

**Arklow Bank Offshore Windfarm Environmental Monitoring
Benthic Ecology Survey Report**

Surveys October 13th –15th October 2004

HYDROSERV PROJECTS LTD

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1. INTRODUCTION

Centre for Marine and Coastal Studies (CMACS Ltd) has been requested by North East Diving Services (on behalf of *HydroServ* Hydrographic and Marine Services for Arklow Energy Ltd) to provide scientific support for environmental monitoring of Arklow Bank Offshore Wind Farm. The survey reported in this document was carried out from 13th to 15th October 2004 as part of post construction monitoring of the Arklow OWF.

The Arklow offshore windfarm lies 13km east of Arklow (County Wicklow, Republic of Ireland) and currently consists of seven 3.6 MW turbines. Construction was begun in 2002 with the building of these seven turbines. However, it is a possibility 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 3 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 second 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 generated.

Surveys during June / July 2004 using Day grabs encountered severe problems with hard ground, and it was impossible to obtain samples from many of the sites (see monitoring report for June/July 2004). For this October 2004 monitoring survey it was decided that semi quantitative anchor dredges would be used to sample infauna and sediments. As with the June/July 2004 survey semi-quantitative beam trawls were used to sample epifauna and benthic fish communities. The locations of both the beam trawl and grab sites for the October 2004 survey were specified by the client and are displayed in Figure 1. They are identical to those sampled in June/July 2004. None of the anchor dredge sites coincide with any of the baseline survey sites, although many of them are within a few hundred metres. Samples were successfully obtained at all sites in the case of both beam trawls and anchor dredges. It is not presently clear whether any of the beam trawl sites coincide with the sites surveyed for the baseline surveys.

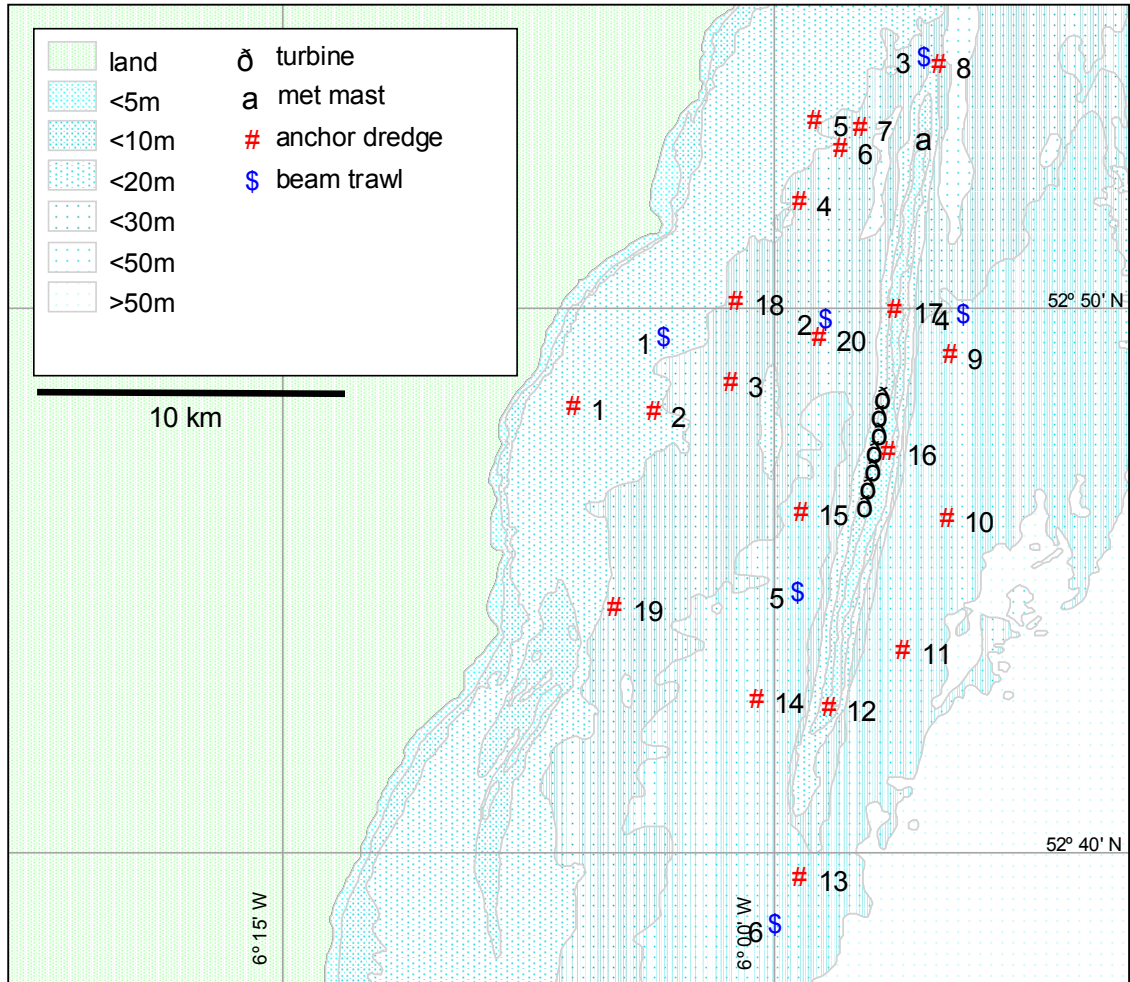


Figure 1 Dredge sites (numbered 1 to 20) and trawl locations (numbered 1 to 6) for October 2004 surveys

2. METHODOLOGY

All benthic grabbing and beam trawl surveys were undertaken out of the Port of Arklow using the work vessel 'MV Husky, a 25m workboat supplied by Hydrosurveys Ltd. Surveys were conducted on a daily basis with the vessel returning to its berth at the end of each day. Health and safety was considered important at all times with the project risk assessment forming the main guidelines. The following section details survey dates in addition to the methods used for the beam trawl and benthic grab surveys.

2.1 Beam trawls

Beam trawl surveys were undertaken on 13th to the 15th October 2004 during daylight hours using a 2m beam trawl equipped with a chain matrix and 4mm square mesh cod-end (Figure 2) towed from the 'Husky'. Tows were carried out into the current for a distance of 300m at a speed of 2 knots equating to approximately 15mins over the ground, with a warp length of a minimum of 2.5 times the water depth to allow the gear to fish the bottom properly. Once on board the contents of each trawl were photographed prior to being sorted (these can be provided on CD at the clients request).

All organisms were identified in the field where possible, although a few invertebrates were retained for confirmation of identification. Commercial fish species were measured using a graduated fish board and elasmobranchs were measured and sexed. Colonial organisms (such as hydroids and bryozoans) and also barnacles, which can be extremely numerous, were quantified according to a suitable scale of abundance, based on visual assessment (see Appendix 6.3).

Sub-sampling was required where extremely large numbers of organisms were encountered. In this case the entire catch was initially pre-sorted in order to remove and quantify all fish and any large or obvious specimens. The remaining material was then sub-sampled to an appropriate fraction with care being taken to ensure that this was a fair representation of the entire catch. This was carefully sorted and all animals identified and recorded. These numbers were then multiplied by the appropriate factor to get an estimate of the true number in the sample remainder, and these estimates added to those found during the initial search.

2.2 Anchor Dredge Sampling

The dredge survey was undertaken on 13th October 2004 using a standard anchor dredge (Figure 2). At each of the twenty sites (see Figure 1) a single sample was obtained, with no replication of samples. In general the anchor dredge was dropped around 20m in advance of the target, sufficient warp paid out, and the anchor dredge then dragged through the target point. On the first attempt it was generally dragged through to approximately 20m beyond the target point, and if this provided a poor sample the process was repeated with a longer pull.

Once an acceptable sample was received a digital photograph was taken, a small sub-sample (circa 400 g) suitable for particle size determination was taken, and then, wherever possible, three identical 10 litre faunal sub-samples taken, sieved and preserved. Field notes were taken, to include sample number, date and time of sample, a brief visual description of the sample, an

estimate of volume of each sub-sample before sieving, and any pertinent additional information such as difficulties in sampling. The sediment sub-samples were stored in a cool location and transferred to a freezer once ashore. The faunal sub-samples were then sieved through a 1.0 mm mesh as gently as possible, sediments passing through the sieve were discarded and the material retained on the sieve was carefully transferred to a labelled bucket and fixed with buffered 10% formalin solution to a final concentration of at least 5%. A separate waterproof label duplicating the main external label was added to the sample bucket.

It was decided by the client that one of the three faunal subsamples was to be worked up in each case, and analysis of the samples was then carried by an experienced laboratory taking part in the UK's NMBAQC (National Marine Biological Analytical Control) scheme, with samples being thoroughly sorted to remove all organisms which were then identified, where possible, to species level, counted and logged. The remaining sub-samples were held in storage in case of loss of the first samples.



Figure 2 The anchor dredge (left) and 2m beam trawl (right) used during the October 2004 surveys.

2.3 Geophysical analysis

Once at the laboratory the sediment sub samples from each of the grabs underwent particle size analysis. Firstly they were dried to a constant weight at a set temperature of 105°C before being sieved using an Endecott BS410/1986 sieve series and an Endecott EFL2 mk3 electronic shaker with the sieve sizes displayed in Table 1.

Table 1 Sieve series sizes (mm) used for particle size analysis (PSA).

Sieve Series Sizes (mm)										
25.4	12.7	6.35	4.0	2.0	1.0	0.500	0.250	0.125	0.063	<0.063

The weights of the sediment retained on each of the sieve series were then used to calculate the mean and median particle sizes, and the determination of sorting index by calculating the standard deviation of Phi. These were then used to determine sediment type according to the Folk and Ward classification system as used by the British Geological Survey (Figure 3) and also the definitions as used by Buchanan *et al* (1984) (see Table 2 and Table 3).

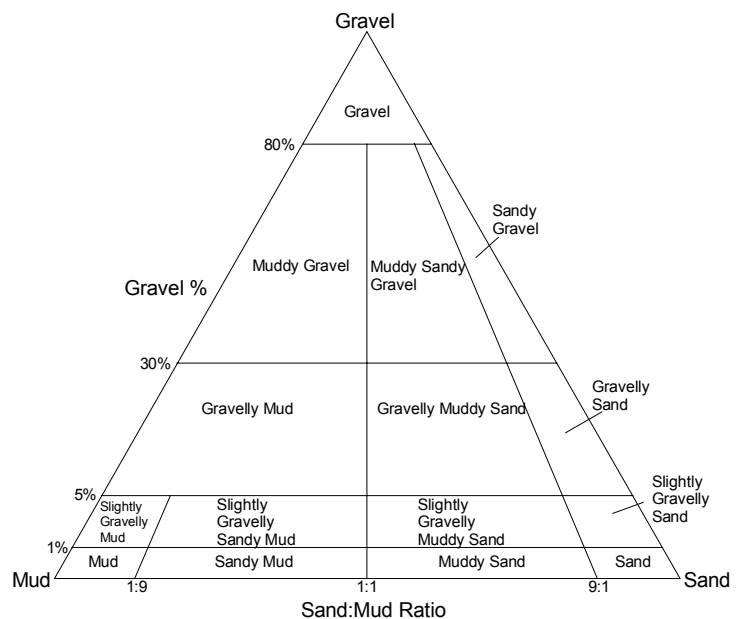
Table 2 Classification used for defining sediment type (from Buchanan, 1984).

>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 3 Classification used defining degree of sediment sorting (from Buchanan, 1984).

<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

Figure 3 Sediment classification after Folk (1954) as also used by the BGS. “Gravel” is greater than 2mm and “mud” is less than 63µm.



2.4 Data Analysis

Once all laboratory analysis was completed the data was then subjected to various analyses. A summary of the different methods used in the baseline study and the study performed by CMACS Ltd are displayed in Table 4.

2.4.1 Beam Trawls

Due to the different types of trawl equipment used and the different number of trawls for each of the baseline and the monitoring surveys it is very difficult to postulate any suitable analysis for the trawl data other than descriptive. The low number of trawls per survey renders the use of statistical analysis inaccurate and the fact that data was recorded only on a presence/absence basis in the baseline surveys means that community comparisons are extremely difficult. As the beam trawl used in these monitoring surveys is more similar to the Agassiz trawls than the larger otter trawls of the baseline it is more practical to use the Agassiz trawls as a means of community comparison rather than the results from the otter trawl surveys.

2.4.2 Grab Samples

Once the raw data had been obtained from the sorted samples and organized into electronic format, analysis was undertaken, mainly using PRIMER Version 5 (see Clark and Warwick, 1994, for an introduction to PRIMER). A variety of univariate, multivariate and graphical techniques were also used to provide information concerning species richness, universal features of community structure and diversity indices. Unlike the attempts at Day Grab sampling carried out in June/July 2004, no replication was attempted on this survey - each site was sampled only once.

Multivariate analysis were based on square-root transformed abundance of species found, which provides a sensible balance between rare and common species, and using the Bray-Curtis similarity coefficient (Bray and Curtis, 1957) or, where appropriate, presence / absence data only.

Multi-Dimension Scaling (MDS) ordination was also based on the Bray-Curtis similarity coefficient. Stress values are provided for each MDS plot, whereby 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.

In the previous report (reporting the June/July 2004 surveys) comparison was made between the sites in the 2004 grab survey to identify any differences or similarities between the communities of organisms found at those sites. These were based on pooled data for the replicate samples at each site. The data from the June 2000 dredge survey was compared with the data from the 2004 grab survey, which simply highlighted the fact that the survey methods were so different (anchor dredge versus Day Grabs) that comparison was pointless. In this report, a comparison was made between the dredge surveys in September 2000, and those of October 2004 to assess whether there were any differences or similarities between sites in different seasons. In order to do this

the October 2004 data had to be reduced to presence / absence data in order to make the data comparable.

Table 4 Methods of analysis during the 2000 and 2004 surveys.

