East Channel association

EASTERN ENGLISH CHANNEL MONITORING REPORT 2008

Section 5. Regional Fish Communities and Associated Epifauna Communities derived from 4m Beam Trawl Survey

Volume I (Report)

East Channel Association

Report No. 09/J1031333/0875

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EMU

The East Channel Association (ECA) consists of companies developing marine aggregate extraction applications in the Eastern English Channel. This Regional Environmental Monitoring Report has been produced to fulfil the ECA's commitment to undertake regional environmental monitoring as outlined in the ECA Regional Monitoring Blueprint v0.3 (ECA & Emu Ltd., 2005).

The Companies of the ECA

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1.0 INTRODUCTION

1.1 Study Background

The six companies of the East Channel Association (ECA) have all made applications for licences to extract marine aggregates (sand and gravel) from a region of the UK continental shelf known as the East Channel Region (ECR) (Chart 5.1).

During the application process for marine aggregate extraction and subsequent Regional Environmental Assessment (REA) the companies made a commitment to undertake assessment and monitoring of their activities using both licence specific and coordinated regional methods. As part of this approach the REA provided an assessment of the environmental conditions and sensitivities of the region and the likely cumulative and in-combination effects of extraction activities.

The recommendations of the REA included a requirement for the companies of the ECA to collaborate in undertaking a programme of regional monitoring. This monitoring programme was developed in consultation with the relevant regulatory bodies and technical specialists in order to provide data capable of identifying the impacts of extraction activities in the ECR.

The scope of monitoring was developed following extensive discussions with government scientific advisors and was progressively revised during development. The initial monitoring scope was presented in the ECA Regional Monitoring Blueprint v0.3 (ECA and Emu Ltd., 2005). The scope of analysis and reporting has been under continual review since the issue of the Blueprint v0.3 as issues have arisen during the monitoring activities.

1.2 Report Objectives

This report has been produced on behalf of the ECA by Emu Limited to describe the monitoring activities with respect to the regional fish communities and associated epifauna communities of the region for the year 2008. These data have been obtained through the employment of a 4m Beam Trawl. The report includes a description of the field methods used, the samples taken, analysis and interpretation of the data.

1.3 Survey Array for 2008

The 2008 survey array consisted of 48 4m beam trawl locations to provide data for commercially important species. The survey array was designed to demonstrate broad trends over the ECR with the potential to further develop hypotheses and thresholds with respect to the whole region and for individual licence blocks, where possible.

1.4 Reporting of Biological Monitoring

This report is one of seven documents covering the biological monitoring undertaken within 2008. The ECR biological monitoring report schedule is listed in Table 5.1.

Report Title	Report Number
1. Seabed Sediment Characteristics	09/J1031333/0871
2. Benthic Communities and Habitats from grabbing Surveys	09/J1031333/0872
3. Regional Habitats and Biotopes based on Static Image Analysis	09/J1031333/0873
4. Regional Epifaunal Communities Derived from 2m Beam Trawls	09/J1031333/0874
5. Regional Fish and Associated Epifaunal Communities derived from 4m Beam Trawls	09/J1031333/0875
6. Regional Shellfish Populations derived from Scallop Dredge Surveys and Beam Trawl Surveys	09/J1031333/0876
7. Example Habitat and Biotope Monitoring site Employing Hydrographic and Video Monitoring Methods	09/J1031333/0877
8. Comparative Analysis Including Theoretical Frameworks	09/J1031333/0878

Table 5. 1 ECR Biological Monitoring Report Schedule

2.0 METHODS

The 4m beam trawl survey array was designed to demonstrate broad trends over the regional area. The sampling sites were distributed over the whole region with the emphasis on a representative distribution with respect to the Primary Impact Zones (PIZ), Secondary Impact Zones (SIZ) and reference areas. The target species were the larger mobile epibenthic species, a selection of sessile epibenthic species and the demersal fish species.

2.1 Field Methods and Operations Summary

This section includes a summary of the survey operations and field methods employed during the 4m beam trawling survey carried out in September 2008 to achieve selected objectives of the ECA Regional Monitoring Blueprint v0.3: Section 4 (ECA and Emu Ltd., 2005).

Details of vessels, equipment and navigation are summarised in Table 5.2. Detailed descriptions of the methods employed in the field are documented in full within Sections 3 and 4, and Annex 3 of the ECA Regional Monitoring Blueprint v0.3 (ECA and Emu Ltd., 2005). Key points from these are summarised in sections 2.1.1 to 2.1.3 together with details of any deviations from those proposed within the Blueprint v0.3.

Vessel, Equipment and Navigation Information	
Vessel	*Sara Lena*
Survey Dates	5 days: 10/09/08 to 14/09/08 (Full details are located in Appendix A & B)
Navigation Equipment	Decca DGPS and fish plotter
Sampling Equipment	4m steel beam trawl with a stone chain mat and 40mm mesh codend (Plate 1 and 2).

Table 5. 2 Vessel, Equipment and Navigation Information

Plate 1

Mouth of 4m steel beam trawl showing shoes being deployed.

Plate 2

4m steel beam trawl showing stone chain mat being deployed.

2.1.1 Field Methods

A total of 48 4m beam trawl sites were completed within the Eastern English Channel in and around the licence areas (Chart 5.1). Details of sample positions are detailed in Appendix A. Daily logs of events were recorded and are detailed in Appendix B. Full details of methods can be found in the ECA Regional Monitoring Blueprint v0.3: Section 4 and Annex 3 (ECA and Emu Ltd., 2005).

The 4m beam trawl was constructed from heavy gauge steel with a underlying stone chain mat and a 40mm mesh cod end. All trawls where of at least 15 minutes duration (on bottom time), this period being from the time that the warp has ceased paying out to the time that hauling begins. The warp that was paid out was three times the water depth. All tow lengths were recorded (Appendix A).

2.1.2 Field Treatment of Beam Trawl Samples

Upon recovery, the beam trawl was emptied by releasing the cod end into fish crates. Samples were photographed prior to processing (Appendix C). Fauna were identified on site and abundance counts made, including weights of certain invertebrate species for calculation of abundance equivalents. Other species, including some of the colonial epifauna, were recorded as presence absence only. Fish species and commercially exploited shellfish were measured, with weighed and counted subsamples necessary for certain species to enable total populations to be estimated. Species that could not be identified in the field were retained, along with representative examples of other invertebrate fauna to confirm identity.

Beam trawl samples were fixed on site using 4% buffered saline formaldehyde solution. A full raw species list can be found detailed in Appendix D plus shellfish measurements (Appendix E), Aequipecten measurements (Appendix F), fish lengths (Appendix G) and trawl sample details (Appendix H).

2.1.3 Laboratory Processing of 4m Beam Trawl Samples

The laboratory analysis of the samples collected by 4m beam trawling was carried out by Emu. These samples were retained for confirmation of species identifications which could not be determined with confidence in the field. The laboratory identifications were subject to internal QC, with the final full species list for each of the 4m beam trawl site presented in Appendix D.

2.2 Data Analysis

Data sets from the 4m beam trawl surveys were investigated with the use of programmes from the Plymouth Routine In Multivariate Ecological Research (PRIMER) suite (Clarke & Warwick, 2001; Clarke & Gorley, 2006) using univariate and multivariate analyses. Additional analysis with respect to population structure of commercially important species was also investigated. The data from the commercially exploited shellfish species are considered in Section 6 of this report series.

2.2.1 Initial Data Treatment

An important consideration in the comparison of different datasets is that the 4m beam trawl samples using a 40mm cod end. In some cases this means individuals less than 40mm in size will remain unsampled, however individuals of the same species which are greater than 40mm will have been enumerated. This could cause potential differences in the data. Another important consideration is the way the gear is 'fishing'. It was noted from the 2008 surveys that samples were being retrieved were 'cleaner' than samples from previous years (i.e. no sediment was being caught). This has thought to have been attributed to new rollers and nets on the 4m beam trawls used.

The source data set of species abundance was subjected to reconciliation with the 2005, 2006 and 2007 data sets to identify any sources of potential difference that might cause inconsistency within the PRIMER analysis. This was undertaken by comparing data sets using Excel spreadsheets to identify simple errors, taxonomic inconsistency and separation of juveniles, etc.

The source data (prior to reconciliation) is presented in Appendix D with the weight converted and 1000m standardised species abundance tables presented in Appendix I, while the PRIMER ready data are included in Appendix J.

2.2.2 Multivariate Analysis

Two analyses were undertaken on the 4m beam trawl data using fish species only and fish combined with epifaunal invertebrates. An analysis on epifaunal invertebrates alone indicated an almost identical output to the combined fish and epifauna data.

Initial data transformation was applied using 4th Root (or Root-Root) conversion. This transformation serves to down-weight the dominant species, taking a much greater account of the less abundant species, and allowing the underlying community structure to be assessed.

Details of each of the multivariate routines (e.g. Bray Curtis % similarity used in faunal data clustering) and univariate measures that have been applied are summarised in Report Section 2, Table 2.3 and 2.4.

3.0 RESULTS

3.1 Principal Observations Fish Species Data

The data were divided into two data sets and subjected to univariate and multivariate analysis. The first analysis was restricted to the fish species, while the second analysis considers fish species in combination with the epibenthic invertebrates.

3.1.1 Community Structure Measures.

The total number of species identified was 29, with the mean number of species per site at just over 8 and the mean number of individuals at just over 30 (Table 5.3). The variability of most data was relatively low suggesting uniform community structure, although abundance differences, in a limited number of species, have affected the variability of the diversity indices overall.

