Environmental Surveys
Beneath Finfish cages
at Deenish and Inisfarnard
Kenmare River
County Kerry

July 2011

Produced by

AQUAFACT International Services Ltd

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1. Introduction

This report documents the environmental conditions of the seabed at two Marine Harvest Ireland finfish (*Salmo salar*) aquaculture sites in Kenmare River, Co. Kerry and Co. Cork on 27th July, 2011 (see Figures 1 and 2 for location maps). One of the sites investigated during the current work is situated close to Deenish Island, County Kerry on the northern shore of Kenmare River. The second site is located at Inisfarnard, County Cork, off Kilcatherine point, on the southern shore of Kenmare River.

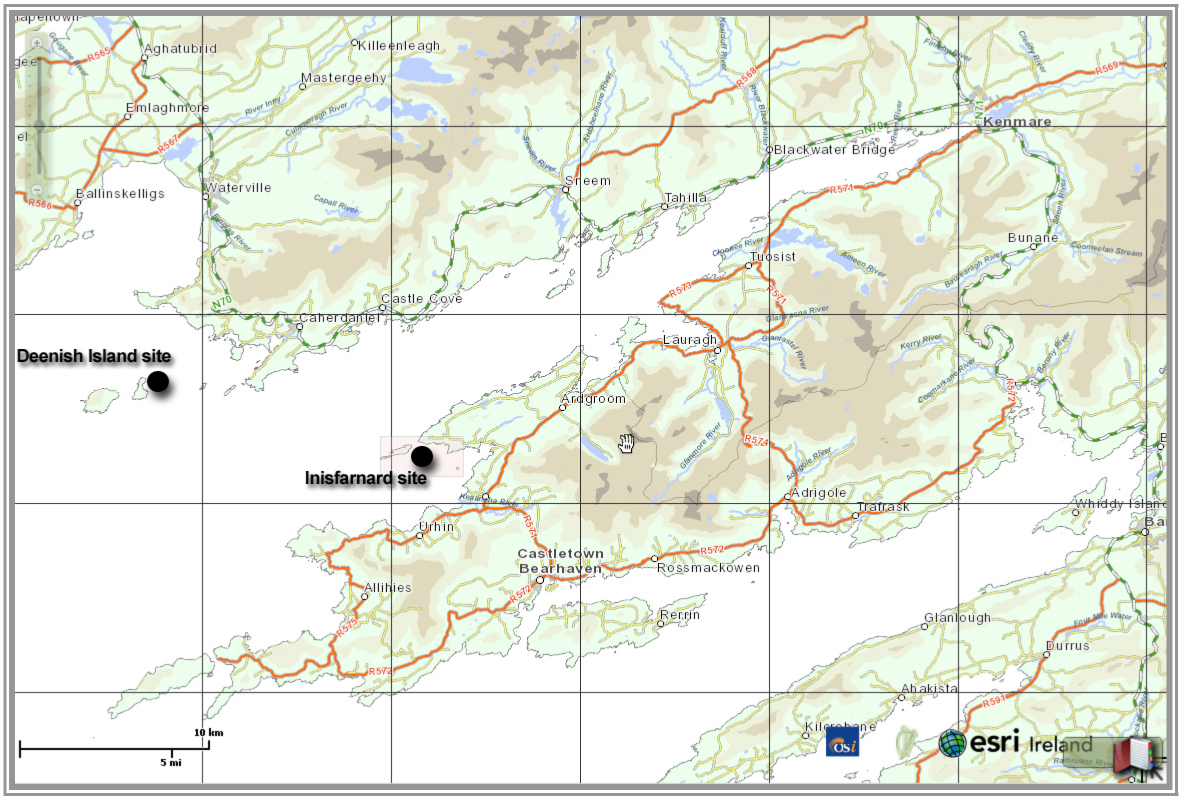


Figure 1. Map showing the location of the two sites surveyed in Kenmare River.

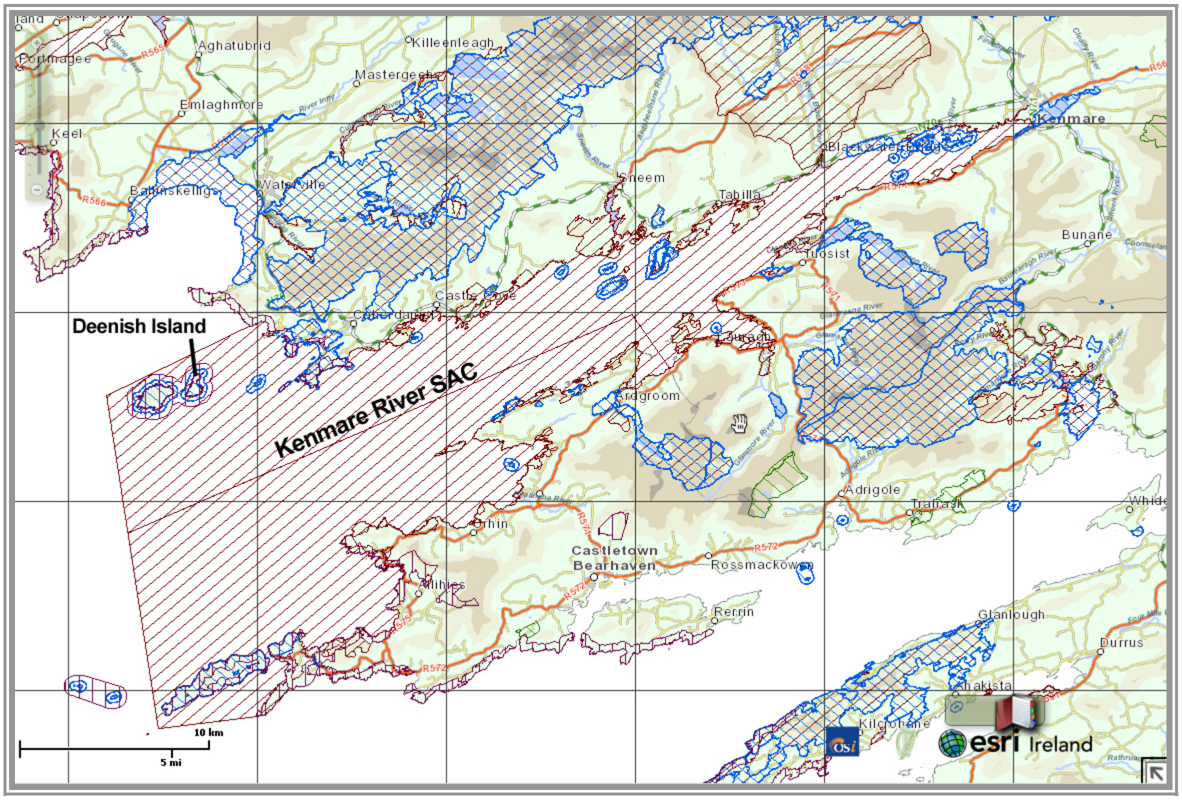


Figure 2. Map showing the location of the Dinish Island in relation to the Kenmare River SAC (map © OSI).

Kenmare River, Co. Kerry, is a long and narrow, south-west facing bay. It is a deep, drowned glacial valley and the bedrock is mainly Old Red Sandstone which forms reefs along the middle of the bay throughout its length. Exposure to prevailing winds and swells at the mouth diminishes towards the head of the bay. Numerous islands and inlets along the length of the bay provide further areas of additional shelter in which a variety of habitats and unusual communities occur.

Two Natura 2000 sites are of relevance for the Deenish site. Deenish Island is located in the outer reaches of the Kenmare River SAC (site code: 002158) and the island forms part of the Deenish Island and Scariff Island SPA (site code: 004175).

Kenmare River SAC has a very wide range of marine communities from exposed coast to ultra-sheltered areas. The site contains three marine habitats listed on Annex I of the EU Habitats Directive, namely reefs, large shallow bay and caves. There is also an extremely high number of rare and notable marine species present (24) and some uncommon communities. Kenmare River is the only known site in Ireland for the northern sea-fan, *Swiftia pallida* and is the only known area where this species and the southern sea-fan *Eunicella verrucosa* co-occur. Midway along the south coast of Kenmare River, a series of sea caves stretch back into the cliff. They typically support encrusting sponges, ascidians and bryozoans.

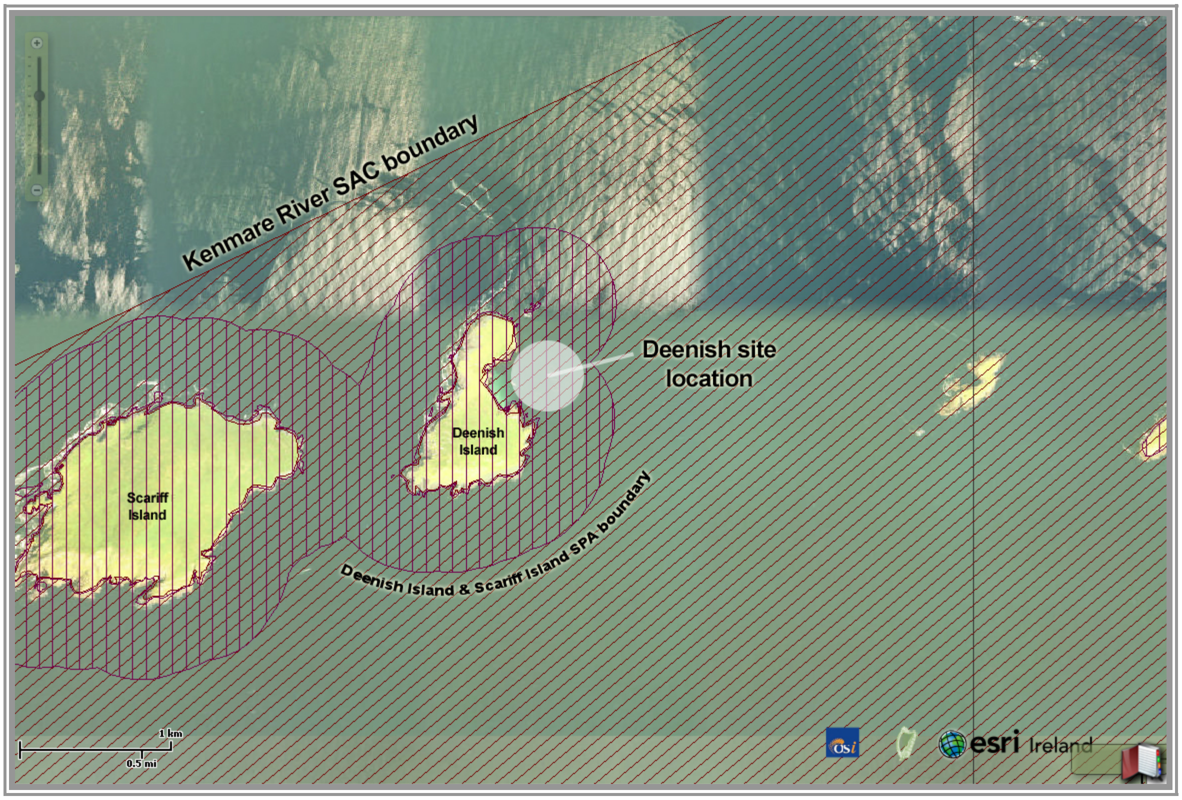


Figure 3. Location map showing Natura 2000 site boundaries in relation to the site location at Deenish Island (map © OSI).

Deenish Island and Scariff Island are small- to medium-sized islands situated between 5 and 7 km west of Lamb's Head off the Co. Kerry coast; they are thus very exposed to the force of the Atlantic Ocean. The site is a Special Protection Area (SPA) under the E.U. Birds Directive, of special conservation interest for the following species: Fulmar, Manx Shearwater, Storm Petrel, Lesser Black-backed Gull and Arctic Tern. Scariff is the larger of the two. It is steep-sided all the way around and rises to a peak of 252m. The highest cliffs are on the south side. The island vegetation is a mix of maritime grassland, areas dominated by Bracken and heathy areas with Ling Heather. There are the ruins of a monastic settlement and a cottage in the north-east sector of the island. Deenish is less rugged than Scariff, and rises to 144m in its southern half; the northern half is lower and flatter. The vegetation is mostly grassland, with some heath occurring on the higher ground. Old fields are now overgrown with Bracken and brambles. The sea areas to 500m around the islands are included inside the SPA boundary to provide a 'rafting' area for shearwaters.

Figure 4: View of finfish net pens at the Deenish site.

1.1. Offshore finfish farms – benthic monitoring

The main objective of the survey was to assess the overall state of the environment in relation to the salmon production process. The site was surveyed according to the revised Benthic Monitoring Guidelines laid down by the Department of Agriculture, Fisheries and Food (December 2008). The benthic monitoring requirements at a fish farm are dependent on the level of biomass held at the site and the local hydrography.

Table 1 below sets out the level of benthic monitoring required based on tonnage produced and mean current speeds at a fish farm:

Table 1. Matrix of production tonnage versus current speed to determine level of benthic monitoring required.

	MEAN CURRENT SPEED (CMS^{-1})		
TONNAGE	**<5**	**5-10**	**>10**
0-499	Level 1	Level 7	Level 1
500-999	Level 2	Level 7	Level 1
>1000	Level 2	Level 2	Level 1

The current speed is a mean value calculated from maximum current measurements over spring and neap tidal cycles at the surface and near the bottom. The tonnage refers to the maximum biomass predicted for each site. An annual survey must be carried out at each site (production and smolt) operated by a company. A level 1 or level 2 survey may be carried out as below:

Level 1: Video/photographic and visual observations and recordings shall be made at the following stations:

- At a minimum of 2 sites directly beneath the cages
- At the edges of the cages
- Two transects at right angles to each other. Along each transect sampling stations at +/- 10m, +/- 20m, +/- 50m and + 100m from the cages
- At a control site

In addition to the above, the following samples/measurements shall be taken at the same stations as above. These will be used to calculate sediment quality parameters.

- A minimum of one Redox potential reading shall be made at each sampling station.
- A single sediment sample for Organic Carbon measurement.

Level 2: In addition to the above, three replicate grab samples shall be captured at each of the sample stations for faunal analysis. The exact locations of sampling points should be agreed in advance with the Department of Agriculture Fisheries and Food (DAFF). The identification and abundance of macro-faunal invertebrates shall be estimated and tabulated. Identification of fauna to the level of species will be required.

The current surveys at the Deenish and Inishfarnard sites were carried out at Level 2.

It is important to take note that the exact position of the individual cage structures are not permanently fixed to a single position and there is a relatively large lateral movement due to depth, wind, currents and tides. For this reason bottom stations particularly at the under , edge and 10m zones are taken at the time of sampling but may vary relative to the overlying cage position under various environmental conditions.

2. Sampling Procedure & Processing

All survey work took place on the 27th July 2011. The dive at the Deenish site was conducted at a maximum depth of 23m and underwater visibility on the day was good at approximately 10 - 15m. The dive at the Inishfarnard site was conducted at a maximum depth of 22m and underwater visibility on the day was 7 – 8m. Cage layouts at the time of survey, dive entry points and benthic transects followed by the divers are shown in Figures 8 & 15 for Deenish and Figures 27 and 34 for Inishfarnard (Section 3).

Disinfection

Prior to each dive survey for each location all diving equipment, suits and boats are thoroughly disinfected utilizing both a dipping and spraying protocol.

2.1. Dive survey

Two dive transects (one parallel with the direction of the prevailing current and one perpendicular to the prevailing current) were laid out from the sea surface at each site using a boat equipped with a GPS mapper. Cage locations were noted as DGPS positions using a Trimble GeoXT, which is capable of sub-meter horizontal accuracy using real time corrections from the integrated EGNOS (European Geostationary Navigation Overlay System) receiver. Acoustic beacons were deployed to assist the divers in locating transect marks while underwater. The underwater survey itself involved the direct observation, sampling and recording (photographic and written) of benthic conditions by qualified biologists at a number of sites along the transects:

- directly under the cage (T1 Under)
- under the edge of the cage (T1 Edge)
- at 10m (T1 10m, T1 10m), 20m (T1 20m, T2 20m), 50m (T1 50m, T2 50m) and 100m (T1 100m) from the cages.

A reference station (Ref) was also assessed to give a representation of ambient benthic conditions in the area immediately surrounding the cage installations and served for comparison purposes. As such, it represents the 'undisturbed' condition of the seafloor surrounding the sites – it was taken at a distance greater than 200m from the cage installations.

All dives were carried out by highly experienced, qualified biologists who made notes of features and species encountered during the dives – these were transcribed to logs upon surfacing. In addition to standard SCUBA gear the divers were equipped with:

- A high end dSLR camera for photographing epibenthos. Photographs were taken at the prescribed stations along each transect and observations on benthic conditions at the site were noted down. The camera used was a Nikon D200 in a Subal ND20 underwater housing fitted with a 12-24mm lens and two INON strobes.
- A hand-held dSPI camera for photographing sediment profiles.i.e images were taken of the sediment in cross profile at depths of to 23cm (Mean redox measurements were made using digital sediment profile imagery (SPI). This unit uses a Canon EOS 450D camera with Nikkor optics).
- A SONAR receiver & compass for underwater navigation.
- Three × 5cm diameter corers for taking faunal samples (for the Under station only, grabs were used for all other stations).
- Pre-labelled bags to take sediment samples for organic carbon analysis.
- Dive slates and waterproof pencils for making notes.
- Torches.

The divers photographed representative areas of the sediment and fauna and recorded observations in situ at the various stations investigated. Notes were completed during discussion immediately on surfacing and a map of the dive track was drawn up. Observations recorded during the dive include:

- Presence of bacterial mats and uneaten food
- Presence of farm-derived litter
- Presence of gas bubbles or anoxic areas
- Animals visible or evidence of their presence
- Macroalgae visible
- Sediment colour and texture – among other things.

By noting the species of animals present and their densities, any tracks of animals or the presence of species that are known to be connected with certain states of benthic enrichment, the health of the benthos (including the highlighting of some potential problems) may be gauged.

An acoustic beacon was dropped on a buoyed line at the end of the 100m transect to allow the divers (equipped with an acoustic receiver unit) to determine their distance from this mark. This also allowed simplified underwater navigation – the unit gives the divers both range and direction of the beacon.

2.2. Sediment Profile Imagery (SPI)

A Sediment Profile Image (SPI) was also acquired at each of the stations mentioned above. These images were acquired using a diver-deployed sediment profile imaging camera system. This system is comprised of a digital SLR camera in a water-tight pressure vessel that is mounted above a prism that penetrates the upper 25cm of sediment (see Figure 5 for image). The sediment profile is viewed through a plexiglass window. Its image is reflected to the camera lens via a plane mirror. Illumination is provided by an internally-mounted strobe.

The diver depresses the unit into the seafloor and manually triggers the camera. This process is repeated at each station investigated. The prism unit is filled with distilled water – thus ambient water clarity is never a limiting factor in image quality. Refer to Appendix 1 for details on the SPI apparatus.

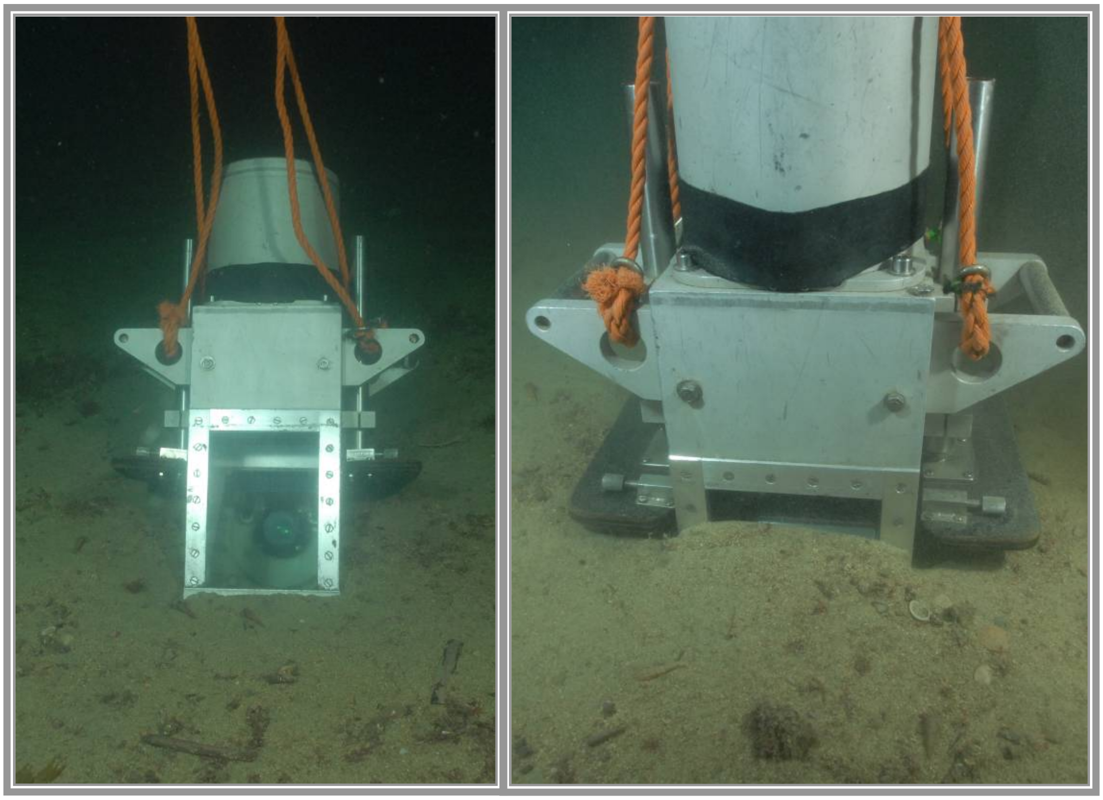


Figure 5. Diver operated Sediment Profile Imaging camera. The left-hand image gives a view of the camera at the sediment surface. The right-hand image shows the SPI camera when inserted into the sediment.

A great deal of information about benthic processes is available from sediment profile images. Measurable parameters, many of which are calculated directly by image analysis, include physical/chemical parameters (i.e. sediment type measured as grain size major mode, prism penetration depth providing a relative indication of sediment shear strength, sediment surface relief, condition of mud clasts, redox potential discontinuity depth and degree of contrast, sediment gas voids) and biological parameters (i.e. infaunal successional stage of a well documented successional paradigm for soft marine sediments (see Pearson and Rosenberg, 1978), degree of sediment reworking, dominant faunal type, epifauna and infauna, depth of faunal activity, presence of microbial aggregations).

For the purposes of the current survey the primary feature of interest is the depth of oxygen penetration into the sediments in the vicinity of the finfish cages (this information is required to satisfy the requirements of the Benthic Monitoring Protocol (DAFF, 2008).

In this case the apparent redox potential discontinuity or ARPD depth is measured. Features of particular interest that may be gleaned from SPI images taken in sediments in the vicinity of finfish cages include the presence of:

- uneaten feed pellets (and depth of this material)
- faecal casts
- and depth of shell gravel deposits
- of gas voids in the sediment (refer to Figure 6)

Figure 6. Typical sediment profile images with examples of features.

2.3. Sampling for faunal analysis

Sediment samples for faunal analysis were collected in one of two ways:

- Using handheld (15cm diameter) corers at the under cage station.
- Using a small (0.025m^2) van Veen grab at all other stations.

At each station, three replicate grab/core samples were collected. The faunal returns were sieved on a 1 mm mesh sieve, stained with Rhodamine dye, fixed with 10% buffered formalin and preserved in 70% alcohol. Samples were then sorted under a microscope (x 10 magnification) back in the laboratory, into four main groups:

polychaeta, mollusca, crustacea and others. The 'others' group consisted of echinoderms, nematodes, nemerteans, cnidarians and other lesser phyla. The taxa were then identified to species level where possible.

2.3.1. Data Processing

All three faunal replicates for each station were combined to give a total abundance for each station prior to analyses. A data matrix of all the combined faunal abundance data was compiled and used for statistical analyses. The faunal analysis was carried out using PRIMER ® (Plymouth Routines in Multivariate Ecological Research).

Univariate statistics in the form of diversity indices were calculated on the combined replicate data. The following diversity indices were calculated:

1) Margalef's species richness index (D), (Margalef, 1958).

$$D = \frac{S-1}{\log_2 N}$$

where: N is the number of individuals

S is the number of species

2) Pielou's Evenness index (J), (Pielou, 1977).

$$J = \frac{H'(\text{observed})}{H'_{max}}$$

where: H'_{max} is the maximum possible diversity, which could be achieved if all species were equally abundant (= $\log_2 S$)

3) Shannon-Wiener diversity index (H'), (Pielou, 1977).

$$H' = -\sum_{i=1}^{S} p_i(\log_2 p_i)$$

where: p_I is the proportion of the total count accounted for by the i^{th} taxa

Species richness is a measure of the total number of species present for a given number of individuals. Evenness is a measure of how evenly the individuals are distributed among different species. The diversity index incorporates both of these parameters.

The PRIMER ® manual (Clarke & Warwick, 2001) was used to carry out multivariate analyses on the station-by-station faunal data. All species/abundance data were fourth root transformed and used to prepare a Bray-Curtis similarity matrix in PRIMER®. The fourth root transformation was used in order to down-weigh the importance of the highly abundant species and allow the mid-range and rarer species to play a part in the similarity calculation. The similarity matrix was then used in classification/cluster analysis. The aim of this analysis was to find "natural groupings' of samples, i.e. samples within a group that are more similar to each other, than they are similar to samples in different groups (Clarke & Warwick, *loc. cit.*). The PRIMER ® programme CLUSTER carried out this analysis by successively fusing the samples into groups and the groups into larger clusters, beginning with the highest mutual similarities then gradually reducing the similarity level at which groups are formed. The result is represented graphically in a dendrogram, the x-axis representing the full set of samples and the y-axis representing similarity levels at which two samples/groups are said to have fused. The CLUSTER programme was set to include a series of 'similarity profile' (SIMPROF) permutation tests, which look for statistical evidence of genuine clusters in samples which are *a priori* unstructured. SIMPROF performs tests at every node of a completed dendrogram, that the group being sub-divided has 'significant' internal structure. The test results are displayed in a colour convention on the dendrogram plot (samples connected by red lines cannot be significantly differentiated).

The Bray-Curtis similarity matrix was also subjected to a non-metric multi-dimensional scaling (MDS) algorithm (Kruskall & Wish, 1978), using the PRIMER ® program MDS. This programme produces an ordination, which is a map of the samples in two- or three-dimensions, whereby the placement of samples reflects the similarity of their biological communities rather than their simple geographical location (Clarke & Warwick, 2001). With regard to stress values, they give an indication of how well the multi-dimensional similarity matrix is represented by the two-dimensional plot. They are calculated by comparing the interpoint distances in the similarity matrix with the corresponding interpoint distances on the 2-d plot. Perfect or near perfect matches are rare in field data, especially in the absence of a single overriding forcing factor such as an organic enrichment gradient. Stress values increase not only with the reducing dimensionality (lack of clear forcing structure), but also with increasing quantity of data (it is a sum of the squares type regression coefficient). Clarke and Warwick (*loc. cit.*) have provided a classification of the reliability of MDS plots based on stress values, having compiled simulation studies of stress value behaviour and archived empirical data. This classification generally holds well for 2-d ordinations of the type used in this study. Their classification is given below:

- Stress value < 0.05: Excellent representation of the data with no prospect of misinterpretation.
- Stress value < 0.10: Good representation, no real prospect of misinterpretation of overall structure, but very fine detail may be misleading in compact subgroups.
- Stress value < 0.20: This provides a useful 2-d picture, but detail may be misinterpreted particularly nearing 0.20. Stress value 0.20 to 0.30: This should be viewed with scepticism, particularly in the upper part of the range, and discarded for a small to moderate number of points such as < 50.
- Stress values > 0.30: The data points are close to being randomly distributed in the 2-d ordination and not representative of the underlying similarity matrix.

Each stress value must be interpreted both in terms of its absolute value and the number of data points. In the case of this study, the moderate number of data points indicates that the stress value can be interpreted more or less directly. While the above classification is arbitrary, it does provide a framework that has proved effective in this type of analysis.

