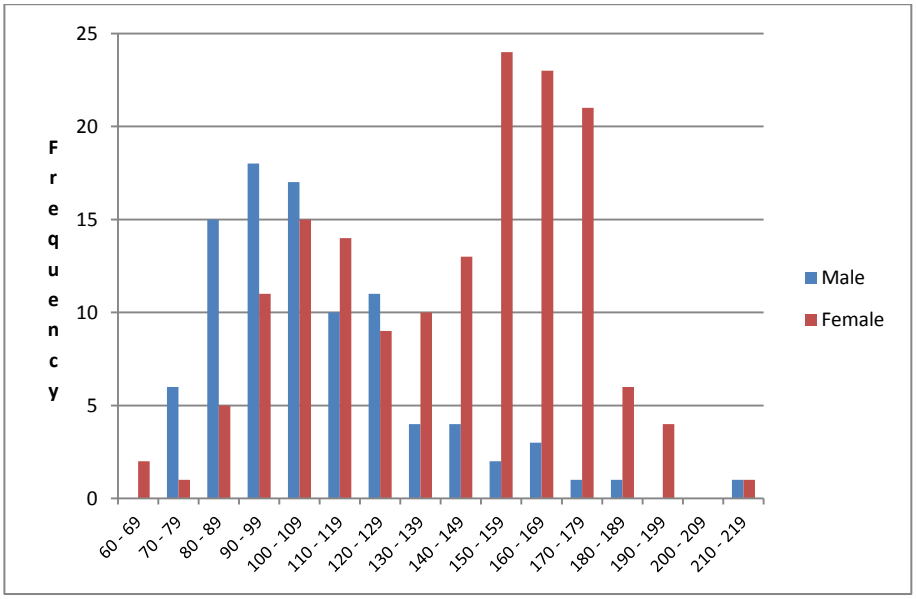

Figure 41. Brown crab length frequency data

3.2.3.2. Velvet crab

The most abundant length frequency class for velvet crab was observed in the 65mm – 69mm size range, where 8 were individuals recorded. The lowest abundance was observed in the 45mm – 49mm and 75mm – 79mm ranges, while 42% of velvet crab captured were above the MLS of 65 mm.

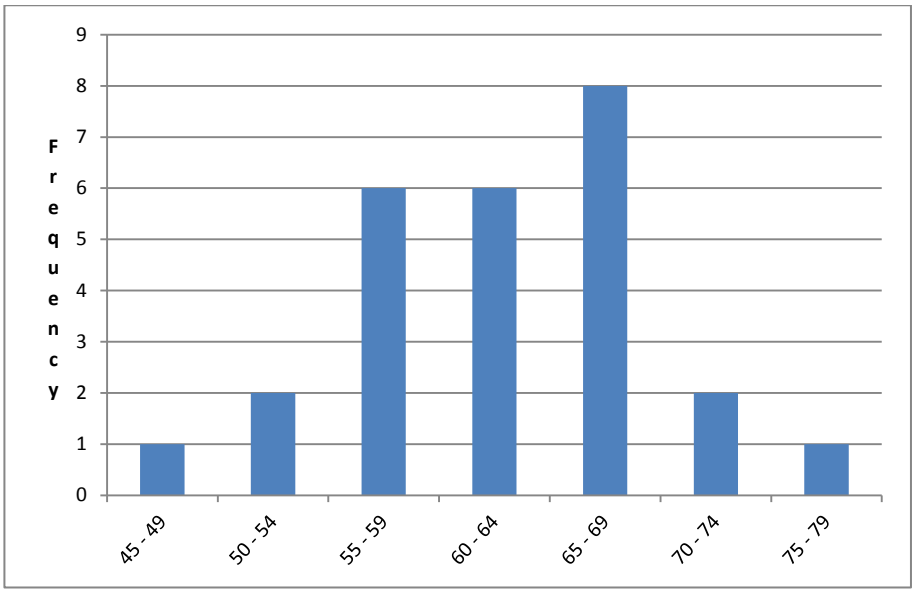

Figure 42. Velvet crab length frequency data

3.2.4. Mean species length in individual fleets

3.2.4.1. Dab

Station 3 represented the largest mean length with 232mm for males and 257mm for females (Figure 43).

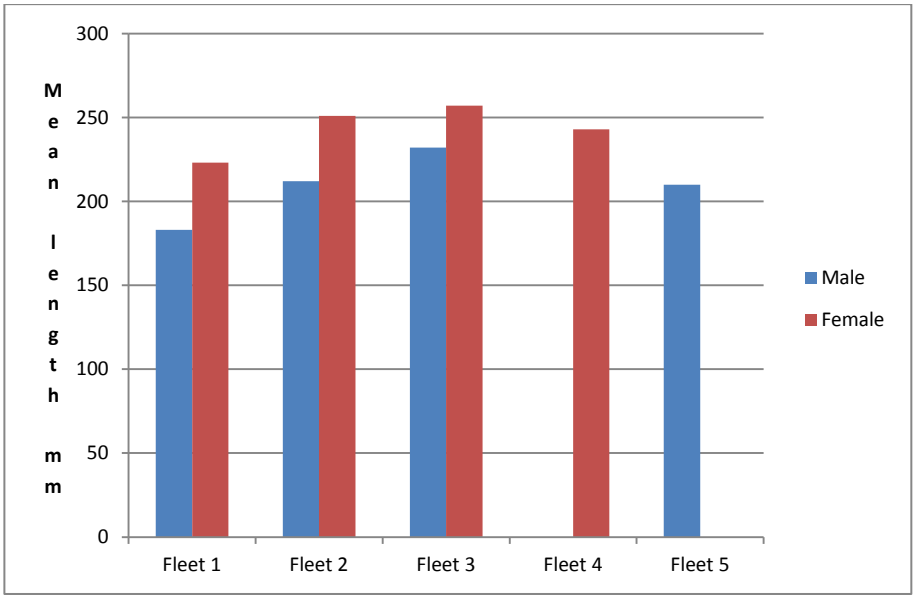

Figure 43. Dab mean length for individual fleets

3.2.4.2. Brown Crab

The largest mean length of male brown crab (140 mm) was observed in station 5, whilst the largest mean length for the female brown crab was observed at station 2 (157 mm). Station 3 represented the smallest mean length for males and females (Figure 44).

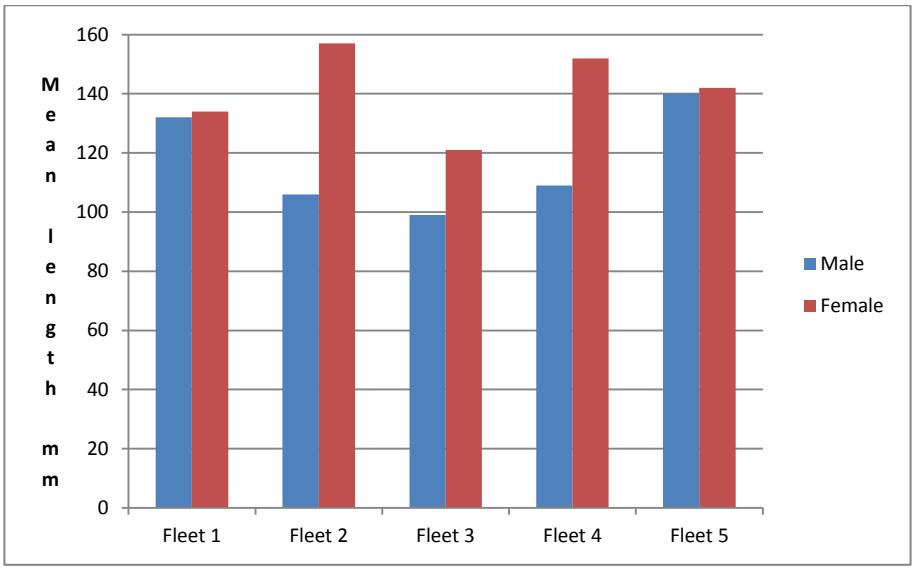

Figure 44. Combined male and female brown crab mean length for individual fleets

3.2.4.3. Velvet crab

The largest mean length for velvet crab was recorded at station 1 and 5 (64mm). The mean length value was below the MLS of 65mm at all stations.

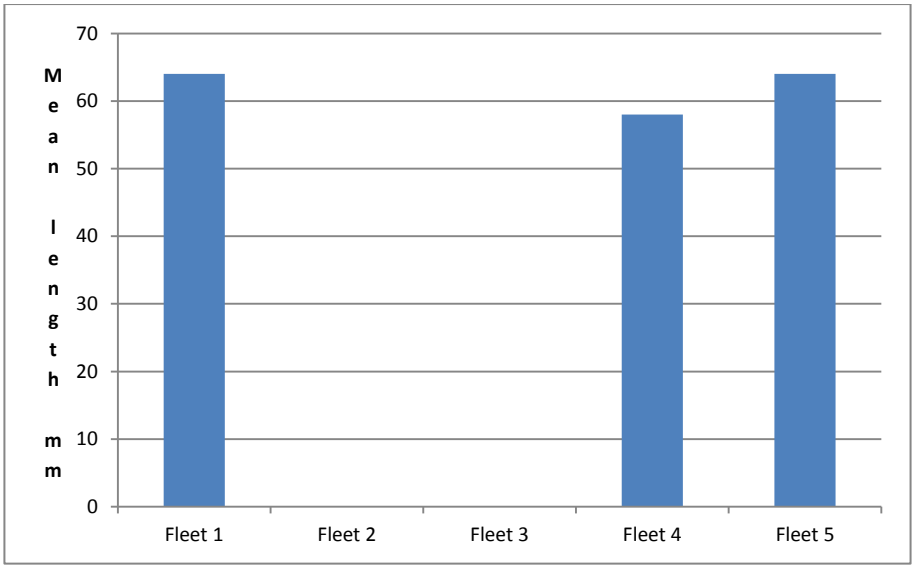

Figure 45. Velvet crab mean length for individual fleets

3.2.5. Sex ratios and occurrence of ovigerous females

Figure 45 provides detail of the percentage composition of males and females.

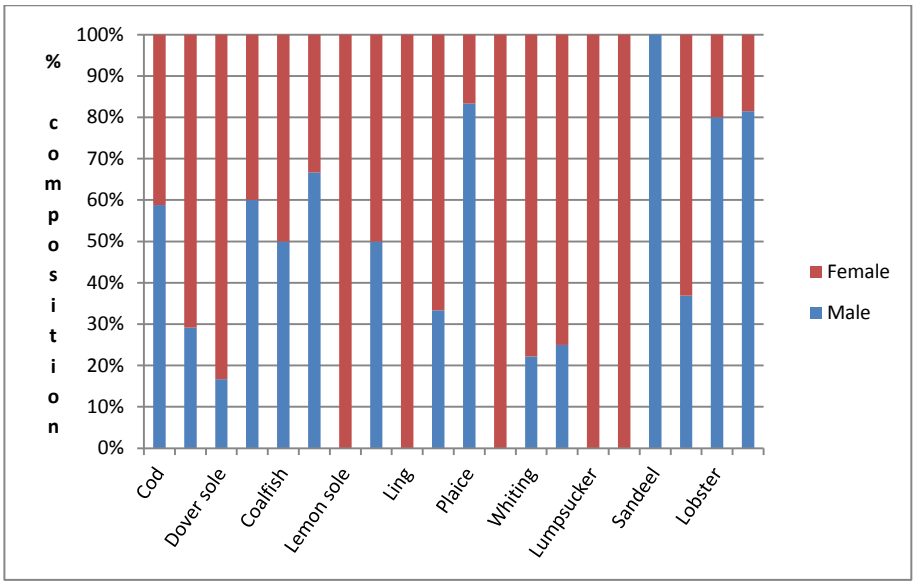

Figure 46. Combined sex ratios of species recorded in all fleets

3.2.5.1. Brown crab

Station 1 produced a ratio of 1:5 females; similarly females were more abundant at stations 4 and 5 (1:4). No egg-bearing brown crabs were reported.

3.2.5.2. Lobster

No lobsters were caught at stations 1 and 2. Male lobster were significantly more abundant in fleet 3, exhibiting a ratio of 5:1, whilst no female lobsters were recorded in fleet 5, with just 2 males recorded. For the overall study area, male lobster were more abundant with a ratio of 4:1. No berried lobsters were reported during the spring 2013 trammel net survey.

3.2.5.3. Velvet crab

No velvet crabs were recorded at stations 2 and 3, one female was recorded at station 1 and two males at station 5. At station 4 a ratio of 5:1 males was observed. No egg bearing velvet crabs were reported.

3.2.5.4. Dab

A ratio of 1:2 females was recorded at station 1 and 2.No males were recorded at station 4, whilst no females were recorded at station 5. Overall, a ratio of 1:3 females was recorded.

3.2.5.5. Cod

No cod were recorded at stations 1 and 3, and females were absent at station 2. A higher number of males were recorded at station 4, giving a ratio of 5:1..However, males were dominant at station 5 producing a ratio of 1:11. The overall ratio of males to females was 4:3.

3.2.5.6. Lesser spotted dogfish

Males were the most dominant sex at all stations with the exception of station 1.

3.2.6. Statistical Analysis of Trammel Netting Data

Similarly to the fish data derived from the otter trawl survey, the aim of the trammel netting study was to describe the fish assemblage within the nearshore coastal margins, particularly, where alternative sampling methods i.e. trawling, could not be used due to the presence of static gears. A detailed statistical analysis of the data is unwarranted, given the low sample size.

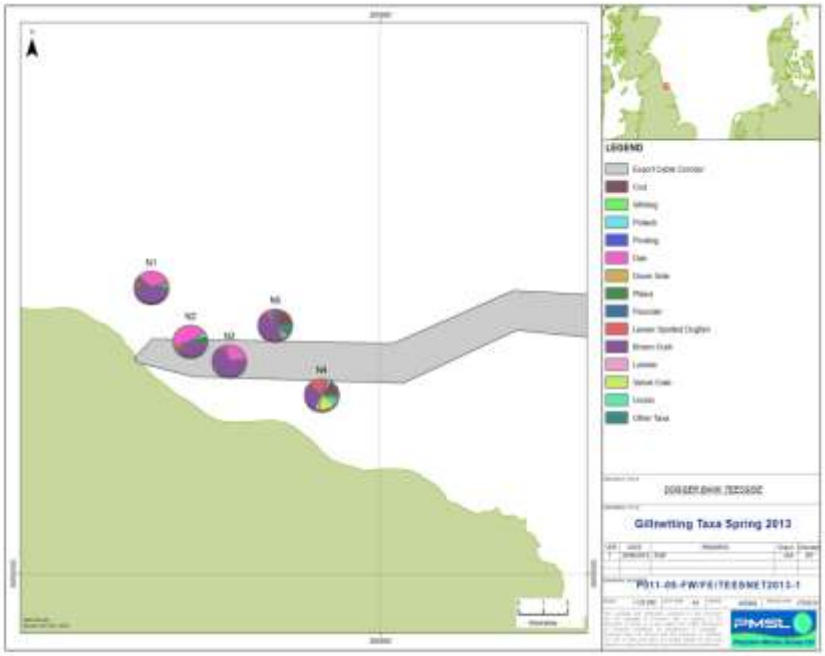

Figure 47. Distribution of taxa groups for the trammel net survey along the Dogger Bank Teesside A & B export cable corridor

It is, however, considered useful to undertake some basic univariate analyses to clarify patterns in similarity between the survey sites. The methods of statistical analysis employed are similar for those described for the otter trawl data and subsequent assessment; however, due to the low sample number the analysis was reduced to evaluate taxa by sample station only. The analyses indicate that trammel netting stations N1, N2 and N3 are broadly similar, whilst stations N4 and N5 are generally different as a result of the higher diversity recorded at the two stations (N4 & N5).

3.3. Shellfish survey

The shellfish survey commenced on 22nd September, for four days; giving a soak period of between 68.5 and 72 hours (Table 8).