Trawl Survey					
June 2000	Otter trawl	Descriptive	July 2004	2m Beam trawl	Descriptive, comparison with Agassiz trawls. Key species' abundance mapped
Sept 2000	Agassiz trawl	Descriptive	October 2004	2m Beam trawl	
April 2001	Agassiz trawl	Descriptive			
Grab / dredge Survey					
June 2000	Anchor dredge	Descriptive	June/July 2004	Day grab	Descriptive including comparison with 2000 data. MDS plots. Sediment description
Sept 2000	Anchor dredge	Descriptive	October 2004	Anchor dredge	

3. RESULTS

3.1 Beam Trawls

Raw data from the beam trawl surveys are displayed in Appendix 6.3 with fish length data and elasmobranch sex information in Appendix 6.4. A total of 51 taxa were recorded in October 2004 with 9 of these being fish species (a species list is given in Appendix 6.1). This is lower than the total of 61 taxa which were recorded in July 2004 of which 17 were fish species. These are broadly comparable with the baseline survey Agassiz trawls in which a total of 60 taxa, (8 fish species), and 23 taxa (4 fish species) were recorded in September 2000 and the April 2001 respectively. In the baseline surveys the autumn trawls were richer than the spring trawls. In this survey the summer trawls were richer than the autumn trawls.

The number of fish taxa found at each trawl location is displayed in Figure 4 and the number of individual fish recorded at each trawl location in Figure 5. In contrast to the July 2004, surveys, numbers of fish taxa and individuals were particularly low (it is worth pointing out that numbers of both individuals and species in July 2004 were by no means high). The largest numbers of individuals were recorded at Trawl site 3 to the north; however, these consisted of only seven sand eels *Ammodytes tobianus* and a single lesser weever *Echiichthys vipera*. In contrast, site 6 was the richest site in terms of both species and individuals in July, but very poor in the October surveys with only four individuals from two species. a

The most abundant fish species caught from the 6 trawls in October 2004 was, as in July 04, the Sand Goby, *Pomatoschistus minutus* but there were only 10 individuals recorded (cf 23 in July) at 3 of the trawl sites (site no's 1,2 and 6 as opposed to sites 2,4 and 5 in July). As in July the Poor Cod *Trisopterus minutus* was also one of the more abundant species, although only seven individuals were caught. Commercially important species were limited to two dogfish and single specimens of juvenile whiting, cod, lemon sole and thornback rays.

A total of only three elasmobranchs (two dogfish and a thornback) were caught in October compared to ten during the July 2004 beam trawls when the most abundant were the thornback ray, *Raja clavata* and the spotted ray, *Raja montagui*.

While it must be acknowledged that small beam trawls are a far from ideal survey method for fish, and routinely subject to very large variations in catches, overall it seems clear that benthic fish populations at the sites surveyed are generally low.

The beam trawl surveys also yielded a total of 42 invertebrate species (see Appendix 6.3) as compared to 43 species in July, although total numbers of countable organisms were approximately half at 1,820 (cf 3,020 in July). The most numerous species (see summary in Table 5) were *Pagurus bernhardus* (common hermit crab), *Psammechinus miliaris* (sea urchin), *Crangon crangon* (brown Shrimp), *Macropodia rostrata* (long legged spider crab), *Asterias rubens* (common starfish), and *Pandalus montagui* (pink shrimp). These were broadly the same as in the July survey although numbers of many species, including many of the mobile crustaceans such as the pink shrimp *Pandalus montagui*, shrimp *Crangon crangon* and various other prawns and crabs, were generally lower. Some species were more abundant in the October samples, such as the variegated scallop *Chlamys variegata* and the brittle star *Ophiura albida*, although these were only found in small numbers.

As in July, the bryozoan *Flustra foliacea* was also relatively common and was recorded at every trawl location with highest abundance at site 1. In general, bushy hydroids and bryozoans, including *Flustra*, were slightly more abundant than during July.

The Ross worm, *Sabellaria spp*¹ was present in small clumps at trawl sites 3 and 4 (cf site 4 only in July). *Sabellaria spp* were also found in the dredge samples (see below).

Table 5 Numbers of the most common countable species found in the July 2004 and October 2004 beam trawl surveys (limited to those species where at least 20 specimens were found in either survey).

Latin name	Common name	Jul-04	Oct-04
<i>Pagurus bernhardus</i>	Common hermit crab	802	583
<i>Psammechinus miliaris</i>	Sea urchin	496	464
<i>Crangon crangon</i>	Brown Shrimp	427	130
<i>Macropodia rostrata</i>	Long legged spider crab	98	128
<i>Asterias rubens</i>	Common Starfish	295	100
<i>Pandalus montagui</i>	Pink shrimp	725	99
<i>Chlamys varia</i>	Variegated scallop	0	57
<i>Buccinum undatum</i>	Common Whelk	60	43
<i>Ophiura albida</i>	Brittle star	0	36
<i>Liocarcinus holsatus</i>	Flying crab	18	31
<i>Crossaster papposus</i>	Common sun star	56	21
<i>Henricia sanguinolenta</i>	Blood Sea star	28	4
<i>Calliostoma zizyphinum</i>	Painted top shell	36	2
<i>Pisidia longicornis</i>	Long clawed porcelain crab	52	1
<i>Liocarcinus depurator</i>	Harbour crab	44	1
<i>Liocarcinus marmoreus</i>	Marbled swimming crab	108	0
<i>Pandalus propinquus</i>	prawn	48	0
<i>Macropodia tenuirostris</i>	Spider crab	36	0
<i>Ophiothrix fragilis</i>	Brittlestar	28	0
<i>Eurynome aspera</i>	Short legged spider crab	22	0
<i>Leptochiton sp</i>	Chiton	20	0

¹ Unusually, *Sabellaria alveolata*, which is relatively uncommon in subtidal *Sabellaria* aggregations, was present in the dredge samples as well as *Sabellaria spinulosa*. Both species were also recorded in the baseline surveys

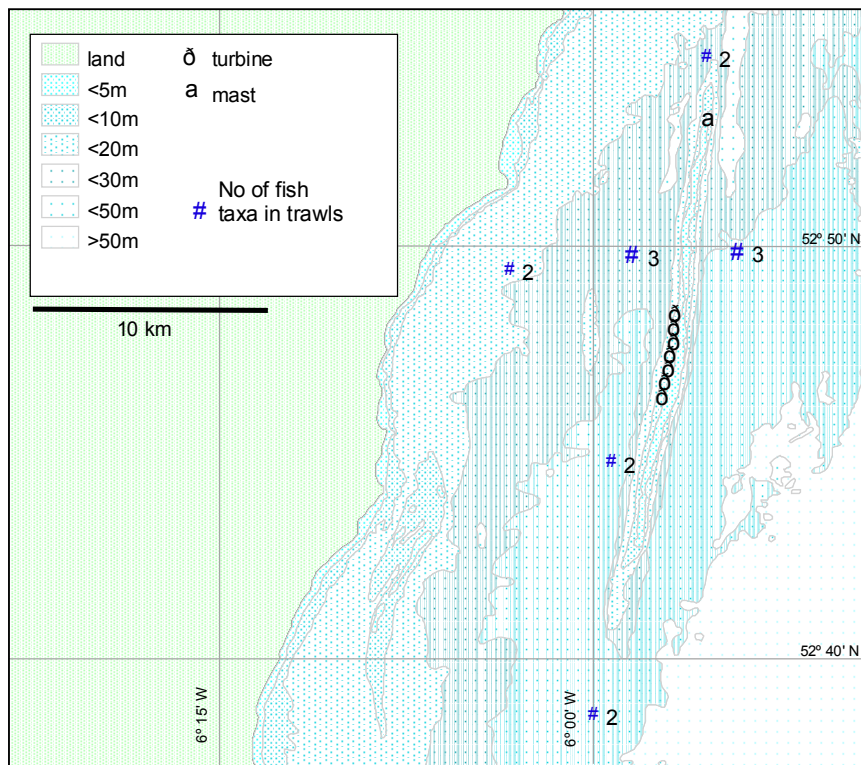


Figure 4 Total number of fish taxa per trawl site (October 2004)

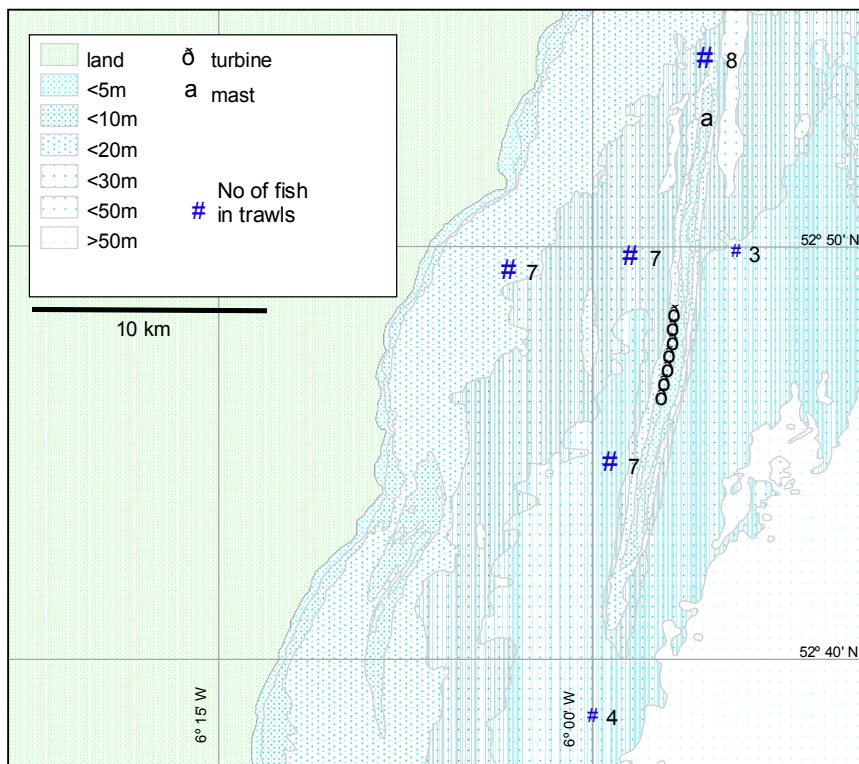


Figure 5 Total number of fish individuals per trawl site (October 2004)

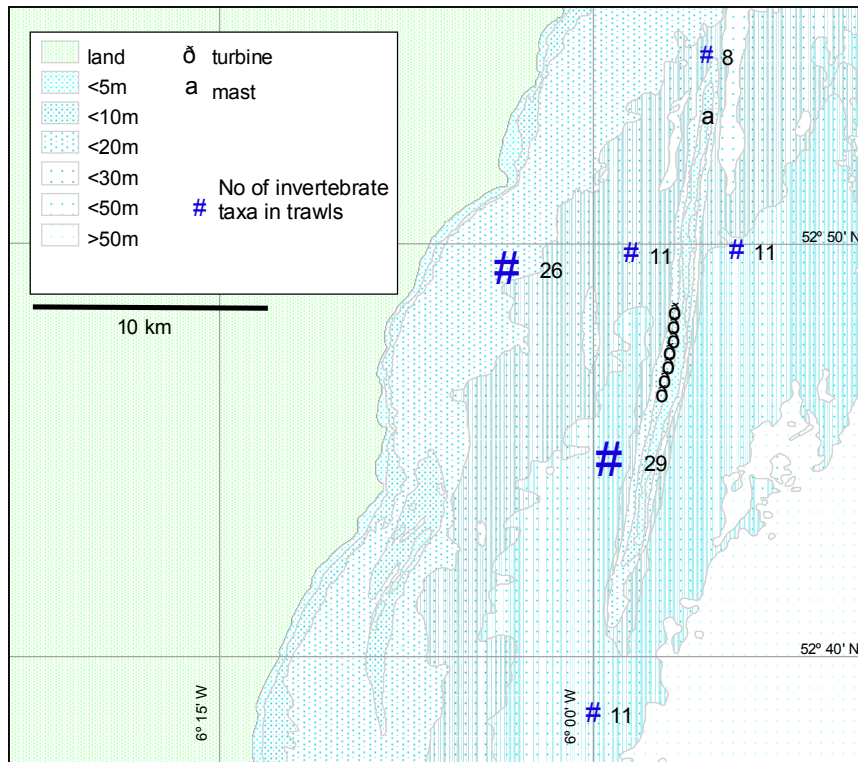


Figure 6 Number of invertebrate taxa per trawl site (October 2004)

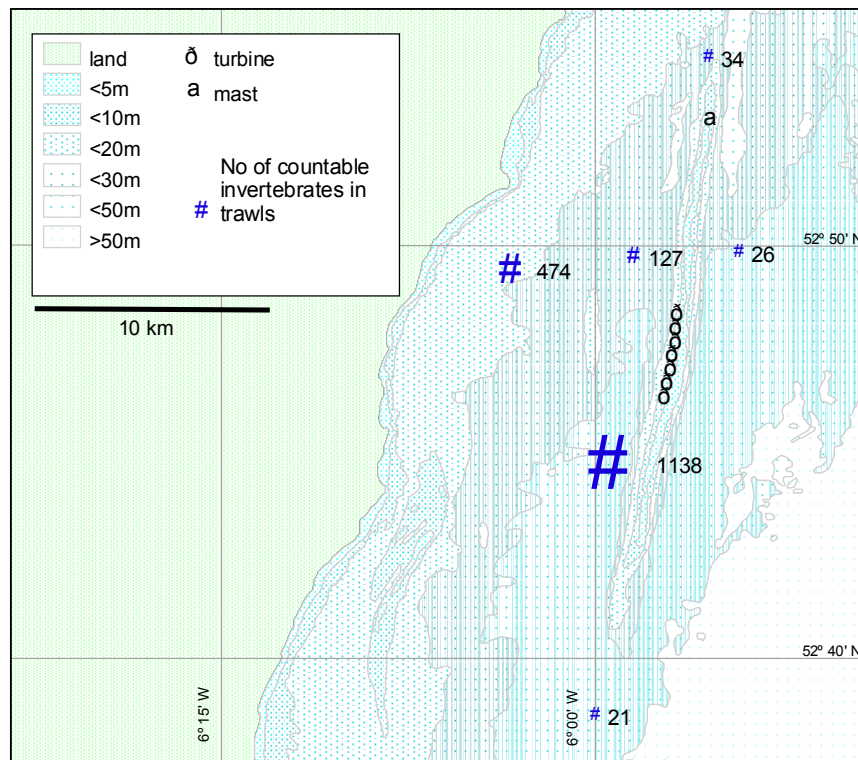


Figure 7 Total number of countable invertebrates per trawl site (October 2004)

3.2 Grab samples

Due to the coarse nature of the ground quantity the sediment at sites 4, 6 and 7 was deemed unsuitable for particle size analysis by the client representative. Visual assessment of the sediments from notes taken at the time, and aided by photographs, was used to classify these according to the BGS version of the Folk and Ward classification.

