Annex 10.1

South Humber Channel Marine Studies: Intertidal and Subtidal Benthic & Fish Surveys 2010

(IECS)

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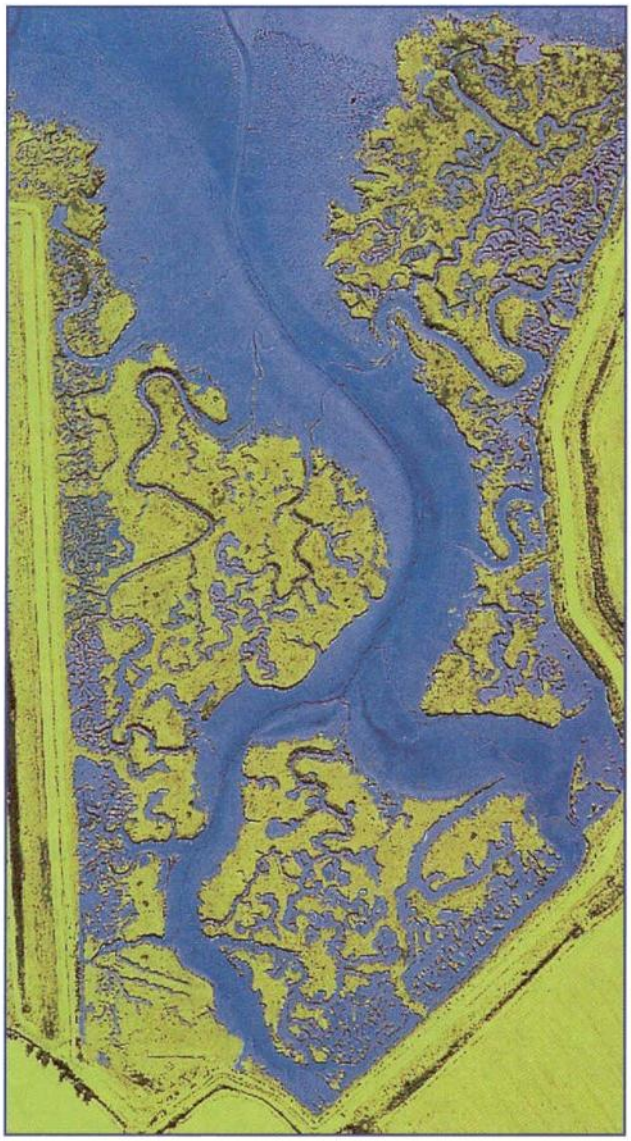

THE UNIVERSITY OF HULL
Institute of Estuarine and Coastal Studies (IECS)

South Humber Channel Marine Studies: Intertidal and Subtidal Benthic & Fish Surveys 2010

Report to Yorkshire Forward

Institute of Estuarine and Coastal Studies
University of Hull

21st January 2011

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Yorkshire Forward

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For and on behalf of the Institute of Estuarine and Coastal Studies

Approved by:	Nick Cutts
Signed:	
Position:	Deputy Director, IECS
Date:	21 January 2011

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1. INTRODUCTION

Yorkshire Forward is currently investigating the feasibility of a potential commercial development in the Humber Estuary between the Humber Sea Terminal and Immingham Port (Figure 1). This area may provide a suitable location for a variety of developments e.g. multi-user marine facility or tidal power generating farm. However, in order for any such development to take place a host of studies relating to the planning and design of the marine elements of the development are required.

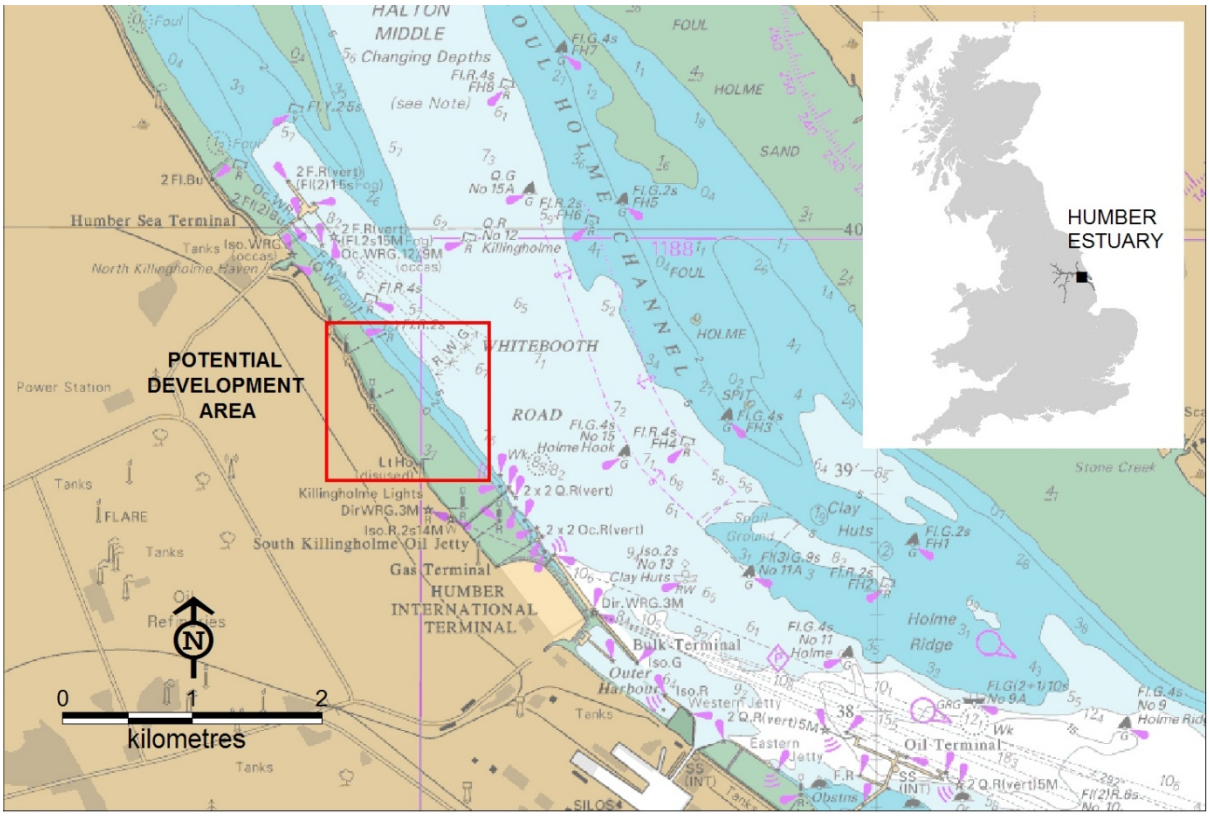

Figure 1: Potential development area in the Humber estuary.

The Institute of Estuarine & Coastal Studies was commissioned in association with Roger Tym & Partners to undertake some of the ecological components required for Yorkshire Forward's investigations.. This report presents the methodologies employed and the data obtained from the intertidal and subtidal benthic and fish surveys undertaken in May/June 2010. The aim of these surveys was to provide baseline data on the benthic and fish communities within the area. This report presents the initial findings of these surveys, with no further discussion or analysis of the data.

The information provided in this report will ultimately be used to assess the potential impacts to the benthic and fish communities in the vicinity of any proposed marine development in the Humber Estuary.

2. METHODOLOGY

2.1 Benthos and fish survey logs

The survey log presented in Table 1 summarises the timings of the intertidal and subtidal benthic and fish surveys. The methodology and results of the sediment analyses (PSA, organic carbon and contaminants) are presented along with the water quality data in a separate report.

Table 1: Survey log for the intertidal and subtidal benthic and fish surveys.

Intertidal benthic survey		**Subtidal benthic survey**	
Date	Friday 14 May 2010	**Date**	Tuesday 4 May 2010
Personnel	Oliver Dawes (IECS) James Thurlow (Hovercraft Pilot)	**Personnel**	Ann Leighton (IECS) Will Musk (IECS) (plus EA crew onboard)
Vessel	Hovercraft	**Vessel**	RV Water Guardian
Components undertaken	36 benthic samples 36 PSA samples 36 organic carbon samples 36 contaminant samples	**Components undertaken**	30 benthic samples 30 PSA samples 30 organic carbon samples 30 contaminant samples
Intertidal fish survey		**Subtidal fish survey**	
Date	Tuesday 8 June 2010 Wednesday 9 June 2010	**Date**	Wednesday 5 May 2010
Personnel	Mike Bailey (IECS) Tim Smith (IECS)	**Personnel**	Will Musk (IECS) Chris Baulcomb (IECS) (plus EA crew onboard)
Vessel	N/A	**Vessel**	RV Water Guardian
Components undertaken	4 double-ended fyke nets	**Components undertaken**	8 beam trawls

2.2 Intertidal benthic survey

Each sample station was accessed either via hovercraft or on foot and each sample point was located using a hand-held WAAS enabled Thales Mobile Mapper GPS. At each of the sampling stations, a single 0.01m^2 core, penetrated to a depth of 15cm, was extruded from the sediment and placed into a sealable bag which was labelled externally detailing client, project, site, replicate, date and analysis required (e.g. YF Humber estuary Tran1_Mid 01/05/10 Macrofauna).

In addition, at each site, sediment samples were collected for particle size analysis, organic carbon and contaminants analysis. Each sample was collected using a clean plastic spoon to remove the top layer, 2-3cm, 5mm and 0-2cm respectively, of undisturbed sediment within two metres of the invertebrate core sample. The samples were stored in sealed plastic bags and labelled externally detailing client, project, site, date and analysis required.

The sediment samples were placed in a cool box containing ice packs to maintain a constant low temperature (approximately 4-5°C). At the end of each day the OC and PSA samples were transferred to the IECS laboratory where they were kept frozen until analysis. The sediments for contaminant analysis were forwarded to ALcontrol, a UKAS accredited laboratory, for analysis.

A complete survey log was maintained throughout the survey detailing time, position, physical characteristics of the sediment, climatic conditions, biological surface features (e.g. tubes, casts, feeding pits, faecal mounds) and any other notable features.

Particular attention was paid to the extent of ephemeral/opportunistic algae and other algal cover, as well as any modification to the community structure which may have resulted from the presence of algae. Evidence of human activities and pressures which may be influencing each survey area was also noted.

Photographs of the site and each sampling location were taken (see Annex 1). At the end of each day the invertebrate core samples were transferred to pre-labelled sealable containers and borax buffered 4% formo-saline solution containing Rose Bengal vital stain was added as a fixative.

The above methodology follows the protocol given by Rees *et al.* (1990)[1], & (1993)[2] Davies *et al.* (2001)[3], with the rationale for different benthic sampling designs in Gray & Elliott (2009)[4].