2.4. Sampling for organic carbon analysis

An additional grab/core sample was taken at each of the stations and used for organic carbon analyses. All samples were stored in pre-labelled plastic bags, kept in cold freezer boxes onboard the vessel and frozen at -20°C on return to the lab.

Organic carbon analysis was carried out by OMAC laboratories using the Loss on Ignition (LOI) technique. This method involves oven drying the sediment sample in a muffle furnace (1000ºC for a period of 2 hours) after which time the organic content of the sample is determined by expressing as a percentage the weight of the sediment after ignition over the initial weight of the sediment.

3. Results

3.1. Deenish

3.1.1. Recent Stocking History

Fish were stocked to the Deenish cages on 25th April 2011. The Deenish Island site was fallow for a period of 42 days prior to stocking. Mean current speed at the site is $0.3ms^{-1}$. A maximum biomass of 200 tonnes is stocked in each cage. These fish are due to be ongrown on site and harvested between June and December 2012.

Figure 7. View of cage and feed barge at Deenish Island site, viewed at sea, July 27th 2011.

3.1.2. Seabed Physical Characteristics

The seabed was composed of a mix of sediment types with areas of:

- Sand – The seabed at the under cage and cage edge stations was composed of fine-medium sand. The seafloor at the 10m and 20m stations was composed of a slightly coarser sand mix.
- Shell gravel and sand mix – the seafloor beyond the 20m stations was composed of sand with coarse shelly gravel armouring.

3.1.3. Photographic Record; Transect 1

This transect began beneath the north westernmost cage moored on site (see Figure 8). A total of six stations were investigated.

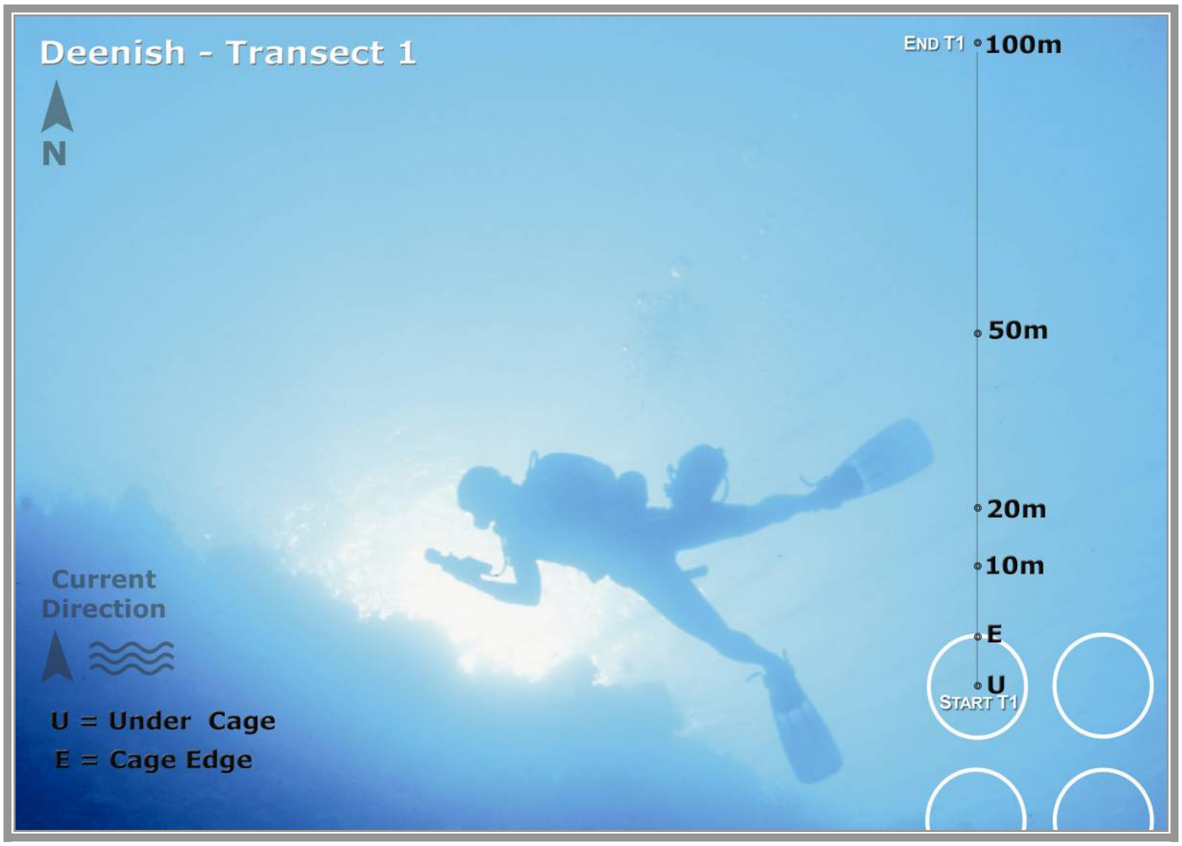


Figure 8. Transect 1 seafloor station layout, Deenish Island site, July 27th 2011.

3.1.3.1. Under Cage Location

The cages on site were stocked. There were some obvious signs on the seafloor that finfish cages were overlying the site:

- Scattering of uneaten food (visible in the background of this photograph)
- A scattering of faecal casts (far less material than uneaten feed)
- Shallow ARPD depths at this station
- Layer of *Beggiatoa* spp. (white layer in image)

A number of small hermit crabs (Paguridae), common starfish (*Asterias rubens*), numerous brittlestars (*Amphiura* sp.) and anemones (*Cerianthus lloydii*) were noted. Some small fragments of drifting kelp were noted.

Figure 9. T1 – Under cage, Deenish Island site, July 27th 2011

3.1.3.2. Edge of Cage Location

Flat fine-medium sand with some mussel shell. There were some signs on the seafloor that finfish cages were overlying the site:

- A scattering of uneaten feed pellets
- A small number of faecal casts
- A layer of *Beggiatoa* spp.*
- Relatively shallow ARPD depth

Drifting algal material (*Delesseria* sp. and kelp frond fragments), sea slugs (*Faceliniidae* and *Aeolidiidae*) and hermit crabs (Paguridae) were recorded.

Figure 10. T1 – Cage edge, Deenish Island, July 27th 2011.

* *Beggiatoa* spp. – gliding, colourless filamentous sulphur bacteria, thriving in low oxygen/high organic environments. Commonly referred to as sewage fungus. Visible as a whitish layer or as white patches in benthic photographs.

3.1.3.3. <u>10m from Cage</u>

The seafloor at the 10m station was composed of sand. There were some signs that finfish cages were nearby:

- Small patches of feed material
- A very light scattering of faecal casts
- Patches of *Beggiatoa* spp.
- Patches of sediment with relatively shallow ARPD depth.

A layer of benthic diatoms was noted at the sediment surface.

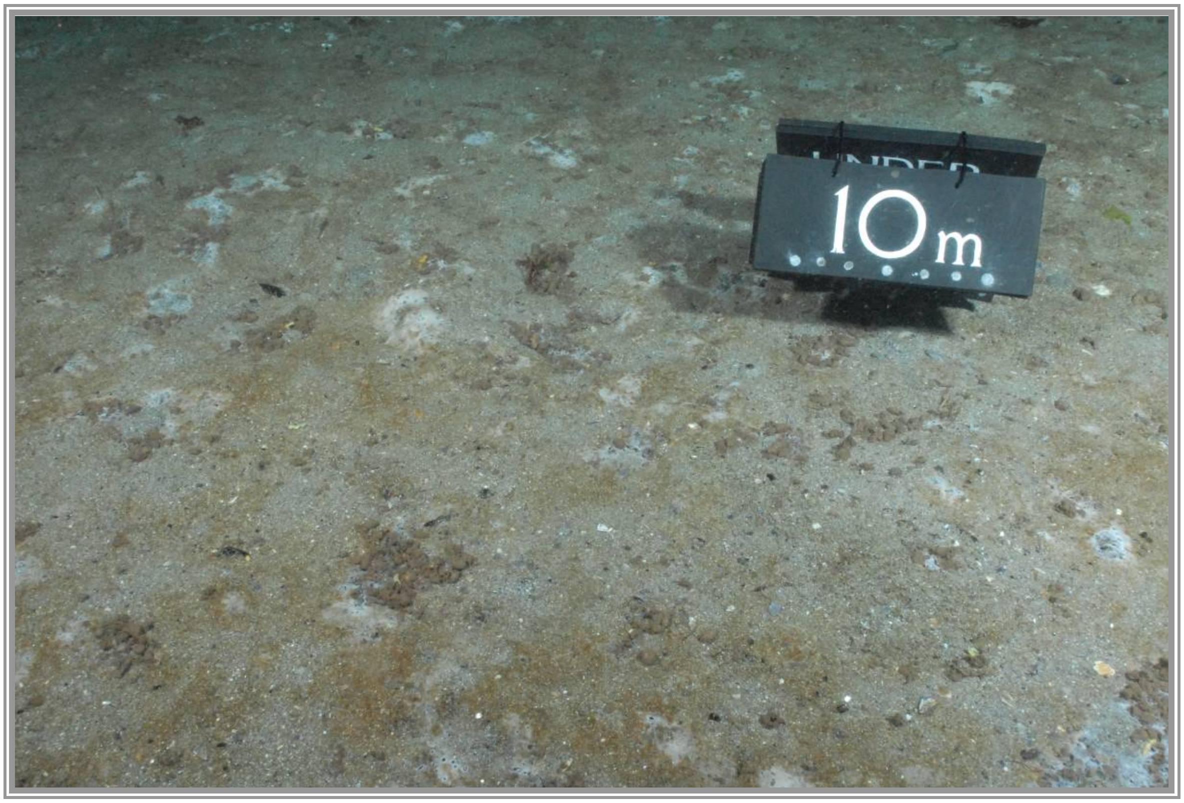


Figure 11. T1 – 10m, Deenish Island, July 27th 2011.

3.1.3.4. 20m from Cage

The seafloor at the 20m station was composed of relatively flat fine-medium sand. There were some signs of the nearby finfish rearing operation:

- A light scattering of faecal casts
- Very small patches of *Beggiatoa* spp.

The sediment surface was covered in a thin layer of benthic diatoms. A king scallop (*Pecten maximus*), sand mason (*Lanice conchilega*), small fragments of drifting algal material, brittlestars (*Ophiura* sp.) and burrowing brittlestars (*Amphiura* sp.) were recorded.

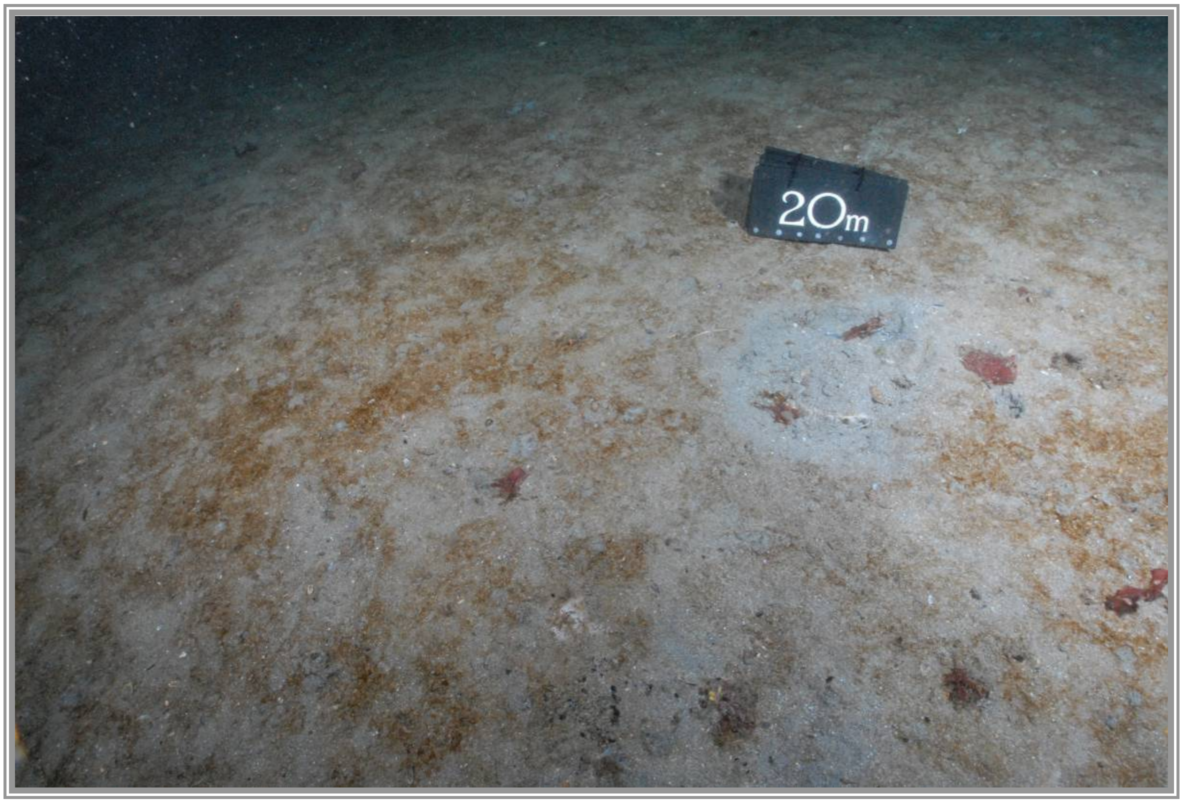


Figure 12. T1 – 20m, Deenish Island, July 27th 2011.

3.1.3.5. 50m from Cage

The seafloor at the 50m station was composed of sand with shell gravel armouring. Much of the shell material was composed of mussel shell. There were slight signs of impact from the nearby finfish rearing operation:

- Variable ARPD depth – relatively shallow for this location

A few specimens of the parchment worm (*Chaetopterus variopedatus*) were recorded at this station. This is a species of filter feeding polychaete worm – parts of its body are phosphorescent. Small plants of a common epilithic and epiphytic red seaweed (*Phycodrys rubens*) were noted attached to some of the larger shell fragments. A kelp stipe can be seen in the upper left quadrant of the image.

Figure 13. T1 – 50m, Deenish Island, July 27th 2011.

3.1.3.6. <u>100m from Cage</u>

A sand, shell and pebble gravel seafloor. There were no apparent signs of impact from the nearby finfish rearing operation.

Small starfish (probably juvenile *Asterias* sp. or *Marthasterias* sp.), numerous anemones (*Cerianthus lloydii*), calcareous tube worms (*Pomatoceros* sp.) and drift algae (*Alaria esculenta*) were noted. This station marked the end of Transect 1.

Figure 14. T1 – 100m, Deenish Island, July 27th 2011.

3.1.4. Sediment Profile Imagery – Transect 1

The following two plates present sediment profile images taken at the six stations visited on Transect 1 of the Deenish site. They display a single image and the maximum and minimum apparent redox potential discontinuity (ARPD) depths measured at each station. The composition of sediments at each station can be seen – fine sand at the under cage station to a coarser shelly gravelly sand at the outer end of the transect. Each image is 15.5cm × 25cm. Uneaten feed and faecal material can be seen as a thin layer at the under cage station.


TRANSECT 1
UNDER
ARPD depth
Min: 0.00cm
Max: >10.26cm
Mean: 3.54cm
EDGE
ARPD depth
Min: >7.09cm
Max: >7.53cm
Mean: >7.09cm
10m
ARPD depth
Min: 0.00cm
Max: >7.33cm
Mean: 4.21cm
FINFISH SITE
DEENISH
TRANSECT 1
AQUAFACT
ENVIRONMENTAL SURVEY SPECIALISTS


Transect 1
20m
ARPD depth
Min: 0.00cm
Max: >10.12cm
Mean: 4.89cm
50m
ARPD depth
Min: 2.39cm
Max: >10.66cm
Mean: 4.63cm
100m
ARPD depth
Min: 6.27cm
Max: 13.39cm
Mean: 8.26cm
Finfish Site
Deenish
Transect 1
AQUAFACT
Environmental Survey Specialists

3.1.5. Photographic Record; Transect 2

This transect began beneath the same cage as Transect 1. A total of five stations were investigated on Transect 2 (See Figure 15) with an additional (reference) station investigated just over 200m from the cage edge.

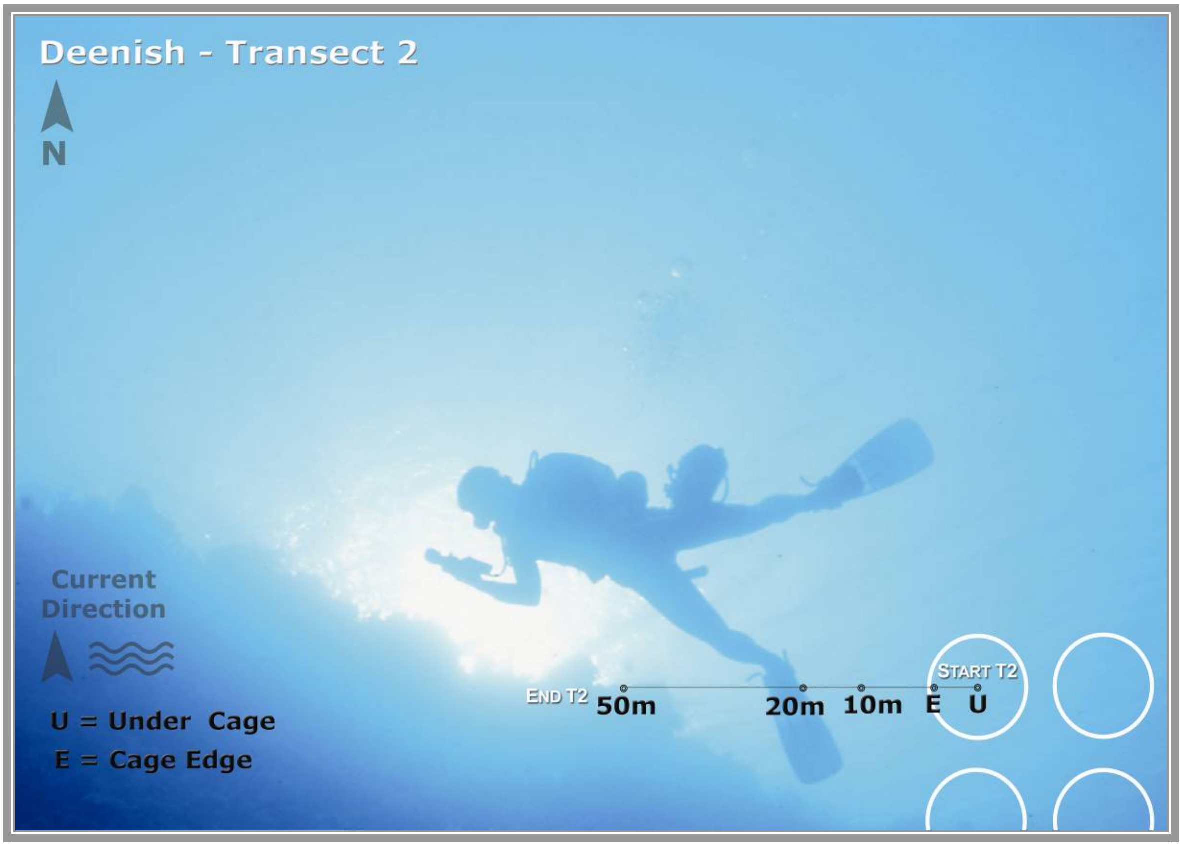


Figure 15. Transect 2 seafloor station layout, Deenish Island site, July 27th 2011.

3.1.5.1. Under Cage Location

This station was located beneath the same cage as the *Under Cage* station on Transect 1. Seafloor conditions are therefore similar. There were some obvious signs on the seafloor that finfish cages were overlying the site:

- Scattering of uneaten feed pellets and faecal casts
- Shallow ARPD depths at this station
- Layer of *Beggiatoa* spp. (white layer in image)

A number of small gobies (*Pomatoschistus* sp.), numerous common starfish (*Asterias rubens*), numerous brittlestars (*Amphiura* sp.) and nudibranchs were noted. Some small fragments of drifting kelp were noted.

Figure 16. T2 – Under cage, Deenish Island, July 27th 2011.

3.1.5.2. Edge of Cage Location

Fine-medium sands with a small amount of shell gravel. There were some obvious signs on the seafloor that finfish cages were overlying the site:

- Feed pellets and faecal casts on the seabed
- A layer of *Beggiatoa* spp.
- Shallow ARPD depths

Numerous small anemones (*Cerianthus* sp.) were noted.

Figure 17. T2 – Cage edge, Deenish Island, July 27th 2011.

3.1.5.3. 10m from Cage

Fine-medium sand with a small amount of mussel shell. There were no obvious signs that a finfish rearing facility was nearby, though some small patches of *Beggiatoa* spp. cover were noted. Burrowing brittlestars (*Amphiura* sp.), a benthic biofilm layer, seven-armed starfish (*Luidia ciliaris*) and numerous anemones (*Cerianthus lloydii*) were recorded.

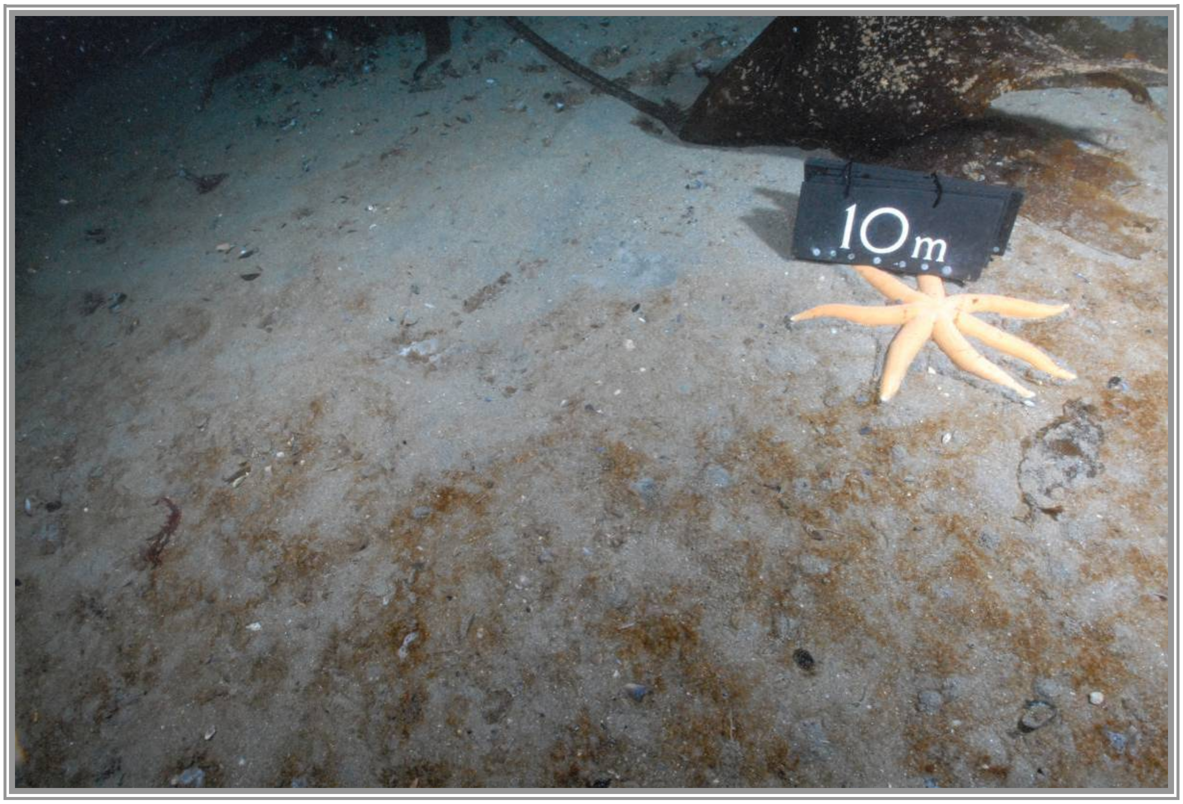


Figure 18. T2 - 10m, Deenish Island, July 27th 2011.

3.1.5.4. <u>20m from Cage</u>

A relatively flat fine-medium sand seafloor with some shell gravel. There were no obvious signs that a finfish farm was nearby.

Biological features encountered included two parchment worms (*Chaetopterus variopedatus*), numerous burrowing brittlestars (*Amphiura* sp.) and a patchy surface biofilm covering the seafloor.

Figure 19. T2 – 20m, Deenish Island, July 27th 2011.

3.1.5.5. 50m from Cage

A sandy gravel seafloor. A substantial amount of the shell gravel was composed of mussel shell. Numerous gobies (*Pomatoschistus* sp.), small red algal plants (*Phycodrys* sp.) and a king scallop (*Pecten maximus*) were recorded.

Figure 20. T2 – 50m, Deenish Island, July 27th 2011.

3.1.6. Reference Station

This photograph was taken at a distance of approximately 200m from the cage edge. Sediments at the reference station were composed of sand and shell gravel forming a relatively flat seabed. There were no apparent signs of impact from the nearby finfish rearing operation:

- Seafloor 'clean' and free of feed/faecal material, *Beggiatoa* spp. cover
- No items of farm debris
- Presence of 'normal' flora and fauna for this area.

Numerous tube anemones (*Cerianthus lloydii*) – fourteen visible in this image alone, gobies (*Pomatoschistus* sp.), calcareous tube worms (*Pomatoceros* sp.) and a seven-armed starfish (*Luidia ciliaris*) were recorded.

Figure 21. Reference Station, Deenish Island, July 27th 2011.

3.1.7. Sediment Profile Imagery – Transect 2 & Reference

The following two plates present sediment profile images taken at the five stations visited on Transect 2 of the Deenish site. A sediment profile image was also taken at the Reference station. They display a single image and the maximum and minimum apparent redox potential discontinuity (ARPD) depths measured at each station. The composition of sediments at each station can be seen. Sediment type varied from fine/medium sands under and close to the cage compared with higher proportions of gravel and shell with increasing distance from the cage. Each image is 15.5cm × 25cm.


TRANSECT 2
UNDER
ARPD depth
Min: >9.04cm
Max: >10.96cm
Mean: 9.50cm
EDGE
ARPD depth
Min: 0.00cm
Max: >10.59cm
Mean: 7.32cm
10m
ARPD depth
Min: 0.00cm
Max: 5.02cm
Mean: 3.36cm
FINFISH SITE
DEENISH
TRANSECT 2
AQUAFACT
ENVIRONMENTAL SURVEY SPECIALISTS


TRANSECT 2
20m
ARPD depth
Min: 0.00cm
Max: >6.62cm
Mean: 2.26cm
50m
ARPD depth
Min: 1.82cm
Max: >10.31cm
Mean: 2.85cm
REF
ARPD depth
Min: >8.30cm
Max: >10.63cm
Mean: 9.56cm
FINFISH SITE
DEENISH
TRANSECT 2
AQUAFACT
ENVIRONMENTAL SURVEY SPECIALISTS

3.1.8. Transect Species List

Table 2 shows a list of species observed during the dives at the Deenish fish farm site.

Table 2. Species noted during dives on the seabed beneath the Deenish cages, 27th July 2011.

Group	Species	Common Name
(Cnidaria) Hexacorallia	*Cerianthus lloydii*	Tube anemone
(Annelida) Polychaeta	*Pomatoceros* sp.	Tube worm
	Lanice conchilega	The sand mason
	Chaetopterus variopedatus	Parchment tube worm
(Mollusca) Bivalvia	*Pecten maximus*	King scallop
	Faceliniidae	Sea slugs
	Aeolidiida	Sea slugs
	Nudibranch	Sea slugs
(Arthropoda) Decapoda	*Paguridae*	Hermit crab
Echinodermata	*Luidia ciliaris*	Seven armed starfish
	Asterias rubens	Common starfish
	Marthasterias sp	Starfish
	Ophiura sp.	Brittlestar
	Amphiura sp.	Brittlestar
(Chordata) Osteiichthyes	*Pomatoschistus* sp.	Gobies
Rhodophyta	*Delesseria* sp.	Sea beech
	Phycodrys rubens	Sea oak
Ochrophyta	*Alaria esculenta*	Edible kelp

3.1.9. Supplementary Photos

3.1.9.1. Octocoral, anemone & brittlestars

This photograph was taken just beyond the 50m Station on Transect 1. A length of encrusted rope is visible spanning the image. The animal extending downward from the rope is the "Dead Mans Fingers" (*Alcyonium digitatum*), its many polyps extending into the water column**.** Other animals recorded here included tunicates (*Clavelina* sp. and *Dendrodoa* sp.), anemones, bryozoans and brittlestars (*Ophiothrix* sp.).

