Arklow Bank Offshore Windfarm Environmental Monitoring
Benthic Ecology Survey Report

June 2010

A Report to GE Wind Energy

January 2011

ISLAND SHIPPING
TUGS & WORKBOATS

Aquatic Services Unit

ERI
ENVIRONMENTAL RESEARCH INSTITUTE
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1. INTRODUCTION

Aquatic Services Unit, University College Cork, was requested by Island Shipping Ltd., on behalf of Arklow Energy Ltd., to undertake a benthic biological survey, as part of a post construction monitoring programme, for the Arklow Bank Offshore Windfarm. The following report outlines the work undertaken for this survey. Work for this report was undertaken from the 24th & 25th June, 2010.

The Arklow Bank Offshore Wind Farm lies 13 km east of Arklow town and consists of seven 3.6 MW turbines. Construction began in 2002 with the building of these seven turbines. However, it is a possibility that large numbers of additional turbines may be built in the general area in the future. A baseline survey of the Arklow Bank area and cable route was conducted in 2000–01 (pre-construction), consisting of three sampling periods: June 2000, September 2000 and April 2001. Various sampling techniques were used during the baseline survey; the first survey used otter trawls and anchor dredges, while the following two used Agassiz trawls and anchor dredges. Only qualitative data was produced from the anchor dredge samples and species were recorded as present/absent. Plankton was also sampled and temperature/salinity profiles were generated.

The initial surveys undertaken in June/July 2004 were taken using Day Grabs, and these encountered severe problems with the hard ground. Subsequent surveys were undertaken using semi-quantitative anchor dredges to assess the benthic infauna and associated sediments. In addition, semi-quantitative beam trawls were used to assess benthic epifauna and benthic fish communities.

The locations of the sampling positions of the current survey are consistent with previous monitoring surveys. These sampling locations were specified by the client and are presented in Figure 1.1 and as a table in Table 1.1. These positions are the same as those sampled in previous surveys. As reported in the previous survey, the positions of the current stations do not coincide with the positions of the baseline survey.

	Beam Trawl Co-ordinates			
	Trawl In		Trawl Out	
	Easting	Northing	Easting	Northing
Trawl 1	698291	5856829	698403	5856594
Trawl 2	703872	5857747	703889	5857277
Trawl 3	707373	5865477	707398	5865099
Trawl 4	708600	5837887	708526	5858196
Trawl 5	703281	5848414	703316	5848870
Trawl 6	703081	5837518	703058	5836991

	Anchor Dredge Co-ordinates			
	Dredge In		Dredge Out	
	Easting	Northing	Easting	Northing
D1	695354	5854491	695396	5854404
D2	698121	5854387	698095	5854281
D3	700689	5855536	700730	5855382
D4	702726	5861780	702860	5861642
D5	703230	5864451	703222	5864690
D6	704086	5863483	704170	5863728
D7	704700	5864343	704813	5864461
D8	707403	5866652	707314	5866159
D9	708149	5856815	708099	5856678
D10	708285	5851250	708324	5851103
D11	707054	5846712	706921	5846485
D12	704520	5844512	704542	58445492
D13	703769	5838839	703785	5838716
D14	702048	5844766	702113	5844617
D15	703299	5851147	703251	5851222
D16	706193	5853439	706149	5853361
D17	706248	5858202	706190	5858176
D18	700729	5858261	700906	5858182
D19	697064	5847691	697075	5847577
D20	703641	5857165	703825	5857101

Table 1.1. Positions of the sampling positions for the ongoing monitoring programme at the Arklow Bank Offshore Windfarm. All locations are presented in UTM CM 9°W. Zone UTM 29N.

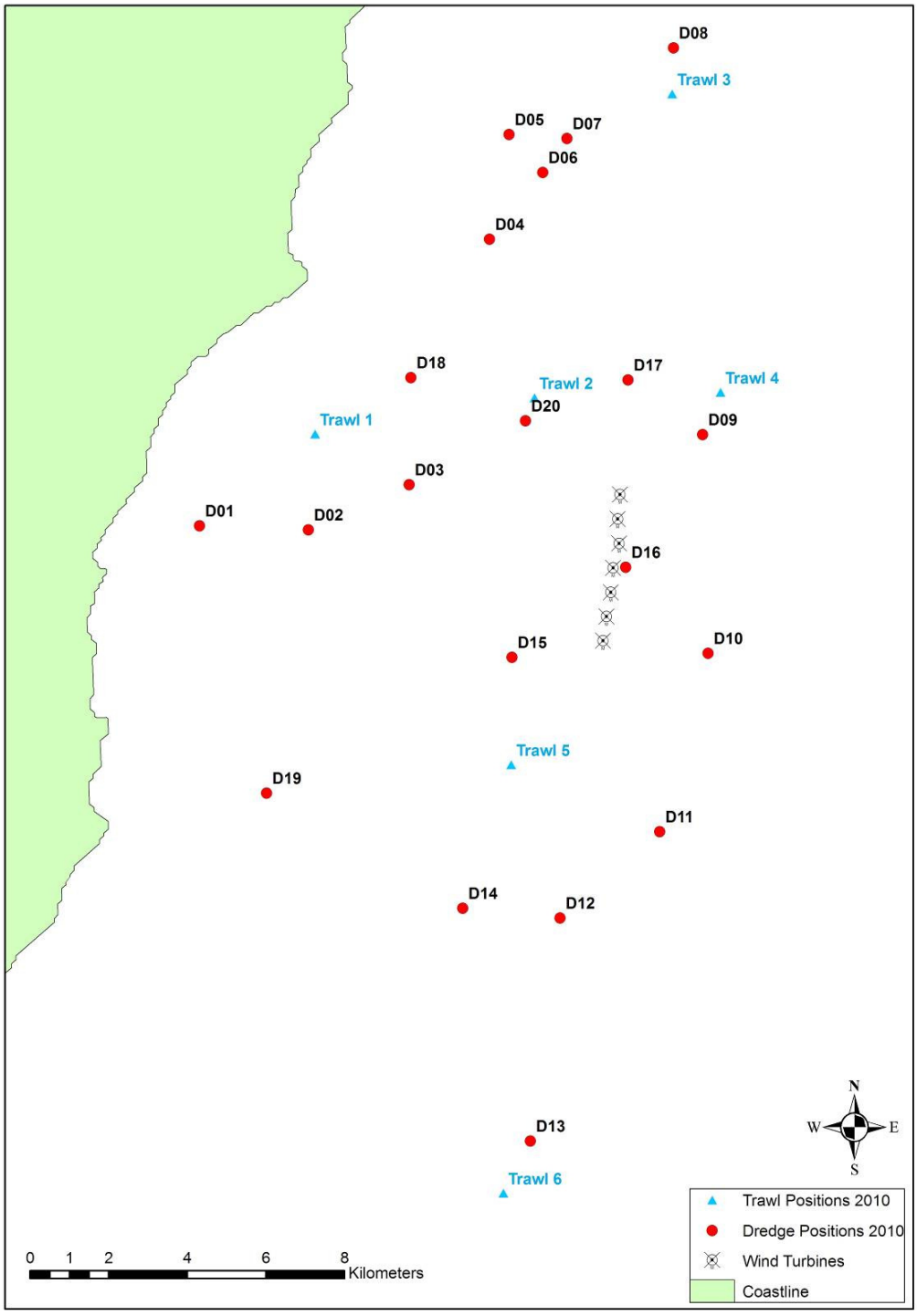


Figure 1.1 Anchor Dredge (● numbered D1 to D20) and Beam Trawl locations (▲ numbered Trawl 1 to Trawl 6) for the present monitoring survey (June 2010). These stations correspond to locations sampled in previous surveys.

2. METHODOLOGY

All sampling was undertaken from the MV Husky, based out of the port of Wicklow. The present survey was completed over the course of two days in June (24th and 25th) 2010.

2.1 Beam trawls

All trawls were taken using a 2 m Beam Trawl, equipped with tickler chains and a 4 mm mesh cod-end, as per previous surveys. All tows were 10-15 mins duration over the ground at a speed of ~2 knots, with a warp of 2½ times water depth. This equated to a distance of approximately 300 m. Once on board, the contents were placed into a sorting table and photographed prior to processing.

Fish species (both commercial and non-commercial) were separated and counted. Fish were measured using a graduated fish board before being returned to the sea. Colonial organisms (such as hydroids, bryozoans etc.) were marked present or absent.

Organisms were identified in the field, where possible. Organisms which were difficult to identify were retained in formalin for later processing. There was no sub-sampling undertaken in the present survey. Where the volume of sample was deemed to be too large, larger specimens were identified, counted and returned. All other specimens were retained for later identification and enumeration.

2.2 Anchor Dredge Sampling

At each sample station, a single anchor dredge sample was obtained with no replication of samples. The anchor dredge was deployed 20 m in advance of the target and sufficient warp was paid out. The dredge was then dragged through the target to 20 m beyond the target point. Where this proved unsuccessful, the process was repeated and the anchor dredge was dragged for a further distance.

After successful deployment and retrieval of the anchor dredge, the sample was transferred to a large container. The sample was labelled and photographed. Field notes were taken to include information such as sample number, date and time of sampling, a visual description of the sample, an estimate of the volume of the sample and any other relevant information in relation to the sampling effort.

A small sub-sample (~ 400 g) was removed and transferred to a labelled container for Particle Size Analysis (PSA). This sample was placed in a cooler box whilst aboard the vessel and transferred immediately to a freezer on return to the laboratory until processing.

The remaining dredge sample was then sub-divided into three identical sampling units. Each unit was sieved through a 1.0 mm mesh using a gentle puddling motion. Sediment which passed through the sieve was discarded, and the material retained on the sieve was transferred to a labelled container and fixed with 40% buffered formalin to a final concentration of 4% minimum. A waterproof label was then added to the sample bucket and the sample number was written in triplicate using a waterproof marker on the outside of each sample container.

As per previous surveys, only one of the three sampling units per site was processed and analysed. Samples were manually sorted by eye, using a binocular microscope where necessary. Sorted samples were then stored in 70% alcohol until identification. Samples were sent to qualified taxonomists for enumeration and identification to species level, where possible. The remaining sub-samples are held in storage.

2.3 Particle Size Analysis (PSA)

On arrival at the laboratory, Particle Size Analysis (PSA) samples were immediately stored in a freezer until processing. Samples were dried to a constant weight at a temperature of 100°C. Prior to dry-sieving, samples were pre-treated using the methods employed by Buchanan and Kain (1984). Dried samples were then sieved through a series of nested sieves (Endecott BS410/1986) using an electronic sieve shaker. A list of sieves used is displayed in Table 2.3.1.

Sediment grainsize distribution and statistics were then calculated for each of the sediment samples using the GRADISTAT package (Blott & Pye, 2001). This package was used to determine the mean and median particle sizes and determination of sorting co-efficient. Each sample was ascribed to a sediment type (Figure 2.3.1) based on Folk (1954) with size division based on the Wentworth Scale (Table 2.3.2). Sorting co-efficient terms are defined in Table 2.3.3.

Sieve Series Sizes (mm)							
4.0	2.0	1.0	0.5	0.25	0.125	0.63	<0.63

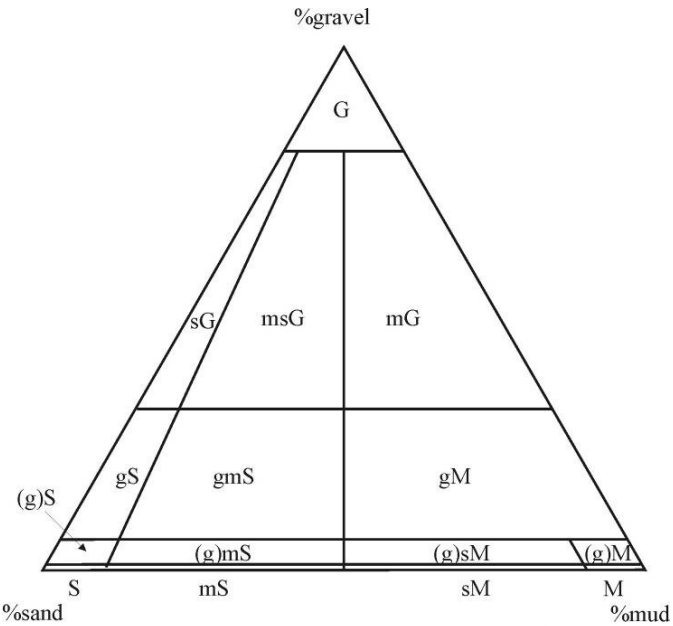
Table 2.3.1 Sieve series sizes (mm) used for particle size analysis (PSA).

Wentworth Scale (mm)	Phi units	Sediment types
>256 mm	<-8	Boulders
64 - 256 mm	-8 to -6	Cobble
4 - 64 mm	-6 to -2	Pebble
2 - 4 mm	-2 to -1	Granule
1 - 2 mm	-1 to 0	Very coarse sand
0.5 - 1 mm	0 - 1	Coarse sand
250 - 500 µm	1 - 2	Medium sand
125 - 250 µm	2 - 3	Fine sand
63 - 125 µm	3 - 4	Very fine sand
<63 µm	>4	Silt

Table 2.3.2 Classification used for defining sediment type (from Buchanan & Kain, 1984).

Standard Deviation of mean Phi	Classification
<0.35	Very well sorted
0.35 - 0.5	Well sorted
0.5 - 0.71	Moderately well sorted
0.71 - 1	Moderately sorted
1 - 2	Poorly sorted
2 - 4	Very poorly sorted
>4	Extremely poorly sorted

Table 2.3.3 Classification used defining degree of sediment sorting (from Buchanan & Kain, 1984).



G = gravel
msG = muddy sandy gravel
gS = gravelly sand
gM = muddy gravel
(g)mS = slightly gravelly muddy sand
(g)M = slightly gravelly mud
mS = muddy sand
M = mud

sG = sandy gravel
mG = muddy gravel
gmS = gravelly muddy sand
(g)S = slightly gravelly sand
(g)sM = slightly gravelly sandy mud
S = sand
sM = sandy mud

Figure 2.3.1 Sediment classification after Folk (1954) as also used by the BGS. "Gravel" is greater than 2 mm and "mud" is less than 63 µm.

2.4 Data Analysis

On completion of the sample processing and identification the data was analysed using a variety of univariate and multivariate analyses to determine community structure and assess change compared to previous surveys.

As stated in previous reports different types of sampling gear have been used in previous surveys, as well as different levels of species identification. Therefore the present report will compare the current dataset against the previous surveys which were samped using the same methodology (2004 - 2009). Statistical analysis between the previous surveys and the baseline survey has been undertaken in the previous surveys and will not be addressed in the current report. An assessment on the habitats identified in the present survey will be made.

Multivariate analysis was performed on the raw datasets using PRIMER *v* 5 (Clarke & Warwick, 1994). The data was subjected to a variety of multivariate analyses, including non-metric Multi Dimensional Scaling (MDS).

2.4.1 Beam Trawls

In the present survey, as in previous surveys, a total of 6 beam trawls were taken across the survey area. Although this number of trawls is quite small and results from multivariate analysis can only be described as descriptive, it was considered a useful exercise to compare against the results of the previous surveys.

Square-root transformations were performed on the abundance data with colonial organisms removed. In addition the beam trawl data was subjected to analysis on the presence/absence dataset including all identified taxa.

2.4.2 Anchor dredge samples

As in previous reports, a variety of univariate, multivariate and graphical techniques were used to provide the information concerning species diversity and community structure.

Multivariate analysis was based on square-root transformed abundances of species present, which allows for a sensible balance between the rare and common species. Multi-Dimension Scaling (MDS) ordination was based on the Bray-Curtis similarity coefficient. Stress values are provided for each MDS plot. It is important to note that these stress values represent the relationship between the various samples. In brief, a stress value of <0.05 indicates that there is an excellent representation of the relationship between the various samples, <0.1 indicates good ordination and <0.2 indicates a potentially useful 2-dimensional picture (Clarke and Warwick, 1994). In order to investigate the effect of the environmental data on the stations, sample clustering determined from the above analysis was repeated with mean sediment particle size superimposed.

The initial monitoring report (Hydroserv, 2004) compared pooled replicates between the sites taken with a 0.1 m^2 Day Grab. This information was compared to information obtained in the baseline survey of 2000. Analysis indicates that comparisons between these two surveys were incompatible due to inherent differences in the sampling equipment used. A resurvey was undertaken in October 2004 using the current sampling methodology (anchor dredge and beam-trawl sampling methods). This report indicated that the assemblages reported in October 2004 were broadly similar to those identified in the baseline survey (Ecoserve, 2001), although direct comparisons were difficult due to the different sampling methods used (Hydroserv, 2005).

