A marine ecological study of the Arklow Bank for a proposed off-shore windpark development

Chapter 1. Baseline survey

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1. INTRODUCTION

Fehily Timoney & Co. are preparing an EIS for Eirtricity for a proposal to establish a windpark on the Arklow Bank in Co. Wicklow. This will involve the siting of wind turbines on the seabed along the Arklow Bank. Turbines will be connected by three submarine cables which will come ashore at three locations to the north of Arklow. Work will commence in 2002 with 200 turbines erected on the bank over a 4-5 year period with a generating capacity of 500MW of power. Ecological Consultancy Services Ltd (EcoServe) have been asked by Fehily Timoney & Co. to prepare an assessment of the marine ecology and to provide recommendations and mitigation measures to minimise the impact of the proposed windpark on the Arklow Bank and on a corridor of seabed likely to contain the route of the cable.

Due to the paucity of existing marine biological information available on the Arklow Bank area it was necessary to obtain new data on the benthos, fish and plankton. Sampling was carried out three times during the year 2000/2001. This report presents the results of all three sampling seasons. A member of Fehily Timoney & Company was part of the sampling team each season.

1.1. Study area

The Arklow Bank is approximately 26 km long and 1.7 km wide at its widest point. It is located 13km from Arklow pier. The area of the Bank shallower than 20 m below chart datum (BCD) is 29.7 km², of which 14.9 km² is shallower than 10 m BCD. The shallowest part of the bank is 0 m BCD, it slopes down to the east to depths exceeding 40 m BCD and to the west to 30 m BCD. The Bank forms a natural barrier to the strong tidal streams which occur in the south west Irish Sea and subsequently the whole of the bank is subject to tidal scour.

1.2. Aims

The aims of this survey were:

- to establish baseline data on the littoral fauna and flora at the landfalls of the proposed cable routes,
- to establish baseline data on the benthic fauna and flora, fish populations and plankton communities for each season,
- to compare data from each survey to identify possible seasonal variations,
- to provide recommendations and mitigation measures to minimise impacts of the proposed windpark on the existing environment.

2. METHODS

2.1. Littoral survey

The littoral sites were sampled from the shore at low water spring tides on the 10th June 2001. The littoral habitats, and communities (biotopes) at two proposed cable routes (A and B) were surveyed in order to provide an assessment of the marine fauna, flora and habitats present and the likely impact of the development. Each habitat present was described and a species list compiled for each. Species were identified to species level where possible (Figure XX).

Sediment shores were sampled using a 6.5 cm diameter corer. At each station four replicate samples were taken to a depth of 20 cm. Stations were placed on the shore. Samples were passed through a 1 mm mesh sieve and the material collected were preserved in 70 % Industrial Methylated Spirits (IMS) and returned to the laboratory for identification. A voucher collection of specimens were retained.

2.2. Sublittoral survey

Sampling was carried out during three seasons; Summer (7th – 15th June 2000), Autumn (12th – 15th September 2000) and Spring (19th – 22nd April 2001). Due to extremely poor weather conditions during November to March is was not possible to conduct any fieldwork for the winter season.

Sample sites were selected to identify the full range of habitats likely to occur along the Arklow Bank and the surrounding seabed. Sites were also selected along a corridor for the proposed cable routes. Twenty one sites were surveyed for benthic fauna and flora in June 2000, 19 sites in September 2000 and 15 sites in April 2001. Four sites were examined for for fish in June 2000, six in September 2000 and three in April 2001. Four sites were surveyed for plankton in both the June and September 2000 surveys and four phytoplankton samples and three zooplankton samples were surveyed in the April 2001 survey (Appendix 5, Figures 5.1 – 5.3). The sites from the first (summer) survey were examined and the most appropriate sites chosen to be resurveyed in Autumn and Spring.

2.2.1. Benthic fauna and flora

The benthos was sampled using a biological dredge (approximately 50 cm by 25 cm) with a 1 cm mesh bag. The dredge was deployed from a boat fitted with an A-frame and winch for retrieval. Deployment was over the stern of the boat for between 1 and 9 minutes, depending whether the substrata was hard (deployment for a shorter time) or soft (deployment for a longer time). The samples were passed through a 1 mm mesh sieve, the material collected was sorted onboard and the relative abundance of conspicuous fauna and flora recorded. Species which could not be identified *in situ* were preserved in 70 % Industrial Methylated Spirits (IMS) and returned to the laboratory for identification. Where possible notes on the substratum type was recorded.

Specimens were identified to the lowest possible taxonomic level, using Makings (1977) for mysid crustaceans, Crothers and Crothers (1988) for crabs, Smaldon (1993) for shrimps and prawns, Graham (1988) and Picton and Morrow (1994) for marine molluscs, Picton (1993) for echinoderms and Wheeler (1978) for marine fish. A voucher collection of representative specimens was made. Species nomenclature follows Howson & Picton (1997).

2.2.2. Biotopes

A biotope is a term which describes the physical 'habitat' of an area with its biological 'community'. Using the list of species recorded from each site and information on the habitat type (from the field survey results and Admiralty charts) each site was allocated a biotope(s) following Connor *et al*. (1997) (Appendix 1, Tables 1.2a-c and Appendix 6). Allocations were made by careful examination of the biotope descriptions from Connor *et al.* (1997) and applying the principal of best fit to each site. In many cases it was not possible to identify a single biotope and in these cases several biotopes were assigned to that site. Biotope information was then mapped using bathymetry data and substrata data from Admiralty charts to produce a final biotope map (Appendix 5, figure 5.1). The aim of this map is to provide an overall image which captures the types of habitats and species communities which occur on and around the Arklow Bank, giving the reader an immediate impression of the marine ecology of the area.

2.2.3. Fish

Fish populations around the Arklow Bank were sampled using two different methods. During the first sampling season (June 2000), an otter trawl (approximately 4 m wide and 10 m long with a 1 cm mesh cod end) was used. The trawl was deployed for a minimum of 20 minutes. During the Autumn and Spring sampling seasons, fish were sampled using an Agassiz trawl (approximately 2 m wide and 3.5 m long with a 1 cm mesh cod end). The Agassiz trawl was used as it has a smaller mesh size and was therefore able to catch smaller benthic fish which may not have been caught in the first sampling trip. The Agassiz trawl was deployed for a minimum of 15 minutes. All fish caught were identified to species level in the field and details of their number, size and sex (where possible) were recorded. Additional, benthic species retained in the trawl were also recorded.

2.2.4. Plankton

2.2.4.1. Zooplankton

Zooplankton samples were collected using a 500 µm mesh net (64 cm diameter and 2.8 m in length). The net was lowered to 20 m and slowly hauled vertically in order to take a cross section of the water column. Two replicate 250 ml samples of zooplankton concentrated in seawater were collected. These samples were preserved in 99% IMS and brought back to the laboratory for identification. The samples were counted and screened to take into account all the zooplankton species present.

Results from the Summer and Autumn surveys indicated that the water column around the Arklow Bank was well mixed, due to the large amount of sediment in the samples. For this reason and also because it was important to locate the fish eggs and larvae (which tend to be nearer the surface and less numerous than other zooplankton species), it was decided to slowly tow the zooplankton net along the surface for approximately 5 minutes, during the Spring surveys. In this way more water was filtered through the net and the chance of recording fish larvae/eggs was increased. These samples were preserved in 4% formaldehyde to aid counting and identification.

2.2.4.2. Phytoplankton

Phytoplankton samples were taken using a Fieldmaster™ perspex water sampler (9 cm in diameter and 41 cm in length). The sampler enables water to be collected from depths of up to 20 m below sea level (BSL) and brought to the surface without contamination from the surrounding shallower water. Two 250 ml subsamples of seawater containing phytoplankton

were taken at each site from 3 m BSL and preserved in lugol¹s Iodine. The samples were subsequently examined using an inverted microscope at X100-X400 in the laboratory and the main phytoplankton species identified.

2.2.4.3. Temperature and salinity profiles

Temperature and salinity profiles were taken at the same sites as the plankton. Water samples were collected at 20 m, 15 m, 10 m, 5 m and at the surface (Appendix 4) using the Fieldmaster™ perspex water sampler (used for the phytoplankton) and measurements of temperature and salinity made using a WTW (Wissenschaftlich-Technische Workstäten) LF 330/SET meter. Water samples were collected and the temperature was measured immediately before equilibrium with the surrounding air temperature was reached. During the Spring sampling, only temperature values were recorded.

3. RESULTS

3.1. Littoral fauna and flora

3.1.1. Landfall A

This site was located at the southern end of Ennereilly Beach adjacent to a rocky outcrop (Irish National Grid reference 273500 177300) (Appendix 7, Plate 1). The beach was gently sloping and backed by a bank (circa 20 m high) which was thickly vegetated with ferns, horsetails, marram grass, other grasses, gorse, dandelion and brambles. The extreme upper shore consisted of very coarse sand with empty oyster shells. No obvious fauna or flora occurred in this zone. The midshore below this consisted of a wide zone of fine and coarse mobile sand with gravel and cobbles. Further down the shore there was a narrow band of shingle with oyster and mussel shells and drift weed with talitrid amphipods. The lower shore consisted of coarse gravely sand with talitrid amphipods. Patches of bedrock outcrops on the lower shore and were colonised by mussels, *Mytilus edulis*, limpets, *Patella vulgata,* with sparse barnacles, the green ephemeral algae, *Enteromorpha* sp., the algae *Mastocarpus stellatus* and the dog whelk *Nucella lapillus* were sparse (Appendix 7, Plate 2). A patch of kelp, *Laminaria* sp. was visable a few metres offshore but was not surveyed in detail.

At the south of the site, the shore was backed by a 10 m cliff of grass with the sea pink, *Armeria maritima,* on top of a 2 m base of bedrock. The bedrock had a very narrow yellow and green lichen zone and an extensive black lichen, *Verrucaria maura* zone. The base of the rock was scoured. A rocky outcrop on the lower shore to the south of the site was colonised by grass and *Armeria maritima* on the top with *Verrucaria* sp., *Porphyra* sp. and *Littorina saxatilis* below this. Lower down the rock supported *Mastocarpus stellatus* and *Enteromorpha* sp. The base of the rock was scoured with sparse *Patella vulgata,* barnacles, mussels *Mytilus edulis*, *Nucella lapillus* and *Enteromorpha* sp.

3.1.2. Landfall B

This site was located to the south of a large bedrock outcrop at the northern end of a beach, north of the Arklow mobile home park (Irish National Grid reference 268000 175500) (Appendix 7, Plate 3). The shore consisted of very fine clean mobile sand with gravel, cobbles and patches of scoured bedrock. The site was backed by a 15 m high grass cliff with unimproved grassland behind it. To the north of the site the shore was backed by bedrock overlaid by a grass cliff with sparse *Armeria maritima*. The bedrock had a sparse flora of yellow and grey lichens, followed by a very sparse broad band of the black lichen *Verrucaria maura* and no obvious fauna. The base of the cliffs were scoured clean by the coarse sand and cobbles on the shore.

Marram grass occurred on the extreme upper shore growing on very coarse sand, oyster shells and cobbles. The shore was backed by a 2 m high bank with coarse sand, gravel and cobbles below it (Appendix 7, Plate 5). Talitrid amphipods were present here. This zone was wide extending into the low shore. A band of shingle occurred in the midshore. The lower shore consisted of extremely coarse mobile sand and gravel with fine sand overlaying it in places. No obvious infaunal species were recorded.

At the north of the beach there was a scoured rocky outcrop. On the top of the rocks *Enteromorpha* sp. occurred in rockpools with some *Porphyra* sp. A wide zone of *Verrucaria maura* occurred below this with the periwinkle *Littorina saxatilis*. Nearer the base of the rock a sparse band of barnacles and the limpet *Patella vulgata* were present. The base of the

rock was very scoured and supported sparse *Mastocarpus stellatus, Nucella lapillus* and *Mytilus edulis* (Appendix 7, Plate 4).

3.1.3. Landfall C

Landfall C has been selected to follow the same route as the Irish Fertilizer Industries Ltd (IFI) ammonia intake on the northern Arklow pier. The intake consisted of a large construction in the centre of the pier which was connected into pipes which ran westwards under the pier (Appendix 7, Plate 6). The pipes surfaced at the main road where they were attached to the side of the pier wall above the high water mark, and ran under the Arklow bridge, and along the National Heritage Area (NHA) salt marsh (Appendix 7, Plate 7). There was no littoral marine fauna or flora at this landfall site and was therefore beyond the scope of this study.

3.2. Benthic fauna

3.2.1. June 2000 survey

A total of 21 dredges were taken, seven along the line of the proposed location of the cable, six on the Arklow Bank and eight around the Bank, to the north, south, east and west (Appendix 5, Figure 5.1 and Appendix 1, Table 1.1a). From these sites a total of 82 species or higher taxa were recorded (Appendix 1, Table 1.2a). The fauna was dominated by hydroids, bryozoans, molluscs and crustaceans. No species of flora were recorded from the dredge samples.

3.2.2. September 2000 survey

A total of 19 dredge samples were taken, three in the line of the proposed location of the cable, nine on the Arklow Bank and seven around the Bank (Appendix 5, Figure 5.2 and Appendix 1, Table 1.1b). From these sites a total of 61 species or higher taxa were recorded (Appendix 1, Table 1.2b). The fauna was dominated again by hydroids, crustaceans, molluscs, bryozoans and echinoderms. The only flora recorded were some unidentified red algae from dredging station number 7.

3.2.3. April 2001 survey

A total of 15 dredges were taken during this survey, four along the Bank and 11 around the Bank (Appendix 5, Figure 5.3 and Appendix 1, Table 1.1c). Three dredges (D2, D7 and D10) were taken to explore the extent of the *Sabellaria* colonies previously found in the summer and autumn surveys. From all of these sites a total 63 species or higher taxa were recorded (Appendix 1, Table 1.2c). The fauna was dominated by hydroids, crustaceans, molluscs and echinoderms. Only one algal species was recorded at dredge station number 2, north west of the Bank.

3.3. Biotopes

In total nine biotopes were recorded. All these biotopes are common on the east coast of Ireland (EcoServe, SensMap project website ((Ecological Consultancy Services Ltd, EcoServe 2001). Descriptions of these biotopes can be found in Appendix 6. In order to facilitate mapping, biotope No.9 (MCR.Flu.Hbys) was described as its higher biotope (MCR.Flu).

3.3.1. June 2000 survey

Seven biotopes were identified from the 21 station (Appendix 1, Table 1.2a).

3.3.2. September 2000 survey
Seven biotopes were identified from the 19 station (Appendix 1, Table 1.2b).

3.3.3. April 2001 survey
Five biotopes were identified from the 15 station (Appendix 1, Table 1.2c).

3.4. Fish

3.4.1. June 2000 survey
Four trawls were taken, one in the path of the proposed cable and, one each to the west, east and south of the Bank (Appendix 5, Figure 5.1 and Appendix 2, Table 2.1a). Six species of fish were caught, all of which were bottom feeding species (Appendix 2, Table 2.2a). The most abundant species recorded was the thornback ray (*Raja clavata*).