Figure 22. Encrusted submerged rope – Deenish Island, July 27th 2011.

3.1.9.2. Spiny starfish on gravel

This image was taken just beyond the Reference station at the Deenish Island site. The main subject of this image is a specimen of the spiny starfish (*Marthasterias glacialis*). Burrowing anemones (*Halcampa chrysanthellum*), tube anemones (*Cerianthus lloydii*), juvenile starfish (probably *Asterias* sp.) and ophiuroids were recorded.

Figure 23. Boulder with epifauna/flora, Deenish Island, July 27th 2011.

3.1.10. Benthic Macrofaunal Analysis

It should be noted that no faunal sample could be retrieved from Station T1 100m due to the presence of hard ground. The taxonomic identification of the benthic infauna across all 9 stations sampled at the Deenish fish farm site yielded a total count of 209 taxa accounting for 7,526 individuals, ascribed to 8 phyla. A complete listing of the taxa abundance is provided in Appendix 1.

Of the 209 taxa enumerated, 80 were annelids (segmented worms), 54 were crustaceans (crabs, shrimps, prawns), 51 were molluscs (mussels, cockles, snails etc.), 17 were echinoderms (starfish, brittlestars, sea cucumbers), 4 were chelicerata (sea spiders), 1 was a platyhelminthean (flat worm), 1 was a sipulculid (peanut worms) and 1 was a dragonet (pisces).

3.1.10.1. Univariate Analysis

Univariate statistical analyses were carried out on the combined replicate station-by-station faunal data. The following parameters were calculated and can be seen in Table 3; taxon numbers, number of individuals, richness, evenness and diversity. Taxon numbers ranged from 35 (T1 Edge) to 100 (Ref). Numbers of individuals ranged from 346 (T1 50m) to 1,383 (T2 20m). Richness ranged from 5.08 (T1 Edge) to 14.79 (Ref). Evenness ranged from 0.28 (T1 Under) to 0.82 (T1 50m). Diversity ranged from 1.48 (T1 Under) to 5.26 (Ref).

Table 3: Diversity indices.

Station	No. Taxa	No. Individuals	Richness	Evenness	Diversity
T1 Under	39	1080	5.44	0.28	1.48
T1 Edge	35	808	5.08	0.46	2.37
T1 10m	50	1134	6.97	0.42	2.36
T1 20m	49	761	7.23	0.49	2.76
T1 50m	74	346	12.49	0.82	5.08
T2 10m	50	856	7.26	0.49	2.78
T2 20m	47	1383	6.36	0.30	1.68
T2 50m	77	352	12.96	0.79	4.96
Ref	100	806	14.79	0.79	5.26

3.1.10.2. Multivariate analysis

The dendrogram and the MDS plot can be seen in Figures 24 and 25 respectively. The stress value of the MDS is 0.02 which indicates an excellent representation of the data. SIMPROF analysis revealed 4 statistically significant groupings between the 9 stations (hence the black line joining each group of stations in the dendrogram).

The dendrogram shows a clear divide between the stations, Groups a and b separated quite clearly from Groups c and d i.e. those stations away from the cage and those stations in close proximity to the cage.

Group d had an average similarity of 50.92%. This group consisted of T1 Edge, T1 10m, T1 20m, T2 10m and T2 20m. Three species accounted for approximately 81% of the faunal abundance in this group: the polychaetes *Capitella* sp. (34%) and *Phyllodoce mucosa* (31%) and the bivalve mollusc *Mytilidae* sp. (16%).

T1 Under joined this group of stations at a similarity level of 38.87%. This station differed to the others due to the much higher numbers of *Mytilidae* sp. (79.6% of the faunal abundance) and the much lower number of *Phyllodoce mucosa* (0.37% of the faunal abundance).

Stations T1 50m and T2 50m formed Group b at a similarity level of 59.77%. This group was dominated by the amphipod *Photis longicaudata* (11.5%), the brittlestar *Amphipholis squamata* (7.7%) and the chiton *Leptochiton cancellatus* (7.5%). Both of these stations had high species diversity and richness.

The reference station (Group a) joined Group b at a similarity level of 50.81%. This station had the highest richness and diversity values. Both brittle species *Ophiocomina nigra* and *Amphipholis squamata* dominated this station.

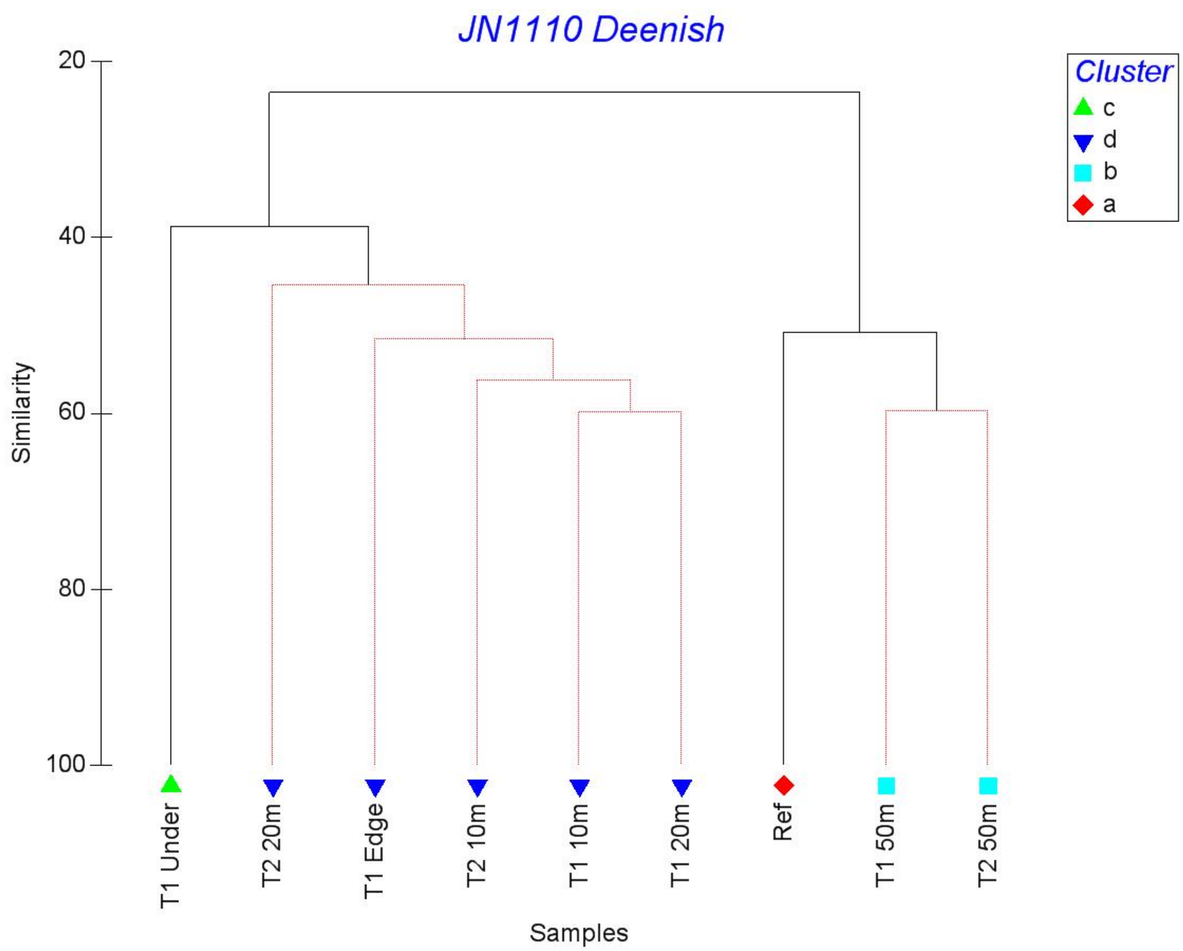


Figure 24: Dendrogram produced from Cluster analysis.

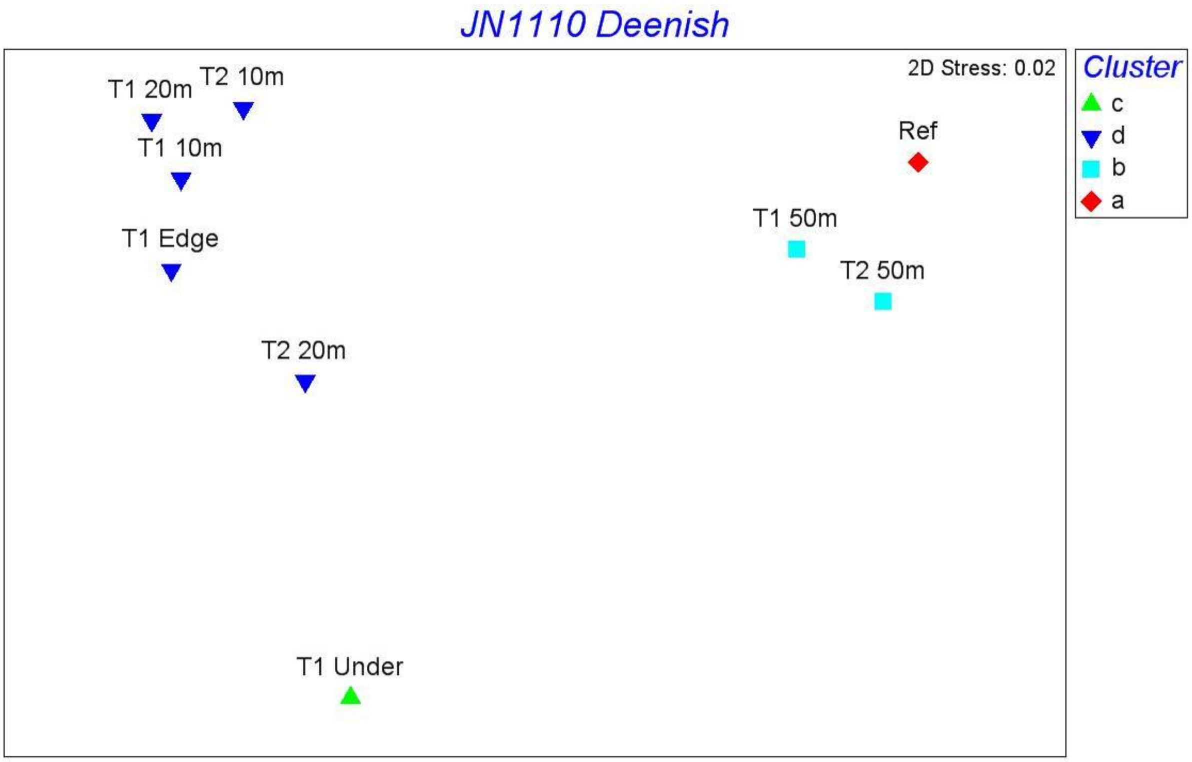


Figure 25: MDS plot.

3.1.11. Organic Carbon Analysis

Table 4 gives the organic carbon results for the Deenish site.

T1	Under	Edge	10m	20m	50m	100m
%	16.68	23.02	20.68	42.05	19.41	20.18
T2	**Under**	**Edge**	**10m**	**20m**	**50m**	**REF**
%	-	19.11	20.11	22.32	19.12	20.12

Table 4: Organic carbon results from the Deenish stations (% values, Loss on Ignition at 1000°C).

3.2. Inishfarnard

3.2.1. Recent Stocking History

Fish were stocked to the Inisfarnard cages on 15th and 27th May 2010. Additional fish were brought from the Deenish site in March 2011. The site was fallow for a period of 42 days prior to stocking. Mean current speed at the site is $0.2ms^{-1}$. A maximum biomass of 200 tonnes is stocked in each cage. These fish are due to be ongrown on site and harvested between July 2011 and January 2012. No fish are harvested on site. The licence for the Inisfarnard site states *"The licensee shall not harvest any more than 500tons " dead weight" in any given year."*

Figure 26. Cages at the Inisfarnard site, viewed at sea, July 27th 2011.

3.2.2. Seabed Physical Characteristics

The seabed was composed of a mix of seafloor types with areas of:

- Firm muddy sand – directly under, at the edge of and 10m from the cage
- Medium/coarse sand with shell gravel further away from the cage.

There was some obvious evidence on the seafloor that indicated proximity to a fish farming operation.

3.2.3. Photographic record; Transect 1

This transect began beneath the cage second in from the western side of the farm in the southernmost row of cages (see Figure 27) and ended approximately 100 m to the south. A total of six stations were investigated.

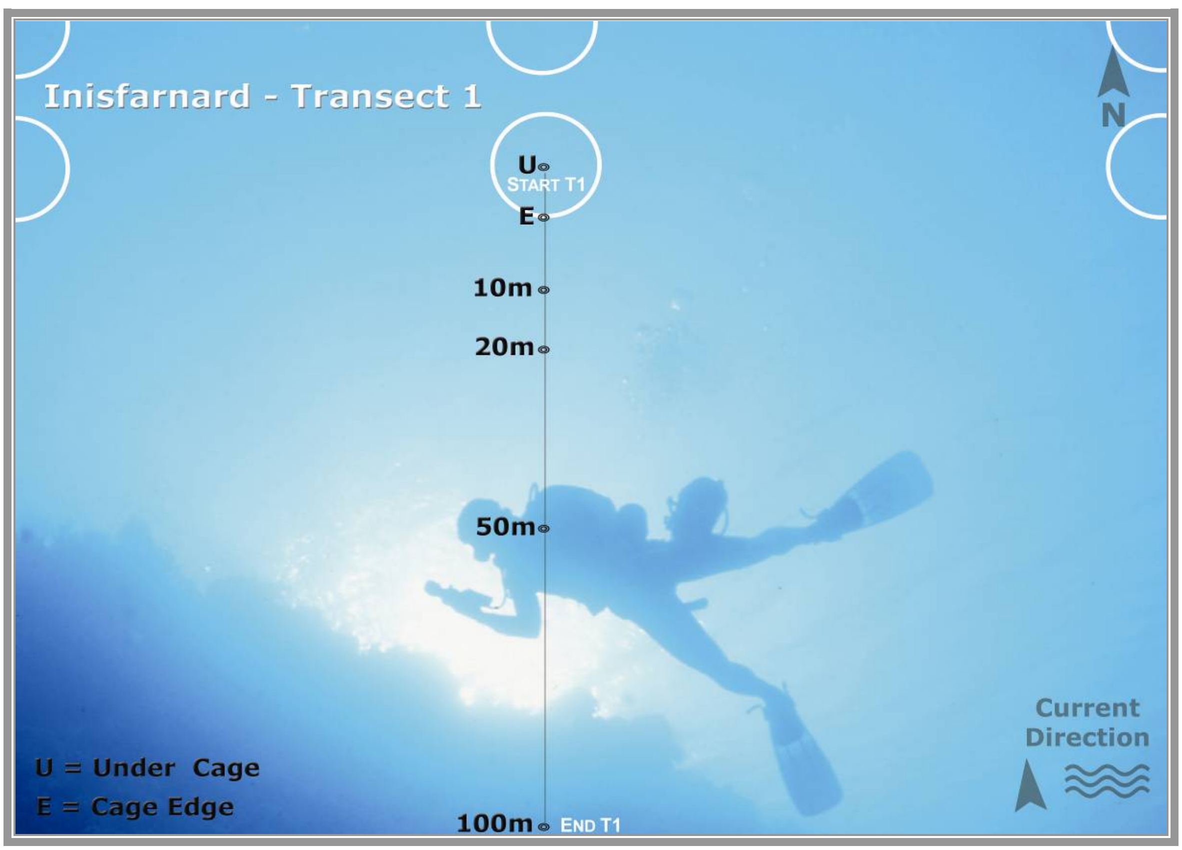


Figure 27. Transect 1 seafloor station layout, Inisfarnard site, July 27th 2011.

3.2.3.1. Under Cage Location

The cages on site were stocked at the time of the survey. The seafloor here was composed of firm sand with a silt/mud fraction. There were obvious signs on the seafloor that finfish cages were overlying the site:

- Waste feed pellets and faecal casts
- A layer of *Beggiatoa* spp. at the sediment surface
- Small fragments of farm debris (rope fragments, length of steel)
- Shallow ARPD depths

Small fragments of drift algal material were noted.

Figure 28. T1 – Under cage, Inisfarnard site, Kenmare River, July 27th 2011.

3.2.3.2. Edge of Cage Location

Firm muddy sand. There were obvious signs on the seafloor that finfish cages were overlying the site:

- Waste feed pellets and faecal casts
- A layer of *Beggiatoa* spp. at the sediment surface
- Shallow ARPD depths

Fragments of drifting algae were noted.

Figure 29. T1 – Cage edge, Inisfarnard site, Kenmare River, July 27th 2011.

3.2.3.3. 10m from Cage

The seafloor at the 10m station was composed primarily firm muddy sand. There were clear signs that finfish cages were nearby.

- Waste feed pellets and faecal casts
- A layer of *Beggiatoa* spp. at the sediment surface
- Shallow ARPD depths

Specimens of a burrowing brittlestar (*Amphiura* sp.), tube anemones (*Cerianthus lloydii*) and seven—armed starfish (*Luidia ciliaris*) were recorded.

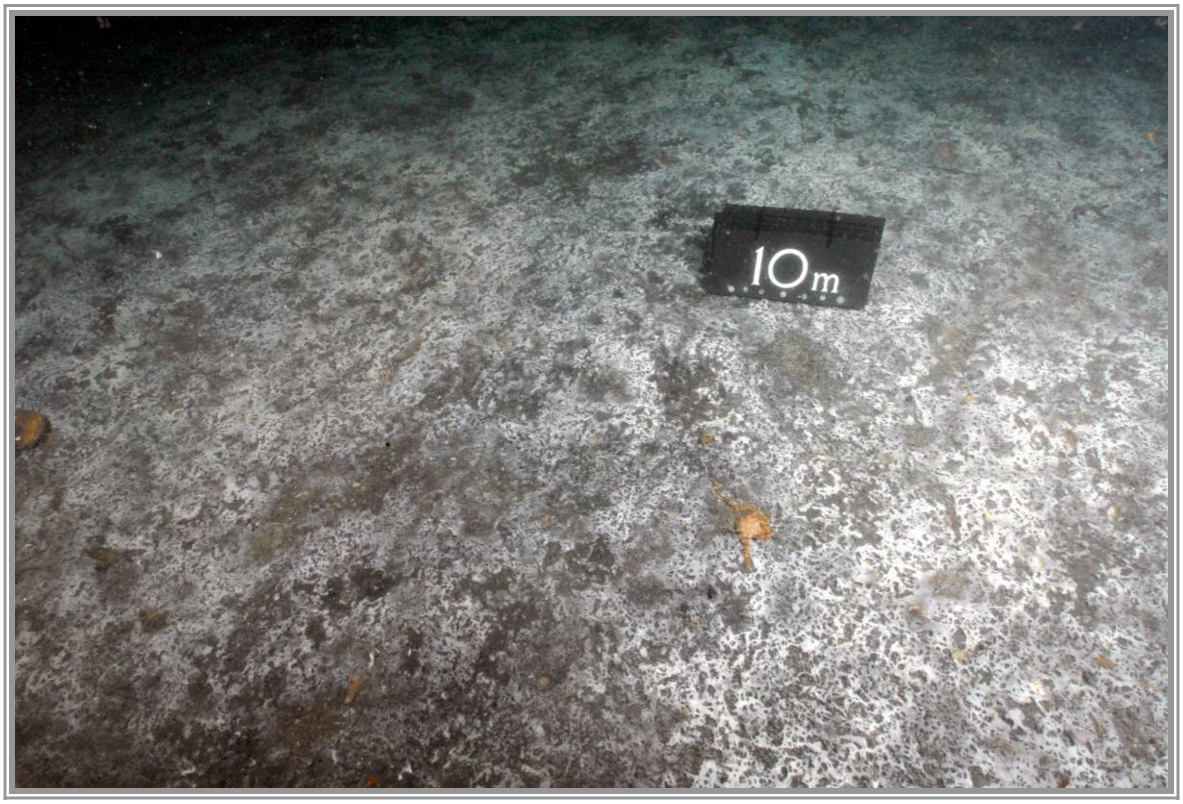


Figure 30. T1 – 10m, Inisfarnard site, Kenmare River, July 27th 2011.

3.2.3.4. 20m from Cage

The seafloor at the 20m station was composed of a mix of coarse and medium sand with some shell gravel. There were some signs of the nearby finfish rearing operation:

- Small patches of *Beggiatoa* spp.

A number of tube anemones (*Cerianthus lloydii*) were recorded.

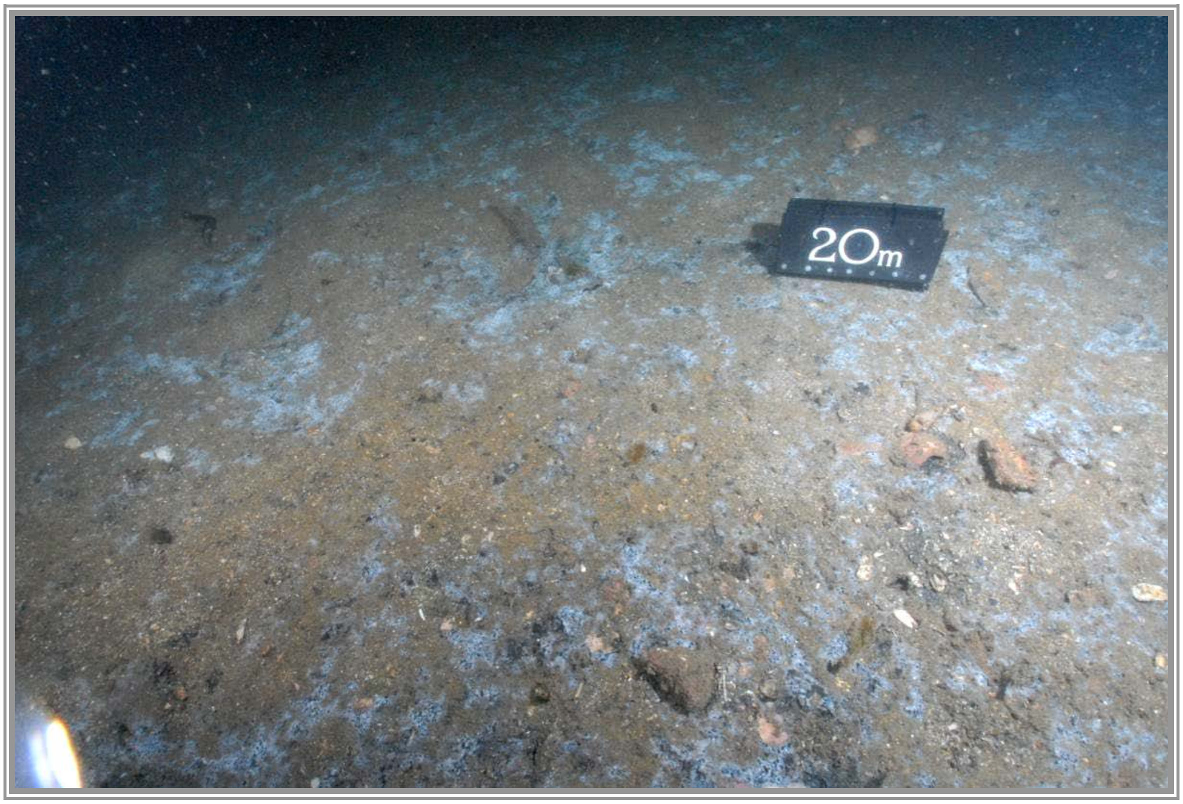


Figure 31. T1 – 20m, Inisfarnard site, Kenmare River, July 27th 2011.

3.2.3.5. 50m from Cage

Medium and coarse sand with shell gravel. There were little if any signs of impact from the nearby finfish rearing operation:

- Seafloor 'clean' and free of feed/faecal material
- Substrate conditions & species typical of this site

A specimen of edible crab (*Cancer pagurus*), numerous juvenile starfish (*Asterias rubens*) and calcareous tube worms (*Pomatoceros* sp.) were noted. Drifting fragments of algal fronds were recorded at the sediment surface.

Figure 32. T1 – 50m, Inisfarnard site, Co. Cork, July 27th 2011.

3.2.3.6. 100m from Cage

A seafloor composed of medium and coarse sand with shell gravel. There were no apparent signs of impact from the nearby finfish rearing operation:

- Seafloor 'clean' and free of feed/faecal material.
- No items of farm debris recorded

Species recorded included tube anemones (*Cerianthus lloydii*), the parchment tube worm (*Chaetopterus variopedatus*), seaweed (*Phycodrys* sp.) and gobies (*Pomatoschistus* sp.). This station marked the end of Transect 1.

Figure 33. T1 – 100m, Inisfarnard site, Co. Cork, July 27th 2011.

3.2.4. Sediment Profile Imagery - Transect 1

The following two plates present sediment profile images taken at the six stations visited on Transect 1 of the Inisfarnard site. They display a single image and the maximum and minimum apparent redox potential discontinuity (ARPD) depths measured at each station. The composition of sediments at each station can be seen. The variation of the shell fraction in surface sediments can be seen from station to station – increasing with increasing distance from the cages. Each image is 15.5cm × 25cm.

Uneaten feed and faecal material can be seen as a thin layer at the under cage station.


TRANSECT 1
UNDER
ARPD depth
Min: 0.00cm
Max: 0.00cm
Mean: 0.00cm
EDGE
ARPD depth
Min: 0.00cm
Max: >8.00cm
Mean: 1.24cm
10m
ARPD depth
Min: 0.00cm
Max: >7.66cm
Mean: 2.46cm
AQUAFACT
ENVIRONMENTAL SURVEY SPECIALISTS
FINFISH SITE
INISFARNARD
TRANSECT 1


TRANSECT 1
20m
ARPD depth
Min: 0.00cm
Max: >10.09cm
Mean: 5.11cm
50m
ARPD depth
Min: 0.00cm
Max: >8.00cm
Mean: 6.80cm
100m
ARPD depth
Min: >7.43cm
Max: >9.92cm
Mean: 8.57cm
AQUAFACT
ENVIRONMENTAL SURVEY SPECIALISTS
FINFISH SITE
INISFARNARD
TRANSECT 1

3.2.5. Photographic record - Transect 2

This transect began beneath the same cage as transect 1. A total of five stations were investigated on Transect 2 with an additional (reference) station investigated just over 200m from the cage edge.