3. RESULTS

3.1 Beam Trawls

Raw data from the beam trawls are presented in the appendices (Appendix 6.3), in addition to information on fish species and lengths (Appendix 6.4). A total of 158 taxa were identified in the present survey. Of these 158 taxa, 12 are fish species. Overall, the number of taxa identified is in keeping with previous surveys; the total number of taxa is higher than the June 2006 (98 taxa), June 2005 (47 taxa) and October 2004 (51 taxa) surveys, and similar to those identified in 2007 (177 taxa), 2008 (170 taxa) and 2009 (132 taxa).

The number of fish species and abundances found at each trawl location in the 2006 – 2009 surveys, as well as the present surevy, are presented in Figures 3.1.1 and 3.1.2. The total number of fish taxa identified in the present survey (12 taxa) is similar to those identified in previous surveys (10 – June 2009, 12 – May 2008, 14 – June 2006, 13 – June 2005), but higher than the October 2004 (9 taxa) and May 2007 (7 taxa) surveys. In addition, the number of fish caught in the present survey (33 individuals) is similar to that caught in 2008 and 2009 (33 and 32 individuals respectively); although it is much lower than earlier surveys (55 – June 2006, 74 – June 2005 and 80 – October 2004). In the present survey, the western most station, Trawl 1, had the highest number of species (5) although Trawl 2 had the highest number of individuals (13). Overall, fish abundances are quite low, ranging from 2 individuals in Trawls 4 & 5 to 13 individuals in Trawl 2.

Important commercial fish were limited to 4 Plaice (*Pleuronectes platessa*), 1 Whiting (*Merlangius merlangus*), 1 Dogfish (*Scyliorhinus caniculus*), 1 Spotted Ray (*Raja montagui*) and 1 Common Sole (*Solea solea*). Two elasmobranchs were caught in the present survey (1 x *Scyliorhinus caniculus* & 1 x *Raja montagui*) compared to 1 (2009), 4 (May 2008), 3 (June 2006), 4 (June 2005), 3 (October 2004). No elasmobrancjhs were returned during the 2007 survey.

As mentioned in previous reports, the use of small (2 m) beam trawls is far from ideal as a survey method for fish sampling. However, it has been shown to be quite effective for most bottom dwelling fish species (ICES 2003). Results from the present survey concur with the findings of previous reports, that benthic fish populations are quite low in the surveyed area.

The beam trawl surveys yielded a total of 158 taxa, which is in keeping with more recent previous surveys (2007, 2008 & 2009). Total numbers of countable organisms (1,819) is similar to that identified in 2009 (1779). Although numbers identified in the present survey are still reduced from levels identified in 2007, this is related to the non-sampling of the *Sabellaria* reef identified in Trawl 3 that year. Twenty taxa were found in numbers ≥ 20 over the whole survey area, compared with 15 taxa in 2009, 9 taxa in 2008 and 19 taxa in 2007. Abundances and diversity have remained similar across the trawls compared to those identified in 2009. A complete list of the most countable faunal species identified in the present survey is presented in Table 3.1.1.

The highest numbers of taxa encountered at the trawl sites were found in Trawls 1 and 5 (71 and 70 taxa respectively). These stations also had the highest number of countable taxa (55 and 48 respectively). In addition, these trawls also had the highest abundances recorded in the present survey with 625 and 422 individuals respectively. The most abundant species present in the survey area are the shrimp species *Pandalus montagui* and *Crangon almanni* and the encrusting barnacle *Balanus crenatus*.

	June 2010	June 2009	May 2008	May 2007	June 2006	June 2005
Pandalus montagui	287	406	16	13	187	65
Crangon almanni	218	124	68	52	53	0
Balanus crenatus	148	245	68	34	0	0
Pisidia longicornis	81	0	21	1033	238	4
Gammaropsis nitida	77	0	10	3	0	0
Pagurus bernhardus	69	94	33	54	26	95
Harmothoe indet.	56	9	4	28	5	0
Eusyllis blomstrandi	54	17	17	0	0	0
Pomatoceros lamarcki	54	56	7	4	0	0
Atylus swammerdami	52	1	1	1	0	0

Table 3.1.1 Numbers of the 10 most common countable faunal species found in June 2009 compared to abundances found in June 2009, May 2008, May 2007, June 2006 and June 2005 beam trawl surveys

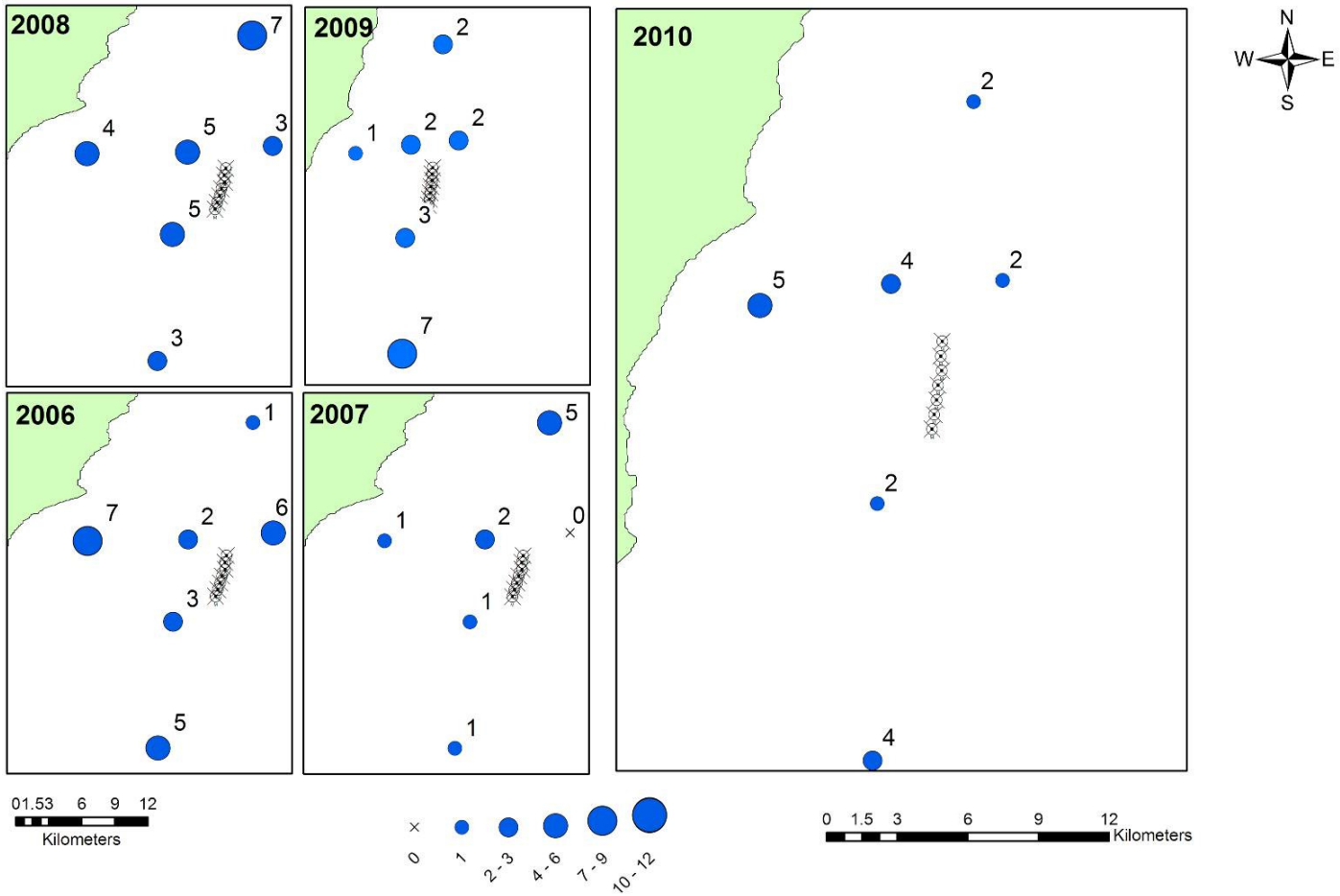


Figure 3.1.1 Total number of fish taxa per trawl site (June 2006, May 2007, May 2008, June 2009 & June 2010)

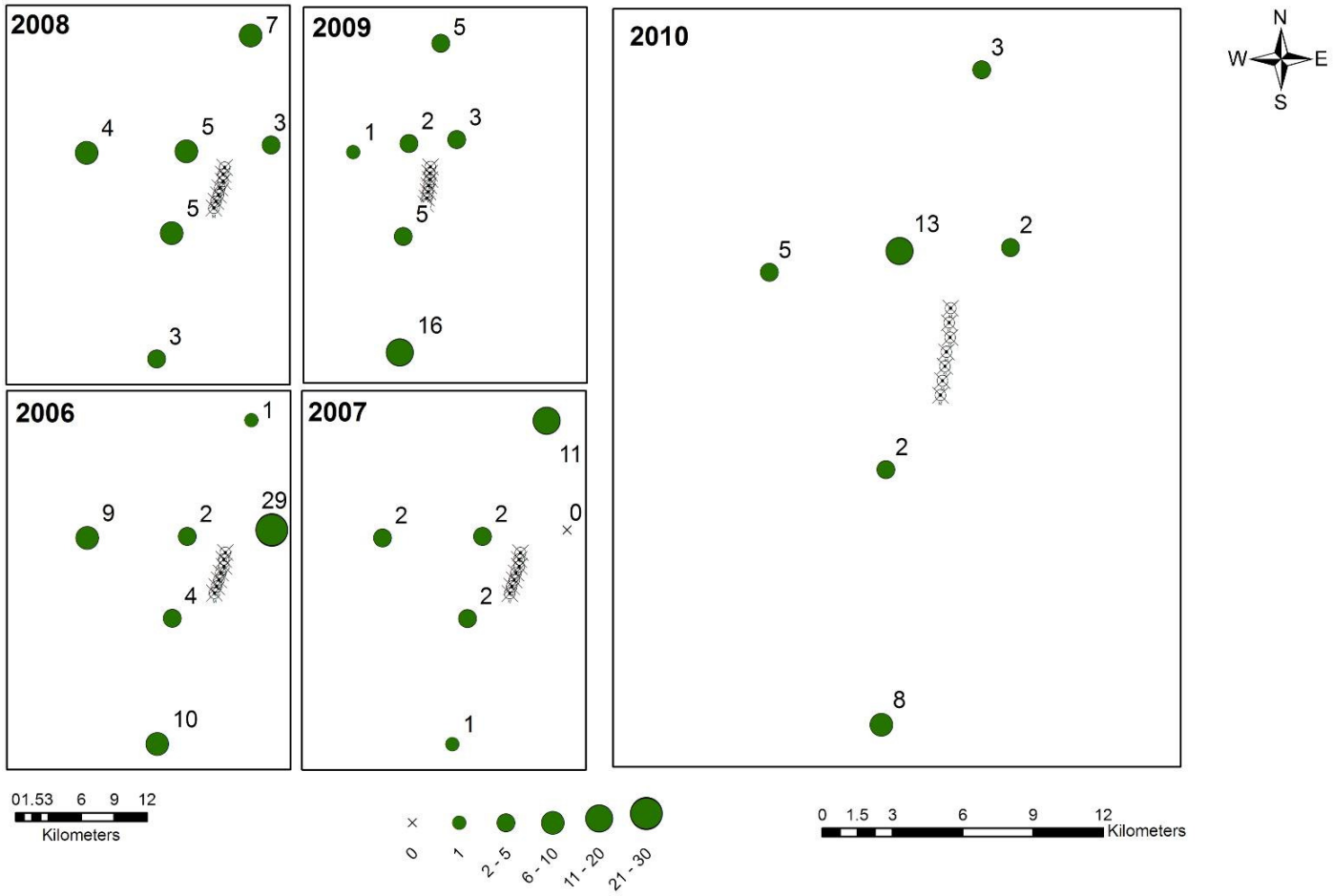


Figure 3.1.2 Total number of fish per trawl site (June 2006, May 2007, May 2008, June 2009 & June 2010)

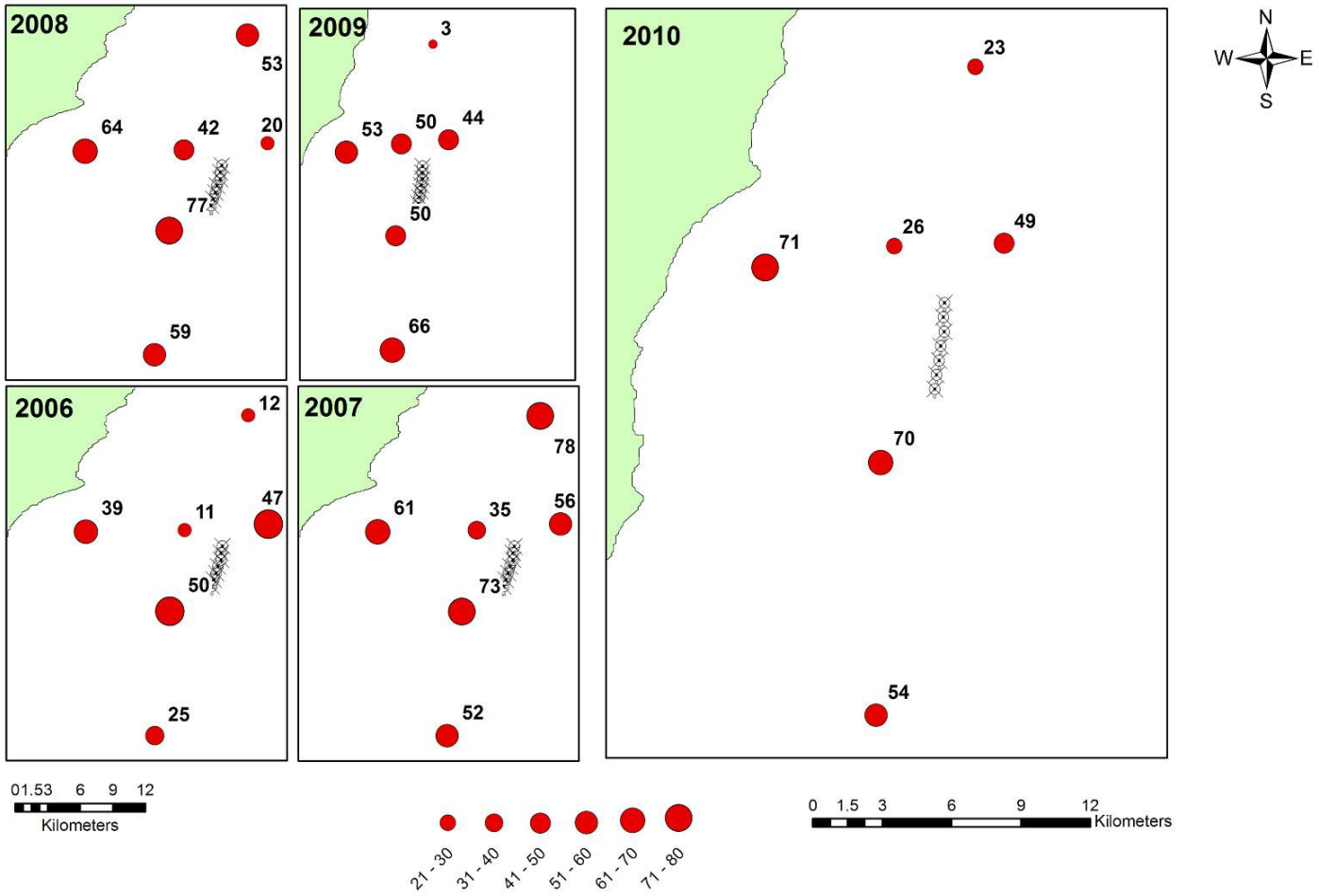


Figure 3.1.3 Total number of invertebrate taxa per trawl site (June 2006, May 2007, May 2008, June 2009 & June 2010)