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1 Rees, H.L., Moore, D. C., Pearson, T. H., Elliot, M., Service, M., Pomfret, J. and Johnson, D. (1990). Procedures for the monitoring of marine benthic communities at UK sewage sludge disposal sites. *Scottish Fisheries Information Pamphlet*, No. 18: 78pp.

2 Rees, H. L. and Service, M. A. (1993). Development of improved strategies for monitoring the epibenthos at sewage sludge disposal sites. In: Analysis and interpretation of benthic community data at sewage sludge disposal sites. In: *Aquatic Environmental Monitoring Report, MAFF Directorate of Fisheries Research, Lowestof*t, No. 37: 55-61.

3 Davies, J., Baxter, J., Bradley, M., Connor, D., Khan, J., Murray, E., Sanderson, W., Turnbull, C. & Vincent, M., (2001). *Marine Monitoring Handbook*, 405pp. JNCC. Peterborough, UK.

4 Gray, J.S., Elliott, M., (2009). *Ecology of marine sediments: From science to management 2nd ed*. Oxford University Press.

2.3 Subtidal benthic sampling

At each pre-determined station position (located by DGPS), a 0.1m^2 Hamon grab was lowered to the seabed and the resulting sample recovered (see Plate 1). Due to the lack of inspection doors within the Hamon grab design, the volume of the sample cannot be assessed whilst the sample is retained within the grab, and therefore the collected sediment was removed to an underlying container prior to evaluation. The retained material should have a minimum volume of 5 litres, any less and the sample was rejected.

Plate 1: Recovery of the Hamon grab.

Plate 2: Sieving of a sample onboard.

If persistently less than 5 litres were collected, expert judgement was used to retain representative samples of less than 5 litres however this should be an occasional incidence rather than a frequent occurrence.

For the incidence of low levels of material, five attempts were made and the vessel repositioned, if required, between attempts. If no sample was accepted within a location, the sample point was moved and a further attempt conducted. If the additional attempt failed, the benthic sample would ordinarily be replaced by video footage, however due to the turbid nature of the Humber Estuary it is unlikely that adequate video footage could be collected. As such data from the bathymetry survey would be used to derive relevant information. Once an acceptable sample was placed in the sample container, a digital image was taken of the disturbed sediment (see Annex 2).

Two replicate grab samples were taken at each station, one for macrofaunal analysis and the second for sediment analysis. This is because given the expected volume of sediment removal from the sample for a suite of subsequent physico-chemical determinands, it was considered that the removal of a sediment sample from the macrofaunal grab would compromise the integrity of the invertebrate data, particularly as the potentially mixed nature of the sediment may limit the amount of sediment collected by the grab. A full survey log was maintained throughout the survey detailing time of sampling, position (DGPS derived), station, attempts, water depth, physical characteristics of the sample, digital image number (cross referencing (QA)), and the presence of any other relevant features.

The macrofaunal samples were processed on a sequential basis utilising a nested sieving technique. Each acceptable sample was removed from the Hamon grab, placed into a clean fish box and photographed (see Annex 2). The sample was then transferred into a hopper and sieved on-board through a nest of 5mm and 0.5mm sieves in order to separate large sediment types that could produce physical damage to invertebrates during sieving (see Plate 2 above). The sieved residues were gently back-washed into sealable containers and borax buffered 4% formo-saline solution (containing Rose Bengal vital stain) was added as a fixative. Each sample was labelled clearly on the side of the container and an additional internal label placed in the container.

The second grab sample, taken for sediment analysis, was removed from the Hamon grab, placed in a clean plastic fish box and photographed. A clean plastic scoop was then used to mix the sample and remove approximately 20g of sediment for organic carbon analysis. This sample was stored in a plastic bag, which was clearly labelled, and kept in a cool box until the end of the day, at which point it will be transferred to IECS and kept frozen until analysis. A second scoop of approximately 2kg was removed from the main sample using a clean plastic scoop and stored in appropriate containers, supplied by ALcontrol, for contaminant analysis. The remaining sediment was retained for PSA and stored in appropriately labelled plastic containers and kept in a cool box until the end of the day, at which point it was transferred to IECS and kept frozen until analysis.

2.4 Intertidal fish and shellfish sampling

One double fyke net assembly, consisting of two facing fyke nets joined by a central net wall (53cm entrance, 10 m central panel, 14mm mesh), was deployed at each station parallel to the shore (Plate 3). Fykes were secured with canes and/or anchors at low tide and left in place for 24h (two tidal cycles); the catch was collected after 12h and 24h to stop the catch drying out. Following sampling, the catch was placed in a shallow container. Coarse debris was carefully removed and the whole catch placed in a chilled insulated container. Macro invertebrates and epifaunal organisms (i.e. brown shrimps) were identified, quantified and released. A representative selection of crabs and prawns was taken to the laboratory to ensure accurate species identification and kept for further reference. All fish were transported to the laboratory for further processing or immediately frozen.

Plate 3: Double-ended fyke net deployed at low tide (Site 1).

2.5 Subtidal fish and shellfish sampling

The survey used a 2m-wide research beam trawl (the trawl frame is comprised of two 60mm x 500mm x 500mm steel shoes, with a 2120mm steel tube brace) fitted with a 5mm cod end sleeve. The start point for each trawl commenced from the point at which the gear reached the seabed after the warp length is paid out and the winch is locked. Trawling was conducted with a warp length of three times the depth at constant speed (2 knots) following a straight path (towards or away from the station fix) to a predetermined finish point.

The survey leader supplied recording sheets on which the skipper recorded the start and end positions of each trawl, date, tow number and station, gear, shooting and hauling times and position (DGPS), time, any significant change in tow direction, depth, warp out and speed over ground. These and all other observations from individual trawls (e.g. tidal state, weather and sea conditions, and shipping activity) were recorded on the survey log.

After the completion of the sampling run, the trawl was quickly hauled to the vessel's deck and the sample was recovered into a container. The net was then checked for any remaining epifauna and fish, before the cod end was refastened, prior to redeployment at the next station. Each accepted sample was initially cleared of large debris and the total catch was photographed (see Annex 4). Fish species will be sorted from epifaunal invertebrates, divided into species groups, counted and measured (total length) to the closest millimetre. All sample bags and buckets will be clearly coded inside and out and the same codes will be carried forward during all the sample analysis. Any species not identified on board will be coded and preserved in 10% buffered formaldehyde solution in seawater or frozen and identified on return to the IECS laboratory. A full survey log was maintained throughout the sorting and sample processing detailing station, date, processing time, gear, species ID, total counts and sub-sample lengths. The data derived from each haul and subsequent fish

analysis was compiled initially in Excel spreadsheet format and was then backed-up with all photographs onto secure digital media.

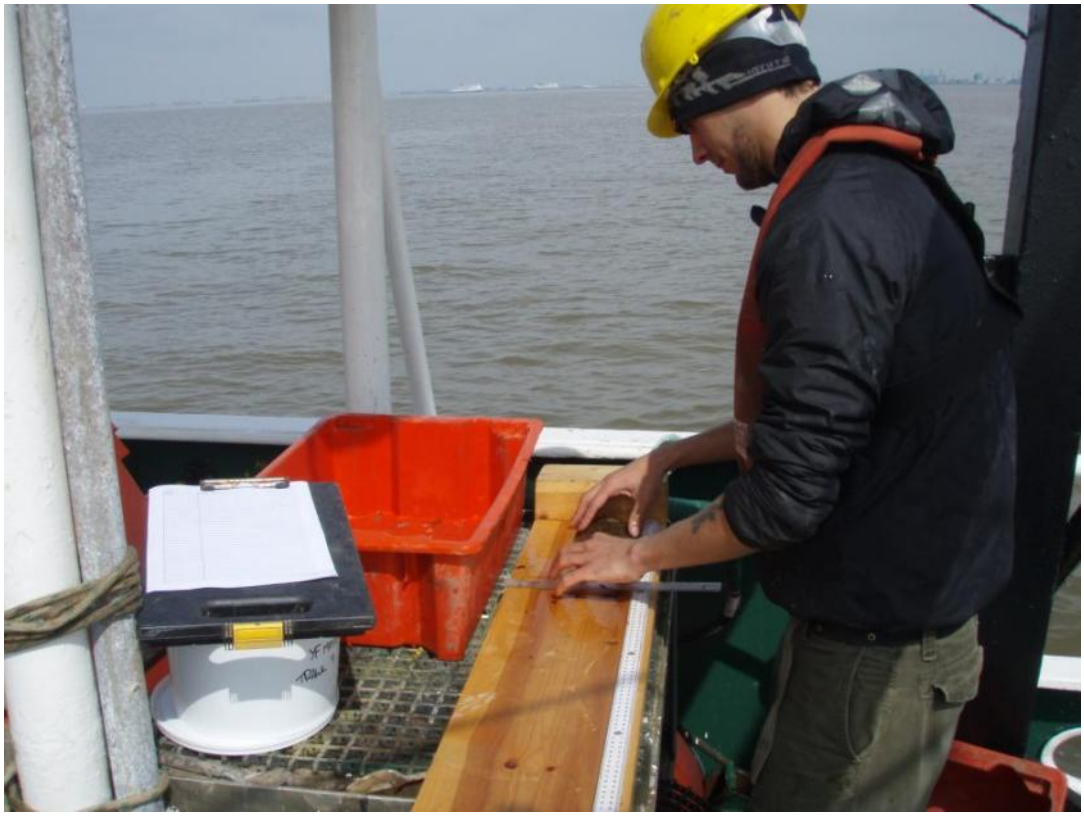


Plate 4: Measuring fish onboard the RV Water Guardian.

2.6 Laboratory analysis

IECS is one of the few independent laboratories to be part of the UK National Marine Biological Analytical Quality Control Scheme (NMBAQC). This scheme assesses the quality of marine benthic work carried out by laboratories, with independent checking of outputs, staff training and technique refinement. IECS is regularly placed within the top two laboratories for test compliance.

2.6.1 BENTHIC SAMPLE SORTING

The same team of benthic technicians undertook the sample sorting for all samples, conducting all the sieving, sorting work and sample description using the standard methodology explained below. Standard sorting quality control was carried out by a member of IECS senior staff. Similarly, the identification of the sorted fauna derived from all samples was carried out by IECS' team of senior taxonomists. Again, standard identification quality control was carried out by a different member of IECS staff. A standard sample tracking procedure was followed throughout the analysis period.

The proposed sorting methodology was as follows:

The 4% formaldehyde solution was decanted from the sample through a 212µm sieve using appropriate exposure prevention controls as detailed in the Health & Safety documentation.