Table 8. Shellfish positional data

					Fleet Start WGS 84			Fleet End WGS 84		
Station	Deployment Date	Deployment Time (GMT)	Recovery Date (End)	Recovery Time (End)	Latitude	Longitude	Depth (m)	Latitude	Longitude	Soak time (days)
S1	22/04/2013	15:28:00	25/04/2013	13:30:00	54.37.207N	001.00.805W	11.1	54.37.060N	001.00.150W	2.92
S2	22/04/2013	16:14:00	25/04/2013	12:40:00	54.36.176N	000.56.222W	18.5	54.36.068N	000.55.539W	2.84
S3	22/04/2013	14:40:00	25/04/2013	13:56:00	54.38.594N	000.59.394W	34.7	54.38.384N	000.58.849W	2.96
S4	22/04/2013	16:53:00	25/04/2013	11:45:00	54.36.681N	000.52.576W	32.2	54.36.518N	000.51.934W	3
S5	22/04/2013	16:37:00	25/04/2013	11:18:00	54.35.740N	000.49.726W	34	54.35.545N	000.49.160W	2.85

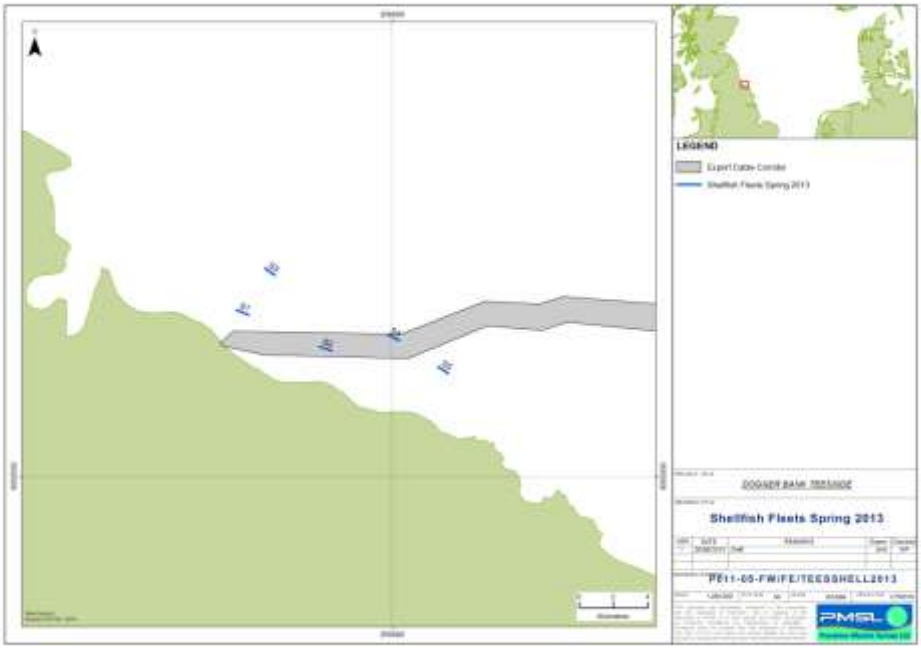

Figure 48. Positions of individual fleets

3.3.1. Species density and diversity

Figure 48 illustrates the species diversity and the percentage contribution they made towards the total abundance. Brown crab represents 48% of the total catch.

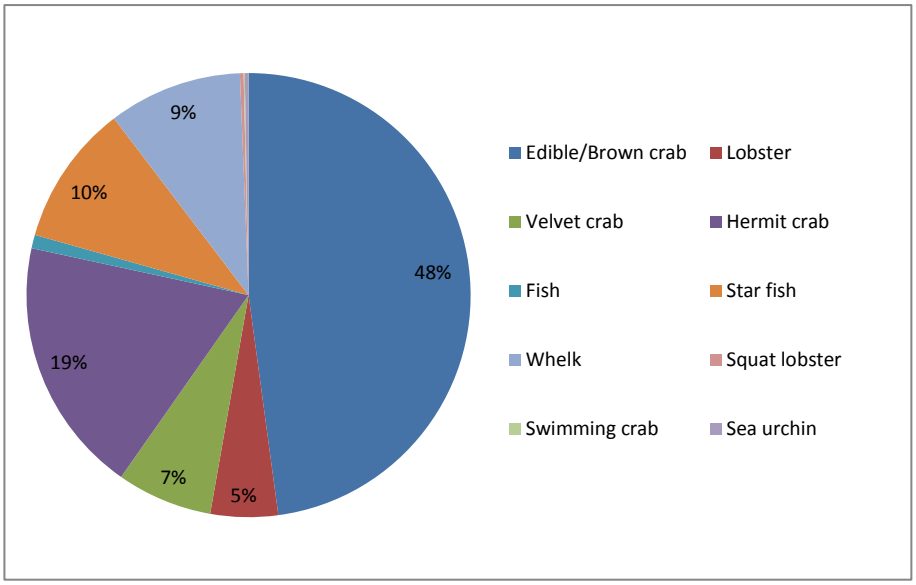

Figure 49. Overall abundance of species for all fleets

Table 9 provides catch densities and the diversity for each sampling station. Brown crab was the most abundant species at all stations.

Table 9. Species diversity and abundance from the spring 2013 shellfish survey.

Species (Common name)	Species (Latin name)	Fleet 1	Fleet 2	Fleet 3	Fleet 4	Fleet 5	Total
Edible/Brown crab	*Cancer pagurus*	40	336	70	31	59	536
Lobster	*Homarus gammarus*	31	13	5	4	2	55
Velvet crab	*Necora puber*	45	12	1	10	10	78
Hermit crab	*Pagurus bernhardus*	3	7	62	27	110	209
Cod	*Gadus morhua*	1	2	0	0	1	4
Whiting	*Merlangius merlangus*	0	1	0	1	0	2
Pouting	*Trisopterus luscus*	0	0	0	1	2	3
Dab	*Limanda limanda*	0	0	1	0	0	1
Sea scorpion	*Taurulus bubalis*	0	0	0	0	1	1
Star fish	*Asterias rubens*	0	1	33	24	57	115
Whelk	*Buccinum undatum*	0	0	41	22	46	109
Squat lobster	*Galathea intermedia*	0	0	3	0	0	3
Swimming crab	*Liocarcinus holsatus*	0	0	0	1	0	1
Sea urchin	*Echinus esculentus*	0	0	0	2	1	3
Density		**120**	**372**	**216**	**123**	**289**	**1120**
Diversity		**5**	**7**	**8**	**10**	**10**	**10**

.

Figure 49 shows that highest abundance was recorded for edible crab in fleet 2.

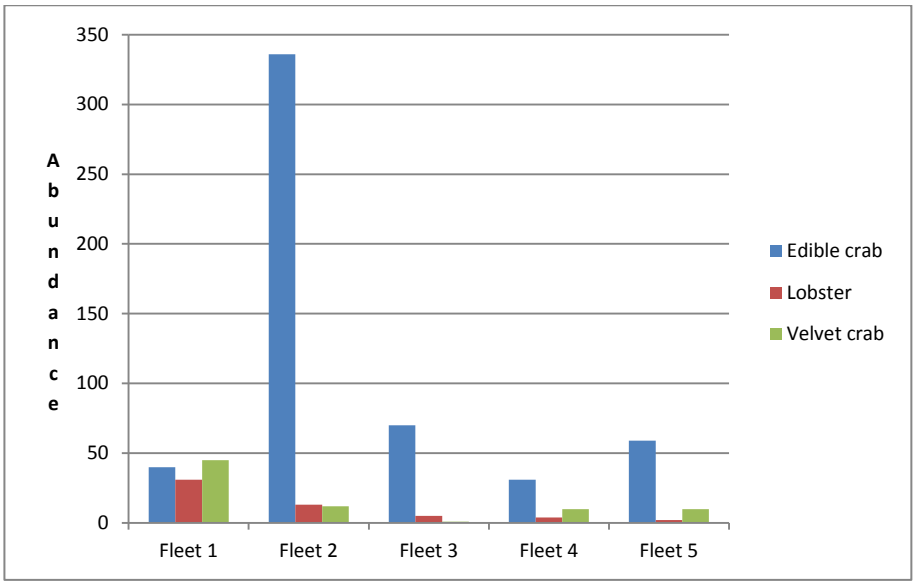

Figure 50. Abundance of key targets species for individual fleets

3.3.2. Individual Fleet Composition

3.3.2.1. Station 1

Station 1 recorded the lowest species diversity, with brown crab and velet crab contributing 70% of the catch.

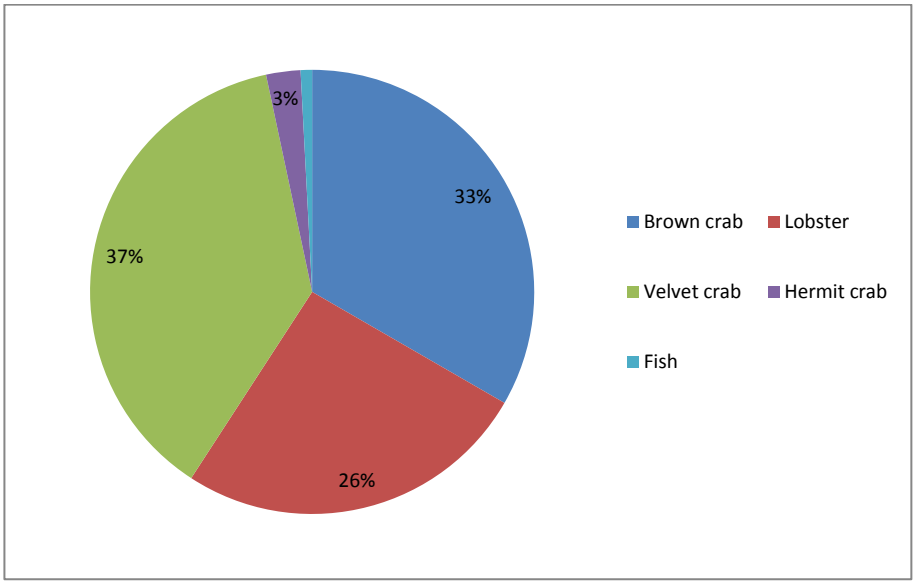

Figure 51. Percentage composition of species in fleet 1

3.3.2.2. Fleet 2

Brown crab represents 90% of the catch at station 2, similar to that recorded in the Autumn survey (Figure 52).

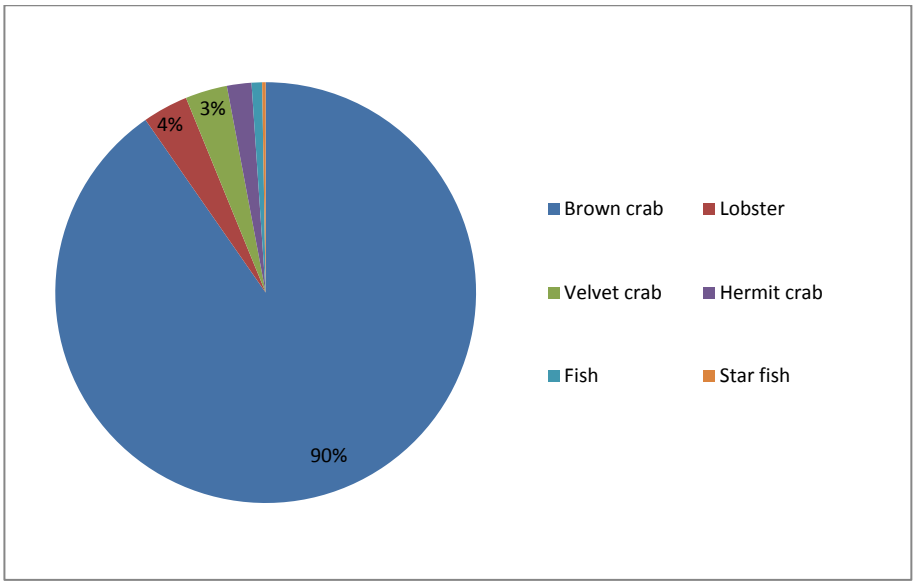

Figure 52. Percentage composition of species in fleet 2

3.3.2.3. Fleet 3

Brown crab, hermit crab and whelk were the most abundant species at station 3 representing 80% of the catch.

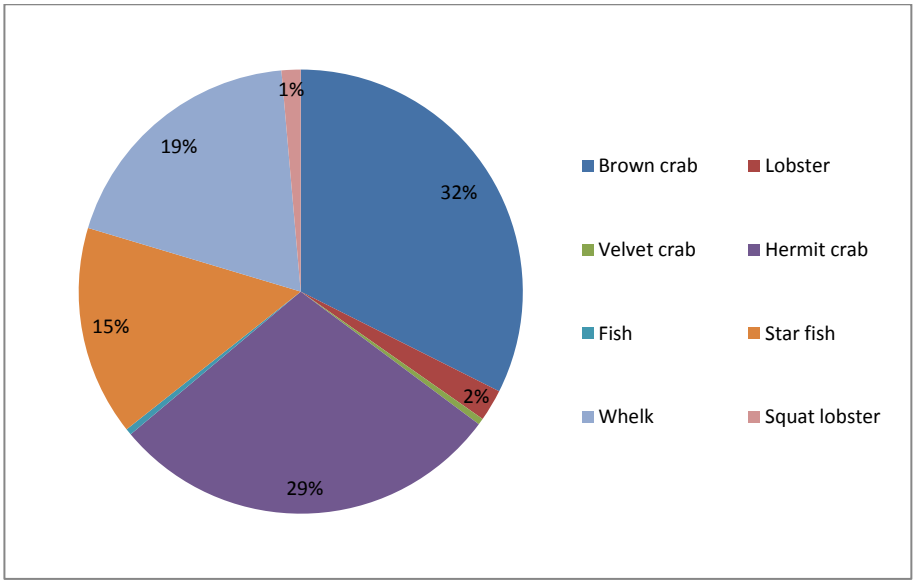

Figure 53. Percentage composition of species in fleet 3

3.3.2.4. Fleet 4

Station 4 had the highest species diversity recorded (10 species), with brown crab contributing 25% of the total catch.

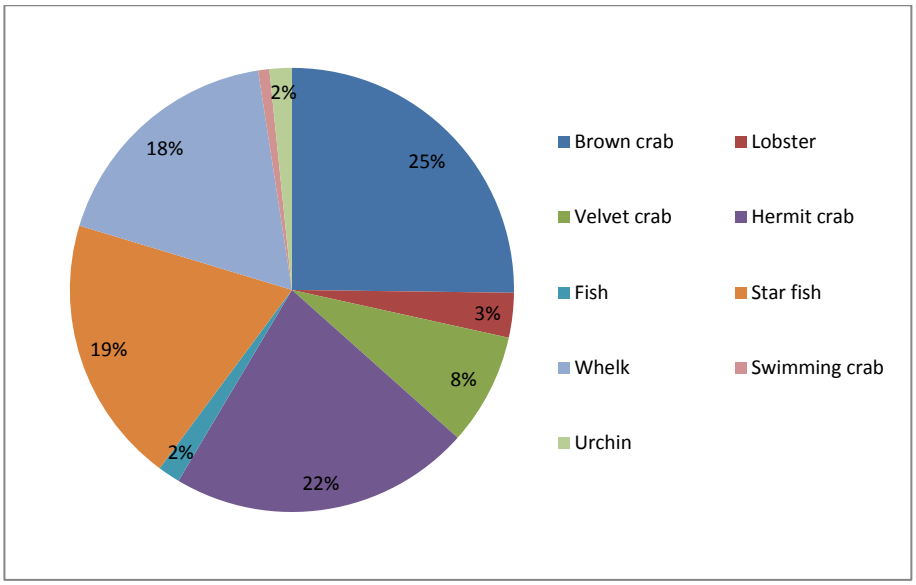

Figure 54. Percentage composition of species in fleet 4

3.3.2.5. Fleet 5

Fleet 5 recorded a relatively high abundance and species diversity with hermit crab, brown crab and starfish representing 78% of the catch.

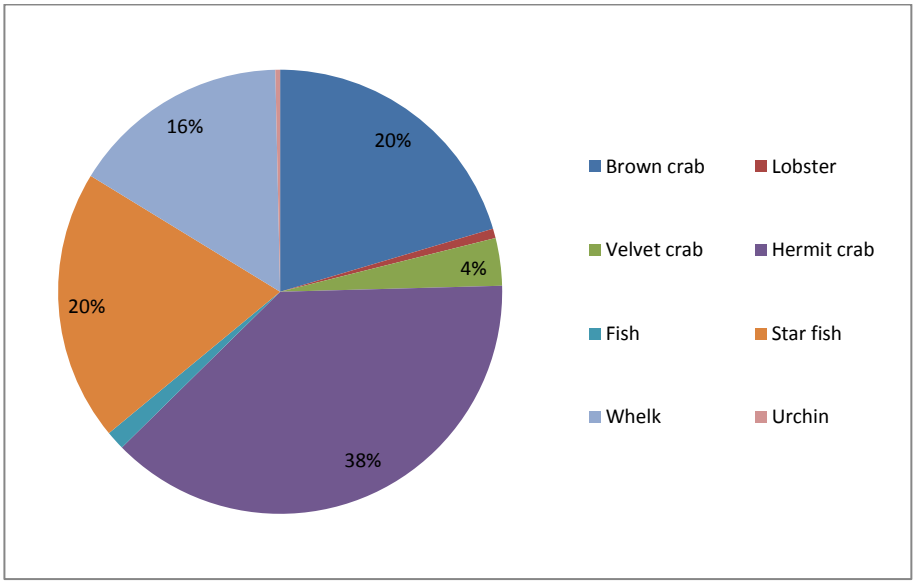

Figure 55. Percentage composition of species in fleet 5

3.3.3. Fine Mesh Pots

The percentage of catches in the fine mesh pots can be observed in Figure 55.

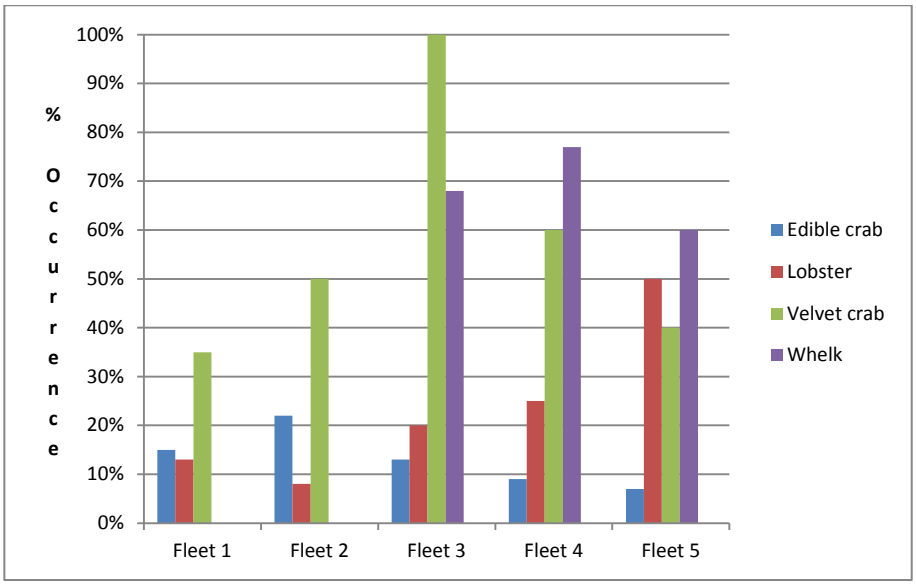

Figure 56. Percentage of species caught in FMP's

Velvet crab, edible (brown) crab and lobster was recorded in fine mesh pots in all fleets. Whelk was abundant in fleets 3, 4 and 5.