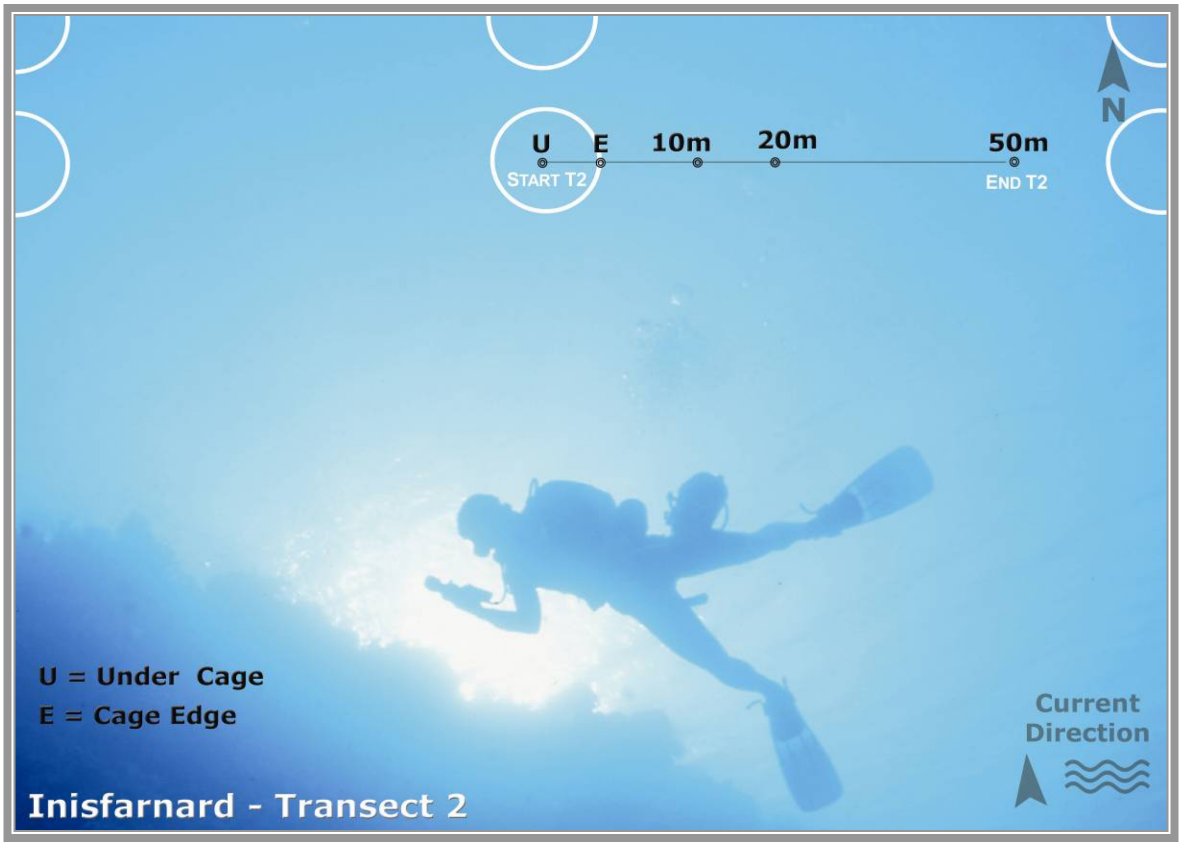


Figure 34. Transect 2 seafloor station layout, Inisfarnard site, July 27th 2011.

3.2.5.1. Under Cage Location

This station was located beneath the same cage as the *Under Cage* station on Transect 1. Seafloor conditions are therefore similar. There were obvious signs on the seafloor that finfish cages were overlying the site:

- Uneaten feed pellets
- A scattering of faecal casts
- A layer of *Beggiatoa* spp. overlying the sediment (medium sand)

Figure 35. T2 – Under cage, Inisfarnard site, Co. Cork, July 27th 2011.

3.2.5.2. Edge of Cage Location

Medium sand with silt and high organic content. There were some obvious signs on the seafloor that finfish cages were overlying the site:

- A scattering of uneaten feed pellets
- Patches of *Beggiatoa* spp.
- Numerous faecal casts

Figure 36. T2 – Cage edge, Inisfarnard site, Co. Cork, July 27th 2011.

3.2.5.3. 10m from Cage

Medium/coarse sand with some shell gravel. There some slight signs on the seafloor that finfish cages were close by:

- Occasional uneaten feed pellets
- A patchy layer of *Beggiatoa* spp.

A substantial amount of decaying algal material was noted on the seafloor at this station. Two seven-armed starfish (*Luidia ciliaris*) were recorded as were numerous small tube anemones (*Cerianthus lloydii*).

Figure 37. T2 - 10m, Inisfarnard site, Co. Cork, July 27th 2011.

3.2.5.4. 20m from Cage

Medium/coarse sand with shell gravel.

- Seafloor free of feed and faecal material
- Patchy layer of *Beggiatoa* spp. cover

Numerous tube anemones (*Cerianthus lloydii*) were recorded.

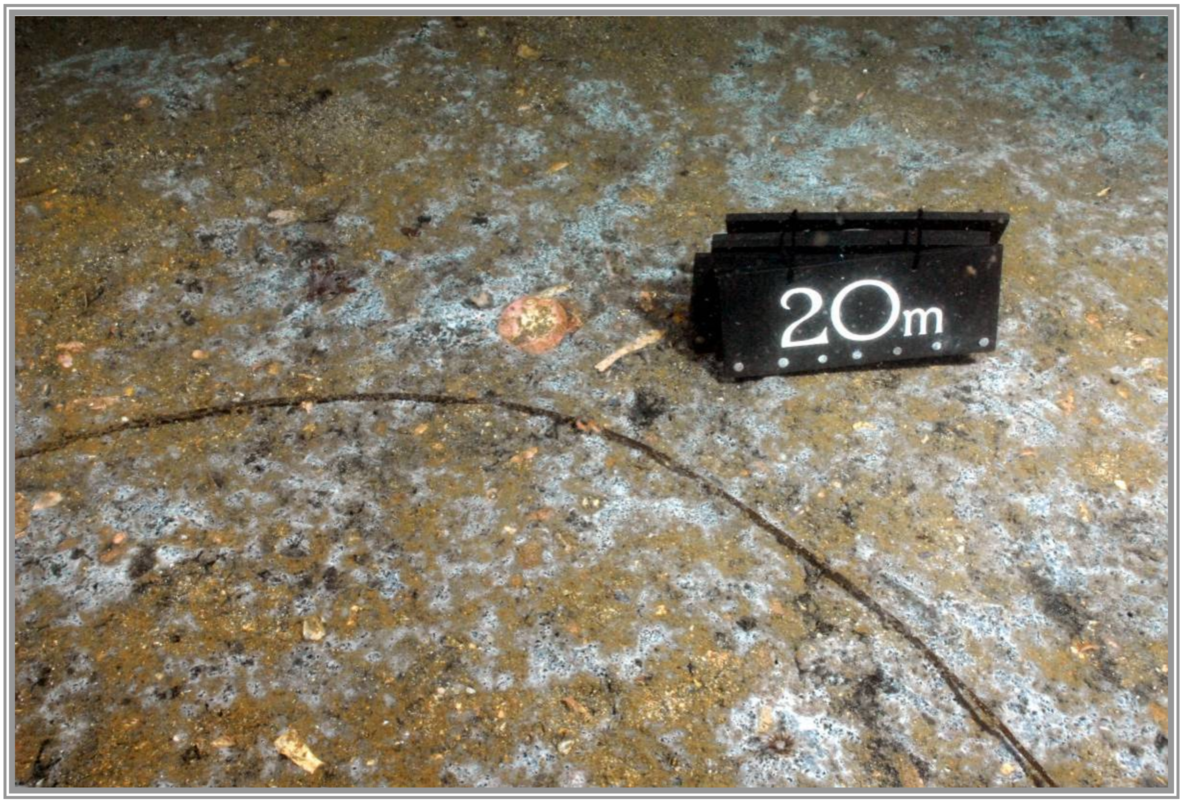


Figure 38. T2 – 20m, Inisfarnard site, Co. Cork, July 27th 2011.

3.2.5.5. <u>50m from Cage</u>

The seabed here was composed of medium/coarse sand with a shell gravel fraction. Occasional fragments drifting algal fronds and parchment worms (*Chaetopterus variopedatus*) were noted.

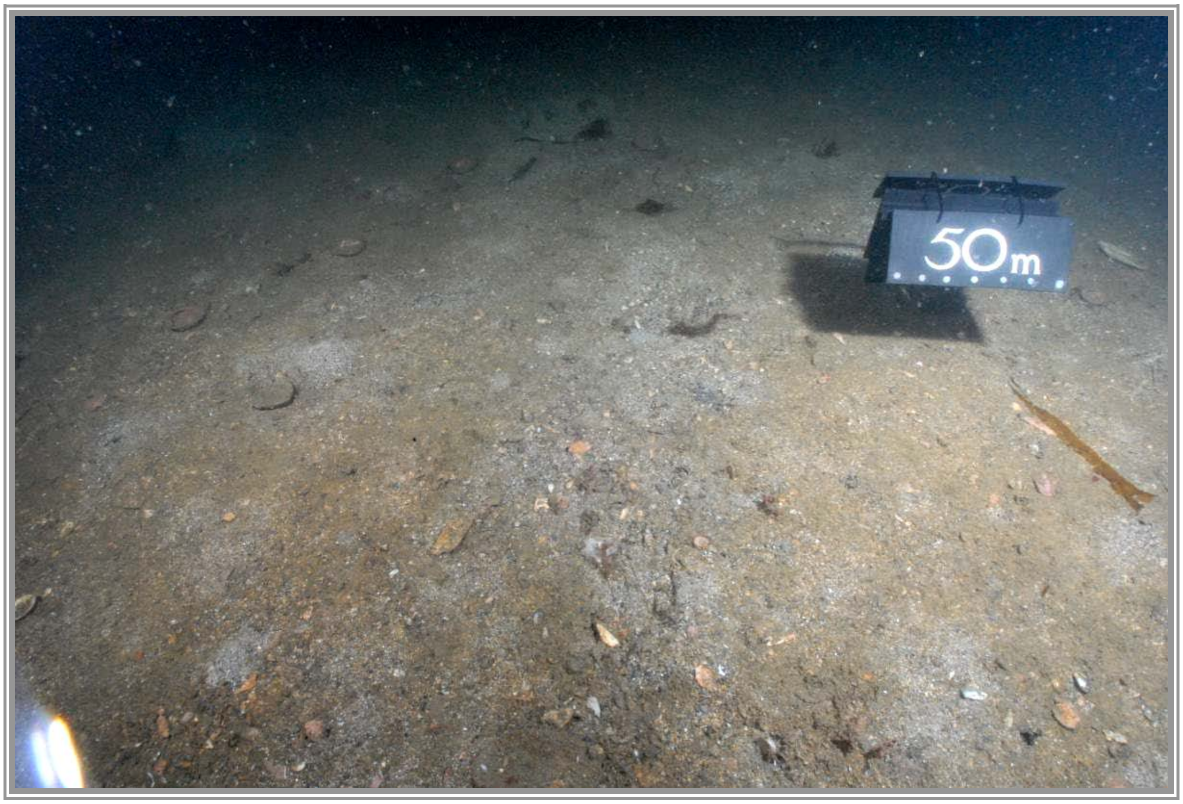


Figure 39. T2 – 50m, Inisfarnard site, Co. Cork, July 27th 2011.

3.2.6. Reference Station

This photograph was taken at a distance of approximately 200m from the cage edge. Sediments at the reference station were composed of medium/coarse sand with shell gravel and occasional cobbles. There were no apparent signs of impact from the nearby finfish rearing operation:

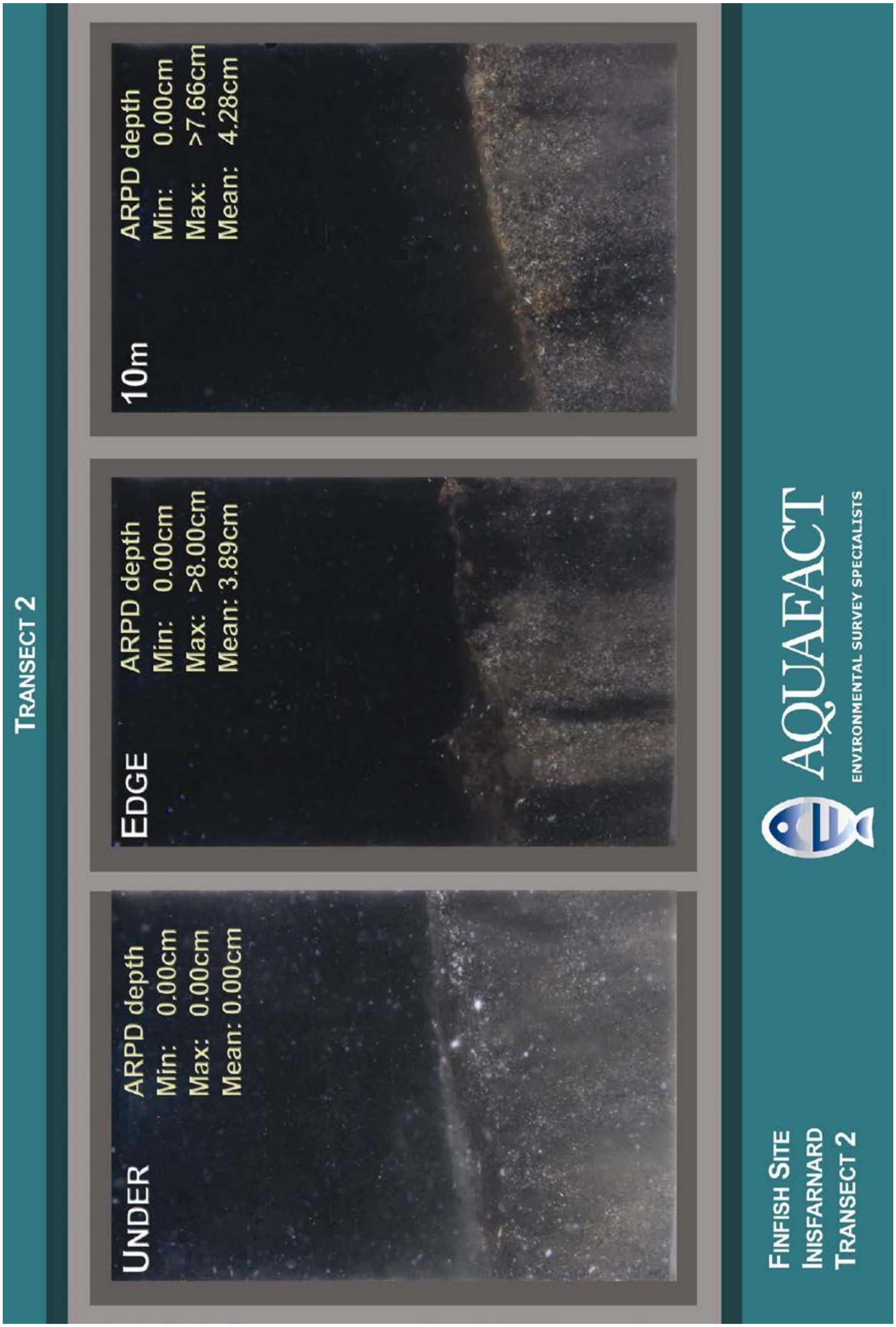
- Seafloor 'clean' and free of feed/faecal material, *Beggiatoa* spp. cover
- No items of farm debris
- Presence of 'normal' flora and fauna for this area

Numerous tube anemones (*Cerianthus lloydii*), parchment worms (*Chaetopterus variopedatus*) and a king scallop were noted. Drifting fragments of algal fronds were recorded.

Figure 40. Reference Station, Inisfarnard site, Co. Cork, July 27th 2011.

3.2.7. Sediment Profile Imagery Transect 2 & Reference

The following two plates present sediment profile images taken at the five stations visited on Transect 2 of the Inisfarnard site and the reference station. They display a single image and the maximum and minimum apparent redox potential discontinuity (ARPD) depths measured at each station. The composition of sediments at each station can be seen. The variation of the shell fraction in surface sediments can be seen from station to station – increasing with increasing distance from the cages. Each image is 15.5cm × 25cm.


Transect 2
Under
ARPD depth
Min: 0.00cm
Max: 0.00cm
Mean: 0.00cm
Edge
ARPD depth
Min: 0.00cm
Max: >8.00cm
Mean: 3.89cm
10m
ARPD depth
Min: 0.00cm
Max: >7.66cm
Mean: 4.28cm
AQUAFACT
ENVIRONMENTAL SURVEY SPECIALISTS
Finfish Site
Inisfarnard
Transect 2


TRANSECT 2
20m
ARPD depth
Min: 0.00cm
Max: >8.45cm
Mean: 6.47cm
50m
ARPD depth
Min: 4.14cm
Max: >9.48cm
Mean: 5.64cm
REF
ARPD depth
Min: >8.77cm
Max: >10.53cm
Mean: 9.65cm
FINFISH SITE
INISFARNARD
TRANSECT 2
AQUAFACT
ENVIRONMENTAL SURVEY SPECIALISTS

3.2.8. Transect Species List

Table 5 gives the species recorded during the dive survey at the Inishfarnard fish farm site on the 27th July 2011.

Table 5: Species recorded during the dive at the Inishfarnard fish farm site.

Group	Species	Common Name
(Cnidaria) Hexacorallia	*Cerianthus lloydii*	Tube anemone
(Annelida) Polychaeta	*Pomatoceros* sp. *Chaetopterus variopedatus*	Tube worm Parchment tube worm
(Arthropoda) Decapoda	*Cancer pagurus*	Edible crab
Echinodermata	*Luidia ciliaris* *Asterias rubens* *Amphiura sp.*	Seven armed starfish Common starfish Brittlestar
(Chordata) Osteiichthyes	*Pomatoschistus* sp.	Gobies
Rhodophyta	*Phycodrys sp.*	Sea oak

3.2.9. Supplementary photograph

3.2.9.1. Compass jellyfish

Many compass jellyfish were noted in the water column surrounding the Inisfarnard site at the time of the current survey. This is a pelagic species, common in the summer months and has a relatively strong sting. It's stinging tentacles and oral arms provide a mobile, mid-water safe haven from predation for the young of some fish species. The photograph shows a downed specimen at the sediment surface. Numerous tube anemones were recorded at the sediment surface. This photograph was taken just beyond the 50m station on Transect 2 of the current survey.

Figure 41. Downed compass jellyfish (*Chrysaora hysoscella*) – Inisfarnard site, Co. Cork, July 27th 2011.

3.2.9.2. Seven-armed starfish

A view of a seven-armed starfish (*Luidia ciliaris*) taken just beyond the Reference station on Transect 2. This individual has probably sustained major damage in the past – it appears to have regenerated from little more than a single arm. Tube anemones (*Cerianthus lloydii*) were noted here. The coarse nature of the sediment surface is evident.

Figure 42. Luidia ciliaris, Inisfarnard site, Co. Cork, July 27th 2011.

3.2.10. Benthic Macrofaunal Analysis

The taxonomic identification of the benthic infauna across all 10 stations sampled at the Inishfarnard fish farm site yielded a total count of 189 taxa accounting for 8,775 individuals, ascribed to 10 phyla. A complete listing of the taxa abundance is provided in Appendix 3.

Of the 189 taxa enumerated, 78 were annelids (segmented worms), 43 were crustaceans (crabs, shrimps, prawns), 45 were molluscs (mussels, cockles, snails etc.), 15 were echinoderms (starfish, brittlestars, sea cucumbers), 2 were chelicerata (sea spiders), 2 were cnidarians (sea anemones), 1 was a hemichordate (worm-like creatures closely related to Chordata and Echinodermata), 1 was a sipulculid (peanut worms), 1 was a cephalochordate (lancelet) and 1 was a phoronid (horseshoe worm).

3.2.10.1. Univariate Analysis

Univariate statistical analyses were carried out on the combined replicate station-by-station faunal data. The following parameters were calculated and can be seen in Table 6; taxon numbers, number of individuals, richness, evenness and diversity. Taxon numbers ranged from 41 (T1 Under) to 78 (Ref). Numbers of individuals ranged from 178 (T1 100m) to 2,648 (T1 Edge). Richness ranged from 5.32 (T2 10m) to 13.89 (Ref). Evenness ranged from 0.26 (T1 Edge) to 0.92 (T1 100m). Diversity ranged from 1.53 (T1 Edge) to 5.50 (T1 100m).

Table 6: Diversity indices.

Station	No. Taxa	No. Individuals	Richness	Evenness	Diversity
T1 Under	41	940	5.84	0.32	1.69
T1 Edge	56	2648	6.98	0.26	1.53
T1 10m	60	1330	8.20	0.47	2.75
T1 20m	72	1037	10.22	0.49	3.03
T1 50m	61	255	10.83	0.82	4.86
T1 100m	63	178	11.96	0.92	5.50
T2 10m	38	1045	5.32	0.36	1.90
T2 20m	66	569	10.25	0.70	4.25
T2 50m	70	517	11.04	0.50	3.05
Ref	78	256	13.89	0.86	5.38

3.2.10.2. Multivariate analysis

The dendrogram and the MDS plot can be seen in Figures 43 and 44 respectively. The stress value of the MDS is 0.06 which indicates a good representation of the data with no real prospect for misinterpretation. SIMPROF analysis revealed 5 statistically significant groupings between the 10 stations (hence the black line joining each group of stations in the dendrogram).

The stations which were the most similar to each other were T1 Under, T1 Edge and T1 10m. These stations formed Group d at a similarity level of 64.26%. Four species accounted for 86.9% of the faunal abundance at these stations: the polychaetes *Capitella* sp. (65.6%) and *Phyllodoce mucosa* (14%), the bivalve mollusc *Mytilidae* sp. (4.4%) and the polychaete *Mediomastus fragilis* (3%).

Group d was joined by three other stations (Group e; T1 20m, T1 50m and T2 20m) at a similarity level of 54.05%. Group e itself, had a similarity level of 57.66 and was dominated by the same species as Group d but in different percentage abundances: *Mytilidae* sp. (41.5%), *Mediomastus fragilis* (8.3%), *Phyllodoce mucosa* (7.1%) and *Capitella* sp. (5.6%).

Both of these groups were joined by station T2 10m (Group c) at a similarity level of 49.69%. Four species accounted for 92.8% of the faunal abundance at this station: the polychaete *Capitella* sp. (46.3%), the bivalve mollusc *Mytilidae* sp., (41.4%) and the polychaetes *Phyllodoce mucosa* (4%) and *Mediomastus fragilis* (1.2%).

Group b (T1 100m and Ref) formed a group at a similarity level of 54.82%. This group joined the three previously mentioned groups at a similarity level of 44.88%. These stations were richer and more diverse than the other stations and this is evidenced by the fact that 18 different species account for approximately 60% of the faunal abundance. The top five species accounted for 32% of the faunal abundance: the gastropod *Caecum trachea* (9.5%), the chiton *Leptochiton cancellatus* (7.1%), the polychaete *Pholoe inornata* (6.7%), the sea cucumber *Neopentadactyla mixta* (4.8%) and the polychaete *Sabellidae* sp. (3.9%).

Station T2 50 (Group a) separated from all other stations due to the predominance of one species *Mytilidae* sp. at this station. *Mytilidae* sp. accounted for over 60% of the faunal abundance at this station. The next two dominant species were the tanaid crustacean *Tanaopsis graciloides* (3.7%) and the polychaete *Mediomastus fragilis*

(3.1%).

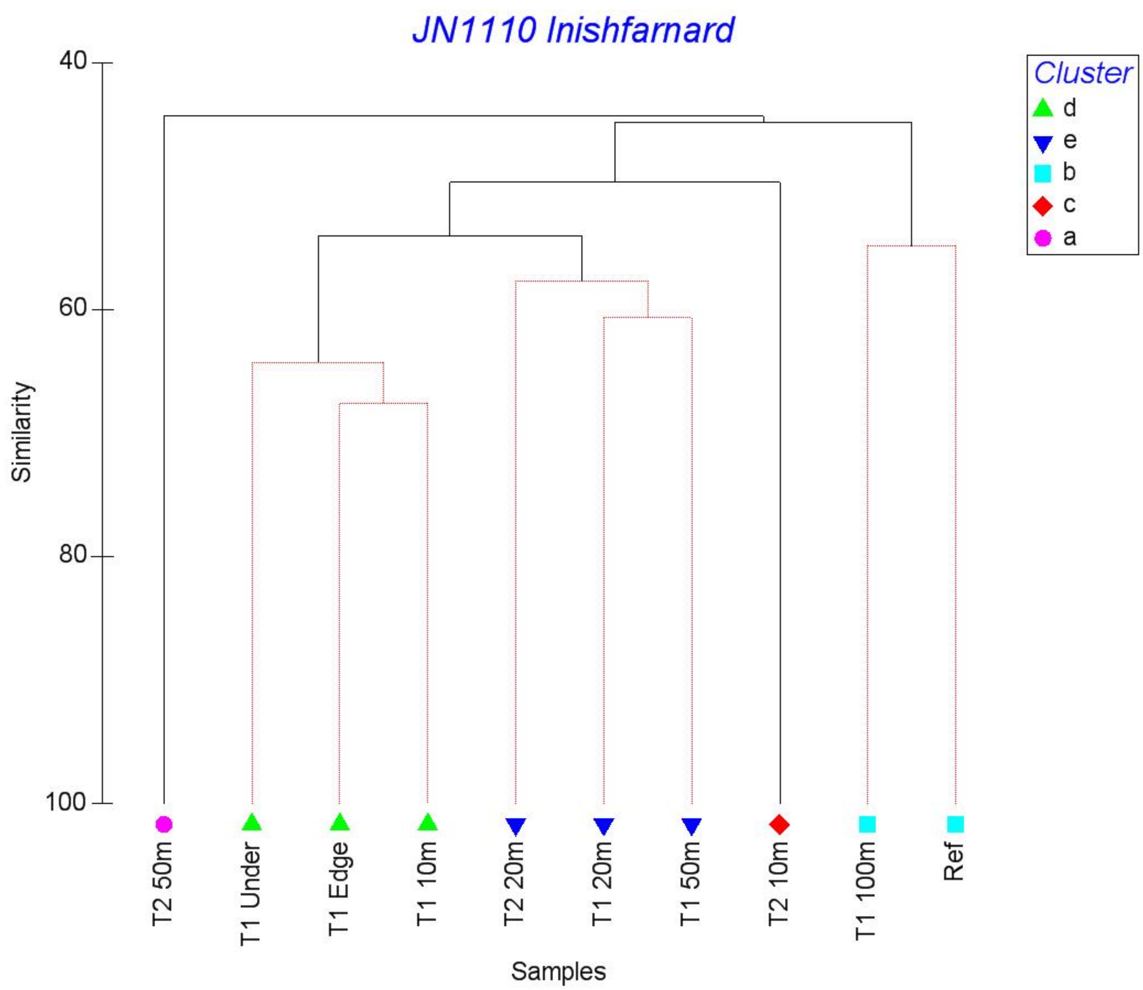


Figure 43: Dendrogram produced from Cluster analysis.

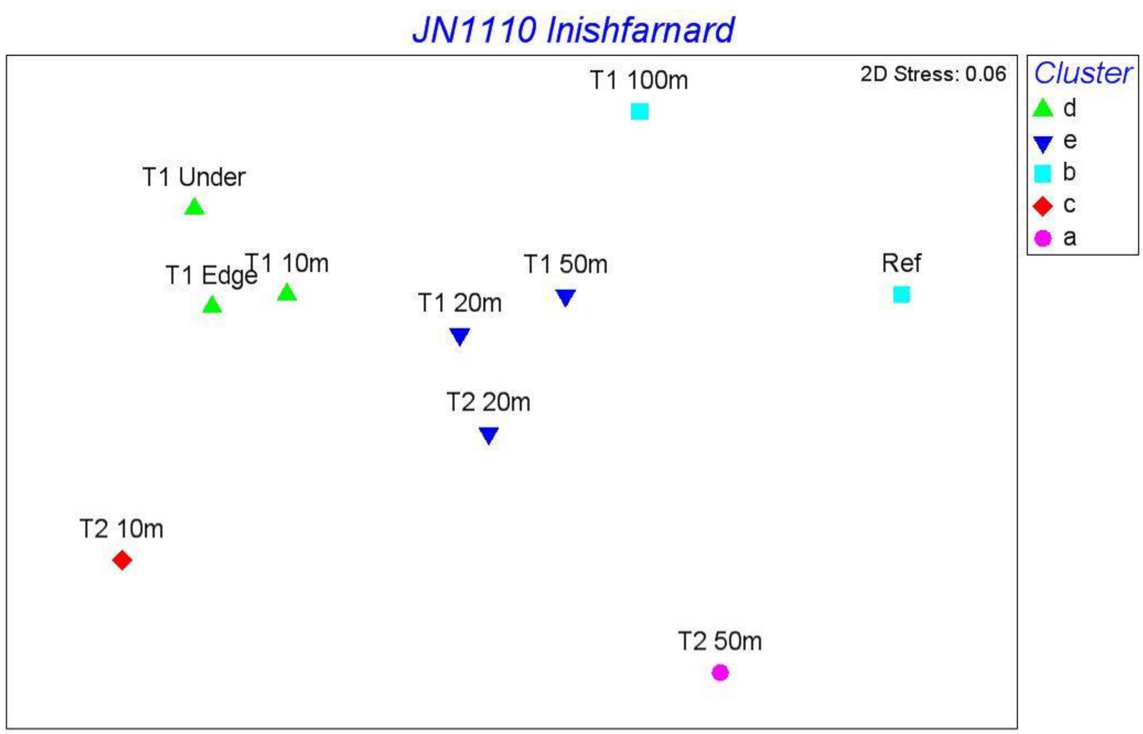


Figure 44: MDS plot.