Formaldehyde residue was stored in sealed containers and later disposed in full accordance with current hazardous substances regulations. Material retained on the sieve was washed back into the sample container. A small amount of sediment was then emptied onto a 0.5mm sieve and washed with running tap-water to remove excess formal-saline solution and to complete the sieving process. If there was a large proportion of stone or large shell fragment, a 1mm and 10mm sieve was placed above the 0.5mm sieve to separate into three fractions prior to sorting therefore preventing damage to specimens. The sieve contents were backwashed into a white tray and examined by eye using a 1.5x illuminated magnifier to remove larger specimens. The sample was then sorted under a low powered microscope to ensure the extraction of small specimens. Specimens were removed and sorted into major phyla. Sieves and trays were washed thoroughly between samples to ensure there is no contamination of subsequent samples. The sediment was gradually worked through in this manner until all the material had been sorted, with the internal label kept in the white tray until completion. Specimens were then stored in appropriately labelled containers (specifying client, date, site, and sample no.), preserved in 70% Industrial Methylated Spirits (IMS) and passed on for identification to the team of taxonomists.

The Institute values data quality greatly and uses a variety of in-house procedures to train staff and audit samples. The Institute is a subscriber to the NMBAQC scheme which involves the external auditing of work. A sample tracking procedure is used in the laboratory to ensure traceability and accountability of work.

2.6.2 TAXONOMIC IDENTIFICATION

The procedure for the identification of the sample material is as follows:

Identification was carried out using Olympus SZ40 zoom microscopes with 10x and 20x eyepieces, giving a maximum magnification of up to 80x. An additional 2x objective can occasionally be used to increase the potential magnification to 160X. Olympus BX41 compound microscopes are used for further magnification, if necessary, up to 1000x.

Identification of infaunal samples was to the lowest possible taxonomic level (i.e. species). During identification, all individuals were initially separated into families, with part animals being assigned to families where possible. The macrofauna were identified to species level using standard taxonomic keys, low and high power stereoscopic microscopes and dissection, when necessary, for identification. Juvenile bivalves were opened using sodium hypochlorite. Incomplete animals without anterior ends were not recorded as individuals to be included in the quantitative dataset, however they were identified where possible and recorded as present. Similarly, colonial sessile / epibenthic taxa (e.g. barnacles, hydroids), motile epibenthic taxa (e.g. decapods) and meiofauna were recorded but were not included within the infaunal quantitative dataset.

Regular cross reference identification was carried out by Mr Will Musk (IECS Senior Taxonomist) as part of the standard IECS QA procedure.

Each sample residue was described textually and the residue retained for further analysis and Analytical Quality Control (AQC). All fauna was retained under the standard codes and can be returned to the clients representative for further analysis and AQC should this be required. A reference collection was compiled containing three specimens of each taxa where possible, each vial being fully labelled using standard codes detailing species, sample origin and date.

It is IECS standard procedure to store identified taxa individually in pots for each sample with a label recording the site, date, replicate number and name of who analysed the sample. A permanent internal label bearing the same information is also included inside all containers.

The taxonomic literature used is essentially as given in Rees *et al*. (1990). Reporting nomenclature used Howson & Picton (1997)[5].

2.6.3 BIOMASS

Biomass analysis was performed by wet weight (tissue blotted) and carried out for individual species in each sample. Each taxon was placed on blotting paper to allow the absorption of preservative into the blotting paper, the individuals were then placed on a zeroed microbalance for 30 seconds and the reading taken. The macrofaunal organisms were then placed back in their respective pots and stored. Biomass calculations include all identifiable fragments and were recorded to ± 0.0001g.

2.6.4 FISH AND SHELLFISH PROCESSING

In the laboratory, all the fish not processed in the field were identified using standard taxonomic literature (Ingle, 1983[6]; Whitehead *et al*., 1989[7]; Hayward & Ryland, 1990[8], 1996[9] and Maitland & Herdson, 2008[10]) and were measured to the closest mm. All data from the field and laboratory were combined and were entered into an Excel spreadsheet. Data were recorded for each of the four fyke nets, in turn being sub-divided into the west and east fykes (hence the use of double-ended fyke nets). All sorted samples will be retained for at least 12 months following the reporting sign-off and thereafter a small reference collection will be maintained in case future external auditing is requested.

5 Howson CM and Picton BE (1997). *The species directory of the marine fauna and flora of the British Isles and surrounding seas*. Ulster museum and the Marine Conservation Society.

6 Ingle, R.W., (1983). *Shallow-water Crabs. Synopses of the British Fauna No. 25*. Brackish-Water Sciences Association.

7 Whitehead, P.J.P., Bauchot M.-L., Hureau J.-C., Nielsen j. & E. Tortonese (Ed.) (reprinted) (1989). *Fishes of the North-eastern Atlantic and the Mediterranean*. UNESCO.

8 Hayward, P.J. & J.S. Ryland, (Ed.), (1990). *The marine fauna of the British Isles and North-West Europe: 2. Molluscs to chordates.* Clarendon Press.

9 Hayward, P.J. & J.S. Ryland, (Ed.), (1996). *Handbook of the marine fauna of North-West Europe*. Oxford University Press.

10 Maitland, P.S. Herdson, D., (2008). *Key to the Marine and Freshwater Fishes of Britain and Ireland*. Environment Agency.

3. RESULTS

3.1 Intertidal benthic survey

Figure 2 presents the intertidal survey sampling stations at which samples were collected for benthos (abundance and biomass) and sediment analysis (PSA, organic carbon and contaminants). The positions of the sampling stations are presented in Table 2 below.

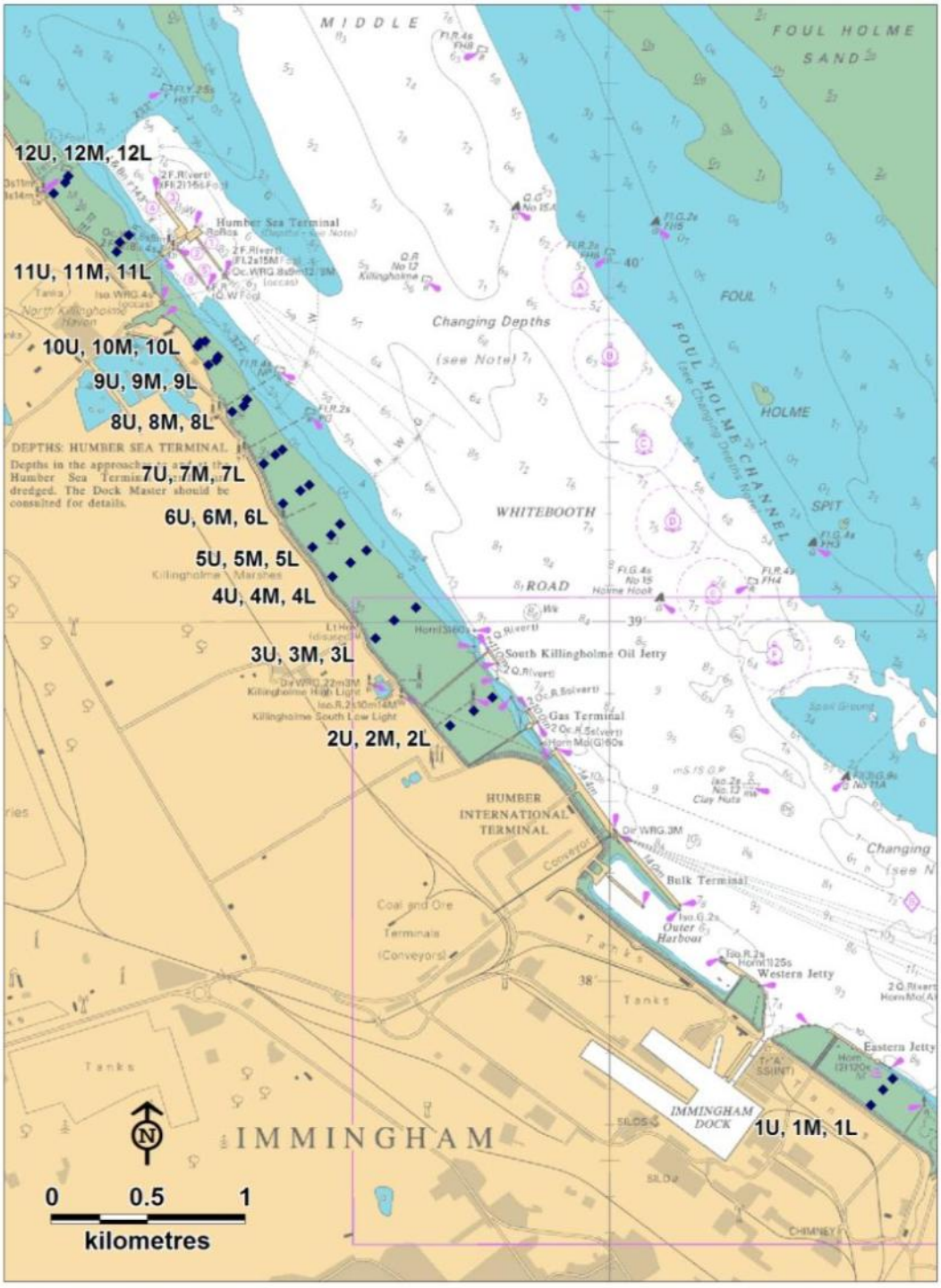


Figure 2: Location of the 12 intertidal transects with upper, middle and lower shore sampling stations at each.

Table 2: Positions of the intertidal sampling stations.