3.4.2. September 2000 sampling
Six trawls were taken, one south of the route of the proposed cable and, one to the west, two to the east, and one to the south and north of the Bank (Appendix 5, Figure 5.2, Appendix 2 Table 2.1b). Eight species of fish were caught, the majority of which are bottom feeding species (Appendix 2, Table 2.2b).

In addition invertebrate and algae species which were also collected in the trawls were recorded (Appendix 2, Table 2.3a). The most abundant species included crustaceans (*Palaemon serratus, Crangon crangon*), echinoderms (*Crossaster papposus*) and hydroids. The number of species collected in each trawl ranged from 0 to 25. A total of 52 species were recorded.

3.4.3. April 2001 survey
Three trawls were taken from the east, south and west of the Bank (Appendix 5, Figure 5.3 and Appendix 2, Table 2.1c). Four species of fish were recorded (Appendix 2, Table 2.2c). Invertebrate species collected in the trawls were recorded (Appendix 2, Table 2.3b). The most abundant species were the crustaceans (*Crangon* spp.) and echinoderms. Fifteen species were recorded in total.

3.5. Plankton
During each season four zooplankton and phytoplankton samples were taken to the north west, north east, south west and south east of the Arklow Bank (Appendix 5, Figure 5.1 – 5.3, Appendix 3, Table 31.a – d). Two replicates were taken at each site. In April however, no zooplankton sample was taken to the north east of the Bank due to poor weather conditions.

3.5.1. June 2000 survey
Zooplankton
A total of 22 species or higher taxa were recorded (Appendix 3, Table 3.2a). Crustaceans were the dominant fauna, with all of the crabs being in the first zoea stage (first stage of development).

Phytoplankton
A total of 12 species or higher taxa were recorded (Appendix 3, Table 3.3a). The flora was dominated by diatoms. Species diversity was very low. There was a large amount of sediment in the samples.

3.5.2. September 2000 survey

Zooplankton

A total of 24 species or higher taxa were recorded from these sites (Appendix 3, Table 3.2b). Overall the sample was dominated by copepods (approximately 99 % of the total species present), particularly *Temora longicornis* and *Centropages hamatus* (Appendix 3, Table 3.2b). Copepods total counts and relative species proportions were consistent among the different sites. Site Z2B had the highest total copepod abundance (greater than 1500 counts) amongst all the other sites. Sample Z2A had deteriorated following collection and could therefore not be analysed.

No fish eggs or larvae were identified in the June or September 2000 samples.

Phytoplankton

All samples were examined and the more common species listed (Appendix 3, Table 3.3b). A total of 19 species were recorded from all sites. Similarly to the summer samples, the sediment load was very heavy in all samples.

3.5.3. April 2001 survey

Zooplankton

Seventeen species or higher taxa were recorded in total. The samples were dominated by capepods and to a lesser extent bryozoans. Due to poor weather conditions it was not possible to obtain a zooplankton sample from the NE of the Bank. These samples are currently being identified.

Fish eggs were relatively numberous, representing 1-2% of the total counts. Approximately 30% of the eggs were presenting advanced embryo stages.

Phytoplankton

A total of 9 species were recorded from all four sites. Cell numbers were extremely low, possibly due to the very heavy sediment load. The species recorded however, were mainly benthic or semi-planktonic which were probably attached to sediment particles which have been resuspended by current.

There is little evidence of the spring bloom of true phytoplankton species. This may be due to an unfavourable light climate which is a consequence of the suspended sediment. Diatoms, rather than dinoflagellates remain the dominant form.

3.6. Temperature and salinity profiles

3.6.1. June 2000 survey

Temperature and salinity data collected from each of the plankton sampling sites showed little variation between depth and site and show that the waters in the top 20 m around the Arklow Bank are well mixed (Appendix 4, Table 4.1a, Figure 4.1).

3.6.2. September 2000 survey

Temperature and salinity data collected from each of the plankton sampling sites showed little variation between depth and site and show that the waters in the top 20 m around the Arklow Bank are well mixed (Appendix 4, Table 4.1b).

3.6.3. April 2001 survey

Temperature data collected from each of the plankton sampling sites showed little variation between depth and site and further show that the waters in the top 20 m around the Arklow Bank are well mixed (Appendix 4, Table 4.1c). Salinity measurements were not recorded on this survey due to equipment failure.

4. DISCUSSION

4.1. Littoral fauna and flora

4.1.1. Landfall A and B

The shores at Landfalls A and B consist of a sandy, gravely beaches with rocky outcrops which are typical along this stretch of the east coast of Ireland (Ecological Consultancy Services Ltd, EcoServe 2001). Very few species of flora or fauna were recorded from either site. The sediment provides an unsuitable habitat for macroinvertebrates as it is coarse and mobile and only supports talitrid amphipods (sandhoppers). The small rocky outcrops are scoured by the sediment, making if difficult for species to colonise. Larger rocky outcrops are only scoured at the base and support the most species at the site, mostly sand scour tolerant species such as barnacles and limpets and ephemeral green algae. No rare species or species of conservation importance were recorded. Previous surveys in the area conducted by the SensMap survey in 1997 recorded a similar range of species (Ecological Consultancy Services Ltd, EcoServe 2001).

4.1.2. Landfall C

The siting of the IFI ammonia intake on the harbour wall meant that no littoral marine fauna or flora occurred there. Once the route linking into the IFI intake has been established it may be necessary to conduct further littoral surveys.

4.2. Benthic fauna

The Arklow Bank is predominantly sedimentary with little or no fixed hard substrata recorded. The Bank itself consists of sand and shell with pebbles at the northern end with fine clean sand at the southern tips.

To the west and off the north and south of the Bank the seabed ranged from sandy shell and gravel with coarse shell and gravel to the east. Some large boulders and rocks were also recorded off the eastern side of the Bank.

Inshore, towards Arklow the seabed was sandy with fine mud, possibly influenced by the outflow of the Avoca River.

None of the species recorded in the survey area are uncommon, rare or are protected. All are commonly found on the east coast of Ireland (Ecoserve. Unpublished data, Picton & Costello, 1998). Species diversity was highest in areas of sandy shell, gravel and cobbles in the north-west, south-west and south-east of the Bank and inshore along the proposed cable route. Of interest was the occurrence of the reef building polychaete *Sabellaria alveolata* (the honey comb worm) and *S. spinulosa* (the ross worm) at the north west of the bank and at a site opposite Arklow Harbour. Both species were recorded from the same ‘colonies’ indicating that they can co-exist. *Sabellaria* species consolidate the sedimentary seabed into hard “reef” like structures, providing additional habitats for colonisation. George & Warwick (1985) and the National Rivers Authority (1984) found that sites with *Sabellaria* sp. had more than twice

as many species and almost three times as many individuals as sites with low or no *Sabellaria* present. *Sabellaria alveolata* was also recorded from dredge site number 13 on the east of the Bank (from the September and April surveys), but was not abundant.

The community *Sabellaria* forms is noted as important by the Marine Conservation Society (Gubbay 1988) and NCC (Davidson *et al.* 1991). Although no statutory conservation status has been assigned to it. However, 'reefs' are recognised as a priority habitat in the EU Habitats and Species Directive and Dúchas, the Heritage Service have recently designated the Wicklow Reef, just north of Arklow Bay, as a proposed candidate Special Area of Conservation (pcSAC) because of the *Sabellaria* sp 'reef' present. *Sabellaria* spp. however has been recorded at several other subtidal locations along the east coast of Ireland (EcoServe, unpublished data), suggesting it is not restricted to the Arklow Bank area and is likely to be under recorded in Irish waters (Chris Emblow pers. comm.).

At the present stage of planning it is not envisaged that the cable routes will pass through the *Sabellaria* 'reefs' and thus will not impact upon them. However, should these routes change and cross the *Sabellaria* 'reefs' they will be impacted upon. However the Marine Life Information Network (MarLIN) initiative in the UK (MarLIN 2001) consider that the recovery of *Sabellaria alveolata* and *Sabellaria spinulosa* to substratum removal is moderate (only partial recovery is likely within 5 years and full recovery is likely to take up to 10 years) and high (full recovery will occur but will take many months [or more likely years] but should be complete within about five years) respectively.

MarLIN considers the sensitivity of both species of *Sabellaria* to smothering by sediment to be low (i.e. up to several weeks burial with no effect) with immediate recoverability (within a few days of being uncovered). It also considers both species to have low sensitivity to suspended solids. However although recoverability for *S. spinulosa* is considered immediate, for *S. alveolata* the recoverability from the effects of suspended solids is considered very high (full recovery is likely within a few weeks or at most 6 months).

Very few species were recorded from sites on the Bank. The substratum consisted of clean, mobile, sand with shell and gravel. The number of species ranged from none to 12 and were dominated by hydroids, bryozoans, hermit crabs and the occasional sand eel.

Surveys were taken during the Summer, Autumn and Spring in order to define seasonality trends. The results show that seasonality does not seem to have an effect on the faunal species on and around the Arklow Bank as similar species were recorded on each survey.

4.3. Fish

The dominant species of fish recorded in June 2000 were the rays *Raja clavata and R. naevus*. The other species were also bottom living fish. In September 2000 a smaller sized mesh trawl was used and the diversity of species caught possibly reflects this. The most abundant species were *Trisopterus minutus* (poor cod), small pelagic fish and a number of other smaller fish including *Agonus cataphractus* (pogge) and *Callionymus lyra* (dragonet). Only one small ray was caught, however more plaice were recorded. In April 2001 the diversity of fish was low. This is probably due to inproper deployment of the trawl during bad weather. Only four species were caught and all were small specimens.

None of the fish species recorded around the Arklow Bank are of direct conservation importance. However several species thornback ray, cuckoo ray, plaice, cod and monkfish,

are taken commercially from around the Bank (see Chapter 2 – Review of Commercial Fisheries).

4.4. Plankton

4.4.1. Zooplankton

The zooplankton species recorded from the survey area are typically found in coastal areas of the Irish Sea (Williamson, 1956; Gowen *et al*, 1998). The dominance of calanoid copepods in autumn and the high abundance of benthic invertebrate larvae, such as barnacle nauplii and bryozoans in spring, are a common feature of coastal waters. The most numerous copepod species found in the samples were *Centropages hamatus* and *Temora longicornis,* both of which are usually common along the Irish Sea coast. The other zooplankton species observed in both autumn and spring samples are also very common in this region with no particular species of conservation importance or unusual zooplankton species of Atlantic origin present.

The fish eggs recorded from the spring survey could not be identified. Fish eggs are notoriously very difficult to identify to species level particularly if they do not present any distinct morphological feature and if the embryo is at a very early stage of its development as was the case. However, in the western Irish Sea, the majority of fish larvae belong to cod (*Gadus morhua*), whiting (*Merlangius merlangus*), sprat (*Sprattus sprattus*) dab (*Limanda limanda*), witch (*Glyptocephalus cynoglossus*), *Callionimidae* and *Gobidae*. These fish species spawn in shallow (< 40 m) vertically mixed waters 15-25 km off the Irish coast during late March to May whereas the newly settled 0-group fish larvae appear in late summer early autumn (Nichols *et al*., 1993).

Although, none of the coastal copepods recorded are of conservation importance they represent a very important food source for first feeding fish larvae and thus for the productivity of a region (Brander and Dickson, 1984).

4.4.2. Phytoplankton

The phytoplankton species recorded around the Arklow Bank are distinctive because of the dominance of diatom species, as opposed to dinoflagelate species, and the very heavy sediment load at all seasons. The presence of benthic diatom forms such as *Bacillaria* sp., *Odontella* sp. and *Paralia* sp. and relatively few dinoflagellate species (*Ceratium* sp. and *Protoperidinium* sp.) are typical of a well mixed water column where stratification does not occur due to strong tidal currents. Such currents re-suspend huge quantities of bottom sediments and their associated diatom flora. The absence of water stratification inhibits the development of dinoflagellates.

In general species diversity and abundance was low from all of the surveys. This may be due to the heavy sediment load in the samples which reduces the availability of light for phytoplankton species and made sample examination difficult. This reduced availability of light will in turn reduce the depletion of nitrate and phosphate due to light induced growth of plankton. The heavy sediment load reflects the strong tidal mixing and absence of stratification that is known to be characteristic of the south-west Irish Sea. Satellite imagery of the coast off Arklow suggest a moderate algal concentration and very obvious plumes of sediment running parallel to the coast. Wafar *et al*. (1987) have described the biological oceanography of such well mixed coastal water. They note that the spring bloom is not well developed and algal biomass is most developed in mid summer. Similarly nitrates and

phosphates are only depleted by late summer. While diatoms are the dominant type of phytoplankton. This type of phytoplankton cycle appears to match the cycle off the Arklow Bank. It should be noted that such an environment is unusual in Irish coastal waters where generally weak tidal currents result in water stratification, early Spring blooms and large dinoflagellate blooms in Autumn.

The phytoplankton samples from the surveys were similar and were dominated by diatoms, with *Guinardia* and *Rhizosolenia* being common. This is unusual compared to the Atlantic coast where *R. shrubsolei* is the commonest species present. All these species have a similar form, being large, cylindrical diatoms with many small chloroplasts. This may be an adaptation to the well mixed, but sediment laden water which probably results in light rather than nutrient shortage. None of the species recorded are known to be of conservation or toxicological interest.

The lack of a marked seasonal succession suggests that hydrographic conditions do not change greatly during summer. One unusual species, the large *Rhizosolenia robusta,* occurred at the north west of the Bank during the Autumn survey. This is a warm water species but may also prefer the mixed water of the Irish Sea, rather than the stratified water of the west coast. This species has only been recorded once before in Irish waters (Cillian Roden, unpublished data).

One of the earliest studies of Irish phytoplankton was conducted at the South Arklow Bank light ship in 1904 (Gough 1906). This survey differed from the present investigation in that samples were collected by net rather than a water bottle, and samples were taken every 14 days. More species were recorded by Gough, although this is primarily due to the different sampling technique used. However the same general pattern of common diatoms and relatively few dinoflagellates occurred in both surveys. The benthic diatom species *Bacillaria* sp., *Odontella* sp. and *Paralia* sp. were as frequent in 1904 as in 2000. Of the 23 species recorded during the present survey, only five species were not recorded in 1904 and these were probably too small to be taken in the coarse net used by Gough.

In conclusion, the plankton around the Arklow Bank is distinctive in comparison to other Irish coastal waters and has persisted for at least the last hundred years. The very heavy sediment load reduces light penetration so it is possible that any extra disturbance will not greatly affect the existing biota. However it is anticipated that a reduction in tidal current speed would affect the ecology of the plankton.

4.4.3. Temperature and salinity

The water temperature around the Arklow Bank varies seasonally, but are uniform in the upper 20 m of the water column. Temperatures ranged from approximately 12 ºC in the Summer to approximately 16 ºC in the Autumn and approximately 8 ºC in the Spring surveys. Salinity values were more or less similar with season. Temperatures in the Summer are higher than the Irish Sea mean Summer surface (13.5-14^{o}C) and bottom temperatures (12-14 ^{o}C) (Lee and Ramster, 1981).