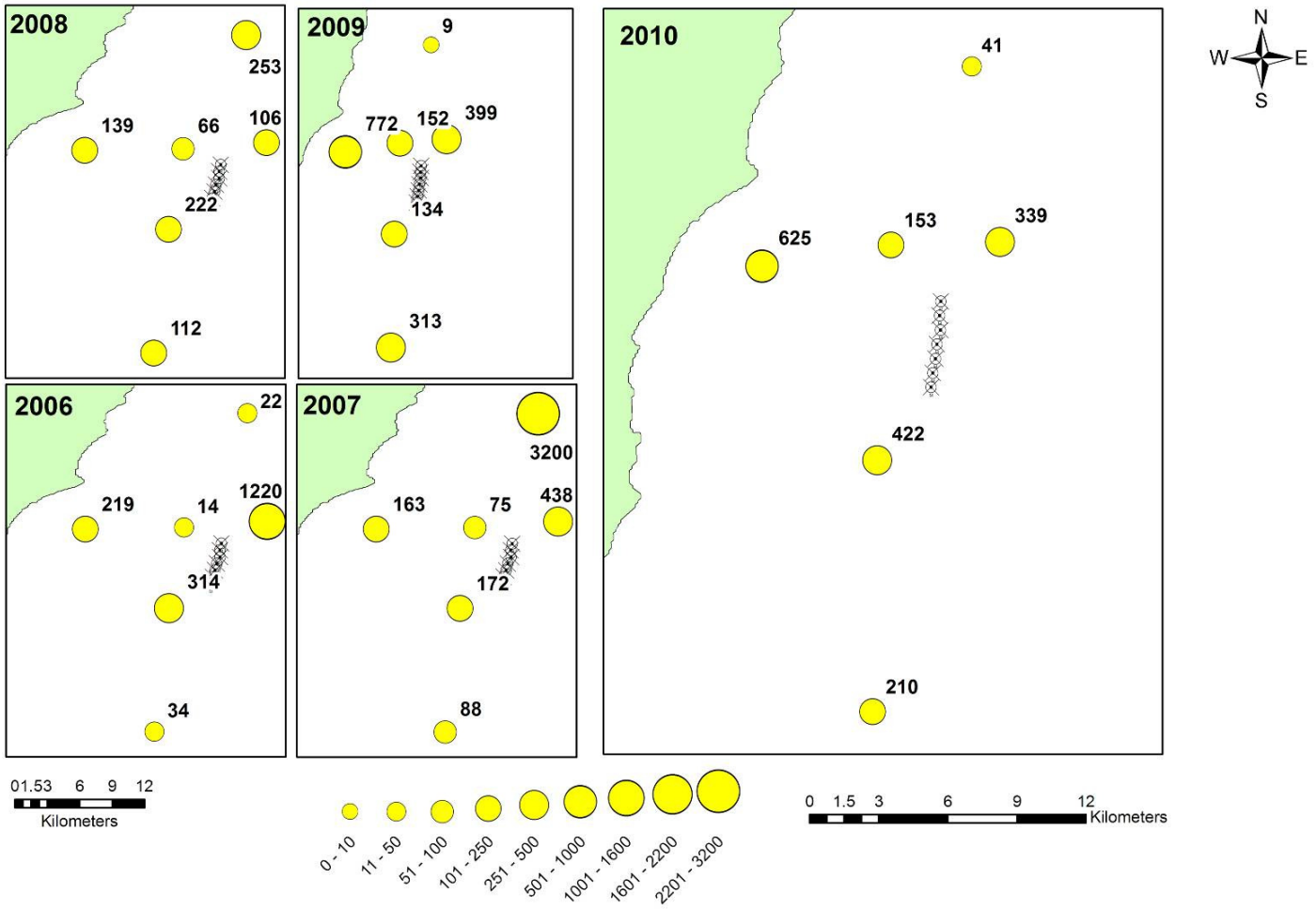


Figure 3.1.4 Total number of countable invertebrates per trawl site (June 2006, May 2007, May 2008, June 2009 & June 2010)

As with previous surveys multivariate analysis of the community structure reveals the presence of no distinct community structure, based on both the presence/absence dataset (Figure 3.2.5 a) and the dataset with colonial organisms removed (Figure 3.2.5 b).

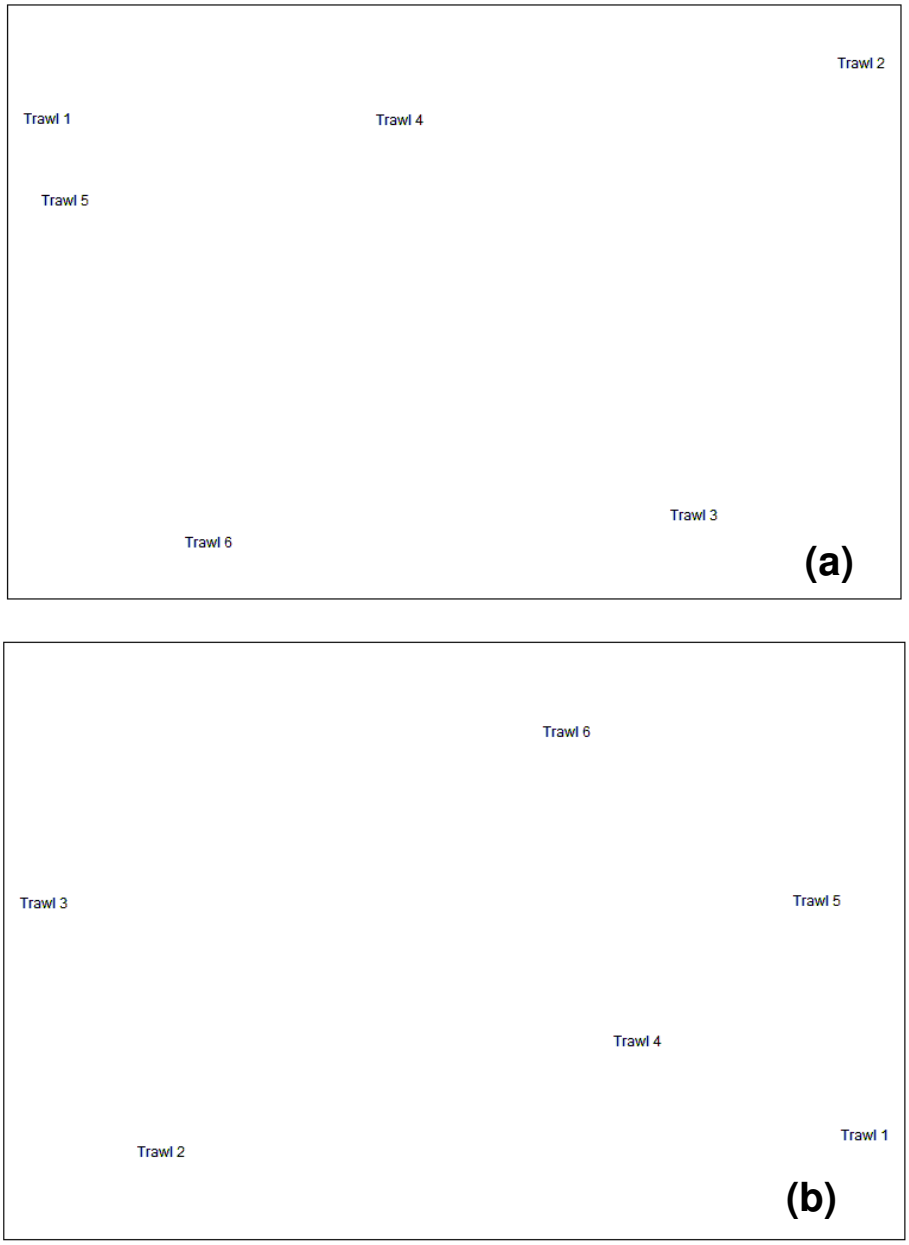


Figure 3.1.5 **(a)** Multivariate analysis (nMDS plot) on the 2010 trawl data, colonial data included (Stress = 0.01).
(b) Multivariate analysis of the countable fauna, colonial data removed (Stress = 0.01).

3.2 Anchor Dredge Samples

3.2.1 Particle Size Analysis

Data for the full Particle Size Assessment is presented in Appendix 6.6. Table 3.2.1 presents a summary of the results and a visual assessment based on the on-board field notes. As with previous surveys there is an extensive range of sediment types present across the study area with sediments ranging from pure gravel at two locations to sand at two locations and a range of sediment types in between. As reported previously, the heterogeneous nature of the sediment in the survey area results in minor differences in the sediment composition across the study site when compared to previous surveys. A distribution map of the sediment encountered in the present survey is presented in Figure 3.2.2. The dominant sediment type in the area consists of sands (D12 & D13) and gravelly sands (D8, D16 & D17), which dominate across the Arklow Bank. The area to the east of the Arklow Bank consists of gravelly sands (D10 & D11) and sandy gravels (D9). The deeper sites along the western part of the Arklow Bank consist primarily of gravels and mixed sediment gravels. Two stations are classified as 100% gravel (D5 & D7). Six stations are classified as gravelly sands (D1, D6, D19 & D20) or slightly gravelly sands (D3 & D4). Two stations were identified with a minor muddy element (D2 & D14). Two stations were identified as sandy gravels (D15 & D18)

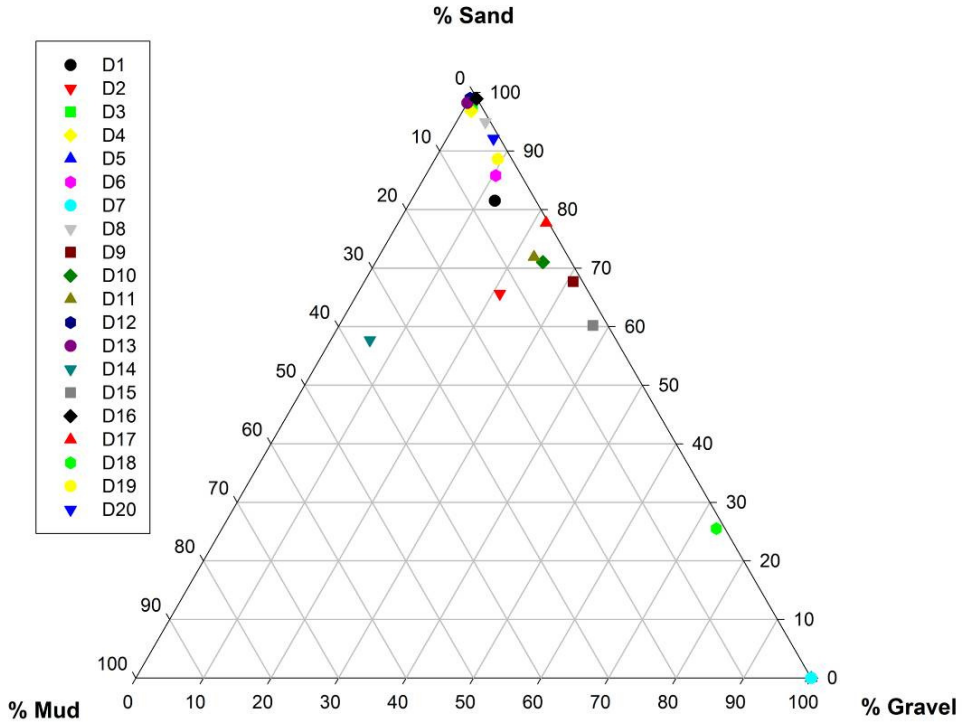


Figure 3.2.1 Ternary plot of PSA results from June 2010 survey.

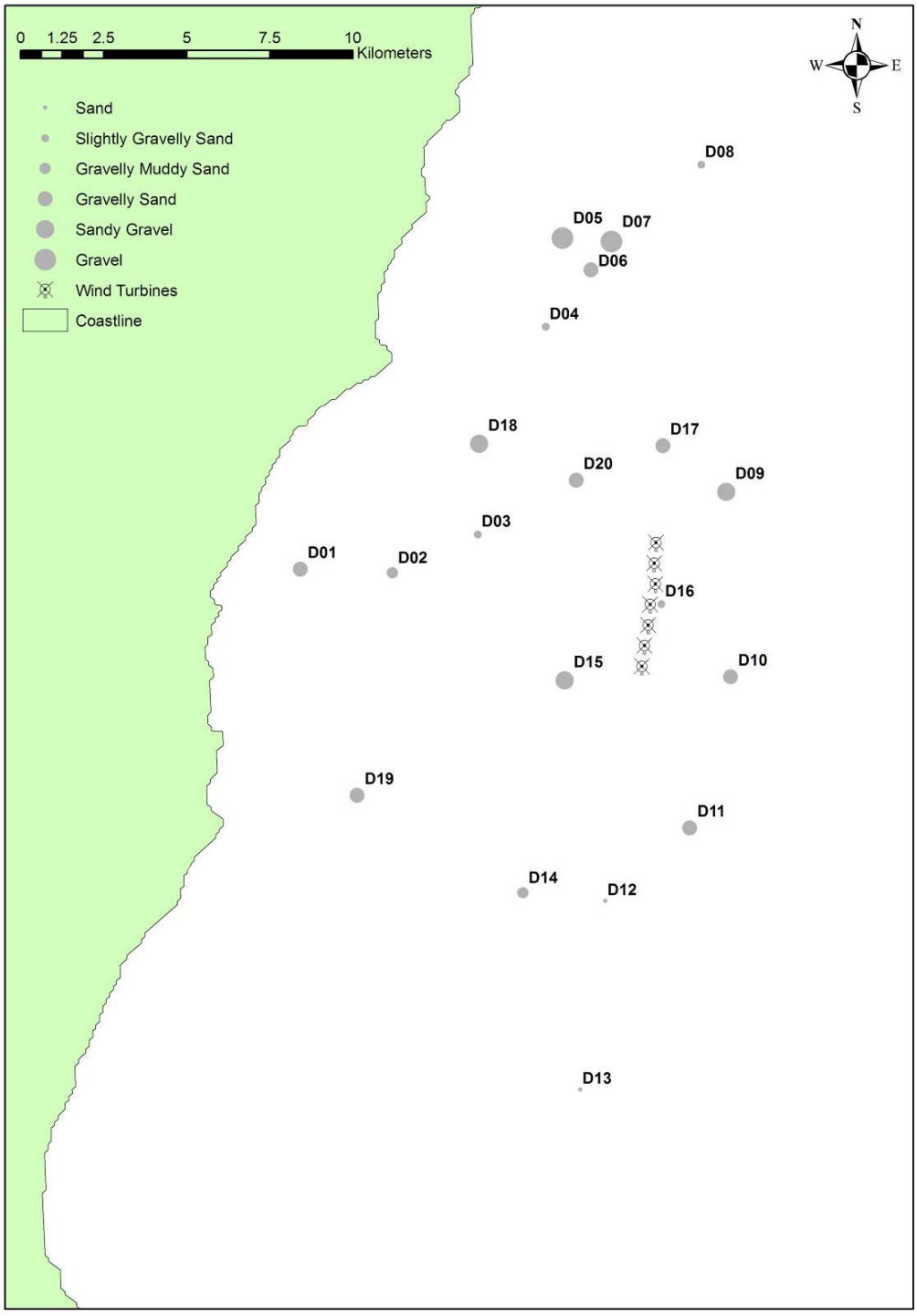


Figure 3.2.2 Distribution of sediment type as determine from the anchor dredge samples in June 2010. Site numbers are shown**.**

Site Code	Classification after Buchanan	Textural Group (June 2010)	Textural Group (June 2009)	Visual assessment
1	Very Fine Gravelly Fine Sand	Gravelly Sand [gS]	Gravelly Sand [gS]	Gravelly muddy sand
2	Fine Gravelly Fine Silty Fine Sand	Gravelly Muddy Sand [gMS]	Slightly Gravelly Sand [(g)S]	Muddy Sand
3	Slightly Very Fine Gravelly Fine Sand	Slightly Gravelly Sand [(g)S]	Slightly Gravelly Sand [(g)S]	Gravelly Sand
4	Slightly Very Fine Gravelly Medium Sand	Slightly Gravelly Sand [(g)S]	Gravelly Sand [gS]	Gravelly Sand
5	Gravel	Gravel [G]	Gravel [G]	Gravel
6	Fine Gravelly Fine Sand	Gravelly Sand	Sandy Gravel [sG]	*Sabellaria* reef
7	Gravel	Gravel [G]	Sandy Gravel [sG]	Gravel with *Sabellaria* tubes
8	Slightly Very Fine Gravelly Medium Sand	Slightly Gravelly Sand [(g)S]	Gravelly Sand [gS]	Coarse Sand
9	Sandy Fine Gravel	Sandy Gravel [sG]	Gravelly Sand [gS]	Shell Gravel & Sand
10	Fine Gravelly Fine Sand	Gravelly Sand [gS]	Sandy Gravel [sG]	Gravelly Sand with *Sabellaria* tubes
11	Fine Gravelly Fine Sand	Gravelly Sand [gS]	Sandy Gravel [sG]	*Sabellaria* reef
12	Well Sorted Medium Sand	Sand [S]	Sand [S]	Sand
13	Well Sorted Medium Sand	Sand [S]	Slightly Gravelly Sand [(g)S]	Coarse Sand
14	Fine Gravelly Fine Silty Fine Sand	Gravelly Muddy Sand [gMS]	Sandy Gravel [sG]	Muddy Gravel
15	Sandy Fine Gravel	Sandy Gravel [sG]	Gravelly Sand [gS]	Sandy Gravel
16	Slightly Very Fine Gravelly Medium Sand	Slightly Gravelly Sand [(g)S]	Slightly Gravelly Sand [(g)S]	Sand
17	Fine Gravelly Medium Sand	Gravelly Sand [gS]	Sandy Gravel [sG]	Coarse Sand
18	Sandy Fine Gravel	Sandy Gravel [sG]	Gravel [G]	Sandy shell gravel
19	Fine Gravelly Medium Sand	Gravelly Sand [gS]	Slightly Gravelly Sand [(g)S]	Sand
20	Very Fine Gravelly Medium Sand	Gravelly Sand [gS]	Gravelly Sand [gS]	Sand

Table 3.2.1 Classification of sediment types at June 2010 grab stations according to methods after Buchanan & Kain and Folk & Ward, as used by BGS (see methods), together with visual assessment of sediments from notes taken at the time. Folk and Ward classification for the June 2009 survey is also given for comparison.