	S	N	d	J'	H'	L
2008 Mean	8.13	30.90	2.30	0.79	1.63	0.77
2008 Standard deviation	1.71	37.72	0.56	0.15	0.35	0.15

Table 5. 3 **Community structure measures (fish species) 2008** (NOTE: S = no. species; N = no. individuals; d = Margalef's species richness; J = Pielou's eveness; H = Shannon's diversity index; L = Simpsons 1-λ')

The 20 most frequently occurring species are recorded in Table 5.4, with the most frequently recorded species being the red gurnard *Aspitrigula* cuculus and the dragonet *Callionymus lyra.*

Species	Common Name	Percentage Frequency
Aspitrigla cuculus	Red gurnard	100
Callionymus lyra	Dragonet	94
Microchirus variegatus	Thick back sole	73
Scyliorhinus canicula	Lesser spotted dogfish	67
Agonus cataphractus	Pogge	56
Microstomus kitt	Lemon Sole	56
Gobiidae	Gobie	50
Trigloporus lastoviza	Streaked gurnard	44
Trisopterus minutus	Poor cod	31
Pleuronectes platessa	Plaice	23
Solea solea	Dover Sole	23
Blennius ocellaris	Blennie	21
Phrynorhombus regius	Eckstroms topknot	15
Trigla lucerna	Tub gurnard	15
Trisopterus luscus	Bib	15
Raja clavata	Thronback ray	13
Solea lascaris	Sand sole	10
Lophius piscatorius	Angler fish	8
Scophthalmus rhombus	Brill	8
Hyperoplus lanceolatus	Sandeel	6

Table 5. 4 **Summary of the most frequently occurring fish species, 2008**

The most abundant species overall (top 20) are listed in Table 5.5 along with the maximum density values for each species (expressed as numbers per 1000m tow). High mean abundances were

noted for poor cod (*Trisopterus minutus*) and bib (*Trisopterus luscus*), although this was on the basis that very high abundances of these species were found at only a few sites. The red gurnard (*Aspitrigula cuculus*) and the dragonet (*Callionymus lyra*) in contrast, were more evenly distributed throughout the region at generally raised abundances.

The distribution of several of these species is presented in Chart 5.3 to Chart 5.10

Species	Common Name	Mean abundance	Maximum abundance
Trisopterus minutus	Poor cod	6.0	149
Aspitrigla cuculus	Red gurnard	5.9	14
Trisopterus luscus	Bib	5.5	215
Callionymus lyra	Dragonet	3.9	13
Microchirus variegatus	Thick back sole	2.0	6
Gobiidae	Gobie	1.7	9
Scyliorhinus canicula	Lesser spotted dogfish	1.5	7
Trigloporus lastoviza	Streaked gurnard	1.1	11
Agonus cataphractus	Pogge	0.8	5
Microstomus kitt	Lemon sole	0.7	3
Pleuronectes platessa	Plaice	0.3	3
Solea solea	Dover sole	0.3	4
Raja clavata	Thornback ray	0.2	4
Blennius ocellaris	Blennie	0.2	2
Phrynorhombus regius	Eckstroms topknot	0.2	1
Solea lascaris	Sand sole	0.1	2
Trigla lucerna	Tub gurnard	0.1	1
Scophthalmus rhombus	Brill	0.1	1
Echiichthys vipera	Lesser weever	0.1	3
Lophius piscatorius	Angler	0.1	1

Table 5. 5 Summary of the mean and maximum abundance values of the top 20 abundant species (corrected to 1000m tows), 2008

3.1.2 Distributional Data

The distribution of the number of fish species at each site is given in Chart 5.2. The number of species at each site varied from 5 species to 11 species. Although Chart 5.2 suggests that some aggregation of sites exist, with low or high numbers of species together, no overall trend can be clearly observed.

Chart 5.3 to Chart 5.10 present the distribution of the abundance of selected demersal fish species collected in the 4m beam trawls across the ECR study area. Abundance data were standardised to a single catch per unit effort (CPUE) index reflecting number of each fish species per 1000m tow.

Aspitrigula cuculus (red gurnard; Chart 5.3) occurred commonly throughout the survey region and was recorded at every site sampled (100% frequency occurrence). Densities of this gurnard species were relatively uniform throughout the ECR, including the reference areas, with a peak abundance occurring at site 27 south east of Area 473 west. Generally lower abundances were observed to the central eastern part of the array.

Callionymus lyra (dragonet; Chart 5.4) was similarly well distributed throughout the region and was recorded at 94% of the sites. However, the 3 sites for which no species of dragonet were recorded appear to aggregate along with the sites which also have a low abundance of this species. This can be observed from Chart 5.4 and to the east of Area 477 south along a north-south axis.

Raja clavata (thornback ray; Chart 5.5) was only recorded at 13% of the sites and abundances in all cases were relatively low, with a peak abundance of 4 individuals at site 27. It would appear that they were generally located across the north of the array, but no clear distributional pattern can be observed.

Pleuronectes platessa (plaice; Chart 5.6) was encountered at 23% of the sites with a low mean abundance of 0.3; however some distributional pattern can be inferred. This species tended to be caught towards the north and east of the ECR and was absent from catches from the central, southern and western portions of the study area.

Solea solea (dover sole; Chart 5.7) as with plaice was encountered at 23% of the sites with a low mean abundance of 0.3 and a peak abundance of 4 individuals at site 28 located south east of the array. All individuals recorded were in the eastern locality of the array.

Trisopterus minutus (poor cod; Chart 5.8) was relatively restricted in terms of its spatial distribution occurring at 31% of the sites, generally within the central area of the region along a north south axis. Genrally, low densities and absences were noted to the east and west of the array.

Trisopterus luscus (bib; Chart 5.9) had the highest maximum abundance and a relatively high mean abundance, however a low frequency of occurrence. This is due to a high number (215) of individuals occurring at site 5. In general, the spatial distribution of this species is restricted with notable absences across the majority of the array.

Scyliorhinus canicula (lesser spotted dogfish; Chart 5.10) occurred frequently throughout the region and was recorded at 67% of the sites. Abundances of this species ranged between 1 and 7 individuals with a mean abundance of 1.5. No clear spatial distribution pattern could be observed although it is noteworthy, that this species was largely absent from the eastern region of the array.

3.1.3 Population Structure

The population structure of the commercially important species and several other species of ecological importance are illustrated in Figures 5.1 to 5.10. Any reference made to known maximum length of species has been acquired from www.fishbase.org (version 02/2008).

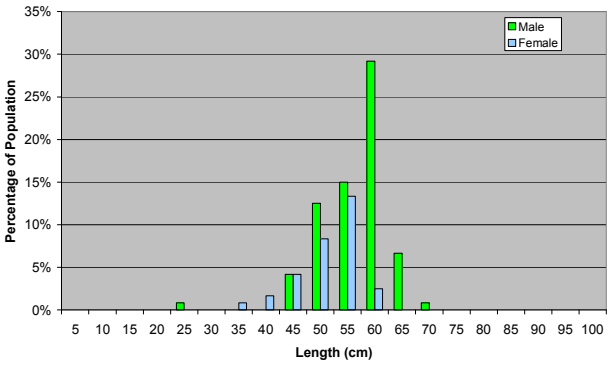

Figure 5. 1 *S.canicula* population structure

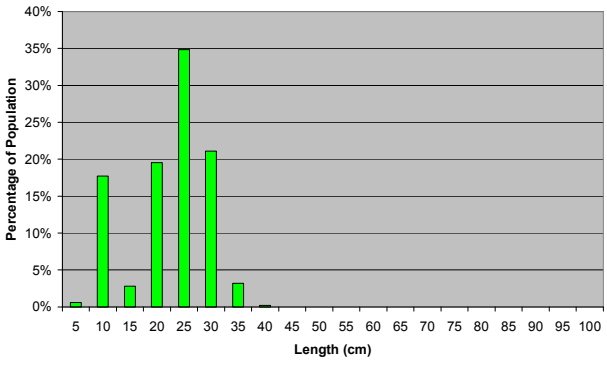

Figure 5. 2 *A.cuculus* population structure

The population structure of the *Scyliorhinus canicula* (Figure 5.1) shows one size class for females of the species and two possible size classes for the males. The larger male size class indicates a modal value of 60cm, with the female size class having a slightly lower modal value of 55cm. Although peak values are known in the order of 100cm, the size of the individuals recorded for both sexes represents a mature adult population. The male individual recorded at 25cm, could possibly represent a juvenile size class, but with only one individual recorded, this cannot be considered conclusive.

The species *Aspitrigla cuculus* (Figure 5.2) was recorded in two size classes. The first, representing juveniles and the remainder comprising an adult population with a modal value of

25cm and maximum length in the size class of 40cm. Maximum length for a mature adult of this species has been recorded as 50cm.

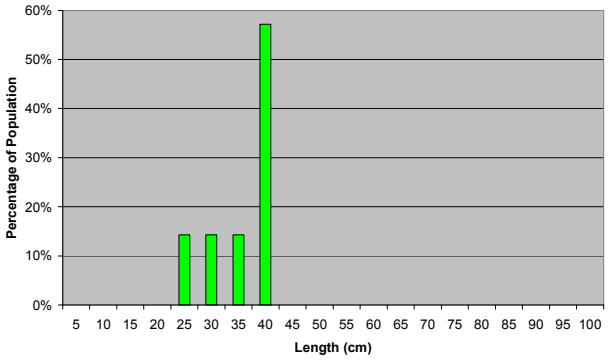

Figure 5. 3 *T.lucerna* population structure

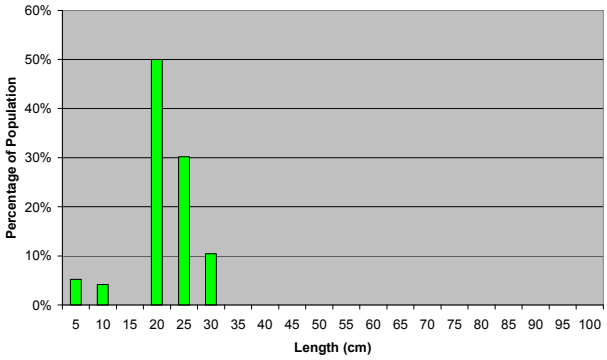

Figure 5. 4 *T.lastoviza* population structure

Two other species of gurnard were recorded in abundance including *Trigla lucerna* and *Trigloporus lastoviza.* The larger of the two species *Trigla lucerna* (tub gurnard; Figure 5.3) has a modal value of 40cm which is also the maximum length of the species recorded during this study, although records show that the maximum length of this species is 75cm. No true size classes can be inferred from the data presented. The data presented for *Trigloporus lastoviza* (streaked gurnard; Figure 5.4) indicates a similar population structure to that of the red gurnard, *Aspitrigla cuculus* with one population centered around 25cm length (maximum adult length recorded at 40cm) and another smaller, potentially juvenile size class.