5. POTENTIAL IMPACTS OF AN OFFSHORE WINDPARK ON MARINE FAUNA AND FLORA

5.1. Short term

- Loss or alteration of habitat

Habitat will be lost in the short term during the construction of the trenches for laying the cables offshore and across the intertidal zone. The loss of habitat is likely to be temporary, as the trench will be back filled. It is expected that the habitat will be returned to its natural state, however during the period of construction the habitat is likely to be unavailable for feeding or spawning.

The habitats likely to be impacted by the development are however, widespread and percentage loss in area and over time is expected to have a minimal impact.

- Loss of species

Species will be lost in the short term during the construction phase both at the landfall sites and in the sublittoral. Directly through the removal of habitat when the cable trench is made, and indirectly through the loss of feeding and spawning grounds. Epifaunal species will be most affected as they are attached to the substratum, however fish species are highly mobile and will move away from areas where environmental conditions are unfavourable.

Once the habitat has been reinstated following the back filling of the cable trench it is expected that species will readily recolonise the area from the surrounding habitat. The loss of species due to loss of feeding and spawning grounds is likely to be negligible due to the small area of seabed likely to be impacted in relation to the wide area of similar feeding and spawning habitat available in the area.

- Increased suspended solids

There will be a short term increase in suspended solids during the construction of the cable trench and during the construction of the turbines. This could result in a reduction of light penetration and result in increase siltation on the seabed and seashore when solids settle out. A decrease in light penetration can in the long term restrict growth of benthic seaweeds and can impair the feeding capabilities of fish who use their vision to capture prey items. Increase solids in the water column can reduce the gill function in fish and reduce the capabilities of filter feeders by blocking their feeding apparatus. High levels of suspended solids settling on the seabed can alter habitat resulting in a potential loss of feeding and spawning grounds.

However, on the Arklow Bank the volume of re-suspended solids during construction is likely to be low and the high tidal current regime in the area will result in rapid dispersion of the sediment. The seashore and seabed in the area are sedimentary, particularly over the Bank, and there is a high degree of naturally suspended solids present. The species recorded are tolerant of these conditions and are not likely to be impacted. Fish are highly mobile and will avoid unfavourable conditions.

- Noise pollution

Noise pollution from activities such as seismic and drilling during the construction phase of the windpark may disturb the surrounding marine fauna, particularly fish. The impact is likely to be minimal and short term and is mainly restricted to the construction phase. Impacts due to noise from the turbines in the operational phase is likely to be negligible.

- Pollutants and waste

Contamination of the seabed and seashore due to accidental spillage of pollutants, e.g. oil and other chemicals, or waste, e.g. litter, may occur during the construction phase. However, if suitable precautions are taken this should be minimal.

5.2. Long term

- Loss or alteration of habitat

There will be a permanent direct loss of seabed habitat from the 'footprint' of the turbine foundations. As a result non-mobile sensitive species occurring in the 'footprint' will be lost and mobile species utilising these habitats for feeding and spawning will lose this resource. However the total area of the turbine 'footprints' is likely to be low compared to the total available habitat in the area and these impacts are likely to minimal as they will be restricted to the 'footprint' of the turbine foundations.

Habitat may also be altered due to a change in water movement both locally around the base of the turbines and perhaps at a larger scale (see water movement).

The addition of substantial areas of hard substrata (the turbine foundations and tower bases), will provide a new habitat within the area. Areas of hard substrata are very limited on the Arklow Bank and it is predicted that the additional habitat will result in the colonisation by species new to the Arklow Bank. Areas of hard substrata are usually more diverse than mobile sediment and the turbine bases could quickly become colonised.

No long term impacts are predicted on the seashore at the landfall sites if habitats are reinstated.

- Loss of species

Species will be lost through the removal of habitat during the construction of the turbines foundations. The loss of habitat at each turbine footprint will result in a permanent loss of species. The reduction in habitat will also reduce the availability of feeding and spawning grounds and indirectly a loss of species. The turbines will be sited in areas of low species diversity and the total habitat loss compared to that available will result in the loss of species being low.

- Water movement

The turbine foundations may alter the pattern of water movement over the Bank both locally and on a wider scale, resulting in a change in sediment deposition and erosion pattern. This may create changes in the substratum and habitat at these locations resulting in an alteration in species composition.

- Noise pollution

The effects of noise and vibrations from turbines during the operational phase are not well documented, however they may have an impact on fish and other species. Although this is likely to be minimal.

- Pollutants and waste

Contamination of the area due to accidental spillage of pollutants or waste from vessels maintaining the turbines, may occur during the operational phase of the windpark. However, if suitable precautions are taken this should be minimal.

- Electromagnetic radiation

The effects of electromagnetic radiation from submerged electric cables are not well documented, however they may have an impact on fish and other species. Although this is likely to be minimal.

6. MITIGATING MEASURES

- Loss or alteration of habitats and loss of species

The siting of the turbine foundations and cable trenches in low species diversity habitats will minimise the loss of species. In particular the cables should avoid the habitats associated with the *Sabellaria* sp. which occur to the north west of the Bank (Appendix 5, Figure 5.4). To minimise habitat loss and disturbance, efforts should be made to keep the area of seabed disturbed by the cable trench (at the landfall and sublittoral sites) and turbine foundations to a minimum. Following construction of the cable trenches, efforts should be made to restore habitats to their current condition, if impacted upon. Cable trenches should be filled to their pre-construction level, minimising changes in water flow regime, and with material of a similar particle size to allow recolonisation of benthic species.

Should a gravity caisson design be used for the turbine foundations, the design should consider the criteria used in the development of artificial reefs. This would maximise the potential of the foundation to be colonised by marine life including species of nature conservation importance.

- Increased suspended solids

To minimise the amount of suspended solids released into the water column during construction, efforts should be made to minimise the area of seabed and intertidal area disturbed. Construction should be carried out over periods of slack tide to minimise the dispersion and removal of material from the area.

If the cables are cited to avoid sensitive habitats, or high biodiversity habitats such as the *Sabellaria* communities recorded from the north and west of the Bank, the short term loss of species will be negligible.

- Noise pollution

Noise pollution should be kept to a minimum and follow the guidelines developed by the UK Joint Nature Conservation Committee to minimise the impacts. The area of seabed impacted upon during dredging or blasting should be kept to a minimum.

- Pollutants and waste

Contamination of the area may occur due to accidental spillage of pollutants from onshore and offshore construction sites and boat traffic. The extent of the impact will depend on the volume and material that is spilt. To minimise the impact of pollution and waste it is necessary to minimise the likelihood of any spillage or contamination. Potential contaminants should be stored in suitable storage facilities, such as bonded containers, both on land, and at sea.

Waste and litter generated during construction should be returned to the shore for authorised disposal at suitable facilities. Utmost care and vigilance should be followed to prevent accidental contamination of the site and surrounding environment during the construction of the windpark. Construction and on site operating procedures should be followed to the highest standard to minimise unnecessary disturbance and prevent accidental spillage of contaminants.

7. FUTURE MONITORING

When the design of the windpark has been fully decided upon it would be necessary to define a monitoring programme for the pre-construction and operational phases. Specific sites, such as those containing vulnerable or species of interest, e.g. *Sabellaria* species should be monitored prior and during the construction phase and on a regular basis during the operational phase of the windpark. Other sites at key locations around the development should also be monitored on a regular basis during the operational phase to detect any change in habitat or species composition. The colonisation of a selection of piles and/or rock armour at the base of the turbines should also be monitored on a regular basis.

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APPENDIX 1. BENTHIC FAUNA

Table 1.1a: Site locations and details of subtidal dredge sites, June 2000. The positions given are Irish National Grid references.

Site no.	Site name	Date	Position (Start)	Position (End)	Duration (min.)	Distance (km)
D1	North of North Buoy	07/06/00	340251 186344	340179 185729	5	0.12
D2	North of North Buoy	07/06/00	340301 186159	340164 186267	8	0.45
D3	North of Arklow Bank	07/06/00	339650 181909	339834 182156	7	0.31
D4	Middle of Arklow Bank	09/06/00	338444 170239	338840 170585	4	0.52
D5	Middle of Arklow Bank	09/06/00	338600 170689	338708 170878	7	0.22
D6	Middle of Arklow Bank	09/06/00	338576 170763	338630 170820	1	0.08
D7	Middle of Arklow Bank	09/06/00	338567 170669	338610 170764	6	0.1
D8	Southerly point of Arklow Bank	14/06/00	337009 164464	336998 164464	6	0.01
D9	South of Arklow Bank	14/06/00	336429 159030	336486 158604	5	0.26
D10	South of Arklow Bank	14/06/00	336372 158638	336345 158786	6	0.12
D11	South East of Arklow Bank	14/06/00	339726 165581	339789 165750	6	0.18
D12	East of Arklow Bank	14/06/00	340788 170548	341133 171059	3	0.62
D13	North West of Arklow Bank	07/06/00	336837 182905	336939 183261	3	0.37
D14	East of Arklow Bank	09/06/00	335116 173356	335172 173747	7	0.39
D15	East of Arklow Harbour	09/06/00	335181 173840	335273 174177	9	0.35
D16	South West of Arklow Bank	06/06/00	335083 165654	335324 166273	6	0.66
D17	East of Arklow Harbour	09/06/00	335989 171116	336242 171717	3	0.65
D18	North East of Arklow Harbour	09/06/00	332850 174351	333210 174750	4	0.54
D19	North East of Arklow Harbour	09/06/00	333228 174936	333399 175238	3	0.35
D20	East of Arklow Harbour	06/06/00	330548 173824	330888 174130	3	0.46
D21	North of Arklow Harbour	09/06/00	327912 173977	328076 174167	5	0.25

Table 1.1b: Site locations and details of subtidal dredge sites, September 2000. The positions given are Irish National Grid references.

Site no.	Site name	Date	Position (Start)	Position (End)	Duration (min.)	Distance (km)
D1	North of Arklow Bank	13/09/00	340335 186585		5	0.1
D2	On the Bank (north)	14/09/00	339242 181603	339252 181568	1	0.04
D3	On the Bank (centre)	14/09/00	338649 171350	338703 171353	2	0.05
D4	On the Bank (south)	15/09/00	336945 164447	336970 164621	4	0.18
D5	South of Arklow Bank	12/09/00	336197 158384	336317 158466	2	0.15
D6	South East of Arklow Bank	15/09/00	339736 166479	339649 166190	3	0.3
D7	North West of Arklow Bank	13/09/00	336908 183579	336951 183346	4	0.24
D8	South West of Arklow Bank	12/09/00	334760 164721	334629 164460	5	0.29
D9	West of Arklow Bank	12/09/00	335758 170721	335798 170598	2	0.13
D10	Along proposed cable route	13/09/00	333335 175227	333434 175395	3	0.19
D11	Along proposed cable route	12/09/00	330761 174256	330874 174476	3	0.25
D12	Along proposed cable route	12/09/00	328099 174284	328280 174526	3	0.3
D13	North East of Arklow Bank	13/09/00	340939 176471	340772 176942	4	0.5
D14	On the Bank (northern half)	14/09/00	338764 177973	338774 177996	2	0.02
D15	On the Bank (southern half)	15/09/00	337970 168758	337988 169032	8	0.27
D16	On the Bank (centre)	14/09/00	339012 176118	339034 176286	2	0.17
D17	On the Bank (northern half)	14/09/00	339240 180844	339206 180811	1	0.05
D18	On the Bank (southern half)	15/09/00	337570 166904	337593 166989	3	0.09
D19	On the Bank (southern half)	15/09/00	337919 168572	337987 168627	2	0.09

Table 1.1c: Site locations and details of subtidal dredge sites, April 2001. The positions given are Irish National Grid references.

Site no.	Site name	Date	Position (Start)	Position (End)	Duration (min.)	Distance (km)
D1	North of Arklow Bank	21/04/01	340474 186356	340405 186144	4	0.22
D2	North West of Arklow Bank	21/04/01	336088 184315	335976 184031	5	0.3
D3	On the Arklow Bank (middle)	20/04/01	338590 171602	338577 171854	3	0.25
D4	On the Arklow Bank (south end)	19/04/01	337119 164364	336972 163999	3	0.39
D5	South of Arklow Bank	19/04/01	335935 157834	335865 157629	4	0.22
D6	South East of Arklow Bank	20/04/01	339593 166306	339365 165682	3	0.66
D7	North West of Arklow Bank	21/04/01	335672 181538	335527 181317	4	0.26
D8	South West of Arklow Bank	19/04/01	334500 164313	334483 164344	4	0.04
D9	West of Arklow Bank	19/04/01	335624 170063	335363 169601	3	0.53
D10	North West of Arklow Bank	21/04/01	337875 184559	337479 183803	3	0.85
D11	Along proposed cable route	20/04/01	330854 173898	330808 173805	3	0.1
D12	Along proposed cable route (Arklow Harbour)	19/04/01	328016 174122	327873 174189	4	0.16
D13	North East of Arklow Bank	22/04/01	340947 176261	340850 175792	2	0.48
D14	On the Arklow Bank (south end)	22/04/01	338975 180428	338966 180373	1	0.05
D15	On the Arklow Bank (southern half)	19/04/01	337247 166768	337164 166668	1	0.13

Table 1.2a: List of species or higher taxa recorded from each site, June 2000. The list is arranged in taxonomic order. P = present.