3.2.2 Biota

3.2.2.1 Abundance and diversity

A full taxonomic list of all species identified for the June 2010 survey is presented in Appendix 6.2 with a full data matrix, including abundance data, presented in Appendix 6.5. In total, 8,398 individuals from 196 countable taxa were recorded in the present survey. An additional 22 colonial taxa were recorded, resulting in 218 taxa in total identified in June 2010. Although overall abundances are lower than the 12,564 from 209 countable taxa obtained in 2009, the results are similar to those obtained in the 2008 survey (7,651 individuals from 198 countable taxa). As identified previously, these values are low compared to other previous surveys (2007 – 17,800 individuals from 184 countable taxa; 2006 – 24,779 individuals from 262 countable taxa; 2005 – 49,811 individuals from 346 countable taxa; 2005 – 31,919 individuals from 300 taxa in October 2004).

In general, numbers of individuals has decreased since 2004 (aside from an increase in 2006). It is difficult to say if this represents a true trend, or whether it is a result of local heterogeneity or some other external factor. For example, several species, which were present in large numbers in previous surveys are absent, or much reduced, in the present dataset.

The keelworm *Pomatoceros lamarcki* shows a reduction compared to values obtained in 2009, and are similar in values to those identified in 2008. In addition, although *Mytilus* edulis is present in the current survey, the high abundances which were present in 2005 & 2006 have not been reached.

The reef forming polychaete *Sabellaria* spp. shows a slight reduction compared 2009 (2,866 in 2010 compared to 3,994 in 2009). The abundances identified in the present survey are up compared to 2007 and 2008 (491 & 51 respectively). Although *Sabellaria* worms were identified at eight sites in the survey area, they were present in large numbers at only 4 of these (D6 – 590; D7 – 143; D10 – 1,291; D11 – 796). As mentioned previously, this variation in abundances can be explained by the heterogeneous nature of the seabed and the scattered distribution of these reefs across the survey sites.

The most abundant species present in the current survey are similar to those identified in previous surveys. Ten taxa were present with greater than 70 individuals across the survey area. This compares to 10 taxa in 2009, 7 taxa in 2008, 11 taxa in 2007, and 17 in 2006, 34 taxa in 2005 and 19 taxa in 2004.

The highest recorded Margelef's species richness score in the present survey was found at Station 14 (12.4). Overall species richness scores increased in 10 of the 20 sites during the present survey compared to 2009. Although the number of countable fauna increased at 11 stations during the present survey compared to 2009, the most significant changes in the present survey were reductions at stations 4 (743 from 1530), 7 (1,720 from 4,360) and 11 (1,320 from 2,610). The station with the most notable increase was station 18 (1,320 from 910). The main reason for the decrease in abundances in the present survey relate to a decrease in the numbers of the keelworm *Pomatoceros* spp. which showed a reduction across the sites from 6,141 in 2009 to 2,750 in 2010. The reduction in the present survey follows significant reductions in 2008 (18,317) and 2007 (14,758).

3.2.2.2 Multivariate analysis

All multivariate analysis was undertaken using the statistical package PRIMER *v* 5.

Non-metric multi-dimensional scaling (MDS) analysis was performed on the 2010 dataset. The sandy sites across the survey area (sands, gravelly sands and muddy sands) tend to show no obvious relationship with each other although the samples tend to group away from the gravel dominated sites. This is related to the reduced abundances present at these sites and the strong hydrodynamic nature of the site. There is some degree of similarity between the gravel and sandy gravel communities due to the large degree of similar species identified at these sites.

This is similar to the results obtained in previous surveys, where no obvious similarity existing between the sandy sites although some similarity was evident between the gravelly sites.

	Number of Taxa (S)	Number of Individuals (N)	Simpson's Dominance Index (d)	Shannon-Wiener Diversity Index (H')	Margalef's Species Richness (Dmg)
D1	42	161	0.144	2.76	8.07
D2	20	46	0.0728	2.8	4.96
D3	1	2	1	0	0
D4	30	743	0.763	0.73	4.39
D5	10	172	0.633	0.836	1.75
D6	48	801	0.526	1.44	7.03
D7	49	1720	0.661	1.02	6.44
D8	0	0	-	-	-
D9	19	97	0.141	2.35	3.93
D10	67	1670	0.487	1.54	8.89
D11	38	1320	0.215	2.12	5.15
D12	2	3	0.556	0.637	0.91
D13	9	27	0.317	1.58	2.43
D14	69	242	0.0575	3.5	12.4
D15	16	46	0.086	2.59	3.92
D16	3	4	0.375	1.04	1.44
D17	3	3	0.333	1.1	1.82
D18	69	1320	0.306	1.8	9.46
D19	5	8	0.312	1.39	1.92
D20	5	11	0.289	1.39	1.67

Table 3.2.2 Univariate descriptors of abundance and richness in the 20 dredge samples from June 2010.

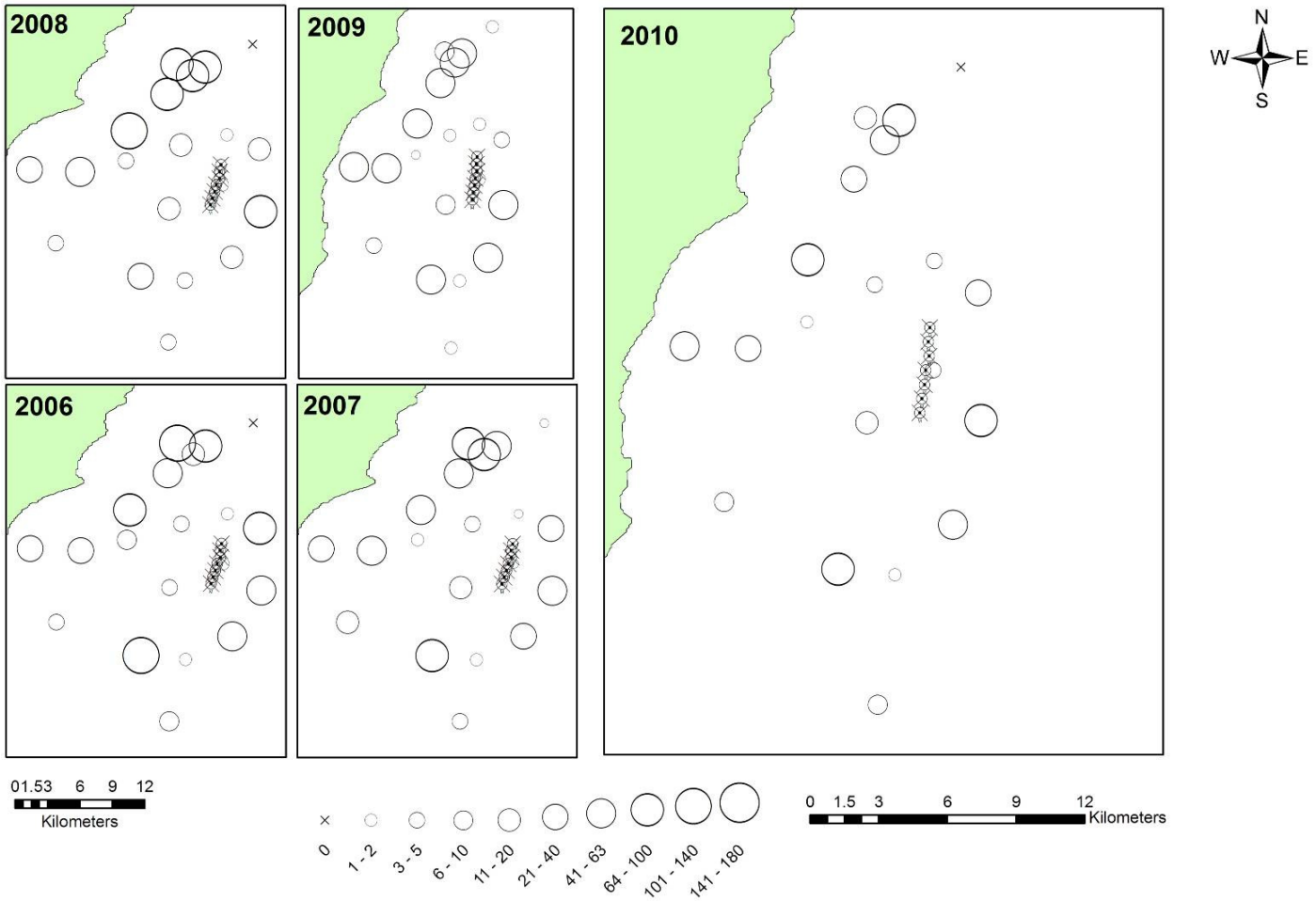


Figure 3.2.3 Total number of taxa per anchor dredge (June 2006, May 2007, May 2008, June 2009 & June 2010)

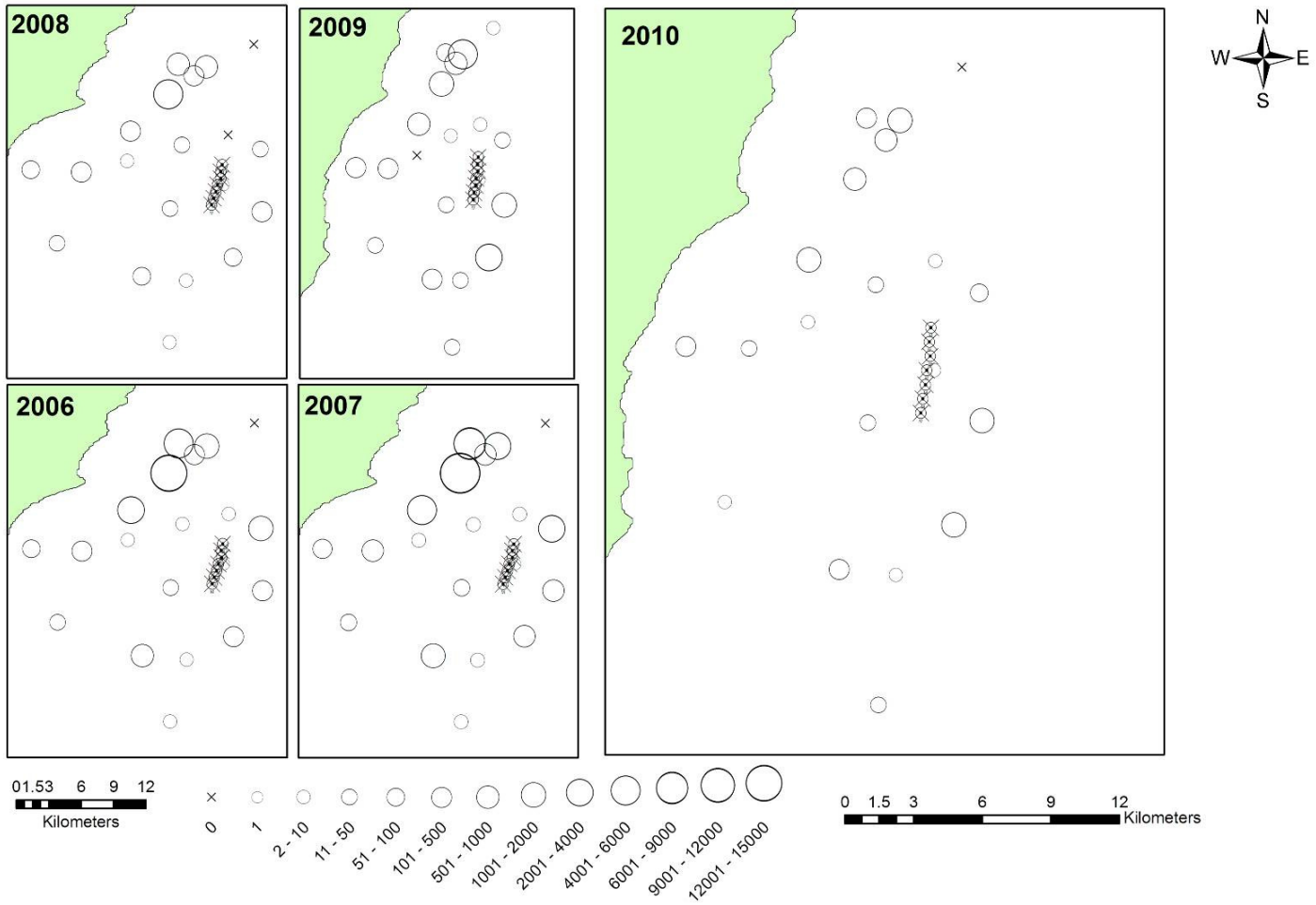


Figure 3.2.4 Total number of countable invertebrates per anchor dredge (June 2006, May 2007, May 2008, June 2009 & June 2010)

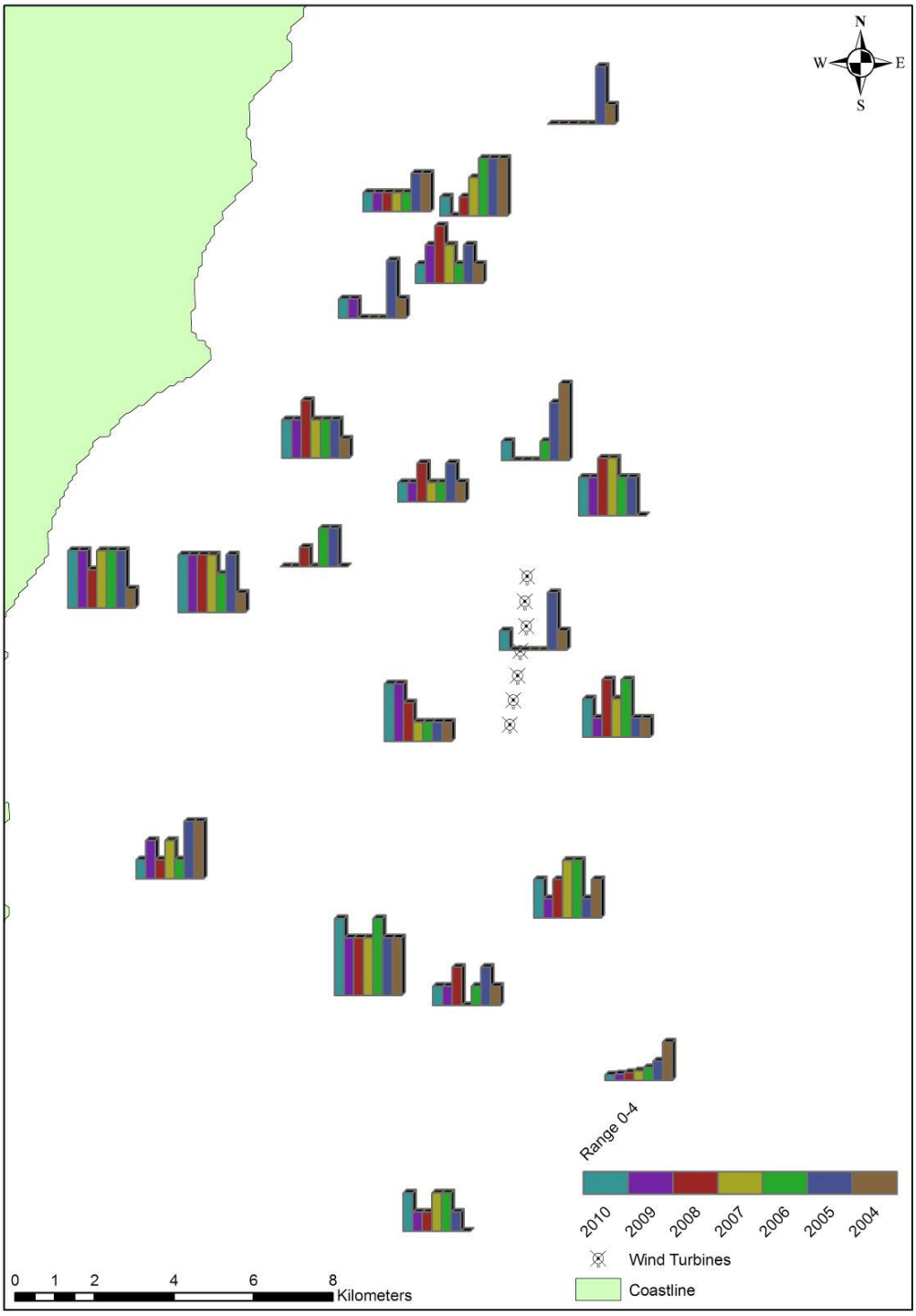


Figure 3.2.5 Shannon Wiener diversity indices per anchor dredge (October 2004, June 2005, June 2006, May 2007, May 2008, June 2009 & June 2010)