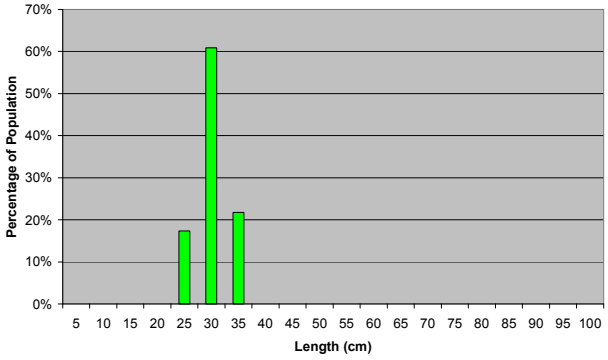

Figure 5. 5 *S.solea* population structure

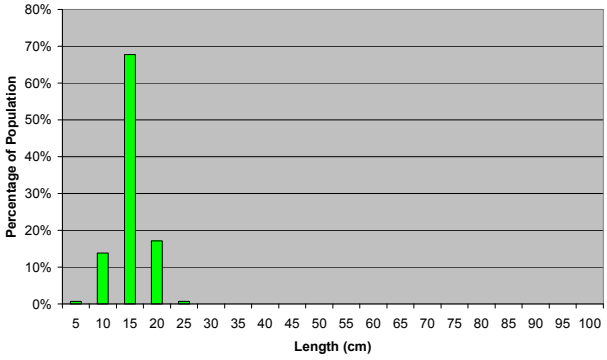

Figure 5. 6 *M.variegatus* population structure

Solea solea (dover sole; Figure 5.5) is the larger of the two sole species presented here and illustrates a relatively restricted population structure, with a modal size of 30cm. *Microchirus variegatus* (thickback sole; Figure 5.6) displays a less restricted population structure with a lower modal value of 15cm.

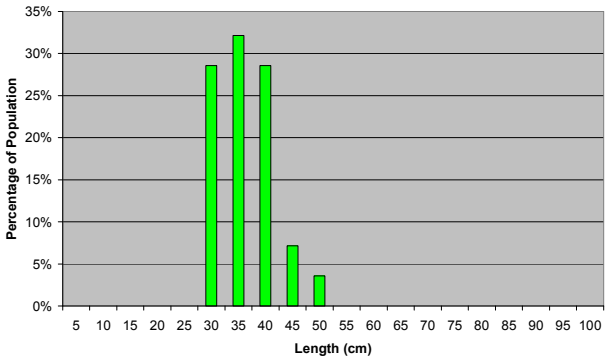

Figure 5. 7 *P.platessa* population structure

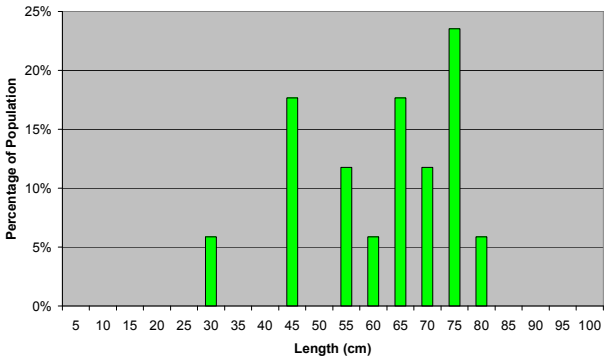

Figure 5. 8 *R.clavata* population structure

The population structure of *Pleuronectes platessa* (plaice; Figure 5.7) shows a population structure skewed to the left with a modal value of 35cm, which probably represents an adult population. *Raja clavata* (thornback ray; Figure 5.8) shows a varied population structure with potentially 3 size classes. The modal value of 75cm appears to represent a mature adult size class, while there appears to be another possible size class around 45cm. The individual at 30cm could represent part of the juvenile population.

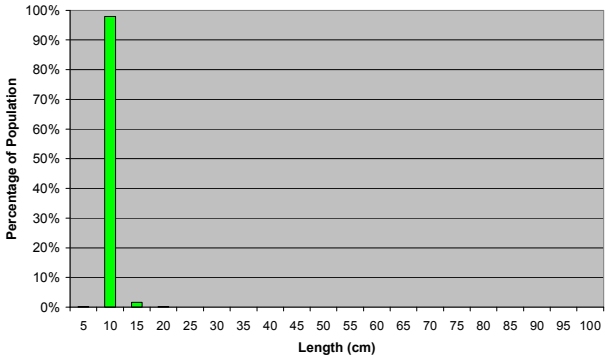

Figure 5. 9 *T.minutus* population structure

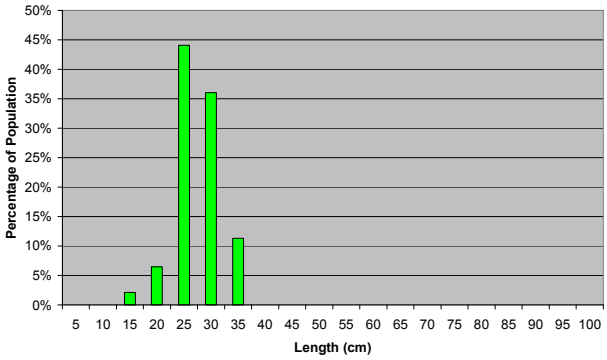

Figure 5. 10 *T.luscus* population structure

The two gadoid species found abundant in the ECR *Trisopterus minutus* (poor cod; Figure 5.9) and *Trisopterus luscus* (bib, Figure 5.10) demonstrate well defined population structures with modal values of 10cm and 25 cm respectively.

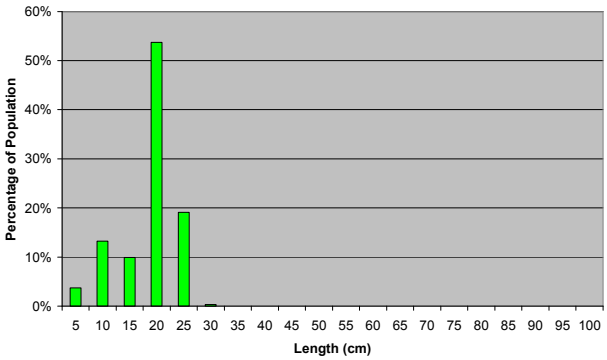

Figure 5. 11 *C.lyra* population structure

Callionymus lyra (dragonet; Figure 5.11) is the most widely distributed and most frequently occurring non-commercial species in the ECR.

The data presented illustrates a clear modal value at 20cm length, with a maximum length recorded within the 30cm size class. 30cm is the maximum length recorded for a mature male of this species.

3.1.4 Multivariate Analysis

Multivariate analysis was carried out on the trawl samples data set to determine which groups of fish communities were present within the study area surveyed in 2008. The results of the similarity matrix, following a 4^{th} root transformation are graphically represented in a dendrogram (Figure 5.12) and a multidimensional scaling plot (MDS) is presented in Figure 5.13, which confirms the division of the clusters.

Using Figures 5.12 and 5.13, two main groups of sampling sites were identified. These groups of samples were subsequently analysed using the Similarity Percentage Analysis (SIMPER), in order to determine which species were characteristic of the groups of the samples. Table 5.6 shows the dominant species within each group. The average abundance of these species is also provided.

The community structure measures were calculated employing the PRIMER DIVERSE routine and the results are also presented in Table 5.6, including number of species, number of individuals, species richness, diversity and evenness

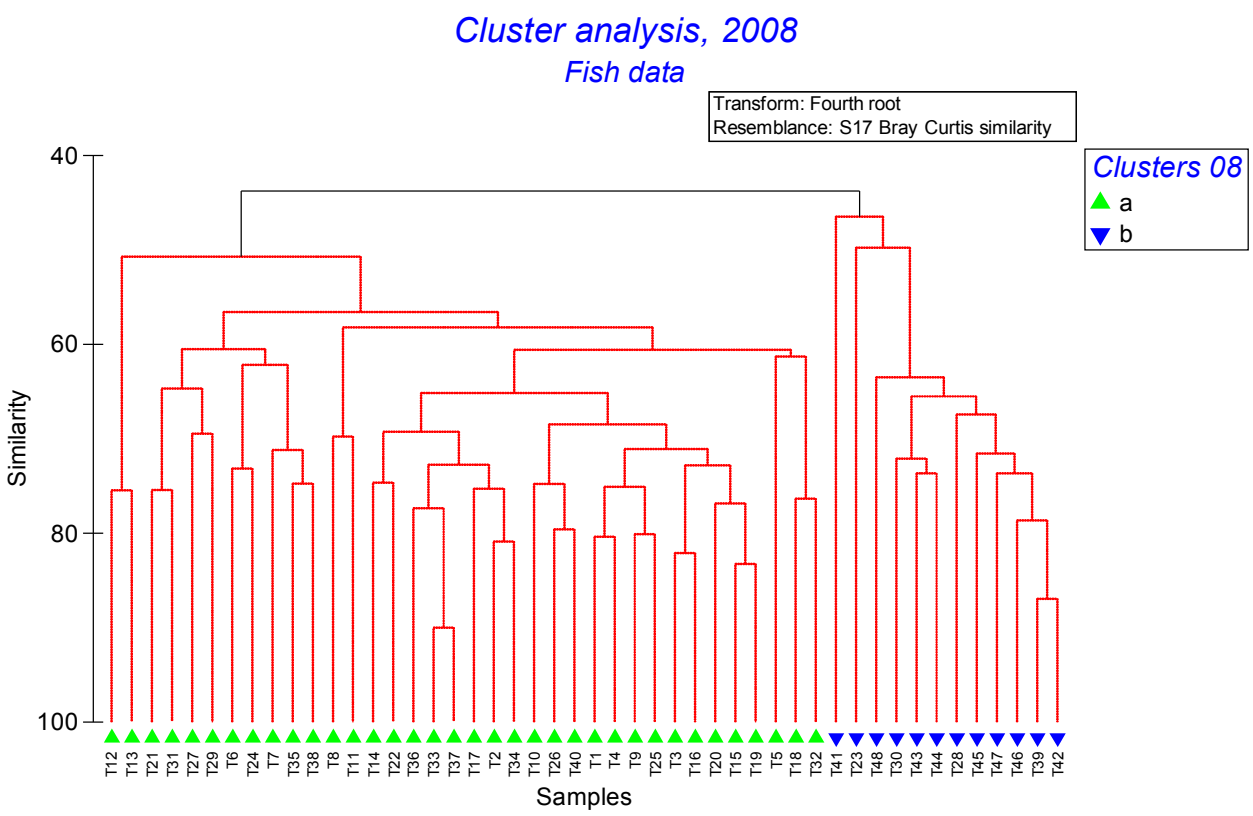

Figure 5. 12 Dendrogram of Bray-Curtis Similarity index of Fish Communities derived from 4m Beam Trawl Samples, 2008.