Transect	Latitude	Longitude	Transect	Latitude	Longitude
Transect 1 Upper	53.62759000	-0.17963200	Transect 7 Upper	53.65738200	-0.22699400
Transect 1 Middle	53.62829200	-0.17871100	Transect 7 Middle	53.65780000	-0.22606400
Transect 1 Lower	53.62879600	-0.17791200	Transect 7 Lower	53.65804100	-0.22551400
Transect 2 Upper	53.64520300	-0.21247000	Transect 8 Upper	53.65980500	-0.22945900
Transect 2 Middle	53.64588100	-0.21060200	Transect 8 Middle	53.66007400	-0.22856000
Transect 2 Lower	53.64653500	-0.20916900	Transect 8 Lower	53.66035000	-0.22829600
Transect 3 Upper	53.64926400	-0.21828200	Transect 9 Upper	53.66196200	-0.23130500
Transect 3 Middle	53.65011100	-0.21679200	Transect 9 Middle	53.66218000	-0.23068800
Transect 3 Lower	53.65069400	-0.21513400	Transect 9 Lower	53.66234400	-0.23053600
Transect 4 Upper	53.65212600	-0.22162700	Transect 10 Upper	53.66283100	-0.23213700
Transect 4 Middle	53.65277000	-0.22021100	Transect 10 Middle	53.66300500	-0.23196800
Transect 4 Lower	53.65334900	-0.21897000	Transect 10 Lower	53.66307000	-0.23155300
Transect 5 Upper	53.65349300	-0.22316400	Transect 11 Upper	53.66721800	-0.23849100
Transect 5 Middle	53.65407700	-0.22174600	Transect 11 Middle	53.66765500	-0.23822700
Transect 5 Lower	53.65456000	-0.22101600	Transect 11 Lower	53.66797500	-0.23752500
Transect 6 Upper	53.65552300	-0.22549500	Transect 12 Upper	53.66994200	-0.24337800
Transect 6 Middle	53.65612700	-0.22414800	Transect 12 Middle	53.67043900	-0.24247300
Transect 6 Lower	53.65640200	-0.22344100	Transect 12 Lower	53.67071900	-0.24224300

3.1.1 SITE DESCRIPTIONS

Table 3 presents site descriptions from the three shore positions (upper, middle, lower) at each of the 12 intertidal transects. Photographs from each of the sampling stations have been appended in Annex 1.

3.1.2 ABUNDANCE

The abundance of each benthic species is presented in Table 4, whilst Table 5 presents the % dominance based on total abundance across the upper, middle and lower shore sites.

3.1.3 BIOMASS

The biomass of each benthic species from the intertidal surveys is presented in Table 6, whilst Table 7 presents the % dominance across the three shore heights, based on the biomass data.

Table 3: Site and sample descriptions from the intertidal survey.

Transect	Time	Sediment type	Biological surface features	Weather	Diatoms present	Human activities	Biological notes during sieving
Transect 1 Upper	12:59:53	Mud	*Hediste* burrows and tracks. Evidence of feeding birds	Cloudy	Yes	No	A few *Hediste*. Quite a few Oligochaetes. 1 Macoma.
Transect 1 Middle	13:04:25	Mud	Evidence of feeding birds	Cloudy/ Sunny intervals	Yes	No	2 *Macoma*. Lots of Oligochaetes.
Transect 1 Lower	13:08:16	Mud	Evidence of feeding birds	Cloudy/ Sunny intervals	Yes	No	2 *Macoma*.
Transect 2 Upper	13:25:16	Cracked mud-anoxic	*Hediste* burrows and tracks Evidence of feeding birds	Cloudy/ Sunny intervals	Yes but only in surface pools	No	No animals
Transect 2 Middle	12:14:55	Mud	Evidence of feeding birds	Sunny	Yes	No	4 *Macoma*. A few Oligochaetes
Transect 2 Lower	12:26:55	Mud	Nothing visible	Cloudy/ Sunny intervals	No	No	2 *Macoma*
Transect 3 Upper	14:28:25	Mud	*Hediste* burrows and tracks Evidence of feeding birds	Sunny	Yes	No	Lots of *Hediste*
Transect 3 Middle	12:07:49	Mud	*Corophium* feeding on the surface	Sunny	Yes	No	Lots of *Corophium*. A few *Macoma*
Transect 3 Lower	13:31:35	Mud	Nothing	Sunny	Yes	No	2 *Macoma*. Possibly Oligochaetes
Transect 4 Upper	14:34:54	Mud	*Corophium* feeding on the surface Evidence of feeding birds	Cloudy	Yes	No	A few *Corophium*. Quite a few Oligochaetes
Transect 4 Middle	12:05:08	Mud	*Corophium* feeding on the surface	Cloudy	No	No	A few *Corophium*. A few Oligochaetes
Transect 4 Lower	13:37:19	Mud	Nothing	Cloudy	Yes	No	A few Oligochaetes
Transect 5 Upper	14:39:25	Mud	*Hediste* feeding holes and tracks Evidence of feeding birds	Sunny	Yes	No	2 *Hediste*

Transect	Time	Sediment type	Biological surface features	Weather	Diatoms present	Human activities	Biological notes during sieving
Transect 5 Middle	11:57:15	Mud	*Corophium* feeding on the surface Evidence of feeding birds	Cloudy	No	No	Lots of *Corophium*
Transect 5 Lower	13:41:43	Mud	Nothing	Sunny	No	No	No animals
Transect 6 Upper	14:43:26	Mud	*Hediste* feeding holes Evidence of feeding birds	Sunny	Yes	No	1 *Corophium*. Quite a few Oligochaetes
Transect 6 Middle	11:48:11	Mud	Nothing	Sunny	No	No	No animals
Transect 6 Lower	13:48:31	Mud	Nothing	Cloudy	No	No	1 *Macoma*. 1 *Hediste/Eteone*
Transect 7 Upper	14:52:29	Mud	Evidence of *Hediste* / *Corophium* feeding Evidence of feeding birds	Sunny	Yes	No	A few *Macoma*. A few *Corophium*. A few *Hediste/Eteone*
Transect 7 Middle	11:42:27	Mud	Evidence of *Hediste* / *Corophium* feeding	Sunny	Yes	No	A few *Macoma*. A few *Corophium*. A few *Hediste*
Transect 7 Lower	13:52:05	Mud	Nothing	Cloudy	No	No	No animals
Transect 8 Upper	14:57:41	Mud	*Hediste* feeding holes and tracks	Sunny	Yes	No	1-2 *Corophium*. Quite a few *Hediste*. 1 *Macoma*. A few Oligochaetes
Transect 8 Middle	11:34:54	Mud	*Corophium* feeding tracks	Sunny	Yes	No	A few *Corophium*. A few *Macoma*. A few *Hediste/ Eteone*
Transect 8 Lower	13:58:29	Mud	*Macoma* burrow and feeding arrangement	Sunny	No	No	No animals
Transect 9 Upper	15:04:43	Mud	*Hediste* burrows and tracks/ Corophium feeding	Cloudy	Yes	No	Lots of *Corophium*. A few *Hediste*. A few Oligochaetes
Transect 9 Middle	11:29:04	Mud	*Corophium* feeding	Sunny	No	No	A few *Corophium*

Transect	Time	Sediment type	Biological surface features	Weather	Diatoms present	Human activities	Biological notes during sieving
Transect 9 Lower	14:02:05	Mud	*Corophium* feeding	Sunny	Yes	No	A few *Corophium*. A few Oligochaetes
Transect 10 Upper	15:09:53	Mud	*Hediste* burrows and tracks/ *Corophium* feeding	Cloudy	Yes	No	A few *Corophium*. 1 *Hediste*. A few Oligochaetes
Transect 10 Middle	11:20:24	Mud	Nothing	Sunny	No	No	2 *Corophium*. 1 Oligochaete
Transect 10 Lower	14:06:15	Mud	*Macoma* burrow and feeding arrangement	Sunny	Yes	No	1 *Macoma*?
Transect 11 Upper	15:20:23	Mud	*Hediste* feeding holes and tracks/ *Corophium* feeding	Cloudy	Yes	No	3 *Corophium*. A few *Hediste*. 1 *Macoma*
Transect 11 Middle	11:13:50	Mud	*Corophium* feeding/ possibly *Hediste*	Cloudy	Yes	No	Lots of *Corophium*. 1 or 2 *Macoma*
Transect 11 Lower	14:11:29	Mud	*Macoma* burrow and feeding arrangement	Cloudy	No	No	1 *Diastylis*. 1 *Macoma*. 1 *Nephtys*. A few Oligochaetes
Transect 12 Upper	15:27:26	Mud	*Hediste* feeding holes and tracks/ *Corophium* feeding Evidence of feeding birds	Cloudy	Yes	No	A few *Corophium*. A few *Hediste*.
Transect 12 Middle	11:03:46	Mud	*Corophium* feeding	Cloudy	No	No	Lots of *Corophium*. 1 or 2 *Macoma*
Transect 12 Lower	14:16:48	Mud	*Corophium* feeding	Sunny	No	No	Quite a few *Corophium*. A few Oligochaetes

Table 4: Raw abundance data from the intertidal benthic surveys.

				1			2			3			4			5			6			7			8			9			10			11			12		
MCS Code		Taxon	Taxon Qualifier	Upper	Mid	Lower	Upper	Mid	Lower	Upper	Mid	Lower	Upper	Mid	Lower	Upper	Mid	Lower	Upper	Mid	Lower	Upper	Mid	Lower	Upper	Mid	Lower	Upper	Mid	Lower	Upper	Mid	Lower	Upper	Mid	Lower	Upper	Mid	Lower
F	2	TURBELLARIA														1																							
HD	1	NEMATODA		5	35	1		10	5	6	8	1	3	3	1	2	7			11	3	2	2		2	5	1	6	3	1		4	4	20		1	3	5	3
P	117/118	*Eteone flava/longa*																					1																
P	462	*Hediste diversicolor*		12						26						5									24			4					3	13			30		
P	499	*Nephtys hombergii*																																	1				
P	672	*Scoloplos armiger*							1																														
P	776	*Pygospio elegans*							1		3					1				1									1										2
P	799	*Streblospio shubsolii*		6	9		1	4		6	4	6	2	4	2	3	2	2	4	6	15	12	6	9		1	15		5	4	6	2	6	9	6	5	1	1	27
P		*Tharyx*	Sp. A														4			2			2			2												
P	846	*Tharyx killariensis*																			1																		
P	907	*Capitella capitata*	Sp. Complex		1																																		
P	931	*Arenicola*	Juvenile												1			1																					
P	1294	*Manayunkia aestuarina*		1	1					32						2						1												5			1		
P	1420	*Paranais litoralis*						6	1	5			9			6						5																	
P	1479	*Heterochaeta costata*					2									1									1									3					
P	1490	*Tubificoides benedii*		38	136	1	2	12	1	43	4	2	55	5	1	38	4	1	50	10	1	30	16	1	6	56	1	1	3			4	3	5	2			19	3
P	1500	*Tubificoides swirencoides*									1	15		1	1														1										
P	1501	Enchytraeidae																																2			1		
S	605	*Corophium*	Juvenile								1																												
S	616	*Corophium volutator*					3			2	34		12	10			32		1	10		10	1		13	12		52	4	2		2	15	3	70		13	27	71
S	1253	*Diastylis rathkei*																																	1				
W	385	*Hydrobia ulvae*		4	6		1																															
W	1695	*Mytilus edulis*																		1																			
W	1906	*Mysella bidentata*																			1																		
W	2007	TELLINACEA	Juvenile	13	1		1		1									1	2														1				1	
W	2029	*Macoma balthica*		2	5	2		4	4		9	2	1	2						4	1	3	3		1	3	1	2	2	1	3	1		1	6	3		8	
W	2064	*Abra tenuis*		3	3	1																																
Total Abundance				84	197	5	10	36	14	120	64	26	82	25	6	59	49	5	57	45	22	63	31	10	47	79	18	65	19	8	9	13	32	61	84	11	49	61	106
Quantitative Species Diversity				9	9	4	6	5	7	7	8	5	6	6	5	9	5	4	4	8	6	7	7	2	6	6	4	5	7	4	2	5	6	9	4	5	6	6	5
Qualitative Species Diversity				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Species Diversity				9	9	4	6	5	7	7	8	5	6	6	5	9	5	4	4	8	6	7	7	2	6	6	4	5	7	4	2	5	6	9	4	5	6	6	5

Table 5: Abundance data displayed as % dominance at the upper, middle and lower shore sites.