3.2.1 Geophysical analysis

Total data for the particle size analysis is presented in Appendix 6.6 including the sieve weights and phi results, together with the visual assessment based on notes taken at the time. A summary of the sediment types after Buchanan and BGS is presented in Table 6. From the results it can be seen that there is a range of sediment types from very well sorted fine sands to very coarse gravels. Those sites of mainly medium sand also contained small quantities of broken shell fragments and pebbles. The map presented in Figure 8, in combination with Table 6, shows that those sites located on top of the bank (12, 16 and 17) as well as those immediately to the north and south (8 and 13) were all composed of very well sorted fine or medium sands, while the deeper sites both inshore and offshore were composed of coarser materials with the exceptions of sites 3 and 19. The coarsest sites were clustered together in the north of the area, although it is not known whether this represents a true trend on the seabed.

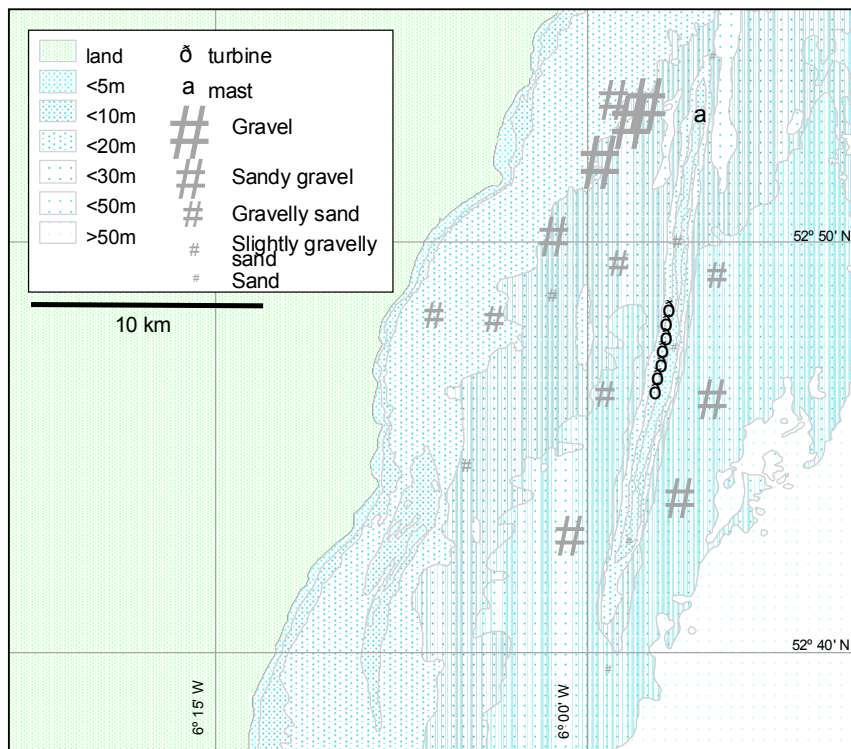


Figure 8 Distribution of sediment type as determine from the anchor dredge samples. Site numbers are shown.

Table 6 Classification of sediment types at June 2004 grab stations according to methods after Buchanan and Folk & Ward, as used by BGS (see methods), together with visual assessment of sediments from notes taken at the time.

Site Code	Classification after Buchanan	Folk Triangles after BGS	Visual assessment
1	Poorly sorted medium sand	Gravelly Sand	Sand with some stones, occasional shell and shell fragments
2	Poorly sorted medium sand	Gravelly Sand	Sand with some stones, occasional shell and many shell fragments
3	Very well sorted fine sand	Slightly Gravelly Sand	Sand with a few small shell fragments and a few small pebbles
4	psa not possible - based on visual assessment only	Gravel	Small boulders, rocks and stones, some gravelly sand
5	Very poorly sorted granule	Sandy Gravel	Muddy sand and gravel with small stones and small amounts of clay
6	psa not possible - based on visual assessment only	Gravel	Small boulders, various rocks and stones, a few shells and shell fragments
7	psa not possible - based on visual assessment only	Gravel	Small boulders and various rocks and stones, a few shells and shell fragments
8	Very well sorted fine sand	Sand	Sand with few fine shell fragments
9	Moderately sorted fine sand	Gravelly Sand	Sand with shells, shell fragments and large aggregations of Sabellaria
10	Very poorly sorted pebble	Sandy Gravel	Very little sand - mainly large pebbles and stones, shells and shell fragments
11	Poorly sorted very coarse sand	Sandy Gravel	Very little sand - mainly large pebbles and stones, shells and shell fragments
12	Very well sorted fine sand	Sand	Very well sorted sands, very few shell fragments
13	Very well sorted medium sand	Sand	Very well sorted sands, very few shell fragments
14	Very poorly sorted coarse sand	Sandy Gravel	Muddy gravel
15	Poorly sorted medium sand	Gravelly Sand	Gravelly sands with a few shells and shell fragments
16	Moderately well sorted medium sand	Sand	V well sorted sands with very few shell fragments
17	Well sorted medium sand	Slightly Gravelly Sand	Sand with small stones, shells and shell fragments
18	Very poorly sorted very coarse sand	Sandy Gravel	Sandy gravel with various rocks, stones, shell and shell fragments
19	Very well sorted fine sand	Slightly Gravelly Sand	Very well sorted sands, very few shell fragments
20	Moderately well sorted medium sand	Gravelly Sand	Sand with a few shell fragments and shells

3.2.2 Biota

The following section presents the biota results from the October 2004 Grab survey and attempts some comparisons with the data, where applicable, from the June 2004 survey and from the baseline surveys undertaken in September 2000.

3.2.2.1 Abundance and diversity

A taxonomic list of all the species recorded in the June/July 2004 survey is presented in Appendix 6.2 with full data displayed in Appendix 6.4. Overall 31,919 countable individuals were recorded from 300 taxa from the twenty samples. (This compares to 1,258 individuals from 180 taxa at eight sites sampled by duplicate Day Grabs in June/July 2004). The number of taxa and individuals recorded at each site for the grab sample survey are displayed as distribution maps in Figure 9 (number of taxa) and Figure 10 (number of individuals). It is clear that the sites along, and immediately to the north and south, of the Arklow Bank are all particularly poor in both species and individuals, and that this is related to the well sorted sandy nature of the sediments at these sites (see Figure 8). Many other sites are much richer in either taxa, numbers of organisms, or both, particularly offshore from the Arklow Bank and along the north west edge of the survey area. In the main sites with high numbers of both taxa and organisms tended to be those with higher Shannon Wiener diversity indices (Figure 11) although site 1 was notable for having a large number of taxa, but few very dominant organisms, and therefore a high diversity.

The list of most abundant taxa is very different to the list of dominant species found in the Day Grabs from June/July 2004, but this is unsurprising since on that occasion all of the coarser sites proved impossible to sample.

3.2.2.2 Multivariate analysis

Further statistical analysis has also been undertaken on the grab sample data through the use of PRIMER.

Multidimensional scaling (MDS) analysis shows the relationships between the communities found at the different sites (Figure 13). Clearly sites 4,5,6,7,9,10,11,14 and 18 all have very similar communities (Figure 13a), and by superimposing the sediment type over the MDS plot (Figure 13b), it can be seen that sediment type has a very clear structuring role in the communities. The closely clustering sites listed above are all the very rich sites with large amounts of gravel, as a result of which they have large numbers of epifaunal invertebrates such as the tubeworms *Pomatoceros triqueter*, *P. larmarckii* and *Hydroides norvegica*, the tunicate *Dendrodoa grossularia*, barnacles *Balanus crenatus* and *Verruca stroemia*, the chiton *Leptochiton asellus*; the colony forming tubeworms *Sabellaria spinulosa* and *S. alveolata* which are often associated with harder substrates where there is a good supply of suspended sand (discussed further below), and numerous other organisms, including which, while not strictly epifauna, are often associated with stoney sediments (Table 7). The very sandy sites tend not to cluster well together; this probably represents the fact that they have extremely species poor fauna, consisting of only a single specimen of the crustacean *Gastrosaccus spinifer* at site 8, for example; clearly even if the fauna is extremely similar the random nature of sampling from within such a sparse community would lead to mathematical dissimilarity as has occurred here. The gravelly sands cluster with the gravelly sites where the gravel content is high (site 9), but are closer to the sandier communities where the gravel content is lower (sites 1,2 and especially 15 and 20).

Figure 14 displays the results of the cluster analysis undertaken upon the anchor dredge data of June 2000 and the Day grab survey of 2004. This analysis has been carried out on presence/absence data only, since the two surveys were carried out using different methods. Nevertheless, it is clear that there is only an extremely poor relationship between the two sets of data. Sites 12, 14 and 16 from the two surveys cluster well together, but the remaining repeated sites (8,13,15,17,19,20) do not cluster closely together. Perhaps surprisingly, there is no clear link between sediment/community type and this clustering. For example, sites 12 and 16 (which did show similarity between surveys) are species poor well sorted sands, but other species poor sandy sites, such as 8 and 13, did not show strong similarity between surveys. Site 14, which again showed similarity between surveys, was a gravelly, species rich site dominated by large number of polychaete worms, although in the main such sites were not successfully sampled by the Day grab.

It can be seen from Figure 15 that there is no similarity between the data from the baseline survey undertaken in September 2000 and that undertaken in October 2004. There are a number of significant differences between the surveys which mean that this is not surprising; the surveys were carried out using different gear (anchor dredge with large net mesh in 2000; anchor dredge with closed metal base in 2004). In 2004 the samples were identified on board the boat and this would undoubtedly have meant that large numbers of small organisms would have been missed. The the surveys were carried out at different locations and, the length of the tows in September 2000 was more variable than in 2004, the length of tow depending upon the nature of the ground, and being up to seven minutes on some occasions (Ecoserve, 2001). Finally, the 2000 data consist of presence/absence data only, whereas full counts were carried out here. This was counteracted by carrying out the comparisons using presence/absence data only, however.

However, there are nevertheless broad similarities between the baseline data and the data presented here. Both surveys found very sparse communities on the sands along, and immediately to the north and south of, the Arklow Bank, and richer communities associated with coarser, gravelly sediments elsewhere, especially offshore from the Arklow bank and to the north-west of the survey area. Both surveys found evidence of clumps or aggregations of *Sabellaria spinulosa* and *S. alveolata* in the same areas (the north end of the survey site and just offshore from the Arklow Bank).

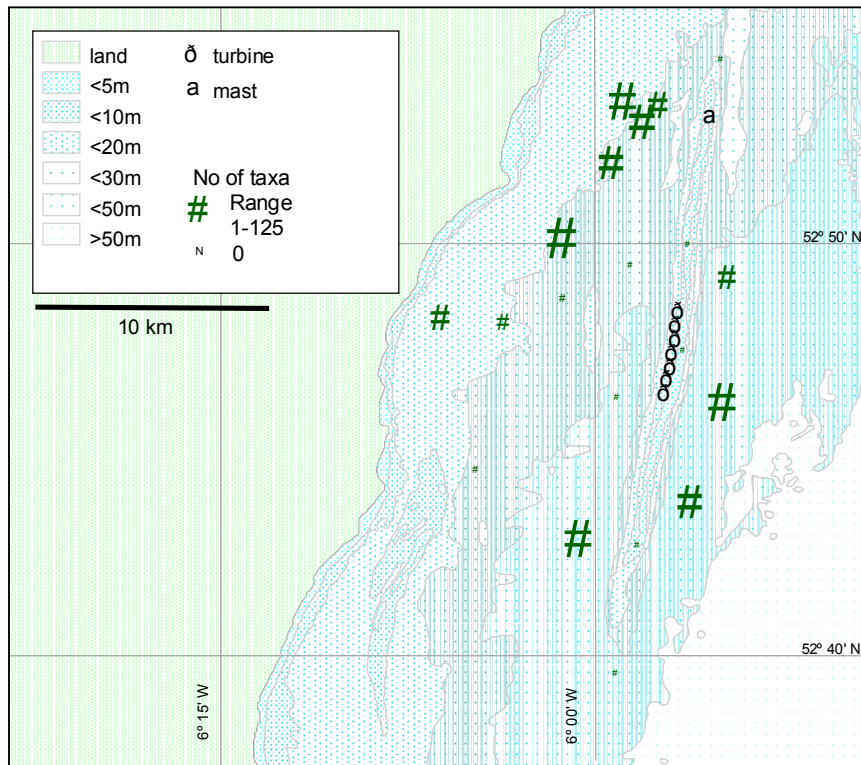


Figure 9 Number of taxa found at each dredge survey site in October 2004

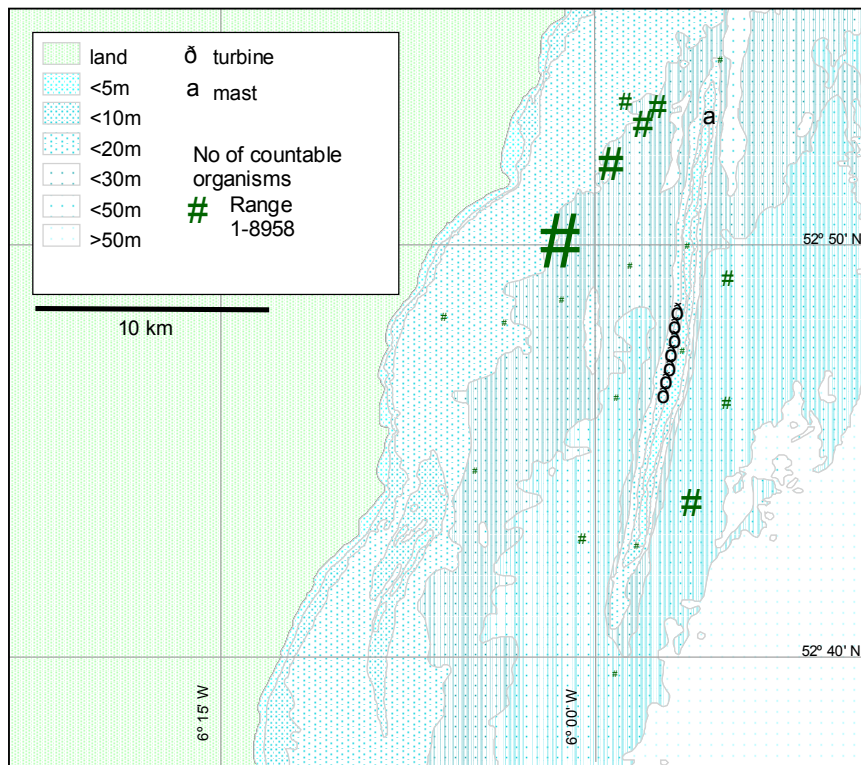


Figure 10 Total number of individuals found at each dredge location in October 2004