3.3.4. Length Frequency Analysis

Length measurements and sex (where possible) were recorded for abundant species. Due to the large numbers of brown crab length frequency figures have been produced by station.

3.3.4.1. Brown Crab

At station 1 brown crab males were smaller in size than females (Figure 57), and majority of male (86%) and female (81%) brown crab were below the MLS of 130mm.

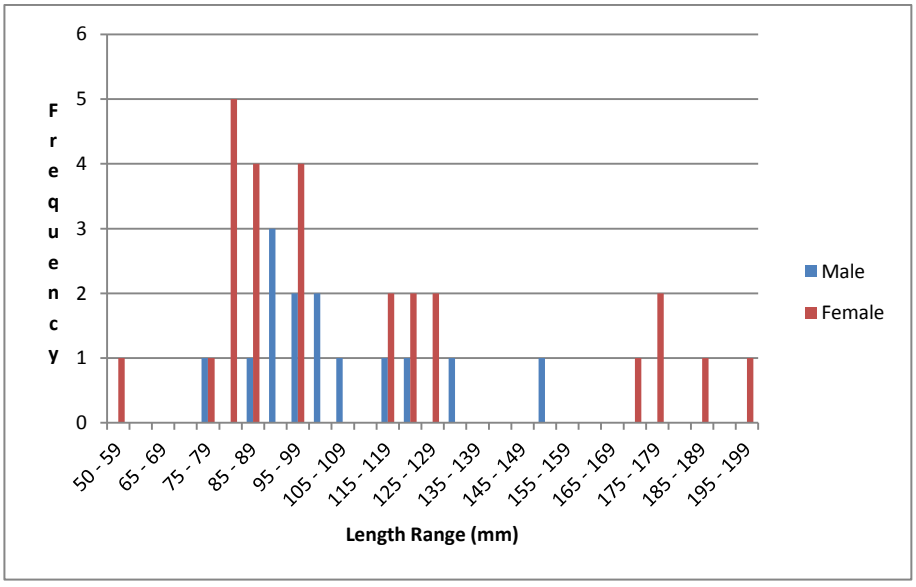

Figure 57. Brown crab length frequency data for fleet 1

The largest length frequency class at station 2 was 95mm-99mm (female) and 90mm-94mm (males) (Figure 98). At station 2, 89% of brown crabs measured were below the MLS.

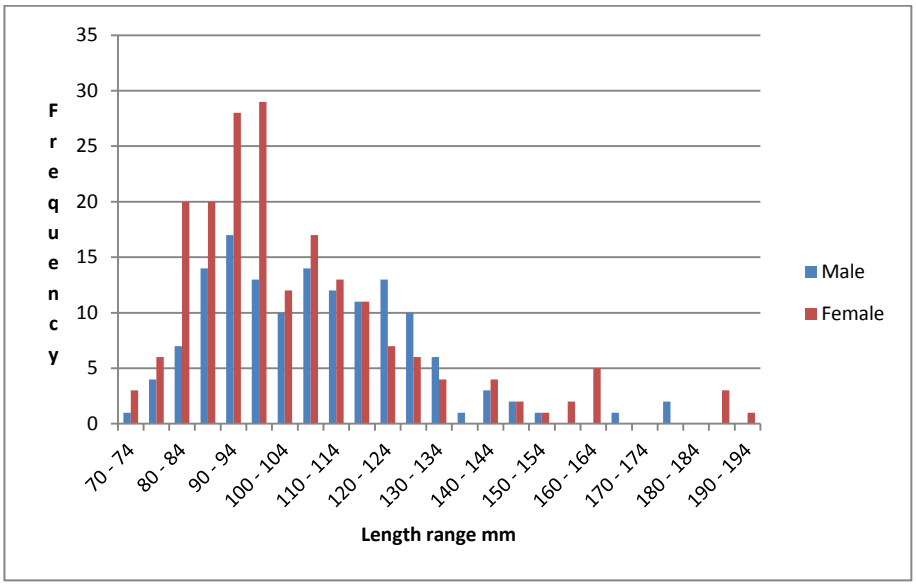

Figure 58. Brown crab length frequency data for fleet 2

At station 3, 54% of males and 63% of females were below the MLS. The largest length frequency class recorded for male brown crab was 110mm–114mm.

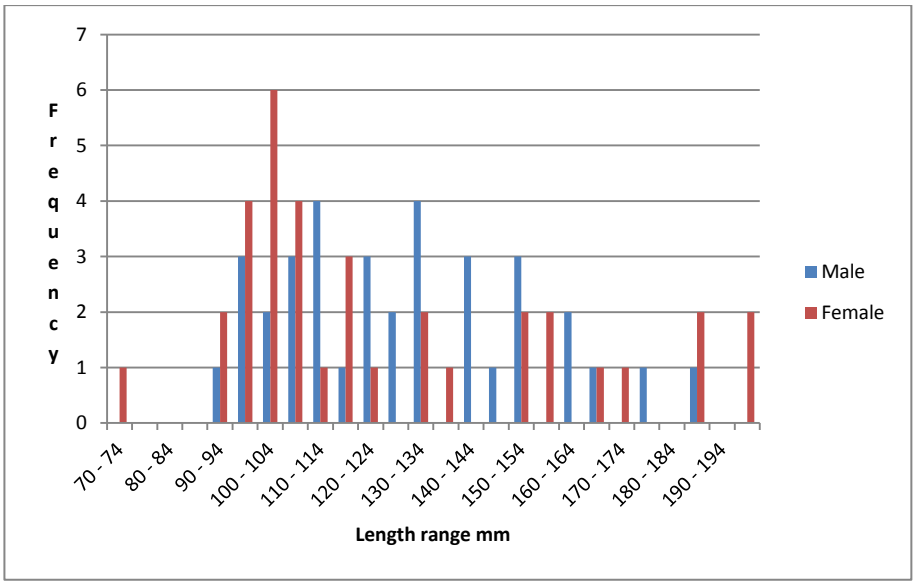

Figure 59. Brown crab length range frequency data for fleet 3

Figure 60 shows that with all stations combined, male and females were of similar abundance. in total, 78% of brown crabs captured were below the MLS of 130 mm.

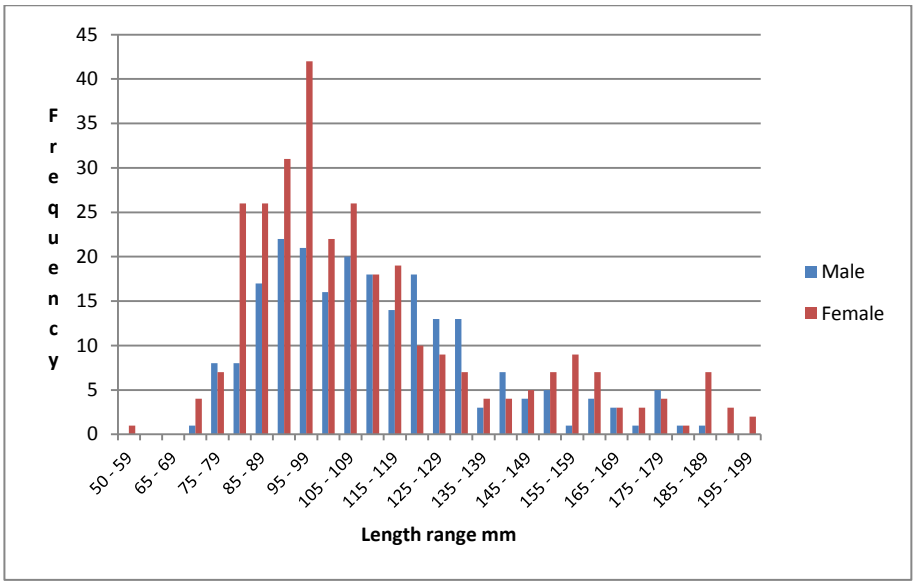

Figure 60. Combined brown crab length range frequency data for all fleet

The mean carapace width at stations 1-3 is below the MLS (130mm) for male and female brown crab.

At station 4 the mean carapace width was 148mm and 150mm for males and females respectively. The overall mean carapace width was 122mm and 123mm for males and females respectively.

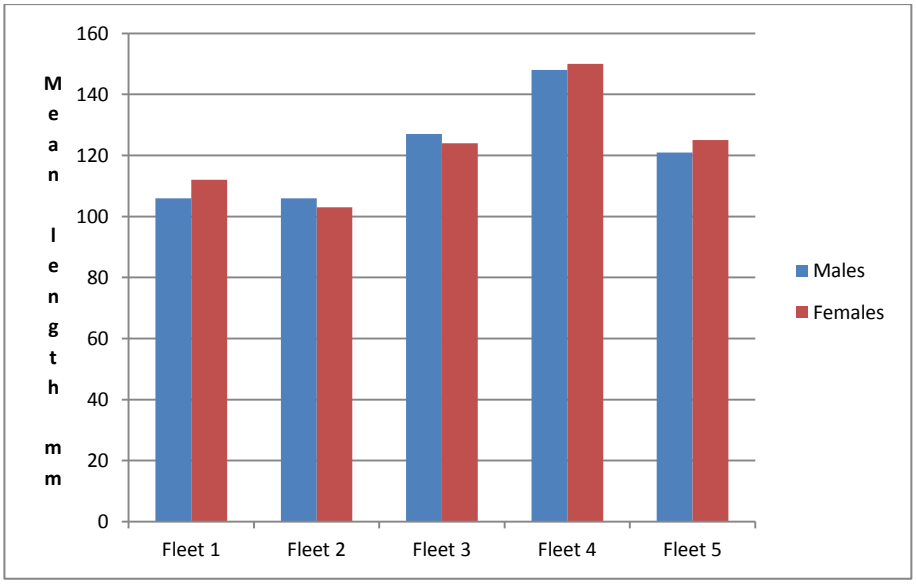

Figure 61. Brown crab mean carapace width for individual fleets

3.3.4.2. Lobster

Male lobsters were more abundant in smaller size classes, whereas females were more abundant in the larger size classes (Figure 62). The mean carapace length for lobsters was below the MLS (87mm) at all stations except Station 5 (Figure 63).

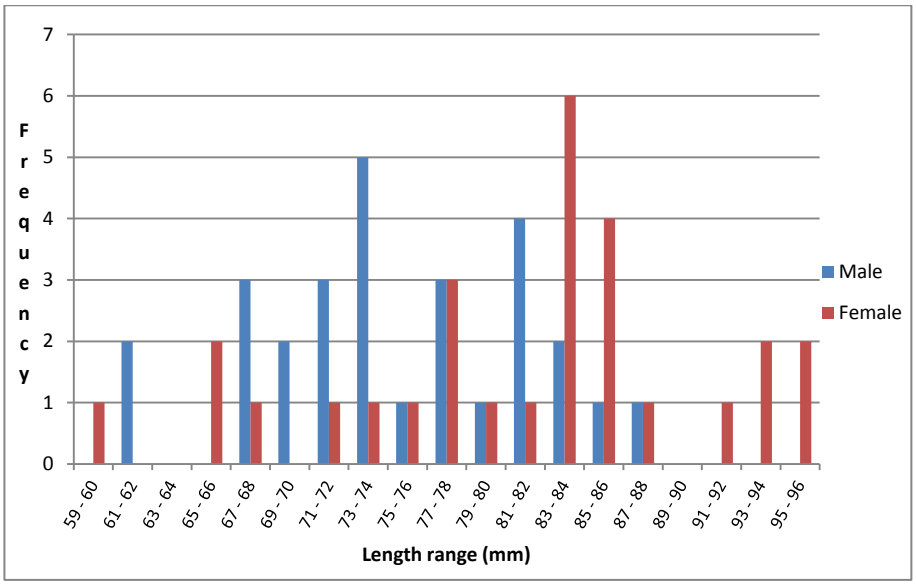

Figure 62. Combined lobster length range frequency data for all fleets

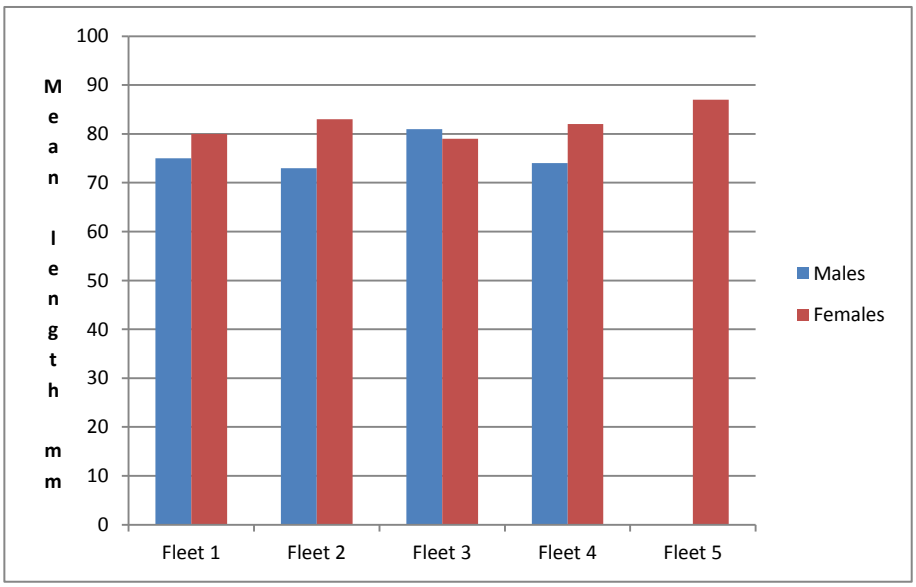

Figure 63. Lobster mean carapace length for all fleets

3.3.4.3. Velvet Crab

Male velvet crabs were more abundant than females, with 54 males compared to 18 females. Over 60% of velvet crabs were above the MLS of 65mm (Figure 64). The mean carapace widths for male and female velvet crabs are illustrated in Figure 65. The mean carapace width for all stations was 71mm for males and 65mm for females.

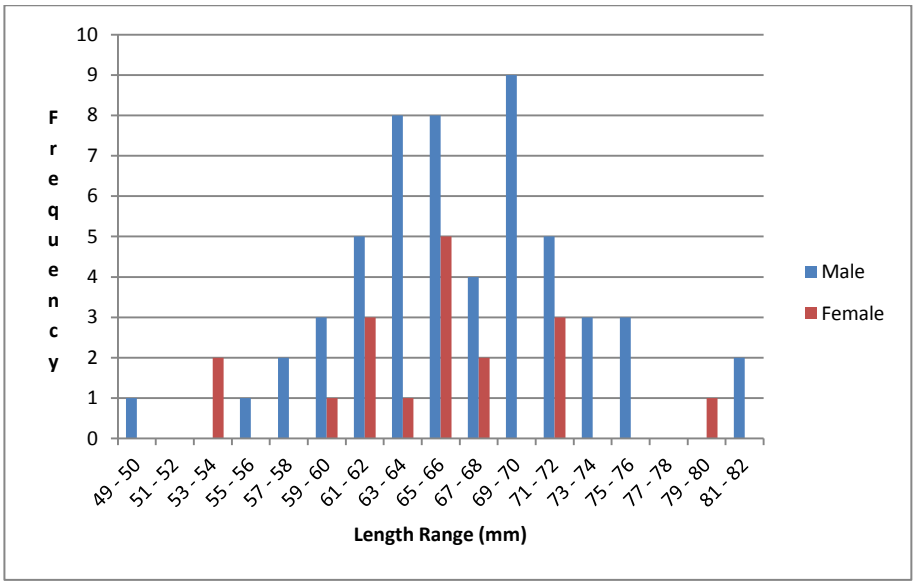

Figure 64. Combined velvet crab length frequency data for all fleets

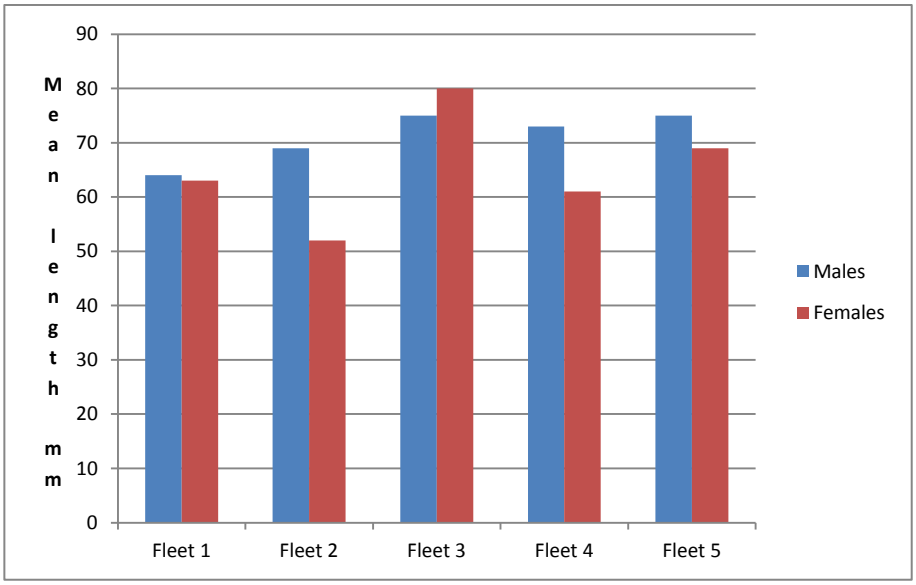

Figure 65. Velvet crab mean carapace width for all fleets

3.3.4.4. Whelk

Whelks (*Buccinum Undatum*) were caught at station 3, 4 and 5. Figure 66 shows the length frequency data, of which a large percentage was above the MLS of 45mm. All whelks measured were above the MLS of 45mm.