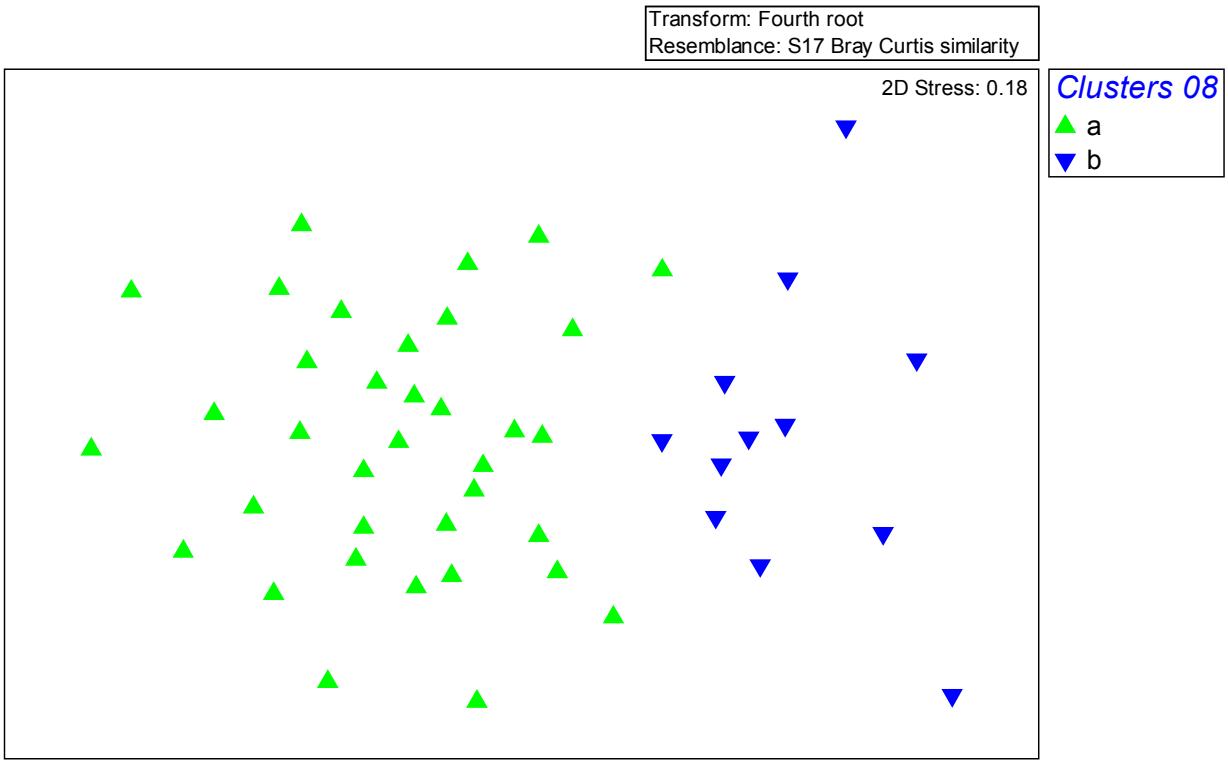

Figure 5. 13 Multi-Dimensional Scaling (MDS) Ordination plot of Fish Communities derived from 4m Beam Trawl Samples, 2008

Clusters				
	Cluster A (36 sites) Average similarity:	44%	**Cluster B** (12 sites) Average similarity:	54%
	Species	**Mean**	**Species**	**Mean**
	Trisopterus minutus	8.02	*Microchirus variegatus*	3.38
	Trisopterus luscus	7.3	*Pleuronectes platessa*	1.26
	Aspitrigla cuculus	6.62	*Microstomus kitt*	1.07
	Gobiidae	2.2	*Solea solea*	1.02
	Scyliorhinus canicula	1.9	*Solea lascaris*	0.52
	Trigloporus lastoviza	1.51	*Echiichthys vipera*	<1
	Agonus cataphractus	<1	*Hyperoplus lanceolatus*	<1
	Phrynorhombus regius	<1	*Trigla lucerna*	<1
	Blennius ocellaris	<1		
	Raja clavata	<1		
Community Structure Measures				
	Mean	**sd**	**Mean**	**sd**
S	8.3	1.60	7.6	1.98
N	35.9	42.41	15.8	5.10
d	2.3	0.50	2.4	0.74
J'	0.8	0.17	0.9	0.04
H'	1.6	0.37	1.7	0.24

Table 5. 6 **Fish Clusters derived from all sites, 2008. As only two clusters are present all species listed within a group are characteristic.** Species included contribute >70% to cumulative separation of clusters and greater than >2% individual contribution to cluster similarity.

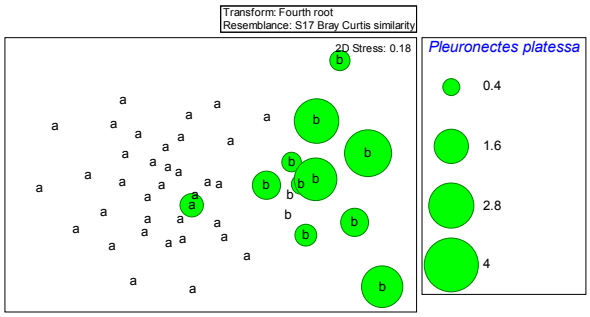

Figure 5. 14 MDS with *P.platessa* abundance

Cluster B comprised of only 12 of the 48 samples. The cluster derived from multivariate analysis highlighted that the group supported several flat fish species (plaice, sand sole and dover sole) and other species typical of sandier sediments (lesser weever and sandeel). However, no single species occurred at every site within Cluster B. Figures 5.14 to 5.18 illustrate the species causing the separation between Clusters A and B

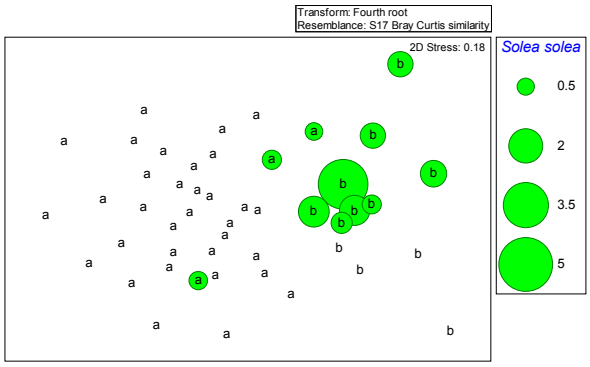

Figure 5. 15 MDS with *S.solea* abundance

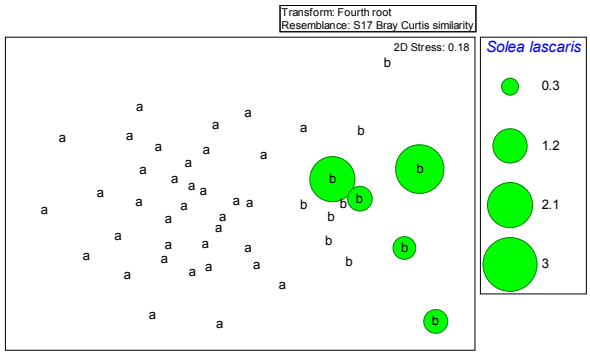

Figure 5. 16 MDS with *S.lascaris* abundance

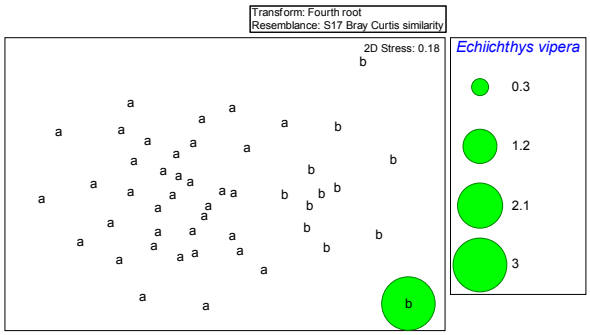

Figure 5. 17 MDS with *E.vipera* abundance

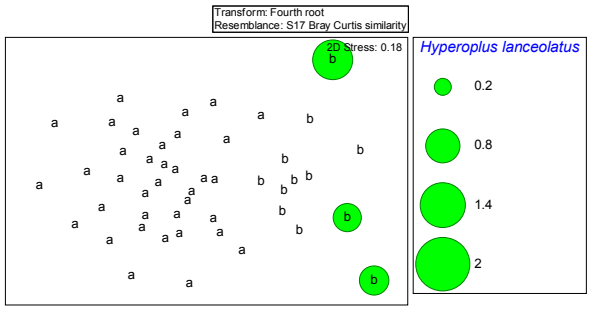

Figure 5. 18 MDS with *H.lanceolatus* abundance

Cluster A comprised the majority of the trawl samples (36 sites) and was characterised by a slightly higher mean number of species and a notably higher number of individuals.

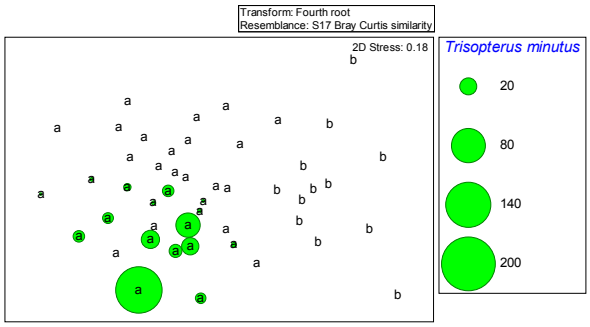

Figure 5. 19 MDS with *T.minutus* abundance

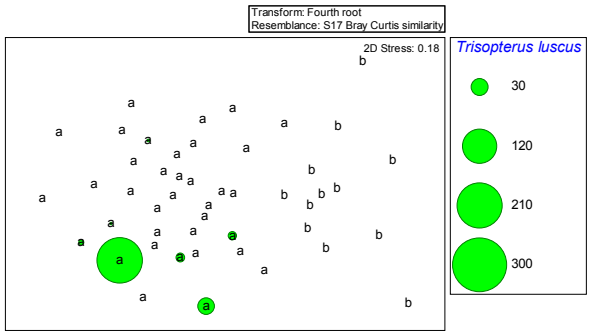

Figure 5. 20 MDS with *T.luscus* abundance

Although the *Trisopterus* species (poor cod and bib), had the highest recorded mean abundance within **Cluster A**, this was due to high abundances of these particular species recorded at a limited number of sites; these species were not well distributed throughout the cluster.

