Arklow Bank Offshore Windfarm Environmental Monitoring
Benthic Ecology Survey Report

June 2011

A Report to GE Wind Energy

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ISLAND SHIPPING
TUGS & WORKBOATS


ERI
ENVIRONMENTAL RESEARCH INSTITUTE
UNIVERSITY COLLEGE CORK


Aquatic
Services
Unit

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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 on the 07th June, 2011.

The Arklow Bank Offshore Wind Farm lies 13 km east of Arklow town and consists of seven 3.6 MW turbines. Construction was begun 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	698365	5856812	698347	5855773
Trawl 2	703956	5856874	703293	5857380
Trawl 3	706944	5866885	706860	5866494
Trawl 4	708523	5858186	708645	5857734
Trawl 5	703147	5847963	703085	5848436
Trawl 6	703055	5836917	703072	5837505

	Anchor Dredge Co-ordinates			
	Dredge In		Dredge Out	
	Easting	Northing	Easting	Northing
D1	695364	5854444	695227	5854460
D2	699254	5854467	699534	5854301
D3	700669	5855488	700711	5855551
D4	702787	5860447	702834	5860681
D5	703196	5864494	703345	5864844
D6	704080	5863629	704090	5863493
D7	704761	5864365	704880	5864656
D8	707380	5866618	707457	5866821
D9	708143	5856666	708217	5856960
D10	708280	5851229	708379	5851342
D11	707005	5846527	707070	5846801
D12	704197	5844452	704144	5844552
D13	703831	5838715	703800	5838930
D14	702002	5844922	702005	5844625
D15	703280	5851169	703275	5851319
D16	706239	5853396	706174	5853390
D17	706230	5858155	706252	5858209
D18	700360	5857060	700500	5857363
D19	697163	5847650	696981	5847680
D20	703650	5857125	703748	5857206

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.

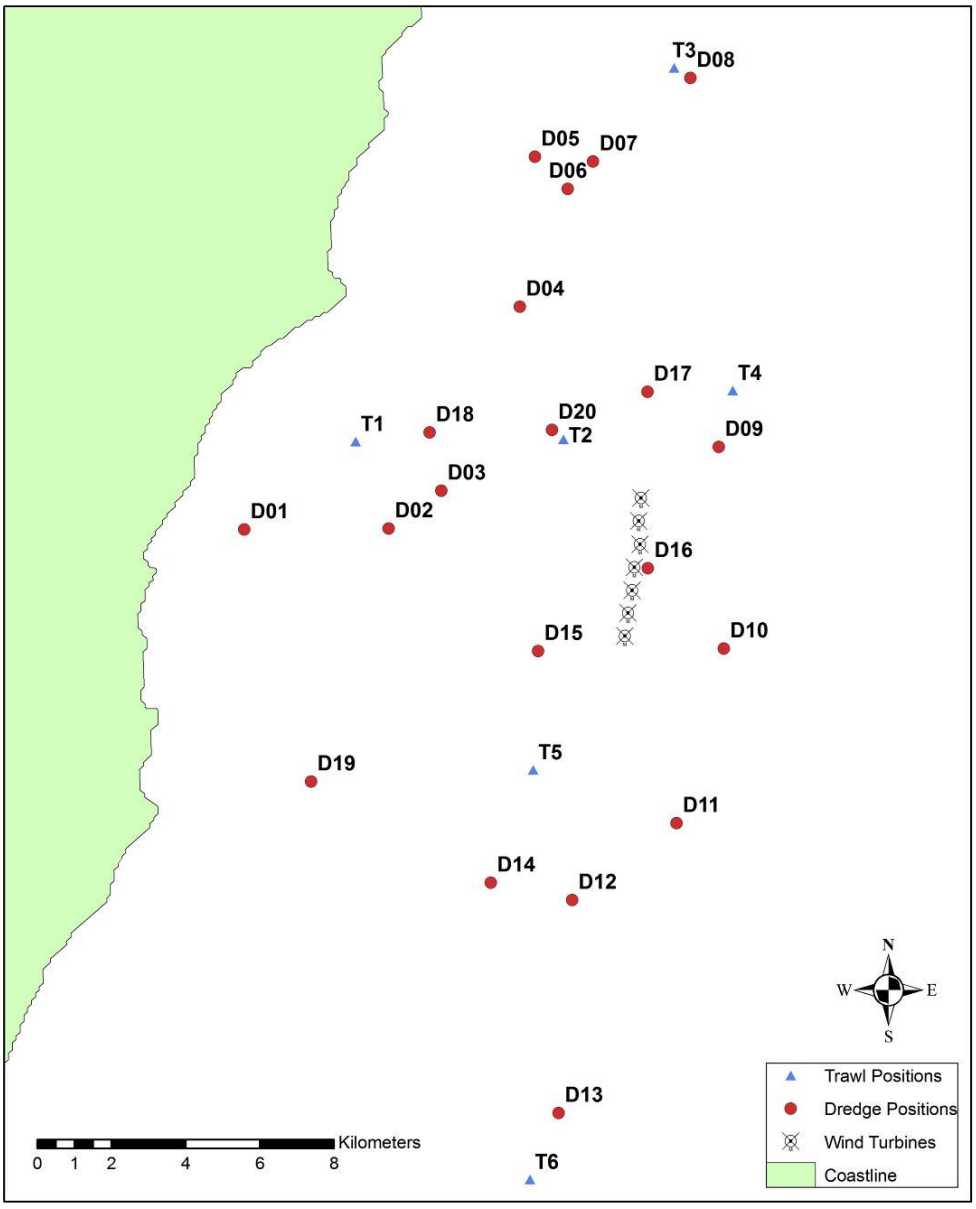


Figure 1.1 Anchor Dredge (● numbered D1 to D20) and Beam Trawl locations (▲ numbered T1 to T6) for the present monitoring survey (June 2011). These stations correspond to locations sampled in previous surveys.

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 the 6th & 7th June 2011.

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

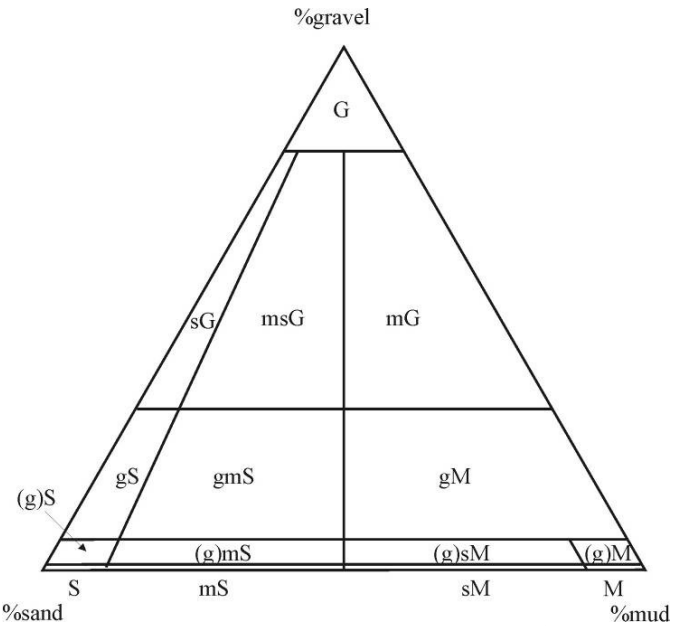
Table 2.3.1 Sieve series sizes (mm) used for particle size analysis (PSA).

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 sampled using the same methodology. Statistical analysis between the previous surveys and the baseline survey has been undertaken in 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 187 taxa were identified in the present survey. Of these 187 taxa, 14 are fish species. Overall, the number of taxa identified is higher than all previous surveys; the total number of taxa is much higher than the June 2006 (98 taxa), June 2005 (47 taxa) and October 2004 (51 taxa) surveys, and marginally higher than those identified in 2007 (177 taxa), 2008 (170 taxa), 2009 (132 taxa) and 2010 (158 taxa).

The number of fish species and abundances found at each trawl location in the 2006 – 2010 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 (14 taxa) is similar to those identified in previous surveys (12 – June 2010, 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 51 individuals) is similar to those caught in previous surveys (33 – 2010, 32 – 2009, 33 – 2008, 55 – 2006) but lower than those identified in 2005 (74) and 2004 (80). In the present survey, Trawls 1 and 2, had the highest number of species (6) and the highest number of individuals (13). Overall, fish abundances ranged from 1 individual in Trawls 6 to 13 individuals in two trawls (Trawls 1 & 2).

Important commercial fish were limited to 4 Plaice (*Pleuronectes platessa*), 1 Whiting (*Merlangius merlangus*), 3 Dogfish (*Scyliorhinus caniculus*) and 1 John Dory (*Zeus faber*). Three elasmobranchs were caught in the present survey (3 x *Scyliorhinus caniculus*) compared to 2 (2010), 1 (2009), 4 (May 2008), 3 (June 2006), 4 (June 2005), 3 (October 2004). No elasmobranchs 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 187 taxa, which is in keeping with more recent previous surveys (2007, 2008 & 2009). Total numbers of countable organisms (2,457) has increased from those identified in 2010 (1819) and 2009 (1779). Twenty taxa were found in numbers ≥ 20 over the whole survey area, compared with 20 taxa in 2010, 15 taxa in 2009, 9 taxa in 2008 and 19 taxa in 2007. 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 Trawl 1 (117). This station also had the highest number of countable taxa (96) and colonial taxa (21) as well as the highest abundances recorded in the present survey with 1,450 individuals. The most abundant species present in the survey area are the polychaete *Sabellaria alveolata* and the crustaceans *Pandalus montagui*, *Crangon almanni* and *Pagurus* bernhardus.

	Jun-11	Jun-10	Jun-09	May-08	May-07	Jun-06	Jun-05
Sabellaria alveolata	651	4	3	111	2083	668	0
Crangon allmanni	234	218	124	68	52	53	0
Pandalus montagui	170	287	406	16	13	187	65
Pagurus bernhardus	146	69	94	33	54	26	95
Macropodia rostrata	131	10	29	26	39	31	28
Asterias rubens	112	36	52	70	131	39	8
Psammechinus miliaris	104	22	40	13	53	130	162
Hippolyte varians	72	3	11	4	2	0	0
Pisidia longicornis	66	81	0	21	1033	238	4
Lepidopleurus asellus	62	10	30	10	10	5	0

Table 3.1.1 Numbers of the 10 most common countable faunal species found in June 2011 compared to abundances found in June 2010, June 2009, May 2008, May 2007, June 2006 and June 2005 beam trawl surveys

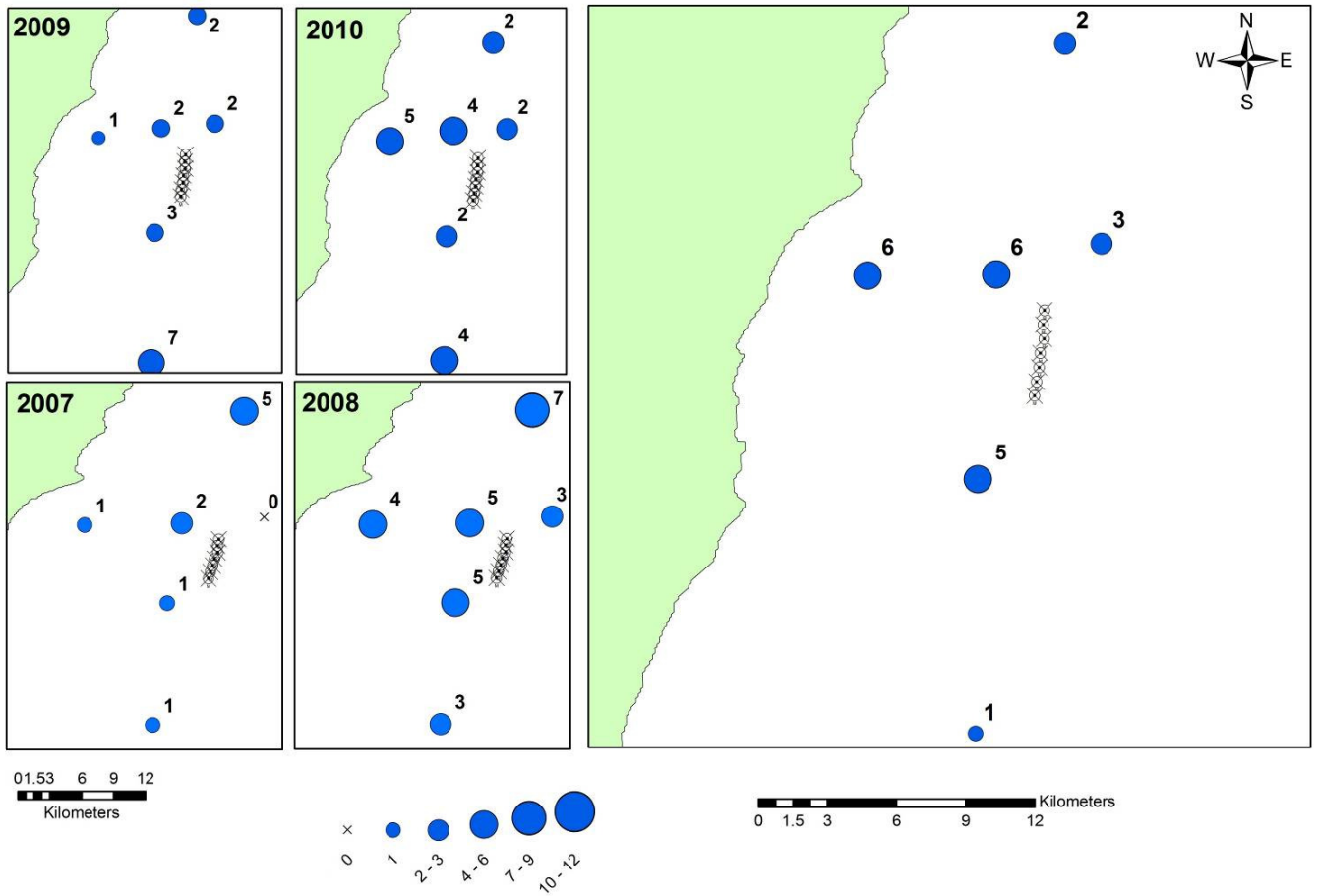


Figure 3.1.1 Total number of fish taxa per trawl site (May 2007, May 2008, June 2009, June 2010 & June 2011)