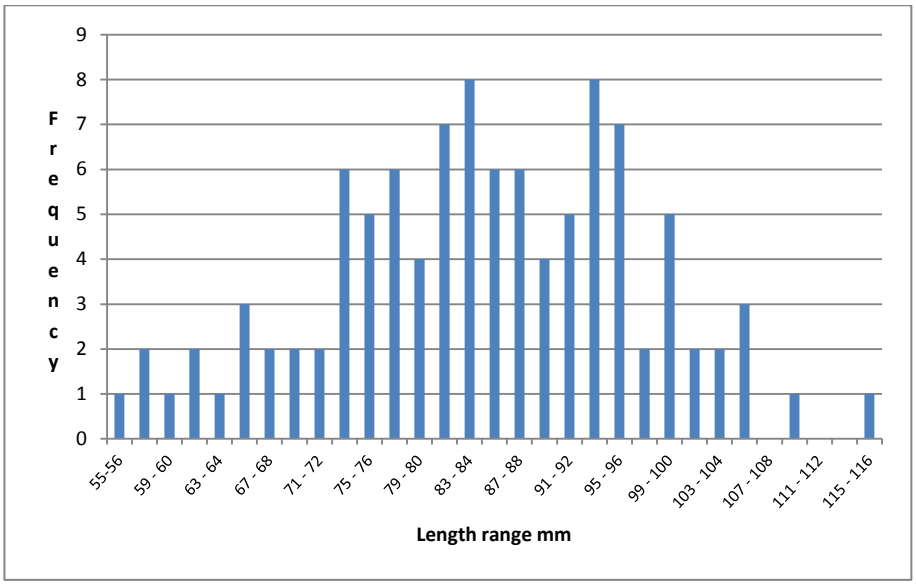

Figure 66. Length frequency data for whelk

3.3.5. Sex ratios and occurrence of ovigerous females

The ratio of males to females for all species was recorded at all stations (Figure 67).

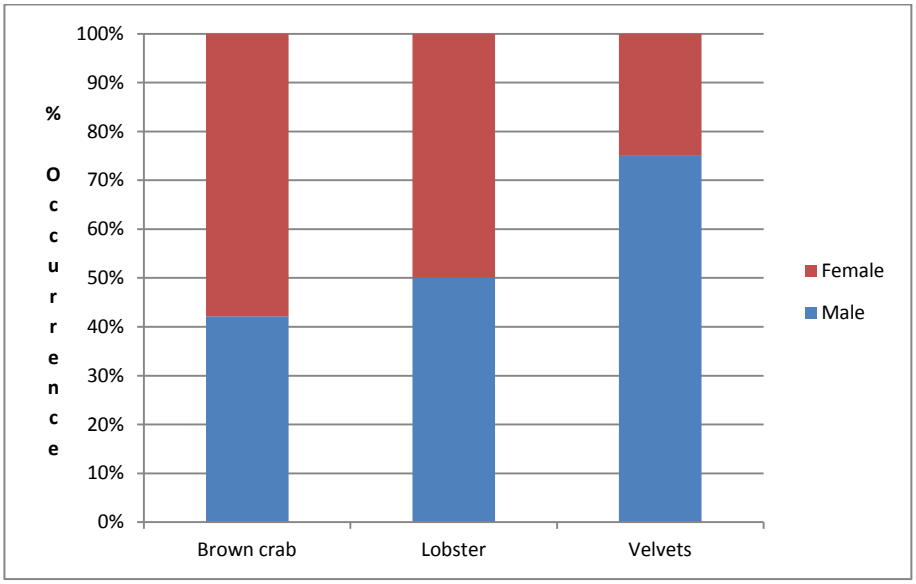

Figure 67. Sex ratio composition for key target species in all fleets

3.3.5.1. Brown crab

The furthest offshore station (station 3) recorded an equal distribution of males and females (1:1). Females were the dominant species at all stations except station 3. No egg bearing females were recorded at any of the stations.

3.3.5.2. Lobster

Station 1 and station 5 recorded a higher number of females, whereas station 2, 3 and 4 recorded a higher number of males. However, combining all stations provides an equal ratio of males to females. Station 1 and station 2 recorded 11 % and 25% egg carrying female lobsters.

3.3.5.3. Velvet crab

As seen in the autumn surveys, male velvet crabs (54) were more abundant than females (18). At station 1, 8 males to every 1 female were observed. Females were the most abundant sex at station 5. An overall ratio of 3:1 male to female velvet crabs was recorded. Egg bearing females were recorded at sampling stations 1 (17%), 4 (100%) and 5 (50%).

3.3.7. Statistical analysis of shellfish data

Similarly to the fish data derived from the otter trawl and trammel net surveys, the aim of the shellfish study was to describe the shellfish fish assemblage within the nearshore coastal margins. A detailed statistical analysis of the data is unwarranted, given that this would initially be based on data from five shellfish potting samples. The relative abundance of shellfish at each station is presented in Figure 68.

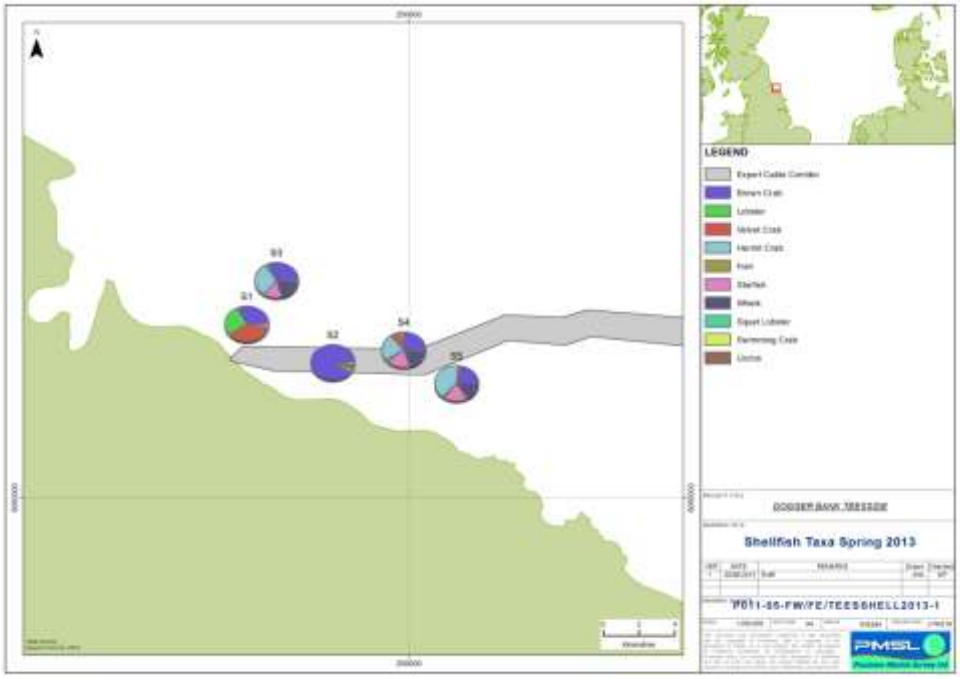

Figure 68. Distribution of taxa groups for the shellfish survey on the nearshore Dogger Bank Teesside A & B export cable corridor

3.4. *Nephrops* Trawling Survey

The Nephrops trawl survey took place on 16th March 2013 providing trawl times of 40 minutes (Figure 68).

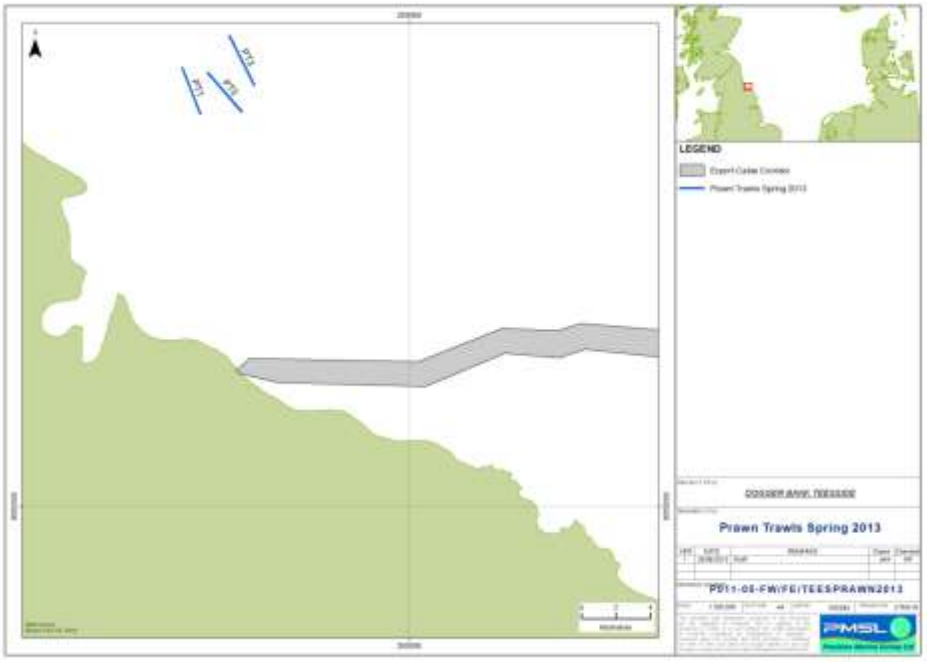

Figure 69. Distribution of prawn trawl sites in close proximity to the Dogger Bank Teesside A & B export cable corridor

Table 10. Prawn trawling positional data

			WGS 84				WGS 84			
Station	**Date**	**Deployment Time (GMT)**	**Latitude**	**Longitude**	**Depth (m)**	**Recovery Time (End)**	**Latitude**	**Longitude**	**Depth (m)**	**Duration (mm:ss)**
PT1	16/03/2013	11:54:47	54.45.550N	001.05.477W	26.9	12:36:23	54.44.149N	001.04.359W	28.4	41:36
PT2	16/03/2013	09:38:09	54.45.442N	001.04.069W	29.4	10:29:07	54.44.289N	001.02.121W	28.5	40:58
PT3	16/03/2013	07:17:26	54.46.650N	01.03.030W	38.6	08:01:43	54.45.141N	001.01.529W	39.5	44:17

3.4.1. Species density and diversity

In total, 26 fish species and 8 invertebrate species were recorded. *Nephrops* equated to 71% of the total catch (Figure 70).

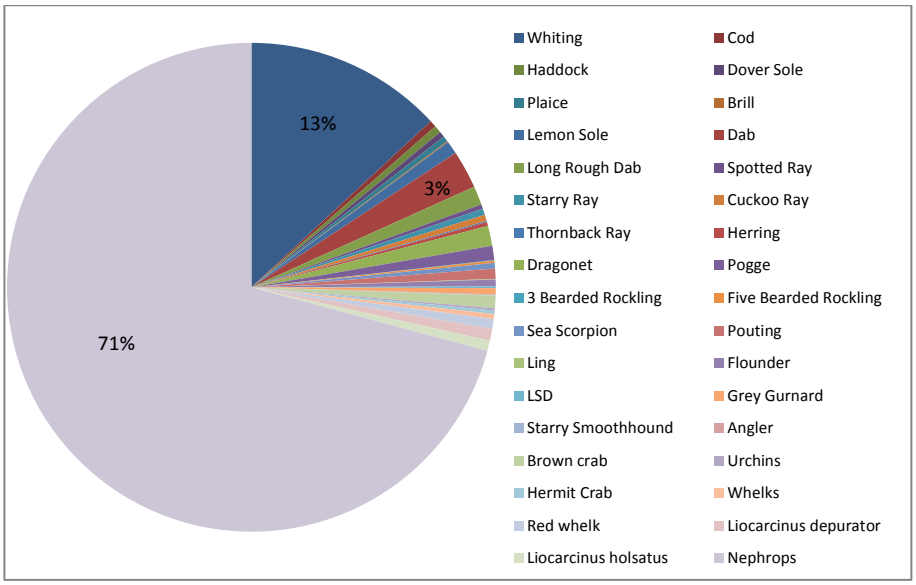

Figure 70. Overall percentage abundance for all species caught in the *Nephrops* trawls

Whiting represents 51% and Dab contributes 10% of the total catch of fish (Figure 70). With the exception of *Nephrops*, the whiting was the most abundant species at all sampling stations. Table 15 gives catch abundance and the diversity for all sampling stations.

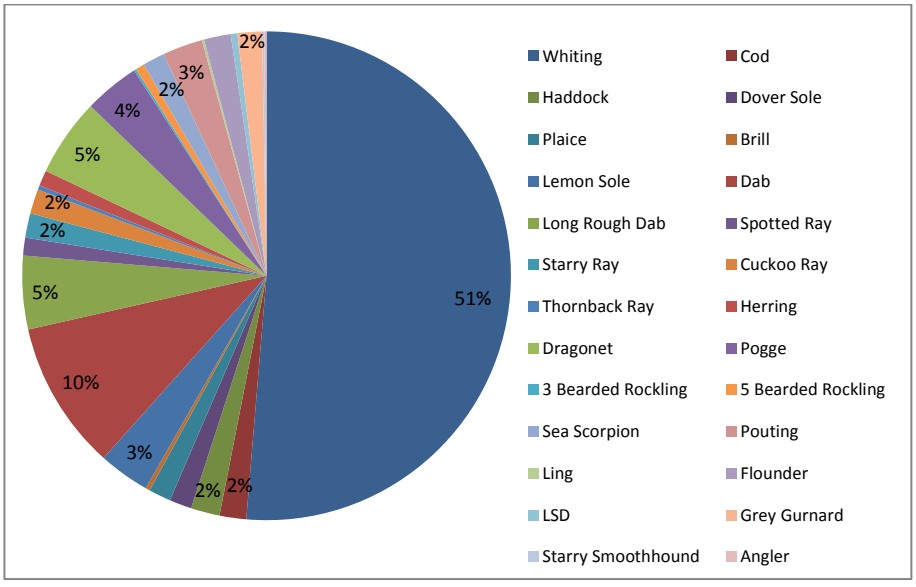

Figure 71. Overall percentage abundance for fish only in all *Nephrops* trawls

Table 11. Species diversity and abundance from the prawn trawl survey.

Species	Latin name	Trawl 1	Trawl 2	Trawl 3	Total
Whiting	*Merlangius merlangus*	127	99	123	349
Cod	*Gadus morhua*	3	5	4	12
Haddock	*Melanogrammus aeglefinus*	2	6	5	13
Dover Sole	*Solea solea*	2	5	3	10

Plaice	*Pleuronectes platessa*	5	3	2	10
Brill	*Scophthalmus rhombus*	1	1	0	2
Lemon Sole	*Microstomus kitt*	4	11	8	23
Dab	*Limanda limanda*	21	27	19	67
Long Rough Dab	*Hippoglossoides platessoides*	5	16	12	33
Spotted Ray	*Raja montagui*	2	4	2	8
Starry Ray	*Raja radiata*	5	4	2	11
Cuckoo Ray	*Raja naevus*	1	6	4	11
Thornback Ray	*Raja clavata*	1	1	0	2
Herring	*Clupea harengus*	4	1	2	7
Dragonet	*Callionymus lyra*	5	16	14	35
Pogge	*Agonus cataphractus*	5	11	9	25
Three Bearded Rockling	*Gaidropsarus vulgaris*	0	1	0	1
Five Bearded Rockling	*Ciliata mustela*	2	1	1	4
Sea Scorpion	*Taurulus bubalis*	2	5	3	10
Pouting	*Trisopterus luscus*	5	6	7	18
Ling	*Molva molva*	0	1	0	1
Flounder	*Platichthys flesus*	4	5	3	12
Lesser Spotted Dogfish	*Scyliorhinus canicula*	0	2	1	3
Grey Gurnard	*Eutrigla gurnardus*	2	3	6	11
Starry Smoothhound	*Mustela asterias*	0	1	0	1
Angler fish	*Lophius piscatorius*	0	1	0	1
Prawn	*Nephrops norvegicus*	825	708	352	1885
Brown crab	*Cancer pagurus*	15	4	3	22
Sea urchin	*Echinus esculentus*	1	0	3	4
Hermit Crab	*Pagurus bernhardus*	1	0	5	6
Whelks	*Buccinum undatum*	5	1	3	9
Red whelk	*Neptunea antiqua*	11	4	2	17
Harbour crab	*Liocarcinus depurator*	7	9	5	21
Livid swimming crab	*Liocarcinus holsatus*	5	11	2	18
Density		**1078**	**979**	**605**	2662
Diversity		**29**	**32**	**28**	

3.4.2. Individual Trawl Composition

3.4.2.1. Trawl 1

Nephrops represented 77% (825) of the catch at station 1 (Figure 72). Figure 73 shows that whiting and dab are the most abundant fish species at station 1.