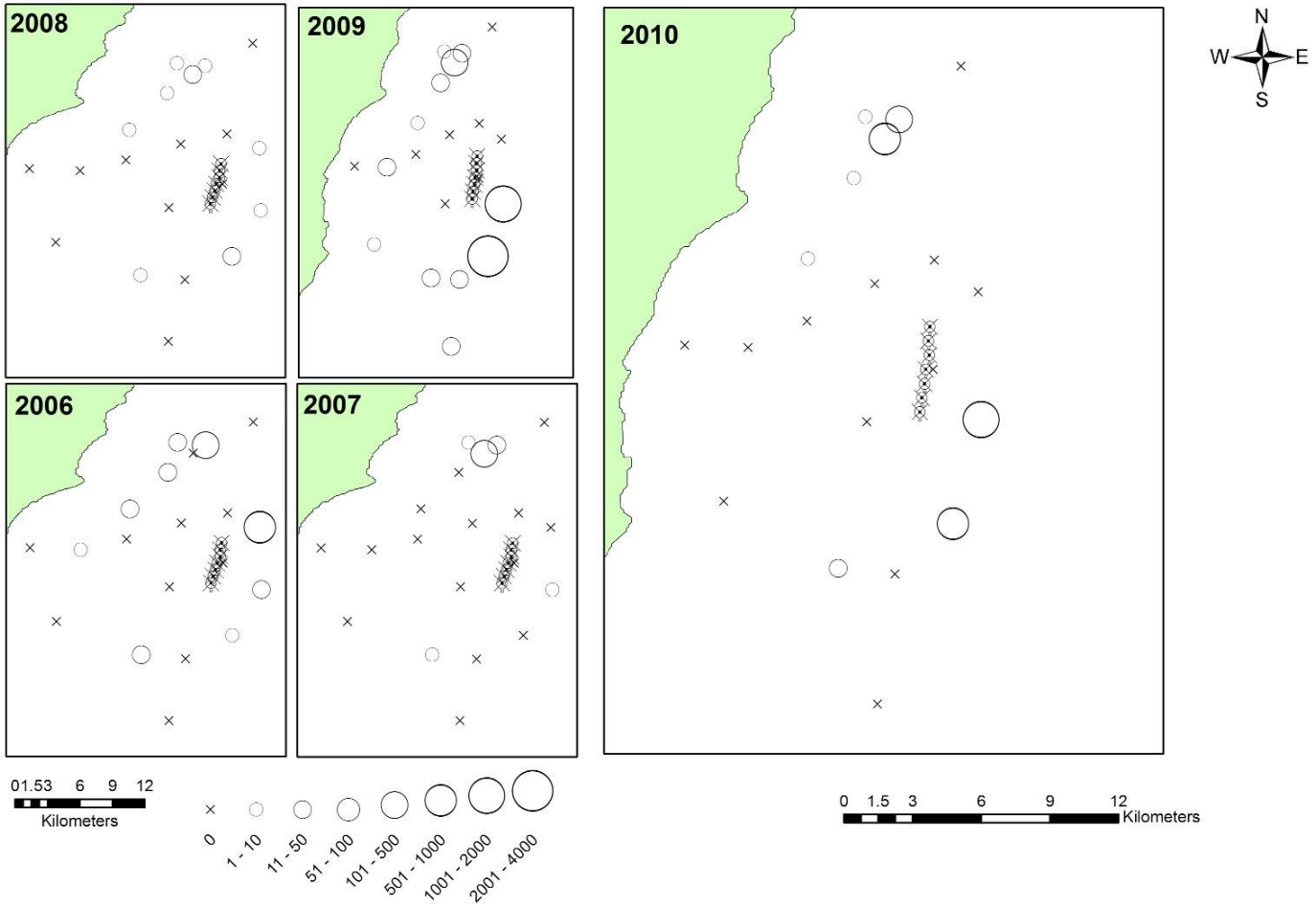


Figure 3.2.6 Total number of *Sabellaria* spp. found at each dredge (June 2006, May 2007, May 2008, June 2009 & June 2010)

Table3.2.3 List of the most abundant taxa (where >60 individuals were recorded across the survey area) in descending order of abundance from the anchor dredge survey of June 2010.

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Total
Annelida	*Pomatoceros lamarcki*	2	5	0	648	135	3	1393	0	10	8	4	0	0	8	2	0	0	528	0	4	2750
Annelida	*Sabellaria spinulosa*	0	0	0	5	3	13	68	0	0	1152	468	0	0	27	0	0	0	7	0	0	1743
Annelida	*Sabellaria alveolata*	0	0	0	3	0	577	75	0	0	139	328	0	0	1	0	0	0	0	0	0	1123
Mollusca	*Nucula nucleus*	0	0	0	27	0	2	1	0	0	0	0	0	0	0	0	0	0	499	0	1	530
Mollusca	*Abra alba*	54	0	0	0	0	14	0	0	0	0	204	0	0	1	0	0	0	11	1	0	285
Annelida	*Jasmineira elegans*	0	0	0	2	0	21	7	0	0	87	40	0	0	13	0	0	0	20	0	0	190
Amphipoda	*Urothoe brevicornis*	0	6	0	6	0	12	0	0	0	6	0	1	0	0	0	2	0	81	0	0	114
Annelida	*Clymenura johnstoni*	4	6	0	4	0	1	18	0	0	23	4	0	0	37	0	0	0	7	0	0	104
Annelida	*Lumbrineris gracilis*	1	0	0	1	0	1	1	0	0	35	44	0	0	8	2	0	0	0	0	0	93
Decapoda	*Pisidia longicornis*	0	0	0	0	0	54	1	0	0	4	16	0	0	2	0	0	0	2	0	0	79

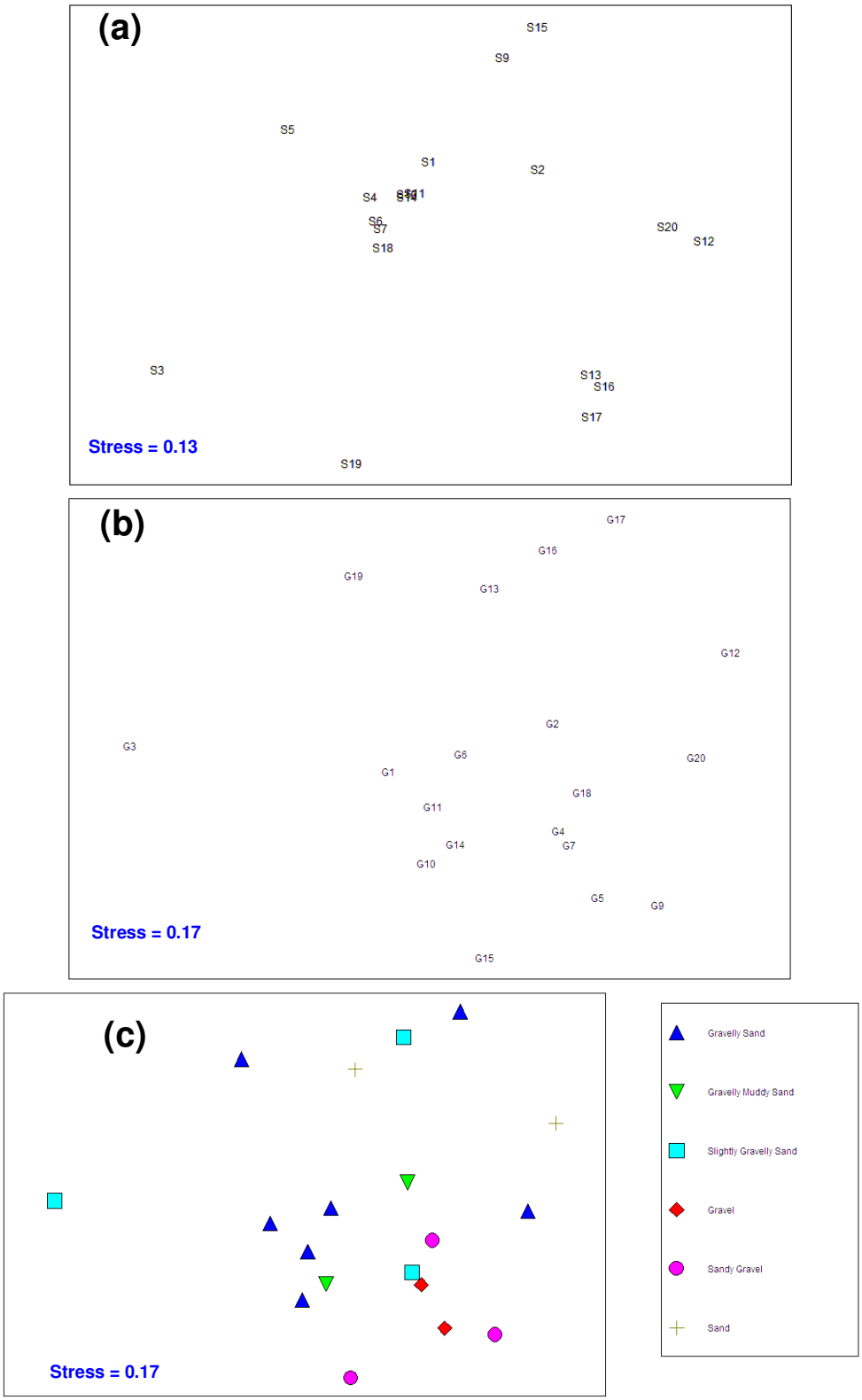


Figure 3.2.7 Multi-dimensional scaling plot of faunal data from the anchor dredge survey, June 2010. [(a) Presence/Absence data; (b) Abundance data, colonial organisms removed; (c) Abundance data, no colonial's; with sedimentary environment superimposed]

3.3 Biotope Classification

Because of the nature of the current monitoring survey and the inherent differences in sampling protocol undertaken in both study types, direct comparison of the datasets is difficult. As such, it is easier to assess the communities identified in each of the surveys to assess potential change in the benthos compared to the baseline survey. The baseline survey undertaken in 2000 identified six separate biotopes within the survey (Ecoserve 2001) area using the 1997 JNCC classification system (Connor *et al*, 1997). These are presented in Table 3.3.1.

Biotope Classification	**Description of Biotope**	**Approximate location within the survey area**
IGS.Mob	Sparse fauna in infralittoral mobile clean sand	Along the Arklow Bank and to the south-west of the survey area. Small presence closer inshore near Arklow.
IGS.Scup.Hyd	*Sertularia cupressina* and *Hydrallmania falcata* on tide swept sublittoral cobbles or pebbles in coarse sand	Immediately surrounding the Arklow Bank, and also dominating the north-east corner of the survey area
MCR.CSab	Circalittoral *Sabellaria* reefs	Present north-west of the survey area. Also small patches located to the west of the survey area towards Arklow.
MCR	Circalittoral rock or mixed substrata in moderately exposed environments.	Immediately to the east of the Arklow Bank.
MCR.Flu	*Flustra foliacea* and other hydroid/bryozoan turf species on slightly scoured circalittoral rock or mixed substrata	To the north-west of the survey area surrounding MCR.CSab
IMS	Infralittoral clean or muddy sand	Immediately within the vicinity of Arklow Town.

Table 3.3.1 Biotope classifications identified in baseline survey (Ecoserve, 2001)

The current data is presented in Table 3.3.2 with the sampling positions broadly classified using the JNCC classification scheme for marine biotopes. To facilitate comparison with the baseline data, the 1997 JNCC classification was used (Connor *et al*., 1997).

	Biotope Classification		Biotope Classification
Station 1	IGS.FaS Shallow sand faunal communities [Previously IGS.FaS.Scup.Hyd *Serularia cupressina* and *Hydrallmania flacata* on tide-swept sublittoral cobbles or pebbles in coarse sand.]	***Station 11***	MCR.CSab Circalittoral *Sabellaria* reefs. [No Change]
Station 2	IGS.FaS Shallow sand faunal communities [Previously reported as MCR Circalittoral rock or mixed substrata in moderately exposed environments.]	***Station 12***	IGS.Mob Sparse fauna in infralittoral mobile clean sand [No Change]
Station 3	IGS.Mob Sparse fauna in infralittoral mobile clean sand [No Change]	***Station 13***	IGS.Mob Sparse fauna in infralittoral mobile clean sand [No Change]
Station 4	MCR.Flu.SerHyd *Sertularia argentea*, *S. cupressina* and *Hydrallmania falcata* on tide swept circalittoral cobbles and pebbles [No Change]	***Station 14***	MCR Circalittoral rock or mixed substrata in moderately exposed environments. [No Change]
Station 5	MCR Circalittoral rock or mixed substrata in moderately exposed environments. [No Change]	***Station 15***	IGS.Mob Sparse fauna in infralittoral mobile clean sand [No Change]
Station 6	MCR.CSab Circalittoral *Sabellaria* reefs. [No Change]	***Station 16***	IGS.Mob Sparse fauna in infralittoral mobile clean sand [No Change]
Station 7	MCR.CSab Circalittoral *Sabellaria* reefs. [Previously MCR Circalittoral rock or mixed substrata in moderately exposed environments]	***Station 17***	IGS.Mob Sparse fauna in infralittoral mobile clean sand [No Change]
Station 8	IGS.Mob Sparse fauna in infralittoral mobile clean sand [No Change]	***Station 18***	MCR.Flu.Flu *Flustra foliacea* on slightly scoured silty circalittoral rock or mixed substrata. [No Change]
Station 9	MCR.Flu.Flu (*Flustra foliacea* on slightly scoured silty circalittoral rock or mixed substrata). [No Change]	***Station 19***	IGS.Mob Sparse fauna in infralittoral mobile clean sand [No Change]
Station 10	MCR.CSab Circalittoral *Sabellaria* reefs. [No Change]	***Station 20***	IGS.Mob Sparse fauna in infralittoral mobile clean sand [No Change]

Table 3.3.2 Biotope classifications identified in the present survey (June 2010).

4. DISCUSSION AND CONCLUSIONS

As identified previously, the survey area is characterised by a range of sediments ranging from sands to gravel which is reflected in the fish and invertebrate species identified during the survey. Previous scientific reviews have shown that the fish species expected to be found in these habitats are quite characteristic. In sandy areas <50m depth species diversity is reported to be pretty high with many elasmobranchs, gadoids, wrasses and flatfish. This is similar to species found in gravel areas <50m depth (Nash, 1990). The fish species which were found in the present survey are consistent with those found in previous surveys. Overall fish species and abundances are similar to those observed in 2008 & 2009which have increased on 2006 & 2007 surveys, and are similar in nature to the abundances and diversity on the 2004 and 2005 surveys. All species identified during the present and in previous trawl surveys are considered common throughout the survey area and within the Irish Sea (Ellis *et al*., 2000).

A total of 158 taxa were identified in the trawls during the present survey. Of these 158 taxa, 12 are fish species. Overall, the number of taxa identified is in keeping with previous surveys; the total number of taxa is higher than the June 2006 (98 taxa), June 2005 (47 taxa) and October 2004 (51 taxa) surveys and is similar to those identified in May 2007 (177 taxa), May 2008 (170 taxa) and June 2010 (132 taxa).

Total numbers of countable organisms in the trawls (1,819) has remained similar to 2009 (1,779) and similar to abundances recorded in 2006. Although numbers identified in the present survey are still much reduced from levels identified in 2007, this is directly related to the non-sampling of the *Sabellaria* reef identified in Trawl 3 that year.

The important *Sabellaria* reef communities identified in previous surveys were identified at four locations in the present survey. These biogenic reefs are very important and are listed under Annex I of the EU Habitats Directive (Code 1170: Reefs). They play an important role in stabilising sediments, in addition to improving species diversity and community stability (Holt *et al*., 1998). It should be noted that the distribution of the *Sabellaria* reef communities throughout the survey area would be considered patchy, which is reflected in the sporadic identification of reef communities across various stations over the years.