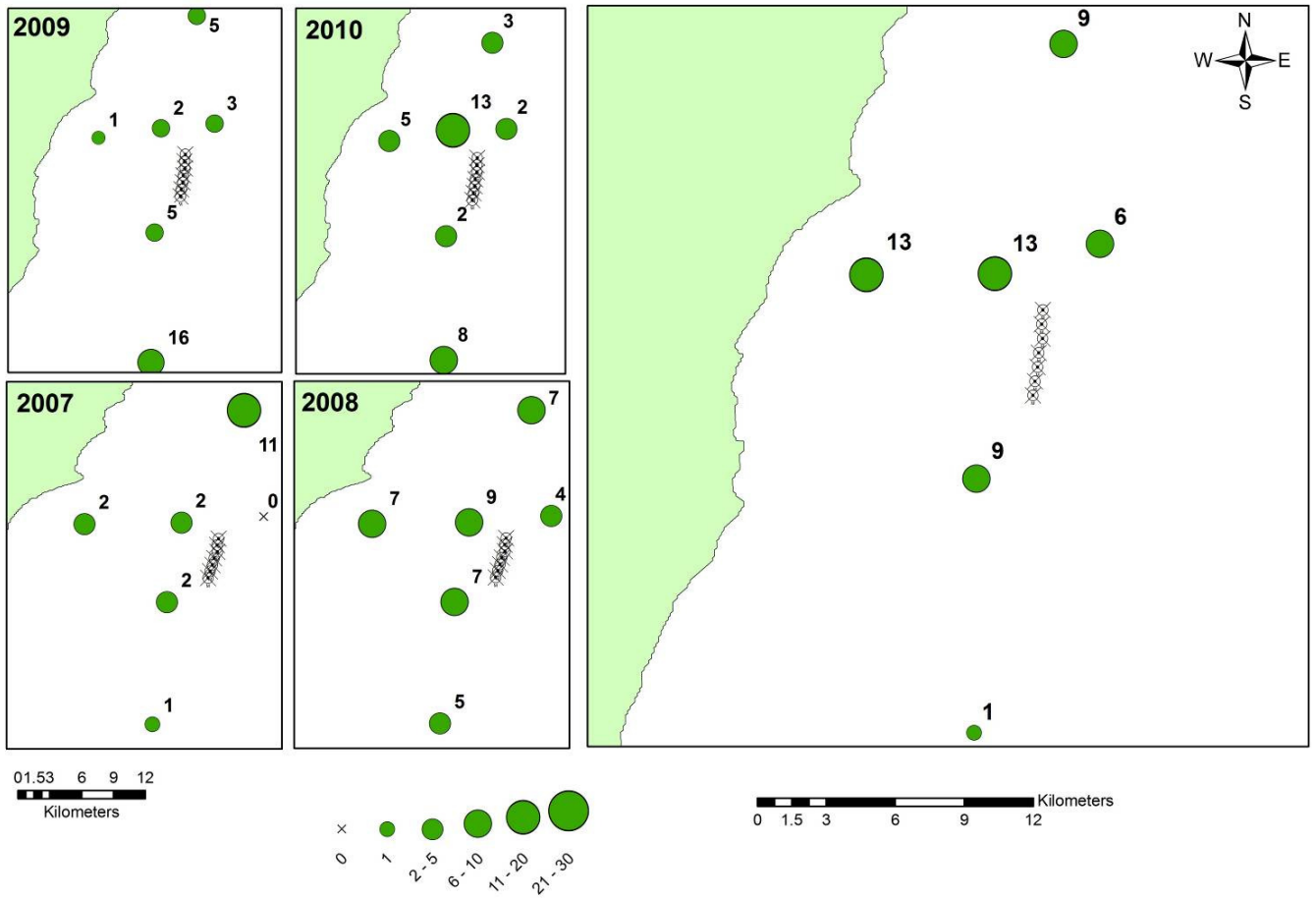


Figure 3.1.2 Total number of fish per trawl site (May 2007, May 2008, June 2009, June 2010 & June 2011)

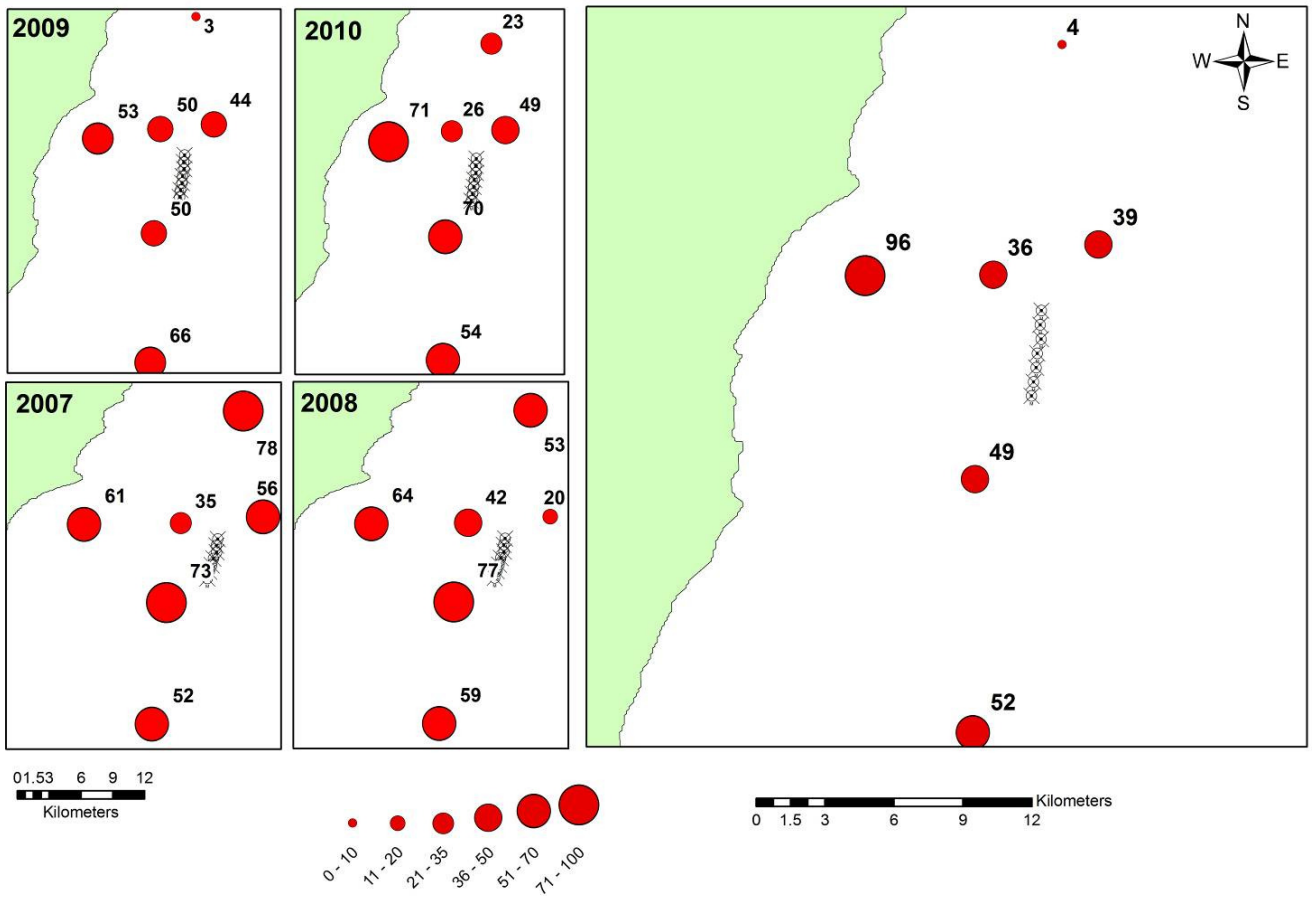


Figure 3.1.3 Total number of invertebrate taxa per trawl site (May 2007, May 2008, June 2009, June 2010 & June 2011)

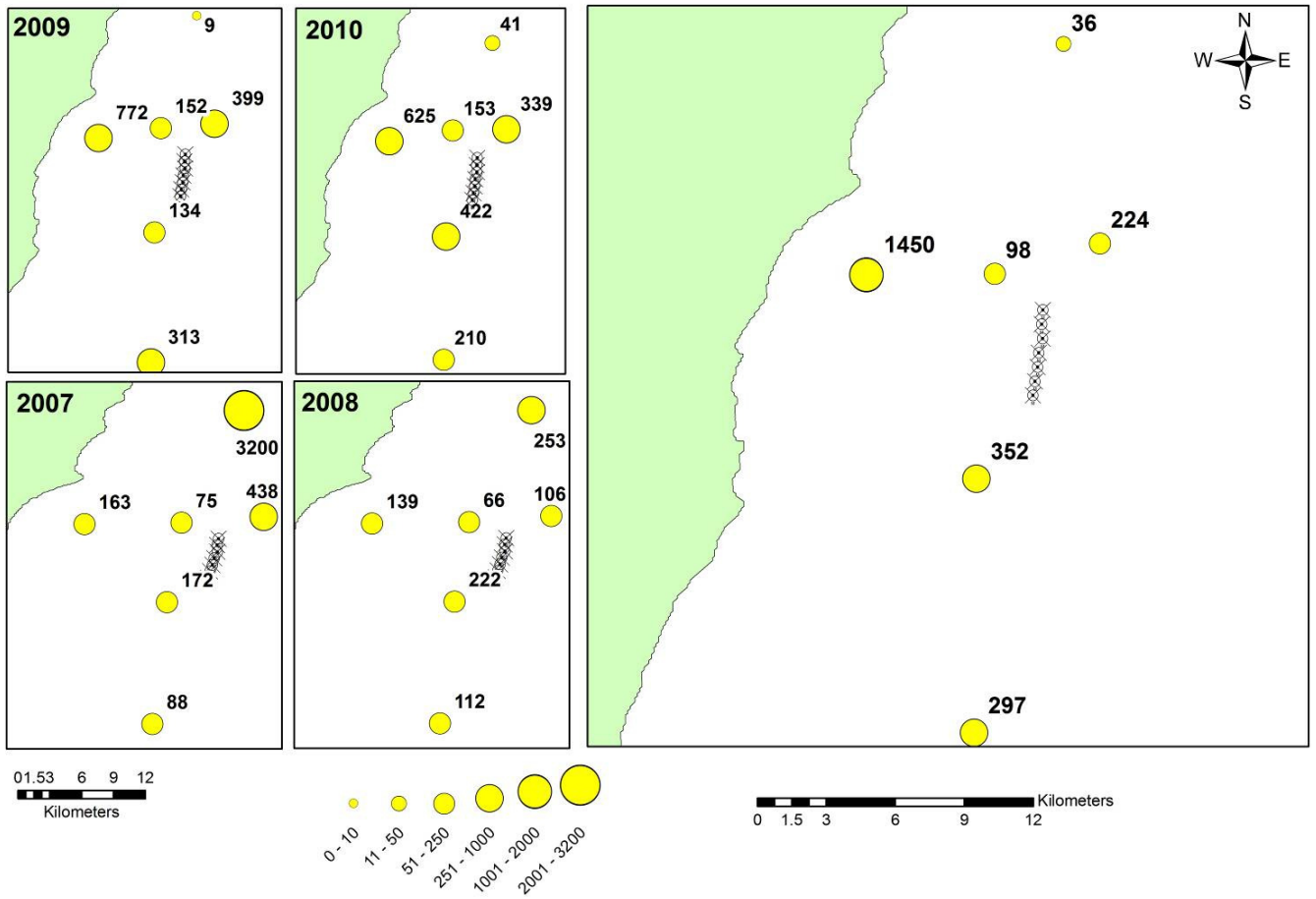


Figure 3.1.4 Total number of countable invertebrates per trawl site (May 2007, May 2008, June 2009, June 2010 & June 2011)

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).