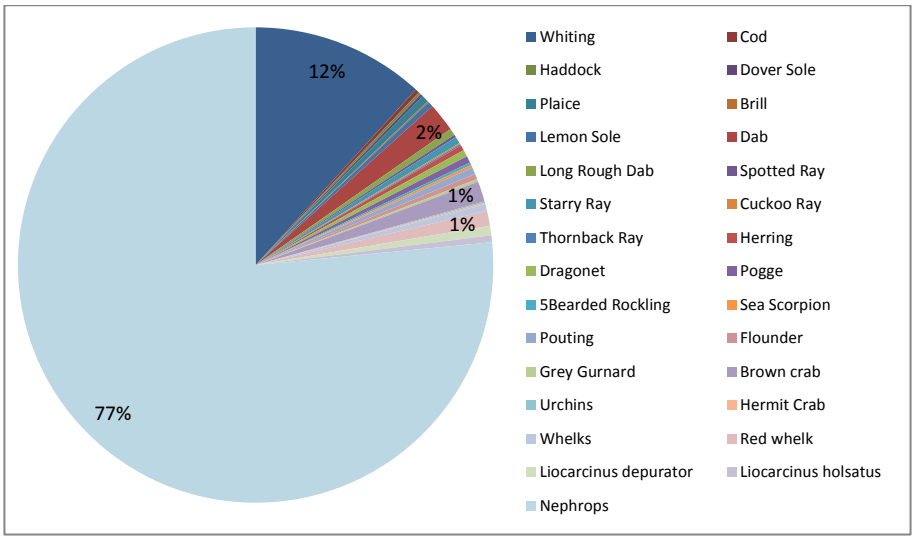

Figure 72. Percentage composition of all species at prawn trawl station 1

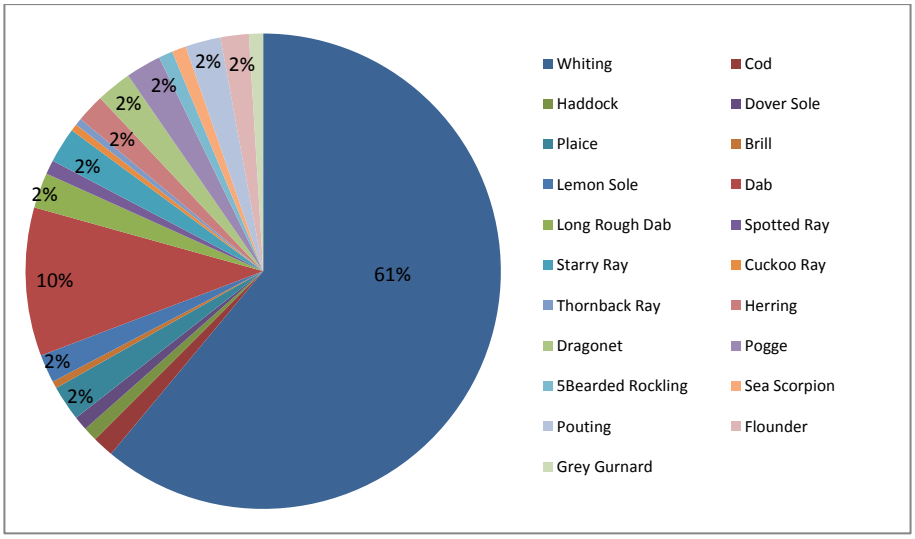

Figure 73. Percentage composition of fish species at prawn trawl station 1

3.4.2.2. Trawl 2

Nephrops represented 72% of the catch at station 2 (Figure 74). A total of 708 Nephrops were recorded at station2 with an estimated total wet weight biomass of 24kg. Whiting and dab were the most abundant fish species at station 2 (Figure 75).

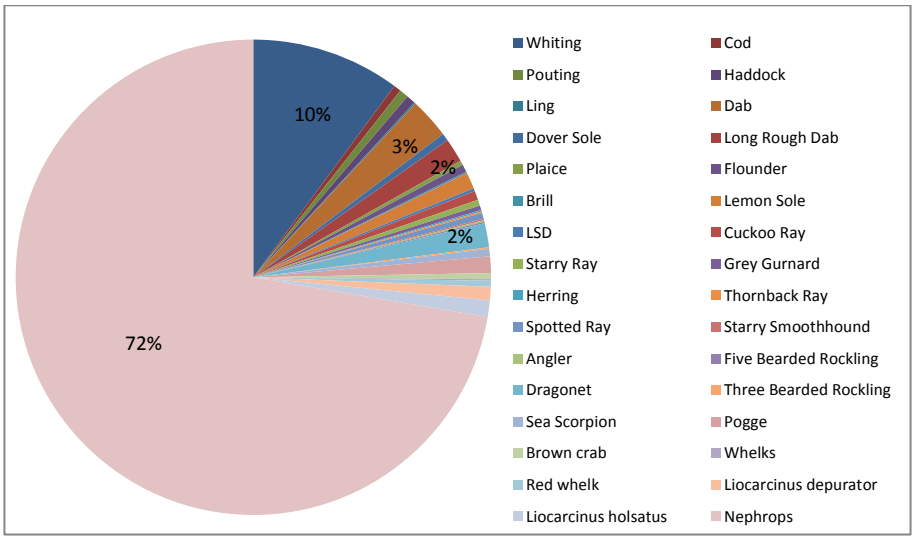

Figure 74. Percentage composition of all species at prawn trawl station 2

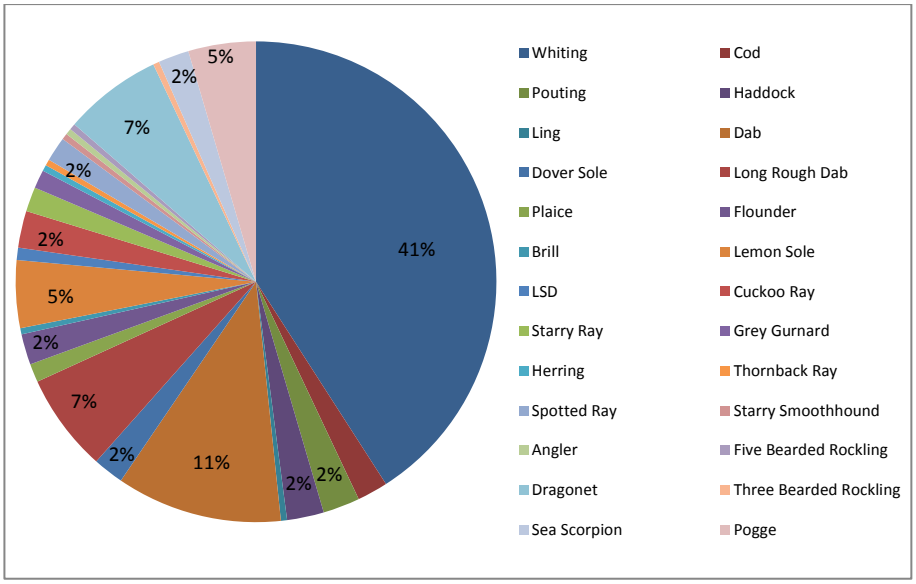

Figure 75. Percentage composition of fish species at prawn trawl station 2

3.4.2.3. Trawl 3

Nephrops contributed 58% of the total catch at station 3. Whiting and dab were the most abundant fish species (Figure 76 and Figure 77)

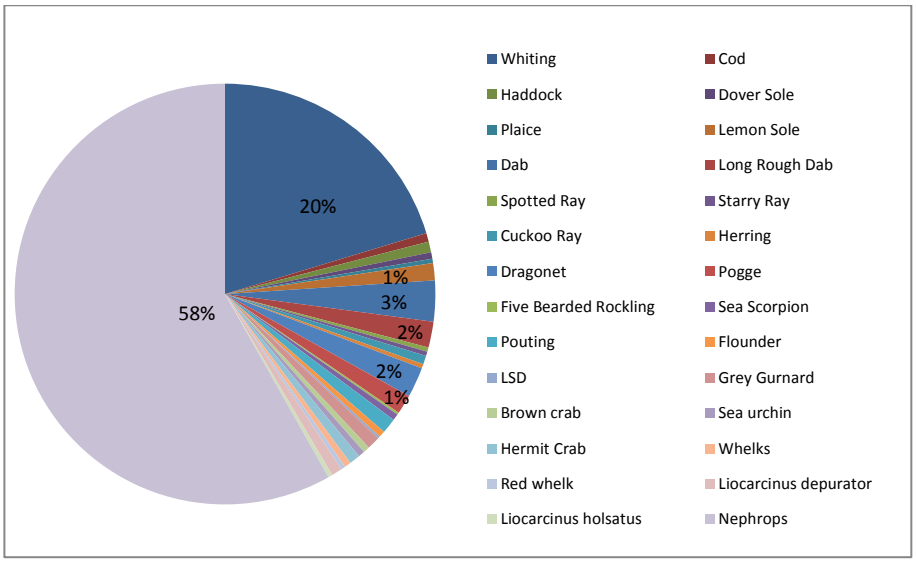

Figure 76. Percentage composition of all species at prawn trawl station 3

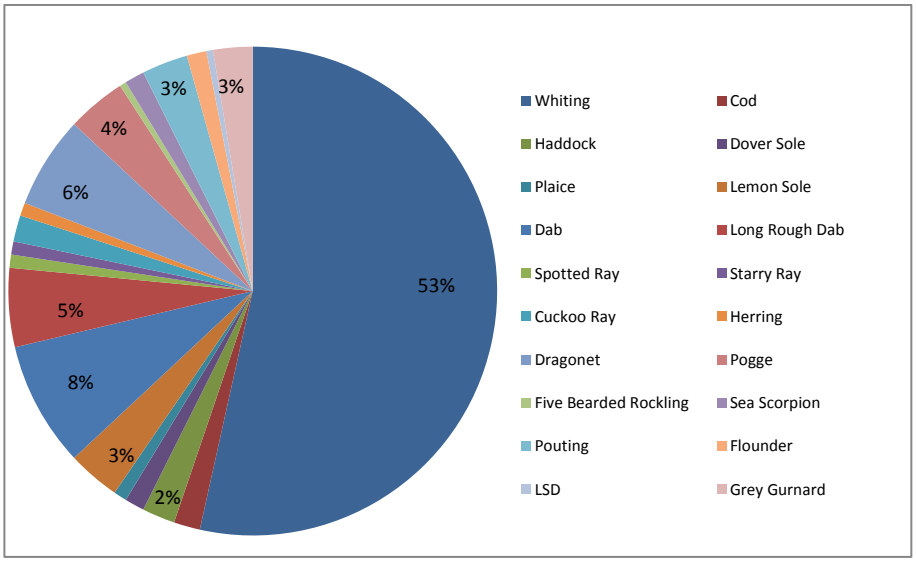

Figure 77. Percentage composition of fish species at prawn trawl station 3

3.4.3. Length Frequency Analysis

Length frequency data has been collated for *Nephrops*, whiting and dab.

3.4.3.1. Whiting

The most abundant size class recorded for whiting was 280mm - 289mm (Figure 78)..

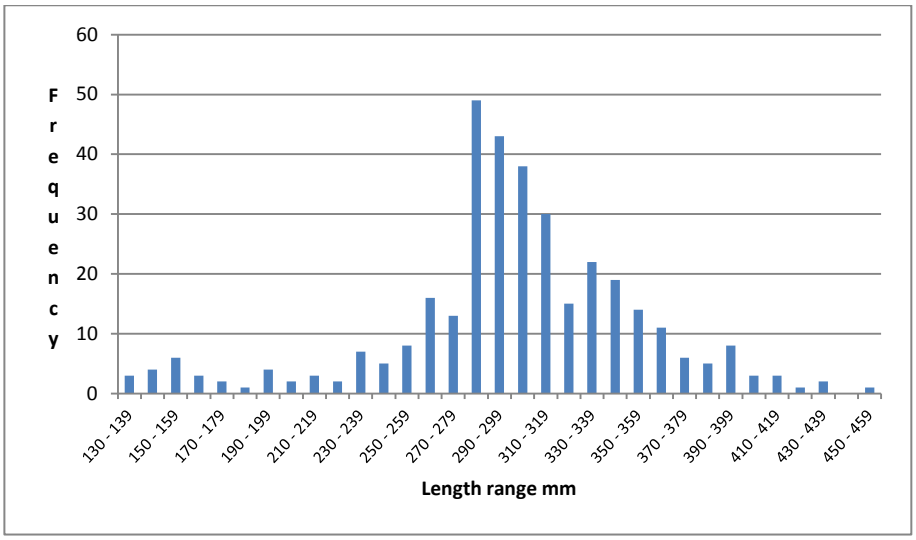

Figure 78. Whiting length frequency data

3.4.3.2. *Dab*

The length frequency data collated for dab show the majority of dab caught were juveniles or adolescents below the age of sexual maturity (c. 25cm).

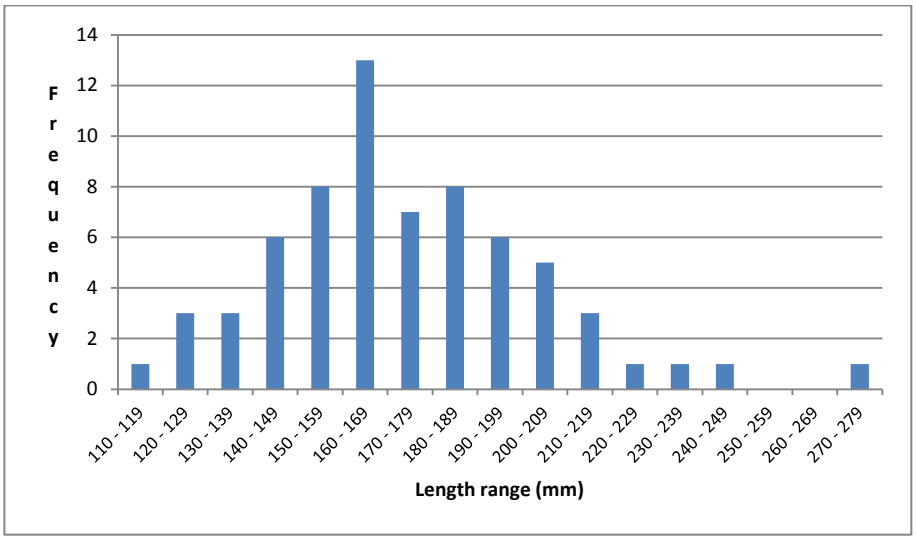

Figure 79. Dab length frequency data

The most abundant size class was observed at 160mm – 169 mm.

3.4.3.3. Nephrops

Over 20% of the total abundance of *Nephrops* were measured to determine the length frequency range. The most abundant length frequency class was observed at 25mm – 26 mm. Figure 79 illustrates that 97% were above the MLS of 20mm.

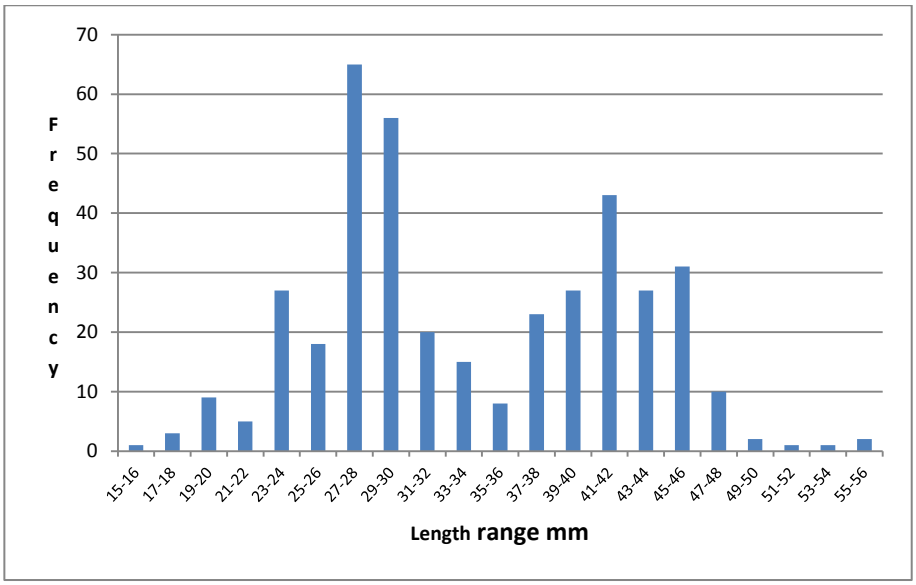

Figure 80. Prawn (Nephrops) length range frequency data

3.4.4. Statistical analysis of prawn trawl data

Given the low number of sampling stations and differences in mesh size, it is considered that an extensive statistical analysis of the data collated from the three prawn trawl stations is unwarranted, however the distribution of taxa by station are given in Figure 80.