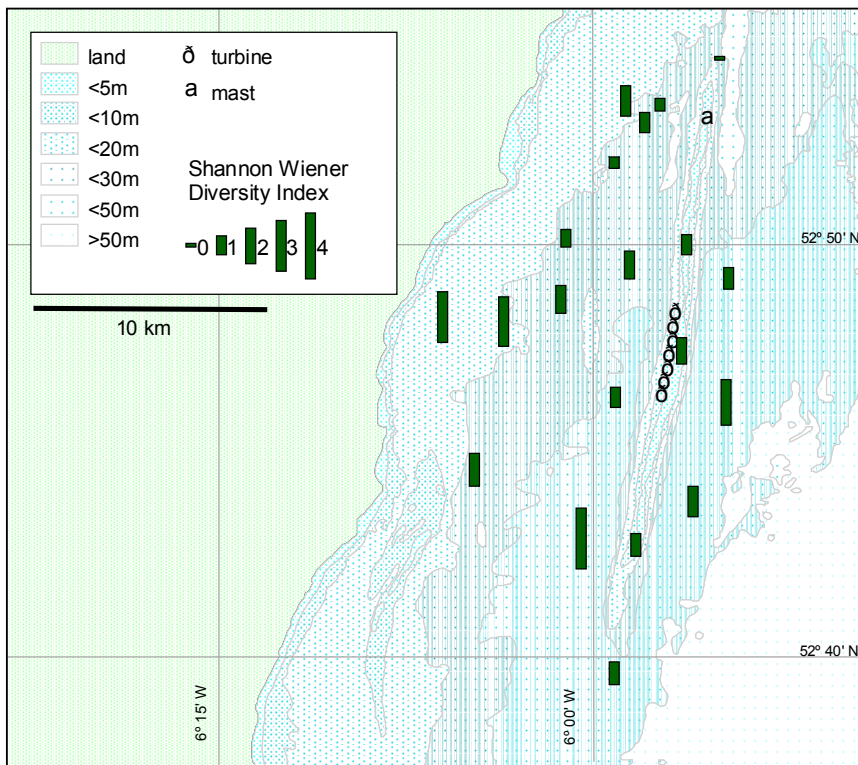


Figure 11 Shannon Wiener diversity indices at each dredge location in October 2004

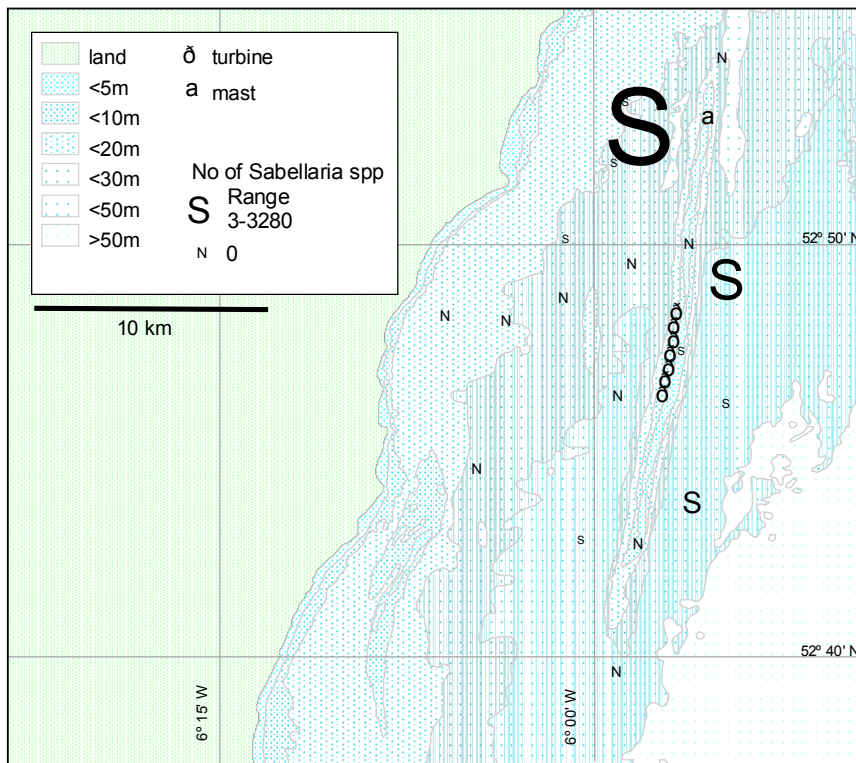


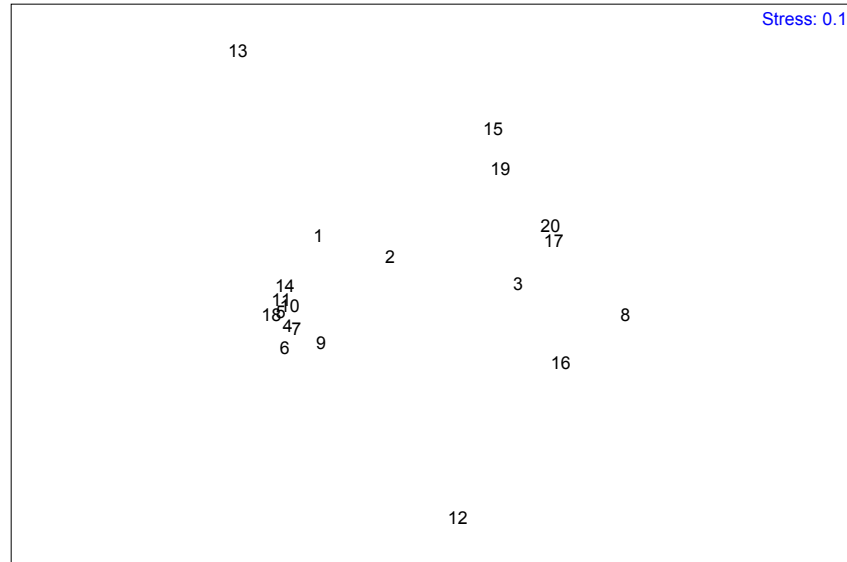
Figure 12 Total number of *Sabellaria* spp found at each dredge sample site in October 2004

Table 7 List of the most abundant taxa in descending order of abundance from the anchor dredge survey of October 2004. All taxa where more than 50 individuals in total were recorded are shown.

Group	Family	Name	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	TOTAL
Annelida	Serpulidae	Pomatoceros triquetter				4800	1380	48	2970		75	540	2056			221					7650		19740
Annelida	Sabellariidae	Sabellaria alveolata				2	7	3200	4		1440							3					4656
Tunicata	Styelidae	Dendrodoa grossularia		35		27	4		20		14	72	984			60							1216
Mollusca	Nuculidae	Nucula nucleus				3	283														456		744
Annelida	Sabellariidae	Sabellaria spinulosa				8	2	80	4		90	24	389			19					3		619
Crustacea	Porcellanidae	Pisidia longicornis				18	36	131	8		21	8	4			35					61		322
Mollusca	Leptochitonidae	Leptochiton asellus				23	6	1	1		2	112	13			27					33		218
Mollusca	Anomiidae	Anomiidae sp.				1	1	1			2	18	160			23					1		207
Mollusca	Mytilidae	Mytilidae sp. Juv.	106	2	1	5	4	11	2		5	17	20			4					9		186
Annelida	Maldanidae	Clymenura johnstoni	9	3	1	5	81	3			1	2	7			32					28		172
Annelida	Serpulidae	Hydroides norvegica		2			5	1			10	22	100			20							160
Annelida	Phyllococidae	Eumida bahusienis	1			37		13	35		2	3	1								52		144
Annelida	Polynoidae	Harmothoe sp.				15	8	43	4		12	14	12			6		1			21		136
Crustacea	Balanidae	Balanus crenatus					4	60	60							5							129
Annelida	Cirratulidae	Cauleriella zettlandica	58	3			1	1				2	6		1	19					1		92
Annelida	Serpulidae	Pomatoceros lamarcki						3			22		56			1							82
Mollusca	Trochidae	Gibbula umbilicalis					7	7	2			5									60		81
Annelida	Spionidae	Laonice bahusienis				4						8	18			45							75
Mollusca	Semellidae	Abra alba									3										1		73
Annelida	Polynoidae	Lepidonotus				11	3	19	13												23		69
Annelida	Orbiniidae	Scoloplos armiger						1				10	33			23					1		68
Crustacea	Verrucidae	Verruca stroemia							7			39				22							68
Mollusca	Trochidae	Gibbula tumida				6	4		5			12									40		67
Crustacea	Paguridae	Pagurus bernhardus				2	4	6	7		18	13	4			4					8		66
Echinoderma	Amphiruridae	Amphipholis squamata	1			1	10	2	1			3	4			34					5		61
Annelida	Syllidae	Typosyllis variegata		4		10	12	11	5		6						1				7		56
Mollusca	Semellidae	Abra sp. Juv.		1			1				1	20	9			15					6		53
Annelida	Ampharetidae	Ampharete lindstroemi	6								11	12				22					1		52
Annelida	Cirratulidae	Cauleriella alata	31								4	2				12					3		52
Mollusca	Hiattellidae	Hiattella arctica				2		27	1		1	18									2		51

a)

Arklow Bank Infaunal Abundance Oct 2004



b)

Arklow Bank Infaunal Abundance Oct 2004 with the sediment type superimposed

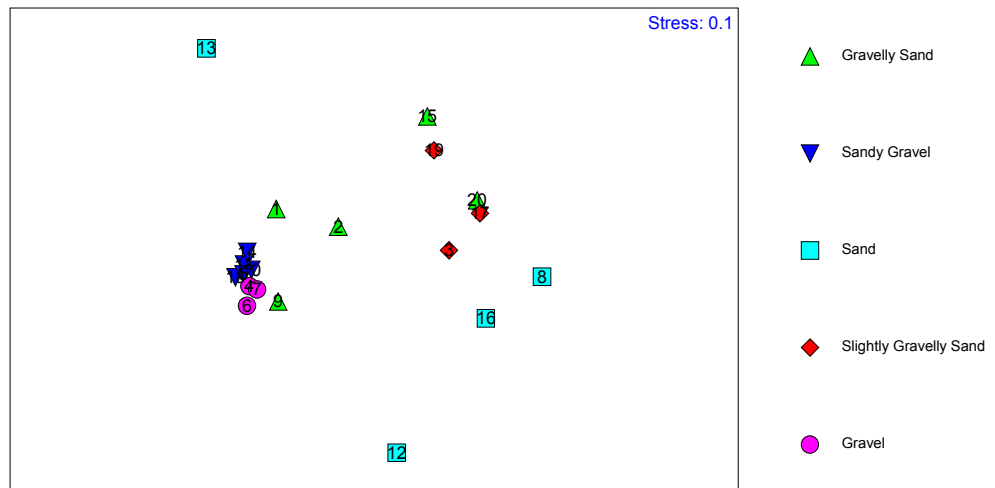


Figure 13 Cluster analysis of the communities from the dredge survey, October 2004

a) with site labels superimposed

b) with sediment type as classified according to BGS methods superimposed .