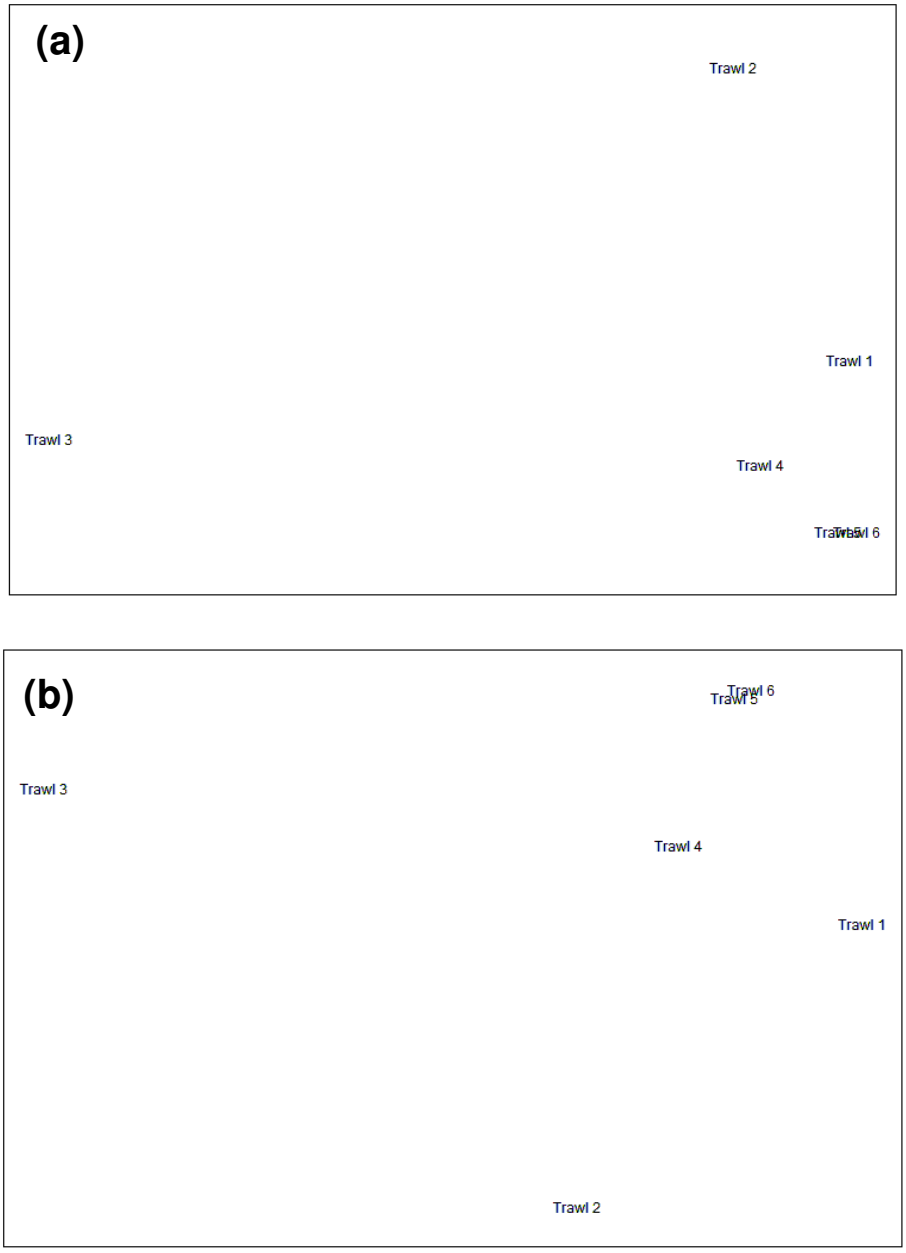


Figure 3.1.5 **(a)** Multivariate analysis (nMDS plot) on the 2011 trawl data, colonial data included (Stress = 0.01).
(b) Multivariate analysis of the countable fauna, colonial data removed (Stress = 0.01).

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 a single location 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 sediments across the Arkow Bank are dominated by sands (D12 & D16) and gravelly sands (D8, D9, D13, D14 & D15). The deeper areas of the survey area are dominated by sandy gravels (D7, D10, D17 and D20) and gravelly sands (D1, D2, D3, D4, D6 & D18). A single area is characterised as pure gravel (D5).

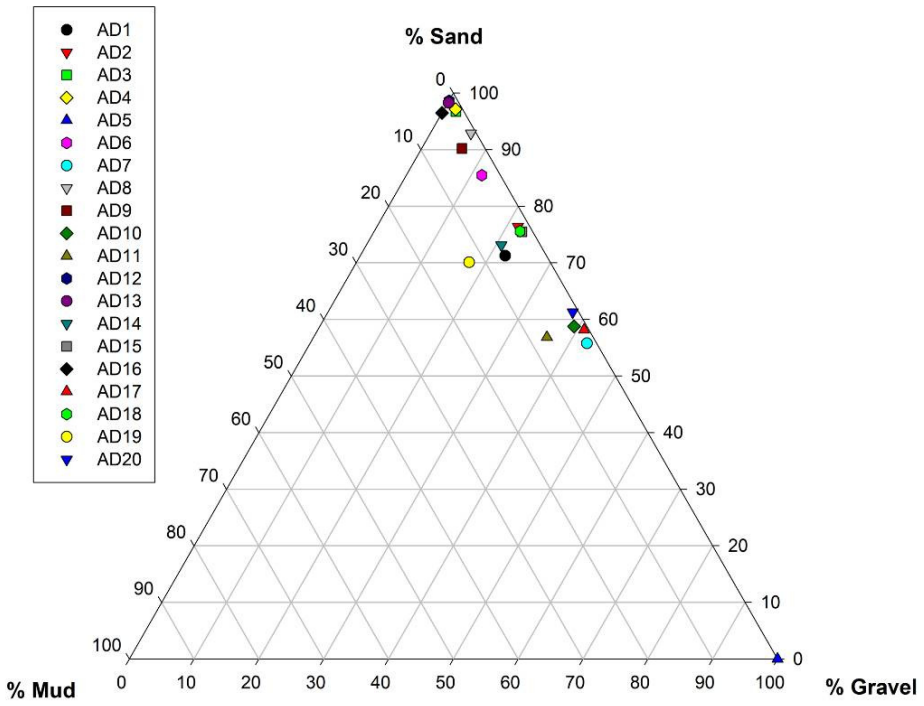


Figure 3.2.1 Ternary plot of PSA results from June 2011 survey.

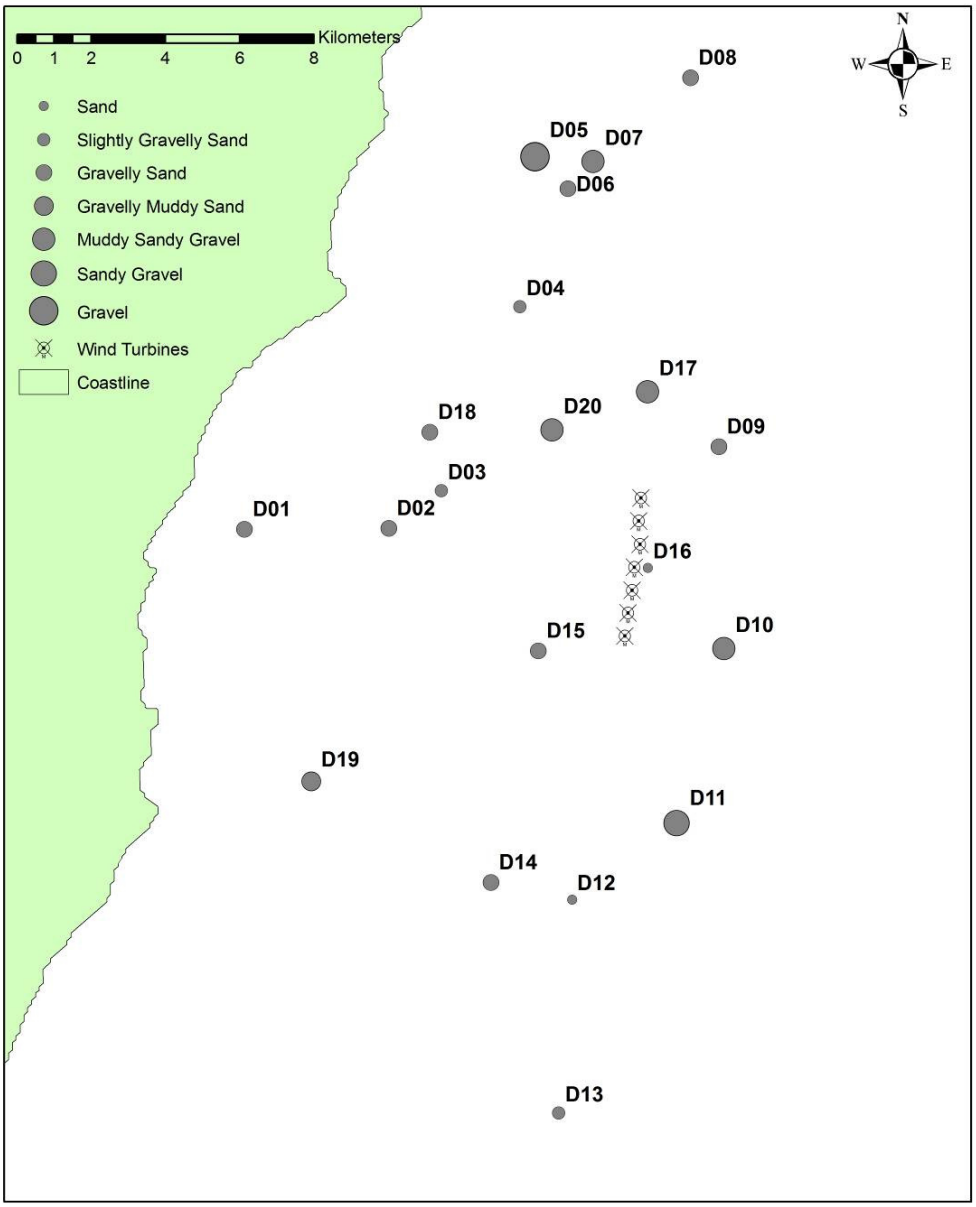


Figure 3.2.2 Distribution of sediment type as determine from the anchor dredge samples in June 2011. Site numbers are shown**.**

Site Code	Classification after Buchanan	Textural Group (June 2011)	Textural Group (June 2010)	Visual assessment
1	Fine Gravelly Fine Sand	Gravelly Sand [gS]	Gravelly Sand [gS]	Gravelly muddy sand
2	Very Fine Gravelly Fine Sand	Gravelly Sand [gS]	Gravelly Muddy Sand [gMS]	Gravelly Muddy Sand
3	Slightly Very Fine Gravelly Fine Sand	Slightly Gravelly Sand [(g)S]	Slightly Gravelly Sand [(g)S]	Sand
4	Slightly Very Fine Gravelly Medium Sand	Slightly Gravelly Sand [(g)S]	Slightly Gravelly Sand [(g)S]	Gravelly Sand
5	Gravel	Gravel [G]	Gravel [G]	Gravel
6	Very Fine Gravelly Medium Sand	Gravelly Sand [gS]	Gravelly Sand	*Sabellaria* reef
7	Sandy Fine Gravel	Sandy Gravel [sG]	Gravel [G]	Sandy Gravel
8	Very Fine Gravelly Medium Sand	Gravelly Sand [gS]	Slightly Gravelly Sand [(g)S]	Coarse Sand
9	Very Fine Gravelly Medium Sand	Gravelly Sand [gS]	Sandy Gravel [sG]	Gravelly Sand
10	Sandy Fine Gravel	Sandy Gravel [gS]	Gravelly Sand [gS]	Sandy Gravel
11	Coarse Silty Sandy Fine Gravel	Muddy Sandy Gravel [msG]	Gravelly Sand [gS]	Muddy gravelly sand
12	Moderately Well Sorted Fine Sand	Sand [S]	Sand [S]	Sand
13	Slightly Very Fine Gravelly Medium Sand	Slightly Gravelly Sand [(g)S]	Sand [S]	Sand
14	Fine Gravelly Fine Sand	Gravelly Sand [gS]	Gravelly Muddy Sand [gMS]	Gravelly muddy sand
15	Fine Gravelly Medium Sand	Gravelly Sand [gS]	Sandy Gravel [sG]	Sandy shell gravel
16	Moderately Well Sorted Fine Sand	Sand [S]	Slightly Gravelly Sand [(g)S]	Sand
17	Sandy Fine Gravel	Sandy Gravel [sG]	Gravelly Sand [gS]	Sandy Gravel
18	Very Fine Gravelly Fine Sand	Gravelly Sand [gS]	Sandy Gravel [sG]	Shell gravel and sand
19	Fine Gravelly Very Coarse Silty Fine Sand	Gravelly Muddy Sand [gMS]	Gravelly Sand [gS]	Muddy Sand
20	Sandy Fine Gravel	Sandy Gravel [sG]	Gravelly Sand [gS]	Gravelly Sand

Table 3.2.1 Classification of sediment types at June 2011 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 2010 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 2011 survey is presented in Appendix 6.2 with a full data matrix, including abundance data, presented in Appendix 6.5. In total, 2,876 individuals from 144 countable taxa were recorded in the present survey. An additional 19 colonial taxa were recorded, resulting in 165 taxa in total identified in June 2011. Overall abundances are lower than those identified in all previous surveys and continue the trend in decreasing faunal abundances identified in previous surveys. 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 reduction in keelworm (*Pomatoceros* spp.) abundances identified in previous surveys continues in the present survey. Abundances identified in the present survey are mainly limited to only a single station with 1252 individuals from a total of 1318 identified coming from AD7.

The largest reduction in abundances in the present survey comes from the reef-forming polychaete *Sabellaria* spp. A total of 618 individuals were identified from the dredges in 2011. This shows a decrease from 2,866 in 2010 and 3,994 in 2009 and are similar to those identified in 2007 (491) and 2008 (51). *Sabellaria* spp. were identified in 7 stations, although they only occurred in large numbers in a single dredge (429 individuals in AD6). As mentioned previously, this variation in abundances may be explained by the heterogeneous nature of the seabed and the scattered distribution of these reefs across the surveys sites.