MCS Code		Taxon	Taxon Qualifier	Upper	%
P	1490	*Tubificoides benedii*		268	38
P	462	*Hediste diversicolor*		114	16
S	616	*Corophium volutator*		109	15
P	799	*Streblospio shubsolii*		50	7
HD	1	NEMATODA		49	7
P	1294	*Manayunkia aestuarina*		42	6
P	1420	*Paranais litoralis*		25	4
W	2007	TELLINACEA	Juvenile	16	2
W	2029	*Macoma balthica*		13	2
P	1479	*Heterochaeta costata*		7	1
W	385	*Hydrobia ulvae*		5	1
P	1501	Enchytraeidae		3	0
W	2064	*Abra tenuis*		3	0
F	2	TURBELLARIA		1	0
P	776	*Pygospio elegans*		1	0
P	117/118	*Eteone flava/longa*		0	0
P	499	*Nephtys hombergii*		0	0
P	672	*Scoloplos armiger*		0	0
P		*Tharyx*	Sp. A	0	0
P	846	*Tharyx killariensis*		0	0
P	907	*Capitella capitata*	Sp. Complex	0	0
P	931	*Arenicola*	Juvenile	0	0
P	1500	*Tubificoides swirencoides*		0	0
S	605	*Corophium*	Juvenile	0	0
S	1253	*Diastylis rathkei*		0	0
W	1695	*Mytilus edulis*		0	0
W	1906	*Mysella bidentata*		0	0
			Total Abundance	**706**	**100**
			Quantitative Species Diversity	**15**	**15**
			Qualitative Species Diversity	**0**	**0**
			Total Species Diversity	**15**	**15**

MCS Code		Taxon	Taxon Qualifier	Middle	%
P	1490	*Tubificoides benedii*		271	39
S	616	*Corophium volutator*		202	29
HD	1	NEMATODA		93	13
P	799	*Streblospio shubsolii*		50	7
W	2029	*Macoma balthica*		47	7
P		*Tharyx*	Sp. A	10	1
P	1420	*Paranais litoralis*		6	1
W	385	*Hydrobia ulvae*		6	1
P	776	*Pygospio elegans*		5	1
P	1500	*Tubificoides swirencoides*		3	0
W	2064	*Abra tenuis*		3	0
W	2007	TELLINACEA	Juvenile	2	0
P	117/118	*Eteone flava/longa*		1	0
P	907	*Capitella capitata*	Sp. Complex	1	0
P	1294	*Manayunkia aestuarina*		1	0
S	605	*Corophium*	Juvenile	1	0
W	1695	*Mytilus edulis*		1	0
F	2	TURBELLARIA		0	0
P	462	*Hediste diversicolor*		0	0
P	499	*Nephtys hombergii*		0	0
P	672	*Scoloplos armiger*		0	0
P	846	*Tharyx killariensis*		0	0
P	931	*Arenicola*	Juvenile	0	0
P	1479	*Heterochaeta costata*		0	0
P	1501	Enchytraeidae		0	0
S	1253	*Diastylis rathkei*		0	0
W	1906	*Mysella bidentata*		0	0
			Total Abundance	**703**	**100**
			Quantitative Species Diversity	**17**	**16**
			Qualitative Species Diversity	**0**	**0**
			Total Species Diversity	**17**	**16**

MCS Code		Taxon	Taxon Qualifier	Lower	%
P	799	*Streblospio shubsolii*		91	35
S	616	*Corophium volutator*		88	33
HD	1	NEMATODA		21	8
P	1500	*Tubificoides swirencoides*		16	6
P	1490	*Tubificoides benedii*		15	6
W	2029	*Macoma balthica*		14	5
P	462	*Hediste diversicolor*		3	1
P	776	*Pygospio elegans*		3	1
W	2007	TELLINACEA	Juvenile	3	1
P	931	*Arenicola*	Juvenile	2	1
P	499	*Nephtys hombergii*		1	0
P	672	*Scoloplos armiger*		1	0
P	846	*Tharyx killariensis*		1	0
P	1420	*Paranais litoralis*		1	0
S	1253	*Diastylis rathkei*		1	0
W	1906	*Mysella bidentata*		1	0
W	2064	*Abra tenuis*		1	0
F	2	TURBELLARIA		0	0
P	117/118	*Eteone flava/longa*		0	0
P		*Tharyx*	Sp. A	0	0
P	907	*Capitella capitata*	Sp. Complex	0	0
P	1294	*Manayunkia aestuarina*		0	0
P	1479	*Heterochaeta costata*		0	0
P	1501	Enchytraeidae		0	0
S	605	*Corophium*	Juvenile	0	0
W	385	*Hydrobia ulvae*		0	0
W	1695	*Mytilus edulis*		0	0
			Total Abundance	**263**	**100**
			Quantitative Species Diversity	**17**	**16**
			Qualitative Species Diversity	**0**	**0**
			Total Species Diversity	**17**	**16**

Table 6: Raw biomass data from the intertidal benthic surveys.

				1			2			3			4			5			6			7			8			9			10			11			12		
MCS Code		Taxon	Taxon Qualifier	Upper	Mid	Lower	Upper	Mid	Lower	Upper	Mid	Lower	Upper	Mid	Lower	Upper	Mid	Lower	Upper	Mid	Lower	Upper	Mid	Lower	Upper	Mid	Lower	Upper	Mid	Lower	Upper	Mid	Lower	Upper	Mid	Lower	Upper	Mid	Lower
F	2.00	TURBELLARIA														0.00																							
HD	1.00	NEMATODA		0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00		0.00	0.00	0.00	0.00
P	117/118	*Eteone flava/longa*																					0.00																
P	462.00	*Hediste diversicolor*		0.28						1.36						0.26									0.34			0.03					0.07	0.15			0.43		
P	499.00	*Nephtys hombergii*																																	0.00				
P	672.00	*Scoloplos armiger*							0.00																														
P	776.00	*Pygospio elegans*							0.00		0.00					0.00				0.00									0.00										0.00
P	799.00	*Streblospio shubsolii*		0.00	0.00		0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.01		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
P		*Tharyx*	Sp. A														0.00			0.00			0.00			0.00													
P	846.00	*Tharyx killariensis*																			0.00																		
P	907.00	*Capitella capitata*	Sp. Complex		0.00																																		
P	931.00	*Arenicola*	Juvenile												0.00			0.00																					
P	1294.00	*Manayunkia aestuarina*		0.00	0.00					0.00						0.00						0.00														0.00			0.00		
P	1420.00	*Paranais litoralis*						0.00	0.00	0.00			0.00			0.00						0.00																		
P	1479.00	*Heterochaeta costata*					0.00									0.00									0.00										0.00					
P	1490.00	*Tubificoides benedii*		0.03	0.12	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.04	0.01	0.00	0.02	0.00	0.00	0.03	0.00	0.00	0.03	0.01	0.00	0.01	0.04	0.00	0.00	0.00			0.00	0.00	0.00	0.00			0.01	0.00
P	1500.00	*Tubificoides swirencoides*									0.00	0.00		0.00	0.00														0.00										
P	1501.00	Enchytraeidae																																	0.00			0.00		
S	605.00	*Corophium*	Juvenile								0.00																													
S	616.00	*Corophium volutator*					0.02			0.00	0.09		0.08	0.03			0.09		0.00	0.01		0.05	0.00		0.03	0.03		0.19	0.00	0.00		0.01	0.02	0.01	0.15		0.04	0.03	0.11
S	1253.00	*Diastylis rathkei*																																	0.00				
W	385.00	*Hydrobia ulvae*		0.00	0.02		0.00																																
W	1695.00	*Mytilus edulis*																		0.00																			
W	1906.00	*Mysella bidentata*																			0.06																		
W	2007.00	TELLINACEA	Juvenile	0.00	0.00		0.00		0.00									0.00	0.00														0.00				0.00		
W	2029.00	*Macoma balthica*		0.09	0.12	0.03		0.10	0.08		0.39	0.03	0.04	0.01						0.01	0.00	0.11	0.16		0.01	0.03	0.00	0.00	0.00	0.00	0.01	0.01		0.01	0.51	0.07		0.22	
W	2064.00	*Abra tenuis*		0.00	0.00	0.00																																	
Total Biomass				0.41	0.26	0.03	0.02	0.10	0.08	1.37	0.48	0.03	0.16	0.04	0.00	0.29	0.09	0.00	0.04	0.02	0.07	0.19	0.18	0.00	0.38	0.10	0.01	0.22	0.01	0.00	0.01	0.02	0.09	0.17	0.66	0.07	0.47	0.27	0.12
Quantitative Species Diversity				9	9	4	6	5	7	7	8	5	6	6	5	9	5	4	4	8	6	7	7	2	6	6	4	5	7	4	2	5	6	9	4	5	6	6	5
Qualitative Species Diversity				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Species Diversity				9	9	4	6	5	7	7	8	5	6	6	5	9	5	4	4	8	6	7	7	2	6	6	4	5	7	4	2	5	6	9	4	5	6	6	5

Table 7: % dominance across the upper, middle and lower shore, with respect to total biomass.