Arklow Bank Infaunal Abundance for Jun. 04 and

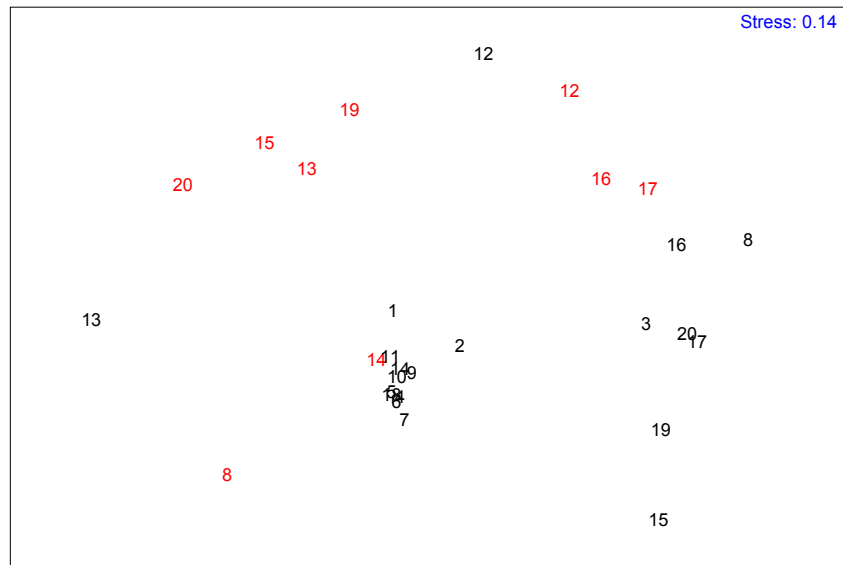


Figure 14 Cluster analysis of June 2004 and October 2004 data, based on presence / absence only

Arklow Bank Infaunal Abundance Oct 2004 and

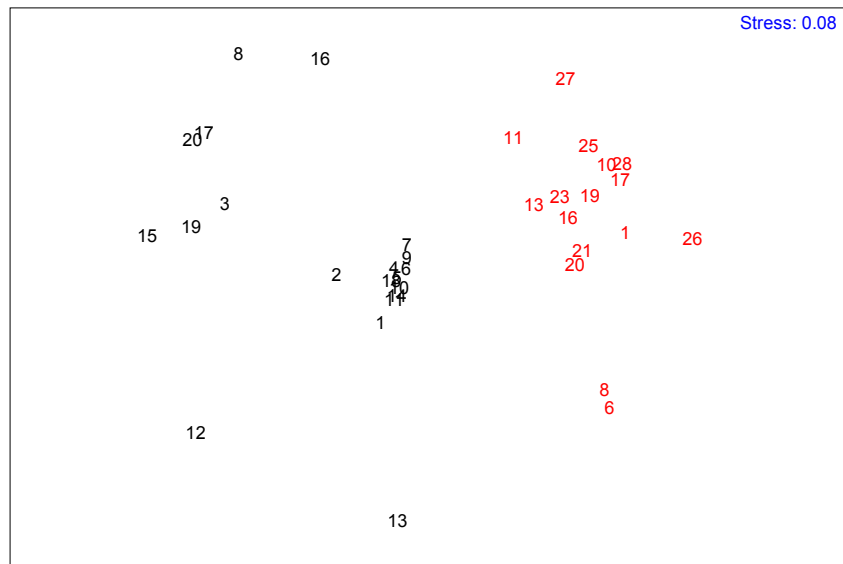


Figure 15 Cluster analysis of September 2000 (red) and October 2004 (black) anchor dredge data, based on presence / absence only. **Note that site numbers are not necessarily comparable in these surveys.**

4. Discussion and Conclusions

The large range of habitats and sediment types found in the Central and Southern Irish Sea support a diverse fish fauna, including many commercially important species. Several commercially exploited species such as whiting, haddock and herring make up a large percentage of the total fish biomass. The region of the Irish Sea investigated for this survey is characterised by hard and soft substratum with the sandy areas typified by the abundance of flatfish and juvenile gadoids with rocky/gravel assemblages being dominated by larger fish including elasmobranchs, gurnards, cod, large whiting and only a few species of flatfish (NERC, 1998). The results from this survey, as in June/July 2004, indicate that the fish species broadly resemble these assemblages with species of invertebrates, hydroids and algae generally associated with hard substrata being coupled with fish species such as rays and whiting. Numbers of fish in the area appear to be generally low.

The sea bed around Arklow bank is described as being the most widespread habitat in the western Irish Sea and is composed of current swept coarse sediments which consist of compact sand, with gravel, shell and/or cobbles in varying proportions. The fauna is characterised by erect hydroids (typically *Hydrallmania falcata*, *Sertularia argentea*, *Nemertesia* spp.) that attach to cobbles or shell (Keegan *et al.*, 1987). The bryozoan *Flustra foliacea* is abundant on bedrock exposed to strong currents and sand scour. All of these species were found regularly during this survey. Other habitats in this region include banks of cobbles and coarse sands characterised by the polychaetes *Nephtys cirrosa*, *Ophelia borealis* and *Lanice conchilega*, and the bivalve *Spisula elliptica* (Keegan *et al.*, 1987). Although all of these species were found in this survey, they were all at very low abundance and showed little association with each other, although it is possible that the small number of sample sites may be at least partly responsible for this.

As in the baseline survey no rare, unusual or vagrant species were recorded during the beam trawl survey. However the Sand Goby, *Pomatoschistus minutus* (which was the most numerous species recorded) is protected under Annex III of the Bern Convention and is thus considered to be of high importance mainly because of its significance to the maintenance of food web stability. However, Sand gobies are considered to be very abundant (Potts & Swaby, 1996) and widely distributed throughout Irish and UK waters being described as frequent in occurrence by Hayward & Ryland (1990). Numbers found at this site in this and previous surveys appear to be very low, however.

Other species of importance found during this survey were the reef forming worms, *Sabellaria spinulosa* and *Sabellaria alveolata*, found both inside; these tube dwelling worms are considered to be of importance due to their ability to produce biogenic reef. Such biogenic reefs are considered to be important due to their ability to stabilise sediments providing an environment for other species to colonise creating a reef environment (Holt *et al.*, 1998). In the wider British Isles *Sabellaria alveolata* is very much more common intertidally than subtidally, and particularly unusual beyond 2 or 3 metres depth, but in the Arklow area it is occurring in 20m or more, and it has previously been found both here and elsewhere on the eastern Irish coast in similar situations (Ecoserve, 2001). Areas containing such biogenic reef structures, containing both *Sabellaria* species, off Wicklow Head have been proposed as Special Areas of Conservation (SACs), the Irish Government's response to requirements for protection of species and habitats under the EU Habitats directive, although no statutory conservation measures have yet been assigned. No very significant clumps were yielded during the trawls in either July or October 2004, suggesting that very extensive biogenic reef is probably not present, although some small aggregations were encountered at site 4 (close to anchor dredge site number nine, where large numbers were also

encountered in the October anchor dredge survey) in both July and October beam trawl surveys. *Sabellaria* communities seemed to have broadly similar distributions in October 2004 as was found in the baseline surveys.

Given the very limited number of trawls and dredges used within the surveys it is very difficult to draw any more detailed observations, especially when data was recorded on a presence or absence basis within the baseline survey. This renders the possibility of any fluctuation at the community level being impossible to identify as it ignores the fact that fluctuations within populations may occur, as well as the fact that both small beam and Agassiz trawls (and anchor dredges) are generally regarded as semi-quantitative at best.

The lack of numerical baseline data also makes it very difficult to attribute whether any changes within the local populations are as a result of impacts from the windfarm or if they are just interannual fluctuations or variations at the population level. Comparison between the data sets generated during the baseline surveys in 2000 and 2001 and those from the 2004 surveys are extremely difficult given the lack of numerical baseline dredge data, the differing methods used in both trawl and dredge surveys, and also the different locations and the different number of samples used within each survey.

Nevertheless, when viewed overall at the species level the assemblages appear to be broadly similar to those found in the baseline surveys with broadly similar species of invertebrates and fish (including commercial species) being recorded in the October 2004 survey. However, the detailed composition of the benthic communities found in the baseline and the 2004 anchor dredge surveys clearly differ greatly as evidenced by MDS analysis, and this is probably directly attributable to the differing sampling methods utilised on each occasion. It is recommended that all future monitoring surveys identify a similar method of survey methodology to allow direct future comparisons and it is also strongly recommended that all organisms continue to be recorded numerically.

It is probably unwise, given the relatively small scale of the survey, to place too much emphasis on the results for individual species or even individual samples and it is likely that the results from this study will become of more value, and allow a slightly greater level of analysis, when a number of surveys have been carried out.

7. References

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6. APPENDICES

Appendix 6.1 Species List for Beam Trawl Surveys 13th to 15th October 2004

Taxon	Family	Authority
Porifera		
<i>Halichondria panicea</i>	Halichondriidae	Pallas, 1766
Cnidaria		
<i>Tubularia indivisa</i>	Tubulariidae	Linnaeus, 1758
<i>Abietinaria abietina</i>	Sertulariidae	(Linnaeus, 1758)
<i>Hydrallmania falcata</i>	Sertulariidae	(Linnaeus, 1758)
<i>Sertularella gayi</i>	Sertulariidae	(Lamouroux, 1821)
<i>Sertularia cupressina</i>	Sertulariidae	Linnaeus, 1758
<i>Nemertesia antennina</i>	Plumulariidae	(Linnaeus, 1758)
<i>Alcyonium digitatum</i>	Alcyoniidae	Linnaeus, 1758
<i>Metridium senile</i>	Metridiidae	Linnaeus, 1761
Annelida		
<i>Aphrodita aculeata</i>	Aphroditidae	Linnaeus, 1758
<i>Sabellaria spinulosa</i>	Sabellariidae	Leuckart, 1849
<i>Lanice conchilega</i>	Terebellidae	Pallas, 1766
<i>Serpula vermicularis</i>	Serpulidae	Linnaeus, 1767
Crustacea		
<i>Balanus</i> sp.	Balanidae	Costa, 1778
<i>Pandalus montagui</i>	Pandalidae	Leach, 1814
<i>Pasiphaeo sivado</i>	Pasiphaeidae	(Risso, 1816)
<i>Crangon crangon</i>	Crangonidae	Linnaeus, 1758
<i>Pagurus bernhardus</i>	Paguridae	Linnaeus, 1758
<i>Pisidia longicornis</i>	Porcellanidae	Linnaeus, 1767
<i>Hyas coarctatus</i>	Majidae	Leach, 1815
<i>Macropodia deflexa</i>	Majidae	Forest, 1978
<i>Macropodia rostrata</i>	Majidae	Linnaeus, 1761
<i>Cancer pagurus</i>	Cancridae	Linnaeus, 1758
<i>Liocarcinus depurator</i>	Portunidae	Linnaeus, 1758
<i>Liocarcinus holsatus</i>	Portunidae	Fabricius, 1798
<i>Liocarcinus pusillus</i>	Portunidae	(Leach, 1815)
<i>Necora puber</i>	Portunidae	Linnaeus, 1767
<i>Pilumnus hirtellus</i>	Xanthidae	(Linnaeus, 1761)
<i>Xantho</i> sp.	Xanthidae	Leach, 1814
Mollusca		
<i>Calliostoma zizyphinum</i>	Trochidae	Linnaeus, 1758
<i>Crepidula fornicata</i>	Calyptraeidae	(Linnaeus, 1758)
<i>Buccinum undatum</i>	Buccinidae	Linnaeus, 1758
<i>Cohus gracilis</i>	Buccinidae	da Costa, 1778
<i>Chlamys varia</i>	Pectinidae	(Linnaeus, 1758)
<i>Sepiola atlantica</i>	Sepiolidae	Orbigny in Férussac & Orbigny, 1840
Bryozoa		
<i>Alcyonidium diaphanum</i>	Alcyonidiidae	Hudson, 1762
<i>Flustra foliacea</i>	Flustridae	Linnaeus, 1758

Echinodermata		
<i>Crossaster papposus</i>	Solasteridae	Linnaeus, 1767
<i>Henricia Sanguinolenta</i>	Echinasteridae	O F Müller, 1776
<i>Asterias rubens</i>	Asteriidae	Linnaeus, 1758
<i>Ophiura albida</i>	Ophiuridae	Forbes, 1839
<i>Psammechinus miliaris</i>	Parechinidae	Gmelin, 1778
Chordata		
<i>Ascidia conchilega</i>	Ascidiidae	O F Müller, 1776
<i>Botryllus schlosseri</i>	Styelidae	(Pallas, 1766)
<i>Scyliorhinus caniculus</i>	Scyliorhinidae	Linnaeus, 1758
<i>Raja clavata</i>	Rajidae	Linnaeus, 1758
<i>Merlangius merlangus</i>	Gadidae	Linnaeus, 1758
<i>Trisopterus minutus</i>	Gadidae	Linnaeus, 1758
<i>Echiichthys vipera</i>	Trachinidae	Cuvier, 1829
<i>Ammodytes tobianus</i>	Ammodytidae	Linnaeus, 1758
<i>Callionymus lyra</i>	Callionymidae	Linnaeus, 1758
<i>Pomatoschistus minutus</i>	Gobiidae	Pallas, 1770
<i>Microstomus kitt</i>	Pleuronectidae	(Walbaum, 1792)

Appendix 6.1 continued

Appendix 6.2 Species List for Anchor Dredge Survey 15th October 2004

GROUP & Family	NAME
ANNELIDA	
Ampharetidae	<i>Ampharete acutifrons</i>
Ampharetidae	<i>Ampharete finmarchica</i>
Ampharetidae	<i>Ampharete lindstroemi</i>
Ampharetidae	<i>Melinna cristata</i>
Ampharetinae	<i>Ampharetinae</i>
Aphroditidae	<i>Aphrodita aculeata</i>
Capitellidae	<i>Capitellidae</i> sp.
Capitellidae	<i>Mediomastus fragilis</i>
Capitellidae	<i>Notomastus</i> sp.
Cirratulidae	<i>Caulleriella alata</i>
Cirratulidae	<i>Caulleriella zetlandica</i>
Cirratulidae	<i>Cirratulidae</i> sp.
Cirratulidae	<i>Tharyx killariensis</i>
Dorvilleidae	<i>Protodorvillea kefersteini</i>
Eunicidae	<i>Nematonereis unicornis</i>
Flabelligeridae	<i>Flabelligera affinis</i>
Glyceridae	<i>Glycera lapidum</i>
Glyceridae	<i>Glycera oxycephala</i>
Glyceridae	<i>Glycera</i> sp.
Glyceridae	<i>Glycera tridactyla</i>
Goniadidae	<i>Goniada maculata</i>
Hesionidae	<i>Psamathe fusca</i>
Hesionidae	<i>Syllidia armata</i>
Lumbrineridae	<i>Lumbrineris gracilis</i>
Maldanidae	<i>Clymenura johnstoni</i>
Maldanidae	<i>Euclymene oerstedii</i>
Maldanidae	<i>Euclymeninae</i>
Maldanidae	<i>Nicomache personata</i>
Maldanidae	<i>Praxillura longissima</i>
Nephtyidae	<i>Nephtys caeca</i>
Nephtyidae	<i>Nephtys cirrosa</i>
Nephtyidae	<i>Nephtys kersivalensis</i>
Nephtyidae	<i>Nephtys</i> sp. (juv.)
Nereididae	<i>Nereis longissima</i>
Nereididae	<i>Nereis zonata</i>
Oeonidae	<i>Notocirrus scoticus</i>
Opheliidae	<i>Ophelia borealis</i>
Opheliidae	<i>Ophelina acuminata</i>