The most abundant species identified in the present survey are similar to those identified in previous surveys. However, the reduction in abundances is reflected in the presence of only 5 taxa with >70 individuals present across the survey area. This compares to 10 taxa in 2010 and 2009, 7 taxa in 2008, 11 taxa in 2007, 17 taxa 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 10 (10.4). Overall species richness scores increased in only 5 stations during the present survey when compared to 2010. In the present survey, abundances recorded in 2011 increased at only 4 stations when compared to 2010. The most significant changes between the results obtained in 2011 and 2010 were reductions at AD 10 (from 1,670 to 232), AD11 (from 1,320 to 141) and AD18 (1,320 to 34). The reasons for the decrease in the numbers in the present survey relate to a further decrease in both *Pomatoceros* spp. abundances (from 2,750 in 2010 to 1318 in 2011) and *Sabellaria* spp. abundances (from 2,866 in 2010 to 618 in 2011) across the survey area.

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 2011 dataset. As recorded in previous surveys, 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.

	Number of Taxa (S)	Number of Individuals (N)	Simpson's Dominance Index (d)	Shannon-Wiener Diversity Index (H')	Margalef's Species Richness (Dmg)
D1	36	208	0.184	2.45	6.56
D2	16	27	0.111	2.5	4.55
D3	0	0	****	****	****
D4	4	29	0.696	0.642	0.891
D5	13	38	0.382	1.62	3.3
D6	45	642	0.451	1.64	6.81
D7	26	1350	0.862	0.426	3.47
D8	1	1	1	0	****
D9	37	114	0.0714	3.13	7.6
D10	56	232	0.199	2.68	10.1
D11	47	141	0.0416	3.47	9.3
D12	3	3	0.333	1.1	1.82
D13	2	2	0.5	0.693	1.44
D14	14	24	0.132	2.36	4.09
D15	6	7	0.184	1.75	2.57
D16	1	1	1	0	****
D17	1	1	1	0	****
D18	9	34	0.234	1.74	2.27
D19	6	17	0.516	1.08	1.76
D20	6	6	0.167	1.79	2.79

Table 3.2.2 Univariate descriptors of abundance and richness in the 20 dredge samples from June 2011.

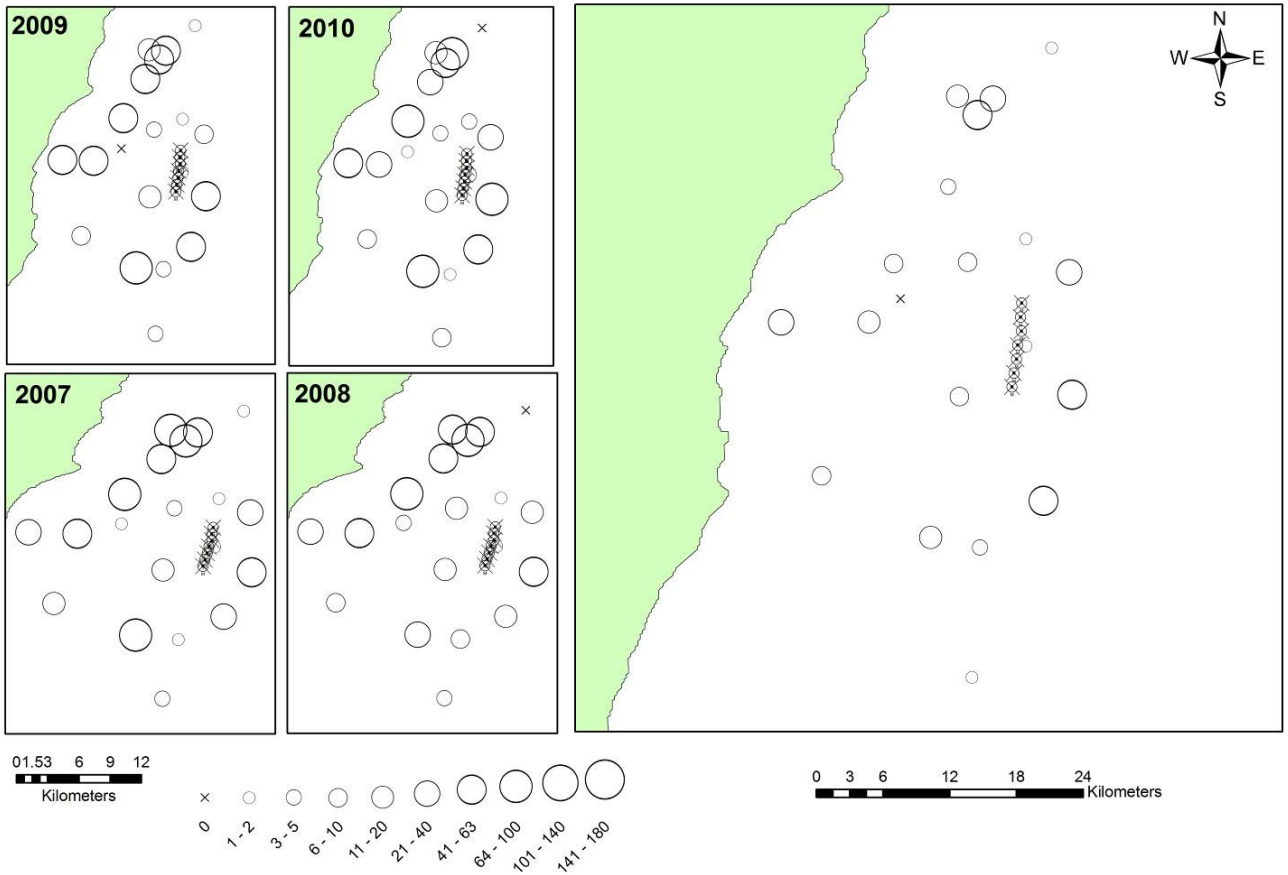


Figure 3.2.3 Total number of taxa per anchor dredge (May 2007, May 2008, June 2009, June 2010 & June 2011)

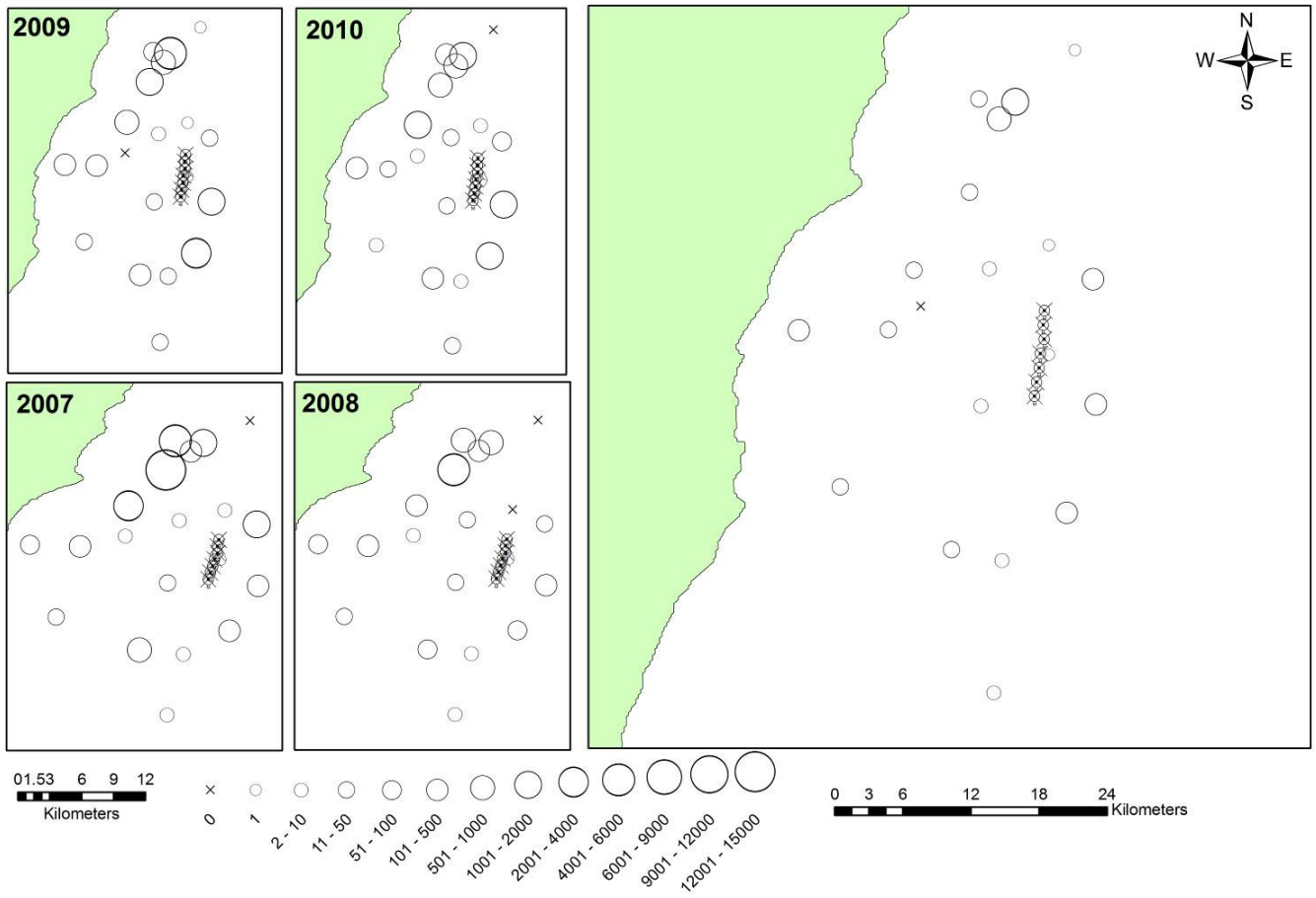


Figure 3.2.4 Total number of countable invertebrates per anchor dredge (May 2007, May 2008, June 2009, June 2010 & June 2011)

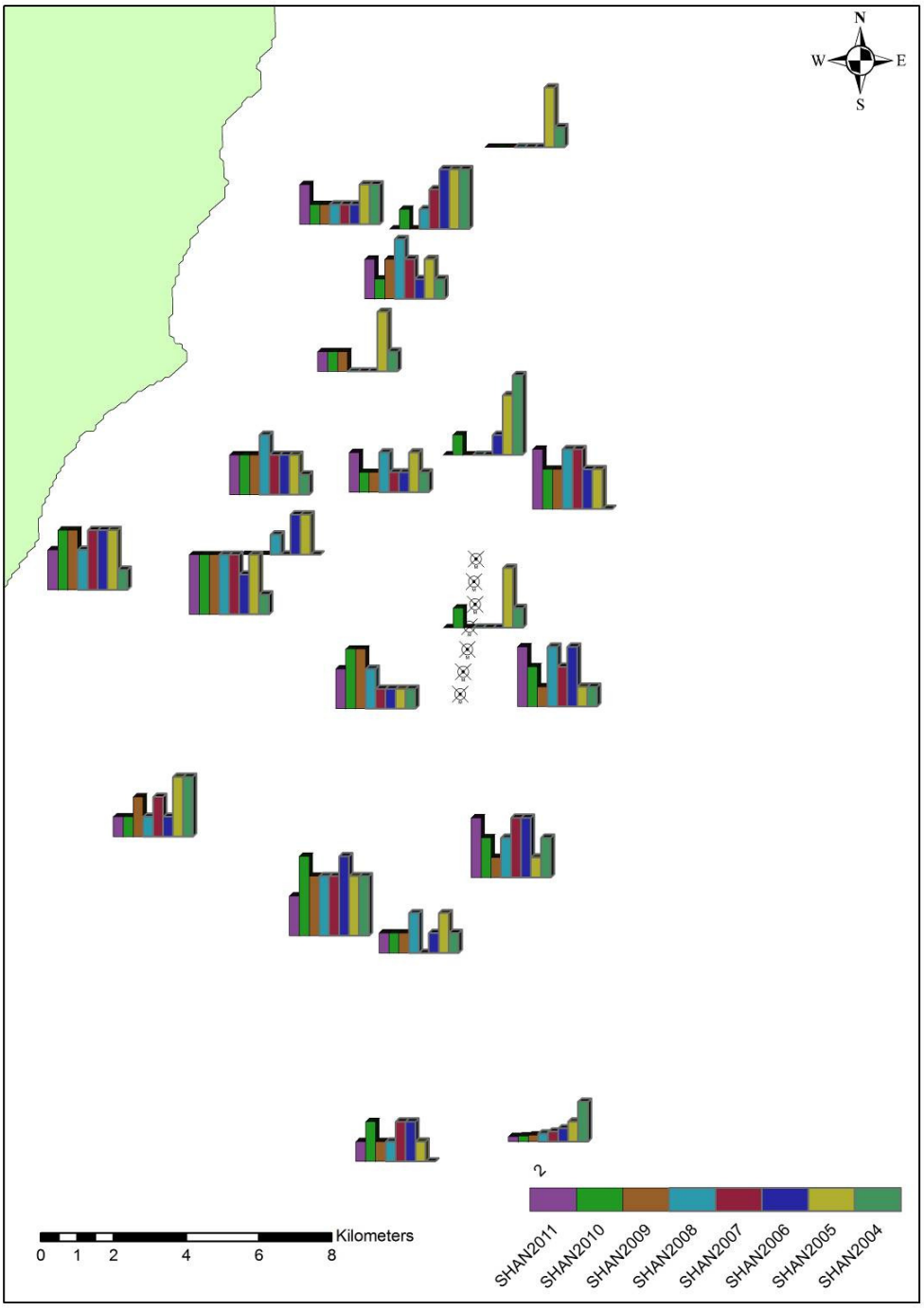


Figure 3.2.5 Shannon Wiener diversity indices per anchor dredge (October 2004, June 2005, June 2006, May 2007, May 2008, June 2009, June 2010 & June 2011)