MCS Code		Taxon	Taxon Qualifier	Upper	%
P	462	*Hediste diversicolor*		2.86	76.40
S	616	*Corophium volutator*		0.42	11.16
W	2029	*Macoma balthica*		0.27	7.19
P	1490	*Tubificoides benedii*		0.17	4.64
P	799	*Streblospio shubsolii*		0.01	0.33
W	385	*Hydrobia ulvae*		0.00	0.11
W	2007	TELLINACEA	Juvenile	0.00	0.03
P	1479	*Heterochaeta costata*		0.00	0.03
P	1294	*Manayunkia aestuarina*		0.00	0.03
HD	1	NEMATODA		0.00	0.02
F	2	TURBELLARIA		0.00	0.02
W	2064	*Abra tenuis*		0.00	0.02
P	1420	*Paranais litoralis*		0.00	0.01
P	1501	Enchytraeidae		0.00	0.01
P	776	*Pygospio elegans*		0.00	0.00
P	117/118	*Eteone flava/longa*		0.00	0.00
P	499	*Nephtys hombergii*		0.00	0.00
P	672	*Scoloplos armiger*		0.00	0.00
P		*Tharyx*	Sp. A	0.00	0.00
P	846	*Tharyx killariensis*		0.00	0.00
P	907	*Capitella capitata*	Sp. Complex	0.00	0.00
P	931	*Arenicola*	Juvenile	0.00	0.00
P	1500	*Tubificoides swirencoides*		0.00	0.00
S	605	*Corophium*	Juvenile	0.00	0.00
S	1253	*Diastylis rathkei*		0.00	0.00
W	1695	*Mytilus edulis*		0.00	0.00
W	1906	*Mysella bidentata*		0.00	0.00
			Total Biomass	**3.74**	**100**
			Quantitative Species Diversity	**15**	**15**
			Qualitative Species Diversity	**0**	**0**
			Total Species Diversity	**15**	**15**

MCS Code		Taxon	Taxon Qualifier	Middle	%
W	2029	*Macoma balthica*		1.55	69.59
S	616	*Corophium volutator*		0.45	19.92
P	1490	*Tubificoides benedii*		0.20	9.03
W	385	*Hydrobia ulvae*		0.02	0.71
P	799	*Streblospio shubsolii*		0.01	0.38
P	117/118	*Eteone flava/longa*		0.00	0.10
HD	1	NEMATODA		0.00	0.08
P		*Tharyx*	Sp. A	0.00	0.08
W	2064	*Abra tenuis*		0.00	0.04
P	1420	*Paranais litoralis*		0.00	0.02
P	776	*Pygospio elegans*		0.00	0.01
P	1500	*Tubificoides swirencoides*		0.00	0.01
W	2007	TELLINACEA	Juvenile	0.00	0.01
P	907	*Capitella capitata*	Sp. Complex	0.00	0.00
P	1294	*Manayunkia aestuarina*		0.00	0.00
S	605	*Corophium*	Juvenile	0.00	0.00
W	1695	*Mytilus edulis*		0.00	0.00
F	2	TURBELLARIA		0.00	0.00
P	462	*Hediste diversicolor*		0.00	0.00
P	499	*Nephtys hombergii*		0.00	0.00
P	672	*Scoloplos armiger*		0.00	0.00
P	846	*Tharyx killariensis*		0.00	0.00
P	931	*Arenicola*	Juvenile	0.00	0.00
P	1479	*Heterochaeta costata*		0.00	0.00
P	1501	Enchytraeidae		0.00	0.00
S	1253	*Diastylis rathkei*		0.00	0.00
W	1906	*Mysella bidentata*		0.00	0.00
			Total Biomass	**2.23**	**100**
			Quantitative Species Diversity	**17**	**17**
			Qualitative Species Diversity	**0**	**0**
			Total Species Diversity	**17**	**17**

MCS Code		Taxon	Taxon Qualifier	Lower	%
W	2029	*Macoma balthica*		0.21	40.75
S	616	*Corophium volutator*		0.13	25.81
P	462	*Hediste diversicolor*		0.07	13.44
W	1906	*Mysella bidentata*		0.06	12.01
P	799	*Streblospio shubsolii*		0.03	5.50
P	1490	*Tubificoides benedii*		0.01	1.13
P	1500	*Tubificoides swirencoides*		0.00	0.65
S	1253	*Diastylis rathkei*		0.00	0.28
HD	1	NEMATODA		0.00	0.20
W	2007	TELLINACEA	Juvenile	0.00	0.06
P	776	*Pygospio elegans*		0.00	0.04
P	931	*Arenicola*	Juvenile	0.00	0.04
P	499	*Nephtys hombergii*		0.00	0.02
P	672	*Scoloplos armiger*		0.00	0.02
P	846	*Tharyx killariensis*		0.00	0.02
P	1420	*Paranais litoralis*		0.00	0.02
W	2064	*Abra tenuis*		0.00	0.02
F	2	TURBELLARIA		0.00	0.00
P	117/118	*Eteone flava/longa*		0.00	0.00
P		*Tharyx*	Sp. A	0.00	0.00
P	907	*Capitella capitata*	Sp. Complex	0.00	0.00
P	1294	*Manayunkia aestuarina*		0.00	0.00
P	1479	*Heterochaeta costata*		0.00	0.00
P	1501	Enchytraeidae		0.00	0.00
S	605	*Corophium*	Juvenile	0.00	0.00
W	385	*Hydrobia ulvae*		0.00	0.00
W	1695	*Mytilus edulis*		0.00	0.00
			Total Biomass	**0.51**	**100**
			Quantitative Species Diversity	**17**	**17**
			Qualitative Species Diversity	**0**	**0**
			Total Species Diversity	**17**	**17**

3.2 Subtidal benthic survey

Figure 3 presents the subtidal survey sampling stations at which samples were collected for benthos (abundance and biomass) and sediment analysis (PSA, LOI and contaminants). The locations and depths of the subtidal sampling stations are presented in Table 8 below.

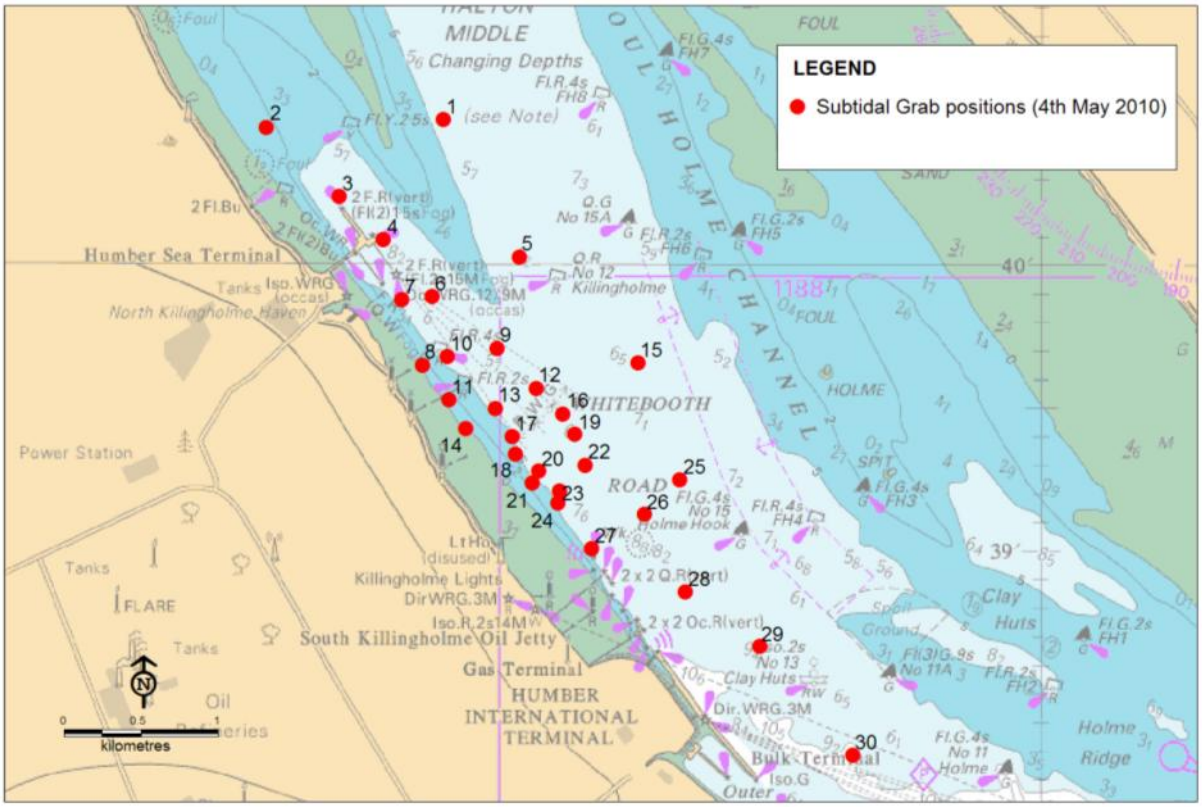


Figure 3: The location of the 30 subtidal sampling stations.

Table 8: Locations and depths of the subtidal benthic sampling sites.

Station No.	Date	Time	Sea State	Attempt	Depth (m)	Position (WGS 84)		Description
						Lat	Long	
1	04/05/2010	11:36	Calm	1st	10.4	53.67483	0.22367	Muddy sand
2	04/05/2010	11:44	Calm	1st	7.9	53.67433	0.24100	Mud
3	04/05/2010	11:58	Calm	2nd	14.1	53.67033	0.23383	Mud
4	04/05/2010	12:05	Calm	1st	12.6	53.66783	0.22950	Muddy sand
5	04/05/2010	12:13	Calm	1st	12.6	53.66683	0.21617	Mud & clay
6	04/05/2010	12:18	Calm	1st	11.3	53.66450	0.22467	Muddy sand
7	04/05/2010	12:25	Calm	1st	11.5	53.66433	0.22767	Mud
8	04/05/2010	12:28	Calm	1st	7.7	53.66050	0.22567	Mud
9	04/05/2010	12:43	Calm	1st	12.2	53.66100	0.22317	Clay with surface layer of sand
10*	04/05/2010	12:40	Calm	1st	12.3	53.66150	0.21833	Sandy mud
11*	04/05/2010	13:40	Calm	1st	13.6	53.65917	0.21450	Sandy mud
12*	04/05/2010	12:50	Calm	1st	10.9	53.65800	0.21850	Medium sand
13	04/05/2010	13:07	Calm	1st	8.5	53.65850	0.22300	Muddy sand
14	04/05/2010	13:22	Calm	1st	7	53.65683	0.22133	Mud
15	04/05/2010	13:44	Calm	1st	11	53.65633	0.21683	Medium sand
16	04/05/2010	13:37	Calm	1st	12.8	53.65767	0.21183	Sand with compacted clay
17*	04/05/2010	13:28	Calm	1st	11.6	53.66067	0.20450	Muddy sand
18*	04/05/2010	14:20	Calm	3rd	10.6	53.65650	0.21067	Medium sand
19*	04/05/2010	13:56	Calm	1st	10.5	53.65433	0.21417	Muddy sand
20	04/05/2010	14:09	Calm	1st	10	53.65533	0.21650	Medium sand
21	04/05/2010	14:29	Calm	3rd	9.4	53.65367	0.21483	Muddy sand
22	04/05/2010	15:02	Calm	1st	10.2	53.65250	0.21233	Sand with compacted clay
23	04/05/2010	14:58	Calm	1st	10.9	53.65317	0.21217	Muddy sand with coal fragments
24	04/05/2010	14:53	Calm	3rd	11.3	53.65467	0.20967	Muddy sand with coal fragments
25	04/05/2010	15:14	Calm	2nd	11.2	53.65383	0.20033	Sandy mud
26	04/05/2010	15:18	Calm	1st	12.5	53.65183	0.20383	Sand with coal fragments
27	04/05/2010	15:29	Calm	1st	12.9	53.64983	0.20900	Sand with coal fragments
28	04/05/2010	15:36	Calm	2nd	12.1	53.64733	0.19983	Clay with a surface layer of sand
29	04/05/2010	15:44	Calm	1st	12.9	53.64417	0.19250	Clay with a surface layer of sand
30	04/05/2010	16:03	Calm	4th	11.6	53.63783	0.18333	Sand with shell & coal fragments

* Sample collected from contaminant analysis

3.2.1 SAMPLE DESCRIPTIONS

Photographs of each subtidal benthic samples are presented in Annex 2, with brief descriptions provided in Table 8 above.