Orbiniidae	<i>Scoloplos armiger</i>
Oweniidae	<i>Galathowenia</i> sp.
Oweniidae	<i>Owenia fusiformis</i>
Paraonidae	<i>Paradoneis lyra</i>
Paraonidae	<i>Paraonidae</i> sp.
Pectinariidae	<i>Lagis koreni</i>
Pholoidae	<i>Pholoe baltica</i>
Pholoidae	<i>Pholoe inornata</i>
Phyllodocidae	<i>Anaitides</i> sp.
Phyllodocidae	<i>Eteone longa/flava</i> (agg.)
Phyllodocidae	<i>Eulalia viridis</i>
Phyllodocidae	<i>Eumida bahusiensis</i>
Phyllodocidae	<i>Hypereteone foliosa</i>
Phyllodocidae	<i>Pseudomystides limbata</i>
Polynoidae	<i>Gattyana cirrosa</i>
Polynoidae	<i>Harmothoe impar</i>
Polynoidae	<i>Harmothoe</i> sp.
Polynoidae	<i>Harmothoe spinifera</i>
Polynoidae	<i>Lepidonotus squamatus</i>
Polynoidae	<i>Malmagrenilla ljungmani</i>
Polynoidae	<i>Polynoidae</i> sp.
Sabellariidae	<i>Sabellaria alveolata</i>
Sabellariidae	<i>Sabellaria spinulosa</i>
Sabellidae	<i>Chone filicaudata</i>
Sabellidae	<i>Chone</i> sp. juv.
Sabellidae	<i>Euchone rubrocincta</i>
Sabellidae	<i>Jasmineira elegans</i>
Sabellidae	<i>Sabella pavonina</i>
Sabellidae	<i>Sabellidae</i> spp.
Scalibregmatidae	<i>Scalibregma celticum</i>
Scalibregmatidae	<i>Scalibregma inflatum</i>
Serpulidae	<i>Hydroides norvegica</i>
Serpulidae	<i>Pomatoceros lamarcki</i>
Serpulidae	<i>Pomatoceros triqueter</i>
Sigalionidae	<i>Sthenelais boa</i>
Spintheridae	<i>Spinther arcticus</i>
Spionidae	<i>Aonides oxycephala</i>
Spionidae	<i>Aonides paucibranchiata</i>
Spionidae	<i>Laonice bahusiensis</i>
Spionidae	<i>Malacoceros</i> sp.
Spionidae	<i>Minuspio cirrifera</i>
Spionidae	<i>Polydora caeca</i>

Spionidae	<i>Polydora caulleryi</i>
Spionidae	<i>Polydora</i> sp.
Spionidae	<i>Pseudopolydora pulchra</i>
Spionidae	<i>Pygospio elegans</i>
Spionidae	<i>Scolelepis tridentata</i>
Spionidae	<i>Spio armata</i> (agg.)
Spionidae	<i>Spio decorata</i>
Spionidae	<i>Spiophanes bombyx</i>
Spionidae	<i>Spiophanes kroyeri</i>
Spirorbidae	<i>Spirorbidae</i> spp.
Syllidae	<i>Autolytus</i> sp.
Syllidae	<i>Eusyllis blomstrandii</i>
Syllidae	<i>Exogone verugera</i>
Syllidae	<i>Procerastea nematodes</i>
Syllidae	<i>Sphaerosyllis hystrix</i>
Syllidae	<i>Sphaerosyllis taylori</i>
Syllidae	<i>Syllidessp.</i>
Syllidae	<i>Syllides benedicti</i>
Syllidae	<i>Syllis cornuta</i>
Syllidae	<i>Typosyllis variegata</i>
Terebellidae	<i>Lanice conchilega</i>
Terebellidae	<i>Nicolea venustula</i>
Terebellidae	<i>Polycirrus medusa</i>
Terebellidae	<i>Polycirrus</i> sp.
Terebellidae	<i>Terebellidae</i> sp. juv.
Trichobranchidae	<i>Terebellides stroemi</i>
Trichobranchidae	<i>Thelepus cincinnatus</i>
Trichobranchidae	<i>Thelepus setosus</i>
Trichobranchidae	<i>Thelepus</i> sp. juv.
BRYOZOA	
Aeteidae	<i>Aetea anguina</i>
Alcyonidiidae	<i>Alcyonidium diaphanum</i>
Alcyonidiidae	<i>Alcyonidium gelatinosum</i>
Alcyonidiidae	<i>Alcyonidium parasiticum</i>
Alcyonidiidae	<i>Alcyonidium</i> sp.
Bugulidae	<i>Bicellariella ciliata</i>
Bugulidae	<i>Bugula</i> sp.
Celleporidae	<i>Cellepora pumicosa</i>
Celleporidae	<i>Celleporina hassallii?</i>
Celleporidae	<i>Turbicellepora avicularis</i>
Chorizoporidae	<i>Chorizopora brongniartii</i>
Crisiidae	<i>Crisia aculeata</i>
Crisiidae	<i>Crisia eburnea</i>
Crisiidae	<i>Crisia</i> sp.
Electridae	<i>Electra pilosa</i>
Escharellidae	<i>Escharella immersa</i>

Escharellidae	<i>Escharella labiosa</i>
Escharellidae	<i>Escharella variolosa</i>
Eucrateidae	<i>Eucratea loricata</i>
Flustridae	<i>Flustra foliacea</i>
Hippothoidae	<i>Hippothoa divaricata</i>
Membraniporidae	<i>Conopeum reticulum</i>
Microporellidae	<i>Fenestulina malusii</i>
Schizoporellidae	<i>Schizomavella auriculata</i>
Tubuliporidae	<i>Tubulipora</i> sp.
Vesiculariidae	<i>Amathia</i> sp.
Vesiculariidae	<i>Bowerbankia</i> sp.
Vesiculariidae	<i>Vesicularia spinosa</i>
CHELICERATA	
Ammotheidae	<i>Achelia echinata</i>
Nymphonidae	<i>Nymphon brevirostre</i>
Phoxichiliidae	<i>Anoplodactylus petiolatus</i>
Endeidae	<i>Endeis charybdaea?</i>
Pycnogonidae	<i>Pycnogonum littorale</i>
CNIDARIA	
	<i>Actinaria</i>
Alcyoniidae	<i>Alcyonium digitatum</i>
Bougainvillidae	<i>Bougainvillia</i> sp.
Campanulariidae	<i>Campanulariidae</i>
Campanulariidae	<i>Clytia hemisphaerica</i>
Edwardsiidae	<i>Edwardsia claparedii</i>
Edwardsiidae	<i>Edwardsia</i> sp.
Eudendriidae	<i>Eudendrium</i> sp.
Lovenellidae	<i>Calycella syringa</i>
Pandeiidae	<i>Leuckartiara octona</i>
Phialellidae	<i>Phialella quadrata</i>
Plumulariidae	<i>Nemertesia antennina</i>
Plumulariidae	<i>Nemertesia ramosa</i>
Plumulariidae	<i>Plumularia setacea</i>
Sagartiidae	<i>Sagartia elegans</i>
Sertulariidae	<i>Abietinaria abietina</i>
Sertulariidae	<i>Abietinaria</i> sp.
Sertulariidae	<i>Hydrallmania falcata</i>
Sertulariidae	<i>Sertularella gayi</i>
Sertulariidae	<i>Sertularella rugosa</i>
Sertulariidae	<i>Sertularella</i> sp.
Sertulariidae	<i>Sertularia cupressina</i>
Sertulariidae	<i>Tamarisca tamarisca</i>
Tubulariidae	<i>Tubularia indivisa</i>
Tubulariidae	<i>Tubularia larynx</i>
Tubulariidae	<i>Tubularia</i> sp.
CRUSTACEA	

Ampeliscidae	<i>Ampelisca brevicornis</i>
Ampeliscidae	<i>Ampelisca diadema</i>
Ampeliscidae	<i>Ampelisca spinipes</i>
Amphilocheidae	<i>Amphilocheus manudens</i>
Anarthruridae	<i>Tanaopsis graciloides</i>
Anthuridae	<i>Anthura gracilis</i>
Aoridae	<i>Aora gracilis</i>
Aoridae	<i>Aoridae</i> sp. female
Atelecyclidae	<i>Atelecyclus rotundatus</i>
Balanidae	<i>Balanus balanus</i>
Balanidae	<i>Balanus crenatus</i>
Bodotriidae	<i>Bodotria scorpioides</i>
Caprellidae	<i>Caprella linearis</i>
Caprellidae	<i>Pariambus typicus</i>
Cirolaniidae	<i>Eurydice spinigera</i>
Corophiidae	<i>Corophium bonnellii</i>
Corophiidae	<i>Corophium sextonae</i>
Corophiidae	<i>Unciola crenatipalma</i>
Dexaminidae	<i>Atylus falcatus</i>
Dexaminidae	<i>Atylus swammerdami</i>
Dexaminidae	<i>Tritaeta gibbosa</i>
Gnathiidae	<i>Gnathia oxyuraea</i>
Gnathiidae	<i>Gnathia</i> sp. female
Goneplacidae	<i>Pilumnus hirtellus</i>
Hippolytidae	<i>Eualus pusiolus</i>
Hippolytidae	<i>Hippolyte varians</i>
Iphimediidae	<i>Iphimedia minuta</i>
Isaeidae	<i>Gammaropsis maculata</i>
Isaeidae	<i>Gammaropsis nitida</i>
Isaeidae	<i>Photis longicaudata</i>
Ischyroceridae	<i>Ericthonius punctatus</i>
Janiridae	<i>Janira maculosa</i>
Liljeborgiidae	<i>Liljeborgia pallida</i>
Lysianassidae	<i>Acidostoma obesum</i>
Majidae	<i>Eurynome aspera</i>
Majidae	<i>Eurynome</i> sp. juv.
Majidae	<i>Hyas coarctatus</i>
Majidae	<i>Macropodia rostrata</i>
Majidae	<i>Macropodia</i> sp. juv.
Majidae	<i>Majidae</i> sp.
Meilitidae	<i>Cheirocratus</i> sp. female
Melitidae	<i>Abludomelita obtusata</i>
Melitidae	<i>Cheirocratus sundevallii</i>
Melitidae	<i>Maera othonis</i>
Melitidae	<i>Melita</i> sp. female
Melitidae	<i>Melitidae</i> sp. female

Mysidae	<i>Gastrosaccus spinifer</i>
Paguridae	<i>Paguridae</i> sp.
Paguridae	<i>Pagurus bernhardus</i>
Phoxocephalidae	<i>Harpinia</i> sp.
Phoxocephalidae	<i>Parametaphoxus fultoni</i>
Phtisicidae	<i>Phtisica marina</i>
Phtisicidae	<i>Pseudoprotella phasma</i>
Pinnotheridae	<i>Pinnotheres pisum</i>
Pleustidae	<i>Parapleustes bicuspis</i>
Pleustidae	<i>Stenopleustes nodifera</i>
Pontoporeiidae	<i>Bathyporeia elegans</i>
Pontoporeiidae	<i>Bathyporeia</i> sp.
Pontoporeiidae	<i>Bathyporeia tenuipes</i>
Porcellanidae	<i>Pisidia longicornis</i>
Portunidae	<i>Liocarcinus</i> sp. juv.
Stenothoidae	<i>Stenothoe marina</i>
Urothoidae	<i>Urothoe elegans</i>
Verrucidae	<i>Verruca stroemia</i>
ECHINODERMATA	
	<i>Asteroidea</i> sp.
	<i>Ophiurida</i> sp. juv.
Amphiuridae	<i>Amphipholis squamata</i>
Amphiuridae	<i>Amphiura brachiata</i>
Amphiuridae	<i>Amphiura chiagei</i>
Amphiuridae	<i>Amphiura filiformis</i>
Asteriidae	<i>Asterias rubens</i>
Cucumariidae	<i>Thyone fusus</i>
Echinidae	<i>Echinidae</i> sp.
Echinidae	<i>Psammechinus miliaris</i>
Ophiotrichidae	<i>Ophiotrix fragilis</i>
Ophiuridae	<i>Ophiura albida</i>
Ophiuridae	<i>Ophiura ophiura</i>
Ophiuridae	<i>Ophiura</i> sp. juv.
Spatangidae	<i>Echinocardium</i> sp. juv.
Synaptidae	<i>Leptosynapta inhaerens</i>
MOLLUSCA	
	<i>Nudibranchia</i> spp.
Acanthochitonidae	<i>Acanthochitona crinita</i>
Acanthochitonidae	<i>Acanthochitona fascicularis</i>
Anomiidae	<i>Anomiidae</i> sp.
Anomiidae	<i>Pododesmus patelliformis</i>
Buccinidae	<i>Buccinum undatum</i>
Cardiidae	<i>Parvicardium</i> sp. juv.
Dotidae	<i>Doto</i> sp.
Fissurellidae	<i>Diodora graeca</i>
Goniodorididae	<i>Goniodoris</i> sp.