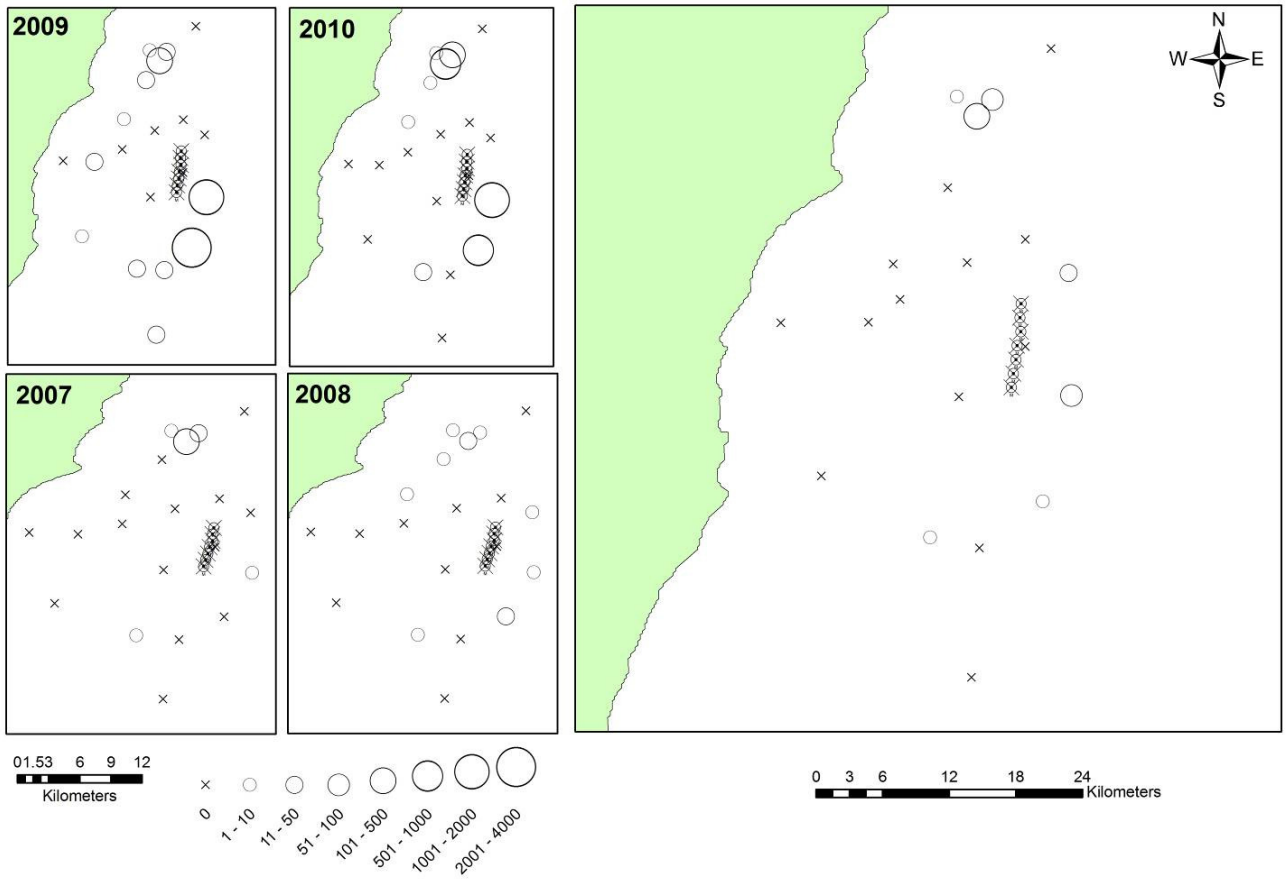


Figure 3.2.6 Total number of *Sabellaria* spp. found at each dredge (May 2007, May 2008, June 2009, June 2010 & June 2011)

Table3.2.3 List of the most abundant taxa (where >30 individuals were recorded across the survey area) in descending order of abundance from the anchor dredge survey of June 2011.

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Total
Annelida	*Pomatoceros lamarcki*	0	0	0	24	23	3	1252	0	6	1	6	0	0	0	1	0	0	2	0	0	1318
Annelida	*Sabellaria alveolata*	0	0	0	0	0	426	35	0	3	0	0	0	0	0	0	0	0	0	0	0	464
Annelida	*Sabellaria spinulosa*	0	0	0	0	1	3	17	0	23	99	9	0	0	2	0	0	0	0	0	0	154
Annelida	*Scoloplos armiger*	80	2	0	0	0	0	0	0	10	7	7	0	0	0	0	0	0	0	0	0	106
Annelida	*Jasmineira elegans*	0	0	0	0	0	41	9	0	5	6	10	0	0	0	0	0	0	0	0	0	71
Annelida	*Clymenura johnstoni*	7	0	0	0	0	0	5	0	6	19	12	0	0	0	0	0	0	0	0	0	49
Decapoda	*Pisidia longicornis*	0	0	0	0	0	38	1	0	2	0	0	0	0	0	0	0	0	0	0	0	41
Annelida	*Lanice conchilega*	24	0	0	0	0	0	1	0	3	3	5	0	0	0	0	0	0	0	0	0	36
Annelida	*Lumbrineris gracilis*	2	5	0	0	0	0	0	0	3	6	9	0	0	7	0	0	0	0	0	0	32

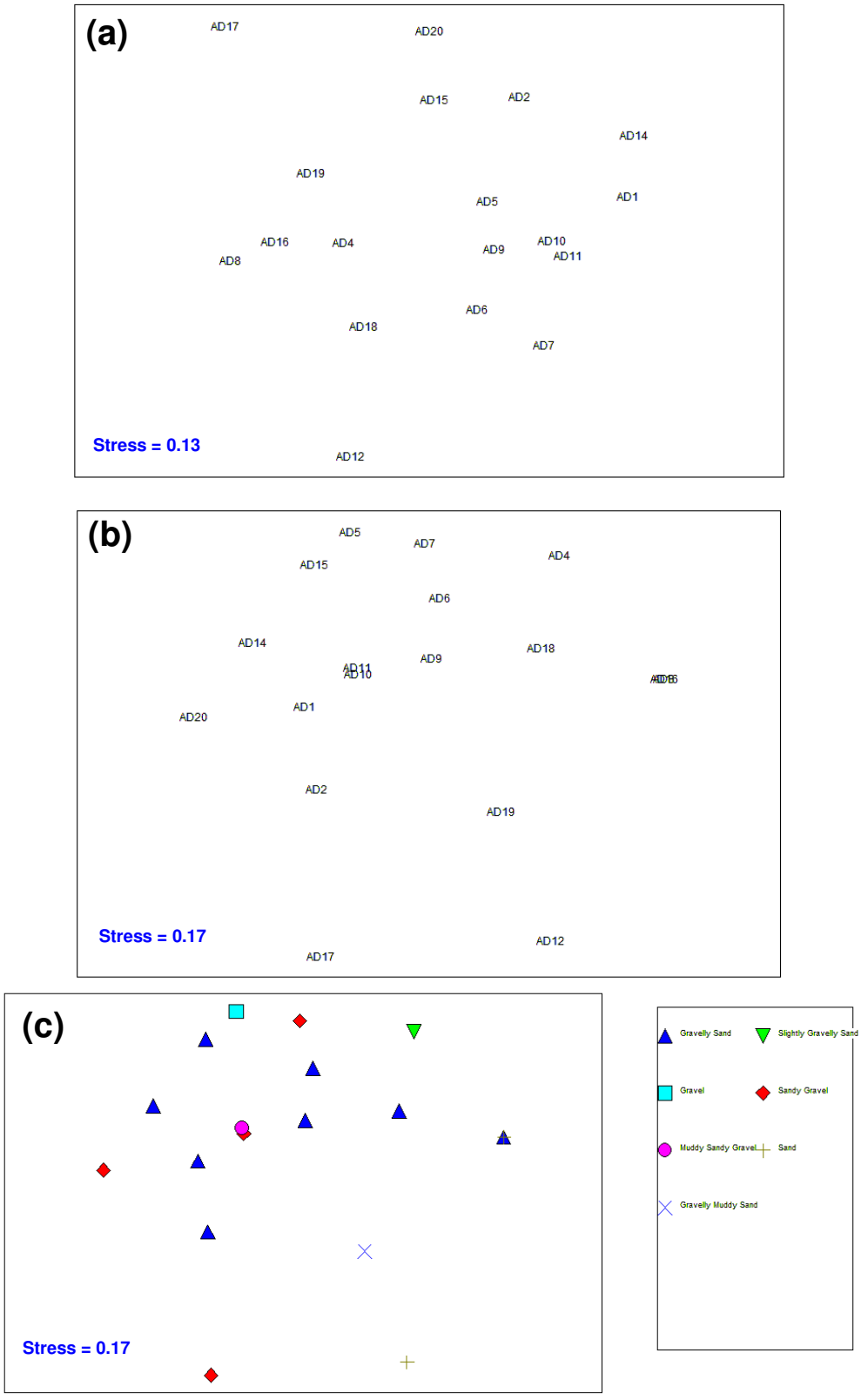


Figure 3.2.7 Multi-dimensional scaling plot of faunal data from the anchor dredge survey, June 2010. [(a) Presence/Absence data; (b) Abundance data, colonial organisms removed; (c) Abundance data, no colonial's; with sedimentary environment superimposed]

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 [No Change]	***Station 11***	IGS.Scup.Hyd *Sertularia cupressina* and *Hydrallmania falcata* on tide swept sublittoral cobbles or pebbles in coarse sand [Previously MCR.CSab Circalittoral *Sabellaria* reefs.]
Station 2	IGS.FaS Shallow sand faunal communities [No Change]	***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	IGS.Mob Sparse fauna in infralittoral mobile clean sand [Previously MCR.Flu.SerHyd *Sertularia argentea*, *S. cupressina* and *Hydrallmania falcata* on tide swept circalittoral cobbles and pebbles]	***Station 14***	IGS.Mob Sparse fauna in infralittoral mobile clean sand [Previously MCR Circalittoral rock or mixed substrata in moderately exposed environments.]
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 Circalittoral rock or mixed substrata in moderately exposed environments [Previously MCR.CSab Circalittoral *Sabellaria* reefs.]	***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 Circalittoral rock or mixed substrata in moderately exposed environments [Previously MCR.Flu.Flu *Flustra foliacea* on slightly scoured silty circalittoral rock or mixed substrata]
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 Circalittoral rock or mixed substrata in moderately exposed environments [Previously MCR.CSab Circalittoral *Sabellaria* reefs.]	***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 2011).

4. DISCUSSION AND CONCLUSIONS

As identified previously, the survey area is characterised by a range of sediments ranging from sands to gravels 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 relatively 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 previous surveys, with marginal increase in taxa identified (14) and abundances (55) from surveys in 2010 and 2009. 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 187 taxa were identified in the trawls during the present survey. Of these 187 taxa, 14 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), June 2009 (132 taxa) and 2010 (158 taxa).

Total numbers of countable organisms in the trawls (2,457) has increased from numbers identified in 2010 (1,819). 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 only a single location 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 look at the biotopes present across the survey area in 2011 reveals a pattern which is largely similar to that idenftified in previous surveys. 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, 4, 12, 13, 14, 15, 16, 17, 19 & 20), are all classified as IGS.Mob (Sparse fauna in infralittoral mobile clean sand). A single station (S11) is classified as IGS.Scup.Hyd, which shows a change from MCR.CSab identified in 2010. Overall, the distribution of these habitats concur 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 2010. The main change identified in the present survey is a change from coarse sediment, and associated fauna, at Station 4 to finer, mobile sediments. This is the first time this has been classified as a fine sediment site.

As identified in 2010, Stations 1 & 2 remain 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 and 2010, 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). A further four stations (Stations 5, 7, 10 & 18) are all classified as MCR (Circalittoral rock or mixed substrata in moderately exposed environments). These results are similar to those identified in previous surveys.

Reef communities were identified at only a single location during the present survey (Station 6). 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 much reduced compared to previous surveys, with a total of 2,876 countable fauna identified in the 2011 survey. This is a large decrease from abundances identified in all previous surveys. The main reason for this is the reduction in abundances of the keelworm *Pomatoceros* spp. which was present in small numbers in the present survey compared to previous surveys. In addition, only 1 station returned significant numbers of the reef forming polychaete *Sabellaria* spp during the course of the present survey.

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, by and large, 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 although some local changes at a number of sites have been identified.