3.2.11. Organic Carbon Analysis

Table 7 shows the organic carbon results from the Inishfarnard stations.

T1	Under	Edge	10m	20m	50m	100m
%	34.47	36.71	36.29	30.78	27.07	39.28
T2	Under	Edge	10m	20m	50m	REF
%	-	35.76	33.74	35.56	37.01	30.94

Table 7: Organic carbon results for Inishfarnard (% values, Loss on Ignition at 1000°C).

4. Discussion

The extent to which an overlying fish farm impacts the seafloor is largely dependant on:

- the feeding regime at that farm, i.e. the amount of food that eventually ends up on the seafloor
- the degree of current movement at the site in question and
- the depth of water at that site.

These factors combine to form either erosional or depositional locations where organic material is either dispersed or accumulates, and subsequently affects the receiving environment, in this case the seafloor. The type of animal community living at a particular site will also play a role in determining bottom conditions there. The influence of feeding activities of populations of starfish, polychaete worms, anemones, crabs and finfish at the Deenish and Inisfarnard sites largely determine the level of impact of overlying farm operations on the benthos there.

Faunal feeding activity can remove large amounts of waste organic material from the seabed beneath a farm facility – with groups of mobile fauna capable of consuming large quantities of material. The fallowing schedule at a site also has a large bearing on benthic impact – most notably the length of time cages have been on site since the last fallow period. The presence of opportunistic deposit feeders such as *Capitella* sp., most notably at the under cage and cage edge stations will tend to help keep the benthic organics in a state of equilibrium at the fish farm sites. Sedimentary organic carbon levels were moderate on the Deenish site and high at all stations investigated at the Inisfarnard site.

Mobile epibenthic scavengers such as starfish, fish and crabs also help in reducing the amount of waste material on the seafloor. This potential speed of the removal of waste was demonstrated in a previous study where photographic evidence was collected showing that epibenthic macrofauna were capable of removing, in less than 7 days, fish feed pellets spread at a density of 3.4kg dry weight per m^2 on the sediment under a marine fish farm (Smith *et al.*, 1997).

Results from previous surveys of the seafloor beneath the Inisfarnard and Deenish Island cage blocks showed few obvious signs of impact and in general, the superficial appearance of the seafloor was healthy beyond the 10m-20m stations.

Based on the benthic photographic records taken during the current surveys, little habitat degradation is obvious beyond the 10m station on both transects at the Deenish site and beyond the 20m station on both transects at the Inisfarnard site.

Detailed faunal analysis of grab and core samples showed a clear divide between the stations closest to the cage and those furthest away at the Deenish site. The faunal results show that the impacts of the fish farm extend at least 20m but less than 50m from the cage on both transects. The species which dominated in and around the cages ranged from species that are tolerant to excess organic matter enrichment (e.g. *Phyllodoce mucosa* and *Mytilidae* sp.) to first order opportunistic species that proliferate in reduced sediments (e.g. *Capitella* sp.). The stations 50m and further from the cages were dominated by species very sensitive to organic enrichment and present under unpolluted conditions (e.g. *Photis longicaudata*, *Amphipholis squamata, Leptochiton cancellatus* and *Ophiocomina nigra*).

The grab and core analysis at the Inishfarnard site revealed that the stations under and at the edge of the cage contained large numbers of first-order opportunistic species which thrive in areas of organic enrichment (e.g. *Capitella* sp.). Both of the 10m stations also contained high numbers of first-order opportunists, along with high numbers of tolerant species who can undergo rapid population growth due to organic enrichment (e.g. *Mytilidae* sp. and *Mediomastus fragilis*). A distance of 20m from the fish farm cage, much lower numbers of first-order opportunists were present, been replaced by tolerant species and further afield by species very sensitive to enrichment (e.g. *Caecum trachea* and *Leptochiton cancellatus*).

5. Conclusion

Benthic audit surveys were carried out at the Deenish and Inishfarnard fishfarm sites operated by Marine Harvest Ireland Ltd. on 27^{h} July 2011. The survey followed the DCMNR Level II monitoring protocols (refer to Table 1 for tonnage/current speed relationships to identify level of benthic monitoring required). In the present surveys beneath the cage blocks there were some obvious signs of impact from the farming operation on the benthos:

- Waste feed/faecal material (and bacterial mat) was present as far as the 20m station on Transect 1 at Inisfarnard, and as far as the 10m on Transect 1 at Deenish. The amount of waste feed and faecal material fell off dramatically with increasing distance from the cage edge.

Detailed faunal analysis at the Deenish site showed a clear divide between the stations closest to the cage and those furthest away. The faunal results show that the impacts of the fish farm extend at least 20m but less than 50m from the cage on both transects.

Detailed faunal analysis at the Inisfarnard site also show that the impacts of the fish farm extend at least 20m but less than 50m from the cage on both transects.

Based on the results of the dive survey no signs of impact were readily appreciable beyond the 20m stations on all transects – no waste feed or faecal material was noted, ARPD depths were good beyond the cage edge stations and no bacterial mat or outgassing was recorded. Results of the detailed analysis of benthic fauna showed that the impact of the fish farm extended beyond 20m but less than 50m at the Deenish site and out to approximately 10m from the cages at the Inishfarnard site.

The good benthic conditions at Inisfarnard can largely be attributed to:

- the favourable hydrographic conditions at the sites
- the relatively low stocking densities and tonnages held in the cages
- the feeding activities of benthic fauna and
- good animal husbandry practice.

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Appendix 1

SPI – Apparatus and data analysis

SEDIMENT PROFILE IMAGERY:

APPARATUS AND DATA ANALYSES

APPARATUS AND DEPLOYMENT

A remotely operated sediment profile camera is used to obtain *in situ* digital profile images of up to 20 cm of the top layers of sediment on the seafloor. It differs from other underwater cameras in that it vertically slices through the sediment-water interface and images the sediment section in profile. Functioning like an inverted periscope, it consists of a wedge-shaped prism with a plexiglass face plate. Light is provided internally by a flash strobe and the back of the prism has a mirror mounted at a 45° angle. This reflects the image of the sediment-water interface at the face plate up to the camera, which is housed on top of the prism. The camera - prism assembly is supported by an inner frame or cradle which can move relative to an outer supporting frame under control of a 'passive' hydraulic piston (see Figure 1).

The camera prism assembly cradle can be moved up and down by producing tension or slack on the winch wire. As the camera is lowered to the seafloor, tension on the winch wire keeps the prism in the up position. The supporting frame lands on the bottom first, leaving the area directly under the prism undisturbed. As the winch wire is slackened, the prism cradle descends toward the bottom at a controlled rate of fall (Figure 2). The wedge-shaped prism enters the bottom and is driven into the sediment by its weight. The piston ensures that the prism enters the bottom slowly and does not disturb the sediment - water interface. Additional lead weights can be attached to the prism cradle to assist prism penetration if required.

On impact with the bottom, a trigger activates a time delay on the camera shutter release and a digital photograph is taken when the prism comes to rest. Because the sediment is photographed directly against the face plate, turbidity of the ambient seawater does not affect image quality. After the photograph or image is taken, tension on the winch wire raises the prism cradle to the up position, a wiper blade cleans off the face plate, the strobe is recharged and the camera can be lowered for another image. In this manner the SPI assembly can be rapidly 'hopped' over the seabed and a series of images obtained at any one sampling location. After the camera is taken back on board a rubber ring records the depth the camera had penetrated and a counter records the number of successful image shots taken. Specific measurement techniques and interpretive considerations for the analysis of a range of parameters from the SPI images are presented below.

A compact, equally effective diver operated sediment profile camera apparatus (Figure 3) has been developed for operation in shallow waters and shallow areas generally inaccessible by the larger remotely operated machine. As with the remotely operated SPI camera, the camera prism is mounted on a supporting stabiliser frame which can be moved up and down in an action controlled by a hydraulic system. Once the camera's frame touches the bottom, the scientific diver exerts pressure on the prism housing causing it to penetrate the sediment fabric under control of the hydraulic piston. This allows the optical prism to enter the bottom at approximately 6 cm sec^{-1}. The slow fall rate ensures that the descending prism does not impact the bottom at a high rate and therefore minimizes disturbance of the sediment-water interface. The prism is driven several centimeters into the seafloor and the camera trigger is tripped so that a photograph is taken. The diver ensures that the SPI frame is not moved or disturbed in any way while the camera is taking a picture so that any physical disturbance of the sediment detected in a SPI image is not an artifact caused by the instrument itself.

DATA ANALYSIS

Images are captured using Canon EOS 450D digital SLR cameras (12 megapixel) and Nikkor optics and are stored on SD (secure digital) memory cards. They are downloaded to a laptop computer before being analysed in detail. The image analysis system used can discriminate a wide range of different grey scales, so subtle features can accurately be digitised and measured.

Customised software in conjunction with an image analysis system is used for the analysis of a series of 21 physical, chemical and biological parameters on each image. Before all measurements from each SPI image are stored on disk, a summary display is made on the screen so the operator can verify if the values stored in memory for each variable are within expected range; if anomalous values are detected, software options allow re-measurement before storage on disk. All data stored on disks are printed out on data sheets for editing by the principal investigator and as a hard-copy backup of the data stored on disk; a separate data sheet is generated for each SPI image. Disk storage of all SPI parameters allows any variable of interest to be compiled, sorted, graphed, or compared statistically.

A great deal of information about benthic processes is available from sediment profile images. Measurable parameters, many of which are calculated directly by image analysis, include physical / chemical parameters (i.e. sediment type measured as grain size major mode, prism penetration depth providing a relative indication of sediment shear strength, sediment surface relief, condition of mud clasts, redox potential discontinuity depth and degree of contrast, sediment gas voids) and biological parameters (i.e. infaunal successional stage of a well documented successional paradigm for soft marine sediments (see Pearson and Rosenberg, 1978), degree of sediment reworking, dominant faunal type, epifauna and infauna, apparent species richness, depth of faunal activity, presence of microbial aggregations).

A multi- parameter organism-sediment index (OSI) is calculated on the basis of the measured physical and biological parameters. This index characterises habitat quality and has been found to be an excellent parameter for mapping disturbance gradients and the health status of the seabed. Specific analytical and interpretative aspects of the parameters measured from the SPI images are outlined below.

SEDIMENT TYPE DETERMINATION

The sediment grain-size major mode and range are visually estimated from the photographs by overlaying a grain-size comparator, which is at the same scale. This comparator was prepared by using the SPI camera to photograph a series of pre-prepared sediments which were graded according to the Udden-Wentworth size classification scheme. The classes of sediment used ranged from mud to granule. There are seven grain-size classes are on the comparator, i.e. < 0.063mm (≥ 4ø) (i.e. silt clay), 0.063 - 0.125mm (4-3ø) (i.e. very fine sand), 0.0125 - 0.25mm (3-2ø) (i.e. fine sand), 0.025- 0.5mm) (2-1 ø) (i.e. medium sand), 0.5 - 1.0mm (1-0ø) (i.e. coarse sand), 1.0 -2.0mm (0 to –(-)1ø) (i.e. very coarse sand), > 2.0mm (< -1ø) (i.e. gravel). Seven grain-size classes are on this comparator: ≥ 4ø, 4-3ø, 3-2ø, 2-1ø, 1-0ø, 0-(-)1ø, < -1ø. The lower limit of optical resolution of the photographic system is about 0.062mm, allowing recognition of grain sizes equal to or greater than coarse silt. The accuracy of the method has been documented by comparing the SPI estimates with grain-size statistics determined from laboratory sieve analyses.

PRISM PENETRATION DEPTH

The SPI prism penetration depth is determined by measuring both the largest and smallest linear distance between the sediment-water interface and the bottom of the digital image frame. The SPI analysis software automatically averages these maximum and minimum values to determine the average penetration depth. All three values, (maximum, minimum, and average penetration depth) are included on the data sheets. Prism penetration is potentially a noteworthy parameter; if the number of weights used in the camera is held constant throughout a survey, the camera functions as a static-load penetrometer. Comparative penetration values from sites of similar grain-size give an indication of the relative sediment bearing capacity or shear strength.

SEDIMENT BOUNDARY ROUGHNESS

Sediment boundary roughness is determined by measuring the vertical distance (parallel to the digital image border) between the highest and lowest points of the sediment-water interface. In addition, the likely origin (e.g. physical or biogenic) of this small-scale topographic relief is indicated when it is evident. In sandy sediments, boundary roughness can be a measure of sand wave height. On silt-clay bottoms, boundary roughness values often reflect biogenic features such as faecal mounds or surface burrows.

MUD CLASTS

When fine-grained, cohesive sediments are disturbed, either by physical bottom scour or faunal activity (e.g. decapod foraging), intact clumps of sediment are often scattered about the seafloor. These mud clasts can be seen at the sediment-water interface in SPI images. During analysis, the number of clasts is counted, the diameter of a typical clast is measured, and their oxidation state is assessed. Depending on their place of origin and the depth of disturbance of the sediment column, mud clasts can be reduced or oxidised (in SPI images, the oxidation state is apparent from their reflectance value; see 'Apparent redox potential discontinuity depth' section below). Also, once at the sediment-water interface, these sediment clumps are subject to bottom-water oxygen levels and bottom currents. Based on laboratory microcosm observations of reduced sediments placed within an aerobic environment, oxidation of reduced surface layers by diffusion alone is quite rapid, occurring within 6-12 hours. Consequently, the detection of reduced mud clasts in an obviously aerobic setting suggests a recent origin. The size and shape of mud clasts, e.g. angular versus rounded, is also considered. Mud clasts may be moved about and broken up by bottom currents and/or animals (macro- or meiofauna) (Germano, 1983). Over time, large angular clasts become small and rounded. Overall, the abundance, distribution, oxidation state, and appearance of mud clasts are used to make inferences about the recent pattern of seafloor disturbance in an area.

APPARENT REDOX POTENTIAL DISCONTINUITY (ARDP) DEPTH

In fine-grained coastal areas, when there is oxygen in the overlying water column, the near surface sediment will have a higher reflectance value relative to hypoxic or anoxic sediment underlying it. This is because the oxidised surface sediment contains particles coated with ferric hydroxide (an olive colour when associated with particles), while the suphidic sediments below this oxygenated layer are grey to black. The boundary between the coloured ferric hydroxide surface sediment and underlying grey to black sediment is defined here as the apparent redox potential discontinuity (abbreviated as the RPD). This 'apparent' depth may, or may not, be equivalent to the actual RPD depth, which is defined as the depth at which the Eh = 0 as measured by microelectrodes. As explained below, in most cases, the depth of Eh = 0 potential in the sediment differs from the 'apparent' RPD as imaged by SPI.

The difference between the depth of the true RPD (Eh = 0) and the imaged apparent RPD can be explained as follows. As dissolved oxygen diffuses into sediment pore water, it is consumed by a variety of biological and geo-chemical reactions. One of these reactions involves the oxidation of iron, which is precipitated onto mineral grains located at, or near, the sediment surface. Once oxidised, these ferric hydroxide-coated particles are bioturbated downward into pore-waters, which lack free molecular oxygen (negative Eh). However, the ferric hydroxide coatings are meta-stable, and reduction of the iron is a slow process relative to the rate of bioturbation. This explains the presence of oxidised grain coatings (high optical reflectance sediment) in reducing pore waters. In the presence of bioturbating infauna, the thickness of the RPD directly reflects the particle bioturbation depth.

The areal extent of the RPD is determined by digitising its unique reflectance value. This oxidised, high-reflectance area is digitised, measured to scale, and divided by the prism window width to obtain a mean depth for the RPD (or particle bioturbation depth). The RPD depth is given special attention in these analyses, because it is a sensitive indicator of the biological mixing depth, infaunal successional status, and within-station sediment patchiness. In the absence of bioturbating infauna, the RPD will achieve a maximum depth of up to 5 mm solely by diffusion depending on the concentration gradient of dissolved oxygen, reducing substrates within the sediment, water temperature (reaction rates), and sediment permeability.

The configuration of the RPD boundary is also of significance. In sandy sediments, physical forces dominate surface relief and RPD depth, which tends to be constant or uniform and does not necessarily follow the surface contours provided by bed-forms. In muddy sediments, the RPD is more complex and convoluted. Here, the RPD layers tend to be broadly uniform and more or less follow the contours of surface sediments. However, smaller scale convolutions are superimposed on this pattern in response to biogenic reworking by a resident infauna. Biogenic structures are regions of enhanced biological and geo-chemical activity where the activities of infaunal organisms can increase flux across the oxic-anoxic sediment interface (Diaz and Schaffner, 1988). Consequently, the RPD boundary is a complicated surface much greater in actual area than a simple aerial measurement would estimate and with a greater effect on sediment-water interface flux rates than is initially apparent (Diaz and Schaffner, 1988).

Another important characteristic of the RPD is the degree of contrast in reflectance values at this boundary. This contrast is related to the interactions among the amount of organic-loading and bioturbational activity in the sediment, and the levels of bottom water dissolved oxygen in an area. High inputs of labile organic material increase sediment oxygen demand, and subsequently sulphate reduction rates (and the abundance of sulphide end-products). This results in more highly reduced (lower-reflectance) sediments at depth and higher RPD contrasts. Although the SPI image analysis system quantifies the degree of contrast, this value can vary as a function of light intensity controls on the image analysis system, which are adjusted by the operator when a wide range of sediment types (e.g. silt-clay to coarse sand) is encountered. As a result, the quantified RPD contrast level may not be a meaningful parameter. However, a qualitative (visual) assessment of the RPD contrast (i.e. high versus low) is often considered in the interpretive process.

SEDIMENTARY METHANE

At extreme levels of organic-loading, pore-water sulphate is depleted, and methanogenesis occurs. The process of methanogenesis is detected by the appearance of methane bubbles in the sediment column. These gas-filled voids are readily discernible because of their irregular, generally circular aspect and glassy texture (due to the reflection of the strobe off the gas). If present, the number and total aerial coverage of all methane pockets is measured.

INFAUNAL SUCCESSIONAL STAGE

The mapping of successional stages is based on the theory that organism-sediment interactions follow a predictable sequence after a major seafloor perturbation. This theory states that primary succession results in the predictable appearance of macrobenthic invertebrates belonging to specific functional types following a benthic disturbance. These invertebrates interact with sediment in specific ways. Because functional types are the biological units of interest, this definition does not demand a sequential appearance of particular invertebrate species or genera. This theory is now well established in the scientific literature (see Pearson and Rosenberg, 1978; Rhoads and Boyer, 1982; Rhoads and Germano, 1986).

The term disturbance is used here to define natural processes, such as seafloor erosion, changes in seafloor chemistry, foraging disturbances which cause major reorganisation of the resident benthos, or anthropogenic impacts, such as dredged material or sewage sludge dumping, thermal effluents from power plants, pollution impacts from industrial discharge, etc. An important aspect of using this successional approach to interpret benthic monitoring results is relating organism-sediment relationships to the dynamical aspects of end-member seres. This involves deducing dynamics from structure, a technique pioneered by Johnson (1972) for marine soft-bottom habitats. The application of an inverse methods approach to benthic monitoring requires the *in situ* measurements of salient structural features of the organism-sediment relationships measured through SPI technology.

Pioneering (Stage 1) species are the first to colonise a new or newly disturbed bottom and reach high densities in a short time. Pioneering (Stage I) assemblages usually consist of dense aggregations of tubicolous or otherwise sedentary organisms that live near the sediment surface and feed at the surface or from the water column (Pearson and Rosenberg, 1978; Rhoads and Germano, 1986). *Capitella capitata, Malacoceros* *fuliginosus* and Spionidae species are typical forms. These functional types are usually restricted to the near surface of the bottom and their sedimentary effects include (i) the construction of dense tube aggregations which can influence sedimentation/erosion, (ii) deepening of the redox boundary by fluid bioturbation, and (iii) the occlusion of the sediment surface with faecal pellets. These associations are typically characterised by a shallow redox boundary and shallow bioturbation depths, particularly in the earliest stages of colonisation.

In the absence of further physical, chemical or biological disturbance, the pioneering assemblages are replaced by deposit feeders. This is progressive and can be arbitrarily divided into an intermediate and an equilibrium phase (Stages II and III, respectively). Typical Stage II species are shallow dwelling bivalves, tubicolous amphipods and some polychaete species.

Stage III taxa, in turn, represent high-order successional stages typically found in low disturbance regimes. A Stage III or equilibrium assemblage is persistent and is dominated by a bioturbating infauna, which feed at depth within the sediment. Sedimentary effects are distinctive and include (i) the transfer of water and particles over vertical distances of 10 - 20 cm, (ii) the production of homogeneously mixed fabrics by intensive reworking, with faecal pellets at and below the sediment surface, (iii) the creation of void feeding spaces at depth within the bottom, (iv) the extension of the redox boundary to c. 20 cm, and (v) the production of a distinctive surface microtopography unless smoothed over by tidal resuspension. Such deep-dwelling species as the polychaetes, *Pectinaria* sp., Maldanidae sp., the echinoderm, *Trachythyone elongata, Amphiura sp*. and *Echinocardium sp*. and the crustaceans *Lysiosquilla* sp., *Nephrops* sp. and *Upogebia* sp. These invertebrates are infaunal, and many feed at depth in a head-down orientation. The localised feeding activity results in distinctive excavations called feeding voids. Diagnostic features of these feeding structures include: a generally semicircular shape with a flat bottom and arched roof, and a distinct granulometric change in the sediment particles overlying the floor of the structure. This relatively coarse-grained material represents particles rejected by the head-down deposit-feeder. These deep-dwelling infaunal taxa preferentially ingest the finer sediment particles. In the retrograde transition of Stage III to Stage I, it is sometimes possible to recognise the presence of relict (i.e. collapsed and inactive) feeding voids. (It should be added to the above generalisations that pioneering and higher successional species may coexist, if disturbance involves only the superficial sediment layers).

These end-member stages (Stages I and III) are easily recognised in SPI images by the presence of dense assemblages of near-surface polychaetes and/or the presence of subsurface feeding voids. Both types of assemblages may be present in the same image.

ADDITIONAL BIOLOGICAL PARAMETERS

Several additional biological parameters are measured from the digital images using the computer image analysis system. These include: the density per linear cm of polychaete and/or amphipod tubes at the sediment water interface; the minimum and maximum depth of faecal pellet layers and the minimum and maximum depth of feeding voids. Dominant faunal type (i.e. epifauna or infauna) and apparent species richness are also estimated.

SPI ORGANISM-SEDIMENT INDEX (OSI)

A multi-parameter SPI Organism-Sediment Index (OSI) has been constructed to characterise habitat quality and the method of its calculation is shown in Table 1.

The OSI is the sum of values allocated to the various physical/chemical and biological SPI parameters measured and it has a potential value range of -10 to +11. The Organism-Sediment Index is calculated automatically from the software after completion of all measurements from each digital image. This index has been found to be an excellent parameter for mapping disturbance gradients in an area and documenting eco-system recovery after disturbance.

Habitat quality is defined relative to two end-member standards. The lowest value is given to those bottoms which have low or dissolved oxygen in the overlying bottom water, no apparent macrofaunal life, and methane gas present in the sediment. The SPI OSI value for such a condition is minus 10. At the other end of the scale, an aerobic bottom with a deeply depressed RPD, evidence of a mature macrofaunal assemblage, and no apparent methane gas bubbles at depth will have a SPI OSI value of plus 11.

Chemical parameters	Index value	Biological parameters	Index value
Mean apparent RPD depth (cm)		**Successional stage (Primary succession)**	
0	**0**		
>0 - 0.75	**1**	Azoic	**-4**
0.76 - 1.50	**2**	Stage 1	**1**
1.51 - 2.25	**3**	Stage 1-2	**2**
2.26 - 3.00	**4**	Stage 2	**3**
3.01 - 3.75	**5**	Stage 2-3	**4**
>3.75	**6**	Stage 3	**5**
Methane Present	**-2**	**(Secondary succession)**	
No / low oxygen	**-4**	Stage 1 on Stage 2	**5**
		Stage 2 on Stage 3	**5**

Table 1. Method of calculating the Organism - Sediment Index (OSI) value.

From experience with mapping this parameter, values of +7 to +11 are typical of undisturbed sediments while values ≤ 6 tend to be found at sites which have experienced recent physical disturbance (e.g. bottom erosion by currents or disturbance of the bottom by scavenging fish or crustaceans) or are chemically stressed, organically loaded, sulphidic or contaminated in some way. In dealing with areas which are subject to organic enrichment (which may have a variety of origins ranging from natural runoff to anthropogenic inputs), OSI values in the range +6 to +1 generally indicate an overload situation where inputs exceed the capacity of the system and organic matter accumulates on the bottom. Index values which fall in the range +1 to -10 identify varying degrees of habitat degradation associated with a continual accumulation of organic matter and an oxygen depletion on the bottom. At the upper end of the scale, it has been found that OSI values of the order of +11 may reflect a productivity enhancement stage of organic enrichment where natural plant and animal production is increase in response to the ready availability of particulate organic material.

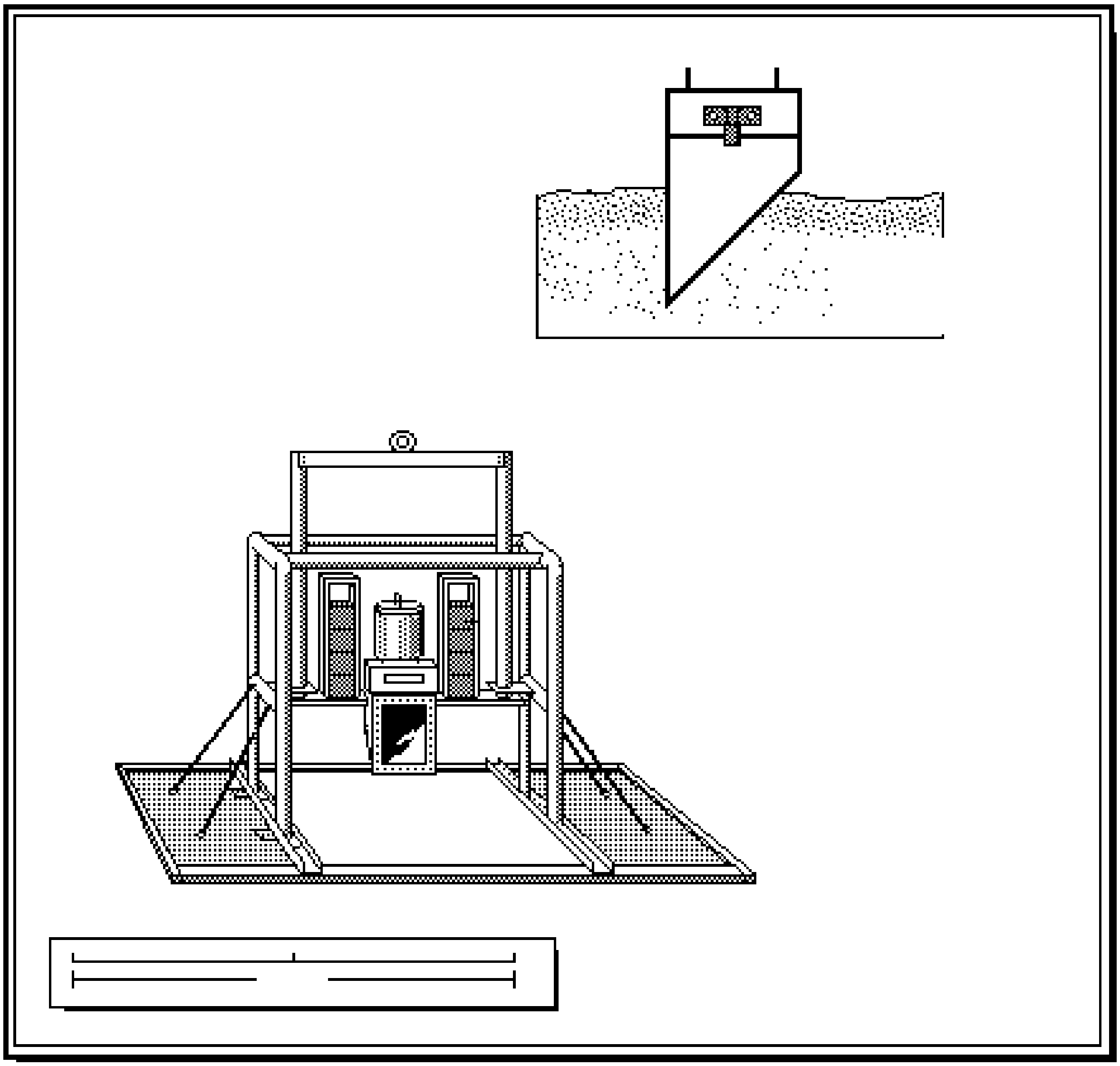


Figure 1. Representation of the remotely operated **S**ediment **P**rofile **I**magery camera.