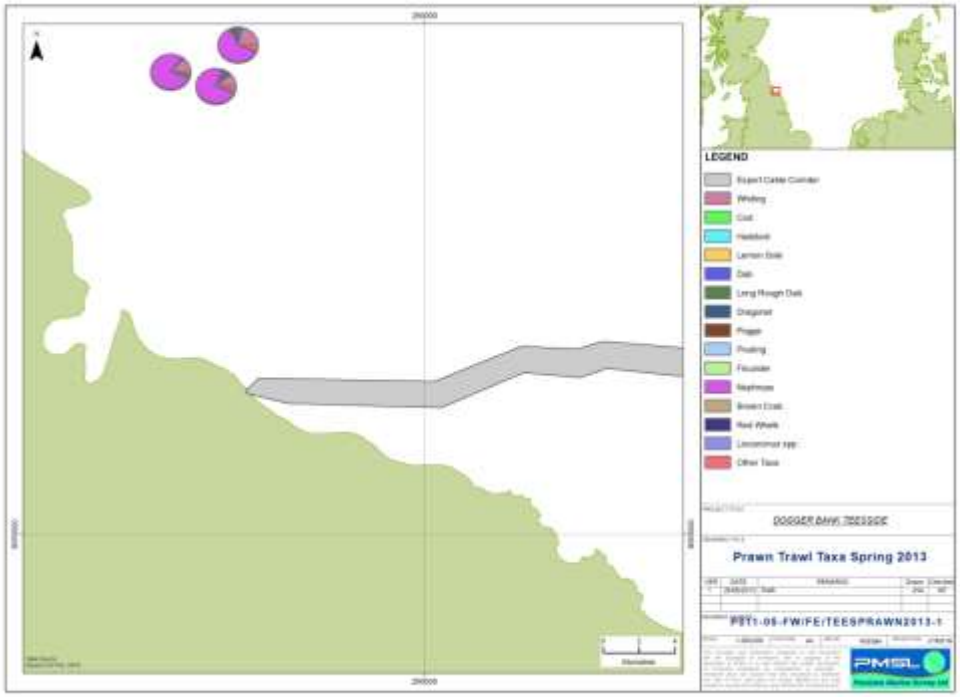

Figure 81. Distribution of taxa groups for the prawn trawl survey along the Dogger Bank Teesside A & B export cable corridor

Figure 80 shows that there is very little difference between the three prawn stations and that the species composition is dominated by the same species which may vary to a minor extent in terms of the percentage composition.

Table 12. Total catch summary per hour for prawn trawls

Species	Total	Average	% of sites	Total Number per hour
Whiting	349	116.33	100.00	165.08
Cod	12	4.00	100.00	5.68
Haddock	13	4.33	100.00	6.15
Dover Sole	10	3.33	100.00	4.73
Plaice	10	3.33	100.00	4.73
Brill	2	0.67	66.67	0.95
Lemon Sole	23	7.67	100.00	10.88
Dab	67	22.33	100.00	31.69
Long Rough Dab	33	11.00	100.00	15.61
Spotted Ray	8	2.67	100.00	3.78
Starry Ray	11	3.67	100.00	5.20
Cuckoo Ray	11	3.67	100.00	5.20
Thornback Ray	2	0.67	66.67	0.95
Herring	7	2.33	100.00	3.31
Dragonet	35	11.67	100.00	16.55
Pogge	25	8.33	100.00	11.82
3 Bearded Rockling	1	0.33	33.33	0.47
Five Bearded Rockling	4	1.33	100.00	1.89
Sea Scorpion	10	3.33	100.00	4.73
Pouting	18	6.00	100.00	8.51
Ling	1	0.33	33.33	0.47
Flounder	12	4.00	100.00	5.68
LSD	3	1.00	66.67	1.42
Grey Gurnard	11	3.67	100.00	5.20
Starry Smoothhound	1	0.33	33.33	0.47
Angler	1	0.33	33.33	0.47
Nephrops	1885	628.33	100.00	891.60
Brown crab	22	7.33	100.00	10.41
Urchins	4	1.33	66.67	1.89
Hermit Crab	6	2.00	66.67	2.84
Whelk	9	3.00	100.00	4.26
Red whelk	17	5.67	100.00	8.04
Liocarcinus depurator	21	7.00	100.00	9.93
Liocarcinus holsatus	18	6.00	100.00	8.51

3.5. Combined Length Frequency Data for all Surveys

The evaluation of size classes of fish caught within the different survey's has to some extent been limited by gear type and in particular mesh size, pooling of length frequency data should provide a clearer view of the wider range of fish sizes, and as a consequence cohorts present throughout the inshore waters of the export cable corridor for the Dogger Bank Teesside projects. Adequate length frequency data from the Spring 2013 survey were available only for whiting and dab.

3.5.1. Whiting

Whiting were only captured in sufficient abundance during the otter and prawn trawl surveys to facilitate an assessment of pooled length frequency data. Similarly to that produced for the autumn survey report (Report No. PMSL/FWD06/TS/06-13-F), the smaller size ranges were largely retained by the prawn trawl which was comprised of 90mm mesh, as opposed to the otter trawl which utilised 100mm mesh, although the largest whiting analysed were also captured in the prawn trawl. The data demonstrate that whilst different gears and mesh sizes have been employed, each gear metier is capturing a similar size class of whiting (Figure 81), although the smaller mesh will retain a wider range of smaller fish. For example there was a fourfold increase in the number of whiting retained in the prawn trawl within the length range 130mm to 240mm in comparison to the otter trawl. Whilst the catch of whiting in the otter trawl, in the length range 240mm to 350mm was twice that of the prawn trawl. The largest whiting recorded were all caught in the prawn trawl survey.

Figure 81 indicates that there are a range of size classes present within the inshore waters of the export cable corridor survey area.

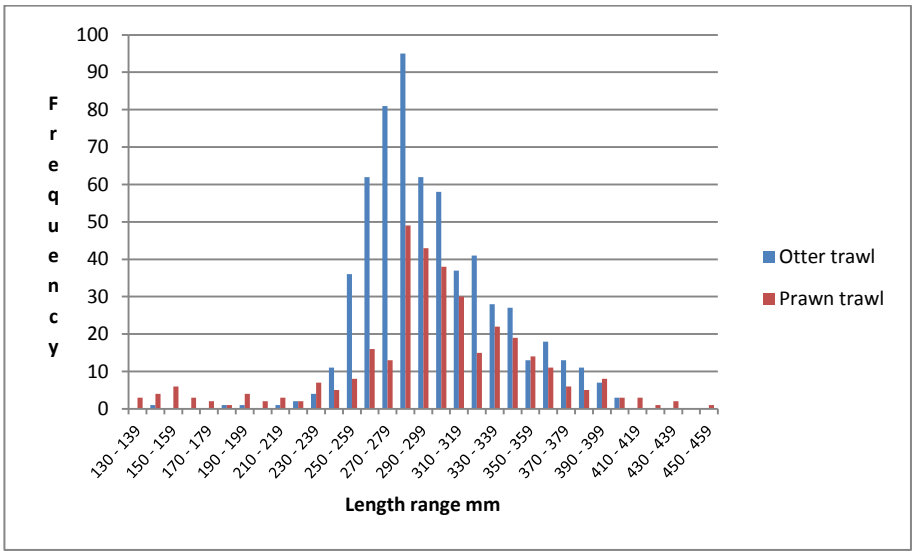

Figure 82. Combined length frequency data for whiting from the otter and prawn trawl surveys

3.5.2. Dab

Data produced for the dab in respect to pooled length frequency are derived from the otter trawl, prawn trawl and trammel net surveys. These data show a relatively distinct separation of sizes by gear which is directly linked to mesh size. In general terms, the smallest dab recorded were in the prawn trawl, which shows a limited range of size classes between 110mm to 220mm, with the most abundant size class being the 160mm to 169mm group. Dab recorded in the otter trawls covered a

wide range of length classes from 140mm to 330mm, whilst the most abundant length frequency class was the 220mm to 229mm size group. Dab were particularly abundant in the otter trawls within the length range of 180mm to 280mm.

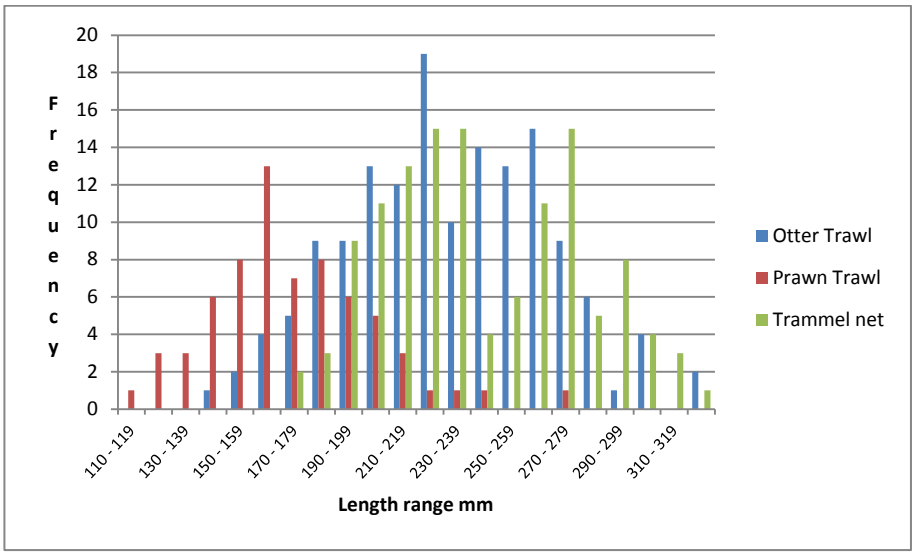

Figure 83. Combined length frequency data for dab from the trammel nets, otter and prawn trawl surveys

The trammel netting survey produced dab in the 170mm to 330mm length ranges, although more typically between the length ranges of 190mm to 299mm.

3.6. 2-m Beam Trawl (juvenile fish and epifauna)

The data collected for the spring 2013 beam trawling survey are represented in the following section. Following significant delay due to poor weather, the survey, which was scheduled for October 2012 commenced on the 19th of May, the timing of which was based on a suitable weather window, appropriate tides and vessel availability. The survey was carried out over a single day; with each run lasting approximately 10 minutes (table 17). The beam trawl locations can be seen in Figure 83 for the spring 2013 survey.

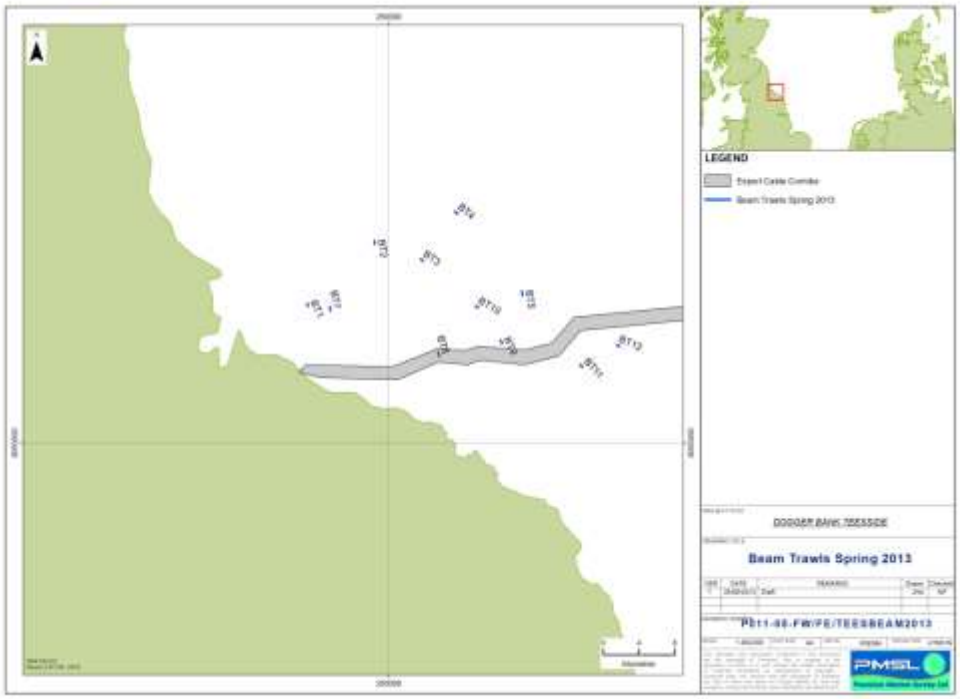

Figure 84. 2-m beam trawl sampling stations for the spring 2013 survey

Table 13. 2-m beam trawl positional data

		Trawl Start				Trawl End			
			WGS 84				WGS 84		
Station	Date	Deployment Time (GMT)	Latitude	Longitude	Depth (m)	Recovery Time (End)	Latitude	Longitude	Duration (mm:ss)
BT1	19/05/2013	06:44:12	54 40.186N	01 01.180W	33.1	06:54:14	54 40.033N	01 01.052W	10:02
BT2	19/05/2013	07:48:37	54 44.141N	00 54.557W	52.1	07:59:03	54 43.962N	00 54.480W	10:34
BT3	19/05/2013	08:34:46	54 43.221N	00 49.615W	52.9	08:44:59	54 43.128N	00 49.348W	10:13
BT4	19/05/2013	09:33:22	54 46.161N	00 46.311W	59.8	09:43:37	54 46.037N	00 46.016W	10:15
BT5	19/05/2013	10:54:59	54 41.610N	00 38.879W	54.8	11:05:02	54 41.375N	00 38.801W	11:03
BT6	19/05/2013	18:05	Station Abandoned too much static gear and close proximity to Braer pipeline						
BT7	19/05/2013	18:58:45	54 39.851N	00 58.710W	36.2	19:09:17	54 40.064N	00 58.813W	10:32
BT8	19/05/2013	16:18:50	54 37.488N	00 47.115W	39.4	16:29:12	54 37.729N	00 47.298W	10:22
BT9	19/05/2013	14:24:23	54 38.640N	00 40.831W	48.9	14:34:56	54 38.445N	00 40.670W	10:33
BT10	19/05/2013	15:26:38	54 40.596N	00 43.622W	48.7	15:37:49	54 40.511N	00 43.343W	11:11
BT11	19/05/2013	12:46:09	54 37.423N	00 32.401W	51.6	12:56:38	54 37.290N	00 32.173W	10:27
BT12	19/05/2013	12:11:28	54 38.700N	00 28.698W	52.9	12:21:36	54 38.642N	00 28.425W	10:08

One sampling station (BT6) was abandoned after attempts at sampling the station were complicated by fishing gears positioned directly across the trawl path. Two attempts were made at sample station 6, however, the trawl path was compromised by static gears during each attempt, whilst any possible relocation would have placed the trawl sample within an unacceptable proximity to the Braer pipeline.

3.6.1. Species Density and Diversity - Fish

Figure 84 illustrates the species diversity for fish retained at all beam trawl sampling stations and the contribution they made towards the total abundance recorded during the 2-m beam trawl survey. In total, 12 species of fish were recorded from the 11 sampling stations during the survey, whilst 59 invertebrate species were identified. The invertebrates can be further broken down into 42 macro-faunal species, including the brown crab, Nephrops and velvet crab; as well as 14 sedentary species *e.g.* Hydrozoa and Bryozoa, and 3 species of invertebrate normally associated with the water column i.e. the sea gooseberry *Pleurobranchia pileus*, were also recorded. For the purpose of this report, only the fish are discussed in detail.

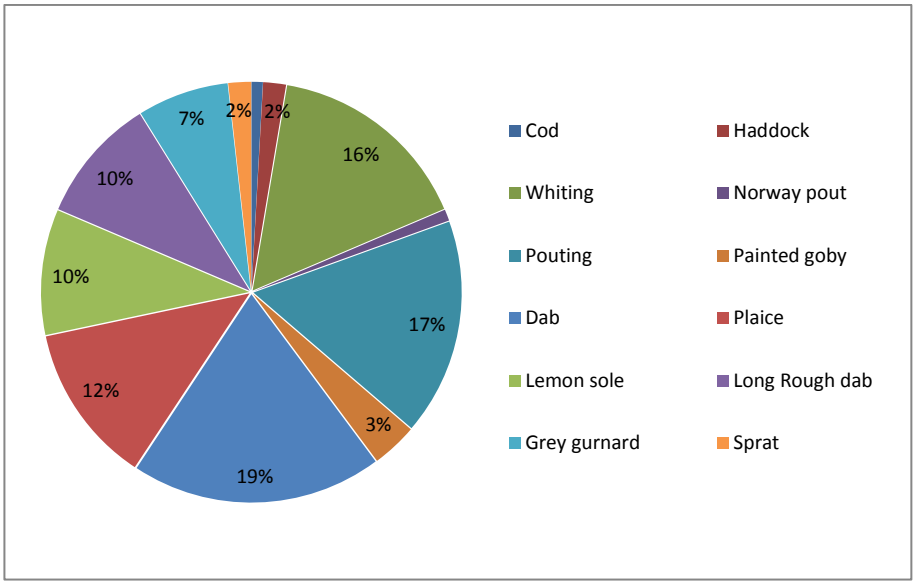

Figure 85. Overall Abundance of Species for all Sampling Stations

Throughout the beam trawl survey, the most abundant species recorded were the dab (19%), pouting (17%) and the whiting (16%) which between these three species comprised 52% of the total abundance (Figure 84). Plaice contributed 12% of the total abundance; with lemon sole and long rough dab each representing 10%. Only grey gurnard contributed any significant further abundance with 7% of the total, the remaining 5 species representing 9% of the total catch collectively. Three species, not previously recorded during any of the surveys were identified during the 2-m beam trawl survey, these were the Norway pout *Trisopterus esmarkii*, where a single fish was recorded at sampling station BT 1. In addition the painted goby *Pomatoschistus pictus* was recorded at sampling stations BT 4, BT 7 and BT 9, whilst the sprat *Sprattus sprattus* was recorded was BT 3 and BT 7.