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6. APPENDICES

Appendix 6.1 Species List for Beam Trawl Survey; June 2011

Annelida
Adyte pellucida
Amphitritides gracilis
Aphrodita aculeata
Autolytus indet.
Branchiomma bombyx
Eulalia aurea
Eulalia expusilla
Eulalia ornata
Eumida juv. indet.
Eumida ockelmanni
Eumida sanguinea
Euphrosine foliosa
Eupolymnia nebulosa
Eusyllis blomstrandi
Exogone naidina
Exogone verugera
Flabelligera affinis
Harmothoe indet.
Harmothoe spinifera
Hydroides norvegicus
Jasmineira elegans
Lanice conchilega
Lepidonotus squamatus
Maldanidae indet.
Malmgrenia indet.
Marphysa sanguinea
Micromaldane ornithochaeta
Nereiphylla rubiginosa
Nereis elitoralis
Nereis longissima
Nereis zonata
Nicolea venustula
Pholoe inornata
Pista cristata
Pista maculata
Polycirrus norvegicus
Polydora cf. socialis
Polydora indet.
Polynoe scolopendrina
Pomatoceros lamarcki
Procerastea sp.

Annelida
Sabella pavonina
Sabellaria alveolata
Sabellaria spinulosa
Sphaerosyllis erinaceus
Sphaerosyllis taylori
Spinther oniscoides
Spio armata
Sthenelais boa
Streblosoma intestinalis
Syllis indet.
Syllis sp. A
Syllis sp. H
Syllis variegata
Thelepus cincinnatus
Thelepus setosus
Arthropoda
Nymphon brevirostre
Phoxichilidium femoratum
Pycnogonum littorale
Crustacea
Aora gracilis
Aoridae sp. females
Atylus swammerdami
Balanus crenatus
Cancer pagurus
Cheirocratus sundevalli
Corophium
Crangon allmanni
Cressa dubia
Epimeria cornigera
Eualus cranchii
Hippolyte varians
Hyas coarctatus
Idotea emarginata
Iphimedia
Liocarcinus holsatus
Liocarcinus sp juv.
Liocarcinus vernalis
Macropodia rostrata
Metopa
Pagurus bernhardus
Pagurus prideaux

Crustacea
Pandalina brevirostris
Pandalus montagui
Paramysis arenosa
Pariambus typicus
Pasiphaea sivado
Photis
Phtisica marina
Pilumnus hirtellus
Pisidia longicornis
Stenothoe
Xantho pilipes
Bryozoa
Alcyonidium diaphanum
Alcyonidium parasiticum
Alcyonium digitatum
Amathia lendigera
Bicellariella biciliata
Bryozoa indet.
Bugula flabellata
Bugula stolonifera
Celleporella hyalina
Crisia eburnea
Electra pilosa
Eucratea loricata
Flustra foliacea
Membranipora membranacea
Cnidaria
Abietinaria abietina
Actinia equina
Actiniaria indet.
Adamsia carciniopodes
Campanularia sp. indet
Halecium halecinum
Hydractinia echinata
Hydrallmania falcata
Hydroidea indet
Metridium senile
Nemertesia antennina
Obelia cf longissima
Sertularia cupressina
Tubularia indivisa

Echinodermata

Amphipholis squamata
Asterias rubens
Crossaster papposus
Echinocyamus pusillus
Henricia sanguinolenta
Ophiothrix fragilis
Psammechinus miliaris

Mollusca

Abra alba
Acanthochitona cf fascicularis
Acanthodoris pilosa
Adalaria loveni
Aeolidia cf papillosa
Aequipecten opercularis
Astarte sulcata
Buccinum undatum
Calliostoma lyonsii
Calliostoma zizyphinum
Colus jeffreysianus
Cuthona sp
Dendronotus frondosus
Doto coronata
Doto fragilis
Doto hystrix
Euspira catena
Euspira pulchella
Heteranomia squamula
Hiatella arctica
Jujubinus montagui
Lepidopleurus asellus
Leptochiton asellus
Modiolarca subpicta
Modiolus modiolus
Musculus costulatus
Mytilus edulis
Necora puber
Nudibranchia indet.
Onchidoris muricata
Sepiola atlantica
Spisula elliptica
Tritonia hombergi
Tritonia sp

Nemertea

Nemertea indet.

Pisces

Agonus cataphractus
Ammodytes tobanius
Aspitrigla cuculus
Callionymus lyra
Echiichthys vipera
Gobiusculus flavescens
Hyperoplus lanceolatus
Liparis montagui
Merlangius merlangius
Pleuronectes platessa
Scyliorhinus caniculus
Syngnathus rostellatus
Taurulus bubalis
Zeus faber

Porifera

Porifera indet
Scypha compressa
Sycon sp. indet

Sipuncula

Golfingia vulgaris
Nephasoma minutum

Tunicata

Ascidiella aspera
Dendrodoa grossularia
Polyclinidae indet

Appendix 6.2 Species List for Anchor Dredge Survey; June 2011

Annelid

Ampharete lindstroemi
Amphitritides gracilis
Anobothrus gracilis
Aonides oxycephala
Aonides paucibranchiata
Aphelochaeta sp. A
Asclerocheilus sp. 1
Autolytus indet.
Caulleriella alata
Caulleriella zetlandica
Chaetozone sp.
Cirrophorus branchiatus
Clymenura johnstoni
Ehlersia ferrugina
Eteone foliosa
Eteone longa
Euchone rubrocincta
Euclymene oerstedii
Eulalia aurea
Eulalia ornata
Eulalia viridis
Eumida juv. indet.
Eumida ockelmanni
Eusyllis blomstrandi
Exogone verugera
Galthowenia oculata
Glycera lapidum
Glycera oxycephala
Glycera tridactyla
Goniada maculata
Harmothoe indet.
Hydroides norvegicus
Jasmineira elegans
Kefersteinia cirrata
Lagis koreni
Lanice conchilega
Laonice bahusiensis
Lepidonotus squamatus
Lumbrineris gracilis
Macrochaeta helgolandica
Maldanidae indet.
Malmgrenia indet.
Marphysa sanguinea
Mediomastus fragilis
Nematonereis unicornis
Nephtys caeca
Nephtys cirrosa
Nephtys kersivalensis
Nephtys hombergii

Annelid

Nephtys longosetosa
Nereis longissima
Nicomache personata
Notocirrus scoticus
Notomastus latericeus
Odontosyllis fulgurans
Ophelia borealis
Ophelina acuminata
Orbinia sertulata
Owenia fusiformis
Paraonidae indet.
Pholoe inornata
Pholoe synophthalmica
Phyllodoce groenlandica
Podarkeopsis capensis
Poecilochaetus serpens
Polycirrus medusa
Polycirrus norvegicus
Polydora indet.
Polynoe scolopendrina
Pomatoceros lamarcki
Praxillella affinis
Pseudonotomastus southerni
Pseudopolydora pulchra
Sabella pavonina
Sabellaria alveolata
Sabellaria spinulosa
Scalibregma celticum
Scoloplos armiger
Sphaerosyllis taylori
Spio armata
Spio decorata
Spio martinensis
Spiochaetopterus typicus
Spiophanes bombyx
Sthenelais boa
Syllis armillaris
Syllis sp. H
Syllis variegata
Terebellidae indet.
Tharyx killariensis
Thelepus cincinnatus
Thelepus setosus
Travisia forbesii

Bryozoa

Alcyonidium diaphanum
Bicellariella biciliata
Clymenura tricirrata
Conopeum reticulum

Bryozoa

Electra pilosa
Escharella variolosa
Eucratea loricata
Flustra foliacea
Vesicularia spinosa

Chelicerata

Nymphon brevirostre

Cnidaria

Abietinaria abietina
Actiniaria indet
Campanularia sp. indet
Cerianthus lloydii
Edwardsia claparedii
Hydrallmania falcata
Nemertesia antennina
Obelia cf longissima
Tubularia

Crustacea

Ampelisca tenuicornis
Atylus swammerdami
Bathyporeia guilliamsoniana
Corophium
Corophium bonelli
Crangon allmanni
Gnathia sp.
Maera sp
Pagurus bernhardus
Pisidia longicornis
Urothoe elegans
Urothoe marina
Xantho pilipes
Cancer pagurus
Cheirocratus sundevalli
Corystes cassivelaunus
Siphonocetes kroyeranus

Echinodermata

Amphiura filiformis
Asterias rubens
Leptosynapta indet.
Ophiothrix fragilis
Ophiura ophiura
Psamechinus miliaris

Hemichordata

Saccoglossus indet.

Mollusc

Abra nitida
Hiatella arctica
Lepidopleurus asellus
Modiolus modiolus

Mollusc
Nucula nucleus
Nudibranch indet
Timoclea ovata
Trivia arctica
Diodora graeca
Monia patelliformis
Nemertea
Cerebratulus sp. 1
Nemertea indet.
Tubulanus polymorphus
Cephalothricidae indet.
Phoronida
Phoronis indet.
Platyhelminthes
Platyhelminth sp
Porifera
Porifera indet
Sipuncula
Golfingia vulgaris
Golfingia elongata
Nephasoma minutum
Sipuncula juv. indet.
Phascolion strombi
Phascolion strombus
Tunicata
Ascidiella scabra
Ascidiella aspera
Dendrodoa grossularia
Triteata sp.

Appendix 6.3 Total results from the Beam Trawl June 2011

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	Good Trawl Sample with Bryozoans	Good Trawl Sample, contains Bryozoans & Starfish	Good Trawl Sample with Bryozoans & urchins	Good Trawl Sample with shell & shell gravel
Date of hauling	07/06/2011	07/06/2011	07/06/2011	07/06/2011	07/06/2011	07/06/2011
Time of hauling	1430	1610	1020	2227	1808	2010
Layback/warp (m)	70	100	75	120	100	125
Speed of Vessel (kts)	2	2.1	2	2.2	2	2.2
Vessel Bearing	180°	0°	180°	180°	0°	0°

Table of Contents for the Beam Trawls taken during the course of the June 2011 survey.

	Trawl 1	Trawl 2	Trawl 3	Trawl 4	Trawl 5	Trawl 6
Abietinaria abietina	0	0	P	P	0	0
Abra alba	2	0	0	1	0	0
Acanthochitona cf fascicularis	3	0	0	0	1	0
Acanthodoris pilosa	1	0	0	0	0	0
Actinia equina	0	0	0	0	0	P
Actiniaria indet.	1	0	0	0	0	1
Adalaria loveni	2	0	0	0	0	0
Adamsia carcinopodes	0	0	0	0	0	P
Adyte pellucida	1	0	0	3	1	0
Aeolidia cf papillosa	0	0	0	0	1	0
Aequipecten opercularis	0	0	0	0	4	0
Alcyonidium diaphanum	P	0	0	P	P	P
Alcyonidium parasiticum	P	P	0	0	0	P
Alcyonium digitatum	0	0	0	0	P	0
Amathia lendigera	P	P	0	0	0	0
Ammodytes tobanius	0	0	0	2	2	2
Amphipholis squamata	4	0	0	0	0	0
Amphitritides gracilis	1	0	0	1	0	0
Aora gracilis	1	0	0	0	0	0
Aoridae sp. females	0	1	0	0	0	0
Aphrodita aculeata	1	0	0	0	1	1
Apogon cataphractus	2	8	0	2	3	0
Ascidiella aspera	P	P	0	0	0	0
Aspitrigla cuculus	0	1	0	0	0	0
Astarte sulcata	0	1	0	0	0	0
Asterias rubens	74	3	0	13	11	11
Atylus swammerdami	0	1	0	0	0	1
Autolytus indet.	1	0	0	0	1	1
Balanus crenatus	0	0	P	0	0	0
Bicellariella biciliata	0	0	0	P	0	P
Branchiomma bombyx	1	1	0	0	1	0
Bryozoa	P	0	0	0	0	P
Buccinum undatum	25	0	0	2	0	0

	Trawl 1	Trawl 2	Trawl 3	Trawl 4	Trawl 5	Trawl 6
Bugula flabellata	P	P	0	0	0	P
Bugula stolonifera	P	0	0	0	0	0
Callionymus lyra	4	0	0	2	2	0
Calliostoma lyonsii	1	0	0	0	0	0
Calliostoma zizyphinum	0	0	0	0	1	0
Campanularia sp. indet	P	0	0	P	0	0
Cancer pagurus	1	0	0	0	0	0
Celleporella hyalina	0	0	0	0	P	P
Cheirocrates sundevalli	0	1	0	0	0	0
Colus jeffreysianus	1	0	0	0	0	0
Corophium	3	0	0	0	0	0
Crangon allmanni	34	14	0	28	65	97
Cressa dubia	1	0	0	0	0	0
Crisia eburnea	P	0	0	0	0	0
Crossaster papposus	13	0	0	2	0	1
Cuthona sp	0	0	0	0	0	3
Dendrodoa grossularia	P	0	0	0	0	0
Dendronotus frondosus	0	0	0	3	0	0
Doto coronata	0	0	0	0	0	1
Doto fragilis	33	0	0	0	0	0
Doto hystrix	1	2	0	0	1	0
Echiichthys vipera	0	0	5	0	0	0
Echinocyamus pusillus	0	0	0	0	1	0
Electra pilosa	P	0	P	0	0	0
Epimeria cornigera	0	0	0	0	0	3
Eualus cranchii	8	0	0	0	0	2
Eucratea loricata	P	P	0	P	0	0
Eulalia aurea	2	0	0	0	1	0
Eulalia expusilla	1	0	0	0	0	0
Eulalia ornata	12	0	0	0	0	0
Eumida juv. indet.	1	0	0	1	1	1
Eumida ockelmanni	4	0	0	0	0	0
Eumida sanguinea	2	0	0	0	0	0
Euphrosine foliosa	1	1	0	0	0	0
Eupolymnia nebulosa	0	0	0	0	1	0
Euspira catena	1	0	0	0	0	0
Euspira pulchella	0	0	0	1	0	0
Eusyllis blomstrandi	4	0	0	0	2	4
Exogone naidina	2	0	0	0	0	0
Exogone verugera	3	0	0	0	0	0
Flabelligera affinis	1	0	0	0	0	0
Flustra foliacea	P	P	P	P	P	P
Gobiusculus flavescens	1	0	0	0	0	0
Golfingia vulgaris	0	0	0	0	0	1
Halecium halecinum	0	0	0	P	0	0
Harmothoe indet.	4	0	0	3	6	2
Harmothoe spinifera	2	0	0	0	0	0
Henricia sanguinolenta	4	0	0	0	0	0
Heteranomia squamula	0	0	0	1	1	0
Hiatella arctica	4	0	0	1	1	2
Hippolyte varians	62	0	0	4	3	3
Hyas coarctatus	17	0	0	2	0	0
Hydractinia echinata	P	P	0	0	0	P