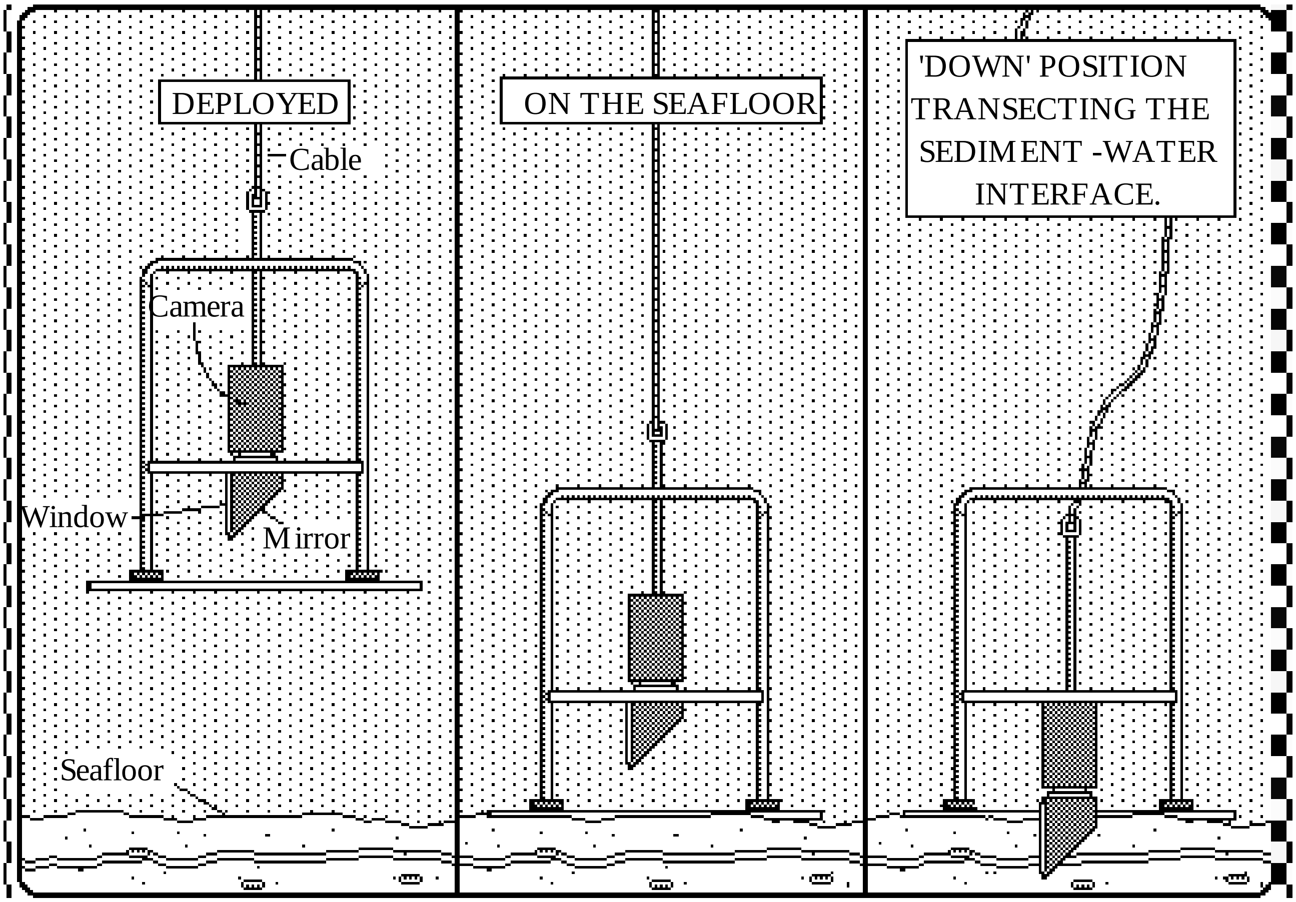
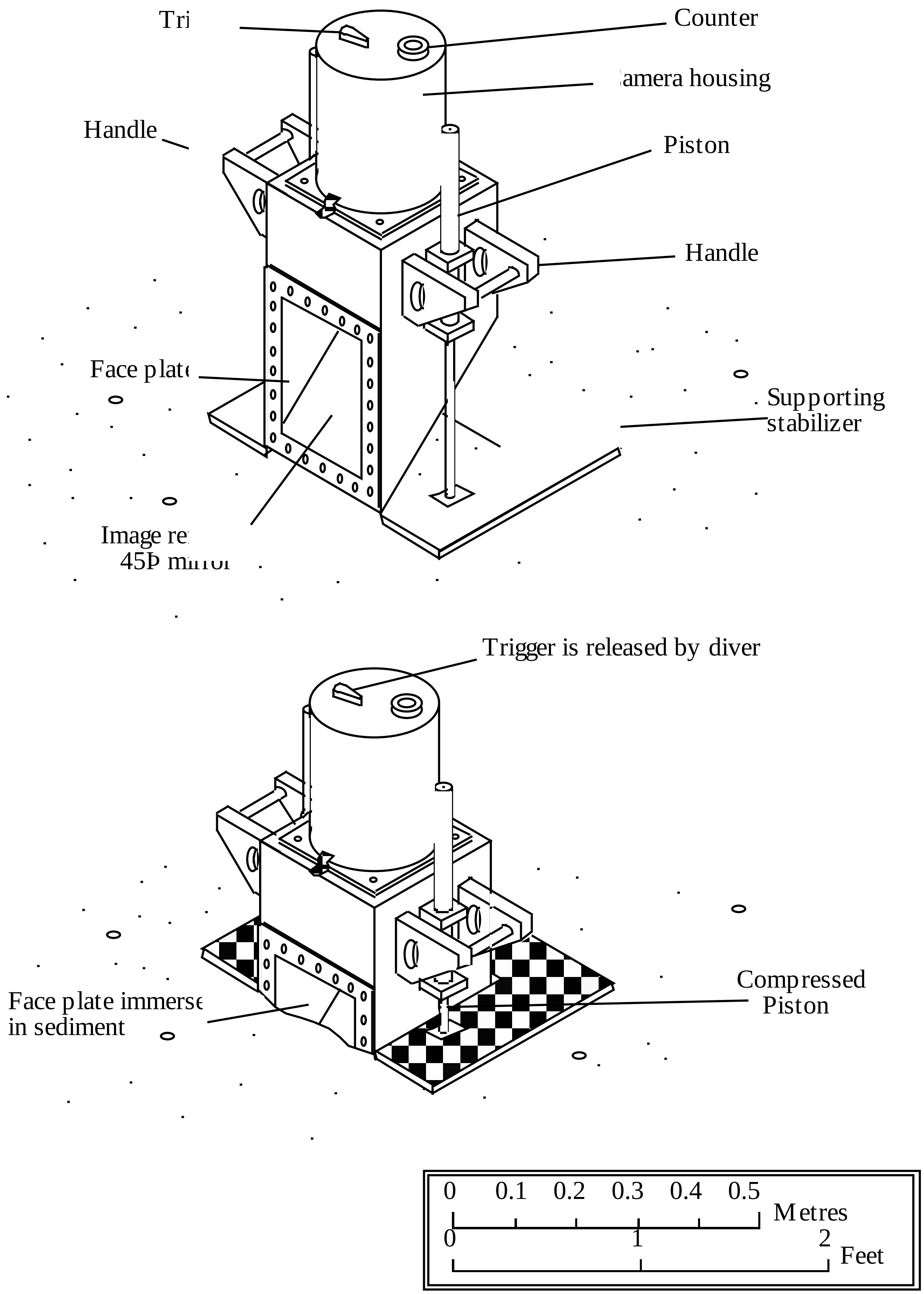


Figure 2. **S**ediment **P**rofile **I**magery (SPI): camera deployment on the seafloor.

Figure 3. Details of the diver operated **S**ediment **P**rofile **I**magery (SPI) camera.



Appendix 2

Faunal Grab Species List – Deenish

Station			T1 Under A	T1 Under B	T1 Under C	T1 Edge A	T1 Edge B	T1 Edge C	T1 10m A	T1 10m B	T1 10m C	T1 20m A	T1 20m B	T1 20m C	T1 50 A
PLATYHELMINTHES	F	1													
TURBELLARIA	F	2													
Turbellaria sp.	F	2													
SIPUNCULA	N	1													
SIPUNCULIDEA	N	2													
GOLFINGIIFORMES	N	10													
Golfingiidae	N	11													
Golfingia sp.	N	12													1
ANNELIDA	P	1													
POLYCHAETA	P	2													
PHYLLODOCIDA	P	3													
Polynoidae	P	25													
Polynoidae sp.	P	25													
Alentia gelatinosa	P	34													
Gattyana cirrosa	P	49									1				
Harmothoe sp.	P	50	2		2										16
Malmgreniella sp.	P		1												
Malmgreniella ljungmani	P	66													
Lepidonotus sp.	P	80													
Lepidonotus clava	P	81													
Pholoidae	P	90													
Pholoe inornata	P	92			1						1			1	14
Phyllodocidae	P	114													
Phyllodocidae sp.	P	114						1			1				2
Eteone longa aggregate	P	118	1			1	2	1				1			1
Phyllodoce mucosa	P	145	1		3	98	8	4	423	20	165	387	9	3	1
Eumida sp.	P	163													
Paranaitis kosteriensis	P	176									1				
Glyceridae	P	254													
Glycera sp.	P	255						1							1

Station			T1 Under A	T1 Under B	T1 Under C	T1 Edge A	T1 Edge B	T1 Edge C	T1 10m A	T1 10m B	T1 10m C	T1 20m A	T1 20m B	T1 20m C	T1 50 A
Glycera alba	P	256												1	
Glycera lapidum	P	260													
Glycera tridactyla	P	265						1	1				1		
Sphaerodoridae	P	277													
Ephesiella peripatus	P														
Sphaerodorum flavum	P														2
Hesionidae	P	293													
Hesionidae sp.	P	293													2
Kefersteinia cirrata	P	305													3
Nereimyra punctata	P	311													
Podarkeopsis helgolandica	P				1										
Syllidae	P	346													
Syllidae sp.	P	346													
Syllis cornuta	P	349													
Syllis sp.	P	358											1		1
Trypanosyllis sp	P	361													
Exogoninae	P	410													
Sphaerosyllis sp.	P	424													
Sphaerosyllis bulbosa	P	425													
Sphaerosyllis hystrix	P	427													
Autolytinae sp.	P	433													
Myrianida sp.	P	434	1												1
Nereididae	P	458													
Platynereis dumerilii	P	482									1				
Nephtyidae	P	490													
Nephtys sp.	P	494												1	
EUNICIDA	P	536													
Eunicidae	P	553													
Eunice sp.	P	554													
Eunice pennata	P	558													2

Station			T1 Under A	T1 Under B	T1 Under C	T1 Edge A	T1 Edge B	T1 Edge C	T1 10m A	T1 10m B	T1 10m C	T1 20m A	T1 20m B	T1 20m C	T1 50 A
Lumbrineridae	P	569													
Lumbrineris sp.	P	572				1		1	1						1
Lumbrineris cf cingulata	P					2				1				1	
Dorvilleidae	P	598													
Ophryotrocha sp.	P	613												1	
Protodorvillea kefersteini	P	638										1	1	1	
ORBINIIDA	P	654													
Orbiniidae	P	655													
Scoloplos armiger	P	672													1
Paraonidae	P	674													
Aricidea (Arcidea) minuta	P	677												1	
Aricidea (Acmira) cerrutii	P	685													
SPIONIDA	P	707													
Spionidae	P	720													
Spionidae sp.	P	720	1			1		2		1					2
Aonides sp.	P	721													
Aonides oxycephala	P	722				2									
Laonice bahusiensis	P	733													1
Malacoceros fuliginosus	P	737													
Polydora sp.	P	748													
Spiophanes bombyx	P	794	1	1	3	1								6	
Magelonidae	P	802													
Magelona filiformis	P	805			1										
Chaetopteridae	P	810													
Chaetopterus variopedatus	P	814													
Cirratulidae	P	822													
Cirratulidae sp.	P	822	1						3		1		3		1
Caulleriella alata	P	829				2		2	1						2
Chaetozone christiei	P													4	
Cirriformia tentaculata	P	839							1			1			

Station			T1 Under A	T1 Under B	T1 Under C	T1 Edge A	T1 Edge B	T1 Edge C	T1 10m A	T1 10m B	T1 10m C	T1 20m A	T1 20m B	T1 20m C	T1 50 A
FLABELLIGERIDA	P	872													
Flabelligeridae	P	873													
Diplocirrus glaucus	P	878							1						
Diplocirrus stopbowitzi	P														
CAPITELLIDA	P	902													
Capitellidae	P	903													
Capitella sp.	P	906	22	8	37	6	111	285	63	55	2	13	31	26	1
Mediomastus fragilis	P	919				8					1		5		1
OPHELIIDA	P	992													
Scalibregmatidae	P	1020													
Scalibregma sp.	P	1025													
Scalibregma celticum	P	1026													1
POLYGORDIIDA	P	1060													
Polygordiidae	P	1061													
Polygordius sp.	P	1062													
OWENIIDA	P	1089													
Oweniidae	P	1090													
Owenia fusiformis	P	1098	2	2	5				5		1	1	1	13	
TEREBELLIDA	P	1099													
Pectinariidae	P	1100													
Pectinaria (Amphictene) auricoma	P	1102				5									
Pectinaria sp.	P	1106						2	3	1		1			
Pectinaria (Lagis) koreni	P	1107					2							2	
Terebellidae	P	1179													
Pista sp.	P	1216													
Polycirrus sp.	P	1235													6
SABELLIDA	P	1256													
Sabellidae	P	1257													
Sabellidae sp.	P	1257													
Serpulidae	P	1324													

Station			T1 Under A	T1 Under B	T1 Under C	T1 Edge A	T1 Edge B	T1 Edge C	T1 10m A	T1 10m B	T1 10m C	T1 20m A	T1 20m B	T1 20m C	T1 50 A
Serpulidae sp.	P	1324													7
Hydroides sp.	P	1330													
Hydroides norvegica	P	1334													4
Pomatoceros sp.	P	1339													2
Pomatoceros lamarcki	P	1340													
Pomatoceros triqueter	P	1341													
OLIGOCHAETA	P	1402													
TUBIFICIDA	P	1403													
Naididae	P	1405													
Tubificidae	P	1425													
Tubificoides benedii	P	1490													
Enchytraeidae	P	1501													
Enchytraeidae sp.	P	1501													
HIRUDINEA	P	1579													
Hirudinea sp.	P	1579													
CHELICERATA	Q	1													
PYCNOGONIDA	Q	2													
Ammotheidae	Q	13													
Achelia echinata	Q	15													
Achelia laevis	Q	17													1
Endeidae	Q	27													
Endeis spinosa	Q	30													
Phoxichilidiidae	Q	41													
Anoplodactylus sp.	Q	42													
CRUSTACEA	R	1													
COPEPODA	R	142													
SIPHONOSTOMATOIDA	R	2061													
Caligidae	R	2206													
Caligus elongatus	R	2215			1										
MALACOSTRACA	S	1													

Station			T1 Under A	T1 Under B	T1 Under C	T1 Edge A	T1 Edge B	T1 Edge C	T1 10m A	T1 10m B	T1 10m C	T1 20m A	T1 20m B	T1 20m C	T1 50 A
LEPTOSTRACA	S	3													
Nebaliidae	S	4													
Nebalia bipes	S	6	4		5	2	2	2	2		8		1		
EUMALACOSTRACA	S	23													
MYSIDACEA	S	25													
Mysidae	S	31													
Praunus inermis	S	83													
AMPHIPODA	S	97													
Stenothoidae	S	187													
Stenothoe marina	S	213													
Phoxocephalidae	S	252													
Metaphoxus fultoni	S	265													
Lysianassidae	S	271													
Lysianassa plumosa	S	305													
Tryphosella sp.	S	341													
Tryphosella lowryi	S														
Tryphosella minima	S														
Liljeborgiidae	S	394													
Liljeborgia pallida	S	397													
Dexaminidae	S	408													
Atylus sp.	S	409		1											
Atlyus guttatus	S	411			1										
Ampeliscidae	S	422													
Ampelisca sp.	S	423						2	7				4		
Ampelisca brevicornis	S	427						5	14		4	6	12	8	
Ampelisca typica	S	442						2	9	5	8	7	5	15	
Gammaridae	S	464													
Gammarus sp.	S	471													
Melitidae	S	495													
Melitidae sp.	S	495													

Station			T1 Under A	T1 Under B	T1 Under C	T1 Edge A	T1 Edge B	T1 Edge C	T1 10m A	T1 10m B	T1 10m C	T1 20m A	T1 20m B	T1 20m C	T1 50 A
Animoceradocus semiserratus	S	502													
Cheirocratus sp.	S	503													
Cheirocratus sundevalli	S	506													
Othomaera othonis	S	519													
Isaeidae	S	537													
Gammaropsis sp	S	537													
Photidae	S														
Photis longicaudata	S	552	1												4
Ischyroceridae	S	558													
Jassa sp.	S	568	2		8	5					5			1	
Jassa falcata	S	569	1	1	5				1					1	
Jassa herdmani	S														
Aoridae	S	577													
Aoridae sp.	S	577													
Leptocheirus sp.	S	586													
Caprellidae	S	639													
Caprella sp.	S	640									1				
Caprella linearis	S	646		1							1				
Pariambus typicus	S	651							4	1	12	1	4	14	1
Hyperiidae	S	728													
Hyperiidae sp.	S	728													
ISOPODA	S	790													
Janiridae	S	883													
Janira sp.	S	891											1		
Janira maculosa	S	892	1												3
Idoteidae	S	933													
Idotea sp.	S	934									1		1		
TANAIDACEA	S	1099													
Anarthruidae	S	1115													
Pseudoparatanais batei	S	1140													

Station			T1 Under A	T1 Under B	T1 Under C	T1 Edge A	T1 Edge B	T1 Edge C	T1 10m A	T1 10m B	T1 10m C	T1 20m A	T1 20m B	T1 20m C	T1 50 A
Tanaopsis graciloides	S	1142										1			
CUMACEA	S	1183													
Bodotriidae	S	1184													
Iphinoe trispinosa	S	1203											1		
Pseudocumatidae	S	1231													
Pseudocuma simile	S	1237									1				
DECAPODA	S	1276													
Decapoda larvae	S	1276													
Caridea	S	1293													
Caridea sp.	S	1293													
Paguridae	S	1445													
Paguridae sp.	S	1445									2				8
Anapagurus hyndmanni	S	1448													1
Anapagurus laevis	S	1449													
Galatheidae	S	1469													
Galathea sp.	S	1470													1
Galathea intermedia	S	1472	1												
Porcellanidae	S	1480													
Pisidia longicornis	S	1482	1			2					7				1
BRACHYURA	S	1485													
Brachyura sp.	S	1485							1				1		
Leucosiidae	S	1502													
Ebalia tumefacta	S	1509													
Atelecyclidae	S	1553													
Atelecyclus rotundatus	S	1555		1	1			1			2				1
Canceridae	S	1563													
Cancer pagurus	S	1566													
BRACHYRHYNCHA	S	1567													
Portunidae	S	1569													
Liocarcinus sp.	S	1577						1	1		3	1			1

Station			**T1 Under A**	**T1 Under B**	**T1 Under C**	**T1 Edge A**	**T1 Edge B**	**T1 Edge C**	**T1 10m A**	**T1 10m B**	**T1 10m C**	**T1 20m A**	**T1 20m B**	**T1 20m C**	**T1 50 A**
Liocarcinus marmoreus	S	1582													
Goneplacidae	S	1603													
Xantho pilipes	S	1620													
MOLLUSCA	W	1													
POLYPLACOPHORA	W	46													
NEOLORICATA	W	47													
Leptochitonidae	W	48													
Leptochiton asellus	W	53													1
Leptochiton cancellatus	W	54													14
Acanthochitonidae	W	83													
Acanthochitona sp.	W	84													
GASTROPODA	W	88													
Gastropoda sp.	W	88													
ARCHAEOGASTROPODA	W	90													
Trochidae	W	140													
Gibbula sp.	W	157													2
Gibbula cineraria	W	163													
Skeneidae	W	194													
Skenea serpuloides	W	198													
PATELLOGASTROPODA	W	219													
Lottiidae	W	221													
Tectura virginea	W	224													9
Patellidae	W	225													
Ansates pellucida	W	234													
MESOGASTROPODA	W	256													
Littorinidae	W	283													
Lacuninae	W	284													
Lacuna sp.	W	285	2												
Rissoidae	W	324													
Rissoa sp.	W	326													

Station			T1 Under A	T1 Under B	T1 Under C	T1 Edge A	T1 Edge B	T1 Edge C	T1 10m A	T1 10m B	T1 10m C	T1 20m A	T1 20m B	T1 20m C	T1 50 A
Rissoa parva	W	334					1				3				2
Hydrobiidae	W	381													
Onoba semicostata	W	371									1				
Caecidae	W	411													
Caecum trachea	W	414													
Naticidae	W	482													
Euspira pulchella	W	491							1		1		1	1	2
Eulimidae	W	599													
Vitreolina phillippi	W	669													1
NEOGASTROPODA	W	670													
Muricidae	W	672													
Trophon sp.	W	674						1							
Buccinidae	W	702													
Nassarius sp.	W	743	1		14	20		22	4		4	1	1		
Nassarius incrassatus	W	747									4				
Nassarius pygmaeus	W	748			2						2		2		
Turridae	W	771													
Bela sp.	W	800													
HETEROSTROPHA	W	878													
Pyramidellidae	W	906													
Odostomia sp.	W	908													3
OPISTHOBRANCHIA	W														
CEPHALASPIDEA	W	1002													
Cylichnidae	W	1024													
Cylichna cylindracea	W	1028													
ANASPIDEA	W	1138													
Akeridae	W	1140													
Akera bullata	W	1142													
Aplysiidae	W	1143													
Aplysia punctata	W	1152													
NUDIBRANCHIA	W	1243													

Station			T1 Under A	T1 Under B	T1 Under C	T1 Edge A	T1 Edge B	T1 Edge C	T1 10m A	T1 10m B	T1 10m C	T1 20m A	T1 20m B	T1 20m C	T1 50 A
Nudibranchia sp.	W	1243	1		1										
Doridina	W														
Doridina sp.	W					1									
PELECYPODA	W	1560													
MYTILOIDA	W	1689													
Mytilidae	W	1691													
Mytilidae sp.	W	1691	245	75	540	74	39	61	74	13	159	16	42	40	9
Modiolus modiolus	W	1702	4		45	5	4							37	
OSTREOIDA	W	1752													
Anomiidae	W	1805													
Anomiidae sp.	W	1805	2												
VENEROIDA	W	1815													
Montacutidae	W	1888													
Kurtiella bidentata	W	1906	1		1			1							
Astartidae	W	1921													
Goodallia triangularis	W	1929													
Cardiidae	W	1938													
Parvicardium sp.	W	1947												1	
Parvicardium pinnulatum	W	1951									1				
Pharidae	W	1995													
Phaxas pellucidus	W	2006								1					
Tellinidae	W	2008													
Tellina sp.	W	2018													
Tellina fabula	W	2019		1											
Psammobiidae	W	2042													
Gari sp.	W	2044													
Gari tellinella	W	2049													
Semelidae	W	2057													
Abra prismatica	W	2062										1			
Veneridae	W	2086													

Station			T1 Under A	T1 Under B	T1 Under C	T1 Edge A	T1 Edge B	T1 Edge C	T1 10m A	T1 10m B	T1 10m C	T1 20m A	T1 20m B	T1 20m C	T1 50 A
Veneridae sp.	W	2086							1			1			1
Gouldia minima	W	2095													
Chamelea striatula	W										1				
Clausinella fasciata	W	2100													2
Timoclea ovata	W	2104											1		
Venerupis sp.	W	2123						1							
Dosinia sp.	W	2126					1		2				1	1	
MYOIDA	W	2140													
Corbulidae	W	2153													
Corbula gibba	W	2157												1	
Hiatella arctica	W	2166			3									1	
PHOLADOMYOIDA	W	2220													
Thraciidae	W	2226													
Thracia sp.	W	2228								1		1		1	2
Thracia papyracea	W	2231		1	2										
ECHINODERMATA	ZB	1													
ASTEROIDEA	ZB	18													
Asteroidea sp.	ZB	18	1		1				1						
Astropectinidae	ZB	24													
Astropecten irregularis	ZB	26													
FORCIPULATIDA	ZB	95													
Asteriidae	ZB	96													
Asteriidae sp.	ZB	96													
OPHIUROIDEA	ZB	105													
Ophiuroidea sp.	ZB	105													1
OPHIURIDA	ZB	121													
Ophiotrichidae	ZB	122													
Ophiothrix fragilis	ZB	124													
Ophiocomidae	ZB	126													
Ophiocomina nigra	ZB	128													21

Station			T1 Under A	T1 Under B	T1 Under C	T1 Edge A	T1 Edge B	T1 Edge C	T1 10m A	T1 10m B	T1 10m C	T1 20m A	T1 20m B	T1 20m C	T1 50 A
Amphiuridae	ZB	148													
Acrocnida brachiata	ZB	151	2		1										
Amphipholis squamata	ZB	161													36
Ophiuridae	ZB	165													
Ophiura sp.	ZB	166													
Ophiura albida	ZB	168													3
ECHINOIDEA	ZB	181													
Echinoidea sp.	ZB	181													
ECHINOIDA	ZB	190													
Echinidae	ZB	194													
Echinocyamus pusillus	ZB	212												1	3
SPATANGOIDA	ZB	213													
Loveniidae	ZB	221													
Echinocardium sp.	ZB	222						2		1	3	1			
Echinocardium flavescens	ZB	224						1						5	1
HOLOTHURIOIDEA	ZB	229													
Holothuriidae	ZB	242													
Holothuria sp.	ZB	243													
DENDROCHIROTIDA	ZB	249													
Phyllophoridae	ZB	258													
Neopentadactyla mixta	ZB	260							1						
Cucumariidae	ZB	266													
Oncus lacteus	ZB	275			1										
CHORDATA															
PISCES															
OSTEICHTHYES	ZG	1													
PERCIFORMES	ZG	302													
Callionymidae	ZG	450													
Callionymus sp.	ZG	451													

Station			**T1 50m B**	**T1 50 C**	**T2 10m A**	**T2 10m B**	**T2 10m C**	**T2 20m A**	**T2 20m B**	**T2 20m C**	**T2 50 A**	**T2 50m B**	**T2 50 C**	**Ref A**	**Ref B**	**Ref C**
PLATYHELMINTHES	F	1														
TURBELLARIA	F	2														
Turbellaria sp.	F	2										2				
SIPUNCULA	N	1														
SIPUNCULIDEA	N	2														
GOLFINGIIFORMES	N	10														
Golfingiidae	N	11														
Golfingia sp.	N	12														
ANNELIDA	P	1														
POLYCHAETA	P	2														
PHYLLODOCIDA	P	3														
Polynoidae	P	25														
Polynoidae sp.	P	25		1								1	1	3	17	10
Alentia gelatinosa	P	34														1
Gattyana cirrosa	P	49														
Harmothoe sp.	P	50	9	7					2		8	7		5	8	12
Malmgreniella sp.	P					1						4			3	
Malmgreniella ljungmani	P	66												3	2	
Lepidonotus sp.	P	80														1
Lepidonotus clava	P	81										1				
Pholoidae	P	90														
Pholoe inornata	P	92	3	2	1					1	6		1	7	6	8
Phyllodocidae	P	114														
Phyllodocidae sp.	P	114	2	1			1					1		3		
Eteone longa aggregate	P	118						1	2	4			2			
Phyllodoce mucosa	P	145		2	5	77	257	12	80	10					6	
Eumida sp.	P	163									1				1	
Paranaitis kosteriensis	P	176														
Glyceridae	P	254														
Glycera sp.	P	255	1					1	1			2			1	