	Dredging stations - D																				
Taxanomic group	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**
Porifera (Sponges)																					
Tethya aurantium	-	-	-	-	-	-	-	-	-	-	-	P	-	-	-	-	-	-	-	-	-
Scypha ciliata	-	-	-	-	-	-	-	-	-	-	-	-	P	-	-	-	-	-	-	-	-
Porifera crusts indet.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	P	-	-
Porifera indet.	-	-	-	-	-	-	-	-	-	-	-	P	-	-	-	-	-	-	-	-	-
Anthozoa (Sea anemones)																					
Anthozoa indet.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	P
Alcyonium digitatum	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	P	P
Urticina sp.	-	-	-	-	-	-	-	-	-	-	P	P	-	-	-	-	-	-	-	P	-
Urticina felina	-	-	-	-	-	-	-	-	-	-	-	-	P	-	-	-	-	-	P	-	F
Hydrozoa (Hydroids/sea firs)																					
Tubularia indivisa	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	P	-	-	F	-	-
Tubularia larynx	-	-	-	-	-	-	-	-	-	-	P	P	P	-	-	-	-	-	P	-	-
Eudendrium sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	P
Halecium halecinum	-	-	-	-	-	-	-	-	-	-	-	P	P	-	-	-	-	-	-	P	P
Nemertesia antennina	-	-	-	-	-	-	-	-	-	-	-	P	-	-	-	-	-	-	-	P	P
Nemertesia ramosa	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	P	-
Abietinaria abietina	P	P	-	-	-	-	P	-	-	-	P	P	P	-	-	P	P	-	P	-	-
Dynamena pumila	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	P	-	-
Hydrallmania falcata	P	-	-	-	-	-	P	-	P	P	P	P	P	-	-	P	P	-	P	F	P
Sertularia sp.	-	-	-	-	-	-	P	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sertularia argentea	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	P	-	F
Clytia hemisphaerica	-	-	-	-	-	-	-	-	-	-	P	-	-	-	-	-	-	-	-	-	-
Obelia sp.	P	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Polychaeta (Worms)																					
Polychaeta indet.	-	-	-	-	-	-	-	-	-	-	P	-	-	-	-	-	-	-	P	-	P
Terebellida indet.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	P
Sabellaria sp.	-	-	-	-	-	-	-	-	-	-	-	-	P	-	-	-	-	-	-	-	-
Lanice conchilega	-	-	-	-	-	-	-	-	-	-	-	P	-	-	-	-	-	-	-	P	P
Sabellidae indet.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	P	-	-	-	-	-
Sabella pavonina	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	P	P	-
Pomatoceros sp.	-	-	-	-	-	-	-	-	-	-	P	P	-	-	-	P	-	-	-	-	-
Pomatoceros triqueter	-	-	-	-	-	-	-	-	-	-	-	-	P	-	-	-	-	-	-	-	-
Aphrodita aculeata	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	P	-
Glyceridae indet.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	P	-	-	-	-
Nephtys sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	P	P
Harmothoe sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	P
Crustacea (Crabs, barnacles and amphipods)																					
Balanus crenatus	-	-	-	-	-	-	-	-	-	-	P	-	P	-	-	-	-	-	P	P	P
Amphipoda indet.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	P	P
Pagurus bernhardus	-	-	-	-	-	-	-	-	-	-	P	P	P	-	-	P	-	-	P	P	-
Pisidia longicornis	-	-	-	-	-	-	-	-	-	-	-	P	P	-	-	P	-	-	-	-	P
Ebalia tuberosa	-	-	-	-	-	-	-	-	-	-	-	P	-	-	-	-	-	-	-	-	-
Hyas coarctatus	-	-	-	-	-	-	-	-	-	-	P	P	P	-	-	-	-	-	-	P	-
Inachus leptochirus	-	-	-	-	-	-	-	-	-	-	-	P	-	-	-	-	-	-	-	-	-
Inachus phalangium	-	-	-	-	-	-	-	-	-	-	-	P	-	-	-	-	-	-	-	P	-
Macropodia rostrata	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	P	P	-

(cont.)	Dredging stations - D																				
Taxanomic group	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**
Macropodia tenuirostris	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	P	-
Eurynome aspera	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	P	-
Cancer pagurus	-	-	-	-	-	-	-	-	-	-	-	P	P	-	-	-	-	-	-	-	-
Liocarcinus depurator	-	-	-	-	-	-	-	-	-	-	-	-	P	-	-	-	-	-	-	-	-
Carcinus maenas	-	-	-	-	-	-	-	-	-	-	-	P	-	-	-	-	-	-	-	-	P
Xantho incisus	-	-	-	-	-	-	-	-	-	-	-	P	-	-	-	P	-	-	-	-	-
Mollusca (Snails and bivalves)																					
Mytilus edulis	-	-	-	-	-	-	-	-	-	-	-	-	P	-	-	-	-	-	-	-	-
Aequipecten opercularis	-	-	-	-	-	-	-	-	-	-	-	P	-	-	-	-	-	-	-	P	-
Mactridae indet.	-	-	-	-	-	-	-	-	-	P	-	-	-	-	-	-	-	-	-	-	-
Calliostoma zizyphinum	-	-	-	-	-	-	-	-	-	-	-	-	P	-	-	-	-	-	-	P	-
Spisula elliptica	-	-	-	-	-	-	-	-	-	P	-	-	-	-	-	-	-	-	-	P	-
Angulus tenuis	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	P
Donax vittatus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	P
Venerupis senegalensis	-	-	-	-	-	-	-	-	-	-	-	-	P	-	-	-	-	-	-	-	-
Chamelea gallina	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	P	-	-	P	-
Clausinella fasciata	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	P	-
Loligo vulgaris	-	-	-	-	-	-	-	-	-	-	-	-	P	-	-	-	-	-	-	-	-
Nucella lapillus	-	P	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Buccinum undatum	-	-	-	-	-	-	-	-	-	-	-	P	P	-	-	-	-	-	-	-	-
Neptunea antiqua	-	-	-	-	-	-	-	-	-	-	-	-	P	-	-	P	-	-	-	-	-
Acanthochitona fascicularis	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	P	-
Bryozoa (Sea mats)																					
Bryozoa indet.	P	P	-	-	-	-	-	-	-	-	P	-	-	-	-	P	-	-	-	P	-
Alcyonidium sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	P
Alcyonidium diaphanum	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	P	-	-
Alcyonidium parasiticum	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	P	-
Vesicularia spinosa	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	P	-	-	P	P
Eucratea loricata	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	P	-	P
Electra pilosa	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	P
Flustra foliacea	P	P	-	-	-	-	-	-	-	-	P	P	P	-	-	-	-	-	P	P	-
Bugula flabellata	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	P	-	-	P	P	-
Echinodermata (Starfish and sea urchins)																					
Henricia oculata	-	-	-	-	-	-	-	-	-	-	-	P	-	-	-	-	-	-	-	-	-
Asterias rubens	-	-	-	-	-	-	-	-	-	-	P	P	P	-	-	-	-	-	-	P	P
Ophiura albida	-	-	-	-	-	-	-	-	-	-	-	P	-	-	-	-	-	-	-	-	-
Ophiura ophiura	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	P
Psammechinus miliaris	-	-	-	-	-	-	-	-	-	-	P	P	P	-	-	P	-	-	-	P	-
Tunicata (Sea squirts)																					
Corella parallelogramma	-	-	-	-	-	-	-	-	-	-	-	-	P	-	-	-	-	-	-	P	-
Ascidia mentula	-	-	-	-	-	-	-	-	-	-	-	-	P	-	-	-	-	-	-	P	-
Polycarpa sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	P	-
Botryllus schlosseri	-	-	-	-	-	-	-	-	-	-	-	-	P	-	-	-	-	-	-	-	-
Molgula sp.	-	-	-	-	-	-	-	-	-	-	-	-	P	-	-	-	-	-	-	-	-
No. of taxa	**5**	**4**	**0**	**0**	**0**	**0**	**3**	**0**	**1**	**3**	**14**	**26**	**27**	**0**	**0**	**12**	**5**	**0**	**17**	**34**	**25**
Biotope No.	**-**	**1**	**-**	**-**	**-**	**-**	**2**	**-**	**1**	**1**	**2**	**8**	**5/6**	**-**	**-**	**1/2**	**1**	**-**	**7**	**8**	**3**
Dredge time - minutes	**5**	**8**	**7**	**4**	**7**	**1**	**6**	**6**	**5**	**6**	**6**	**3**	**3**	**7**	**9**	**6**	**3**	**4**	**3**	**3**	**5**

Table 1.2b: List of species or higher taxa recorded from each site, September 2000. The list is arranged in taxonomic order. P = present.

	Dredging stations - D																		
Taxanomic group	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**
Porifera (Sponges)																			
Porifera indet.	-	-	-	-	-	P	-	-	-	-	-	P	-	-	-	-	-	-	-
Anthozoa (Sea anemones)																			
Alcyonium digitatum	-	-	-	P	-	-	-	P	-	-	-	P	-	-	-	-	-	-	-
Urticina sp.	-	-	-	-	-	-	-	-	-	-	-	P	-	-	-	-	-	-	-
Hydrozoa (Hydroids/sea firs)																			
Tubularia sp.	-	-	-	-	-	-	P	-	-	-	-	-	-	-	-	-	-	-	-
Tubularia larynx	-	-	-	-	-	P	-	P	-	P	-	-	-	-	-	-	-	-	-
Hydractinia echinata	-	-	-	-	-	-	-	P	-	-	-	-	-	-	-	-	-	-	-
Halecium halecinum	-	-	-	-	-	-	-	-	-	-	P	-	-	-	-	-	-	-	-
Nemertesia antennina	-	-	-	-	-	-	-	-	-	-	P	-	P	-	P	-	-	P	-
Nemertesia ramosa	-		-	-	-	-	-	-	-	-	P	-	-	-	-	-	-	-	-
Abietinaria abietina	P	-	-	-	P	-	P	P	P	-	-	P	-	-	P	-	-	-	-
Hydrallmania falcata	P	-	-	-	P	P	P	P	P	P	P	P	P	-	P	-	P	P	-
Sertularia argentea	P	-	-	-	P	-	P	P	P	P	P	-	P	-	-	P	-	P	-
Sertularia cupressina	-	-	-	-	-	-	-	-	P	-	-	P	-	-	-	P	-	-	-
Laomedea flexuosa	-	-	-	-	-	-	-	-	-	-	-	P	-		-	-	-	-	-
Polychaeta (Worms)																			
Polychaeta indet.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	P	-	-
Sabellaria alveolata	-	-	-	-	-	-	P	-	-	-	-	-	P	-	-	-	-	-	-
Pomatoceros triqueter	-	-	-	-	-	P	-	P	-	P	-	-	P	-	-	-	-	-	-
Crustacea (Crabs, barnacles and amphipods)																			
Balanus crenatus	-	-	-	-	-	-	P	P	-	P	P	P	-	-	-	-	-	-	-
Crangon allmanni	-	-	-	-	-	-	-	-	P	-	-	-	-	-	-	-	-	-	-
Pagurus bernhardus	-	-	-	-	-	P	P	P	-	-	-	-	P	-	P	-	-	-	-
Pisidia longicornis	-	-	-	-	-	-	P	-	-	-	-	-	-	-	-	-	-	-	-
Ebalia sp.	-	-	-	-	-	P	-	-	-	-	-	-	-	-	-	-	-	-	-
Hyas coarctatus	-		-	-	-	P	P	-	-	-	-	-	-		-	-	-	-	-
Inachus dorsettensis	-	-	-	-	-	P	-	-	-	-	-	-	-	-	-	-	-	-	-
Macropodia tenuirostris	-	-	-	-	-	P	-	-	-	-	P	-	-	-	-	-	-	-	-
Cancer pagurus	-	-	-	-	-	-	P	-	-	-	-	-	-	-	-	-	-	-	-
Liocarcinus depurator	-	-	-	-	-	-	P	-	-	-	-	-	-	-	-	-	-	-	-
Carcinus maenas	-	-	-	-	-	P	P	-	-	-	-	-	P	-	-	-	-	-	-
Pilumnus hirtellus	-	-	-	-	-	-	P	-	-	-	-	-	-	-	-	-	-	-	-
Mollusca (Snails and bivalves)																			
Diodora graeca	-	-	-	-	-	-	P	-	-	-	-	-	-	-	-	-	-	-	-
Calliostoma zizyphinum	-	-	-	-	-	-	P	-	-	-	-	-	-	-	-	-	-	-	-
Nucella lapillus	-	-	-	-	-	-	P	-	-	-	-	-	-	-	-	-	-	-	-
Buccinum undatum	-	-	-	-	-	-	-	P	-	-	P	-	-	-	-	-	-	-	-
Mytilus edulis	P	-	-	-	-	-	P	-	-	-	-	-	-	-	-	-	-	-	-
Aequipecten opercularis	-		-	-	-	P	P	P	-	-	-	-	-		-	-	-	-	-
Anomia ephippium	-	-	-	-	-	-	-	P	-	-	-	-	-	-	-	-	-	-	-
Mactridae	-	-	-	-	P	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bryozoa (Sea mats)																			
Bryozoa indet.	-	-	-	-	P	P	P	P	P	P	-	P	-	-	P	-	-	P	-
Crisia sp.	-	-	-	-	-	-	-	-	-	-	P	-	-	-	-	-	-	-	-
Alcyonidium sp.	-	-	-	-	-	-	-	-	-	-	P	-	-	-	-	-	-	-	-
Alcyonidium diaphanum	-	-	-	-	-	-	P	-	-	P	P	P	P	-	-	-	-	-	-
Alcyonidium parasiticum	-	-	-	-	-	-	-	-	-	-	P	-	-	-	-	-	-	-	-
Vesicularia spinosa	-	-	-	P	-	-	-	-	-	P	P	P	-	-	-	-	-	-	-
Eucratea loricata	-	-	-	-	-	-	-	-	-	-	P	P	-		-	-	-	P	-

(Contd.)	Dredging stations – D																		
Taxanomic group	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**
Flustra foliacea	P	-	P	P	-	-	P	P	-	-	P	P	P	-	-	-	-	-	-
Echinodermata (Starfish and sea urchins)																			
Antedon bifida	-	-	-	-	-	-	P	-	-	-	-	-	-	-	-	-	-	-	-
Asterias rubens	-	-	-	-	-	-	P	-	-	-	P	P	-	-	-	-	-	-	-
Amphiura chiajei	-	-	-	-	-	-	-	-	-	-	-	P	-	-	-	-	-	-	-
Ophiura albida	-	-	-	-	-	P	-	-	-	-	-	-	-	-	-	-	-	-	-
Ophiura ophiura	-		-	-	-	-	-	-	-	-	-	P	-	-	-	-	-	-	-
Psammechinus miliaris	-	-	-	-	-	P	P	P	-	-	-	-	P	-	-	-	-	-	-
Tunicata (Sea squirts)																			
Tunicata indet.	P	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-
Ciona intestinalis	-	-	-	-	-	-	P	-	-	-	-	-	-	-	-	-	-	-	-
Ascidiella aspersa	-	-	-	-	-	-	P	-	-	-	-	-	-	-	-	-	-	-	-
Dendrodoa grossularia	-	-	-	-	-	P	P	-	-	-	-	-	-	-	-	-	-	-	-
Botryllus schlosseri	-	-	-	-	-	-	P	-	-	-	-	-	-	-	-	-	-	-	-
Osteichthyes (Fish)																			
Scyliorhinus canicula	-	-	-	-	-	P	-	-	-	-	-	-	-	-	-	-	-	-	-
Ammodytes tobianus	-	-	P	P	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rhodophycota (Red algae)																			
Plocamium cartilagineum	-	-	-	-	-	-	P	-	-	-	-	-	-	-	-	-	-	-	-
Phycodrys rubens	-	-	-	-	-	-	P	-	-	-	-	-	-	-	-	-	-	-	-
Polysiphonia elongata	-	-	-	-	-	-	P	-	-	-	-	-	-	-	-	-	-	-	-
No. of taxa	**6**	**0**	**2**	**4**	**5**	**16**	**31**	**15**	**6**	**8**	**16**	**16**	**10**	**0**	**5**	**2**	**2**	**5**	**0**
Biotope No.	**1/2**	**-**	**1/2**	**1**	**1/2**	**4**	**5/6**	**2**	**1/2**	**1/2**	**9**	**3**	**1/2**	**1**	**1/2**	**1**	**1**	**1**	**-**
Dredge time - minutes	**5**	**1**	**2**	**4**	**2**	**3**	**4**	**5**	**2**	**3**	**3**	**3**	**4**	**2**	**8**	**2**	**1**	**3**	**2**

Table 1.2c: List of species or higher taxa recorded from each site, April 2001. The list is arranged in taxonomic order. P = present.