	Trawl 1	Trawl 2	Trawl 3	Trawl 4	Trawl 5	Trawl 6
Hydrallmania falcata	P	0	0	0	P	P
Hydroidea indet	0	0	0	0	0	P
Hydroides norvegicus	0	0	0	0	2	0
Hyperoplus lanceolatus	0	1	4	0	0	0
Idotea emarginata	0	5	0	0	1	0
Iphimedia	1	0	0	0	0	0
Jasmineira elegans	35	1	0	0	1	3
Jujubinus montagui	0	0	0	1	0	0
Lanice conchilega	12	3	0	0	0	6
Lepidonotus squamatus	11	0	0	3	13	2
Lepidopleurus asellus	0	0	0	7	53	2
Leptochiton asellus	0	0	0	0	1	0
Liocarcinus holsatus	0	0	0	0	1	5
Liocarcinus sp juv.	4	11	0	12	0	0
Liocarcinus vernalis	0	0	0	1	0	0
Liparus montagui	0	0	0	0	1	0
Macropodia rostrata	67	10	0	8	15	31
Maldanidae indet.	0	0	0	0	0	P
Malmgrenia indet.	0	0	0	P	0	0
Marphysa sanguinea	0	0	0	0	0	1
Membranipora membranacea	0	P	0	0	0	0
Merlangius merlangius	0	1	0	0	0	0
Metopa	1	0	0	0	0	0
Metridium senile	0	0	0	0	0	P
Micromaldane ornithochaeta	1	0	0	0	0	0
Modiolarca subpicta	1	0	0	0	0	0
Modiolus modiolus	6	1	0	9	0	1
Musculus costulatus	0	0	0	1	0	0
Mytilus edulis	1	0	0	3	0	1
Necora puber	1	0	0	0	0	0
Nemertea indet.	0	0	0	0	1	1
Nemertesia antennina	P	P	0	0	P	0
Nephasoma minutum	7	0	0	0	0	1
Nereiphylla rubiginosa	0	0	0	0	1	0
Nereis elitoralis	0	0	0	0	0	1
Nereis longissima	1	0	0	3	0	0
Nereis zonata	0	0	0	0	0	9
Nicolea venustula	0	1	0	0	0	0
Nudibranchia indet.	0	0	0	0	0	5
Nymphon brevirostre	0	0	0	0	0	1
Obelia cf longissima	P	0	0	0	0	0
Onchidoris muricata	0	1	0	0	0	0
Ophiothrix fragilis	3	1	0	0	1	1
Pagurus bernhardus	48	10	25	19	14	30
Pagurus prideaux	0	0	0	0	0	1
Pandalina brevirostris	1	0	0	0	0	0
Pandalus montagui	127	2	0	18	13	10
Paramysis arenosa	1	1	0	0	0	1
Pariambus typicus	1	0	0	0	0	0
Pasiphaea sivado	0	0	0	0	0	1
Pholoe inornata	1	0	0	0	0	0
Photis	2	0	0	0	0	0
Phoxichilidium femoratus	0	0	0	0	0	1

	Trawl 1	Trawl 2	Trawl 3	Trawl 4	Trawl 5	Trawl 6
Phtisica marina	1	0	0	0	0	0
Pilumnus hirtellus	1	0	0	0	0	0
Pisidia longicornis	6	3	0	42	0	15
Pista cristata	1	0	0	0	0	0
Pista maculata	0	0	0	0	0	1
Pleuronectes platessa	4	0	0	0	0	0
Polycirrus norvegicus	4	0	0	1	0	0
Polyclinidae indet	P	0	0	0	0	0
Polydora cf. socialis	0	0	0	0	1	0
Polydora indet.	1	0	0	0	0	0
Polynoe scolopendrina	6	0	0	0	2	1
Pomatoceros lamarcki	1	0	2	8	19	2
Porifera indet	P	0	0	P	0	P
Proceraea sp.	2	0	0	0	0	0
Psammechinus miliaris	33	0	0	1	66	4
Pycnogonum littorale	0	1	0	1	0	0
Sabella pavonina	0	0	0	0	0	1
Sabellaria alveolata	650	1	0	0	0	0
Sabellaria spinulosa	15	1	0	11	1	0
Scyliorhinus caniculus	1	1	0	0	1	0
Scypha compressa	0	0	0	0	0	P
Sepiola atlantica	1	1	0	0	0	0
Sertularia cupressina	P	0	0	0	P	0
Sphaerosyllis erinaceus	1	0	0	0	0	0
Sphaerosyllis taylori	2	0	0	0	0	0
Spinther oniscoides	3	0	0	0	0	0
Spio armata	1	0	0	0	0	0
Spisula elliptica	0	1	0	1	0	2
Stenothoe	1	0	0	0	0	0
Sthenelais boa	2	0	0	0	0	0
Streblosoma intestinalis	1	0	0	0	0	0
Sycon sp. indet	P	0	0	0	0	0
Syllis indet.	1	0	0	0	0	0
Syllis sp. A	0	0	0	0	4	0
Syllis sp. H	1	0	0	0	0	0
Syllis variegata	10	0	0	0	0	0
Syngnathus rostellatus	0	1	0	0	0	0
Taurulus bubalus	0	1	0	0	0	0
Thelepus cincinnatus	0	0	0	1	21	17
Thelepus setosus	14	3	0	1	5	1
Tritonia hombergi	0	0	0	0	1	1
Tritonia sp	4	1	0	0	0	0
Tubularia indivisa	0	0	0	0	0	P
Xantho pilipes	0	0	0	0	1	1
Zeus faber	1	0	0	0	0	0

Appendix 6.4 Total fish numbers and lengths

	Trawl 1	Trawl 2	Trawl 3	Trawl 4	Trawl 5	Trawl 6
Callionymus lyra	4 [7,8,9,9]			2 [16, x]	2 [18,8]	
Pleuronectes platessa	4 [16,17,12,12]					
Ammodytes tobanius				2 [3,3]	2 [4, x]	1 [x]
Echiichthys vipera			5 [10,7,7,5,6]			
Merlangius merlangius		1 [4]				
Hyperoplus lanceolatus		1 [15]	4 [15,12,10,10]			
Scyliorhinus caniculus	1 [59]	1 [51]			1 [57]	
Zeus faber	1 [15]					
Agonus cataphractus	2 [x]	8 [x]		2 [x]	3 [x]	
Aspitrigla cuculus		1 [22]				
Syngnathus rostellatus		1 [15]				
Gobiusculus flavescens	1 [x]					
Liparis montagui					1 [x]	
Taurulus bubalis		1 [x]				

Measurements in mm (where possible) of all fish species; June 2011 (x denotes no measurement taken).

Appendix 6.5 Anchor dredge raw data, June 2011

		S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17	S18	S19	S20
Annelid	*Ampharete lindstroemi*	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-
Annelid	*Amphitritides gracilis*	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Annelid	*Anobothrus gracilis*	-	-	-	-	-	-	-	-	-	-	7	-	-	-	-	-	-	-	-	-
Annelid	*Aonides oxycephala*	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Annelid	*Aonides paucibranchiata*	-	1	-	-	-	-	1	-	1	1	-	-	-	1	-	-	-	-	-	-
Annelid	*Aphelochaeta sp. A*	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-
Annelid	*Asclerocheilus sp. 1*	-	-	-	-	-	3	-	-	-	-	1	-	-	-	-	-	-	-	-	-
Annelid	*Autolytus indet.*	-	-	-	-	1	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-
Annelid	*Caulleriella alata*	6	-	-	-	-	-	-	-	1	2	2	-	-	-	1	-	-	-	-	-
Annelid	*Caulleriella zetlandica*	3	-	-	-	-	-	-	-	2	1	1	-	-	-	-	-	-	-	-	-
Annelid	*Chaetozone sp.*	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Annelid	*Cirrophorus branchiatus*	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
Annelid	*Clymenura johnstoni*	7	-	-	-	-	-	5	-	6	19	12	-	-	-	-	-	-	-	-	-
Annelid	*Ehlersia ferrugina*	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Annelid	*Eteone foliosa*	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Annelid	*Eteone longa*	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Annelid	*Euchone rubrocincta*	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
Annelid	*Euclymene oerstedii*	10	-	-	-	-	-	-	-	-	-	6	-	-	2	-	-	-	-	-	-
Annelid	*Eulalia aurea*	-	-	-	2	-	4	-	-	1	-	-	-	-	-	-	-	-	-	-	-
Annelid	*Eulalia ornata*	-	-	-	-	-	22	1	-	1	1	-	-	-	-	-	-	-	-	-	-
Annelid	*Eulalia viridis*	-	-	-	-	-	1	1	-	-	1	-	-	-	-	-	-	-	-	-	-
Annelid	*Eumida juv. indet.*	-	-	-	-	-	-	2	-	-	2	-	-	-	-	-	-	-	-	-	-
Annelid	*Eumida ockelmanni*	-	-	-	-	-	5	2	-	-	-	-	-	-	-	-	-	-	-	-	-
Annelid	*Eusyllis blomstrandi*	-	-	-	-	-	-	-	-	-	1	2	-	-	-	-	-	-	-	-	-
Annelid	*Exogone verugera*	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	1	-	-
Annelid	*Galthowenia oculata*	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

		S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17	S18	S19	S20
Annelid	*Glycera lapidum*	-	-	-	-	-	-	-	-	2	1	-	-	-	-	2	-	-	-	-	-
Annelid	*Glycera oxycephala*	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-
Annelid	*Glycera tridactyla*	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Annelid	*Goniada maculata*	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-
Annelid	*Harmothoe indet.*	-	-	-	-	-	3	1	-	-	1	-	-	-	-	-	-	-	-	-	-
Annelid	*Hydroides norvegicus*	-	-	-	-	-	-	1	-	-	1	3	-	-	-	-	-	-	-	-	-
Annelid	*Jasmineira elegans*	-	-	-	-	-	41	9	-	5	6	10	-	-	-	-	-	-	-	-	-
Annelid	*Kefersteinia cirrata*	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-
Annelid	*Lagis koreni*	4	-	-	-	-	-	-	-	-	3	4	-	-	-	-	-	-	-	-	-
Annelid	*Lanice conchilega*	24	-	-	-	-	-	1	-	3	3	5	-	-	-	-	-	-	-	-	-
Annelid	*Laonice bahusiensis*	-	2	-	-	-	-	-	-	-	1	1	-	-	1	-	-	-	-	-	-
Annelid	*Lepidonotus squamatus*	-	-	-	-	-	2	1	-	1	-	-	-	-	-	-	-	-	-	-	-
Annelid	*Lumbrineris gracilis*	2	5	-	-	-	-	-	-	3	6	9	-	-	7	-	-	-	-	-	-
Annelid	*Macrochaeta helgolandica*	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Annelid	*Maldanidae indet.*	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-
Annelid	*Malmgrenia indet.*	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
Annelid	*Marphysa sanguinea*	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
Annelid	*Mediomastus fragilis*	3	-	-	-	-	1	2	-	1	1	-	-	-	-	-	-	-	-	-	-
Annelid	*Nematonereis unicornis*	-	1	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-
Annelid	*Nephtys caeca*	3	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-
Annelid	*Nephtys cirrosa*	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	1
Annelid	*Nephtys hombergii*	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
Annelid	*Nephtys kersivalensis*	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
Annelid	*Nephtys longosetosa*	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	1	-
Annelid	*Nereis longissima*	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Annelid	*Nicomache personata*	-	-	-	-	-	-	-	-	-	2	1	1	-	-	-	-	-	-	-	-
Annelid	*Notocirrus scoticus*	1	-	-	-	-	-	-	-	-	1	3	-	-	1	-	-	-	-	-	-
Annelid	*Notomastus latericeus*	2	-	-	-	-	1	-	-	1	10	1	-	-	-	-	-	-	-	12	1
Annelid	*Odontosyllis fulgurans*	-	1	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-