Station			T1 50m B	T1 50 C	T2 10m A	T2 10m B	T2 10m C	T2 20m A	T2 20m B	T2 20m C	T2 50 A	T2 50m B	T2 50 C	Ref A	Ref B	Ref C
Glycera alba	P	256				1										
Glycera lapidum	P	260		1						1	1			1	2	
Glycera tridactyla	P	265					1									
Sphaerodoridae	P	277														
Ephesiella peripatus	P													1		1
Sphaerodorum flavum	P										1	1		1	1	2
Hesionidae	P	293														
Hesionidae sp.	P	293		3					2				1		1	
Kefersteinia cirrata	P	305														
Nereimyra punctata	P	311									1			2	1	
Podarkeopsis helgolandica	P															
Syllidae	P	346														
Syllidae sp.	P	346												1		
Syllis cornuta	P	349		2					1					2		1
Syllis sp.	P	358													1	
Trypanosyllis sp	P	361		1								1	1		2	4
Exogoninae	P	410														
Sphaerosyllis sp.	P	424										1			1	
Sphaerosyllis bulbosa	P	425												1	5	1
Sphaerosyllis hystrix	P	427												1		
Autolytinae sp.	P	433													1	
Myrianida sp.	P	434		1												
Nereididae	P	458														
Platynereis dumerilii	P	482														
Nephtyidae	P	490														
Nephtys sp.	P	494			1											
EUNICIDA	P	536														
Eunicidae	P	553														
Eunice sp.	P	554	2								1		1	1	2	2
Eunice pennata	P	558										3	1			1

Station			T1 50m B	T1 50 C	T2 10m A	T2 10m B	T2 10m C	T2 20m A	T2 20m B	T2 20m C	T2 50 A	T2 50m B	T2 50 C	Ref A	Ref B	Ref C
Lumbrineridae	P	569														
Lumbrineris sp.	P	572														
Lumbrineris cf cingulata	P					2			1							
Dorvilleidae	P	598														
Ophryotrocha sp.	P	613														
Protodorvillea kefersteini	P	638							1	1				1	2	
ORBINIIDA	P	654														
Orbiniidae	P	655														
Scoloplos armiger	P	672				1										
Paraonidae	P	674														
Aricidea (Arcidea) minuta	P	677														
Aricidea (Acmira) cerrutii	P	685				1										
SPIONIDA	P	707														
Spionidae	P	720														
Spionidae sp.	P	720							1							
Aonides sp.	P	721							1							
Aonides oxycephala	P	722			2											
Laonice bahusiensis	P	733										1				
Malacoceros fuliginosus	P	737						7				5				
Polydora sp.	P	748												1		
Spiophanes bombyx	P	794						1								
Magelonidae	P	802														
Magelona filiformis	P	805														
Chaetopteridae	P	810														
Chaetopterus variopedatus	P	814												1		
Cirratulidae	P	822														
Cirratulidae sp.	P	822			2			1		1						
Caulleriella alata	P	829					1	1				1				
Chaetozone christiei	P															
Cirriformia tentaculata	P	839					2									

Station			T1 50m B	T1 50 C	T2 10m A	T2 10m B	T2 10m C	T2 20m A	T2 20m B	T2 20m C	T2 50 A	T2 50m B	T2 50 C	Ref A	Ref B	Ref C
FLABELLIGERIDA	P	872														
Flabelligeridae	P	873														
Diplocirrus glaucus	P	878														
Diplocirrus stopbowitzi	P														1	
CAPITELLIDA	P	902														
Capitellidae	P	903														
Capitella sp.	P	906			18	12	12	231	71	745			4	9	1	
Mediomastus fragilis	P	919		1				10		1						
OPHELIIDA	P	992														
Scalibregmatidae	P	1020														
Scalibregma sp.	P	1025										1				
Scalibregma celticum	P	1026														
POLYGORDIIDA	P	1060														
Polygordiidae	P	1061														
Polygordius sp.	P	1062												2	1	
OWENIIDA	P	1089														
Oweniidae	P	1090														
Owenia fusiformis	P	1098			2		1		1							1
TEREBELLIDA	P	1099														
Pectinariidae	P	1100														
Pectinaria (Amphictene) auricoma	P	1102			1				1							
Pectinaria sp.	P	1106			1					1						
Pectinaria (Lagis) koreni	P	1107		2							1	2				
Terebellidae	P	1179														
Pista sp.	P	1216										1				
Polycirrus sp.	P	1235		1								1		1	1	1
SABELLIDA	P	1256														
Sabellidae	P	1257														
Sabellidae sp.	P	1257										1				

Station			T1 50m B	T1 50 C	T2 10m A	T2 10m B	T2 10m C	T2 20m A	T2 20m B	T2 20m C	T2 50 A	T2 50m B	T2 50 C	Ref A	Ref B	Ref C
Serpulidae	P	1324														
Serpulidae sp.	P	1324	1	2							1		1		1	
Hydroides sp.	P	1330												1		
Hydroides norvegica	P	1334		2							2		1	18		2
Pomatoceros sp.	P	1339		2	7				1		21	7	1	6	2	3
Pomatoceros lamarcki	P	1340	2	1	4						1	2		3		
Pomatoceros triqueter	P	1341									4	1		1	1	1
OLIGOCHAETA	P	1402														
TUBIFICIDA	P	1403														
Naididae	P	1405														
Tubificidae	P	1425														
Tubificoides benedii	P	1490						2		7						
Enchytraeidae	P	1501														
Enchytraeidae sp.	P	1501													1	
HIRUDINEA	P	1579														
Hirudinea sp.	P	1579			1											
CHELICERATA	Q	1														
PYCNOGONIDA	Q	2														
Ammotheidae	Q	13														
Achelia echinata	Q	15										1				
Achelia laevis	Q	17														
Endeidae	Q	27														
Endeis spinosa	Q	30										1				
Phoxichilidiidae	Q	41														
Anoplodactylus sp.	Q	42												1		
CRUSTACEA	R	1														
COPEPODA	R	142														
SIPHONOSTOMATOIDA	R	2061														
Caligidae	R	2206														
Caligus elongatus	R	2215														

Station			T1 50m B	T1 50 C	T2 10m A	T2 10m B	T2 10m C	T2 20m A	T2 20m B	T2 20m C	T2 50 A	T2 50m B	T2 50 C	Ref A	Ref B	Ref C
MALACOSTRACA	S	1														
LEPTOSTRACA	S	3														
Nebaliidae	S	4														
Nebalia bipes	S	6			1					46						
EUMALACOSTRACA	S	23														
MYSIDACEA	S	25														
Mysidae	S	31														
Praunus inermis	S	83												1		
AMPHIPODA	S	97														
Stenothoidae	S	187														
Stenothoe marina	S	213				1										
Phoxocephalidae	S	252														
Metaphoxus fultoni	S	265													1	
Lysianassidae	S	271														
Lysianassa plumosa	S	305			1											1
Tryphosella sp.	S	341								1						
Tryphosella lowryi	S														1	
Tryphosella minima	S													1		
Liljeborgiidae	S	394														
Liljeborgia pallida	S	397													13	1
Dexaminidae	S	408														
Atylus sp.	S	409	1		1								1			
Atlyus guttatus	S	411														
Ampeliscidae	S	422														
Ampelisca sp.	S	423		1				1								
Ampelisca brevicornis	S	427			3	4	1									
Ampelisca typica	S	442		1	6	4	2									
Gammaridae	S	464														
Gammarus sp.	S	471									1					
Melitidae	S	495														

Station			T1 50m B	T1 50 C	T2 10m A	T2 10m B	T2 10m C	T2 20m A	T2 20m B	T2 20m C	T2 50 A	T2 50m B	T2 50 C	Ref A	Ref B	Ref C
Melitidae sp.	S	495														6
Animoceradocus semiserratus	S	502														9
Cheirocratus sp.	S	503	1									5	1	2	11	2
Cheirocratus sundevalli	S	506												1	1	
Othomaera othonis	S	519	1	2								2		41	12	1
Isaeidae	S	537														
Gammaropsis sp	S	537	1	1							3				3	3
Photidae	S															
Photis longicaudata	S	552							13			73	3			
Ischyroceridae	S	558														
Jassa sp.	S	568			1	135				3						
Jassa falcata	S	569														
Jassa herdmani	S					6										
Aoridae	S	577														
Aoridae sp.	S	577										1				
Leptocheirus sp.	S	586													1	
Caprellidae	S	639														
Caprella sp.	S	640			1	3		1		1	1					
Caprella linearis	S	646				1										
Pariambus typicus	S	651				17				1						
Hyperiidae	S	728														
Hyperiidae sp.	S	728						1								
ISOPODA	S	790														
Janiridae	S	883														
Janira sp.	S	891														
Janira maculosa	S	892		6							3	1		3	18	9
Idoteidae	S	933														
Idotea sp.	S	934														
TANAIDACEA	S	1099														
Anarthruidae	S	1115														

Station			T1 50m B	T1 50 C	T2 10m A	T2 10m B	T2 10m C	T2 20m A	T2 20m B	T2 20m C	T2 50 A	T2 50m B	T2 50 C	Ref A	Ref B	Ref C
Pseudoparatanais batei	S	1140										1				
Tanaopsis graciloides	S	1142			1											
CUMACEA	S	1183														
Bodotriidae	S	1184														
Iphinoe trispinosa	S	1203														
Pseudocumatidae	S	1231														
Pseudocuma simile	S	1237														
DECAPODA	S	1276														
Decapoda larvae	S	1276						1								
Caridea	S	1293														
Caridea sp.	S	1293												1		
Paguridae	S	1445														
Paguridae sp.	S	1445	1	1	1				5	2	2	8	1	2	2	
Anapagurus hyndmanni	S	1448														
Anapagurus laevis	S	1449										1				
Galatheidae	S	1469														
Galathea sp.	S	1470												1	1	6
Galathea intermedia	S	1472		1								1				5
Porcellanidae	S	1480														
Pisidia longicornis	S	1482	1		1	2				1	10	4		5	3	7
BRACHYURA	S	1485														
Brachyura sp.	S	1485				2										1
Leucosiidae	S	1502														
Ebalia tumefacta	S	1509														1
Atelecyclidae	S	1553														
Atelecyclus rotundatus	S	1555														
Canceridae	S	1563														
Cancer pagurus	S	1566									1					
BRACHYRHYNCHA	S	1567														
Portunidae	S	1569														

Station			T1 50m B	T1 50 C	T2 10m A	T2 10m B	T2 10m C	T2 20m A	T2 20m B	T2 20m C	T2 50 A	T2 50m B	T2 50 C	Ref A	Ref B	Ref C
Liocarcinus sp.	S	1577							1				2			
Liocarcinus marmoreus	S	1582			1							1				
Goneplacidae	S	1603														
Xantho pilipes	S	1620													2	
MOLLUSCA	W	1														
POLYPLACOPHORA	W	46														
NEOLORICATA	W	47														
Leptochitonidae	W	48														
Leptochiton asellus	W	53	1	3					3		3	1		3	1	5
Leptochiton cancellatus	W	54	16	1					5	1	14	6	1	11	17	15
Acanthochitonidae	W	83														
Acanthochitona sp.	W	84										1	1			
GASTROPODA	W	88														
Gastropoda sp.	W	88	1									1			3	
ARCHAEOGASTROPODA	W	90														
Trochidae	W	140														
Gibbula sp.	W	157	1	2							2	4		10	2	5
Gibbula cineraria	W	163													3	
Skeneidae	W	194														
Skenea serpuloides	W	198													2	
PATELLOGASTROPODA	W	219														
Lottiidae	W	221														
Tectura virginea	W	224	2	4							17	1		1		3
Patellidae	W	225														
Ansates pellucida	W	234		1												
MESOGASTROPODA	W	256														
Littorinidae	W	283														
Lacuninae	W	284														
Lacuna sp.	W	285														
Rissoidae	W	324														

Station			T1 50m B	T1 50 C	T2 10m A	T2 10m B	T2 10m C	T2 20m A	T2 20m B	T2 20m C	T2 50 A	T2 50m B	T2 50 C	Ref A	Ref B	Ref C
Rissoa sp.	W	326												1		
Rissoa parva	W	334														
Hydrobiidae	W	381														
Onoba semicostata	W	371														
Caecidae	W	411														
Caecum trachea	W	414													2	
Naticidae	W	482														
Euspira pulchella	W	491				2		4	3			1			1	1
Eulimidae	W	599														
Vitreolina phillippi	W	669													1	
NEOGASTROPODA	W	670														
Muricidae	W	672														
Trophon sp.	W	674														1
Buccinidae	W	702														
Nassarius sp.	W	743					4		1		1	2		7	1	1
Nassarius incrassatus	W	747	1							4						
Nassarius pygmaeus	W	748														
Turridae	W	771														
Bela sp.	W	800									1					
HETEROSTROPHA	W	878														
Pyramidellidae	W	906														
Odostomia sp.	W	908														
OPISTHOBRANCHIA	W															
CEPHALASPIDEA	W	1002														
Cylichnidae	W	1024														
Cylichna cylindracea	W	1028													1	
ANASPIDEA	W	1138														
Akeridae	W	1140														
Akera bullata	W	1142												1		
Aplysiidae	W	1143														

Station			**T1 50m B**	**T1 50 C**	**T2 10m A**	**T2 10m B**	**T2 10m C**	**T2 20m A**	**T2 20m B**	**T2 20m C**	**T2 50 A**	**T2 50m B**	**T2 50 C**	**Ref A**	**Ref B**	**Ref C**
Aplysia punctata	W	1152												2		
NUDIBRANCHIA	W	1243														
Nudibranchia sp.	W	1243	1		1					1		1				
Doridina	W															
Doridina sp.	W															
PELECYPODA	W	1560														
MYTILOIDA	W	1689														
Mytilidae	W	1691														
Mytilidae sp.	W	1691		4	20	186	3		52	18		4		9	6	17
Modiolus modiolus	W	1702			20			1								
OSTREOIDA	W	1752														
Anomiidae	W	1805														
Anomiidae sp.	W	1805														
VENEROIDA	W	1815														
Montacutidae	W	1888														
Kurtiella bidentata	W	1906								2		1			20	10
Astartidae	W	1921														
Goodallia triangularis	W	1929													3	
Cardiidae	W	1938														
Parvicardium sp.	W	1947														
Parvicardium pinnulatum	W	1951										1				
Pharidae	W	1995														
Phaxas pellucidus	W	2006			2											
Tellinidae	W	2008														
Tellina sp.	W	2018											1			
Tellina fabula	W	2019														
Psammobiidae	W	2042														
Gari sp.	W	2044														1
Gari tellinella	W	2049													3	2
Semelidae	W	2057														

Station			**T1 50m B**	**T1 50 C**	**T2 10m A**	**T2 10m B**	**T2 10m C**	**T2 20m A**	**T2 20m B**	**T2 20m C**	**T2 50 A**	**T2 50m B**	**T2 50 C**	**Ref A**	**Ref B**	**Ref C**
Abra prismatica	W	2062														
Veneridae	W	2086														
Veneridae sp.	W	2086		1							1	2			3	11
Gouldia minima	W	2095													2	1
Chamelea striatula	W															
Clausinella fasciata	W	2100		1								1				1
Timoclea ovata	W	2104														1
Venerupis sp.	W	2123													1	
Dosinia sp.	W	2126			1											
MYOIDA	W	2140														
Corbulidae	W	2153														
Corbula gibba	W	2157														
Hiatella arctica	W	2166										1				
PHOLADOMYOIDA	W	2220														
Thraciidae	W	2226														
Thracia sp.	W	2228		1												
Thracia papyracea	W	2231														
ECHINODERMATA	ZB	1														
ASTEROIDEA	ZB	18														
Asteroidea sp.	ZB	18		1		1				1				3	1	4
Astropectinidae	ZB	24														
Astropecten irregularis	ZB	26										1				
FORCIPULATIDA	ZB	95														
Asteriidae	ZB	96														
Asteriidae sp.	ZB	96			1											
OPHIUROIDEA	ZB	105														
Ophiuroidea sp.	ZB	105				1					4	2		1	21	
OPHIURIDA	ZB	121														
Ophiotrichidae	ZB	122														
Ophiothrix fragilis	ZB	124									1			1	2	1

Station			T1 50m B	T1 50 C	T2 10m A	T2 10m B	T2 10m C	T2 20m A	T2 20m B	T2 20m C	T2 50 A	T2 50m B	T2 50 C	Ref A	Ref B	Ref C
Ophiocomidae	ZB	126														
Ophiocomina nigra	ZB	128	7	6		1					7	3	3	4	20	88
Amphiuridae	ZB	148														
Acrocnida brachiata	ZB	151														
Amphipholis squamata	ZB	161	3	1							7	7		8	41	28
Ophiuridae	ZB	165														
Ophiura sp.	ZB	166										1				
Ophiura albida	ZB	168	2									1		1		
ECHINOIDEA	ZB	181														
Echinoidea sp.	ZB	181														1
ECHINOIDA	ZB	190														
Echinidae	ZB	194														
Echinocyamus pusillus	ZB	212	1											2	2	2
SPATANGOIDA	ZB	213														
Loveniidae	ZB	221														
Echinocardium sp.	ZB	222				1										
Echinocardium flavescens	ZB	224			1						1	2	1	1		1
HOLOTHURIOIDEA	ZB	229														
Holothuriidae	ZB	242														
Holothuria sp.	ZB	243										1				
DENDROCHIROTIDA	ZB	249														
Phyllophoridae	ZB	258														
Neopentadactyla mixta	ZB	260		1					2					1		
Cucumariidae	ZB	266														
Oncus lacteus	ZB	275														
CHORDATA																
PISCES																
OSTEICHTHYES	ZG	1														
PERCIFORMES	ZG	302														
Callionymidae	ZG	450														

Station			T1 50m B	T1 50 C	T2 10m A	T2 10m B	T2 10m C	T2 20m A	T2 20m B	T2 20m C	T2 50 A	T2 50m B	T2 50 C	Ref A	Ref B	Ref C
Callionymus sp.	ZG	451								2						

Appendix 3

Faunal Grab Species List – Inishfarnard

Station			**T1 Under A**	**T1 Under B**	**T1 Under C**	**T1 Edge A**	**T1 Edge B**	**T1 Edge C**	**T1 10m A**	**T1 10m B**	**T1 10m C**	**T1 20m A**	**T1 20m B**	**T1 20m C**	**T1 50 A**	**T1 50m B**	**T1 50 C**
CNIDARIA	D	1															
ANTHOZOA	D	583															
ACTINIARIA	D	662															
Edwardsiidae	D	759															
Edwardsiidae sp.	D	759													1		
Edwardsia sp.	D	764							1								
SIPUNCULA	N	1															
SIPUNCULIDEA	N	2															
GOLFINGIIFORMES	N	10															
Phascolionidae	N	29															
Phascolion strombus strombus	N	34										1			1		
ANNELIDA	P	1															
POLYCHAETA	P	2															
PHYLLODOCIDA	P	3															
Pisionidae	P	13															
Pisione remota	P	15							1								
Aphroditidae	P	17															
Aphrodita aculeata	P	19										1					
Polynoidae	P	25															
Polynoidae sp.	P	25		1					1	3		2	2			2	
Harmothoe sp.	P	50										1				3	
Malmgreniella sp.	P		1				2	1	1								
Malmgreniella mcintoshi	P	70															
Pholoidae	P	90															
Pholoe inornata	P	92	2	5		6	12	6	3	8	4	4	2	1	2	2	
Pholoe cf baltica (sensu Petersen)	P	95															
Phyllodocidae	P	114															
Phyllodocidae sp.	P	114	1					2	1	2		2	2			1	

Station			T1 Under A	T1 Under B	T1 Under C	T1 Edge A	T1 Edge B	T1 Edge C	T1 10m A	T1 10m B	T1 10m C	T1 20m A	T1 20m B	T1 20m C	T1 50 A	T1 50m B	T1 50 C
Eteone longa aggregate	P	118	5	5		7	21	18	6		21	4	7	1	3	5	1
Phyllodoce longipes	P	143															
Phyllodoce mucosa	P	145	5	5	2	71	3		349	209	42	46	6	21	1	5	1
Eumida sp.	P	163															
Eumida bahusiensis	P	164															
Paranaitis kosteriensis	P	176									1	2	1		1	1	
Phyllodoce sp.	P	178													1		
Glyceridae	P	254															
Glycera sp.	P	255	3	2		1	4	5	2	3	3	1				3	
Glycera alba	P	256											1				
Glycera lapidum	P	260					1	4	3	1		3	3	1	2		1
Goniadidae	P	266															
Goniadidae sp.	P	266				1											
Hesionidae	P	293															
Hesionidae sp.	P	293		1				1									
Kefersteinia cirrata	P	305				2											
Podarkeopsis helgolandica	P		1	2			3	1	2	1							
Microphthalmus similis	P	333															
Syllidae	P	346															
Syllis cornuta	P	349	3	2		1	2		1	1		2				1	
Syllis sp.	P	358	2				1			1		1					
Syllis sp. E (after Garwood)	P	358		8				6			5		1				
Syllis sp. H (after Garwood)	P	358															
Trypanosyllis sp.	P	361							2			1					
Exogoninae	P	410															
Exogone sp.	P	418															
Sphaerosyllis bulbosa	P	425															
Myrianida sp.	P	434										1					
Nereididae	P	458															

Station			T1 Under A	T1 Under B	T1 Under C	T1 Edge A	T1 Edge B	T1 Edge C	T1 10m A	T1 10m B	T1 10m C	T1 20m A	T1 20m B	T1 20m C	T1 50 A	T1 50m B	T1 50 C
Nereididae sp.	P	458				1					1						
Platynereis dumerilii	P	482															
Nephtyidae	P	490															
Nephtys sp.	P	494										1				1	
EUNICIDA	P	536															
Onuphidae	P	537															
Aponuphis bilineata	P	538	1	6			1	1	2		1		2				
Eunicidae	P	553															
Eunice sp.	P	554										1			1		
Eunice pennata	P	558														1	
Lumbrineridae	P	569															
Lumbrineridae sp.	P	569															
Lumbrineris sp.	P	572						1									
Lumbrineris cf cingulata	P			2				1									
Dorvilleidae	P	598															
Protodorvillea kefersteini	P	638	20	3	1	9	5	22	10	2	6	7	2	1		7	
Schistomeringos rudolphi	P	643				1		1									
ORBINIIDA	P	654															
Paraonidae	P	674															
Aricidea (Acmira) cerrutii	P	685		2		1	1	1	1	1	5	2			1	1	
Paradoneis lyra	P	699						1									
SPIONIDA	P	707															
Spionidae	P	720															
Spionidae sp.	P	720	1	1			2		2			2	1		1		
Malacoceros fuliginosus	P	737				3	1										
Polydora sp.	P	748													1		1
Prionospio sp.	P	763										1					
Pseudopolydora pulchra	P	774															
Spio sp.	P	787														1	
Magelonidae	P	802															

Station			T1 Under A	T1 Under B	T1 Under C	T1 Edge A	T1 Edge B	T1 Edge C	T1 10m A	T1 10m B	T1 10m C	T1 20m A	T1 20m B	T1 20m C	T1 50 A	T1 50m B	T1 50 C
Magelona alleni	P	804															
Magelona filiformis	P	805															
Cirratulidae	P	822															
Cirratulidae sp.	P	822			1	1	2				1	4	2			1	1
Caulleriella alata	P	829	4	5	1	4	7	8	13	7	7	8	1			1	1
Chaetozone gibber	P	833															1
FLABELLIGERIDA	P	872															
Flabelligeridae	P	873															
Diplocirrus glaucus	P	878										1					
Diplocirrus stopbowitzi	P											1					
CAPITELLIDA	P	902															
Capitellidae	P	903															
Capitellidae sp.	P	903															
Capitella sp.	P	906	462	264	10	643	789	695	34	5	325	28	7	43	3		
Mediomastus fragilis	P	919	8	18	5	6	17	15	8	5	66	64	15		2	8	3
Arenicolidae	P	928															
Arenicola marina	P	931				1											
OPHELIIDA	P	992															
Scalibregmatidae	P	1020															
Scalibregma inflatum	P	1027	2	2	1		4	4	2		2	6			5	3	
OWENIIDA	P	1089															
Oweniidae	P	1090															
Owenia fusiformis	P	1098	1			1		1		1		6	2	1	2		1
TEREBELLIDA	P	1099															
Pectinariidae	P	1100															
Pectinaria (Amphictene) auricoma	P	1102											1		1		
Pectinaria sp.	P	1106						1		3		3	3			1	
Pectinaria (Lagis) koreni	P	1107						1			2	3				1	
Pectinaria belgica	P	1109								1			2				

Station			T1 Under A	T1 Under B	T1 Under C	T1 Edge A	T1 Edge B	T1 Edge C	T1 10m A	T1 10m B	T1 10m C	T1 20m A	T1 20m B	T1 20m C	T1 50 A	T1 50m B	T1 50 C
Trichobranchidae	P	1171															
Terebellides stroemii	P	1175															
Terebellidae	P	1179															
Eupolymnia sp.	P	1188										3	4		9	12	
Pista sp.	P	1216	1									1					
Pista cristata	P	1217						1									
Pista lornensis	P	1218															
Polycirrus sp.	P	1235	1				1			4			1			1	
Polycirrus norvegicus	P	1243															
SABELLIDA	P	1256															
Sabellidae	P	1257															
Sabellidae sp.	P	1257				2						1	3		1	1	1
OLIGOCHAETA	P	1402															
TUBIFICIDA	P	1403															
Tubificidae	P	1425															
Tubificoides benedii	P	1490		1		2	2		5			1		1			
Enchytraeidae	P	1501															
Enchytraeidae sp.	P	1501	1													1	
CHELICERATA	Q	1															
PYCNOGONIDA	Q	2															
Ammotheidae	Q	13															
Achelia sp.	Q	14															
Endeidae	Q	27															
Endeis spinosa	Q	30															
CRUSTACEA	R	1															
COPEPODA	R	142															
HARPACTICOIDA	R	785															
Longipediidae	R	787															
Longipedia sp.	R	788															
OSTRACODA	R	2412															

Station			T1 Under A	T1 Under B	T1 Under C	T1 Edge A	T1 Edge B	T1 Edge C	T1 10m A	T1 10m B	T1 10m C	T1 20m A	T1 20m B	T1 20m C	T1 50 A	T1 50m B	T1 50 C
MYODOCOPIDA	R	2413															
Cylindroleberididae	R	2424															
Cylindroleberis mariae	R	2426															
MALACOSTRACA	S	1															
LEPTOSTRACA	S	3															
Nebaliidae	S	4															
Nebalia bipes	S	6		1		10	5	4	1		2			1		9	
EUMALACOSTRACA	S	23															
AMPHIPODA	S	97															
Oedicerotidae	S	118															
Monoculodes carinatus	S	125															
Synchelidium maculatum	S	138															
Urothoidae	S	245															
Urothoe sp.	S	246														3	
Urothoe elegans	S	248													2		
Urothoe marina	S	249								1			1			3	
Phoxocephalidae	S	252															
Metaphoxus fultoni	S	265									1						
Lysianassidae	S	271															
Lysianassa plumosa	S	305															
Tryphosella horingii	S	342															
Synopioidea	S	348															
Argissa hamatipes	S	360															
Dexaminidae	S	408															
Atylus vedlomensis	S	413															
Guernea coalita	S	418															
Ampeliscidae	S	422															
Ampelisca sp.	S	423														1	
Ampelisca typica	S	442											1		2		
Gammaridae	S	464															