3.2.2 ABUNDANCE

The raw abundance data from the subtidal benthic survey is presented in Table 9, with the % dominance of each species, based on total biomass, presented in Table 10.

3.2.3 BIOMASS

The raw biomass data for the subtidal benthic stations is presented in Table 11, with the % dominance of each species, with respect to total biomass, presented in Table 12.

Table 9: Raw abundance data from the subtidal benthic survey.

MCS Code		TAXON	TAXON Qualifier	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
D	158	Tubulariidae		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	p	-	-	-	-	-	-	-
D	433	*Sertularia*		p	p	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	p	p	-	P	-	-	-	-
D	510	*Hartlaubella gelatinosa*		p	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	P	-	P	-	-	P	-	-	-	-	-	-
D	662	ACTINIARIA		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	1
F	1	PLATYHELMINTHES		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-		-	-	-	-	2	-	-	6	2
HD	1	NEMATODA		-	6	-	-	-	-	-	3	-	1	5	-	-	1	-	-	-	3	-	-	4	-	-	2	-	-	-	-	-	-
K	45	*Pedicellina*		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	p	-	-	-	-	-
P	117/118	*Eteone flava/longa*	aggregate	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-
P	499	*Nephtys hombergii*		-	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-
P	672	*Scoloplos armiger*		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	-	-		-	-	-	-	-	-	-	-	-
P	753	*Polydora cornuta*																						13									
P	799	*Streblospio shrubsolii*		-	3	-	-	-	-	3	11	-	-	22	-	-	5	-	-	-	1	-	-		-	-	-	-	-	-	-	-	-
P	845	*Tharyx*	species A	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-
P	907	*Capitella capitata*	species complex	2	-	3	1	-	-	-	-	1	-	-	2	1	-	1	-	2	6	-	2	7	-	2	9	14	8	4	-	-	-
P	919	*Mediomastus fragilis*		-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-
P	931	*Arenicola marina*		9	-	4	42	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	7	1	1	-	-	-
P	1083	*Protodriloides chaetifer*		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-	1
P	1490	*Tubificoides benedii*		-	-	-	1	-	-	1	1	-	-	9	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-
P	1498	*Tubificoides pseudogaster*																						1									
P	1500	*Tubificoides swirencoides*		-	-	-	-	-	-	-	-	-	-	3	-	-	1	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-
Q	53	ACARI		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	1	-	-	-	-	-	-	-
R	14	CIRRIPEDIA	indeterminate	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-	1
R	68	*Elminius modestus*		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	14	-	-	-	-	-	-	-	-	-
R	78	*Balanus improvisus*		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	124	-	-	-	-	-	-	-	-	-
R	142	COPEPODA	indeterminate	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	1	1	3	-	2	10	1	1	2	-	-
S	76	*Neomysis integer*		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	1	-
S	86	*Schistomysis kervillei*		-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-
S	471	*Gammarus*	juvenile																					1									
S	481	*Gammarus salinus*		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	2	-	-	-	-
S	616	*Corophium volutator*		-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-
S	1197	*Bodotria scorpioides*																						1	1								
S	1253	*Diastylis rathkei typica*																						1									
W	1696	*Mytilus edulis*	juvenile	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	11	-	-	-	1	-	-	-	-	-
W	2007	TELLINACEA	juvenile	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-
W	2029	*Macoma balthica*		-	-	1	1	-	-	-	1	-	-	-	-	-	1	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-
Y	112	*Walkeria uva*		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	p	-	-	-	-	-	-
Y	137	*Bowerbankia*		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	p	-	p	P	-	-	-	-
Y	176	*Electra crustulenta*		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	P	-	-	-	-	P	-	-	-	-
Y	177	*Electra monostachys*		p	-	-	-	-	-	-	-	-	P	P	P	-	-	p	-	-	-	-	-	P	-	p	p	p	-	-	-	-	-
Y	187	*Flustra foliacea*		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	P	-	-	-	-	-	p	-	-	-
Y	222	*Amphiblestrum auritum*		p	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-
Y	255	*Bicellariella ciliata*		-	-	-	-	-	-	p	-	-	p	-	-	-	-	-	-	-	-	-	-		-	-	-	-	P	-	-	-	-
			Quantitative	**3**	**3**	**3**	**4**	**0**	**1**	**5**	**6**	**1**	**1**	**4**	**3**	**1**	**5**	**1**	**1**	**1**	**4**	**0**	**2**	**13**	**2**	**2**	**3**	**4**	**5**	**3**	**1**	**2**	**4**
			Colonial	**4**	**1**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**2**	**1**	**1**	**0**	**0**	**1**	**0**	**0**	**0**	**1**	**0**	**4**	**0**	**4**	**4**	**3**	**4**	**1**	**0**	**0**	**0**
			Total Taxa	**7**	**4**	**3**	**4**	**0**	**1**	**6**	**6**	**1**	**3**	**5**	**4**	**1**	**5**	**2**	**1**	**1**	**4**	**1**	**2**	**17**	**2**	**6**	**7**	**7**	**9**	**4**	**1**	**2**	**4**
			Total Abundance	**12**	**10**	**8**	**45**	**0**	**1**	**9**	**18**	**1**	**1**	**39**	**4**	**1**	**9**	**1**	**1**	**2**	**15**	**0**	**3**	**184**	**4**	**3**	**13**	**32**	**14**	**6**	**2**	**7**	**5**

Table 10: % dominance with respect to total abundance from the subtidal surveys (quantitative species only).

MCS Code		TAXON	TAXON Qualifier	Total Abundance	%
R	78	*Balanus improvisus*		124	28
P	931	*Arenicola marina*		69	15
P	907	*Capitella capitata*	species complex	65	14
P	799	*Streblospio shrubsolii*		45	10
HD	1	NEMATODA		25	6
R	142	COPEPODA	indeterminate	22	5
R	68	*Elminius modestus*		14	3
W	1696	*Mytilus edulis*	juvenile	14	3
P	753	*Polydora cornuta*		13	3
P	1490	*Tubificoides benedii*		12	3
F	1	PLATYHELMINTHES		11	2
P	672	*Scoloplos armiger*		5	1
D	662	ACTINIARIA		4	1
P	1500	*Tubificoides swirencoides*		4	1
W	2029	*Macoma balthica*		4	1
P	499	*Nephtys hombergii*		2	0
S	481	*Gammarus salinus*		2	0
S	1197	*Bodotria scorpioides*		2	0
P	117/118	*Eteone flava/longa*	aggregate	1	0
P	845	*Tharyx*	species A	1	0
P	919	*Mediomastus fragilis*		1	0
P	1083	*Protodriloides chaetifer*		1	0
P	1498	*Tubificoides pseudogaster*		1	0
Q	53	ACARI		1	0
R	14	CIRRIPEDIA	indeterminate	1	0
S	76	*Neomysis integer*		1	0
S	86	*Schistomysis kervillei*		1	0
S	471	*Gammarus*	juvenile	1	0
S	616	*Corophium volutator*		1	0
S	1253	*Diastylis rathkei typica*		1	0
W	2007	TELLINACEA	juvenile	1	0
D	158	Tubulariidae		0	0
D	433	*Sertularia*		0	0
D	510	*Hartlaubella gelatinosa*		0	0
K	45	*Pedicellina*		0	0
Y	112	*Walkeria uva*		0	0
Y	137	*Bowerbankia*		0	0
Y	176	*Electra crustulenta*		0	0
Y	177	*Electra monostachys*		0	0
Y	187	*Flustra foliacea*		0	0
Y	222	*Amphiblestrum auritum*		0	0
Y	255	*Bicellariella ciliata*		0	0
			Total Abundance	**450**	**100**
			Total Quantitative Species	**31**	

Table 11: Raw biomass data from the subtidal benthic survey.