Hiatellidae	<i>Hiatella arctica</i>
Leptochitonidae	<i>Leptochiton asellus</i>
Mactridae	<i>Spisula elliptica</i>
Montacutidae	<i>Mysella bidentata</i>
Muricidae	<i>Ocenebra erinacea</i>
Myidae	<i>Mya arenaria</i>
Myidae	<i>Mya truncata</i>
Mytilidae	<i>Modiolus</i> sp. juv.
Mytilidae	<i>Musculus discors</i>
Mytilidae	<i>Mytilidae</i> sp. juv.
Mytilidae	<i>Mytilus edulis</i>
Nuculidae	<i>Nucula nucleus</i>
Nuculidae	<i>Nucula</i> sp. (juv.)
Pectinidae	<i>Aequipecten opercularis</i>
Pectinidae	<i>Chlamys varia</i>
Pyramidellidae	<i>Odostomia</i> sp.
Semelidae	<i>Abra alba</i>
Semelidae	<i>Abra prismatica</i>
Semelidae	<i>Abra</i> sp. juv.
Trochidae	<i>Calliostoma zizyphinum</i>
Trochidae	<i>Gibbula tumida</i>
Trochidae	<i>Gibbula umbilicalis</i>
Veneridae	<i>Chamelea gallina</i>
Veneridae	<i>Timoclea ovata</i>
Veneridae	<i>Veneridae</i> sp. juv.
NEMATODA	

	<i>Nematoda</i> spp.
NEMERTEA	
	Nemertea spp.
PHORONIDA	
Phoronidae	<i>Phoronis</i> spp.
PLATYHELMINTHES	
	Turbellaria sp.
PORIFERA	
	<i>Porifera</i> crusts indet.
Scyctidae	<i>Scypha ciliata</i>
PROTOZOA	
	<i>Foraminiferida</i>
Folliculinidae	<i>Lagotia viridis</i>
SIPUNCULA	
Phascolionidae	<i>Phascolion strombus</i>
TUNICATA	
	<i>Tunicata</i> sp.
	<i>Tunicata</i> sp. colonial
Asciidiidae	<i>Ascidia conchilega</i>
Asciidiidae	<i>Ascidia</i> sp.
Molgulidae	<i>Molgula</i> sp.
Styelidae	<i>Dendrodoa grossularia</i>
Styelidae	<i>Polycarpa fibrosa</i>
Styelidae	<i>Polycarpa scuba?</i>

Appendix 6.3 Total results from the Beam Trawl survey undertaken 13th – 15th October 2004

A Field notes

	Site number					
	1	2	3	4	5	6
DESCRIPTION	No stones very little shell, much hydroid / bryozoan, especially Flustra foliaces	Clean shell mostly Aequipecten with v small amounts of Flustra	Stones, shell, gravel and sand, one fist sized lump of Sabellaria (small tubes, 3-5 cm, mostly less than 4mm diameter at mouth, presumably relatively young circa 1000 tubes)	Much shell gravel and some stones; a few v small clumps of Sabellaria on stones	Abundant old oyster shell and some large stones and small boulders	Clean trawl, small amounts of shell
Date of hauling	13-Oct-04	13-Oct-04	13-Oct-04	13-Oct-04	14-Oct-04	14-Oct-04
Time of hauling	14:48	15:45	17:18	18:15	17:10	17:45

B Contents of beam trawls

SCIENTIFIC NAME	COMMON NAME	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Total
Fish								
<i>Ammodytes tobianus</i>	Lesser sand eel	0	0	7	1	0	0	8
<i>Callionymus lyra</i>	Dragonet	0	0	0	0	5	0	5
<i>Echiichthys vipera</i>	Lesser weaver	0	0	1	0	0	0	1
<i>Merlangius merlangus</i>	Whiting	0	1	0	0	0	0	1
<i>Microstomus kitt</i>	Lemon sole	0	0	0	1	0	0	1
<i>Pomatoschistus minutus</i>	Sand goby	5	3	0	0	0	2	10
<i>Raja clavata</i>	Thornback ray	0	0	0	1	0	0	1
<i>Scyliorhinus caniculus</i>	Lesser spotted dogfish	0	0	0	0	2	0	2
<i>Trisopterus minutus</i>	Poor cod	2	3	0	0	0	2	7
Crustacea								
<i>Balanus sp.</i>	Barnacle	0	0	0	0	P	0	n/a
<i>Cancer pagurus</i>	Edible crab	0	0	0	0	2	0	2
<i>Crangon crangon</i>	Brown shrimp	48	75	0	4	0	3	130
<i>Hyas coarctatus</i>	Spider crab	5	0	0	1	0	0	6
<i>Liocarcinus depurator</i>	Harbour crab	1	0	0	0	0	0	1
<i>Liocarcinus holsatus</i>	Flying crab	2	13	9	0	7	0	31
<i>Liocarcinus pusillus</i>	Small swimming crab	0	0	0	0	4	0	4
<i>Macropodia deflexa</i>	Spider crab	0	0	0	0	2	0	2
<i>Macropodia rostrata</i>	Long legged spider crab	69	7	0	4	48	0	128
<i>Necora puber</i>	Velvet swimming crab	4	0	0	0	0	0	4
<i>Pagurus bernhardus</i>	Hermit crab	12	12	14	1	542	2	583
<i>Pandalus montagui</i>	Pink shrimp	62	8	0	0	21	8	99
<i>Pasiphaea sivado</i>	Prawn	0	0	0	0	0	1	1
<i>Pilumnus hirtellus</i>	Hairy crab	0	0	0	0	1	1	2
<i>Pisidia longicornis</i>	Porcelain crab	1	0	0	0	0	0	1

SCIENTIFIC NAME	COMMON NAME	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Total
<i>Xantho</i> sp.	Xanthiid crab	0	0	0	0	19	0	19
Molluscs								
<i>Chlamys varia</i>	Variegated scallop	0	0	0	0	56	1	57
<i>Buccinum undatum</i>	Common whelk	4	0	0	0	39	0	43
<i>Calliostoma zizyphinum</i>	Painted top Shell	2	0	0	0	0	0	2
<i>Colus gracilis</i>	Whelk	0	0	0	0	2	0	2
<i>Sepiolo atlantica</i>	Little cuttle	4	0	0	0	0	0	4
Echinoderms								
<i>Asterias rubens</i>	Common starfish	54	5	3	13	25	0	100
<i>Crossaster papposus</i>	Common sun star	18	0	0	0	3	0	21
<i>Henricia sanguinolenta</i>	Starfish	3	0	0	0	1	0	4
<i>Ophiura albida</i>	Brittle star	0	0	0	0	36	0	36
<i>Psammechinus miliaris</i>	Sea urchin	169	0	0	0	295	0	464
Others								
<i>Abietinaria abietina</i>	Hydroid	P	-	-	P	P	P	n/a
<i>Alcyonidium diaphanum</i>	Pipeweed (bryozoan)	P	P	-	P	P	-	n/a
<i>Aphrodita aculeata</i>	Sea mouse	6	0	0	0	0	0	6
<i>Ascidia conchilega</i>	Sea squirt	3	0	0	0	1	0	4
<i>Botryllus schlosseri</i>	Colonial sea squirt	F	-	-	-	-	-	n/a
<i>Flustra foliacea</i>	Hornwrack (bryozoan)	A	F	P	F	P	O	n/a
<i>Halichondria panicea</i>	Breadcrumb sponge	-	-	-	-	-	F	n/a
<i>Hydrallmania falcata</i>	Hydroid	C	P	P	F	P	P	n/a
<i>Lanice conchilega</i>	Sand mason	0	0	0	0	16	1	17
<i>Metridium senile</i>	Plumose anenome	0	0	0	0	1	0	1
<i>Nemertesia antennina</i>	Hydroid	P	P	-	-	-	-	n/a
<i>Sabellaria</i> spp	Ross worm	-	-	C	O	-	-	n/a
<i>Serpula vermicularis</i>	Tubeworm	0	0	0	0	10	0	10
<i>Sertularia cupressina</i>	Whiteweed (hydroid)	C	P	P	P	P	-	n/a
<i>Sertularella gayi</i>	Hydroid	P	-	-	-	P	-	n/a
<i>Tubularia indivisa</i>	Hydroid	-	-	P	-	P	-	n/a

P	RARE(= PRESENT)	<10 g
O	OCCASIONAL	10-100 g
F	FREQUENT	100-1000 g
C	COMMON	1-10 KG
A	ABUNDANT	>10KG

Appendix 6.3 contd.

Appendix 6.4 Total fish lengths (mm) of main commercial fish species from trawl surveys 13th – 15th October 2004. Sex is also given for elasmobranches (f = female, m = male).

Species	Site					
	1	2	3	4	5	6
<i>Merlangius merlangus</i> Whiting		119				
<i>Raja clavatus</i> Thornback Ray			368m			
<i>Microstomus kitt</i> Lemon Sole			224			
<i>Scyliorhinus caniculus</i> Dogfish					425f, 440f	

Appendix 6.5 Anchor dredge raw data - October 15th 2004 survey

Taxon	G1	G2	G3	G4	G5	G6	G7	G8	G9	G10	G11	G12	G13	G14	G15	G
Annelida																
<i>Ampharete acutifrons</i>										2	7			14		
<i>Ampharete finmarchica</i>										4				6		
<i>Ampharete lindstroemi</i>	6									11	12			22		
<i>Melinna cristata</i>										1						
Ampharetinae										2	2			3		
<i>Aphrodita aculeata</i>										1				2		
Capitellidae sp.											1					
<i>Mediomastus fragilis</i>	2				3									5		
<i>Notomastus</i> sp.	4			1	3									11		
<i>Caulleriella alata</i>	31									4	2			12		
<i>Caulleriella zetlandica</i>	58	3			1	1				2	6		1	19		
Cirratulidae sp.					1									3		
<i>Tharyx killariensis</i>																
<i>Protodorvillea kefersteini</i>	1				2					1				1		
<i>Nematonereis unicornis</i>														2		
<i>Flabelligera affinis</i>					1		1			1						
<i>Glycera lapidum</i>														3		
<i>Glycera oxycephala</i>													2			
<i>Glycera</i> sp.	1	1														
<i>Glycera tridactyla</i>	7															
<i>Goniada maculata</i>														3		
<i>Psamathe fusca</i>				3	2	5								2		
<i>Syllidia armata</i>				1		1										
<i>Lumbrineris gracilis</i>					1	1				3	12			26		
<i>Clymenura johnstoni</i>	9	3	1	5	81	3			1	2	7			32		
<i>Euclymene oerstedii</i>														1		
Euclymeninae	3	1			7						4			6		
<i>Nicomache personata</i>										4	1					
<i>Praxillura longissima</i>						1										
<i>Nephtys caeca</i>					2						1			2		
<i>Nephtys cirrosa</i>	2									1						
<i>Nephtys kersivalensis</i>														2		
<i>Nephtys</i> sp. (Juv.)											1					
<i>Nereis longissima</i>						1			2	1	2			1		
<i>Nereis zonata</i>						1			1	3	2					
<i>Notocirrus scoticus</i>	1				2					1	2			2		
<i>Ophelia borealis</i>			1						1			3				
<i>Ophelina acuminata</i>		1								2	3			3		
<i>Scoloplos armiger</i>					1					10	33			23		
<i>Galathowenia</i> sp.	15								1			1				
<i>Owenia fusiformis</i>	1	1			1					1	2					
<i>Paradoneis lyra</i>											2			3		
Paraonidae sp.											1					
<i>Lagis koreni</i>	2										2			1		

Taxon	G1	G2	G3	G4	G5	G6	G7	G8	G9	G10	G11	G12	G13	G14	G15	G
<i>Pholoe baltica</i>				1										8		
<i>Pholoe inornata</i>				11	8	1	3		1	3	3					
<i>Anaitides</i> sp.	1															
<i>Eteone longa/flava</i> (agg.)	1									1	1			6		
<i>Eulalia viridis</i>				2		13	2		14							
<i>Eumida bahusiensis</i>	1			37		13	35		2	3	1					
<i>Hypereteone foliosa</i>	1										1			3		
<i>Pseudomystides limbata</i>		1				1	1									
<i>Gattyana cirrosa</i>				1		1										
<i>Harmothoe impar</i>				1	2											
<i>Harmothoe</i> sp.				15	8	43	4		12	14	12			6		
<i>Harmothoe spinifera</i>				1	2		1				1					
<i>Lepidonotus squamatus</i>				11	3	19	13									
<i>Malmagrenilla ljunghmani</i>				2	2		2									
<i>Polynoidae</i> sp.				2			2			1						
<i>Sabellaria alveolata</i>				2	7	3200	4		1440							
<i>Sabellaria spinulosa</i>				8	2	80	4		90	24	389			19		
<i>Chone filicaudata</i>										1				8		
<i>Chone</i> sp. Juv.											1					
<i>Euchone rubrocincta</i>														2		
<i>Jasmineira elegans</i>				2	1	14	2									
<i>Sabella pavonina</i>	1	1								3	3			4		
<i>Sabellidae</i> spp.	1								1	1	1					
<i>Scalibregma celticum</i>					1						2			11		
<i>Scalibregma inflatum</i>										1	1			30		
<i>Hydroides norvegica</i>		2			5	1			10	22	100			20		
<i>Pomatoceros lamarcki</i>						3			22		56			1		
<i>Pomatoceros triqueter</i>				4800	1380	48	2970		75	540	2056			221		
<i>Sthenelais boa</i>	1			2	2					2	1			5		
<i>Spinther arcticus</i>					1											
<i>Aonides oxycephala</i>					1	1										
<i>Aonides paucibranchiata</i>	1	2		3	1						3			14		
<i>Laonice bahusiensis</i>				4						8	18			45		
<i>Malacoceros</i> sp.				1												
<i>Minuspio cirrifera</i>														1		
<i>Polydora caeca</i>							4									
<i>Polydora caulleryi</i>											1					
<i>Polydora</i> sp.				1	1											
<i>Pseudopolydora pulchra</i>	2			1										1		
<i>Pygospio elegans</i>						1										
<i>Scoelepis tridentata</i>											1					
<i>Spio armata</i> (agg.)					5	1			1	1	1					
<i>Spio decorata</i>	6															
<i>Spiophanes bombyx</i>	2								1		1					
<i>Spiophanes kroyeri</i>	1															
<i>Spirorbidae</i> spp.				1	1		1									1
<i>Autolytus</i> sp.	1			6	2	6			11	3	3			2		
<i>Eusyllis blomstrandii</i>	1			2	4	1			2	1	6			3		