A detailed look of the biotopes present reveals a similar pattern to that found in the baseline survey. The Arklow Bank samples (Stations 8, 12, 16 & 17), in addition to the samples located to the south and west of the bank (Stations 3, 13, 15, 19 & 20), are all classified as IGS.Mob (Sparse fauna in infralittoral mobile clean sand). This agrees with the results of the baseline survey which showed similar distribution patterns for this community type (although it was interspersed with IGS.Scup.Hyd [*Sertularia cupressina* and *Hydrallmania falcata* on tide swept sublittoral cobbles or pebbles in coarse sand]). This is similar to results obtained in the survey of 2009.

Stations 1 & 2 have been tentatively classified as IGS.FaS (Shallow sand faunal communities). These stations have been previously classified as MCR (Station 2) and IGS.FaS.ScupHyd (Station 1). Further classification of these stations wasn't possible due to the absence of key identifying taxa.

As identified in 2009, a single station along the eastern part of the Arklow Bank (Station 9) is classified as MCR.Flu.Flu (*Flustra* foliacea on slightly scoured silty circalittoral rock or mixed substrata). Another inner shore site (Station 18) is also classified as MCR.Flu.Flu. This corresponds to findings observed in 2008 & 2009. A further two stations (Stations 5 & 14) are all classified as MCR. This corresponds to findings in the baseline survey which identify the presence of coarse sediments across the western part of the Arklow Bank.

A single site (Station 4) has been classified as *Sertularia argentea*, *S. cupressina* and *Hydrallmania falcate* on tide swept circalittoral cobbles and pebbles. This classification remains unchanged from the 2008 and 2009 surveys.

Reef communities were identified at four locations during the present survey. As previously reported, the reefs around the Arklow Bank would be considered patchy, and this is reflected in the variation of *Sabellaria* abundances and the sporadic identification of these reefs across the years. The largest number of reef sites identified within the survey area was in 2005, when a total of 5 reef sites were identified; three reef sites were identified in 2009 & 2004; two sites in 2006; one site in 2007; and no reef sites were identified in 2008.

The number of countable fauna identified in the present survey is reduced compared to 2009 (8,398 in 2010 compared to 12,564 in 2009). This is directly related a decrease in abundances of a single taxa, *Pomatoceros lamarcki* which reduced from 6,141 in 2009 to 2,750 in 2010. The numbers identified in the present survey are similar to those identified in 2008 (2,467). These abundances are much reduced compared to surveys undertaken between 2004 & 2007. The reason for the reduction in this species is unclear, although it may in part be related to small scale, local patchiness, typical of heterogeneous subtidal benthic communities.

There have been no records in the present survey of rare or unusual species. This is concurrent with findings in previous surveys with no rare or unusual species recorded in the survey area. Overall results from the present survey indicate that there is very little variation at the community level between the communities recorded in the present survey and the communities recorded in the baseline survey.

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6. APPENDICES

Appendix 6.1 Species List for Beam Trawl Survey; June 2010

ANNELIDA
Aphrodita aculeata
Autolytus alexandri
Autolytus brachycephalus
Autolytus indet.
Clymenura johnstoni
Eumida sanguinea
Eupolymnia nebulosa
Eusyllis blomstrandi
Harmothoe impar
Harmothoe indet.
Jasmineira elegans
Lanice conchilega
Lepidonotus squamatus
Lumbrineris gracilis
Nephtys cirrosa
Nephtys longosetosa
Nereis juv. indet.
Nereis pelagica
Nicolea venustula
Pholoe inornata
Phyllochaetopterus sp.
Polydora caeca
Polynoe scolopendrina
Pomatoceros lamarcki
Proceraea sp.
Sabella pavonina
Sabellaria alveolata
Sabellaria spinulosa
Sthenelais boa
Syllis armillaris
Syllis indet.
Syllis variegata
Thelepus cincinnatus
Thelepus setosus
Aphelochaeta marioni
Gattyana cirrosa
Glycera alba
Hydroidea indet
Hydroides norvegicus
Lysilla loveni
Nicomache personata
Notomastus latericeus
Procerastea sp.
Sabellides octocirrata
Sphaerodoropsis minuta
Sphaerodorum gracilis
Streblosoma intestinalis
Travisia forbesii
Websterinereis glauca

BRYOZOA
Alcyonidium parasiticum
Alcyonium digitatum
Bicellariella biciliata
Bryozoa
Bugula avicularia
Electra pilosa
Flustra foliacea
Scrupocellaria scruposa
Turbicellepora avicularis
Vesicularia spinosa
Alcyonidium diaphanum
Amphiblestrum foliacea
Cellepora pumicosa
Celleporina hassallii
Chorizopora brogniarti
Conopeum reticulum
Crisia sp.
Escharella immersa
Escharella ventricosa
Eucratea loricata
Fenestrulina malusii
Hippothoa divaricata
Membranipora membranacea
Tubulipora sp

CNIDARIA
Halecium halecinum
Hydractinia echinata
Hydralmania falcata
Sertularia cupressina
Abietinaria abietina
Actinia indet
Aurelia aurita
Chrysaora hysoscella
Obelia sp

CRUSTACEA
Ampelisca spinipes
Aora typica
Atylus guttatus
Atylus swammerdami
Balanus crenatus
Corophium bonnelii
Crangon almanni
Gastrosaccus spinifer
Hippolyte varians
Hyas coarctatus
Iphimedia obesa
Liocarcinus corrugatus

CRUSTACEA
Liocarcinus marmoreus
Liocarcinus sp. (juv)
Macropodia rostrata
Macropodia sp. (jv)
Pagurus bernhardus
Pandalus montagui
Philocheras trispinosus
Pisidia longicornis
Praunus inermis
Anoplodactylus petiolatus
Apherusa bispinosa
Colomastix pusilla
Epimeria cornigera
Eualus pusiolus
Galathea squamifera
Gammaropsis nitida
Idotea linearis
Lembos sp.
Leucothoe spinicarpa
Maera othonis
Melita obtusata
Photis sp.
Pinnotheres pisum
Scalpellum scalpellum
Thoralus cranchi
Urothoe brevicornis
Verruca stroemi

ARTHROPODA
Endeis spinosa

ECHINODERMATA
Asterias rubens
Crossaster papposus
Henricia sangionolenta
Psammechinus miliaris
Amphipholis squamata

MOLLUSCA
Buccinum undatum
Calliostoma zizyphinum
Heteranomia squamula
Lacuna crassior
Leptochiton asellus
Modiolarca subpicta
Modiolus modiolus
Mytilus edulis
Natica catena (eggmass)
Nudibranch sp indet
Sepiola atlantica
Spisula elliptica
Spisula solida

CHELICERATA
Anoplodactylus petiolatus
Nymphon brevirostre
MOLLUSCA
Circomphalus casina
Dendronotus frondosus
Euspira pulchella
Lamellaria latens
Monia patelliformis
Musculus costulatus
Musculus discors
PISCES
Agonus cataphractus
Ammodytes tobianus
Callionymus lyra
Pleuronectes platessa
Solea solea
Pholus gunnelus
Echiichthys vipera
Merlangius merlangus
Raja montagui
Hyperoplus lanceolatus
Scylliorhinus caniculus
Trisopterus minutus
PORIFERA
Porifera indet
Scypha ciliata
Suberites domuncula
TUNICATA
Ascidiella scabra
Dendrodoa grossularia
CTENOPHORA
Pleurobrachia indet
NEMERTEA
Oerstedia dorsalis

Appendix 6.2 Species List for Anchor Dredge Survey; June 2010

Annelid

Adyte pellucida
Alentia gelatinosa
Gattyana cirrosa
Harmothoe indet.
Lepidonotus squamatus
Polynoe scolopendrina
Pholoe inornata
Pholoe synophthalmica
Sthenelais boa
Eteone foliosa
Mystides caeca
Phyllodoce groenlandica
Eulalia aurea
Eulalia ornata
Eulalia viridis
Eumida juv. indet.
Eumida ockelmanni
Eumida sanguinea
Glycera indet.
Glycera lapidum
Glycera tridactyla
Glycinde nordmanni
Goniada maculata
Kefersteinia cirrata
Syllis sp. D
Syllis sp. H
Syllis armillaris
Syllis variegata
Eusyllis blomstrandi
Odontosyllis fulgurans
Opisthodonta sp.
Exogone verugera
Sphaerosyllis bulbosa
Sphaerosyllis tetralix
Autolytus indet.
Autolytus alexandri
Autolytus brachycephalus
Nereis elitoralis
Nereis longissima
Nereis pelagica
Nephtys caeca
Nephtys cirrosa
Nephtys kersivalensis
Eunicidae indet.
Marphysa bellii
Nematonereis unicornis
Lumbrineris gracilis
Notocirrus scoticus
Protodorvillea kefersteini
Scoloplos armiger
Paraonidae indet.
Aricidea catherinae
Paradoneis lyra
Poecilochaetus serpens
Aonides oxycephala
Aonides paucibranchiata
Laonice bahusiensis
Polydora indet.
Polydora caulleryi
Polydora flava
Pseudopolydora paucibranchiata
Pseudopolydora pulchra
Pygospio elegans
Spio martinensis
Spio armata
Spio decorata
Spiophanes bombyx
Magelona filiformis
Cirratulidae indet.
Aphelochaeta marioni
Caulleriella alata
Caulleriella zetlandica
Chaetozone sp.
Tharyx killariensis
Macrochaeta helgolandica
Mediomastus fragilis
Notomastus latericeus
Maldanidae indet.
Praxillura longissima
Clymenura johnstoni
Euclymene lombricoides
Euclymene oerstedii
Praxillella affinis
Nicomache personata
Ophelia borealis
Travisia forbesii
Ophelina acuminata
Asclerocheilus sp. 1
Scalibregma celticum
Scalibregma inflatum
Galthowenia oculata
Owenia fusiformis
Lagis koreni
Sabellaria alveolata
Sabellaria spinulosa
Ampharete lindstroemi
Anobothrus gracilis
Lanice conchilega
Nicolea zostericola
Lysilla loveni
Polycirrus indet.
Polycirrus medusa
Polycirrus norvegicus
Streblosoma intestinalis
Thelepus cincinnatus
Thelepus setosus
Sabellidae indet.
Chone indet.
Euchone rubrocincta
Jasmineira elegans
Pseudopotamilla reniformis
Sabella pavonina
Hydroides norvegicus
Pomatoceros lamarcki
Tubificoides benedii

Bryozoa

Alcyonidium diaphanum
Electra pilosa
Amphiblestrm foliacea
Bicellariella biciliata
Bugula avicularia
Cellepora pumicosa
Chorizopora brongniartii
Conopeum reticulum
Escharella immersa
Eucratea loricata
Flustra foliacea
Membranipora membranacea
Scrupocellaria scruposa
Securiflustra securifrons

Chaetognath

Spadella cephaloptera

Chelicerata

Nymphon brevirostre

Cnidaria

Cerianthus lloydii
Edwardsia claparedii
Abietinaria abietina
Halecium halecinum
Obelia sp.
Sertularia cupressina

Crustacea

Ischryocerid
Aora gracilis
Pseudoprotella phasma
Anthura gracilis
Gammaridea indet.
Ampelisca sp.
Ampelisca spinipes

Crustacea contd.
Ampelisca tenuicornis
Apherusa bispinosa
Atylus swammerdami
Balanus crenatus
Bathyporeia guilliamsoniana
Corophium bonnelii
Cumopsis goodsiri
Ebalia tuberosa
Epimeria cornigera
Ericthonius sp
Gammaropsis nitida
Gastrosaccus spinifer
Gnathia sp
Harpinia crenulata
Harpinia indet
Hyas coarctatus
Iphimedia obesa
Janira maculosa
Leucothoe spinicarpa
Maera othonis
Maerella tenuimana
Microjassa cumbrensis
Pagurus bernhardus
Photis sp.
Phtisica marina
Pisidia longicornis
Scalpellum scalpellum
Thoralus cranchi
Tryphosella sarsi
Unciola crenatipalma
Urothoe brevicornis
Urothoe elegans
Xantho sp (juv)

Echinodermata
Leptosynapta indet.
Amphiura filiformis
Asterias rubens
Holothuria forskali
Ophiothrix fragilis
Psammechinus miliaris

Nemertea
Nemertea indet.
Tubulanus polymorphus
Cerebratulus sp. 1

Phoronida
Phoronis indet.

Porifera
Scypha ciliata
Porifera indet

Sipuncula
Sipuncula juv. indet.

Golfingia vulgaris
Nephasoma minutum

Tunicata
Dendrodoa grossularia
Ascidiella scabra
Molgula manhattensis

Mollusc
Nudibranchia indet
Abra alba
Abra prismatica
Acanthochitona crinita
Gibbula cineraria
Heteranomia squamula
Hiatella arctica
Lacuna crassior
Leptochiton asellus
Limaria hians
Modiolus modiolus
Musculus costulatus
Musculus discors
Mytilus edulis
Nucula nucleus
Oenopota rufa
Phaxas pellucidus
Philine sp
Spisula elliptica
Spisula solida
Timoclea ovata
Trivia arctica

Pisces
Ammodytes tobianus

Appendix 6.3 Total results from the Beam Trawl June 2010

Trawl Description

	Trawl 1	Trawl 2	Trawl 3	Trawl 4	Trawl 5	Trawl 6
Description	Good Trawl Sample, contains Bryozoans & Starfish	Good Trawl Sample with Bryozoans, Jellyfish & Starfish	Good Trawl Sample with Bryozoans & *Pagurus bernhardus*	Good Trawl Sample, contains Bryozoans & Starfish	Good Trawl Sample with Bryozoans & shell gravel	Good Trawl Sample with shell & shell gravel
Date of hauling	24/06/2010	24/06/2010	25/06/2010	25/06/2010	24/06/2010	22/06/2009
Time of hauling	1822	1740	1014	1120	2255	2120
Layback/warp (m)	125	175	150	175	200	225
Speed of Vessel (kts)	1.5	1.4	1.4	1.8	1.8	1.6
Vessel Bearing	180°	180°	180°	0°	0°	180°

Table of Contents for the Beam Trawls taken during the course of the June 2010 survey.

	TRAWL1	TRAWL 2	TRAWL 3	TRAWL 4	TRAWL 5	TRAWL 6
Abietinaria abietina	0	0	0	0	P	0
Actinia indet	0	0	P	0	0	0
Agonus cataphractus	1	0	0	0	1	0
Alcyonidium diaphanum	P	P	P	P	P	P
Alcyonidium parasiticum	P	0	0	0	0	0
Alcyonium digitatum	P	0	0	0	P	0
Ammodytes tobianus	0	0	0	0	1	P
Ampelisca spinipes	0	0	0	0	1	0
Amphiblestrm foliacea	0	0	0	P	P	0
Amphipholis squamata	0	0	0	0	0	1
Anoplodactylus petiolatus	2	0	0	0	0	0
Aora typica	40	0	0	0	0	0
Aphelochaeta marioni	0	0	0	0	0	1
Apherusa bispinosa	0	0	0	0	0	1
Aphrodita aculeata	0	0	0	0	1	0
Ascidiella scabra	P	0	P	P	0	P
Asterias rubens	20	5	0	6	5	0
Atylus guttatus	0	0	0	1	0	0
Atylus swammerdami	0	48	3	1	0	0
Aurelia aurita	0	3	0	4	0	0
Autolytus alexandri	4	0	0	0	0	1
Autolytus brachycephalus	2	0	0	0	0	0
Autolytus indet.	0	0	0	0	2	0
Balanus crenatus	32	12	20	31	1	52
Bicellariella biciliata	0	0	0	0	0	P
Bryozoa	P	0	0	0	P	0
Buccinum undatum	2	0	0	1	0	0
Bugula avicularia	0	0	P	0	P	P
Calliostoma zizyphinum	0	0	0	0	0	1
Cellepora pumicosa	0	0	0	0	P	P
Celleporina hassallii	0	0	0	0	P	0
Chorizopora brogniarti	0	0	0	0	0	P