	Dredging stations - D														
Taxanomic group	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
Porifera (Sponges)															
Porifera indet.	-	P	-	-	-	-	-	-	-	-	P	-	-	-	-
Anthozoa (Sea anemones)															
Alcyonium digitatum	-	-	-	-	-	P	-	-	-	-	-	P	-	-	-
Urticina sp.	-	-	-	-	-	-	-	-	-	-	P	P	P	-	-
Hydractinia echinata	-	-	-	P	-	-	-	-	-	-	-	-	-	-	-
Hydrozoa (Hydroids/sea firs)															
Tubularia larynx	-	P	-	-	-	-	-	P	-	-	-	-	-	-	-
Nemertesia antennina	-	-	-	-	-	P	-	-	-	-	P	-	P	-	-
Nemertesia ramosa	-	-	-	-	-	-	-	-	-	-	-	-	P	-	-
Abietinaria abietina	-	P	-	-	-	P	P	P	P	-	P	-	P	-	-
Hydrallmania falcata	P	P	-	-	-	P	P	P	P	-	P	P	P	P	-
Sertularia argentea	-	-	-	-	-	-	-	-	P	-	-	-	-	-	-
Sertularia cupressina	-	-	-	-	-	-	-	-	-	-	-	P	-	-	-
Tamarisca tamarisca	-	-	-	-	-	P	-	-	-	-	-	-	-	-	-
Laomedea flexusoa	-	-	-	-	-	-	-	-	-	-	-	P	-	-	-
Polychaeta (Worms)															
Polychaeta indet.	P	-	-	-	-	P	P	P	-	-	-	-	-	-	-
Terebellidae indet.	-	P	-	-	-	-	-	-	-	-	-	-	-	-	-
Aphrodita aculeata	-	-	-	-	-	P	-	-	-	-	P	-	-	-	-
Sabellaria sp.	-	-	-	-	-	-	-	-	-	-	-	-	P	-	-
Sabellaria spinulosa	-	-	-	-	-	-	-	-	-	P	P	-	-	-	-
Sabellaria alveolata	-	-	-	-	-	-	-	-	-	-	P	-	-	-	-
Nepthys hombergi	-	-	-	-	-	-	-	P	-	-	-	-	-	-	-
Pomatoceros triqueter	-	P	-	-	P	P	-	P	P	P	P	-	P	-	-
Crustacea (Crabs, barnacles and amphipods)															
Balanus crenatus	-	P	-	-	-	P	-	-	P	P	-	-	P	-	-
Palaemon sp.	-	-	-	-	-	-	P	-	-	-	-	-	-	-	-
Pandalus montagui	-	-	-	-	-	-	-	-	-	-	P	-	-	-	-
Crangon crangon	-	P	-	P	-	-	-	-	-	-	P	-	-	-	-
Pagurus bernhardus	-	P	-	P	P	P	P	P	P	-	P	-	-	-	-
Macropodia sp.	-	-	-	-	-	-	-	P	-	-	-	-	-	-	-
Macropodia rostrata	-	-	-	-	-	P	-	-	-	-	-	-	-	-	-
Macropodia linaresi	-	-	-	-	-	-	-	P	-	-	P	-	-	-	-
Carcinus maenas	-	P	-	-	-	-	-	P	-	-	P	-	-	-	-
Portumnus latipes	-	-	-	P	-	-	-	-	-	-	-	-	-	-	-
Hyas coarctatus	-	P	-	-	-	P	P	P	-	-	P	-	-	-	-
Xantho incisus	-	-	-	-	-	-	-	P	-	-	-	-	-	-	-
Monodaeus couchi	-	-	-	-	-	P	-	-	-	-	-	-	-	-	-
Maja squinado	-	-	-	-	-	-	-	-	-	-	-	P	-	-	-
Mollusca (Snails and bivalves)															
Calliostoma zizyphinum	-	P	-	-	-	P	-	-	-	-	-	-	-	-	-
Buccinum undatum	-	P	-	-	P	P	-	-	-	-	P	P	P	-	-
Neptunea antiqua	-	-	-	-	P	-	-	-	-	-	-	-	-	-	-
Chamelea gallina	-	-	-	-	-	-	-	-	-	-	P	-	-	-	-
Nucula sp.	-	P	-	-	-	-	-	-	-	-	-	-	-	-	-
Ensis sp.	-	-	-	-	-	-	-	-	-	-	P	-	-	-	-
Aequipecten opercularis	-	-	-	-	-	P	P	-	-	-	-	-	-	-	-
Polyplacophora *indet.*	-	P	-	-	-	-	P	-	-	-	-	-	-	-	-
Bryozoa (Sea mats)															
Bryozoa indet.	-	P	-	-	-	P	-	P	P	-	P	P	-	-	-
Alcyonidium sp.	-	-	-	-	-	-	-	-	-	-	-	P	-	-	-

	Dredging stations - D														
Taxanomic group	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
Alcyonidium diaphanum	-	-	-	-	-	-	-	-	-	-	P	-	-	-	-
Alcyonidium parasitica	-	-	-	-	-	-	-	-	-	-	-	P	-	-	-
Flustra foliacea	-	P	P	-	-	P	P	P	P	P	P	P	P	-	-
Cellaria sinuosa	-	-	-	-	-	-	-	-	-	-	P	-	-	-	-
Vesicularia spinosa	-	-	-	-	-	-	-	-	-	-	P	P	-	-	-
Eucratea loricata	-	-	-	-	-	-	-	-	-	-	-	P	-	-	-
Echinodermata (Starfish and sea urchins)															
Asterias rubens	-	-	-	-	-	P	P	P	-	P	-	P	P	-	-
Astropecten irregularis	-	P	-	-	-	-	-	-	-	-	-	-	-	-	-
Crossaster papposus	-	P	-	-	-	-	P	-	-	-	-	-	-	-	-
Henricia oculata	-	P	-	-	-	-	P	-	-	-	-	-	-	-	-
Ophiothrix fragilis	-	-	-	-	-	-	-	-	-	-	P	-	-	-	-
Ophiura albida	-	-	-	-	-	P	-	-	-	-	-	P	-	-	-
Ophiura ophiura	-	-	-	-	-	-	-	-	-	-	-	P	-	-	-
Psammechinus miliaris	-	P	-	-	-	P	P	P	-	-	P	-	P	-	-
Tunicata (Sea squirts)															
Tunicata indet.	-	P	-	-	-	-	-	-	-	P	P	-	-	-	-
Dendrodoa grossularia	-	-	-	-	-	-	P	-	-	-	-	-	-	-	-
Osteichthyes (Fish)															
Agonus cataphractus	-	-	-	-	-	-	-	-	-	-	-	P	-	-	-
Ammodytes tobianus	-	-	-	-	P	-	-	-	-	-	-	-	-	P	-
Rhodophycota (Red algae)															
Plocamium cartilagineum	-	P	-	-	-	-	-	-	-	-	-	-	-	-	-
No. of taxa	**2**	**23**	**1**	**4**	**5**	**21**	**14**	**16**	**8**	**6**	**26**	**17**	**12**	**2**	**0**
Biotope No.	**2**	**9**	**1**	**1**	**1**	**9**	**9**	**2**	**2**	**5**	**5**	**8**	**2**	**1**	**-**
Dredge time – minutes	**4**	**5**	**3**	**3**	**4**	**3**	**4**	**4**	**3**	**3**	**3**	**4**	**2**	**1**	**1**

APPENDIX 2. FISH

Table 2.1a: Location and duration of fish trawls, June 2000. The positions given are Irish National Grid references.

Site	Date d/m/y	Location	Position (Start)	Position (End)	Duration (min.)	Distance (km)
T1	14/06/00	South of Arklow Bank	335539 158968	336542 155785	40	3.33
T2	14/06/00	West of Arklow Bank	341448 173388	341621 174414	20	1.04
T3	09/06/00	East of Arklow Bank	331139 172356	329280 171193	35	2.19
T4	09/06/00	Along proposed cable route	334673 173492	334556 174899	43	1.41

Table 2.1b: Location and duration of fish trawls, September 2000. The positions given are Irish National Grid references.

Site	Date d/m/y	Location	Position (Start)	Position (End)	Duration (min.)	Distance (km)
T1	12/09/00	South of Arklow Bank	330069 169373		30	1.08
T2	15/09/00	East of Arklow Bank	334015 158233	340177 185472	15	1.28
T3	12/09/00	West of Arklow Bank	341101 172724	340177 185472	34	1.45
T4	12/09/00	South of the proposed cable	340639 171529	339287 178408	34	2.48
T5	13/09/00	North of Arklow Bank	334316 173227	338812 175078	4	-
T6	14/09/00	North East of Arklow Bank	333840 171853	340765 182045	40	4.96

Table 2.1c: Location and duration of fish trawls, April 2001. The positions given are Irish National Grid references.

Site	Date d/m/y	Location	Position (Start)	Position (End)	Duration (min.)	Distance (km)
T1	19/04/01	South of Arklow Bank	334762 158215	334005 156685	32	1.7
T2	20/04/01	East of Arklow Bank	341208 171286	339992 167968	32	3.53
T3	20/04/01	West of Arklow Bank	331195 172382	330381 169686	44	2.81

Table 2.2a: List of fish species collected in the trawls, June 2000.

Site	Species	Common name	Abundance	Notes
T1	*Lophius piscatorius*	Monkfish	1	60 cm in length *Carcinus maenas* and *Asterias rubens* also collected
T2	*Raja clavata*	Thornback Ray	1	60 cm in length
T3	*Raja clavata*	Thornback Ray	7	3 male, 4 female
	Scyliorhinus canicula	Dogfish	2	1 male, 1 female
	Platichthys flesus	Flounder	1	20 cm in length *Asterias rubens* also collected
T4	*Scyliorhinus canicula*	Dogfish	1	1 female
	Raja clavata	Thornback Ray	5	5 female
	Raja naevus	Cuckoo Ray	1	1 female
	Pleuronectes platessa	Plaice	1	20 cm in length

Table 2.2b: List of fish species collected in the trawls, September 2000.

Site	Species	Common name	Abundance	Notes
T1	*Scyliorhinus canicula*	Dogfish	2	1 male 60 cm in length, 1 female 40 cm in length
	Pleuronectes platessa	Plaice	1	15 cm in length
T2	*Agonus cataphractus*	Pogge	2	5cm in length
T3	*Pleuronectes platessa*	Plaice	3	2 x 30 cm, 1 x 50 cm
	Limanda limanda	Dab	1	15 cm in length
T4	*Raja naevus*	Cuckoo Ray	1	female, 10 cm in length
	Agonus cataphractus	Pogge	2	5 cm in length
	Pleuronectes platessa	Plaice	2	30 cm in length
	Trisopterus minutus	Poor Cod	25	7 cm in length
	Gadus morhua	Cod	1	7 cm in length
T5	No fish species			
T6	*Callionymus lyra*	Dragonet	1	7 cm

Table 2.2c: List of fish species collected in the trawls, April 2001.

Site	Species	Common name	Abundance	Notes
T1	*Gadus morhua*	Cod	1	Juvenile 8cm in length
T2	*Ammodytes tobianus*	Sandeels	1	
	Trisopterus minutes	Poor Cod	2	8cm in length
T3	*Limanda limanda*	Dab	1	8cm in length

Table 2.3a: List of invertebrate and algae collected in the trawls, September 2000. P=present.

	Trawl sites						
Taxanomic group	**T1**	**T2**	**T3**	**T4**	**T5**	**T6**	**T7**
Porifera (Sponges)							
Porifera indet.	-	-	P	-	-	-	-
Hydrozoa (Hydroids/sea firs)							
Halecium halecinum	-	-	P	-	-	-	-
Nemertesia ramosa	-	-	P	-	-	-	-
Abietinaria abietina	P	P	P	P	P	-	P
Hydrallmania falcata	P	P	P	P	P	-	P
Sertularia argentea	P	-	P	-	P	-	P
Sertularia cupressina	P	-	-	-	-	-	-
Polychaeta (Worms)							
Aphrodita aculeata	-	-	-	P	-	-	-

	Trawl sites						
Taxanomic group	**T1**	**T2**	**T3**	**T4**	**T5**	**T6**	**T7**
Crustacea (Crabs, barnacles and amphipods)							
Balanus crenatus	-	P	-	-	-	-	-
Pagurus bernhardus	P	-	P	-	-	-	P
Hyas coarctatus	-	-	-	P	-	-	-
Macropodia rostrata	-	-	-	P	-	-	-
Carcinus maenas	-	-	-	-	P	-	-
Palaemon serratus	-	P	-	-	-	-	-
Crangon crangon	-	P	-	-	-	-	-
Crangon allmanni	-	-	-	P	-	-	-
Pandalus propinquus	-	-	-	P	-	-	-
Pandalus montagui	-	-	-	P	-	-	-
Mollusca (Snails and bivalves)							
Mytilus edulis	-	-	P	-	-	-	-
Aequipecten opercularis	-	P	-	-	-	-	P
Calliostoma zizyphinum	-	-	-	P	-	-	-
Onchidoris bilamellata	-	-	-	P	-	-	-
Sepiola atlantica	-	-	-	P	-	-	-
Bryozoa (Sea mats)							
Bryozoa indet.	P	-	P	P	-	-	P
Alcyonidium sp.	P	-	-	P	-	-	-
Alcyonidium diaphanum	-	-	P	-	-	-	-
Vesicularia spinosa	P	-	P	P	-	-	-
Eucratea loricata	P	-	P	P	-	-	-
Electra pilosa	-	-	-	-	P	-	-
Flustra foliacea	P	P	-	P	P	-	P
Scrupocellaria scrupea	P	-	-	-	-	-	-
Scrupocellaria scruposa	-	-	-	P	-	-	-
Sertularella gayi	-	-	P	-	-	-	-
Sertularella sp.	-	-	-	-	-	-	P
Bicellariella ciliata	-	-	P	-	-	-	-
Bugula sp.	-	-	-	P	-	-	-
Echinodermata (Starfish and sea urchins)							
Asterias rubens	P	-	-	P	-	-	P
Psammechinus miliaris	-	P	P	P	-	-	P
Crossaster papposus	P	-	P	P	-	-	-
Holothuria forskali	P	-	-	-	-	-	-
Tunicata (Sea squirts)							
Ascidella indet.	-	-	-	P	-	-	-
Botryllus schlosseri	-	-	P	P	-	-	P
Rhodophycota (Red weed)							
Polysiphonia elongata	P	-	P	-	-	-	-
Acrosorium reptans	P	-	P	-	-	-	-
Plocamium cartilagineum	P	-	P	P	-	-	-
Cryptopleura ramosa	-	-	P	P	-	-	-
Heterosiphonia plumosa	P	-	P	-	-	-	-
Chromophycota (Brown weed)							
Desmerestia sp.	P	-	-	-	-	-	-
Desmerestia aculeata	-	-	P	-	-	-	-
Dictyota dichotoma	P	-	P	-	P	-	-
Laminaria hyperborea	-	-	-	-	P	-	-
Laminaria saccharina	-	-	-	-	P	-	-
No. of taxa	**20**	**8**	**24**	**25**	**9**	**0**	**11**

Table 2.3b: List of invertebrate and algae collected in the trawls, April 2001. P=present.