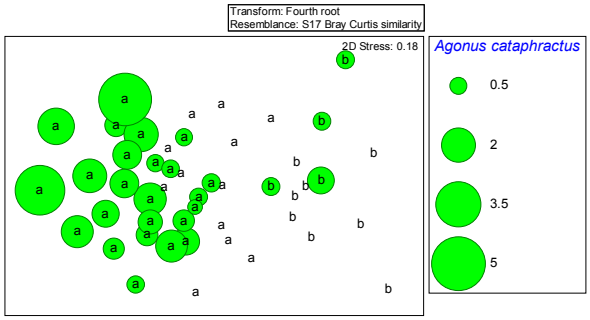

Figure 5. 21 MDS with *A.cataphractus* abundance

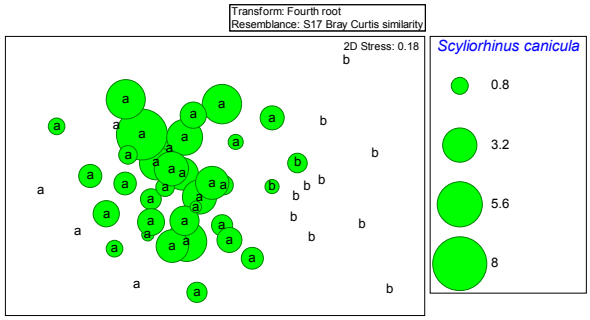

Figure 5. 22 MDS with *S.canicula* abundance

Cluster A appears to be characterised by several species which appear to be well distributed throughout the cluster.

These include the pogge (*Agonus cataphractus*), lesser spotted dogfish (*Scyliorhinus canicula*), streaked gurnard (*Trigloporus lastoviza*) and species of gobiidae.

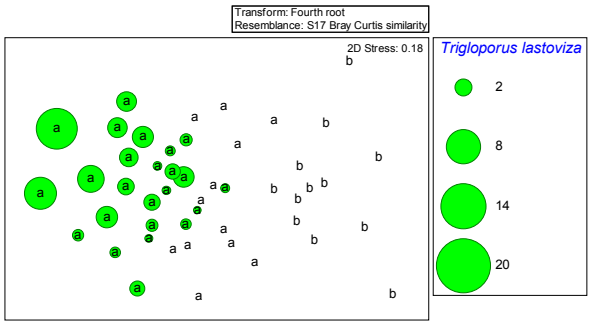

Figure 5. 23 MDS with *T.lastoviza* abundance

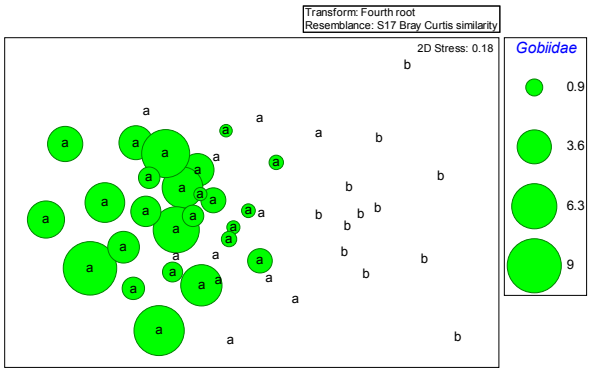

Figure 5. 24 MDS with Gobiidae abundance

3.1.5 Cluster Distribution

The regional distribution of the clusters as defined by multivariate analysis, are illustrated in Chart 5.11. The physical conditions prevailing across the region have previously been described in Sections 1 and 2 of this report series and the current analysis indicates that the **Clusters A** and **B** defined by characteristic demersal fish species are related to the general physical conditions of the seabed.

Cluster B comprised flat fish species and species characteristically found in sandier sediments to the east of the region. Further to the north, the sediment becomes more mobile and in this area the fish species are characteristic of highly mobile sediments, with the lesser weever, *Echiichthys vipera* and the greater sandeel, *Hyperoplus lanceolatus* particularly indicative of these conditions.

Cluster A in contrast tended to be found in more stable seabed conditions extending across the majority of the area. A potential sub-grouping may exist in relation to areas with high near seabed current conditions over more stable substrata, typified by the presence of the *Trisopterus* species.

3.2 Principal Observations Combined Invertebrate and Fish Species

A total of 127 taxa were identified from the 4m beam trawl survey (see Appendix D). The invertebrate fauna were drawn from a range of taxonomic groups, including the echinodermata (12), mollusa (18), crustacean (24), cnidaria (18) and ascidiacea (14). The fish species were well represented with 29 species.

3.2.1 Community Structure Measures

	S	N	d	J'	H'	L
2008 Mean	27.2	669	4.27	0.415	1.36	0.574
2008 Standard deviation	6.6	605	1.11	0.122	0.40	0.146

Table 5. 7 Community structure measures (all species) 2008 (NOTE: S = no. species; N = no. individuals; d = Margalef's species richness; J = Pielou's eveness; H = Shannon's diversity index; L = Simpsons 1-λ')

The main characteristic of the data as with previous years, is the high variability of the abundance (Table 5.7). This is also reflected in some of the other community structure measures, particularly evenness, which is relatively low, suggesting concentrations of high abundance individuals at some sites.

The distribution of species numbers is illustrated in Chart 5.12, indicating a central western area with high species numbers which extends from Area 461 to Area 473 west. In general, the sites to the west also support raised numbers of species in comparison to those in the east of the region, with the sites at the far east of the array hosting the lowest number of species. The reference areas overall supported lower species numbers than the impact sites.

A total of 127 species were sampled at the 48 sites. The most frequently occurring species are listed in Table 5.8. These species comprised substantially of the red gurnard (*Aspitrigula cuculus*), the echinoderms *Asterias rubens* and *Psammechinus milliaris* and the molluscs *Aequipecten opercularis* and *Sepia officianlis*. Numerous fish species were present as indicated in the previous section, although the abundances of these fish species were generally lower than the most numerous of the epifauna.

Species	Common Name	Percentage Frequency
Aspitrigla cuculus	Red gurnard	100
Asterias rubens	Common starfish	100
Aequipecten opercularis	Queen scallop	96
Psammechinus miliaris	Common urchin	96
Sepia officinalis	Cuttlefish	96
Callionymus lyra	Dragonet	94
Inachus dorsettensis		94
Macropodia tenuirostris		92
Anseropoda placenta	Goosefoot starfish	88
Microchirus variegatus	Thickback sole	73
Hydrallmania falcata		69
Scyliorhinus canicula	Lesser spotted dogfish	67
Abietinaria abietina		58
Agonus cataphractus	Pogge	56
Microstomus kitt	Lemon sole	56

Table 5. 8 Summary of the most frequently occurring species, 2008

The most abundant species overall and their maximum abundance in the region are summarised in Table 5.9. It is evident from the data that several species occurred at very high mean abundances including *Aequipecten opercularis* and *Asterias rubens,* which also occurred at very high maximum abundances. Several other species occurred at relatively low mean abundances compared to their maximum mean abundance, such as *Ophiothrix fragilis, Trispoterus minutus* and *Trisopterus luscus,* indicating that high concentrations of individual species exist, as indicated by the diversity indices in Table 5.7.

Species	Mean abundance	Maximum abundance
Aequipecten opercularis	393	3211
Asterias rubens	145	381
Alcyonium digitatum	28	320
Psammechinus miliaris	23	205
Ophiothrix fragilis	14	319
Inachus dorsettensis	7	42
Trisopterus minutus	6	149
Aspitrigla cuculus	6	14
Macropodia tenuirostris	6	40
Trisopterus luscus	5	215
Anseropoda placenta	5	35
Callionymus lyra	4	13
Alcyonidium spp.	3	100
Sepia officinalis	2	6
Microchirus variegatus	2	6

Table 5. 9 Summary of the mean and maximum abundance values of the top 15 abundant species (corrected to 1000m tows), 2008

3.2.2 Distributional Data

Chart 5.13 to Chart 5.17 present the distribution of the abundance of several of the most frequently occurring and numerous species collected in the 4m beam trawls across the ECR study area. Abundance data were standardised reflecting number of each species per 1000m tow.

Psammechinus milliaris (Chart 5.13) population demonstrates a clear gradient across the ECR with the lowest numbest to the northwest of the survey array and the highest numbers to the east and south east. Notably, no individuals of this species were recorded at site 32 (Area 473 east) and site 13 (Area 478).

Aequipecten opercularis (Chart 5.14) is recorded in very low numbers and even absent at some sites to the northeast of the ECR. However aggregations of high abundances were recorded across the rest of the remaining region, with a peak abundance recorded at site 7.

Alcyonium digitatum (Chart 5.15) appears to demonstrate a patchy distribution across the ECR with high abundances located in the central north and central south, with a discrete distribution within and south of West Bassurelle.

Ophiothrix fragilis (Chart 5.16) demonstrates a clear distribution with *Ophiothrix* occurring just to the west of the centre of the region along a north-south axis, with the highest abundance being recorded at site 11 (Area 461) and site 22 (north east of Area 473 west). Large areas where no *Ophiothrix* were noted are found to the east and the extreme west of the region.

***Pagurus bernhardus* and *Pagurus prideaux* combined** (Chart 5.17) no clear distribution pattern can be observed; however there appears to be an aggregation of sites hosting Paguridae to the east and west of the region, avoiding central areas.

3.2.3 Multivariate Analysis

Multivariate analysis was carried out on the trawl samples data set to determine which groups of communities were present within the study area surveyed in 2008. The results of the similarity matrix, following a 4th root transformation are graphically represented in a dendrogram (Figure 5.25) and a multidimensional scaling plot (MDS) is presented in Figure 5.26, which confirms the division of the clusters.

Using Figures 5.25 and 5.26, four main groups of sampling sites were identified with a further 3 sites (6, 7 and 11) occurring as outliers. Within **Cluster D**, further clusters could be defined (Figure 5.27; to be discussed later). The main groups of samples were analysed using the Similarity Percentage Analysis (SIMPER), in order to determine which species were characteristic of the groups of samples. Table 5.10 shows the dominant species within each group, with the characterising species highlighted, (based on those species that contribute >70%, on a cumulative basis, to the cluster similarity). The average abundance of these species is also provided.