	TRAWL1	TRAWL 2	TRAWL 3	TRAWL 4	TRAWL 5	TRAWL 6
Chrysaora hysoscella	0	1	0	0	0	0
Circomphalus casina	2	0	0	0	0	0
Clymenura johnstoni	0	0	0	0	1	0
Colomastix pusilla	0	0	0	0	1	0
Conopeum reticulum	0	0	0	P	P	0
Corophium bonnelii	6	0	0	0	0	0
Crangon almanni	12	2	0	44	134	26
Crisia sp.	0	0	P	0	P	0
Crossaster papposus	2	0	0	1	0	0
Dendrodoa grossularia	0	0	1	0	3	0
Dendrodoa grossularia	0	0	P	0	0	0
Dendronotus frondosus	0	2	0	0	0	0
Electra pilosa	P	0	P	P	P	P
Endeis spinosa	10	0	0	0	0	0
Epimeria cornigera	0	0	0	1	0	1
Escharella immersa	0	0	0	0	P	P
Escharella ventricosa	0	0	0	0	P	0
Eualus pusiolus	0	0	0	1	0	0
Eucratea loricata	P	0	0	0	P	0
Eumida sanguinea	8	0	0	1	1	0
Eupolymnia nebulosa	4	0	0	0	0	1
Euspira pulchella	0	0	0	0	0	1
Eusyllis blomstrandi	34	9	2	0	3	6
Fenestrulina malusii	0	0	0	0	P	0
Flustra foliacea	P	P	0	P	P	P
Galathea squamifera	0	0	0	0	1	0
Gamaropsis nitida	48	4	0	0	7	18
Gastrosaccus spinifer	0	2	0	0	0	9
Gattyana cirrosa	0	0	0	0	2	0
Glycera alba	2	0	0	0	0	0
Halecium halecinum	P	0	P	0	P	0
Harmothoe impar	2	0	0	0	0	0
Harmothoe indet.	46	1	1	3	5	0
Henricia sangionolenta	2	0	0	0	0	0
Heteranomia squamula	0	2	0	5	0	0
Hippolyte varians	0	0	0	0	2	1
Hippothoa divaricata	0	0	0	0	P	0
Hyas coarctatus	12	2	0	1	5	1
Hydractinia echinata	0	0	0	0	P	0
Hydralmania falcata	0	P	0	0	0	0
Hydroidea indet	P	0	0	0	0	0
Hydroides norvegicus	0	0	0	2	2	1
Idotea linearis	0	1	2	0	0	0
Iphimedia obesa	6	0	0	0	0	0
Jasmineira elegans	2	0	0	1	2	0
Lacuna crassior	0	0	0	3	0	0
Lamellaria latens	0	0	0	0	0	1
Lanice conchilega	13	0	0	0	6	0
Lembos sp.	0	0	0	2	0	0
Lepidonotus squamatus	20	0	0	6	9	0
Leptochiton asellus	0	10	0	0	0	0
Leucothoe spinicarpa	4	0	0	0	0	0
Liocarcinus corrugatus	0	0	0	0	3	0

	TRAWL1	TRAWL 2	TRAWL 3	TRAWL 4	TRAWL 5	TRAWL 6
Liocarcinus marmoreus	2	0	0	0	0	0
Liocarcinus sp. (juv)	2	4	3	12	16	1
Lumbrineris gracilis	0	0	0	0	1	0
Lysilla loveni	0	0	0	0	1	0
Macropodia rostrata	0	0	0	3	7	0
Macropodia sp. (jv)	32	0	0	0	0	1
Maera othonis	0	1	0	0	0	0
Melita obtusata	38	0	0	0	3	1
Membranipora membranacea	P	0	P	0	0	0
Modiolarca subpicta	0	0	0	0	0	1
Modiolus modiolus	0	1	0	4	0	0
Monia patelliformis	0	0	0	1	0	0
Musculus costulatus	0	0	0	2	0	0
Musculus discors	0	0	0	0	0	2
Mytilus edulis	0	10	0	9	0	2
Natica catena (eggmass)	0	0	0	P	0	0
Nephtys cirrosa	0	0	0	0	0	3
Nephtys longosetosa	2	0	0	0	0	4
Nereis juv. indet.	0	0	0	0	1	0
Nereis pelagica	10	0	0	2	0	0
Nicolea venustula	2	0	0	0	0	0
Nicomache personata	0	0	0	0	9	0
Notomastus latericeus	0	0	0	0	1	0
Nudibranch sp indet	0	0	1	1	0	1
Nymphon brevirostre	10	0	0	0	0	0
Obelia sp.	0	0	0	P	0	P
Oerstedia dorsalis	0	0	0	0	0	1
Pagurus bernhardus	6	7	7	11	6	32
Pandalus montagui	72	0	0	85	112	18
Philocheras trispinosus	6	0	0	0	0	0
Pholoe inornata	2	0	0	0	0	1
Photis sp.	0	0	0	1	0	0
Phyllochaetopterus sp.	2	0	0	0	0	0
Pinnotheres pisum	0	0	0	0	1	0
Pisidia longicornis	12	0	0	65	4	0
Pleurobrachia indet	0	18	0	0	0	0
Polydora caeca	0	0	0	0	2	0
Polynoe scolopendrina	10	0	0	0	2	0
Pomatoceros lamarcki	6	0	0	9	32	7
Porifera indet	P	0	0	0	0	0
Praunus inermis	0	0	0	0	1	2
Proceraea sp.	2	0	0	0	0	0
Procerastea sp.	2	0	0	0	0	0
Psammechinus miliaris	11	0	0	2	9	0
Sabella pavonina	6	0	0	0	0	0
Sabellaria alveolata	2	0	0	2	0	0
Sabellaria spinulosa	0	0	1	8	4	1
Sabellides octocirrata	2	0	0	0	0	0
Scalpellum scalpellum	0	0	0	0	2	1
Scrupocellaria scruposa	0	0	0	0	0	P
Scypha ciliata	P	0	P	0	P	P
Sepiola atlantica	0	0	0	1	0	0
Sertularia cupressina	P	0	P	P	P	P

	TRAWL1	TRAWL 2	TRAWL 3	TRAWL 4	TRAWL 5	TRAWL 6
Sphaerodoropsis minuta	2	0	0	0	0	0
Sphaerodorum gracilis	2	0	0	0	0	0
Spisula elliptica	0	0	0	0	0	2
Spisula solida	0	0	0	0	0	3
Sthenelais boa	8	0	0	0	1	0
Streblosoma intestinalis	0	0	0	0	4	0
Suberites domuncula	P	0	0	0	0	0
Syllis armillaris	0	0	0	1	0	0
Syllis indet.	0	0	0	0	1	0
Syllis variegata	4	0	0	0	0	1
Thelepus cincinnatus	2	0	0	2	1	0
Thelepus setosus	30	0	0	2	2	0
Thoralus cranchi	0	7	0	0	0	0
Travisia forbesii	0	0	0	0	0	1
Tubulipora sp	0	0	0	0	P	0
Turbicellepora avicularis	0	0	P	0	0	0
Urothoe brevicornis	0	1	0	0	0	0
Verruca stroemi	0	0	0	1	0	0
Vesicularia spinosa	P	0	P	0	0	P
Websterinereis glauca	0	0	0	0	0	1

Appendix 6.4 Total fish numbers and lengths

	Trawl 1	Trawl 2	Trawl 3	Trawl 4	Trawl 5	Trawl 6
Callionymus lyra	1 [50]			1 [180]		
Pleuronectes platessa	1 [200]	2 [210 ,220]		1 [280]		
Solea solea	1 [210]					
Pholus gunnelus	1 [100]					
Ammodytes tobanius		8 [50, 55, 60, 60, 60, 70, 80, 80]			1 [x]	2 [100, x]
Echiichthys vipera		2 [40, 50]	2 [40, 40]			
Merlangius merlangius		1 [50]				
Raja montagui			1 [180]			
Hyperoplus lanceolatus						1 [250]
Scyliorhinus caniculus						1 [500]
Trisopterus minutus						4 [70, 60, 100, 120]
Agonus cataphractus	1 [x]				1 [x]	

Measurements in mm (where possible) of all fish species; June 2010. [x – Denotes where no measurements were taken; j – indicates juveniles]

Appendix 6.5 Anchor dredge raw data, June 2010

		S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17	S18	S19	S20
Annelid	*Adyte pellucida*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Annelid	*Alentia gelatinosa*	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annelid	*Ampharete lindstroemi*	1	0	0	0	0	0	0	0	0	11	4	0	0	9	0	0	0	0	0	0
Annelid	*Anobothrus gracilis*	0	0	0	0	0	0	0	0	0	3	0	0	0	22	0	0	0	0	0	0
Annelid	*Aonides oxycephala*	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annelid	*Aonides paucibranchiata*	0	0	0	0	0	0	0	0	0	2	4	0	0	1	0	0	0	0	0	0
Annelid	*Aphelochaeta marioni*	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	1	0	0
Annelid	*Aricidea catherinae*	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annelid	*Asclerocheilus sp*	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annelid	*Autolytus alexandri*	0	0	0	2	0	0	4	0	0	0	0	0	0	1	0	0	0	6	0	0
Annelid	*Autolytus brachycephalus*	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0
Annelid	*Autolytus indet*	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0
Annelid	*Caulleriella alata*	3	0	0	0	0	0	0	0	0	4	0	0	0	1	1	0	0	0	0	0
Annelid	*Caulleriella zetlandica*	10	0	0	0	0	0	0	0	0	3	0	0	0	0	2	0	0	0	0	0
Annelid	*Chaetozone sp*	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annelid	*Chone indet*	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Annelid	*Cirratulidae indet*	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Annelid	*Clymenura johnstoni*	4	6	0	4	0	1	18	0	0	23	4	0	0	37	0	0	0	7	0	0
Annelid	*Eteone foliosa*	0	0	0	0	0	0	0	0	1	0	4	0	0	1	0	0	0	0	0	0
Annelid	*Euchone rubrocincta*	0	0	0	0	0	0	0	0	0	2	0	0	0	2	0	0	0	0	0	0
Annelid	*Euclymene lombricoides*	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0
Annelid	*Euclymene oerstedii*	9	0	0	0	0	0	0	0	0	1	0	0	0	2	0	0	0	0	0	0
Annelid	*Eulalia aurea*	0	0	0	0	1	0	0	0	0	6	16	0	0	2	0	0	0	0	0	0
Annelid	*Eulalia ornata*	0	0	0	0	0	5	9	0	0	8	0	0	0	0	0	0	0	0	0	0
Annelid	*Eulalia viridis*	0	0	0	0	0	0	3	0	0	1	0	0	0	0	0	0	0	0	0	0
Annelid	*Eumida juv. indet*	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Annelid	*Eumida ockelmanni*	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0
Annelid	*Eumida sanguinea*	0	0	0	11	0	0	17	0	0	3	0	0	0	2	0	0	0	5	0	0
Annelid	*Eunicidae indet*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Annelid	*Eusyllis blomstrandi*	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0
Annelid	*Exogone verugera*	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Annelid	*Galthowenia oculata*	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annelid	*Gattyana cirrosa*	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	3	0	0

		S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17	S18	S19	S20
Annelid	*Glycera indet*	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annelid	*Glycera lapidum*	1	0	0	0	0	0	1	0	3	5	12	0	0	1	5	0	0	0	0	0
Annelid	*Glycera tridactyla*	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annelid	*Glycinde nordmanni*	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Annelid	*Goniada maculata*	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Annelid	*Harmothoe indet*	0	0	0	0	0	7	4	0	0	8	0	0	0	1	0	0	0	7	0	0
Annelid	*Hydroides norvegicus*	0	0	0	0	0	0	2	0	0	2	0	0	0	2	1	0	0	0	0	0
Annelid	*Jasmineira elegans*	0	0	0	2	0	21	7	0	0	87	40	0	0	13	0	0	0	20	0	0
Annelid	*Kefersteinia cirrata*	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Annelid	*Lagis koreni*	1	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0
Annelid	*Lanice conchilega*	22	2	0	1	0	0	0	0	0	3	4	0	0	1	0	0	0	3	0	0
Annelid	*Laonice bahusiensis*	0	2	0	0	0	0	0	0	0	0	0	0	0	3	4	0	0	0	0	0
Annelid	*Lepidonotus squamatus*	0	0	0	1	1	8	1	0	0	1	0	0	0	2	0	0	0	1	0	0
Annelid	*Lumbrineris gracilis*	1	0	0	1	0	1	1	0	0	35	44	0	0	8	2	0	0	0	0	0
Annelid	*Lysilla loveni*	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Annelid	*Macrochaeta helgolandica*	0	0	0	0	0	0	0	0	6	0	0	0	0	0	1	0	0	0	0	0
Annelid	*Magelona filiformis*	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annelid	*Maldanidae indet*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Annelid	*Marphysa bellii*	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0
Annelid	*Mediomastus fragilis*	0	0	0	0	0	0	1	0	0	2	0	0	0	2	0	0	0	1	0	0
Annelid	*Mystides caeca*	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Annelid	*Nematonereis unicornis*	0	0	0	0	0	0	0	0	0	1	0	0	0	2	0	0	0	0	0	0
Annelid	*Nephtys caeca*	2	0	0	0	0	2	0	0	0	7	0	0	0	1	0	0	0	0	0	0
Annelid	*Nephtys cirrosa*	0	2	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	4
Annelid	*Nephtys kersivalensis*	0	0	0	0	0	0	0	0	0	0	8	0	0	3	0	0	0	0	0	0
Annelid	*Nereis elitoralis*	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annelid	*Nereis longissima*	0	0	0	0	0	11	0	0	0	3	24	0	0	1	0	0	0	0	0	0
Annelid	*Nereis pelagica*	0	0	0	0	0	0	0	0	0	10	4	0	0	1	0	0	0	0	0	0
Annelid	*Nicolea zostericola*	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Annelid	*Nicomache personata*	0	0	0	0	0	0	0	0	0	36	4	0	0	0	0	0	0	0	0	0
Annelid	*Notocirrus scoticus*	2	0	0	0	0	0	0	0	0	6	0	0	0	4	0	0	0	0	0	0
Annelid	*Notomastus latericeus*	0	0	0	1	0	4	0	0	0	2	20	0	0	7	0	0	0	0	1	0
Annelid	*Odontosyllis fulgurans*	0	0	0	1	0	0	0	0	0	3	0	0	0	2	0	0	0	0	0	0
Annelid	*Ophelia borealis*	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	4	0
Annelid	*Ophelina acuminata*	5	2	0	0	0	0	0	0	0	3	8	0	0	3	0	0	0	2	0	0
Annelid	*Opisthodonta sp*	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0

		S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17	S18	S19	S20
Annelid	*Owenia fusiformis*	2	0	0	0	0	0	0	0	0	3	0	0	0	2	0	0	0	1	0	0
Annelid	*Paradoneis lyra*	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Annelid	*Paraonidae indet*	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Annelid	*Pholoe inornata*	1	0	0	0	0	0	0	0	0	2	0	0	0	1	0	0	0	0	0	0
Annelid	*Pholoe synophthalmica*	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0
Annelid	*Phyllodoce groenlandica*	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annelid	*Poecilochaetus serpens*	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0
Annelid	*Polycirrus indet*	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0
Annelid	*Polycirrus medusa*	3	0	0	0	0	0	0	0	0	0	0	0	0	2	7	0	0	0	0	0
Annelid	*Polycirrus norvegicus*	0	0	0	2	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0
Annelid	*Polydora caulleryi*	0	0	0	0	21	3	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Annelid	*Polydora flava*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Annelid	*Polydora indet*	0	0	0	0	0	0	12	0	3	3	0	0	0	1	0	0	0	0	0	0
Annelid	*Polynoe scolopendrina*	1	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	11	0	0
Annelid	*Pomatoceros lamarcki*	2	5	0	648	135	3	1393	0	10	8	4	0	0	8	2	0	0	528	0	4
Annelid	*Praxillella affinis*	0	2	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0
Annelid	*Praxillura longissima*	0	0	0	0	0	0	0	0	0	3	0	0	0	1	0	0	0	0	0	0
Annelid	*Protodorvillea kefersteini*	0	0	0	0	0	0	0	0	0	0	8	0	0	0	0	0	0	0	0	0
Annelid	*Pseudopolydora paucibranchiata*	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Annelid	*Pseudopolydora pulchra*	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Annelid	*Pseudopotamilla reniformis*	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Annelid	*Pygospio elegans*	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Annelid	*Sabella pavonina*	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Annelid	*Sabellaria alveolata*	0	0	0	3	0	577	75	0	0	139	328	0	0	1	0	0	0	0	0	0
Annelid	*Sabellaria spinulosa*	0	0	0	5	3	13	68	0	0	1152	468	0	0	27	0	0	0	7	0	0
Annelid	*Sabellidae indet*	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0
Annelid	*Scalibregma celticum*	0	0	0	0	0	0	0	0	0	0	4	0	0	2	0	0	0	0	0	0
Annelid	*Scalibregma inflatum*	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0
Annelid	*Scoloplos armiger*	1	0	0	0	0	0	0	0	0	15	4	0	0	3	0	0	0	0	0	0
Annelid	*Sphaerosyllis bulbosa*	0	0	0	0	0	0	0	0	10	0	0	0	0	0	3	0	0	0	0	0
Annelid	*Sphaerosyllis tetralix*	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Annelid	*Spio armata*	1	0	0	1	0	5	9	0	0	0	8	0	5	2	0	1	1	6	0	0
Annelid	*Spio decorata*	1	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0
Annelid	*Spio martinensis*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Annelid	*Spiophanes bombyx*	2	2	0	0	0	0	0	0	0	0	4	0	0	2	0	0	0	0	0	0
Annelid	*Sthenelais boa*	0	0	0	0	0	0	0	0	0	3	4	0	0	0	0	0	0	1	0	0