Table 18 presents species abundance anddiversity for individual sampling stations.

Table 14. Species diversity and abundance from the 2-m beam trawl survey.

Species	*Latin name*	BT 1	BT 2	BT 3	BT4	BT 5	BT 7	BT 8	BT 9	BT 10	BT 11	BT 12	Total
Cod	*Gadus morhua*	1	0	0	0	0	0	0	0	0	0	0	1
Haddock	*Melanogrammus aeglefinus*	0	0	1	1	0	0	0	0	0	0	0	2
Whiting	*Merlangius merlangus*	0	0	2	3	3	3	1	0	1	3	2	18
Norway pout	*Trisopterus esmarkii*	1	0	0	0	0	0	0	0	0	0	0	1
Pouting	*Trisopterus luscus*	3	1	1	0	4	0	2	3	2	1	2	19
Painted goby	*Pomatoschistus pictus*	0	0	0	1	0	1	0	2	0	0	0	4
Dab	*Limanda limanda*	0	0	6	1	4	0	4	2	2	2	1	22
Plaice	*Pleuronectes platessa*	0	0	3	3	1	0	3	1	1	1	1	14

Lemon sole	***Microstomus kitt***	0	0	2	1	**1**	0	2	2	**1**	1	1	**11**
Long Rough dab	***Hippoglossoides platessoides***	0	0	3	0	**1**	0	2	1	**1**	1	2	**11**
Grey gurnard	***Eutrigla gurnardus***	0	0	2	0	1	0	**1**	2	1	0	1	**8**
Sprat	***Sprattus sprattus***	0	0	1	0	0	1	**0**	0	0	0	0	**2**
Sea Gooseberry	***Pleurobranchia pileus***	0	0	5	0	0	0	**1**	3	2	15	0	**26**
Dead mans finger	***Alcynonium digitatum***	0	0	P	0	0	0	0	P	0	P	P	**0**
Arrow worm	***Sagitta elegans***	0	6	0	0	0	9	**1**	0	0	0	0	**16**
Cnidarian	***Hydrozoa sp. Indet***	0	0	P	P	0	0	**P**	P	0	0	P	**0**
Cnidarian	***Lafoea dumosa***	0	P	0	0	0	0	0	0	0	0	0	**0**
Cnidarian	***Halecium halecinum***	0	P	P	P	P	0	**0**	0	0	P	0	**0**
Cnidarian	***Abietinaria abietina***	0	P	P	P	0	0	**0**	P	0	0	P	**0**
Cnidarian	***Sertularella tenella***	0	P	0	P	P	0	**0**	P	0	0	P	**0**
Nemertean	***Nemertea sp. Indet***	0	1	0	0	0	3	**0**	0	0	0	0	**4**
Polychaete worm	***Polychaetae spp. indet***	0	0	1	2	0	0	**0**	2	0	0	0	**5**
Polychaete worm	***Harmothoe Juv sp. Indet***	2	0	0	0	0	0	**0**	0	0	0	0	**2**
Polychaete worm	***Harmothoe impar***	2	0	1	0	0	0	**0**	0	0	0	0	**3**
Polychaete worm	***Lepidonotus squamatus***	1	0	1	0	1	0	**0**	0	0	0	0	**3**
Polychaete worm	***Lepidathenia argus***	1	0	0	0	0	0	**0**	0	0	0	0	**1**
Polychaete worm	***Syllis armilliaris***	0	8	0	1	0	0	**0**	0	0	0	0	**9**
Polychaete worm	***Serpulidae sp. Indet***	0	2	0	1	0	0	**0**	0	0	0	0	**3**
Polychaete worm	***Spirorbidae sp. Indet***	0	3	1	3	0	0	**0**	4	0	1	0	**12**
Mysid shrimp	***Mysidae sp. Indet***	2	0	0	1	0	0	**0**	0	0	1	0	**4**
Mysid shrimp	***Schistomysis kervillei***	3	0	0	0	0	0	**0**	0	0	0	0	**3**
Amphipod	***Abludomelita obstusata***	0	5	0	0	0	0	**0**	0	0	0	0	**5**
Amphipod	***Abludomelita gladiosa***	0	10	3	0	0	0	**1**	0	0	0	0	**14**
Skeleton shrimp	***Pariambus typicus***	0	0	1	2	0	1	**2**	0	0	0	0	**6**
Isopod	***Gnathia dentata***	0	1	0	0	0	0	**0**	0	0	0	0	**1**
Krill	***Euphausiidae sp. Indet***	0	0	0	29	0	492	**0**	8	0	1	5	**535**
Shrimp	***Caridion gordoni***	1	0	0	0	0	0	**0**	0	0	0	0	**1**
Shrimp	***Thoralus cranchii***	1	0	0	0	0	0	**0**	0	0	0	0	**1**
Pink Shrimp	***Pandalus montagui***	53	2	6	1	2	0	**3**	16	0	3	11	**97**
Shrimp	***Philocheras sp. Indet***	0	6	0	1	0	0	**0**	1	0	0	0	**8**
Shrimp	***Philocheras bispinosus***	1	1	0	0	0	0	**0**	0	0	1	0	**3**
Nephrops	***Nephrops norvegicus***	0	0	0	0	0	0	0	0	0	0	3	**3**
Hermit crab	***Pagurus bernhardus***	0	3	1	0	1	0	0	0	0	1	5	**11**
Hermit crab	***Pagurus prideaux***	15	3	0	0	0	0	1	2	0	2	0	**23**
Squat lobster	***Galathea intermedia***	0	0	1	0	0	0	0	0	0	0	0	**1**
Squat lobster	***Galathea strigosa***	4	0	1	0	0	0	**0**	0	0	0	0	**5**
Spider carb	***Macropodia sp. Indet***	0	1	0	0	0	0	**2**	0	0	0	0	**3**
Spider carb	***Macropodia linaresi***	0	3	0	0	0	0	**1**	1	0	0	0	**5**
Brown Crab	***Cancer pagurus***	0	0	0	0	0	0	0	0	0	0	3	**3**
Harbour crab	***Liocarcinus depurator***	0	0	1	**0**	**0**	0	**1**	**0**	0	0	0	**2**
Livid swimming crab	***Liocarcinus holsatus***	1	0	2	**0**	**0**	0	**0**	**0**	0	0	1	**4**
Velvet crab	***Necora puber***	0	0	1	**0**	**0**	0	**0**	**0**	0	1	0	**2**
Bivalve sp.	***Nucula hanleyi***	1	0	0	0	0	0	0	0	0	0	0	**1**
Queen scallop	***Aequipecten opercularis***	1	0	0	0	0	0	0	0	0	0	0	**1**
Netted dog whelk	***Hinia reticulata***	0	1	0	0	0	0	2	1	0	0	1	**5**
Whelk	***Buccinum undatum***	0	0	0	0	0	0	0	0	0	0	5	**5**
Star fish	***Asterias rubens***	0	2	0	0	0	1	2	1	1	0	1	**8**
Brittle star	***Ophiothrix fragilis***	3	15	1	0	0	0	1	2	0	3	0	**25**
Brittle star	***Amphipholis squamata***	0	3	0	1	1	0	1	5	0	0	0	**11**
Brittle star	***Ophiura albida***	17	0	0	0	1	0	3	0	0	1	0	**22**
Sea urchin	***Echinus esculentus***	15	0	1	0	0	0	0	0	4	4	P	**24**
Shore sea urchin	***Psammechinus miliaris***	1	1	0	0	0	0	2	1	0	1	0	**6**
Green sea urchin	***Strongylocentrus droebochiensis***	1	0	0	0	0	0	0	0	0	0	0	**1**
Bryozoan sp.	***Bryozoa spp. indet***	0	0	P	P	P	0	P	P	0	P	0	**0**

Bryozoan sp.	***Vesicularia spinosa***	0	P	P	**P**	0	0	P	0	0	0	0	**0**
Bryozoan sp.	***Eucratea loricata***	0	P	0	**0**	0	0	0	0	0	0	0	**0**
Horn wrack	***Flustra foliacea***	0	P	P	**0**	0	0	P	P	0	P	P	**0**
Bryozoan sp.	***Securiflustra securifrons***	0	P	0	**0**	0	0	0	0	0	P	0	**0**
Bryozoan sp.	***Notoplites jeffreysii***	0	P	0	**0**	0	0	0	0	0	0	0	**0**
Bryozoan sp.	***Celleporina hassallii***	0	P	0	0	0	0	0	0	0	0	0	**0**
Foraminifera	***Astrorhiza sp. Indet***	0	P	0	**0**	0	0	0	0	0	0	0	**0**
	Total abundance	131	78	49	51	21	510	39	58	16	44	45	**1042**
	Total diversity	23	32	32	21	15	7	26	25	10	24	22	

3.2.3. Statistical Analysis of Otter Trawl Data

Despite the small sample size, it is considered useful to undertake some simple multivariate analysis to clarify patterns in similarity between the survey sites, particularly for the fish data collated from the 2-m beam trawls during the May 2013 survey.

Classification (cluster analysis) of the data was undertaken using the Bray-Curtis similarity coefficient and grouped average (UPGMA) clustering technique followed by a non metric MDS (multi dimensional scaling) ordination both using the PRIMER package. Cluster analysis is used to display graphically the similarity between sites based upon their species composition whereby the similarity between sites is calculated (in this case using the Bray-Curtis similarity coefficient) to produce a similarity matrix showing the percent similarity of sites (0% indicating no species in common and 100% indicating an identical community). These values are then used to plot a dendrogram or tree diagram in which sites are linked at their respective similarity to other sites and consequently it is possible to define groups of sites with similar species composition at a predefined level of similarity.

Non metric MDS graphically displays the (rank) similarity between sites as a 2 dimensional plot in which the distances between sites indicates the level of similarity between them. The stress value associated with an MDS plot indicates how faithful the plot is in representing the similarity between sites with low values (below 0.2) generally indicating a good fit. The SIMPROF test within PRIMER was used to derive the presence of any groups of sites that differed significantly in terms of similarity between species.

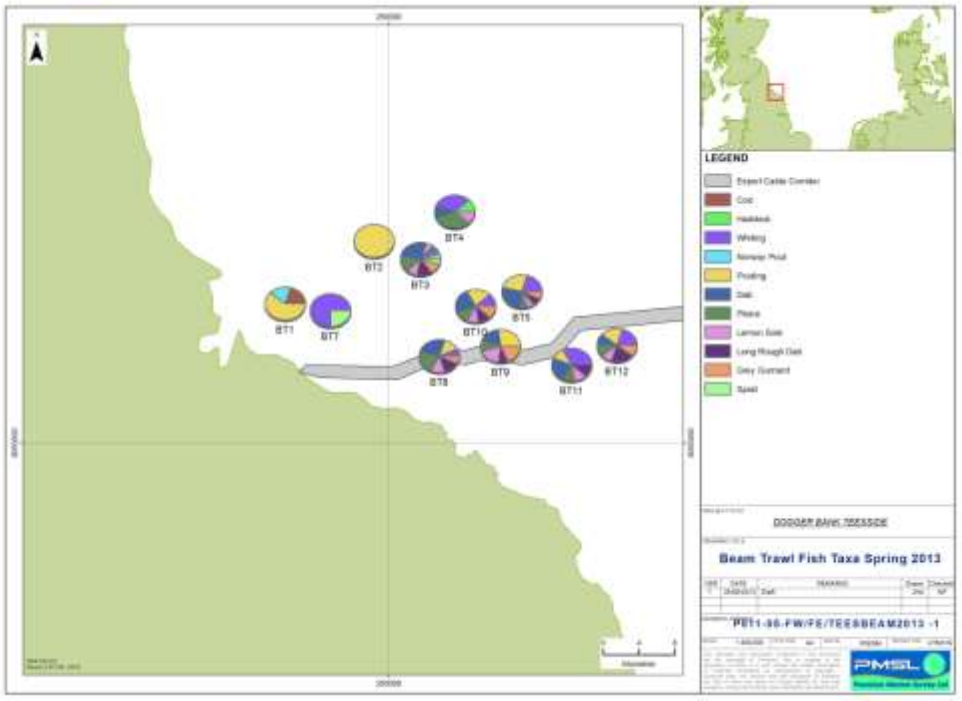

Figure 86. Distribution of fish taxa groups for the 2-m beam trawl survey along the Dogger Bank Teesside A & B export cable corridor

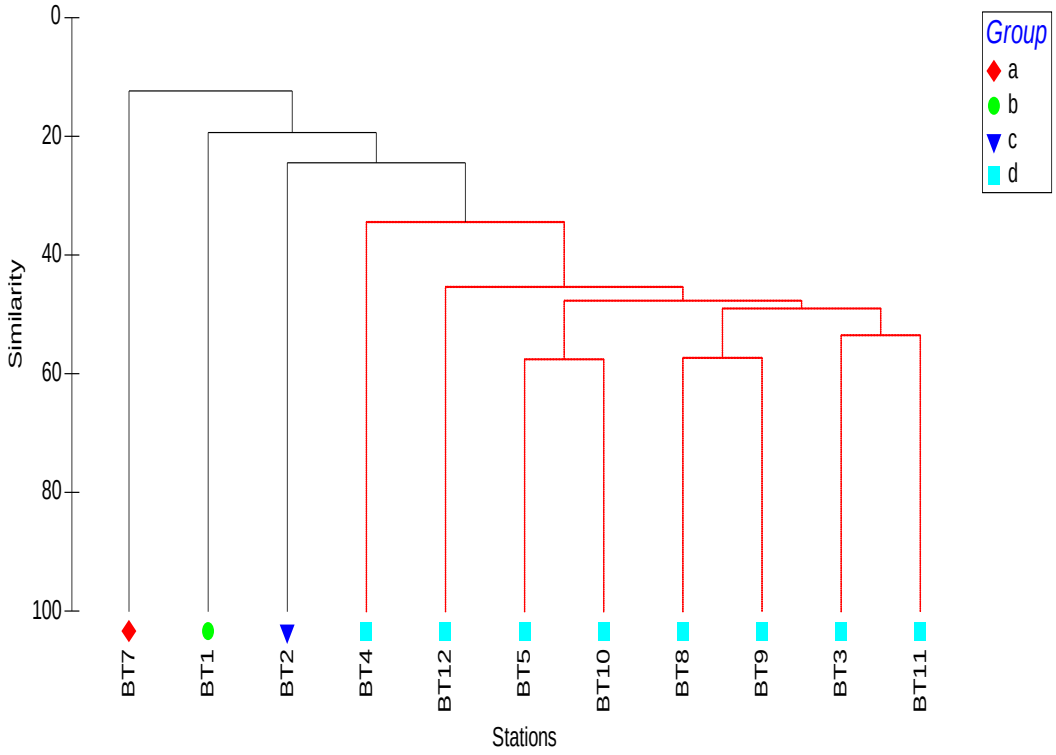

Figure 87. Distribution of fish taxa groups for the 2-m beam trawl survey along the Dogger Bank Teesside A & B export cable corridor

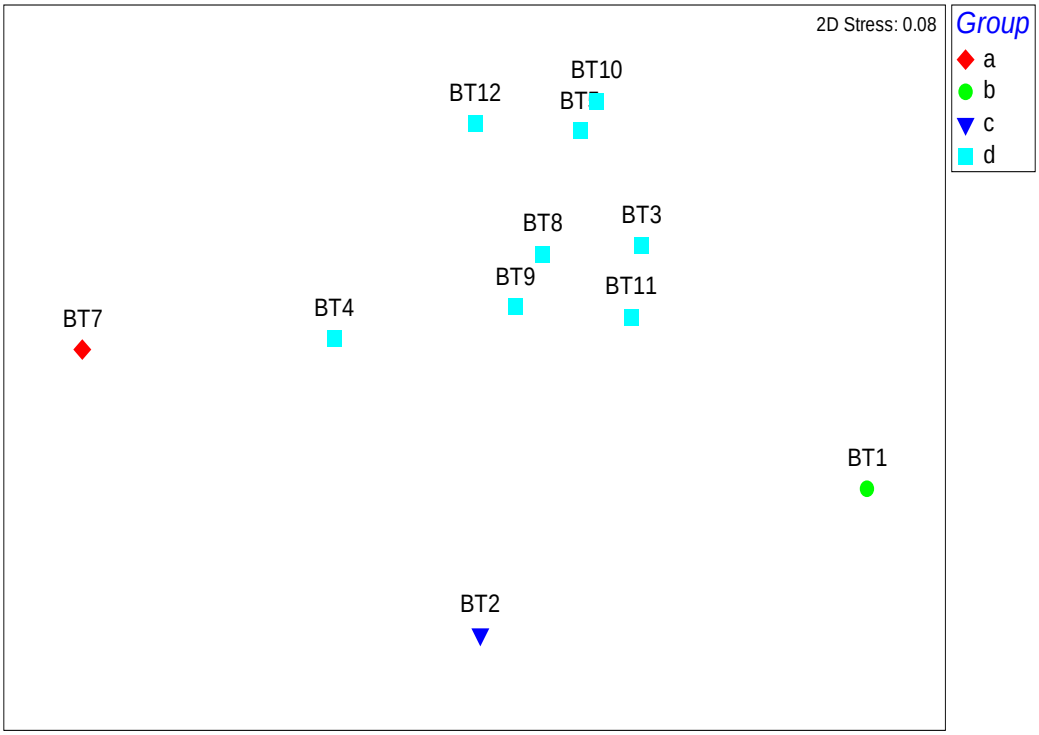

Figure 88. Distribution of invertebrate phyla groups for the 2-m beam trawl survey along the Dogger Bank Teesside A & B export cable corridor