		S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17	S18	S19	S20
Annelid	*Ophelia borealis*	-	-	-	2	-	1	-	1	4	-	-	-	-	-	-	1	-	10	1	-
Annelid	*Ophelina acuminata*	-	-	-	-	-	-	-	-	-	1	-	-	-	1	-	-	-	-	-	-
Annelid	*Orbinia sertulata*	-	6	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	1
Annelid	*Owenia fusiformis*	1	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
Annelid	*Paraonidae indet.*	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Annelid	*Pholoe inornata*	1	-	-	-	-	1	-	-	1	2	1	-	-	-	-	-	-	-	-	-
Annelid	*Pholoe synophthalmica*	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Annelid	*Phyllodoce groenlandica*	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
Annelid	*Podarkeopsis capensis*	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
Annelid	*Poecilochaetus serpens*	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
Annelid	*Polycirrus medusa*	1	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	3	-	-
Annelid	*Polycirrus norvegicus*	-	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-
Annelid	*Polydora indet.*	-	-	-	1	1	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-
Annelid	*Polynoe scolopendrina*	-	-	-	-	1	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-
Annelid	*Pomatoceros lamarcki*	-	-	-	24	23	3	1252	-	6	1	6	-	-	-	1	-	-	2	-	-
Annelid	*Praxillella affinis*	2	-	-	-	-	-	-	-	-	5	3	-	-	-	-	-	-	-	-	-
Annelid	*Pseudonotomastus southerni*	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	1	-
Annelid	*Pseudopolydora pulchra*	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
Annelid	*Sabella pavonina*	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-
Annelid	*Sabellaria alveolata*	-	-	-	-	-	426	35	-	3	-	-	-	-	-	-	-	-	-	-	-
Annelid	*Sabellaria spinulosa*	-	-	-	-	1	3	17	-	23	99	9	-	-	2	-	-	-	-	-	-
Annelid	*Scalibregma celticum*	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
Annelid	*Scoloplos armiger*	80	2	-	-	-	-	-	-	10	7	7	-	-	-	-	-	-	-	-	-
Annelid	*Sphaerosyllis taylori*	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-
Annelid	*Spio armata*	-	-	-	-	-	8	4	-	8	3	3	-	-	-	-	-	-	-	-	-
Annelid	*Spio decorata*	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Annelid	*Spio martinensis*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1
Annelid	*Spiochaetopterus typicus*	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
Annelid	*Spiophanes bombyx*	5	1	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-

		S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17	S18	S19	S20
Annelid	*Sthenelais boa*	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Annelid	*Syllis armillaris*	-	-	-	-	-	1	-	-	3	-	-	-	-	-	-	-	-	-	-	-
Annelid	*Syllis sp. H*	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Annelid	*Syllis variegata*	-	-	-	-	1	13	-	-	-	-	1	-	-	-	-	-	-	-	-	-
Annelid	*Terebellidae indet.*	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Annelid	*Tharyx killariensis*	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-
Annelid	*Thelepus cincinnatus*	-	-	-	-	-	-	-	-	2	1	1	-	-	-	-	-	-	-	-	-
Annelid	*Thelepus setosus*	-	-	-	-	2	1	-	-	-	2	2	-	-	-	-	-	-	-	-	-
Annelid	*Travisia forbesii*	-	1	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-
Bryozoa	*Alcyonidium diaphanum*	P	-	-	-	-	-	-	-	P	-	-	-	-	-	-	-	-	-	-	-
Bryozoa	*Bicellariella biciliata*	-	-	-	-	-	P	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bryozoa	*Clymenura tricirrata*	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
Bryozoa	*Conopeum reticulum*	-	-	-	-	P	-	-	-	-	P	P	-	-	-	-	-	-	-	-	-
Bryozoa	*Electra pilosa*	-	-	-	-	P	-	P	-	P	P	P	-	-	-	-	-	-	-	-	-
Bryozoa	*Escharella variolosa*	-	-	-	-	-	-	-	-	P	-	-	-	-	P	-	-	-	-	-	-
Bryozoa	*Eucratea loricata*	P	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bryozoa	*Flustra foliacea*	-	P	-	-	P	P	-	-	P	-	-	-	-	-	-	P	-	-	-	-
Bryozoa	*Vesicularia spinosa*	-	-	-	-	-	-	-	-	-	P	-	-	-	-	-	-	-	-	-	-
Chelicerata	*Nymphon brevirostre*	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
Cnidaria	*Abietinaria abietina*	-	-	-	-	-	P	-	-	P	P	-	-	-	-	-	P	-	-	-	-
Cnidaria	*Actiniaria indet*	-	-	-	-	-	-	-	-	-	-	P	-	-	P	-	-	-	-	-	-
Cnidaria	*Campanularia sp. indet*	-	-	-	-	P	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cnidaria	*Cerianthus lloydii*	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
Cnidaria	*Edwardsia claparedii*	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-
Cnidaria	*Hydrallmania falcata*	-	-	-	-	-	-	-	-	-	-	P	-	-	-	-	-	-	P	-	-
Cnidaria	*Nemertesia antennina*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	P	-	-
Cnidaria	*Obelia cf longissima*	-	-	-	-	-	P	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cnidaria	*Tubularia*	-	-	-	-	-	-	P	-	-	-	P	-	-	-	-	-	-	-	-	-
Crustacea	*Ampelisca tenuicornis*	-	-	-	-	-	-	-	-	-	1	2	-	-	-	-	-	-	-	-	-

		S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17	S18	S19	S20
Crustacea	*Atylus swammerdami*	-	-	-	-	-	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-
Crustacea	*Bathyporeia guilliamsoniana*	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Crustacea	*Cancer pagurus*	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Crustacea	*Cheirocrates sundevalli*	-	-	-	-	-	-	-	-	-	4	-	-	-	-	-	-	-	-	-	-
Crustacea	*Corophium*	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Crustacea	*Corophium bonelli*	-	-	-	-	-	6	-	-	-	-	1	-	-	-	-	-	-	-	-	-
Crustacea	*Corystes cassivelaunus*	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-
Crustacea	*Crangon allmanni*	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-
Crustacea	*Gnathia sp.*	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-
Crustacea	*Gnathia sp. (praniza)*	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Crustacea	*Maera sp*	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Crustacea	*Pagurus bernhardus*	-	-	-	-	-	1	-	-	4	2	-	-	-	-	-	-	-	-	-	-
Crustacea	*Pisidia longicornis*	-	-	-	-	-	38	1	-	2	-	-	-	-	-	-	-	-	-	-	-
Crustacea	*Siphonocoetes kroyeranus*	-	-	-	-	1	5	-	-	2	-	-	-	-	-	-	-	-	-	-	-
Crustacea	*Urothoe elegans*	-	-	-	-	-	8	5	-	-	1	-	-	-	-	-	-	-	1	-	-
Crustacea	*Urothoe marina*	-	-	-	-	-	-	-	-	5	-	-	-	-	-	-	-	-	-	-	-
Crustacea	*Xantho pilipes*	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
Echinodermata	*Amphiura filiformis*	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Echinodermata	*Asterias rubens*	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
Echinodermata	*Leptosynapta indet.*	1	1	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-
Echinodermata	*Ophiothrix fragilis*	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-
Echinodermata	*Ophiura ophiura*	1	-	-	-	-	-	-	-	-	1	-	-	-	1	-	-	-	-	-	-
Echinodermata	*Psammechinus miliaris*	-	-	-	-	-	-	-	-	-	-	P	-	-	-	-	-	-	-	-	-
Hemichordata	*Saccoglossus indet.*	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mollusc	*Abra nitida*	26	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-
Mollusc	*Diodora graeca*	-	-	-	-	1	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mollusc	*Hiatella arctica*	-	-	-	-	-	10	1	-	-	-	3	-	-	-	-	-	-	1	-	-
Mollusc	*Lepidopleurus asellus*	-	-	-	-	1	-	-	-	-	14	10	-	-	1	-	-	-	-	-	-
Mollusc	*Modiolus modiolus*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-

		S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17	S18	S19	S20
Mollusc	*Monia patelliformis*	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mollusc	*Nucula nucleus*	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	12	-	-
Mollusc	*Nudibranch indet*	-	-	-	-	-	2	-	-	-	-	1	-	-	-	-	-	-	-	-	-
Mollusc	*Timoclea ovata*	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mollusc	*Trivia arctica*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Nemertea	*Cephalothricidae indet.*	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-
Nemertea	*Cerebratulus sp. 1*	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
Nemertea	*Flatworm*	-	-	-	-	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nemertea	*Nemertea indet.*	2	1	-	-	3	6	-	-	-	1	3	-	-	1	1	-	-	-	-	1
Nemertea	*Tubulanus polymorphus*	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Phoronida	*Phoronis indet.*	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Platyhelminthes	*Platyhelminth sp*	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Porifera	*Porifera indet*	-	-	-	-	-	P	-	-	-	-	-	-	-	-	-	-	-	P	-	-
Sipuncula	*Golfingia elongata*	-	-	-	-	-	3	1	-	-	-	-	-	-	-	-	-	-	-	-	-
Sipuncula	*Golfingia vulgaris*	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-
Sipuncula	*Nephasoma minutum*	-	-	-	-	-	2	1	-	-	1	1	-	-	-	-	-	-	-	-	-
Sipuncula	*Phascolion strombi*	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-
Sipuncula	*Phascolion strombus*	-	-	-	-	-	-	1	-	-	1	-	-	-	-	-	-	-	-	-	-
Sipuncula	*Sipuncula juv. indet.*	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-
Tunicata	*Ascidiella aspera*	-	-	-	-	P	P	-	-	P	-	-	-	-	-	-	-	-	-	-	-
Tunicata	*Ascidiella scabra*	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Tunicata	*Dendrodoa grossularia*	-	-	-	-	-	-	-	-	-	-	P	-	-	-	-	-	-	-	-	-
	Triteata sp.	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-
	Total number of Taxa (June 2011)	38	17	0	4	18	50	28	1	44	60	54	3	2	16	6	3	1	12	6	6
	Total number of Indiviuals (June 2011)	208	27	0	29	38	642	1349	1	114	232	141	3	2	24	7	1	1	34	17	6
	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

	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17	S18	S19	S20
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 2011.

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	17.25	5.11	1.25	4.03	8.15	55.33	2.47	6.41	1.17	-0.62	1.36	Very Poorly Sorted Fine Gravelly Fine Sand	Gravelly Sand
D02	10.07	11.68	7.53	6.73	17.73	43.72	0.69	1.85	1.16	-0.56	0.71	Poorly Sorted Very Fine Gravelly Fine Sand	Gravelly Sand
D03	0.00	2.01	0.88	1.08	46.91	47.68	0.19	1.25	2.15	0.36	0.59	Moderately Well Sorted Slightly Very Fine Gravelly Fine Sand	Slightly Gravelly Sand
D04	0.69	1.07	1.75	5.54	73.07	16.70	0.07	1.11	1.95	0.25	2.66	Moderately Well Sorted Slightly Very Fine Gravelly Medium Sand	Slightly Gravelly Sand
D05	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-2.24	0.00	0.74	Gravel	Gravel
D06	5.74	5.88	6.10	7.37	55.02	15.89	1.11	2.90	1.40	-0.43	2.15	Poorly Sorted Very Fine Gravelly Medium Sand	Gravelly Sand
D07	36.06	6.62	4.33	12.83	26.12	11.39	1.10	1.55	0.10	-0.25	0.55	Poorly Sorted Sandy Fine Gravel	Sandy Gravel
D08	2.38	3.88	10.53	26.75	49.80	5.73	0.07	0.87	1.14	-0.54	1.33	Poorly Sorted Very Fine Gravelly Medium Sand	Gravelly Sand
D09	3.08	3.12	4.09	5.70	64.40	14.54	1.47	3.60	1.95	0.13	4.89	Moderately Sorted Very Fine Gravelly Medium Sand	Gravelly Sand
D10	28.67	10.55	5.18	6.68	19.12	25.93	1.86	2.01	0.49	-0.25	0.48	Very Poorly Sorted Sandy Fine Gravel	Sandy Gravel
D11	26.11	9.87	4.00	5.22	20.16	24.30	3.16	7.18	0.77	-0.28	0.66	Very Poorly Sorted Coarse Silty Sandy Fine Gravel	Muddy Sandy Gravel
D12	0.00	0.00	0.00	0.23	33.05	65.08	0.29	1.34	2.41	-0.50	0.61	Moderately Well Sorted Moderately Well Sorted Fine Sand	Sand
D13	0.00	0.12	0.80	10.72	76.21	10.38	0.16	1.61	1.75	0.01	2.65	Well Sorted Slightly Very Fine Gravelly Medium Sand	Slightly Gravelly Sand
D14	15.60	5.22	5.91	11.55	23.12	28.10	4.43	6.08	1.07	-0.32	1.00	Very Poorly Sorted Fine Gravelly Fine Sand	Gravelly Sand
D15	15.07	7.76	9.43	15.16	45.80	4.92	0.15	1.70	0.66	-0.66	0.94	Poorly Sorted Fine Gravelly Medium Sand	Gravelly Sand
D16	0.00	0.00	0.06	0.76	37.82	55.91	1.92	3.53	2.39	-0.24	0.84	Moderately Well Sorted Moderately Well Sorted Fine Sand	Sand
D17	23.08	17.98	13.79	10.47	24.38	9.43	0.09	0.78	-0.15	0.08	0.67	Poorly Sorted Sandy Fine Gravel	Sandy Gravel
D18	10.18	12.31	10.24	6.69	29.10	29.20	0.35	1.94	1.06	-0.49	0.72	Poorly Sorted Very Fine Gravelly Fine Sand	Gravelly Sand
D19	15.46	1.93	2.51	6.71	25.09	25.93	9.80	12.55	1.47	-0.13	1.73	Very Poorly Sorted Fine Gravelly Very Coarse Silty Fine Sand	Gravelly Muddy Sand
D20	22.23	15.52	9.19	5.00	33.89	13.01	0.19	0.97	0.21	-0.32	0.66	Poorly Sorted Sandy Fine Gravel	Sandy Gravel