	Trawl sites		
Taxanomic group	**T1**	**T2**	**T3**
Hydrozoa (Hydroids/sea firs)			
Hydrallmania falcata	P	P	-
Ctenophora indet.	P	-	-
Polychaeta (Worms)			
Aphrodita aculeata	P	-	-
Sabellaria spinulosa	-	P	-
Sabellaria alveolata	-	P	-
Crustacea (Crabs, barnacles and amphipods)			
Balanus crenatus	-	P	-
Pagurus bernhardus	-	P	-
Macropodia rostrata	-	-	P
Crangon crangon	P	P	P
Crangon allmanni	P	P	P
Pandalus montagui	P	-	-
Mollusca (Snails and bivalves)			
Buccinum undatum	-	P	P
Bryozoa (Sea mats)			
Flustra foliacea	-	P	P
Echinodermata (Starfish and sea urchins)			
Asterias rubens	P	P	-
Psammechinus miliaris	-	P	P
Crossaster papposus	P	P	-
No. of taxa	**8**	**11**	**6**

APPENDIX 3. PLANKTON

Table 3.1a: Locations, positions and times of plankton, temperature and salinity samples, June 2000. The positions given are Irish National Grid references.

Site	Date of survey	Location	Position	Time
P1	14/06/00	SE of Arklow Bank	339717 166286	17:24
P2	15/06/00	NE of Arklow Bank	341845 177890	13:05
P3	07/06/00	NW of Arklow Bank	337630 185396	11:49
P4	09/06/00	SW of Arklow Bank	335335 166700	16:40

Table 3.1b: Locations, positions and times of plankton, temperature and salinity samples, September 2000. The positions given are Irish National Grid references.

Site	Date of survey	Location	Position	Time
P1	15/09/00	SE of Arklow Bank	339654 165820	13:00
P2	13/09/00	NE of Arklow Bank	340626 176521	14:25
P3	13/09/00	NW of Arklow Bank	337432 185443	11:55
P4	12/09/00	SW of Arklow Bank	334986 165104	14:50

Table 3.1c: Locations, positions and times of phytoplankton, temperature and salinity samples, April 2001. The positions given are Irish National Grid references.

Site	Date of survey	Location	Position	Time
P1	20/04/01	SE of Arklow Bank	339760 166476	13:50
P2	22/04/01	NE of Arklow Bank	340513 174654	12:15
P3	21/04/01	NW of Arklow Bank	336608 182155	11:30
P4	20/04/01	SW of Arklow Bank	334785 164712	16:50

Table 3.1d: Locations, positions and times of zooplankton samples, April 2001. The positions given are Irish National Grid references.

Site	Date of survey	Location	Position (start)	Position (end)	Duration (min.)
Z1	20/04/01	SE of Arklow Bank	339768 166471	339406 165789	5
Z2	21/04/01	NW of Arklow Bank	336943 183307	336895 182879	5
Z3	19/04/01	SW of Arklow Bank	334672 164819	334623 164825	5

Table 3.2a: List of Zooplankton species recorded from each site, June 2000. P=present.

Site		Z1	Z2	Z3	Z4
Taxanomic group					
Protozoa					
Noctiluca scintillans		-	P	-	-
Cnidaria (Jellyfish)			-	-	-
Scyphozoa indet.		-	-	-	P
Ctenophora (Comb jelly)					-
Beroe cucumis		-	-	P	-
Polychaeta (Worms)					
Polychaeta larva		-	-	P	-
Polychaeta larva (segmented)		P	P	P	P
Polynoid larva		P	P	P	P
Magellonid larva		-	-	-	P
Chaetognata (Worms)					
Sagitta sp.		-	-	P	-
Crustacea (Crabs and amphipods)					
Nauplius larva		-	-	P	-
Amphipoda indet.		-	-	P	-
Caridea indet.		-	P	P	-
Copeopoda Calanoida		P	P	P	P
Cumacea indet.		-	-	P	P
Cancer pagurus	Zoea 1	-	-	-	P
Pagurus bernhardus	Zoea 1	-	-	P	-
Pisidia longicornis	Zoea 1	-	-	P	P
Porcellana plathychelles	Zoea 1	P	-	-	-
Xantho sp.	Zoea 1	-	P	P	P
Pycnogonida (Sea spiders)					
Nymphonidae indet.		-	-	P	-
Mollusca (Snails)					
Polyplacophora indet.		-	-	P	-
Echinodermata (starfish)					
Asteroidea larva		-	P	P	P
Appendicularia					
Appendicularia indet.		-	P	-	P
No. of taxa		**4**	**8**	**16**	**11**

Table 3.2b: List of Zooplankton species recorded from each site, September 2000. Numbers refer to raw counts of total sample volume.

Site Taxanomic group	Z1A	Z1B	Z2A	Z2B	Z3A	Z3B	Z4A	Z4B
Protozoa								
Foraminifera indet.	5	3	-	1	3	4	5	2
Cnidaria (Jellyfish)								
Phialidium sp. (Scyphozoa)	1	0	-	0	2	3	1	0
Polychaeta (Worms)								
Spionid (larvae)	0	0	-	2	4	3	0	2
Chaetognata (Worms)								
Sagitta sp. (larvae)	0	0	-	3	3	0	0	0
Crustacea (Crabs, barnacles and amphipods)								
Barnacle Nauplius (Cirripedia)	2	0	-	0	0	0	0	0
Temora longicornis (Copeopoda Calanoida) %	38.6	56.2	-	33.1	40.3	51.6	46.3	44.7
Centropages hamatus (Copeopoda Calanoida) %	53.7	36.8	-	55.7	51.2	33.9	41.2	49.1
Para-Pseudocalanus sp. (Copeopoda Calanoida) %	1.5	2.1	-	1.7	2.3	3.2	3.4	1.8
Acartia clausii (Copeopoda Calanoida) %	0	1.2	-	0	0	0	1.1	0
Oithona sp. (Copeopoda Ciclopoida) %	3.5	2.4	-	4.2	4.1	4.8	2.3	3.4
Euterpina acutifrons (Copeopoda Harpacticoida) %	2.7	1.3	-	5.3	2.1	6.5	5.7	1
Total Copeopods	584	815	-	1543	972	667	571	995
Cancer pagurus (Crab Zoea)	1	2	-	1	1	0	0	0
Ebalia tuberosa (Crab Zoea)	0	0	-	1	0	0	0	0
Pagurus bernhardus	0	2	-	1	0	3	0	1
Pisidia longicornis (Crab Zoea)	1	0	-	0	0	0	1	0
Porcellana plathycheles (Crab Zoea)	0	0	-	0	1	0	0	0
Caridea indet.	1	2	-	1	5	0	0	0
Mollusca (Snails and bivalves)								
Bivalve (veliger larva)	6	3	-	0	0	2	4	3
Bryozoa (Sea mats)								
Cyphonautes larvae indet.	2	1	-	4	2	3	1	0
Pycnogonida (Sea spiders)								
Nymphonidae indet.	0	0	-	0	0	0	1	0
Echinodermata (Starfish)								
Ophiotrix sp. (Brittlestar, Pluteus larva)	0	0	-	0	0	0	1	0
Appendicularia								
Oikopleura sp.	3	7	-	5	3	2	4	6
Cumacea indet.	0	1	-	1	0	0	0	0
No. of taxa	**14**	**14**	**0**	**15**	**14**	**12**	**14**	**10**

Table 3.2c: List of Zooplankton species recorded from each site, April 2001. Figures represent percentage species composition.

Site	Z1A	Z1B	Z2A	Z2B	Z3A	Z3B
Taxanomic group						
Cnidaria (Jellyfish)						
Phialidium sp. (Scyphozoa)	1	-	-	-	-	-
Polychaeta (Worms)						
Spionid (larvae)	7	3	4	3	11	8
Crustacea (Worms)						
Barnacle Nauplius (Cirripedia)	5	3	21	20	31	17
Calanus helgolandicus/finmarchicus	1	1	-	-	-	-
Temora longicornis	8	4	20	21	5	9
Centropages hamatus	11	19	8	17	41	54
Para-Pseudocalanus sp.	12	14	13	5	3	1
Acartia clausii	3	2	7	9	4	4
Oithona sp.	-	1	2	2	-	-
Cancer pagurus (Crab Zoea)	3	1	-	2	1	2
Pagurus bernhardus	1	1	-	-	-	2
Porcellana plathycheles (Crab Zoea)	1	-	-	-	-	-
Bryozoa (Sea mats)						
Cyphonautes larvae (indet.)	42	46	21	17	2	2
Echinodermata (Starfish)						
Ophiothrix sp. (Brittlestar, Pluteus larva)	1	1	-	1	-	-
Appendicularia						
Oikopleura sp.	1	1	4	-	-	-
Fish eggs	2	2	1	2	2	2
Invertebrate eggs	1	1		1	-	-
Total	**100**	**100**	**100**	**100**	**100**	**100**

Table 3.3a: List of phytoplankton species recorded from each site, June 2000. P=present.

Site Taxanomic group	P1	P2	P3	P4
Bacillaria paradoxa	-	P	-	-
Ceratium longipes	-	-	P	-
Cyst	-	P	-	-
Guinardia flaccida	P	P	P	P
Leptocylindrus danicus	-	P	-	-
N. delictissima	P	P	-	-
Nitzschia sp.	P	P	-	-
Noctiluca scintillans	-	P	-	-
Protoperidinium sp.	-	P	-	-
R. alata	P	P	P	-
R. setigera	-	P	-	-
Rhizosolenia shrubsolei	P	P	P	P
No. of taxa	**5**	**11**	**4**	**2**

Table 3.3b: List of phytoplankton species recorded from each site, September 2000. P=present.

Site Taxanomic group	P1	P2	P3	P4
Bacillaria paradoxa	-	P	-	-
Ceratium furca	P	P	P	P
Ceratium fusus	-	-	P	-
Ceratium longipes	-	P	-	-
Chaetoceros danicus	P	P	P	P
Coscinodiscus radiatus	P	P	-	-
Guinardia delicaula	P	P	P	P
Guinardia flaccida	P	P	P	P
Guinardia striata	-	-	-	P
Leptocylindrus danicus	-	P	-	-
Noctiluca scintillans	-	-	P	-
Odontella sinensis	-	P	-	-
Paralia sulcata	P	P	P	P
Prorocentrum micans	P	P	P	P
Protoperidinium sp.	-	P	-	-
R. setigera	-	P	-	-
Rhizosolenia robusta	-	-	P	-
Rhizosolenia shrubsolei	P	P	P	P
Thalassionema nitzschioides	-	-	-	P
No. of taxa	**8**	**14**	**9**	**10**

Table 3.3c: List of phytoplankton species recorded from each site, April 2001. P=present.

Site Taxanomic group	P1	P2	P3	P4
A. glacialis	-	-	-	P
Actinoptychus senarius	P	P	P	P
Asterionellopsis kariana	-	P	-	P
Bacillaria paradoxa	P	P	P	P
Chaetoceros danicus	-	-	P	-
Coscinodiscus sp.	P	P	P	P
Odontella sinensis	P		P	P
Paralia sulcata	P	P	P	P
Pseudonitzschia sp.	-	-	P	-
No. of taxa	**5**	**5**	**7**	**7**

APPENDIX 4. TEMPERATURE AND SALINITY

Table 4.1a: Temperature and salinity measurements from the plankton sampling sites, June 2000.

Site	P1		P2		P3		P4	
Depth m. BSL	Temp. °C	Salinity ppt.	Temp. °C	Salinity ppt.	Temp. °C	Salinity ppt.	Temp. °C	Salinity ppt.
0	12.6	33.6	12.9	33.4	12.2	33.6	12.0	33.7
5	12.6	33.6	12.9	33.4	12.0	33.6	12.2	33.6
10	12.5	33.6	12.9	33.5	12.3	33.5	12.4	33.4
15	12.4	33.6	13.0	33.6	12.3	33.5	11.9	33.7
20	12.6	33.6	12.8	33.5	12.5	33.4	11.8	33.8

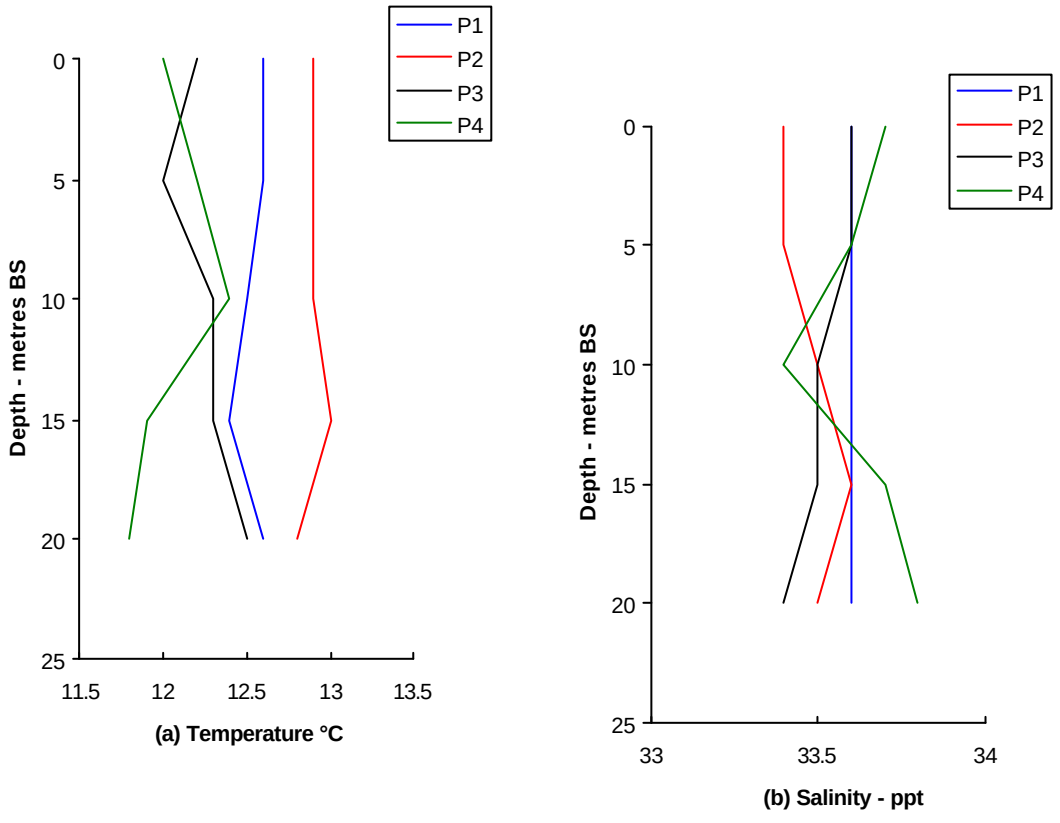

Figure 4.1: Depth profiles for (a) temperature and (b) salinity at the four plankton sample sites, June 2000.

Table 4.1b: Temperature and salinity measurements from the plankton sampling sites, September 2000.

Site	P1		P2		P3		P4	
Depth m. BSL	Temp. °C	Salinity ppt.	Temp. °C	Salinity ppt.	Temp. °C	Salinity ppt.	Temp. °C	Salinity ppt.
0	16	34.1	16	34.1	16	34.3	16	34.1
5	16	34.1	16	34.1	16	34.1	16	34.0
10	16	34.0	16	34.1	16	34.1	16	33.9
15	16	34.0	16	34.0	16	34.1	15	34.0
20	16	34.1	16	34.1	16.5	34.1	16	34.0

Table 4.1c: Temperature and salinity measurements from the plankton sampling sites, April 2001.