Taxon	G1	G2	G3	G4	G5	G6	G7	G8	G9	G10	G11	G12	G13	G14	G15	G
<i>Exogone verugera</i>		3		1	3						1					
<i>Procerastea nematodes</i>									1							
<i>Sphaerosyllis hystrix</i>																
<i>Sphaerosyllis taylori</i>					2						1					
<i>Syllidessp.</i>																
<i>Syllides benedicti</i>				1		1	1									
<i>Syllis cornuta</i>					1											
<i>Typosyllis variegata</i>		4		10	12	11	5		6							1
<i>Lanice conchilega</i>	14	1		2	4					1	7			2		
<i>Nicolea venustula</i>										3						
<i>Polycirrus medusa</i>	1															
<i>Polycirrus sp.</i>	1	1		1	3	4	1							3		
<i>Terebellidae sp. Juv.</i>											2					
<i>Terebellides stroemi</i>										1	1			7		
<i>Thelepus cincinnatus</i>				7						1	1					
<i>Thelepus setosus</i>		1		7	4		6		1					1		
<i>Thelepus sp. Juv.</i>						3	1									
Bryozoa																
<i>Aetea anguina</i>					P											
<i>Alcyonidium diaphanum</i>	P	P		P		P			P	P						
<i>Alcyonidium gelatinosum</i>											P					
<i>Alcyonidium parasiticum</i>											P			P		
<i>Alcyonidium sp.</i>	P	P				P	P		P		P					
<i>Bicellariella ciliata</i>	P	P		P	P	P	P		P	P						
<i>Bugula sp.</i>						P										
<i>Cellepora pumicosa</i>				P	P	P					P					
<i>Celleporina hassallii?</i>							P									
<i>Turbicellepora avicularis</i>						P	P		P	P				P		
<i>Chorizopora brongiartii</i>									P							
<i>Crisia aculeata</i>				P		P										
<i>Crisia eburnea</i>					P					P				P		
<i>Crisia sp.</i>		P				P	P									
<i>Electra pilosa</i>		P		P	P	P	P		P	P	P			P		
<i>Escharella immersa</i>		P	P	P	P		P		P	P	P			P	P	
<i>Escharella labiosa</i>		P														
<i>Escharella variolosa</i>										P				P		
<i>Eucratea loricata</i>	P				P	P										
<i>Flustra foliacea</i>	P			P	P	P	P		P	P	P					
<i>Hippothoa divaricata</i>					P											
<i>Conopeum reticulum</i>	P	P	P			P	P		P		P					
<i>Fenestulina malusii</i>				P					P	P				P		
<i>Schizomavella auriculata</i>				P						P	P			P		
<i>Tubulipora sp.</i>					P											
<i>Amathia sp.</i>						P										
<i>Bowerbankia sp.</i>					P		P									
<i>Vesicularia spinosa</i>	P	P														
Chelicerata																
<i>Achelia echinata</i>	4	1		1	7	3								2		

Taxon	G1	G2	G3	G4	G5	G6	G7	G8	G9	G10	G11	G12	G13	G14	G15	G
Nymphon brevirostre					1	1				1				3		
Anoplodactylus petiolatus	7			2	5				2	1	3			7		
Pycnogonum littorale														1		
Cnidaria																
Actinaria	1	2		1		3				1						
Alcyonium digitatum										P				P		
Bougainvillia sp.										P						
Campanulariidae									P	P	P			P		
Clytia hemisphaerica	P			P	P	P	P		P	P	P			P		
Edwardsia claparedii					1											
Edwardsia sp.												2		4		
Eudendrium sp.																
Calycella syringa										P	P			P		
Leuckartiara octona										P		P				
Phialella quadrata	P															
Nemertesia antennina		P														
Nemertesia ramosa									P							
Plumularia setacea				P		P	P									
Sagartia elegans																
Abietinaria abietina							P		P							
Abietinaria sp.					P											
Hydrallmania falcata				P	P	P	P		P	P	P			P		
Sertularella gayi						P				P				P		
Sertularella rugosa						P										
Sertularella sp.					P											
Sertularia cupressina	P			P	P	P	P		P	P				P		
Tamarisca tamarisca									P	P				P		
Tubularia indivisa										P				P		
Tubularia larynx						P	P									
Tubularia sp.							P		P	P	P			P		
Crustacea																
Endeis charybdaea?														1		
Parametaphoxus fultoni														1		
Tritaeta gibbosa					4	2										
Ampelisca brevicornis	1															
Ampelisca diadema				2		1										
Ampelisca spinipes	1				2		1			2	9			8		
Amphilocheus manudens																
Tanaopsis graciloides	4															
Anthura gracilis				1												
Aora gracilis						2			1	4				5		
Aoridae sp. Female			2	1			1									
Atelecyclus rotundatus						3	2									
Balanus balanus					38		2									
Balanus crenatus					4	60	60							5		
Bodotria scorpioides				1	2					1						
Caprella linearis				2			1									
Pariambus typicus	1															

Taxon	G1	G2	G3	G4	G5	G6	G7	G8	G9	G10	G11	G12	G13	G14	G15	G
Eurydice spinigera		1														
Corophium bonnellii				8		11	2									
Corophium sextonae					10											
Unciola crenatipalma				1		13				2	1					
Atylus falcatus																
Atylus swammerdami	1	1														
Gnathia oxyuraea				3			1									
Gnathia sp. Female											1					
Pilumnus hirtellus										3	2				1	
Eualus pusiolus						2										
Hippolyte varians					2											
Iphimedia minuta				7		5	2			1					1	
Gammaropsis maculata				2	4	2			4	1	8				1	
Gammaropsis nitida						2				5	3					
Photis longicaudata															1	
Eriethonius punctatus				1	3	1	2			3					23	
Janira maculosa				5	3	7	1		2	2						
Liljeborgia pallida				1		4	2									
Acidostoma obesum	1					3										
Eurynome aspera															3	
Eurynome sp. Juv.										1						
Hyas coarctatus					1	1				2	2					
Macropodia rostrata	1															
Macropodia sp. Juv.					1					2	2					
Majidae sp.				1												
Cheirocratus sp. Female					5					4						
Abludomelita obtusata									1							
Cheirocratus sundevallii					1											
Maera othonis				4	3	1				2	1				5	
Melita sp. Female	1															
Melitidae sp. Female				1		1										
Gastrosaccus spinifer	3	3	1					1								
Paguridae sp.				1					4							
Pagurus bernhardus				2	4	6	7		18	13	4				4	
Harpinia sp	2															
Phtisica marina				1												
Pseudoprotella phasma				3		1	1		1							
Pinnotheres pisum		1														
Parapleustes bicuspis				1	1	2										
Stenopleustes nodifera				1						1					1	
Bathyporeia elegans		8	12													
Bathyporeia sp.									1							
Bathyporeia tenuipes	8															
Pisidia longicornis				18	36	131	8		21	8	4				35	
Liocarcinus sp. Juv.										2	1					
Stenothoe marina					1	1				2	3					
Urothoe elegans	6			4	2				1		2					
Verruca stroemia							7			39					22	

Taxon	G1	G2	G3	G4	G5	G6	G7	G8	G9	G10	G11	G12	G13	G14	G15	G
Echinodermata																
Astroidea sp.							1									
Ophiurida sp. Juv.	1			1	4					3	2			5		
Amphipholis squamata	1			1	10	2	1			3	4			34		
Amphiura brachiata	2															
Amphiura chiagei	3															
Amphiura filiformis	1															
Asterias rubens																
Thyone fusus										1						
Echinidae sp.				2	1	1	2							6		
Psammechinus miliaris				7	3	1	3			2	1			1		
Ophiothrix fragilis				1	3	6	2									
Ophiura albida	4															
Ophiura ophiura	2															
Ophiura sp. Juv.	1															
Echinocardium sp. Juv.																
Leptosynapta inhaerens														1		
Mollusca																
Diodora graeca				1												
Nudibranchia spp.					1		1			3	1			2		
Ocenebra erinacea										1	1					
Acanthochitona crinita				1	1	1										
Acanthochitona fascicularis										2						
Anomiidae sp.				1	1	1			2	18	160			23		
Pododesmus patelliformis					1					1						
Buccinum undatum	1			1	1	6	3		1	3				1		
Parvicardium sp. Juv.									1							
Doto sp.																
Goniodoris sp.						2										
Hiatella arctica				2		27	1		1	18						
Leptochiton asellus				23	6	1	1		2	112	13			27		
Spisula elliptica	2								1							
Mysella bidentata					1											
Mya arenaria				1												
Mya truncata						6	1				1					
Modiolus sp. Juv.				1	3	2				2				1		
Musculus discors					3	3				12	1					
Mytilidae sp. Juv.	106	2	1	5	4	11	2		5	17	20			4		
Mytilus edulis						3										
Nucula nucleus				3	283									2		
Nucula sp. (Juv.)				1	12		2							1		
Aequipecten opercularis					1	2			1	10						
Chlamys varia						1										
Odostomia sp.				1			1									
Abra alba	69									3						
Abra prismatica	1												3			
Abra sp. Juv.		1			1				1	20	9			15		
Calliostoma zizyphinum					1	2	9			5						

Taxon	G1	G2	G3	G4	G5	G6	G7	G8	G9	G10	G11	G12	G13	G14	G15	G
Gibbula tumida				6	4		5			12						
Gibbula umbilicalis					7	7	2			5						
Chamelea gallina				1							1					
Timoclea ovata	1			1	4	2			1	20				1		
Veneridae sp. Juv.														1		
Nematoda																
Nematoda spp.				4	7	15			1		1			4		
Nemertea																
Nemertea spp.	8	2		1		3	3		2	7	3		1	5		
Phoronida																
Phoronis spp.	2				13									1		
Platyhelminthes																
Turbellaria sp.		1			2											
Porifera																
Porifera crusts indet.			P	P	P	P	P			P				P		
Scypha ciliata					P											
Protozoa																
Foraminiferida		P		P		P	P		P	P	P	P		P		
Lagotia viridis		P							P	P				P		
Sipuncula																
Phascolion strombus		5		8	3	1			1	3				7		
Tunicata																
Tunicata sp.					6				5					8		
Tunicata sp. colonial						P				P	P					
Ascidia conchilega							4		1							
Ascidiella sp.				6		14										
Molgula sp.	13					3	1		6		24					
Dendrodoa grossularia		35		27	4		20		14	72	984			60		
Polycarpa fibrosa						13										
Polycarpa scuba?						11										
No of taxa	74	40	9	102	113	106	76	1	70	116	99	4	4	115	3	
No of organisms	450	101	21	5154	2126	3919	3247	1	1818	1176	4071	6	7	998	3	

Appendix 6.6. Particle Size Analysis (Raw Data).

Site Code	% 25.4 mm	% 12.7 mm	% 6.35 mm	% 4 mm	% 2 mm	% 1 mm	% 500 um	% 250 um	% 125 um	% 63 um	% <63 um	Mean phi	Mean mm	1 std	skew	kurto	Classifica
1	0.00	2.81	2.74	1.41	3.20	2.53	3.73	12.62	68.59	2.25	0.00	2.00	0.25	1.36	-0.63	2.41	Poorly sorte
2	0.00	7.43	1.50	1.22	3.32	4.10	7.63	44.35	29.72	0.66	0.00	1.85	0.28	1.16	-0.56	3.60	Poorly sorte
3	0.00	0.00	0.00	0.60	0.76	0.29	0.18	24.43	73.45	0.31	0.00	2.35	0.20	0.29	-0.28	1.04	Very well so
4																	psa not possible - base
5	28.95	16.42	11.41	4.59	6.20	4.30	3.39	4.45	18.74	1.51	0.00	-1.07	2.10	2.56	0.33	0.54	Very poorly
6																	psa not possible - base
7																	psa not possible - base
8	0.00	0.00	0.00	0.12	0.51	1.52	7.09	72.69	17.90	0.16	0.00	2.03	0.24	0.30	0.04	1.39	Very well so
9	0.00	2.07	3.13	2.04	3.27	2.95	3.86	50.66	30.91	0.39	0.00	2.03	0.24	0.80	-0.38	2.90	Moderately
10	0.00	38.69	25.84	7.16	7.00	3.37	3.16	5.95	8.15	0.47	0.00	-2.31	4.96	2.26	0.60	1.16	Very poorly
11	0.00	15.45	28.04	13.57	13.52	3.93	2.97	10.02	11.76	0.68	0.00	-0.29	1.22	1.93	0.19	0.72	Poorly sorte
12	0.00	0.00	0.00	0.00	0.00	0.07	0.53	47.23	51.87	0.28	0.00	2.25	0.21	0.31	-0.05	0.74	Very well so
13	0.00	0.00	0.00	0.34	0.30	1.01	11.59	73.72	12.60	0.41	0.00	1.99	0.25	0.29	-0.02	1.42	Very well so
14	4.35	6.29	15.55	8.52	10.62	6.97	8.25	12.66	20.85	5.74	0.00	0.56	0.68	2.02	-0.37	0.74	Very poorly
15	0.00	1.29	6.07	4.36	6.13	7.32	10.48	50.74	13.45	0.12	0.00	1.51	0.35	1.06	-0.64	1.85	Poorly sorte
16	0.00	0.00	0.00	0.28	0.48	0.50	1.17	63.35	34.32	0.06	0.00	1.83	0.28	0.61	0.20	0.81	Moderately
17	0.00	0.00	0.00	0.67	2.06	4.89	16.57	65.32	10.36	0.07	0.00	1.87	0.27	0.41	-0.26	1.64	Well sorted
18	0.00	30.68	22.36	9.19	5.80	3.45	2.90	4.14	20.43	0.96	0.00	-0.54	1.45	2.17	0.35	0.55	Very poorly
19	0.00	0.00	0.00	1.32	2.21	2.49	3.67	74.99	15.13	0.17	0.00	2.01	0.25	0.35	-0.13	1.90	Very well so
20	0.00	0.00	0.00	3.73	3.04	3.89	9.75	63.56	15.82	0.22	0.00	1.91	0.27	0.55	-0.38	2.51	Moderately