		S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17	S18	S19	S20
Annelid	*Streblosoma intestinalis*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Annelid	*Syllis armillaris*	0	0	0	0	1	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0
Annelid	*Syllis D*	0	0	0	0	0	0	0	0	4	1	0	0	0	0	0	0	0	1	0	0
Annelid	*Syllis H*	0	2	0	1	0	0	0	0	11	0	0	0	0	0	5	0	0	0	0	0
Annelid	*Syllis variegata*	0	0	0	2	0	4	5	0	0	0	0	0	0	0	0	0	0	7	0	0
Annelid	*Tharyx killariensis*	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annelid	*Thelepus cincinnatus*	0	0	0	0	0	0	0	0	0	3	0	0	0	2	0	0	0	0	0	0
Annelid	*Thelepus setosus*	0	0	0	8	0	0	6	0	0	0	0	0	0	1	0	0	0	11	0	0
Annelid	*Travisia forbesii*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0
Annelid	*Tubificoides benedii*	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bryozoan	*Alcyonidium diaphanum*	P	0	0	P	P	0	P	0	P	0	0	0	0	0	0	0	0	0	0	0
Bryozoan	*Amphiblestrum foliacea*	0	0	0	0	0	0	P	0	0	P	0	0	0	0	0	0	0	P	0	0
Bryozoan	*Bicellariella biciliata*	P	0	0	P	P	P	P	0	0	0	P	0	0	0	0	0	0	P	0	0
Bryozoan	*Bugula avicularia*	0	0	0	0	0	0	P	0	0	P	0	0	0	0	0	0	0	P	0	0
Bryozoan	*Cellepora pumicosa*	0	0	0	P	0	0	P	0	P	P	P	0	0	P	0	0	0	0	0	0
Bryozoan	*Chorizopora brogniarti*	0	0	0	0	0	0	P	0	0	P	P	0	0	0	0	0	0	0	0	0
Bryozoan	*Conopeum reticulum*	P	0	P	0	P	P	0	0	0	P	0	0	0	P	0	0	0	P	P	0
Bryozoan	*Electra pilosa*	0	0	0	0	P	P	0	0	P	P	0	0	0	P	0	0	0	0	0	0
Bryozoan	*Escharella immersa*	0	0	0	P	0	0	0	0	0	P	P	0	0	P	0	0	0	P	P	0
Bryozoan	*Eucratea loricata*	0	0	0	0	0	0	P	0	0	P	0	0	0	0	0	0	0	0	0	0
Bryozoan	*Flustra foliacea*	P	P	0	0	0	P	P	0	P	P	0	0	0	0	0	0	0	0	0	0
Bryozoan	*Membranipora membranacea*	0	0	0	P	0	0	0	0	0	0	P	0	0	0	0	0	0	0	0	0
Bryozoan	*Scrupocellaria scruposa*	0	0	0	0	0	0	P	0	0	0	0	0	0	0	0	0	0	0	0	0
Bryozoan	*Securiflustra securifrons*	P	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chaetognath	*Spadella cephaloptera*	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Chelicerata	*Nymphon brevirostre*	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	4	0	0
Cnidaria	*Abietinaria abietina*	0	0	0	P	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cnidaria	*Cerianthus lloydii*	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cnidaria	*Edwardsia claparedii*	0	0	0	0	0	1	0	0	0	1	0	0	0	1	0	0	0	1	0	0
Cnidaria	*Halecium halecinum*	0	0	0	P	0	0	P	0	0	P	P	0	0	0	0	0	0	P	0	0
Cnidaria	*Obelia sp.*	0	0	0	0	0	0	P	0	0	P	0	0	0	0	0	0	0	0	0	0
Cnidaria	*Sertularia cupressina*	0	0	0	P	0	0	P	0	0	0	0	0	0	0	0	0	0	P	0	0
Crustacea	*Ampelisca*	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Crustacea	*Ampelisca spinipes*	1	0	0	1	0	0	0	0	0	2	0	0	0	2	0	0	0	0	0	0
Crustacea	*Ampelisca tenuicornis*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0
Crustacea	*Anthura gracilis*	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0

		S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17	S18	S19	S20
Crustacea	*Aora gracilis*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Crustacea	*Apherusa bispinosa*	0	0	0	0	0	1	4	0	0	0	0	0	0	0	0	0	0	0	0	0
Crustacea	*Atylus swammerdami*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0
Crustacea	*Balanus crenatus*	0	1	0	1	1	0	4	0	29	0	0	0	0	1	0	0	0	0	0	0
Crustacea	*Bathyporeia guilliamsoniana*	1	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crustacea	*Corophium bonnelii*	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	3	0	0
Crustacea	*Cumopsis goodsiri*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Crustacea	*Ebalia tuberosa*	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Crustacea	*Epimeria cornigera*	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crustacea	*Ericthonius sp*	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crustacea	*Gamaropsis nitida*	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	2	0	0
Crustacea	*Gammaridea indet*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Crustacea	*Gastrosaccus spinifer*	0	0	0	0	0	0	0	0	0	0	0	2	0	1	0	0	0	0	0	1
Crustacea	*Gnathia sp*	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crustacea	*Harpinia*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Crustacea	*Harpinia crenulata*	1	0	0	0	0	0	0	0	0	3	4	0	0	0	0	0	0	1	0	0
Crustacea	*Hyas coarctatus*	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Crustacea	*Iphimedia obesa*	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crustacea	*Ischryocerid*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Crustacea	*Janira maculosa*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Crustacea	*Leucothoe spinicarpa*	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	2	0	0
Crustacea	*Maera othonis*	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Crustacea	*Maerella tenuimana*	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crustacea	*Microjassa cumbrensis*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0
Crustacea	*Pagurus bernhardus*	0	0	0	0	0	0	1	0	0	2	0	0	0	1	0	0	0	1	0	0
Crustacea	*Photis sp*	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	2	0	0
Crustacea	*Phtisica marina*	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Crustacea	*Pisidia longicornis*	0	0	0	0	0	54	2	0	0	4	16	0	0	2	0	0	0	2	0	0
Crustacea	*Pseudoprotella phasma*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Crustacea	*Scalpellum scalpellum*	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Crustacea	*Thoralus cranchi*	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crustacea	*Tryphosella sarsi*	0	0	0	0	0	0	0	0	9	0	0	0	1	0	0	0	0	0	0	0
Crustacea	*Unciola crenatipalma*	0	0	0	1	0	1	3	0	0	0	0	0	0	0	0	0	0	1	0	0
Crustacea	*Urothoe brevicornis*	0	6	0	6	0	12	0	0	0	6	0	1	0	0	0	2	0	81	0	0
Crustacea	*Urothoe elegans*	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	6	0	0
Crustacea	*Xantho sp (juv)*	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0

		S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17	S18	S19	S20
Echinoderm	*Amphiura filiformis*	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Echinoderm	*Asterias rubens*	0	0	0	0	0	2	1	0	0	0	0	0	0	0	0	0	0	1	0	0
Echinoderm	*Holothuria forskali*	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0
Echinoderm	*Leptosynapta indet*	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Echinoderm	*Ophiothrix fragilis*	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Echinoderm	*Psammechinus miliaris*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0
Mollusc	*Lacuna crassior*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Mollusc	*Abra alba*	54	0	0	0	0	14	0	0	0	0	204	0	0	1	0	0	0	11	1	0
Mollusc	*Abra prismatica*	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Mollusc	*Acanthochitona crinita*	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0
Mollusc	*Gibbula cineraria*	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mollusc	*Heteranomia squamula*	0	0	0	0	6	1	20	0	0	0	0	0	0	2	0	0	0	3	0	0
Mollusc	*Hiatella arctica*	0	0	0	1	2	15	7	0	0	0	0	0	0	0	0	0	0	5	0	0
Mollusc	*Leptochiton asellus*	1	0	0	2	0	1	1	0	0	0	4	0	0	12	0	0	0	16	0	0
Mollusc	*Limaria hians*	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Mollusc	*Modiolus modiolus*	0	0	0	0	0	2	5	0	0	0	0	0	0	0	0	0	0	5	0	0
Mollusc	*Musculus costulatus*	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	1	0	0
Mollusc	*Musculus discors*	0	0	0	0	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0
Mollusc	*Mytilus edulis*	0	0	0	0	0	0	9	0	0	0	0	0	0	0	0	0	0	0	0	0
Mollusc	*Nucula nucleus*	0	0	0	27	0	2	1	0	0	0	0	0	0	0	0	0	0	500	0	1
Mollusc	*Nudibranchia*	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	2	0	0
Mollusc	*Oenopota rufa*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0
Mollusc	*Phaxas pellucidus*	2	0	0	0	0	1	0	0	0	0	8	0	0	0	0	0	0	0	0	0
Mollusc	*Philine sp*	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Mollusc	*Spisula elliptica*	1	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Mollusc	*Spisula solida*	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Mollusc	*Timoclea ovata*	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0
Mollusc	*Trivia arctica*	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Nemertea	*Cerebratulus sp*	0	0	0	0	0	0	0	0	0	1	8	0	0	0	5	0	0	1	0	0
Nemertea	*Nemertea indet*	1	3	0	0	0	3	1	0	2	2	16	0	2	3	2	0	0	0	0	0
Nemertea	*Tubulanus polymorphus*	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Phoronida	*Phoronis indet*	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0
Pisces	*Ammodytes tobianus*	0	0	0	0	0	0	0	0	0	0	0	0	14	0	0	0	0	0	0	0
Porifera	*Porifera indet*	0	0	0	0	0	0	P	0	0	P	0	0	0	0	0	0	0	0	0	0
Porifera	*Scypha ciliata*	0	0	0	0	0	P	P	0	0	0	0	0	0	0	0	0	0	P	0	0
Sipuncula	*Golfingia vulgaris*	0	1	0	0	0	2	1	0	2	0	4	0	0	0	0	0	0	0	0	0

		S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17	S18	S19	S20
Sipuncula	*Nephasoma minutum*	0	2	0	0	0	0	4	0	0	6	4	0	0	0	0	0	0	9	0	0
Sipuncula	*Sipuncula juv. indet*	0	0	0	1	0	1	0	0	0	0	4	0	0	1	0	0	0	0	0	0
Tunicata	*Ascidiella scabra*	P	0	0	P	P	P	P	0	0	0	P	0	0	0	0	0	0	0	0	0
Tunicata	*Dendrodoa grossularia*	0	0	0	P	P	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tunicata	*Molgula manhatensis*	0	P	0	0	0	0	P	0	0	0	0	0	0	0	0	0	0	0	0	0
	Total number of Taxa (June 2010)	42	20	1	30	10	48	49	0	19	67	38	2	9	69	16	3	3	69	5	5
	Total number of Indiviuals (June 2010)	161	46	2	743	172	801	1720	0	97	1670	1320	3	27	242	46	4	3	1320	8	11
	Total number of Taxa (June 2009)	47	61	0	49	22	63	53	2	10	48	61	5	4	66	16	1	1	64	9	3
	Total number of Indiviuals (June 2009)	380	254	0	1529	84	587	4355	3	34	1474	2613	31	16	243	24	1	2	912	17	5
	Total number of Taxa (May 2008)	24	42	3	49	52	64	50	0	20	48	17	6	3	34	13	1	1	83	6	11
	Total number of Individuals (May 2008)	94	144	2	4666	737	306	891	0	26	115	65	7	3	73	21	1	0	471	12	17
	Total number of Taxa (May 2007)	40	45	2	44	83	73	51	1	31	55	38	2	5	74	13	1	1	67	13	4
	Total number of Individuals (May 2007)	50	71	1	6158	9061	796	573	0	25	169	74	0	5	169	5	1	0	594	45	3
	Total number of Taxa (June 2006)	39	56	11	94	131	17	102	0	94	83	64	2	8	128	5	1	2	116	4	4
	Total number of Individuals (June 2006)	68	179	8	12896	4531	347	1433	0	1159	374	200	2	9	742	13	1	3	2793	17	4
	Total number of Taxa (June 2005)	95	38	6	121	155	128	129	8	96	117	108	7	19	125	13	9	5	167	13	15
	Total number of Individuals (June 2005)	816	67	1	7872	7806	9669	1887	2	590	897	2216	1	12	1584	39	5	1	16324	8	14
	Total number of Taxa (Oct 2004)	74	40	9	102	113	106	76	1	70	116	99	4	4	115	3	5	3	125	7	5
	Total number of Individuals (Oct 2004)	450	101	21	5154	2126	3919	3247	1	1818	1176	4071	6	7	998	3	10	3	8972	9	5

Appendix 6.6 Particle Size Analysis: June 2010.

Site Code	4mm	2mm	1mm	0.5mm	0.25mm	0.125mm	0.063mm	<0.063mm	Mean phi	skewness	kurtosis	Classification after Buchanan	Folk Triangles after BGS
D01	5.6%	6.9%	5.1%	5.5%	10.1%	57.0%	3.7%	6.1%	1.808	-0.591	2.180	Poorly Sorted Fine Gravelly Sand	Gravelly Sand
D02	15.2%	6.0%	4.4%	7.0%	19.9%	24.7%	9.6%	13.3%	1.453	-0.122	1.198	Very Poorly Sorted Gravelly Muddy Sand	Gravelly Muddy Sand
D03	0.0%	0.9%	0.2%	0.3%	23.1%	74.1%	0.2%	1.2%	2.456	-0.549	1.617	Well Sorted Slightly Gravelly Fine Sand	Slightly Gravelly Sand
D04	0.0%	1.3%	1.2%	1.2%	65.5%	28.8%	0.1%	1.8%	2.061	0.531	0.641	Moderately Well Sorted Gravelly Medium Sand	Slightly Gravelly Sand
D05	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	-2.243	0.000	0.738	Gravel	Gravel
D06	9.2%	1.2%	1.9%	2.1%	38.5%	40.9%	2.4%	3.8%	2.117	-0.032	2.170	Poorly Sorted Gravelly Fine Sand	Gravelly Sand
D07	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	-2.243	0.000	0.738	Gravel	Gravel
D08	0.3%	4.1%	7.6%	20.7%	58.0%	8.4%	0.1%	0.8%	1.393	-0.436	1.243	Moderately Sorted Fine Gravelly Medium Sand	Slightly Gravelly Sand
D09	17.1%	13.8%	17.0%	19.0%	27.4%	4.2%	0.2%	1.4%	0.111	-0.261	0.706	Poorly Sorted Sandy Fine Gravel	Sandy Gravel
D10	20.9%	3.9%	2.9%	3.7%	20.0%	41.2%	3.1%	4.2%	0.913	-0.511	0.791	Very Poorly Sorted Fine Gravelly Fine Sand	Gravelly Sand
D11	22.0%	1.0%	1.0%	2.4%	28.9%	34.9%	4.6%	5.2%	0.894	-0.462	1.285	Very Poorly Sorted Fine Gravelly Fine Sand	Gravelly Sand
D12	0.0%	0.0%	0.0%	0.4%	76.9%	21.7%	0.0%	1.0%	2.018	0.570	1.717	Well Sorted Medium Sand	Sand
D13	0.0%	0.0%	0.6%	9.6%	75.9%	12.0%	0.2%	1.8%	1.760	0.018	2.631	Well Sorted Medium Sand	Sand
D14	4.5%	1.3%	3.3%	4.1%	11.4%	29.3%	9.6%	36.6%	3.599	0.234	1.291	Very Poorly Sorted Gravelly Muddy Sand	Gravelly Muddy Sand
D15	27.8%	9.8%	5.9%	6.2%	34.4%	13.4%	0.3%	2.2%	0.430	-0.617	0.555	Poorly Sorted Sandy Fine Gravel	Sandy Gravel
D16	0.0%	1.0%	0.9%	2.5%	55.9%	39.3%	0.3%	0.0%	2.099	0.459	0.596	Moderately Well Sorted Gravelly Medium Sand	Slightly Gravelly Sand
D17	14.9%	7.0%	4.8%	6.6%	46.7%	19.6%	0.1%	0.4%	0.949	-0.541	1.006	Poorly Sorted Gravelly Medium Sand	Gravelly Sand
D18	58.2%	15.1%	4.0%	2.1%	4.3%	14.6%	0.5%	1.3%	-0.644	0.871	1.087	Very Poorly Sorted Sandy Fine Gravel	Sandy Gravel
D19	7.8%	1.5%	0.6%	1.0%	66.3%	19.9%	0.9%	2.1%	1.993	-0.006	5.497	Poorly Sorted Fine Gravelly Medium Sand	Gravelly Sand
D20	2.9%	4.0%	4.5%	4.8%	66.35	16.5%	0.1%	1.0%	1.751	-0.229	4.411	Poorly Sorted Fine Gravelly Medium Sand	Gravelly Sand