Site	P1	P2	P3	P4
Depth m. BSL	Temp. °C	Temp. °C	Temp. °C	Temp. °C
0	8.5	8.1	8.6	8.5
5	8.3	8.2	8.4	8.4
10	8.3	8.3	8.4	8.2
15	8.2	8.3	8.4	8.4
20	8.2	8.3	8.5	8.2

APPENDIX 5. MAPS

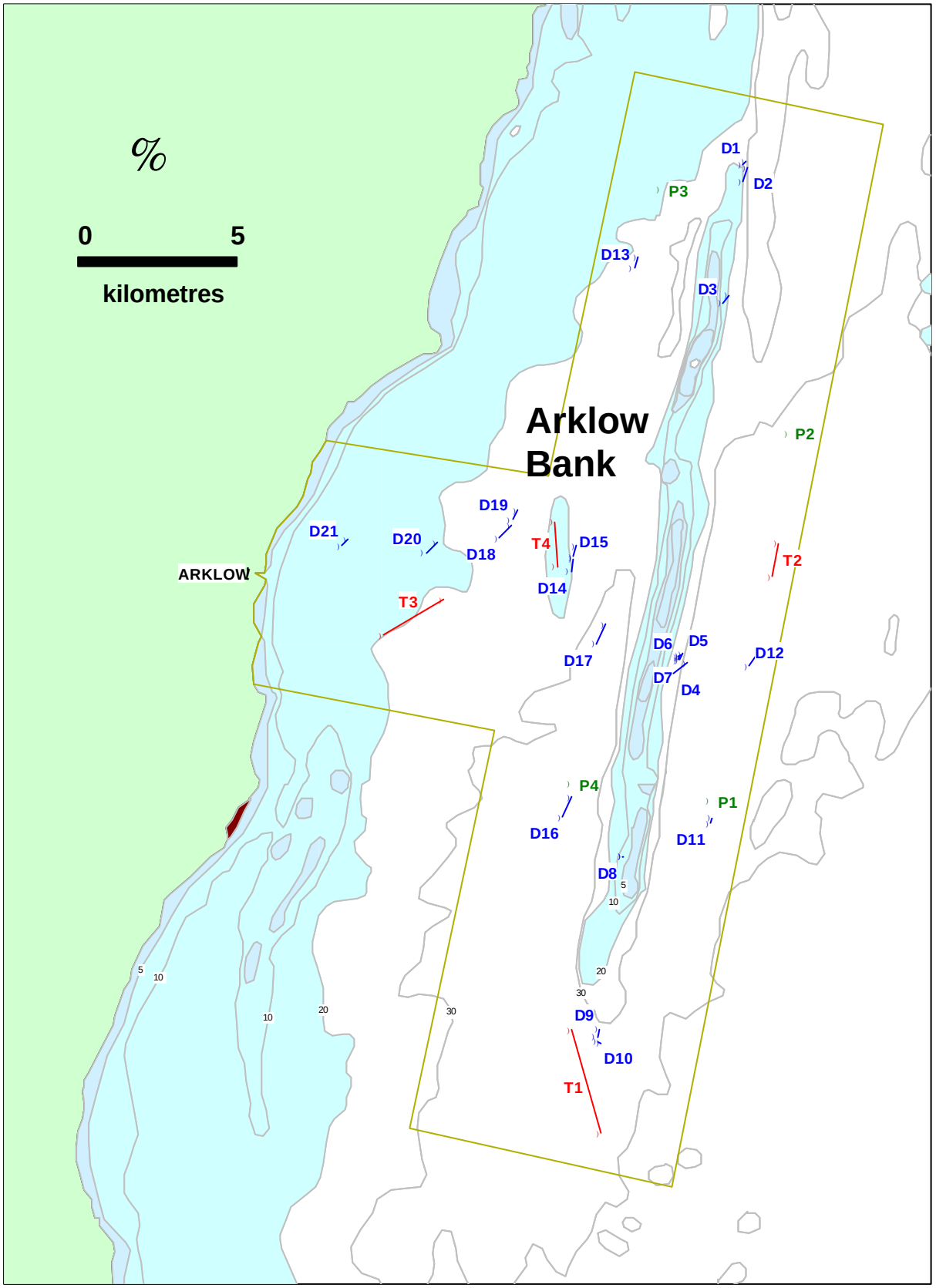

Figure 5.1. Map showing the locations of the June 2000 survey dredge sampling stations (D1-D21 in blue), fish trawls (T1-T4 in red) and plankton sampling sites (P1-P4 in green) in and around the Arklow Bank. The box indicates the study area. The areas in blue show the 5 and 10 m contours.

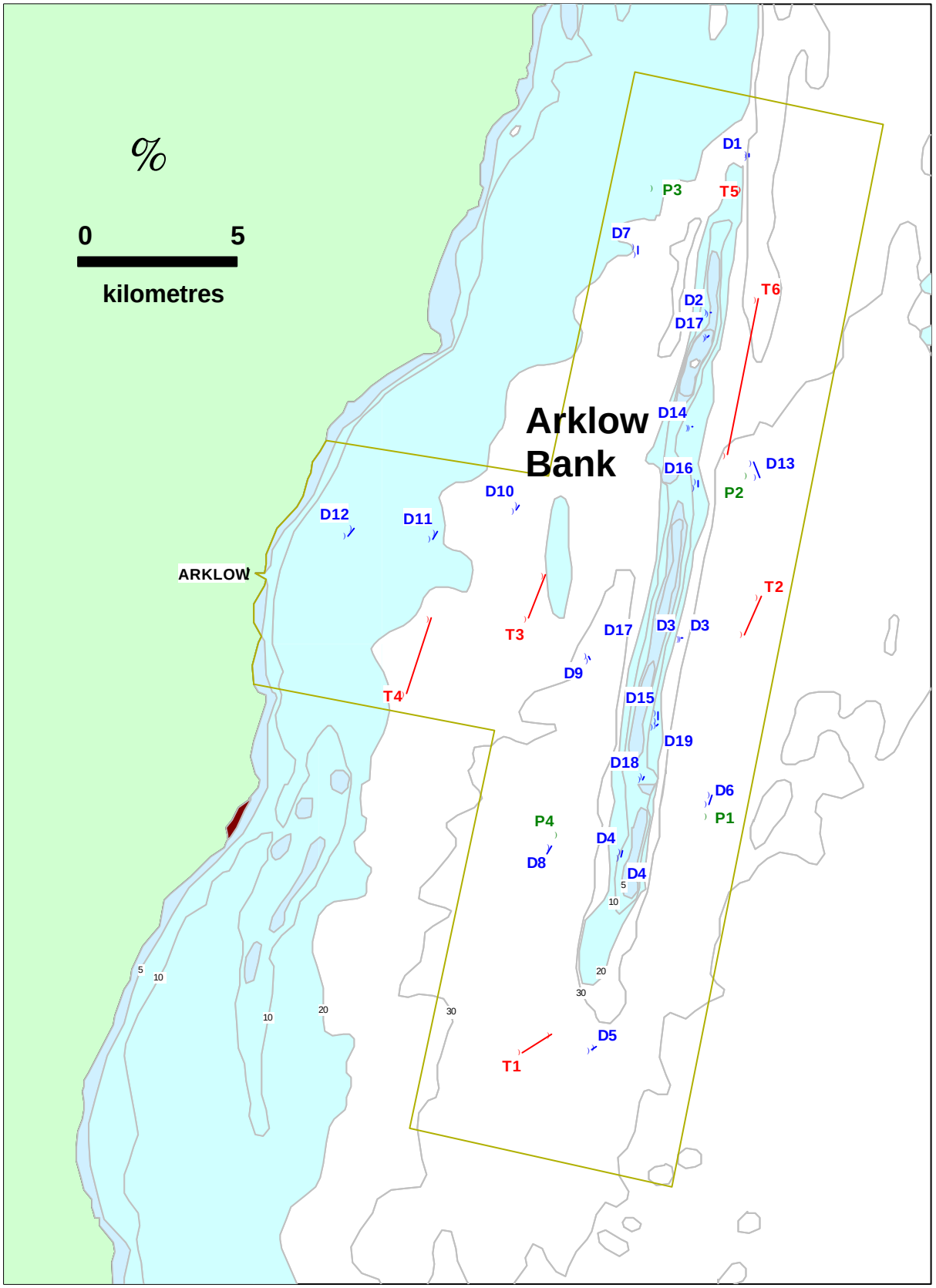

Figure 5.2. Map showing the locations of the September 2000 survey dredge sampling stations (D1-D19 in blue), fish trawls (T1-T6 in red) and plankton sampling sites (P1-P4 in green) in and around the Arklow Bank. The box indicates the study area. The areas in blue show the 5 to 20 m contours.

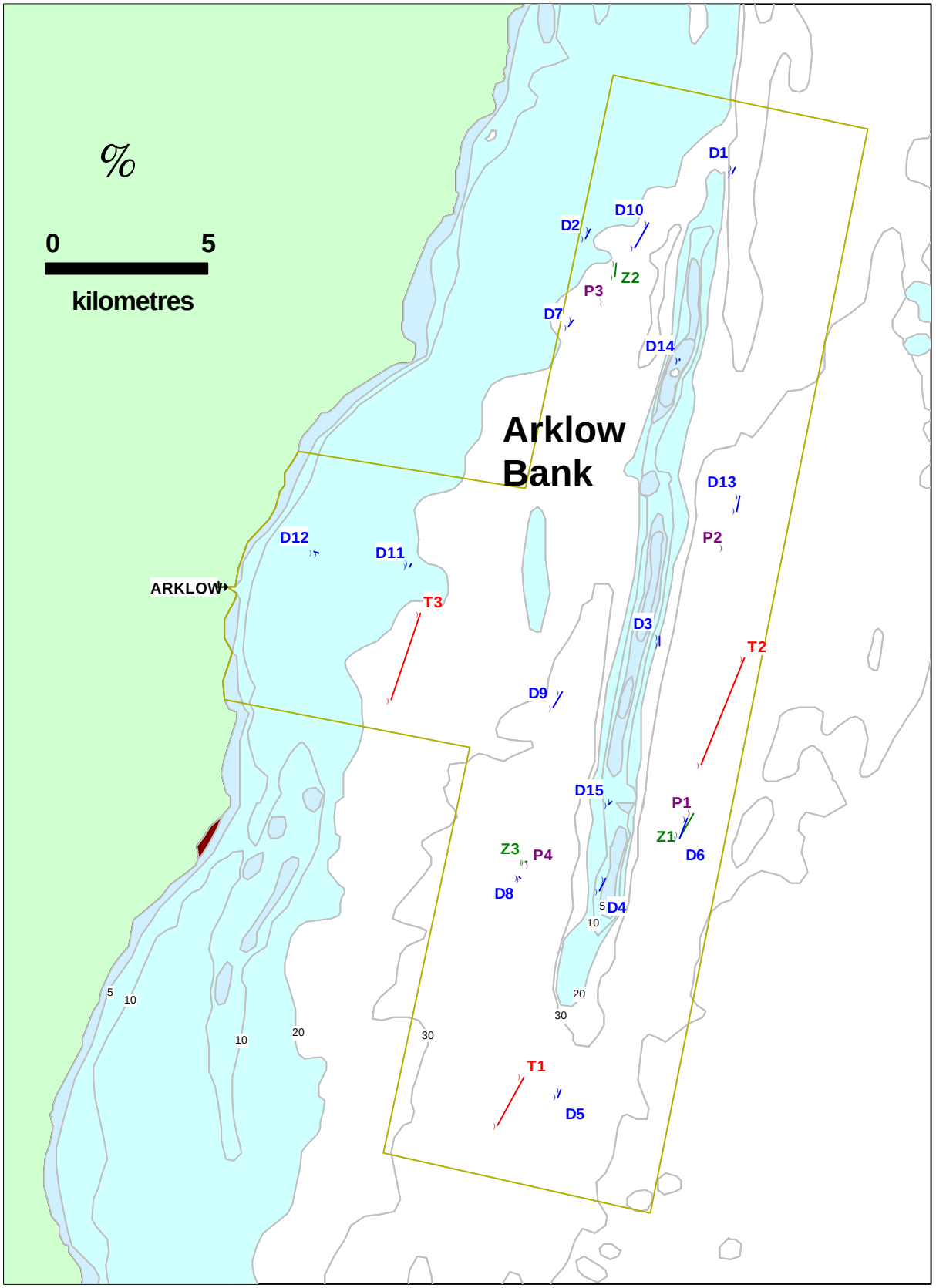

Figure 5.3. Map showing the locations of the April 2001 survey dredge sampling stations (D1-D15 in blue), fish trawls (T1-T3 in red), zooplankton sampling sites (Z1-Z3 in green) and phytoplankton sampling sites (P1-P4 in purple) in and around the Arklow Bank. The box indicates the study area. The areas in blue show the 5 to 20 m contours.

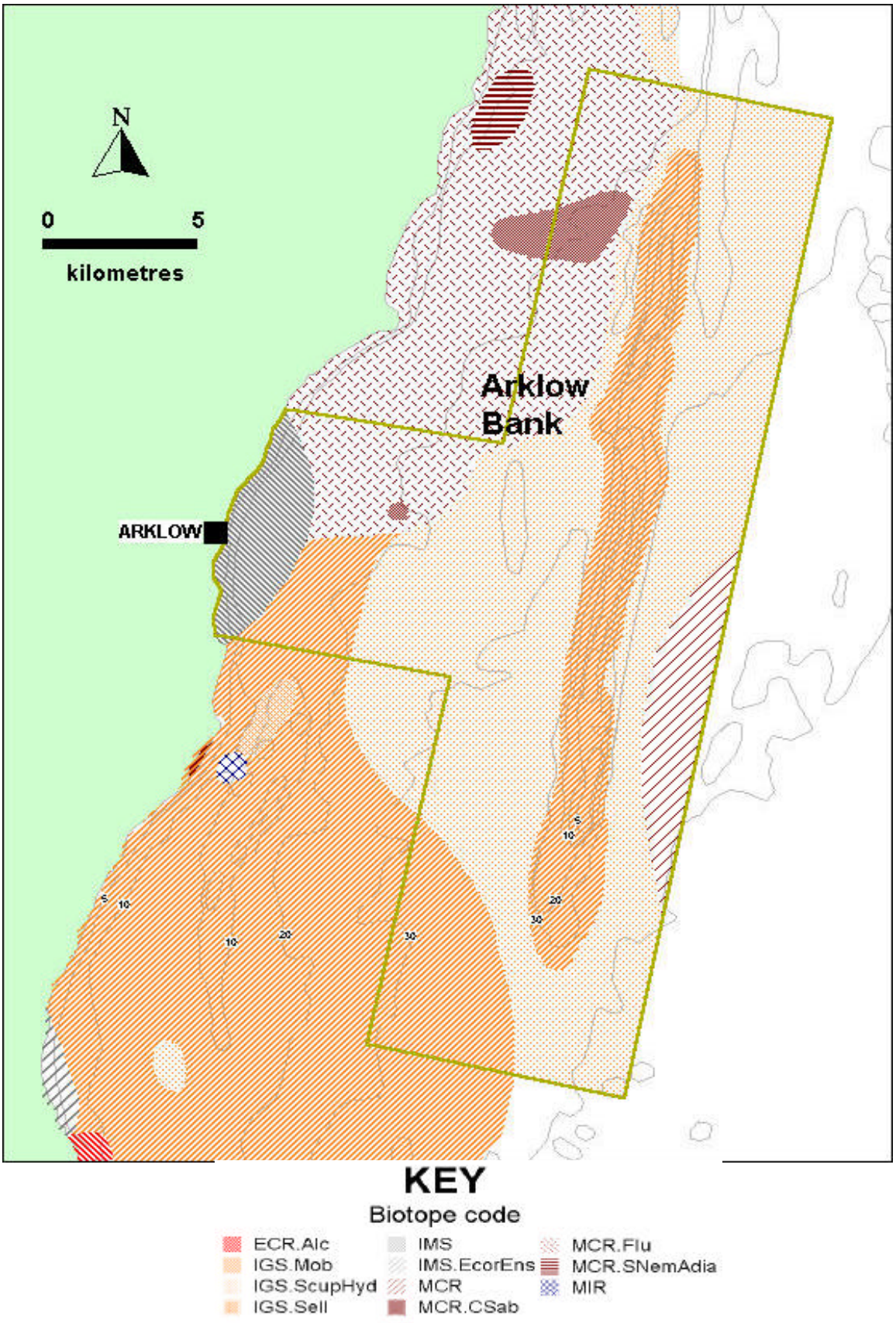

Figure 5.4. Map showing the main biotopes of the Arklow Bank and surrounding area derived from the dredge samples and data from the SensMap survey (Ecological Consultancy Services Ltd, EcoServe 2001).