The community structure measures were calculated employing the PRIMER DIVERSE routine and the results are also presented in Table 5.10, including number of species, number of individuals, species richness, diversity and evenness

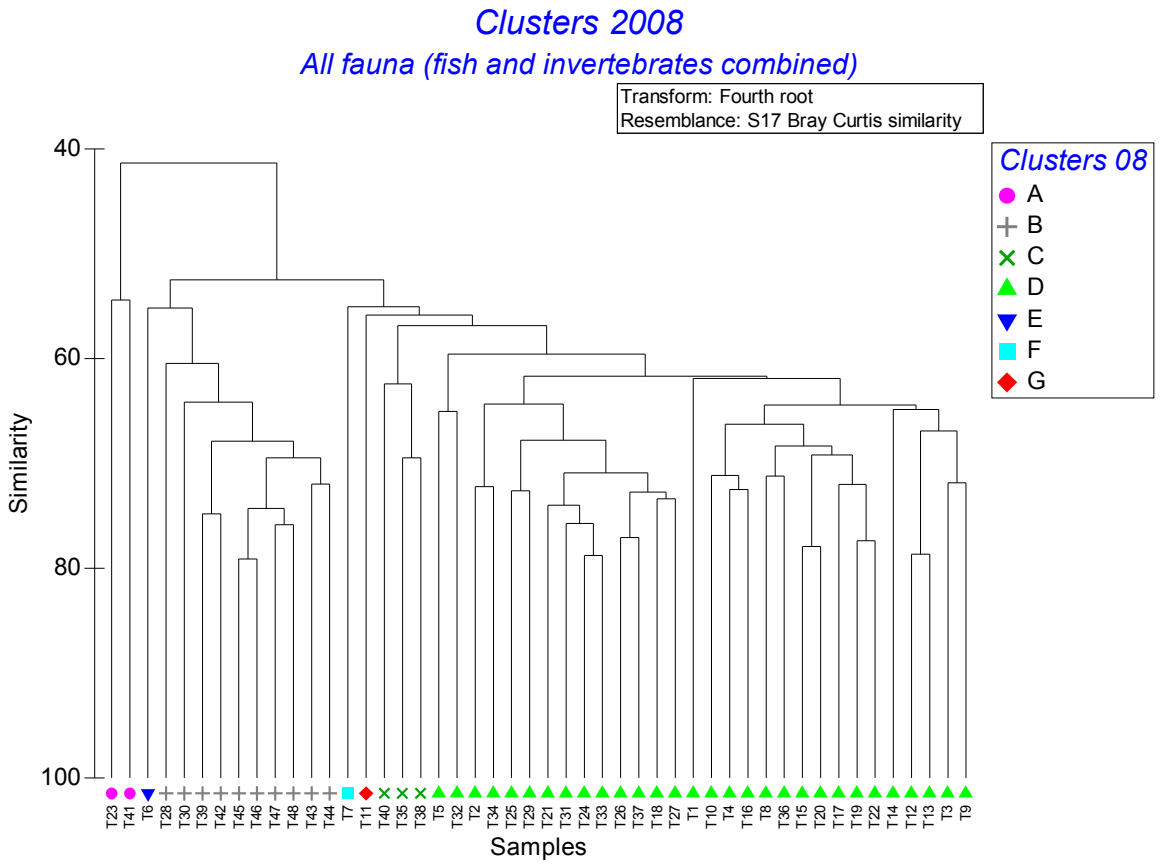

Figure 5. 25 Dendrogram of Bray-Curtis Similarity index of Faunal Communities with the 4 main faunal clusters derived from 4m Beam Trawl Samples, 2008.

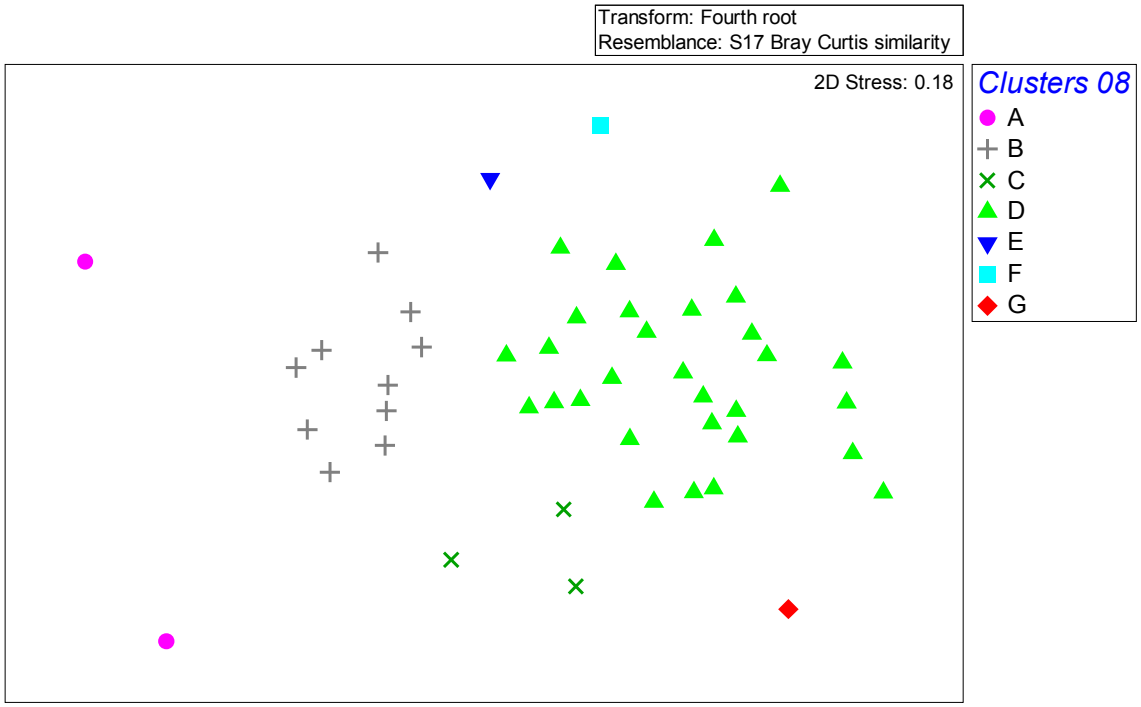

Figure 5. 26 **Multi-Dimensional Scaling (MDS) Ordination plot of Faunal Communities derived from 4m Beam Trawl Samples, 2008**

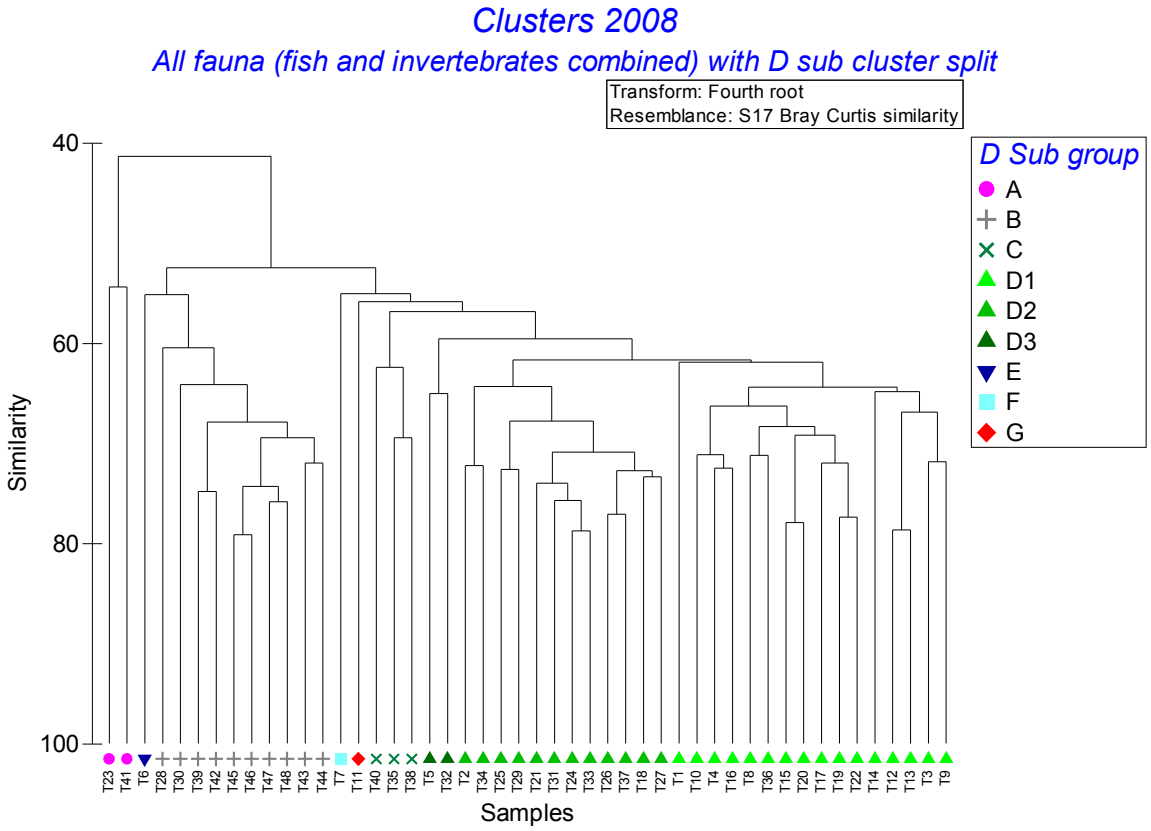

Figure 5. 27 **Dendrogram of Bray-Curtis Similarity index of Faunal Communities showing the 'D sub group split' derived from 4m Beam Trawl Samples, 2008.**