Table 15. Cluster groups species composition

Cluster Groups Species Contributions (SIMPER) Fish & Invertebrates			
	Group a (BT7)		
Species	Abundance per 0.001km2		
Euphausiidae sp. Indet	600.15		
Sagitta elegans	10.98		
Merlangius merlangus	3.66		
Nemertea sp. Indet	3.66		
Sprattus sprattus	1.22		
Pariambus typicus	1.22		
Asterias rubens	1.22		
	Group b (BT1)		
Species	Abundance per 0.001km2		
Pandalus montagui	84.12		
Ophiura albida	26.98		
Pagurus prideaux	23.81		
Echinus esculentus	23.81		
Galathea strigosa	6.35		
Trisopterus luscus	4.76		
Schistomysis kervillei	4.76		
Ophiothrix fragilis	4.76		
Harmothoe Juv sp. Indet	3.17		
Harmothoe impar	3.17		
Mysidae sp. Indet	3.17		
Gadus morhua	1.59		
Trisopterus esmarkii	1.59		
Lepidonotus squamatus	1.59		
Lepidathenia argus	1.59		

Caridion gordoni	1.59		
Thoralus cranchii	1.59		
Philocheras bispinosus	1.59		
Liocarcinus holsatus	1.59		
Nucula hanleyi	1.59		
Aequipecten opercularis	1.59		
Psammechinus miliaris	1.59		
Strongylocentrus droebochiensis	1.59		
	Group c (BT2)		
Species	Abundance per 0.001km2		
Ophiothrix fragilis	21.94		
Abludomelita gladiosa	14.63		
Syllis armilliaris	11.70		
Sagitta elegans	8.78		
Philocheras sp. Indet	8.78		
Abludomelita obstusata	7.31		
Spirorbidae sp. Indet	4.39		
Pagurus bernhardus	4.39		
Pagurus prideaux	4.39		
Macropodia linaresi	4.39		
Amphipholis squamata	4.39		
Serpulidae sp. Indet	2.93		
Pandalus montagui	2.93		
Asterias rubens	2.93		
Trisopterus luscus	1.46		
Nemertea sp. Indet	1.46		
Gnathia dentata	1.46		
Philocheras bispinosus	1.46		
Macropodia sp. Indet	1.46		
Hinia reticulata	1.46		
Psammechinus miliaris	1.46		
	Group d (BT 3, 4, 5, 8, 9, 10, 11, 12)		
	Average similarity: 44.90		
Species	Av.Abundance per 0.001km2	% of Stations	Cum.% Contribution
Limanda limanda	3.60	100.00	12.47
Pleuronectes platessa	2.29	100.00	22.6
Pandalus montagui	7.19	87.50	32.65
Microstomus kitt	1.81	100.00	42.5
Merlangius merlangus	2.53	87.50	51.71
Trisopterus luscus	2.43	87.50	60.7
Hippoglossoides platessoides	1.88	87.50	68.04
Eutrigla gurnardus	1.34	75.00	73.16
Pleurobranchia pileus	4.60	62.50	77.45
Euphausiidae sp. Indet	7.07	50.00	80.73
Asterias rubens	0.80	50.00	82.85
Spirorbidae sp. Indet	1.47	50.00	84.84
Amphipholis squamata	1.21	50.00	86.81
Pagurus bernhardus	1.51	50.00	88.67
Ophiothrix fragilis	1.17	50.00	90.35

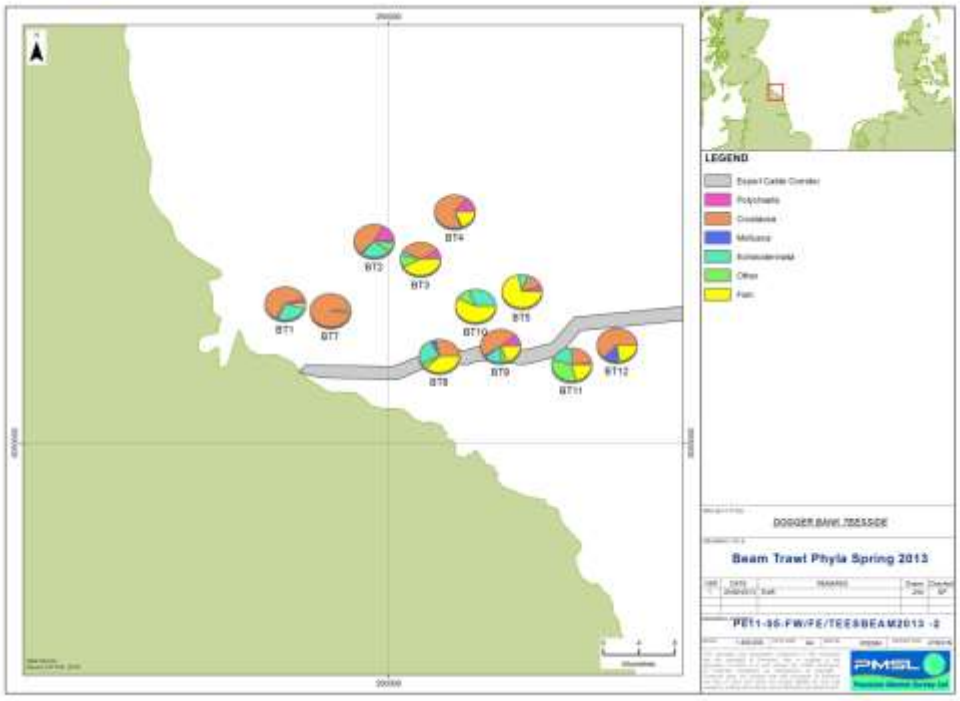

Figure 89. Distribution of invertebrate phyla groups for the 2-m beam trawl survey along the Dogger Bank Teesside A & B export cable corridor

Table 16. Summary of total catchper hour

Species		Total	Average	% of Stations	Number per Hour	Number per 0.001km2
Cod	*Gadus morhua*	1	0.09	9.09	0.52	0.12
Haddock	*Melanogrammus aeglefinus*	2	0.18	18.18	1.04	0.24
Whiting	*Merlangius merlangus*	18	1.64	72.73	9.36	2.18
Norway pout	*Trisopterus esmarkii*	1	0.09	9.09	0.52	0.12
Pouting	*Trisopterus luscus*	19	1.73	81.82	9.88	2.31
Dab	*Limanda limanda*	22	2.00	72.73	11.45	2.67
Plaice	*Pleuronectes platessa*	14	1.27	72.73	7.28	1.70
Lemon sole	*Microstomus kitt*	11	1.00	72.73	5.72	1.34
Long Rough dab	*Hippoglossoides platessoides*	11	1.00	63.64	5.72	1.34
Grey gurnard	*Eutriglia gurnhardus*	8	0.73	54.55	4.16	0.97
Sprat	*Sprattus sprattus*	2	0.18	18.18	1.04	0.24
Sea Gooseberry	*Pleurobranchia pileus*	26	2.36	45.45	13.53	3.16
Dead mans finger	*Alcynonium digitatum*	P	P	36.36	P	P
Arrow worm	*Sagitta elegans*	16	1.45	27.27	8.32	1.94
Cnidarian	*Hydrozoa sp. Indet*	0	P	45.45	P	P
Cnidarian	*Lafoea dumosa*	0	P	9.09	P	P
Cnidarian	*Halecium halecinum*	0	P	45.45	P	P
Cnidarian	*Abietinaria abietina*	0	P	45.45	P	P
Cnidarian	*Sertularella tenella*	0	P	45.45	P	P
Nemertean	*Nemertea sp. Indet*	4	0.36	18.18	2.08	0.49
Polychaete worm	*Polychaetae spp. indet*	5	0.45	27.27	2.60	0.61
Polychaete worm	*Harmothoe Juv sp. Indet*	2	0.18	9.09	1.04	0.24
Polychaete worm	*Harmothoe impar*	3	0.27	18.18	1.56	0.36
Polychaete worm	*Lepidonotus squamatus*	3	0.27	27.27	1.56	0.36

Polychaete worm	***Lepidathenia argus***	1	0.09	9.09	0.52	0.12
Polychaete worm	***Syllis armilliaris***	9	0.82	18.18	4.68	1.09
Polychaete worm	***Serpulidae sp. Indet***	3	0.27	18.18	1.56	0.36
Polychaete worm	***Spirorbidae sp. Indet***	12	1.09	45.45	6.24	1.46
Mysid shrimp	***Mysidae sp. Indet***	4	0.36	27.27	2.08	0.49
Mysid shrimp	***Schistomysis kervillei***	3	0.27	9.09	1.56	0.36
Amphipod	***Abludomelita obstusata***	5	0.45	9.09	2.60	0.61
Amphipod	***Abludomelita gladiosa***	14	1.27	27.27	7.28	1.70
Skeleton shrimp	***Pariambus typicus***	6	0.55	36.36	3.12	0.73
Isopod	***Gnathia dentata***	1	0.09	9.09	0.52	0.12
Krill	***Euphausiidae sp. Indet***	535	48.64	45.45	278.32	64.93
Shrimp	***Caridion gordoni***	1	0.09	9.09	0.52	0.12
Shrimp	***Thoralus cranchii***	1	0.09	9.09	0.52	0.12
Pink Shrimp	***Pandalus montagui***	97	8.82	81.82	50.46	11.77
Shrimp	***Philocheras sp. Indet***	8	0.73	27.27	4.16	0.97
Shrimp	***Philocheras bispinosus***	3	0.27	27.27	1.56	0.36
Nephrops	***Nephrops norvegicus***	3	0.27	9.09	1.56	0.36
Hermit crab	***Pagurus bernhardus***	11	1.00	45.45	5.72	1.34
Hermit crab	***Pagurus prideaux***	23	2.09	45.45	11.97	2.79
Squat lobster	***Galathea intermedia***	1	0.09	9.09	0.52	0.12
Squat lobster	***Galathea strigosa***	5	0.45	18.18	2.60	0.61
Spider crab	***Macropodia sp. Indet***	3	0.27	18.18	1.56	0.36
Spider crab	***Macropodia linaresi***	5	0.45	27.27	2.60	0.61
Brown crab	***Cancer pagurus***	3	0.27	9.09	1.56	0.36
Harbour crab	***Liocarcinus depurator***	2	0.18	18.18	1.04	0.24
Livid swimming crab	***Liocarcinus holsatus***	4	0.36	27.27	2.08	0.49
Velvet crab	***Necora puber***	2	0.18	18.18	1.04	0.24
Bivalve sp.	***Nucula hanleyi***	1	0.09	9.09	0.52	0.12
Queen scallop	***Aequipecten opercularis***	1	0.09	9.09	0.52	0.12
Netted dog whelk	***Hinia reticulata***	5	0.45	36.36	2.60	0.61
Whelk	***Buccinum undatum***	5	0.45	9.09	2.60	0.61
Star fish	***Asterias rubens***	8	0.73	54.55	4.16	0.97
Brittle star	***Ophiothrix fragilis***	25	2.27	54.55	13.01	3.03
Brittle star	***Amphipholis squamata***	11	1.00	45.45	5.72	1.34
Brittle star	***Ophiura albida***	22	2.00	36.36	11.45	2.67
Sea urchin	***Echinus esculentus***	24	2.40	36.36	12.49	2.91
Shore sea urchin	***Psammechinus miliaris***	6	0.55	45.45	3.12	0.73
Green sea urchin	***Strongylocentrus droebochiensis***	1	0.09	9.09	0.52	0.12
Bryozoan sp.	***Bryozoa spp. indet***	0	P	54.55	P	P
Bryozoan sp.	***Vesicularia spinosa***	0	P	36.36	P	P
Bryozoan sp.	***Eucratea loricata***	0	P	9.09	P	P
Horn wrack	***Flustra foliacea***	0	P	54.55	P	P
Bryozoan sp.	***Securiflustra securifrons***	0	P	18.18	P	P
Bryozoan sp.	***Notoplites jeffreysii***	0	P	9.09	P	P
Bryozoan sp.	***Celleporina hassallii***	0	P	9.09	P	P
	Astrorhiza sp. Indet	0	P	9.09	P	P

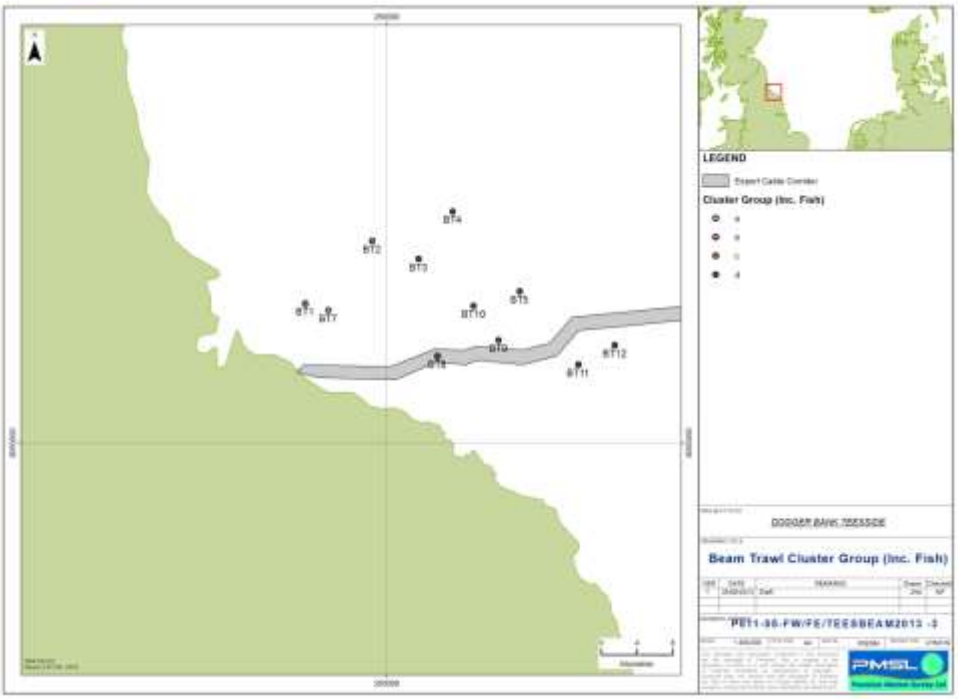

Figure 90. Cluster groups (Including fish)

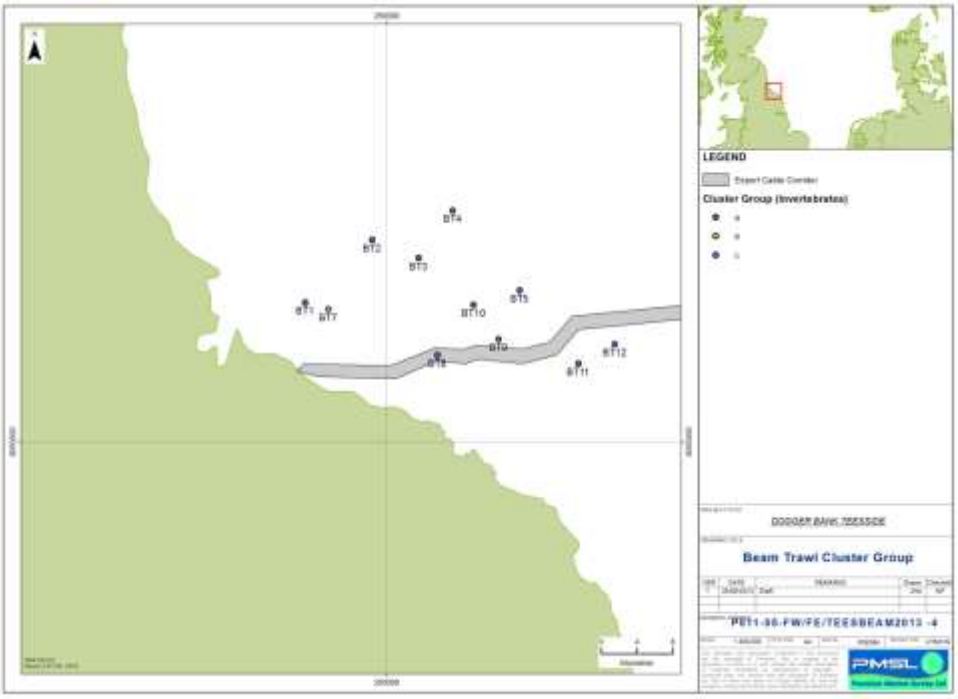

Figure 91. Cluster groups (Invertebrates only)

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