APPENDIX 6. BIOTOPE DESCRIPTIONS

Biotope list. Biotope descriptions from (Connor *et al*. 1997).

No.	Biotope
Biotopes recorded during this survey	
1	IGS.Mob
2	IGS.ScupHyd
3	IMS
4	MCR
5	MCR.Csab
6	MCR.MolPol.Sab
7	MCR.Flu
8	MCR.Flu.HbyS
9	MCR.Flu.SerHyd
Biotopes recorded during SensMap survey	
10	MIR
11	MCR.SnemAdia
12	IGS.Sell
13	IMS.EcorEns
14	ECR.Alc

No. 1 IGS.Mob Sparse fauna in infralittoral mobile clean sand

Biotope description

Coarse sandy sediment in shallow water, often duned, on exposed or tide-swept coasts often contains very little infauna due to the mobility of the substratum. Some opportunistic populations of infaunal amphipods may occur, particularly in less mobile examples. Sand eels *Ammodytes* sp. may occasionally be observed in association with this biotope (and others). This biotope is more mobile than IGS.NcirBat and may be closely related to LGS.BarSnd on the shore. Common epifaunal species such as *Pagurus bernhardus*, *Liocarcinus depurator*, *Carcinus maenas* and *Asterias rubens* may be encountered and are the most conspicuous species present. A similar biotope, IGS.MobRS, occurs in reduced salinities but differs in that the sparse fauna of IGS.Mob are not tolerant of reduced salinities.

No. 2 IGS.ScupHyd *Sertularia cupressina* and *Hydrallmania falcata* on tide-swept sublittoral cobbles or pebbles in coarse sand

Biotope description

Shallow sands with cobbles and pebbles, exposed to strong tidal streams, with conspicuous colonies of hydroids, particularly *Sertularia cupressina* and *Hydrallmania falcata.* These hydroids are tolerant to periodic submergence and scour by sand. Both diving and dredge surveys will easily record this biotope. *Flustra foliacea* and *Alcyonidium diaphanum* may also occur on the more stable cobbles and pebbles, whereas *Lagis koreni* is often a common component of the infaunal sand community. The less scoured biotope MCR.Flu.SerHyd occurs where there is less sand. Infaunal elements of the 'Venus' associations may occur in this biotope; indeed, this biotope may be at one extreme of the spectrum of such associations (E.I.S. Rees pers. comm. 1997).

No. 3 IMS Infralittoral muddy sands

Biotope description

Muddy sand habitats in the infralittoral zone, extending from the extreme lower shore down to more stable circalittoral zone at about 15-20 m. The habitat supports a variety of animal-dominated communities, particularly of polychaetes, bivalves and the urchin *Echinocardium cordatum*, but also includes beds of seagrass (IMS.Sgr).

No. 4 MCR Moderately exposed circalittoral rock

Biotope description

Circalittoral rock subject to moderate wave exposure or some degree of tidal currents in more sheltered conditions. Such habitats occur very widely around the coast and are highly variable in their character, depending on quite subtle differences in water quality (e.g. the degree of suspended silt or sand), tidal current strength, rock topography and rock type. A wide range of biotopes are currently defined, but these may require expansion to fully account for all parts of Britain and Ireland.

No. 5 MCR.MolPol.Sab Dense ascidians, bryozoans and hydroids on a crust of *Sabellaria spinulosa* on tide-swept circalittoral rock

Biotope description

Tide-swept rock in areas with high levels of suspended sand with a *Sabellaria spinulosa* crust which supports a wide variety of other species. A dense carpet of ascidians *Molgula manhattensis*, *Polycarpa* spp. and *Polyclinum aurantium*, a turf of bryozoans (*Cellaria sinuosa*, *Bugula plumosa* and *Flustra foliacea*) and sponges such as *Scypha ciliata* and *Polymastia* spp., bryozoans *Alcyonidium diaphanum* and *Scrupocellaria* sp. and *Antedon bifida* may also be present. In some cases this biotope occurs adjacent to MolPol although in deeper water and more tide-swept (scour/turbulent) conditions.

No. 6 MCRCSab Circalittoral *Sabellaria* reefs

Biotope description

Circalittoral rock or mixed substrata dominated by a crust of *sabellaria spinulosa.*

No. 7 MCR.Flu *Flustra foliacea* and other hydroid/bryozoan turf species on slightly scoured circalittoral rock or mixed substrata

Biotope description

A widespread biotope which has been split into several related entities. The biotope is characterised by silt- and scour-tolerant species which occur in varying proportions around the country, but *Flustra foliacea* tends to dominate. This biotope is characteristic of silty rocky habitats, tending to be moderately exposed to wave action and with a moderate tidal flow which create the slight scour conditions (compared to silted rocky habitats in sheltered conditions). The species associated with and therefore characterising the different *Flustra* biotopes vary from region to region, ranging from the relatively low species-rich Flu.Flu found on North Sea coasts to the similar but far richer biotopes with sponges and hydroids on the west of Britain and Irish Sea coasts (Flu.HByS). There are also several other related biotopes: these include the *Urticina* (Urt.Urt) and *Ciocalypta* (Urt.Cio) biotopes which occur at rock-sediment interfaces; ascidian-dominated biotopes with *Flustra* (StoPaur) and several other biotopes characterised by other slight scour-tolerant or turbid-water species such as *Sabellaria spinulosa* which include *Flustra* (Sspi and MolPol.Sab) and *Alcyonidium diaphanum* (SNemAdia). Only use this biotope if records do not fit into other categories.

No. 8 MCR.Flu.HbyS *Flustra foliacea* with hydroids, bryozoans and sponges on slightly tide-swept circalittoral mixed substrata

Biotope description

Often dense *Flustra foliacea* with a variety of slightly scour/silt-tolerant species forming a dense turf on bedrock, boulders, cobbles and mixtures of sediment. This biotopes does not include the ascidians found in the silty biotope StoPaur although it can have similar suite of 'ubiquitous' species and the more scour-tolerant ascidian *Polyclinum aurantium*. Other species can include *Alcyonidium diaphanum* (see SNemAdia which has more hydroids and less *Flustra*), various robust hydroids such as *Abietinaria abietina* and *Nemertesia antennina* and sponges such as *Dysidea fragilis*, *Polymastia boletiformis* and *Cliona celata.* Has been recorded adjacent to exposed circalittoral rock communities with dense *Corynactis viridis*, although the data has not always been recorded separately. *Securiflustra securifrons* often occurs in this biotope.

Similar biotopes

MCR.Flu See other *Flustra*-dominated biotopes

No. 9 MCR.Flu.SerHyd *Sertularia argentea, S. cupressina* and *Hydrallmania falcata* on tide-swept circalittoral cobbles and pebbles

Biotope description

Circalittoral cobbles and pebbles amongst clean sand or shell gravel in strong tides were covered in hydroids over *Balanus crenatus*. *Sabella pavonina* and *Lanice conchilega* were often common in the coarse sediment around the stones. With increased scouring *S. cupressina* becomes more common (see ScupHyd) although eventually, as tidal stream strength increases to a point at which the stones are kept mobile, all hydroids are scoured off leaving just *Pomatoceros*, bryozoan crusts, *Balanus crenatus* and coralline algae (PomByC).

No. 10 MIR Moderately exposed infralittoral rock

Biotope description

Infralittoral rock subject to moderate wave exposure, or moderately strong tidal streams on more sheltered coasts. On bedrock and stable boulders there is typically a narrow band of kelp *Laminaria digitata* in the sublittoral fringe which lies above a *Laminaria hyperborea* forest and park. Associated with the kelp are communities of seaweeds, predominently reds and including a greater variety of more delicate filamentous types than found on more exposed coasts (EIR.KFaR). In some areas the rock is subject to intense grazing by urchins and may be devoid of erect seaweeds (MIR.GzK). In areas where rock lies near sediment or is less stable (as in winter storms) different communities develop (MIR.SedK). In particular the kelp *Laminaria saccharina* or sea oak *Halidrys siliquosa* may dominate or the habitat may include more robust scour-tolerant species such as *Polyides rotundus* and *Furcellaria lumbricalis* (MIR.PolAhn).

No.11 MCR.SNemAdia Sparse sponges, *Nemertesia* spp., *Alcyonidium diaphanum* and *Bowerbankia* spp. on circalittoral mixed substrata

Biotope description

Mixed substrata of cobbles and coarse silty sediment with occasional boulders and small outcrops of bedrock. A variety of small sponges including erect sponges and fast growing cushions such as *Esperiopsis fucorum,* ephemeral and robust hydroids and bryozoans tolerant of some silt such as *Nemertesia* spp., *Cellaria* spp., *Bugula* spp., *Bowerbankia* spp. and sparse *Flustra*. There are also some records with *Epizoanthus couchii* and *Isozoanthus sulcatus*. This biotope sits somewhere between the *Polymastia* and erect sponge biotope (ErSPbolSH) which occurs on fairly stable substrata and the ephemeral hydroids biotope Flu.SerHyd which cannot develop further presumably because of periodic disturbance from wave and/or tide-scouring action. It therefore has a mixture of scour-tolerant species, ephemeral species and a few 'stable' substratum species on the larger or more consolidated rocks and boulders. Large areas of cobbly seabed in open but moderately exposed bays (e.g. Cardigan Bay) may comprise this biotope.

No.12 IGS.Sell *Spisula elliptica* and venerid bivalves in infralittoral clean sand or shell gravel

Biotope description

Coarse, loose sands subject to moderately strong water movement and containing *Chamelea gallina* may be characterised by a prevalence of *Spisula elliptica*. IGS.Sell differs from IGS.FabMag because it has generally coarser loose sands influenced by greater water movement and populations of the more robust *Spisula elliptica* rather than the brittle-shelled *Fabulina fabula*. The community is less stable in its species composition than IGS.FabMag to which it is closely allied and collectively considered to be the 'Shallow *Venus* Community', the 'Boreal Off-shore Sand Association' and the '*Goniadella-Spisula* association' of previous workers (see Petersen 1918; Jones 1951; Thorson 1957; Salzwedel, Rachor & Gerdes 1985). Epifaunal communities may be reduced in this biotope when compared to IGS.FabMag; both types may have surface sand waves which may be indicative of the presence of venerid bivalves (Warwick & Davies 1977). This hypothesis, however, requires testing. Remote grab sampling is likely to under-estimate deep-burrowing and more dispersed species such as *Paphia, Ensis* and *Spatangus*. This biotope may give way to others characterised by *Angulus tenuis, Donax vittatus* and *Nephtys caeca* on exposed lower shore sands (LGS.AP.Pon) (Jones 1950). In southern regions of the UK, *S. elliptica* is replaced by *S. subtruncata* in this biotope. It is possible that *Spisula solida* may also be characteristic of this habitat (needs clarification) (see Kühne & Rachnor 1996) and it should be noted that for some workers the three species of *Spisula* commonly encountered in UK waters may present difficulties in identification.

No.13 IMS.EcorEns *Echinocardium cordatum* and *Ensis* spp. in lower shore or shallow sublittoral muddy fine sand

Biotope description

Sheltered lower shore and shallow sublittoral sediments of sand or muddy fine sand in fully marine conditions, support populations of the urchin *Echinocardium cordatum* and the razor shell *Ensis siliqua* or *Ensis arcuatus*. A rich variety of polychaetes, such as *Notomastus latericeus, Mediomastus fragilis* and *Scoloplos armiger,* may occur in abundance. Bivalves such as *Mysella bidentata, Tellimya ferruginosa*, *Dosinia lupinus*, *Chamelea gallina* and *Gari fervensis* are typical of this habitat (but may not be present all at once), as are the predatory worms *Pholoe inornata* and *Harmothoe* spp. Seagrass *Zostera marina* may occur in low density (see also IMS.Zmar). *Amphiura brachiata* is common in fine sandy sediments and *Labidoplax media* in slightly muddier sediments. This biotope is currently broadly defined and needs further consideration, especially in relation to IGS.FabMag and IMS.MacAbr.

No.14 ECR.Alc *Alcyonium*-dominated communities (tide-swept/vertical)

Biotope description

A series of biotopes which are characterised by moderate to dense aggregations of dead man's fingers *Alcyonium digitatum*. *Alcyonium* typically thrives in areas with moderate water movement, often on exposed rocky coasts, especially where moderate tides sweep steep and vertical rock faces. Although *Alcyonium* occurs in many, if not most, sublittoral rocky biotopes it only forms dense masses of large colonies in these conditions. Massive sponges such as *Pachymatisma johnstonia* and *Cliona celata* are found amongst the *Alcyonium* on open coasts as well as in tide-swept narrows (ECR.AlcMas) although grazing by *Echinus esculentus* can reduce the species richness so that encrusting forms predominate (ECR.AlcC; see also ECR.AlcSec and MCR.FaAlC). In strongly tide-swept narrows *Tubularia indivisa* thrives, particularly noticeable early in the year before the hydranths are grazed away, and is co-dominant with the *Alcyonium* (ECR.AlcTub).

APPENDIX 7. PHOTOGRAPHS OF LITTORAL SURVEYS OF PROPOSED CABLE LANDFALLS

Plate 1. Landfall A site at Ennereilly Beach

Plate 2. Landfall A, rocky outcrop on lower shore showing barnacles, limpets, mussels and red and green algae.

Plate 3. Landfall B site north of Arklow.

Plate 4. Landfall B, lower shore.

Plate 5. Landfall B, upper shore, showing sand bank.

Plate 6. Landfall C site on the north Arklow pier showing IFI ammonia intake station.

Plate 7. Landfall C, existing IFI pipes on Arklow pier where electrical cables will run along side.