Clusters

Cluster A (2 sites)		Cluster B (10 sites)		Cluster C (3 sites)		Cluster D (30 sites)		Cluster E (1 sites)		Cluster F (1 sites)		Cluster G (1 sites)	
Average similarity:	54%	Average similarity:	67%	Average similarity:	65%	Average similarity:	64%	Average similarity:		Average similarity:		Average similarity:	
Species	**Mean**	**Species**	**Mean**	**Species**	**Mean**	**Species**	**Mean**	**Species**	**Mean**	**Species**	**Mean**	**Species**	**Mean**
Asterias rubens	69.35	Asterias rubens	114.29	Alcyonium digitatum	193.33	Aequipecten opercularis	497.2	Aequipecten opercularis	97	Aequipecten opercularis	3211	Alcyonium digitatum	320
Alcyonidium spp.	51.58	Psammechinus miliaris	44.77	Asterias rubens	141.48	Asterias rubens	161.34	Asterias rubens	24	Asterias rubens	343	Ophiothrix fragilis	319
Aequipecten opercularis	7.33	Aequipecten opercularis	41.73	Psammechinus miliaris	28.73	Psammechinus miliaris	17.79	Aspitrigla cuculus	11	Psammechinus miliaris	14	Asterias rubens	40
Aspitrigla cuculus	4.24	Macropodia tenuirostris	5.61	Anseropoda placenta	9.69	Ophiothrix fragilis	11.13	Pagurus bernhardus	5	Callionymus lyra	10	Aequipecten opercularis	30
Psammechinus miliaris	1.75	Pagurus prideaux	4.94	Callionymus lyra	6.5	Inachus dorsettensis	9.54	Inachus dorsettensis	4	Aspitrigla cuculus	7	Trisopterus minutus	9
Pleuronectes platessa	1.46	Adamsia carciniopados	4.87	Aspitrigla cuculus	5.71	Trisopterus minutus	9	Alcyonidium spp.	3	Trisopterus luscus	7	Gobiidae	9
Callionymus lyra	1.44	Microchirus variegatus	4.05	Macropodia tenuirostris	4.72	Trisopterus luscus	7.49	Psammechinus miliaris	3	Microchirus variegatus	2	Inachus dorsettensis	4
Sepia officinalis	1.14	Aspitrigla cuculus	3.67	Inachus dorsettensis	4.01	Aspitrigla cuculus	6.67	Sepia officinalis	3	Sepia officinalis	2	Aspitrigla cuculus	3
Adamsia carciniopados	0.87	Callionymus lyra	3.59	Ascidia virginea	3.65	Macropodia tenuirostris	6.66	Adamsia carciniopados	2	Gobiidae	2	Psammechinus miliaris	3
Pagurus prideaux	0.87	Sepia officinalis	3.17	Trisopterus minutus	3.14	Anseropoda placenta	6.38	Anseropoda placenta	2	Pagurus bernhardus	2	Trisopterus luscus	3
Hyperoplus lanceolatus	0.85	Alcyonidium spp.	3.01	Scyliorhinus canicula	2.01	Alcyonium digitatum	4.83	Pagurus prideaux	2	Ascidia virginea	2	Liocarcinus sp	2
Nemertesia spp.	0.57	Anseropoda placenta	1.94	Microchirus variegatus	1.48	Callionymus lyra	3.97	Ascidia virginea	1	Scyliorhinus canicula	1	Macropodia tenuirostris	2
Trigla lucerna	0.57	Inachus dorsettensis	1.55	Microstomus kitt	1.48	Ascidia virginea	2.29	Crossaster papposus	1	Inachus dorsettensis	1	Sepia officinalis	2
		Alcyonium digitatum	1.25	Sepia officinalis	0.92	Gobiidae	2.27	Microstomus kitt	1	Microstomus kitt	1	Anseropoda placenta	2
		Microstomus kitt	1.23	Hermonia hystrix	0.73	Scyliorhinus canicula	1.99	Raja clavata	1	Aphrodita aculeata	1	Crossaster papposus	2
		Pleuronectes platessa	1.21	Abietinaria abietina	0.55	Crossaster papposus	1.97	Scyliorhinus canicula	1	Abietinaria abietina	1	Agonus cataphractus	2
		Solea solea	1.11	Hydrallmania falcata	0.55	Sepia officinalis	1.95	Aphrodita aculeata	1	Buccinum undatum	1	Ascidia virginea	1
		Ciona intestinalis	0.93	Pleurobranchus membranaceus	0.54	Trigloporus lastoviza	1.73	Ascidia mentula	1	Trigla lucerna	1	Hexacorallia	1
		Liocarcinus sp	0.66	Phrynorhombus regius	0.37	Microchirus variegatus	1.57	Balanus crenatus	1			Phrynorhombus regius	1
		Hydrallmania falcata	0.61	Pagurus prideaux	0.36	Hermonia hystrix	1.47	Callionymus lyra	1			Myxillidae	1
		Ophiura albida	0.58	Pecten maximus	0.36	Agonus cataphractus	1.05	Eledone cirrhosa	1			Nemertesia spp.	1
		Solea lascaris	0.57			Liocarcinus sp	0.79	Heteranomia squamula	1			Trigloporus lastoviza	1
		Abietinaria abietina	0.5			Galathea intermedia	0.75	Hydrallmania falcata	1			Tritonia hombergii	1
		Pagurus bernhardus	0.33			Ciona intestinalis	0.65	Liocarcinus sp	1				
						Microstomus kitt	0.56	Macropodia tenuirostris	1				
						Hydrallmania falcata	0.55	Microchirus variegatus	1				
						Abietinaria abietina	0.46	Modiolarca tumida	1				
						Alcyonidium spp.	0.46	Molgula manhattensis	1				
						Nemertesia spp.	0.37	Myxillidae	1				
						Archidoris pseudoargus	0.36	Pecten maximus	1				
						Pagurus bernhardus	0.36						
						Pisa sp.	0.29						
						Blennius ocellaris	0.28						
						Raja clavata	0.27						
						Halecium sp.	0.26						

Community Structure Measures

	Mean	sd	Mean	sd	Mean	sd	Mean	sd	Mean	sd	Mean	sd	Mean	sd
S	21.0	0.00	23.1	3.03	26.0	8.00	29.2	6.83	30.0	-	18.0	-	33.0	-
N	286.1	42.07	249.5	164.40	478.7	271.97	769.1	436.35	172.1	-	3605.6	-	762.3	-
d	3.5	0.09	4.1	0.53	4.1	1.33	4.4	1.22	5.6	-	2.1	-	4.8	-
J'	0.3	0.13	0.5	0.06	0.5	0.01	0.4	0.10	0.5	-	0.1	-	0.4	-
H'	1.0	0.40	1.7	0.17	1.6	0.14	1.3	0.37	1.8	-	0.4	-	1.4	-

Table 5. 10 **Faunal Clusters derived from all sites, 2008. Most to least characteristic species are on a red to white scale.** Species included contribute >70% to cumulative separation of clusters and greater than >2% individual contribution to cluster similarity.

Cluster A supported one of the lowest mean species diversity values with an average of 21 species per site at a generally low abundance. The characterising species of this group reflects the findings of the demersal fish analysis, with fauna indicative of mobile sandy habitats, notably the species *Pleuronectes platessa* and *Hyperoplus lanceolatus* (Fig 5.28). Although it appears to be the presence of the colonial bryozoan *Alcyonidium* spp. at high abundances at one site (Fig. 5.29) which has contributed to the separation of **Cluster A** from **Cluster B.**

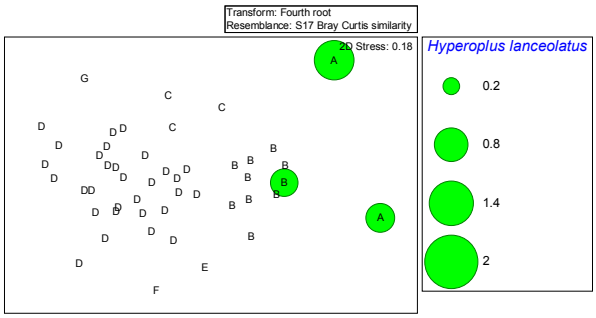

Figure 5. 28 MDS with *H.lanceolatus* abundance

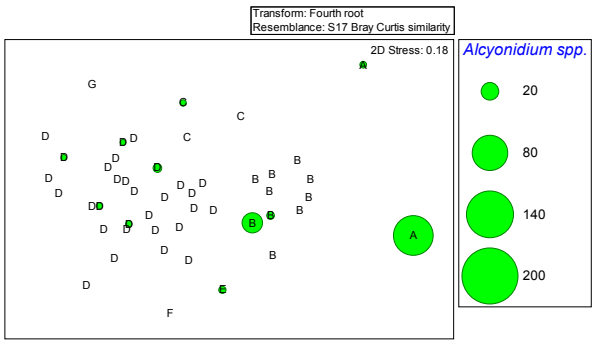

Figure 5. 29 MDS with *Alcyonidium* spp. abundance

As with Cluster A, **Cluster B** supported few species at a generally low abundance. These data also reflect the findings of the demersal fish analysis, with the fish species, such as the sole, *Solea solea* (Fig. 5.30) and the thick back sole, *Michrochirus variegatus* characterising the area. Several characteristic invertebrates, indicative of sandier sediments were also noted, including the hermit crab, *Pagurus prideaux* (Fig. 5.31) and the commensal anemone *Adamsia carcinopados*, along with large numbers of the urchin *Psammechinus milliaris.*

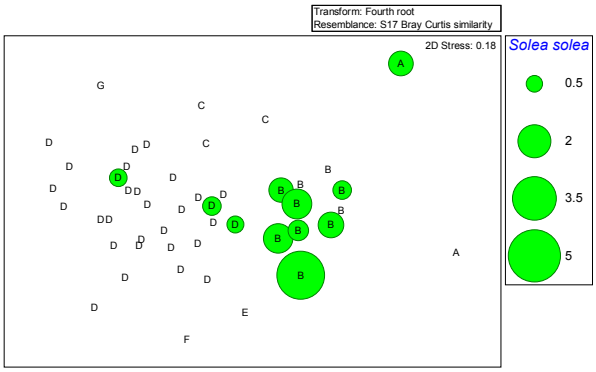

Figure 5. 30 MDS with *S.solea* abundance

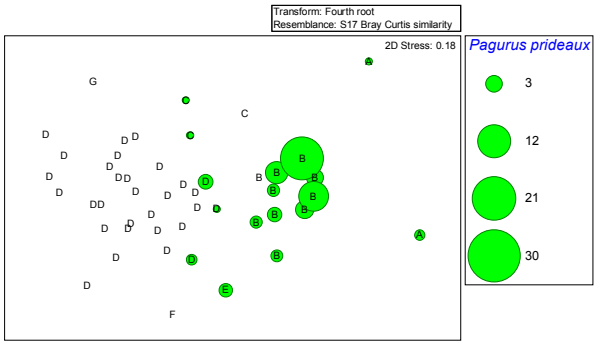

Figure 5. 31 MDS with *P.prideaux* abundance

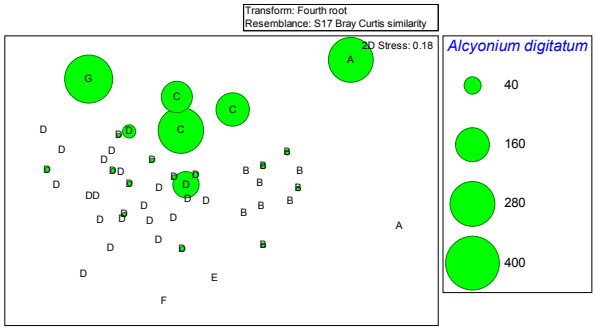

Figure 5. 32 MDS with *A.digitatum* abundance

Cluster C comprised of 3 sites to the east of the ECR. This cluster had some similarity with respect to the dominant fauna, to Cluster D, but was dominated by *Alcyonium digitatum* (Fig. 5.32) and was devoid of *Aequipecten opercularis* (Figure 5.33). It also supported numerous fish species.