Station			T1 Under A	T1 Under B	T1 Under C	T1 Edge A	T1 Edge B	T1 Edge C	T1 10m A	T1 10m B	T1 10m C	T1 20m A	T1 20m B	T1 20m C	T1 50 A	T1 50m B	T1 50 C
Gammaridae sp.	S	464					1				1						
Gammarus sp.	S	471					3										
Melitidae	S	495															
Melitidae sp.	S	495															
Isaeidae	S	537															
Gammaropsis sp	S	537															
Photidae	S																
Photis longicaudata	S	552								1			2				
Ischyroceridae	S	558															
Jassa sp.	S	568		1		2	2	2									1
Jassa falcata	S	569		1													
Aoridae	S	577															
Aoridae sp.	S	577															
Caprellidae	S	639															
Caprella sp.	S	640															
Caprella mutica	S			1													
Pariambus typicus	S	651									2						
ISOPODA	S	790															
Gnathiidae	S	792															
Gnathia sp.	S	793															
Conilera cylindracea	S	849															
Idoteidae	S	933															
Idotea sp.	S	934															
TANAIDACEA	S	1099															
Anarthruidae	S	1115															
Tanaopsis graciloides	S	1142					1			2		7	8	3	13	12	1
CUMACEA	S	1183															
Nannastacidae	S	1214															
Campylaspis legendrei	S	1218															
Diastylidae	S	1244															

Station			T1 Under A	T1 Under B	T1 Under C	T1 Edge A	T1 Edge B	T1 Edge C	T1 10m A	T1 10m B	T1 10m C	T1 20m A	T1 20m B	T1 20m C	T1 50 A	T1 50m B	T1 50 C
Diastylis sp.	S	1224															
DECAPODA	S	1276															
Paguridae	S	1445															
Paguridae sp.	S	1445											1				
Galatheidae	S	1469															
Galathea sp.	S	1470															
Porcellanidae	S	1480															
Pisidia longicornis	S	1482					1	1	1				3				
BRACHYURA	S	1485															
Brachyura sp.	S	1485								1	1	1					
Leucosiidae	S	1502															
Majidae	S	1512															
Macropodia parva	S																
Atelecyclidae	S	1553															
Atelecyclus rotundatus	S	1555												1			
BRACHYRHYNCHA	S	1567															
Portunidae	S	1569															
Liocarcinus sp.	S	1577								1			1	2	1		
Liocarcinus pusillus	S	1584															
Carcinus maenas	S	1594				2											
Goneplacidae	S	1603															
Pilumnus hirtellus	S	1615							1								
MOLLUSCA	W	1															
POLYPLACOPHORA	W	46															
NEOLORICATA	W	47															
Leptochitonidae	W	48															
Leptochiton asellus	W	53					1	1				1					
Leptochiton cancellatus	W	54	2					4		2		2	2		4	5	
GASTROPODA	W	88															
ARCHAEOGASTROPODA	W	90															

Station			**T1 Under A**	**T1 Under B**	**T1 Under C**	**T1 Edge A**	**T1 Edge B**	**T1 Edge C**	**T1 10m A**	**T1 10m B**	**T1 10m C**	**T1 20m A**	**T1 20m B**	**T1 20m C**	**T1 50 A**	**T1 50m B**	**T1 50 C**
Trochidae	W	140															
Gibbula sp.	W	157															
PATELLOGASTROPODA	W	219															
Lottiidae	W	221															
Tectura virginea	W	224															
Patellidae	W	225															
Ansates pellucida	W	234															
MESOGASTROPODA	W	256															
Littorinidae	W	283															
Lacuninae	W	284															
Lacuna vincta	W	292															
Rissoidae	W	324															
Rissoa parva	W	334															
Caecidae	W	411															
Caecum trachea	W	414	12	2		1		2	5	13	8	6	4	3	2	1	
Naticidae	W	482															
Euspira pulchella	W	491	1				2	1	2	1						1	
Eulimidae	W	599															
Melanella sp.	W	633															
NEOGASTROPODA	W	670															
Buccinidae	W	702															
Nassarius sp.	W	743									1	5					1
Nassarius pygmaeus	W	748		2			1	1		2	2						
Turridae	W	771															
Mangelia attenuata	W	797															
Raphitoma sp.	W	859															
Raphitoma leufroyi	W	864															
OPISTHOBRANCHIA	W																
CEPHALASPIDEA	W	1002															
Cylichnidae	W	1024															

Station			T1 Under A	T1 Under B	T1 Under C	T1 Edge A	T1 Edge B	T1 Edge C	T1 10m A	T1 10m B	T1 10m C	T1 20m A	T1 20m B	T1 20m C	T1 50 A	T1 50m B	T1 50 C
Cylichna cylindracea	W	1028									1						
Phylinidae	W	1035															
Philine sp.	W	1036												2			
Philine aperta	W	1038											2				
Philine catena	W	1039										2					
ANASPIDEA	W	1138															
Aplysiidae	W	1143															
Aplysia punctata	W	1152															
NUDIBRANCHIA	W	1243															
Nudibranchia sp.	W	1243												1		1	
Onchidorididae	W	1319															
Onchidoridae sp.	W	1319				1											
SCAPHOPODA	W	1513															
Dentallidae	W	1515															
Antalis entalis	W	1519	1														
PELECYPODA	W	1560															
Bivalvia sp.	W	1560															
NUCULOIDA	W	1561															
Nuculidae	W	1563															
Nucula hanleyi	W	1568															
Nucula nitidosa	W	1569											1				
MYTILOIDA	W	1689															
Mytilidae	W	1691															
Mytilidae sp.	W	1691	21	8		78	11	41	8	17	30	243	149	180	16	30	1
OSTREOIDA	W	1752															
Anomiidae	W	1805															
Anomiidae sp.	W	1805															
VENEROIDA	W	1815															
Montacutidae	W	1888															
Kurtiella bidentata	W	1906				1		10		1	1	1		1			

Station			T1 Under A	T1 Under B	T1 Under C	T1 Edge A	T1 Edge B	T1 Edge C	T1 10m A	T1 10m B	T1 10m C	T1 20m A	T1 20m B	T1 20m C	T1 50 A	T1 50m B	T1 50 C
Cardiidae	W	1938															
Acanthocardia echinata	W	1943															
Parvicardium pinnulatum	W	1951														1	
Pharidae	W	1995															
Phaxas pellucidus	W	2006															
Tellinidae	W	2008															
Tellina sp.	W	2018	1						1		2	6	7	3	1	1	1
Tellina donacina	W	2021	1	1									1				
Tellina pygmaea	W	2023					1		1		4				2	2	
Psammobiidae	W	2042															
Gari tellinella	W	2049															
Semelidae	W	2057															
Abra sp.	W	2058									1		2				
Veneridae	W	2086															
Veneridae sp.	W	2086															
Gouldia minima	W	2095															
Clausinella fasciata	W	2100														2	
Timoclea ovata	W	2104												1			
Venerupis sp.	W	2123						1		1		1				1	
Dosinia sp.	W	2126														1	
MYOIDA	W	2140															
Corbulidae	W	2153															
Hiatella arctica	W	2166				1		1				2	1				
PHOLADOMYOIDA	W	2220															
Thraciidae	W	2226															
Thracia sp.	W	2228															
PHORONIDA	ZA	1															
Phoronidae	ZA	2															
Phoronis sp.	ZA	3															
ECHINODERMATA	ZB	1															

Station			T1 Under A	T1 Under B	T1 Under C	T1 Edge A	T1 Edge B	T1 Edge C	T1 10m A	T1 10m B	T1 10m C	T1 20m A	T1 20m B	T1 20m C	T1 50 A	T1 50m B	T1 50 C
ASTEROIDEA	ZB	18															
Asteroidea sp.	ZB	18															
Astropectinidae	ZB	24															
Astropecten irregularis	ZB	26							1								
FORCIPULATIDA	ZB	95															
Asteriidae	ZB	96															
Asterias rubens	ZB	100												1			
OPHIUROIDEA	ZB	105															
Ophiuroidea sp.	ZB	105							1								
OPHIURIDA	ZB	121															
Ophiocomidae	ZB	126															
Ophiopsila annulosa	ZB	130			1												
Amphiuridae	ZB	148															
Amphipholis squamata	ZB	161														1	
Ophiuridae	ZB	165															
Ophiura affinis	ZB	167															
Ophiura albida	ZB	168										2					
ECHINOIDEA	ZB	181															
ECHINOIDA	ZB	190															
Echinidae	ZB	194															
Echinocyamus pusillus	ZB	212															
SPATANGOIDA	ZB	213															
Loveniidae	ZB	221															
Echinocardium sp.	ZB	222														1	
Echinocardium flavescens	ZB	224															
HOLOTHURIOIDEA	ZB	229															
DENDROCHIROTIDA	ZB	249															
Phyllophoridae	ZB	258															
Neopentadactyla mixta	ZB	260								1		3	3		3	5	3
Thyone sp.	ZB	261													1		

Station			T1 Under A	T1 Under B	T1 Under C	T1 Edge A	T1 Edge B	T1 Edge C	T1 10m A	T1 10m B	T1 10m C	T1 20m A	T1 20m B	T1 20m C	T1 50 A	T1 50m B	T1 50 C
Thyone fusus	ZB	262															
APODIDA	ZB	289															
Synaptidae	ZB	290															
Leptosynapta sp.	ZB	291															
HEMICHORDATA	ZC	1															
Hemichordata sp.	ZC	1	1	1			4	7		3	3	10				4	
CEPHALOCHORDATA																	
Branchiostomidae																	
Branchiostoma lanceolatum									1								

Station			T1 100 A	T1 100m B	T1 100 C	T2 10m A	T2 10m B	T2 10m C	T2 20m A	T2 20m B	T2 20m C	T2 50m A	T2 50m B	T2 50m C	Ref A	Ref B	Ref C
CNIDARIA	D	1															
ANTHOZOA	D	583															
ACTINIARIA	D	662															
Edwardsiidae	D	759															
Edwardsiidae sp.	D	759	6												1	3	5
Edwardsia sp.	D	764															
SIPUNCULA	N	1															
SIPUNCULIDEA	N	2															
GOLFINGIIFORMES	N	10															
Phascolionidae	N	29															
Phascolion strombus strombus	N	34															
ANNELIDA	P	1															
POLYCHAETA	P	2															
PHYLLODOCIDA	P	3															
Pisionidae	P	13															
Pisione remota	P	15															
Aphroditidae	P	17															
Aphrodita aculeata	P	19															
Polynoidae	P	25															
Polynoidae sp.	P	25								1				1	2		1
Harmothoe sp.	P	50		1	1										3		
Malmgreniella sp.	P		1		1					1	2			1			1
Malmgreniella mcintoshi	P	70													1		
Pholoidae	P	90															
Pholoe inornata	P	92	3	1	4	3			3	1	3	2	2	2	11	6	4
Pholoe cf baltica (sensu Petersen)	P	95										1					
Phyllodocidae	P	114															
Phyllodocidae sp.	P	114			1					2			1		2		

Station			T1 100 A	T1 100m B	T1 100 C	T2 10m A	T2 10m B	T2 10m C	T2 20m A	T2 20m B	T2 20m C	T2 50m A	T2 50m B	T2 50m C	Ref A	Ref B	Ref C
Eteone longa aggregate	P	118	2	2	3	3	2	2	13	2	11	1	3		1	2	4
Phyllodoce longipes	P	143										1					
Phyllodoce mucosa	P	145				37	1	4	3	10	39	2					
Eumida sp.	P	163									1						
Eumida bahusiensis	P	164											1				
Paranaitis kosteriensis	P	176				1			3								
Phyllodoce sp.	P	178															
Glyceridae	P	254															
Glycera sp.	P	255	2	1	1	1			2		3			3	1	4	
Glycera alba	P	256							3								
Glycera lapidum	P	260	2	2	1			1			1	2	1		1		3
Goniadidae	P	266															
Goniadidae sp.	P	266												1			1
Hesionidae	P	293															
Hesionidae sp.	P	293									1						
Kefersteinia cirrata	P	305															
Podarkeopsis helgolandica	P									2							
Microphthalmus similis	P	333	1														
Syllidae	P	346															
Syllis cornuta	P	349	1					1							3		
Syllis sp.	P	358	1														
Syllis sp. E (after Garwood)	P	358		1	1									1	1		
Syllis sp. H (after Garwood)	P	358															4
Trypanosyllis sp.	P	361													2		
Exogoninae	P	410															
Exogone sp.	P	418	1														
Sphaerosyllis bulbosa	P	425												2		1	
Myrianida sp.	P	434				1							3				
Nereididae	P	458															

Station			T1 100 A	T1 100m B	T1 100 C	T2 10m A	T2 10m B	T2 10m C	T2 20m A	T2 20m B	T2 20m C	T2 50m A	T2 50m B	T2 50m C	Ref A	Ref B	Ref C
Nereididae sp.	P	458															
Platynereis dumerilii	P	482				1							1				
Nephtyidae	P	490															
Nephtys sp.	P	494															
EUNICIDA	P	536															
Onuphidae	P	537															
Aponuphis bilineata	P	538			3						1						1
Eunicidae	P	553															
Eunice sp.	P	554			1												
Eunice pennata	P	558		1													
Lumbrineridae	P	569															
Lumbrineridae sp.	P	569							1								
Lumbrineris sp.	P	572		1	1						5	1	2				
Lumbrineris cf cingulata	P																
Dorvilleidae	P	598															
Protodorvillea kefersteini	P	638	5				3	1	1		6		4	6	4		
Schistomeringos rudolphi	P	643															
ORBINIIDA	P	654															
Paraonidae	P	674															
Aricidea (Acmira) cerrutii	P	685							2		1						
Paradoneis lyra	P	699			1				5								
SPIONIDA	P	707															
Spionidae	P	720															
Spionidae sp.	P	720		1		1					2					1	
Malacoceros fuliginosus	P	737											1				
Polydora sp.	P	748															
Prionospio sp.	P	763								1	2				2		
Pseudopolydora pulchra	P	774		1													
Spio sp.	P	787							1								

Station			T1 100 A	T1 100m B	T1 100 C	T2 10m A	T2 10m B	T2 10m C	T2 20m A	T2 20m B	T2 20m C	T2 50m A	T2 50m B	T2 50m C	Ref A	Ref B	Ref C
Magelonidae	P	802															
Magelona alleni	P	804							1								
Magelona filiformis	P	805						1									
Cirratulidae	P	822															
Cirratulidae sp.	P	822							3	2	3		2	1	1		2
Caulleriella alata	P	829	2		2	2		1	3		1	1				1	
Chaetozone gibber	P	833						1									
FLABELLIGERIDA	P	872															
Flabelligeridae	P	873															
Diplocirrus glaucus	P	878	1						1		2				1		1
Diplocirrus stopbowitzi	P				1									1			1
CAPITELLIDA	P	902															
Capitellidae	P	903															
Capitellidae sp.	P	903															1
Capitella sp.	P	906	3			26	224	234	5	5	14	1	1		1		
Mediomastus fragilis	P	919		1	1	4	3	5	37	10	16	12		4	1		2
Arenicolidae	P	928															
Arenicola marina	P	931															
OPHELIIDA	P	992															
Scalibregmatidae	P	1020															
Scalibregma inflatum	P	1027	3	4	2	2	1	3	10	8	5	2		2	1	2	2
OWENIIDA	P	1089															
Oweniidae	P	1090															
Owenia fusiformis	P	1098			1	1			1	4	8	1		1			
TEREBELLIDA	P	1099															
Pectinariidae	P	1100															
Pectinaria (Amphictene) auricoma	P	1102								1			1	1	1		
Pectinaria sp.	P	1106			1			3			8						
Pectinaria (Lagis) koreni	P	1107			1		1										

Station			**T1 100 A**	**T1 100m B**	**T1 100 C**	**T2 10m A**	**T2 10m B**	**T2 10m C**	**T2 20m A**	**T2 20m B**	**T2 20m C**	**T2 50m A**	**T2 50m B**	**T2 50m C**	**Ref A**	**Ref B**	**Ref C**
Pectinaria belgica	P	1109													2		
Trichobranchidae	P	1171															
Terebellides stroemii	P	1175		1						1	1						
Terebellidae	P	1179															
Eupolymnia sp.	P	1188			2				8	1	16	4					
Pista sp.	P	1216			1												1
Pista cristata	P	1217							2		2						
Pista lornensis	P	1218							1	1		1			2		1
Polycirrus sp.	P	1235	2	1					1						8		
Polycirrus norvegicus	P	1243													1		
SABELLIDA	P	1256															
Sabellidae	P	1257															
Sabellidae sp.	P	1257	2	7	1				5					5		4	3
OLIGOCHAETA	P	1402															
TUBIFICIDA	P	1403															
Tubificidae	P	1425															
Tubificoides benedii	P	1490					1					1				1	
Enchytraeidae	P	1501															
Enchytraeidae sp.	P	1501	3	1													1
CHELICERATA	Q	1															
PYCNOGONIDA	Q	2															
Ammotheidae	Q	13															
Achelia sp.	Q	14											1				
Endeidae	Q	27															
Endeis spinosa	Q	30													1		
CRUSTACEA	R	1															
COPEPODA	R	142															
HARPACTICOIDA	R	785															
Longipediidae	R	787															

Station			T1 100 A	T1 100m B	T1 100 C	T2 10m A	T2 10m B	T2 10m C	T2 20m A	T2 20m B	T2 20m C	T2 50m A	T2 50m B	T2 50m C	Ref A	Ref B	Ref C
Longipedia sp.	R	788	1														
OSTRACODA	R	2412															
MYODOCOPIDA	R	2413															
Cylindroleberididae	R	2424															
Cylindroleberis mariae	R	2426												2			
MALACOSTRACA	S	1															
LEPTOSTRACA	S	3															
Nebaliidae	S	4															
Nebalia bipes	S	6			1		1					1					
EUMALACOSTRACA	S	23															
AMPHIPODA	S	97															
Oedicerotidae	S	118															
Monoculodes carinatus	S	125												2			
Synchelidium maculatum	S	138												2			
Urothoidae	S	245															
Urothoe sp.	S	246									1		1				1
Urothoe elegans	S	248															
Urothoe marina	S	249			1				1								
Phoxocephalidae	S	252															
Metaphoxus fultoni	S	265		1	1										1		
Lysianassidae	S	271															
Lysianassa plumosa	S	305			1												2
Tryphosella horingii	S	342					1										
Synopioidea	S	348															
Argissa hamatipes	S	360														1	
Dexaminidae	S	408															
Atylus vedlomensis	S	413													2	1	
Guernea coalita	S	418													1		
Ampeliscidae	S	422															

Station			**T1 100 A**	**T1 100m B**	**T1 100 C**	**T2 10m A**	**T2 10m B**	**T2 10m C**	**T2 20m A**	**T2 20m B**	**T2 20m C**	**T2 50m A**	**T2 50m B**	**T2 50m C**	**Ref A**	**Ref B**	**Ref C**
Ampelisca sp.	S	423												1			
Ampelisca typica	S	442		2					1		1				1		
Gammaridae	S	464															
Gammaridae sp.	S	464															
Gammarus sp.	S	471															
Melitidae	S	495															
Melitidae sp.	S	495											1				
Isaeidae	S	537															
Gammaropsis sp	S	537														1	
Photidae	S																
Photis longicaudata	S	552															
Ischyroceridae	S	558															
Jassa sp.	S	568									1						
Jassa falcata	S	569															
Aoridae	S	577															
Aoridae sp.	S	577											11		4		
Caprellidae	S	639															
Caprella sp.	S	640											1				
Caprella mutica	S																
Pariambus typicus	S	651															1
ISOPODA	S	790															
Gnathiidae	S	792															
Gnathia sp.	S	793													1		
Conilera cylindracea	S	849							1					2			
Idoteidae	S	933															
Idotea sp.	S	934				1											
TANAIDACEA	S	1099															
Anarthruidae	S	1115															
Tanaopsis graciloides	S	1142	1	4		2			31	1	15	18	1		1	3	2

Station			T1 100 A	T1 100m B	T1 100 C	T2 10m A	T2 10m B	T2 10m C	T2 20m A	T2 20m B	T2 20m C	T2 50m A	T2 50m B	T2 50m C	Ref A	Ref B	Ref C
CUMACEA	S	1183															
Nannastacidae	S	1214															
Campylaspis legendrei	S	1218			1						1			2		1	2
Diastylidae	S	1244															
Diastylis sp.	S	1224								1	1			1		1	
DECAPODA	S	1276															
Paguridae	S	1445															
Paguridae sp.	S	1445			1									1	1		
Galatheidae	S	1469															
Galathea sp.	S	1470													4		
Porcellanidae	S	1480															
Pisidia longicornis	S	1482				9	1		1		1		2		5		
BRACHYURA	S	1485															
Brachyura sp.	S	1485															
Leucosiidae	S	1502															
Majidae	S	1512															
Macropodia parva	S												1				
Atelecyclidae	S	1553															
Atelecyclus rotundatus	S	1555				1											
BRACHYRHYNCHA	S	1567															
Portunidae	S	1569															
Liocarcinus sp.	S	1577		3						1	1			1			
Liocarcinus pusillus	S	1584														1	
Carcinus maenas	S	1594															
Goneplacidae	S	1603															
Pilumnus hirtellus	S	1615															
MOLLUSCA	W	1															
POLYPLACOPHORA	W	46															
NEOLORICATA	W	47															

Station			**T1 100 A**	**T1 100m B**	**T1 100 C**	**T2 10m A**	**T2 10m B**	**T2 10m C**	**T2 20m A**	**T2 20m B**	**T2 20m C**	**T2 50m A**	**T2 50m B**	**T2 50m C**	**Ref A**	**Ref B**	**Ref C**
Leptochitonidae	W	48															
Leptochiton asellus	W	53															
Leptochiton cancellatus	W	54		1	4					1					26		
GASTROPODA	W	88															
ARCHAEOGASTROPODA	W	90															
Trochidae	W	140															
Gibbula sp.	W	157		1	2										1		
PATELLOGASTROPODA	W	219															
Lottiidae	W	221															
Tectura virginea	W	224													1		
Patellidae	W	225															
Ansates pellucida	W	234											9				
MESOGASTROPODA	W	256															
Littorinidae	W	283															
Lacuninae	W	284															
Lacuna vincta	W	292											1				
Rissoidae	W	324															
Rissoa parva	W	334				1							12				
Caecidae	W	411															
Caecum trachea	W	414	3	2	7	1	1	1	1		3		2	7	23	1	5
Naticidae	W	482															
Euspira pulchella	W	491									1						
Eulimidae	W	599															
Melanella sp.	W	633			1												
NEOGASTROPODA	W	670															
Buccinidae	W	702															
Nassarius sp.	W	743															
Nassarius pygmaeus	W	748					4	1			1						
Turridae	W	771															

Station			**T1 100 A**	**T1 100m B**	**T1 100 C**	**T2 10m A**	**T2 10m B**	**T2 10m C**	**T2 20m A**	**T2 20m B**	**T2 20m C**	**T2 50m A**	**T2 50m B**	**T2 50m C**	**Ref A**	**Ref B**	**Ref C**
Mangelia attenuata	W	797										1					
Raphitoma sp.	W	859					1										
Raphitoma leufroyi	W	864													1		
OPISTHOBRANCHIA	W																
CEPHALASPIDEA	W	1002															
Cylichnidae	W	1024															
Cylichna cylindracea	W	1028								1				1			
Phylinidae	W	1035															
Philine sp.	W	1036												2			
Philine aperta	W	1038										1					
Philine catena	W	1039															
ANASPIDEA	W	1138															
Aplysiidae	W	1143															
Aplysia punctata	W	1152							1								
NUDIBRANCHIA	W	1243															
Nudibranchia sp.	W	1243											2		1		
Onchidorididae	W	1319															
Onchidoridae sp.	W	1319															
SCAPHOPODA	W	1513															
Dentallidae	W	1515															
Antalis entalis	W	1519									1						
PELECYPODA	W	1560															
Bivalvia sp.	W	1560												1			
NUCULOIDA	W	1561															
Nuculidae	W	1563															
Nucula hanleyi	W	1568	1														
Nucula nitidosa	W	1569															
MYTILOIDA	W	1689															
Mytilidae	W	1691															

Station			T1 100 A	T1 100m B	T1 100 C	T2 10m A	T2 10m B	T2 10m C	T2 20m A	T2 20m B	T2 20m C	T2 50m A	T2 50m B	T2 50m C	Ref A	Ref B	Ref C
Mytilidae sp.	W	1691	3	1	3	219	81	132	16	38	99	6	309	2		1	
OSTREOIDA	W	1752															
Anomiidae	W	1805															
Anomiidae sp.	W	1805													1		
VENEROIDA	W	1815															
Montacutidae	W	1888															
Kurtiella bidentata	W	1906		3			1		1		1				1	3	
Cardiidae	W	1938															
Acanthocardia echinata	W	1943									1						
Parvicardium pinnulatum	W	1951			2											1	
Pharidae	W	1995															
Phaxas pellucidus	W	2006								1							
Tellinidae	W	2008															
Tellina sp.	W	2018											2	2	1	1	1
Tellina donacina	W	2021															
Tellina pygmaea	W	2023						1			5			1	1		
Psammobiidae	W	2042															
Gari tellinella	W	2049												1			
Semelidae	W	2057															
Abra sp.	W	2058								1							
Veneridae	W	2086															
Veneridae sp.	W	2086		1	1						1						
Gouldia minima	W	2095		1													
Clausinella fasciata	W	2100	1		1		1							1			2
Timoclea ovata	W	2104															1
Venerupis sp.	W	2123			7												
Dosinia sp.	W	2126															1
MYOIDA	W	2140															
Corbulidae	W	2153															

Station			**T1 100 A**	**T1 100m B**	**T1 100 C**	**T2 10m A**	**T2 10m B**	**T2 10m C**	**T2 20m A**	**T2 20m B**	**T2 20m C**	**T2 50m A**	**T2 50m B**	**T2 50m C**	**Ref A**	**Ref B**	**Ref C**
Hiatella arctica	W	2166															
PHOLADOMYOIDA	W	2220															
Thraciidae	W	2226															
Thracia sp.	W	2228									1			1	1		
PHORONIDA	ZA	1															
Phoronidae	ZA	2															
Phoronis sp.	ZA	3										1					
ECHINODERMATA	ZB	1															
ASTEROIDEA	ZB	18															
Asteroidea sp.	ZB	18						1									
Astropectinidae	ZB	24															
Astropecten irregularis	ZB	26															
FORCIPULATIDA	ZB	95															
Asteriidae	ZB	96															
Asterias rubens	ZB	100															
OPHIUROIDEA	ZB	105															
Ophiuroidea sp.	ZB	105															
OPHIURIDA	ZB	121															
Ophiocomidae	ZB	126															
Ophiopsila annulosa	ZB	130															
Amphiuridae	ZB	148															
Amphipholis squamata	ZB	161		1	1										1		
Ophiuridae	ZB	165															
Ophiura affinis	ZB	167															1
Ophiura albida	ZB	168			2										1		
ECHINOIDEA	ZB	181															
ECHINOIDA	ZB	190															
Echinidae	ZB	194															
Echinocyamus pusillus	ZB	212													4	1	2

Station			T1 100 A	T1 100m B	T1 100 C	T2 10m A	T2 10m B	T2 10m C	T2 20m A	T2 20m B	T2 20m C	T2 50m A	T2 50m B	T2 50m C	Ref A	Ref B	Ref C
SPATANGOIDA	ZB	213															
Loveniidae	ZB	221															
Echinocardium sp.	ZB	222															
Echinocardium flavescens	ZB	224				3											
HOLOTHURIOIDEA	ZB	229															
DENDROCHIROTIDA	ZB	249															
Phyllophoridae	ZB	258															
Neopentadactyla mixta	ZB	260	2	4	2				3		2	3		3	2	2	9
Thyone sp.	ZB	261										1					
Thyone fusus	ZB	262												2			1
APODIDA	ZB	289															
Synaptidae	ZB	290															
Leptosynapta sp.	ZB	291		1							1						
HEMICHORDATA	ZC	1															
Hemichordata sp.	ZC	1			1			4	5	1		2		1			
CEPHALOCHORDATA																	
Branchiostomidae																	
Branchiostoma lanceolatum																	