Three sites appeared as outliers, 6, 7 and 11 (Clusters E, F and G respectively). **Cluster E** although it supported a comparable number of species to the other clusters defined, comprised an overall low number of individuals, with many species represented by a single individual.

Site 7, **Cluster F** had the lowest number of species but supported the highest single abundance of *Aequipecten opercularis*, which has resulted in it separating from Cluster D.

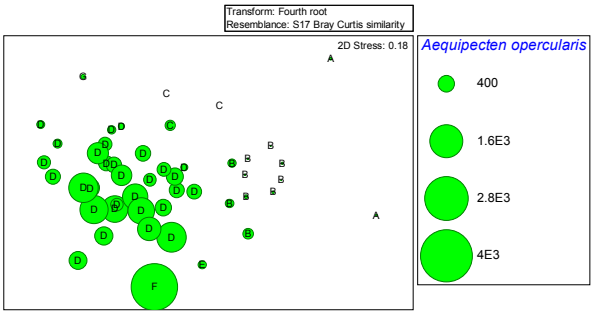

Figure 5. 33 MDS with *A. opercularis* abundance

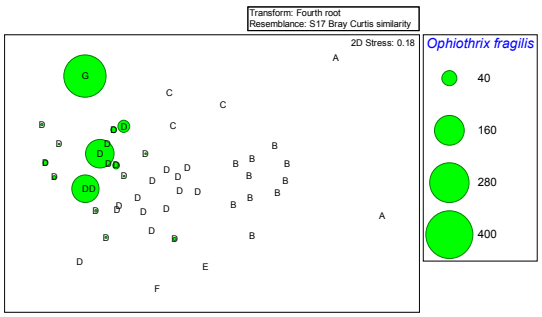

Figure 5. 34 MDS with *O. fragilis* abundance

Site 11 described as **Cluster G** was the most similar to Cluster D but has separated due to the very high abundances of both *Alcyonium digitatum* (Fig. 5.32) and *Ophiothrix fragilis* (Fig. 5.34).

Cluster D comprised the majority of the trawl samples (30 sites) and supported a relatively large mean number of species a generally high abundance. The cluster was characterised by a wide range of species with the queen scallop, *Aequipecten opercularis,* the most abundant (Fig. 5.33) along with the common starfish *Asterias rubens*. Several subdivisions were evident in **Cluster D** (Fig. 5.27) which could be related to several characterising species. These have been illustrated in Figs. 5.35 to 5.37.

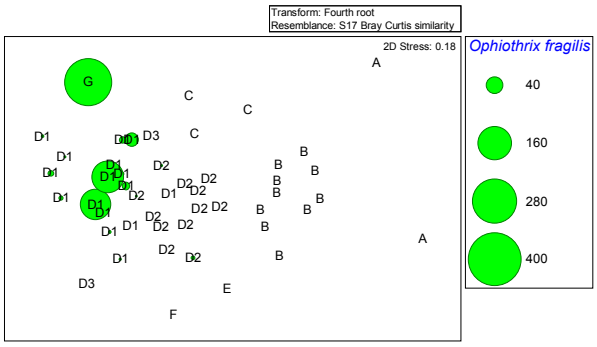

Figure 5. 35 MDS with *O. fragilis* abundance

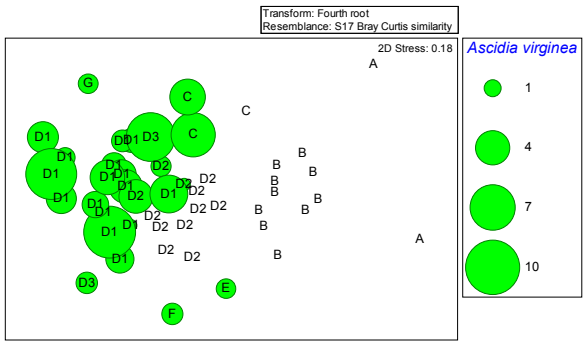

Figure 5. 33 MDS with *A. virginia* abundance

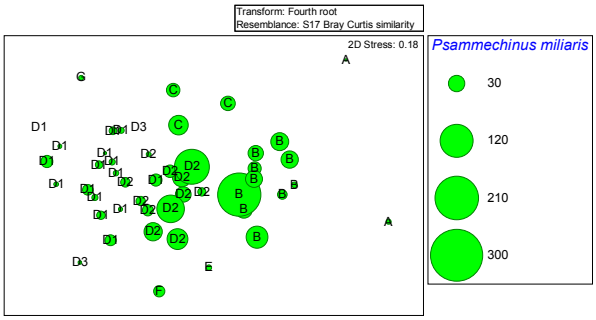

Figure 5. 34 MDS with *P. milliaris* abundance

All three sub-clusters were equally dominated by *Aequipecten opercularis* but the presence of *Ophiothrix fragilis* (Fig. 5.35), albeit in low numbers at some sites, has influenced the separation of **Cluster D1,** with further separation caused by the ascidean, *Ascidea virgina* (Fig. 5.36). **Cluster D2** was largely influenced by the urchin *Psammechinus milliaris* (Fig. 5.37).

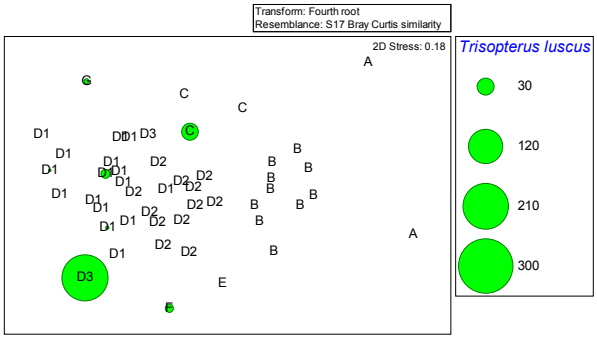

Figure 5. 35 MDS with *T.luscus* abundance

Cluster D3 comprised only two sites and separated largely on the basis of reduced abundances of the species found in clusters D1 and D2, with the abundance of *Trisopterus luscus* (Fig. 5.38) also influencing the separation.

3.2.4 Cluster Distribution

The regional distribution of the clusters as defined by multivariate analysis, are illustrated in Chart 5.18. The physical conditions prevailing across the region have previously been described in Sections 1 and 2 of this report series and the current analysis indicates that the clusters described are related to the general physical conditions of the seabed.

Several clear divisions exist. **Cluster A**, comprised of the most northerly sites within the region, and support fauna indicative of highly mobile sand habitats. To the east, fauna associated with sandy sediments, including several flat fish species and the Pagurids, were characteristic of **Cluster B.**

Cluster C appears to represent a transitional area between the sandier sediments found in cluster A and B to the north and east, and the more stable sediments to the west. In particular it supported no *Aequipecten opercularis* but contained *Alcyonium digitatum,* suggesting the presence of coarser, stable sediments.

It is evident from Chart 5.18, that the majority of the region falls within the community type comprising **Cluster D.** This cluster appears to be associated with the more stable, gravel sediments to the west of the region. Chart 5.19 indicates that Sub-clusters **D1** and **D2** form discrete areas, with **D1** occupying the westernmost region and **D2** the central region, these coincide with a change in the sediments from gravelly sand (**D2**) to sandy gravel (**D1**) (see Sections 1 and 2 of this report series).

3.3 Summary Conclusions

Comparing the analysis of the fish data in combination with the distribution of the complete fauna dataset, it is evident that a west to east gradient of communities exists and that a variation in the interaction between the fish and epibenthic fauna is occurring.

The flat fish such as plaice and dover sole dominate the areas to the east of the region and are probably responding to an increase in the proportion of their preferred food sources such as infaunal crustacea and polychaetes, which in turn are responding to higher levels of sand content in the sediments.

The sites to the far north and north east (forming Cluster A) are characterised by fish species that are adapted to mobile sandy sediments, particularly indicative being the greater sandeel, *Hyperoplus lanceolatus*. Within these sites there was a notably lower abundance of fauna overall and, in some cases, apparent absence of invertebrate fauna, which will have resulted in a restricted food source for most of the fish species.

Further to the west, encompassing Clusters D (which included the majority of sites), E, F and G, the region appears to support more complex invertebrate fauna and fish communities, which are largely characterised by the presence of the queen scallop, *Aequipecten opercularis* and the lesser spotted dogfish, *Scyliorhinus canicula.*

On a regional basis dredging is not demonstrably affecting the fish and epibenthic species communities measured using 4m beam trawling.

4.0 REFERENCES

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5.0 AUDIT INFORMATION

Title: EASTERN ENGLISH CHANNEL MONITORING REPORT 2008 Section 5. Regional Fish Communities and Associated Epifauna Communities derived from 4m Beam Trawl Survey Volume I (Report)			
Report No : 09/J/1/03/1333/0875 Job No : J/1/03/1333 Client Name : East Channel Association Client Contact : Stuart Lowe			
Project Manager	Dr. Nigel Thomas		
Field Manager	Leigh Marsh		
Fieldwork conducted by	Leigh Marsh Alison Bessell Erin Pettifer Ben Cross		
Data analysis and report written by	Leigh Marsh Nigel Thomas		
		Signed	Date
Report checked by	Dr. Nigel Thomas		
Report authorised by	Simon Shaw		

CHARTS