MCS Code		TAXON	TAXON Qualifier	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
D	158	Tubulariidae		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-
D	433	*Sertularia*		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-
D	510	*Hartlaubella gelatinosa*		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-
D	662	ACTINIARIA		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3.750	-	-	-	-	-	-	-	-	0.000
F	1	PLATYHELMINTHES		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	-	-	-	-		-	-	-	-	0.000	-	-	0.000	0.000
HD	1	NEMATODA		-	0.000	-	-	-	-	-	0.000	-	0.000	0.000	-	-	0.000	-	-	-	0.000	-	-	0.000	-	-	0.000	-	-	-	-	-	-
K	45	*Pedicellina*		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-
P	117/118	*Eteone flava/longa*	aggregate	0.001	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-
P	499	*Nephtys hombergii*		-	-	-	-	-	-	0.015	0.003	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-
P	672	*Scoloplos armiger*		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.030	-	-		-	-	-	-	-	-	-	-	-
P	753	*Polydora cornuta*																						0.003									
P	799	*Streblospio shrubsolii*		-	0.000	-	-	-	-	0.001	0.003	-	-	0.007	-	-	0.001	-	-	-	0.000	-	-		-	-	-	-	-	-	-	-	-
P	845	*Tharyx*	species A	-	-	-	-	-	-	-	0.000	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-
P	907	*Capitella capitata*	species complex	0.001	-	0.000	0.000	-	-	-	-	0.000	-	-	0.003	0.000	-	0.000	-	0.002	0.001	-	0.002	0.008	-	0.001	0.007	0.027	0.001	0.003	-	-	-
P	919	*Mediomastus fragilis*		-	0.000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-
P	931	*Arenicola marina*		0.004	-	0.002	0.012	-	-	0.000	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	-	-	-	1.100	0.000	0.000	-	-	-
P	1083	*Protodriloides chaetifer*		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-	0.000
P	1490	*Tubificoides benedii*		-	-	-	0.000	-	-	0.000	0.000	-	-	0.007	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-
P	1498	*Tubificoides pseudogaster*																						0.000									
P	1500	*Tubificoides swirencoides*		-	-	-	-	-	-	-	-	-	-	0.000	-	-	0.000	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-
Q	53	ACARI		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	0.000	-	-	-	-	-	-	-
R	14	CIRRIPEDIA	indeterminate	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-	0.000
R	68	*Elminius modestus*		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.368	-	-	-	-	-	-	-	-	-
R	78	*Balanus improvisus*		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10.135	-	-	-	-	-	-	-	-	-
R	142	COPEPODA	indeterminate	-	-	-	-	-	-	-	-	-	-	-	0.000	-	-	-	-	-	-	-	0.000	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	-	-
S	76	*Neomysis integer*		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	0.009	-
S	86	*Schistomysis kervillei*		-	-	-	-	-	0.018	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-
S	471	*Gammarus*	juvenile																					0.000									
S	481	*Gammarus salinus*		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	0.067	-	-	-	-
S	616	*Corophium volutator*		-	-	-	-	-	-	-	-	-	-	-	-	-	0.001	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-
S	1197	*Bodotria scorpioides*																						0.000	0.000								
S	1253	*Diastylis rathkei typica*																						0.003									
W	1696	*Mytilus edulis*	juvenile	-	-	-	-	-	-	0.000	-	-	-	-	-	-	-	-	-	-	-	-	-	0.019	-	-	-	0.000	-	-	-	-	-
W	2007	TELLINACEA	juvenile	-	-	-	-	-	-	-	-	-	-	-	0.000	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-
W	2029	*Macoma balthica*		-	-	0.004	0.006	-	-	-	0.044	-	-	-	-	-	0.000	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-
Y	112	*Walkeria uva*		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-
Y	137	*Bowerbankia*		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-
Y	176	*Electra crustulenta*		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-
Y	177	*Electra monostachys*		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-
Y	187	*Flustra foliacea*		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-
Y	222	*Amphiblestrum auritum*		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-
Y	255	*Bicellariella ciliata*		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-
			Quantitative	**3**	**3**	**3**	**4**	**0**	**1**	**5**	**6**	**1**	**1**	**4**	**3**	**1**	**5**	**1**	**1**	**1**	**4**	**0**	**2**	**13**	**2**	**2**	**3**	**4**	**5**	**3**	**1**	**2**	**4**
			Colonial	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
			Total Taxa	**3**	**3**	**3**	**4**	**0**	**1**	**5**	**6**	**1**	**1**	**4**	**3**	**1**	**5**	**1**	**1**	**1**	**4**	**0**	**2**	**13**	**2**	**2**	**3**	**4**	**5**	**3**	**1**	**2**	**4**
			Total Biomass	**0.005**	**0.000**	**0.007**	**0.018**	**0.000**	**0.018**	**0.017**	**0.050**	**0.000**	**0.000**	**0.014**	**0.003**	**0.000**	**0.002**	**0.000**	**0.000**	**0.002**	**0.032**	**0.000**	**0.002**	**15.285**	**0.000**	**0.001**	**0.007**	**1.128**	**0.068**	**0.003**	**0.000**	**0.009**	**0.000**

Table 12: % dominance with respect to total biomass from the subtidal surveys.

MCS Code		TAXON	TAXON Qualifier	Total Biomass	%
R	78	*Balanus improvisus*		10.135	60.79
D	662	ACTINIARIA		3.750	22.49
R	68	*Elminius modestus*		1.368	8.20
P	931	*Arenicola marina*		1.119	6.71
S	481	*Gammarus salinus*		0.067	0.40
P	907	*Capitella capitata*	species complex	0.056	0.34
W	2029	*Macoma balthica*		0.054	0.32
P	672	*Scoloplos armiger*		0.030	0.18
W	1696	*Mytilus edulis*	juvenile	0.019	0.11
P	499	*Nephtys hombergii*		0.018	0.11
S	86	*Schistomysis kervillei*		0.018	0.11
P	799	*Streblospio shrubsolii*		0.012	0.07
S	76	*Neomysis integer*		0.009	0.05
P	1490	*Tubificoides benedii*		0.007	0.04
S	1253	*Diastylis rathkei typica*		0.003	0.02
P	753	*Polydora cornuta*		0.003	0.02
R	142	COPEPODA	indeterminate	0.001	0.01
HD	1	NEMATODA		0.001	0.00
P	117/118	*Eteone flava/longa*	aggregate	0.001	0.00
S	616	*Corophium volutator*		0.001	0.00
F	1	PLATYHELMINTHES		0.000	0.00
P	1500	*Tubificoides swirencoides*		0.000	0.00
S	1197	*Bodotria scorpioides*		0.000	0.00
P	845	*Tharyx*	species A	0.000	0.00
P	919	*Mediomastus fragilis*		0.000	0.00
P	1083	*Protodriloides chaetifer*		0.000	0.00
P	1498	*Tubificoides pseudogaster*		0.000	0.00
Q	53	ACARI		0.000	0.00
R	14	CIRRIPEDIA	indeterminate	0.000	0.00
S	471	*Gammarus*	juvenile	0.000	0.00
W	2007	TELLINACEA	juvenile	0.000	0.00
D	158	Tubulariidae		0.000	0.00
D	433	*Sertularia*		0.000	0.00
D	510	*Hartlaubella gelatinosa*		0.000	0.00
K	45	*Pedicellina*		0.000	0.00
Y	112	*Walkeria uva*		0.000	0.00
Y	137	*Bowerbankia*		0.000	0.00
Y	176	*Electra crustulenta*		0.000	0.00
Y	177	*Electra monostachys*		0.000	0.00
Y	187	*Flustra foliacea*		0.000	0.00
Y	222	*Amphiblestrum auritum*		0.000	0.00
Y	255	*Bicellariella ciliata*		0.000	0.00
			Total Biomass	**16.672**	**100**
			Total Quantitative Species	**31**	

3.3 Intertidal fish and shellfish survey

The locations of both the intertidal and subtidal fish sampling stations are shown in Figure 4.

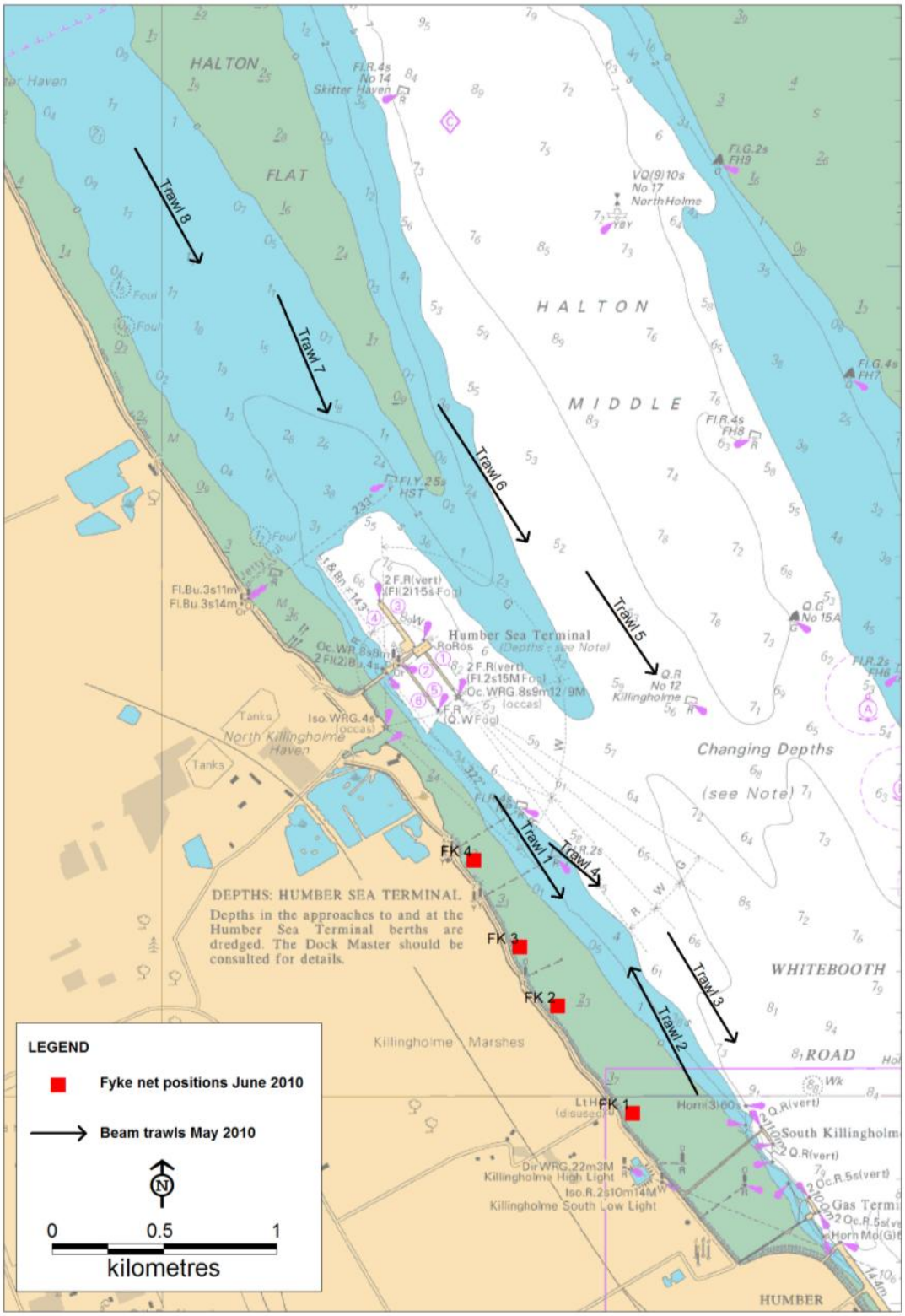


Figure 4: The locations of the 4 intertidal fyke nets and the 8 subtidal fish trawls.

The details of the intertidal fish surveys, including station positions, deployment and retrieval information, and weather conditions, is presented in Table 13.

Table 13: Survey details from the intertidal fish survey.

Site No.	Position (WGS 84)		Deployment		Retrieval	
	Lat (N)	Long (W)	Date	Time	Date	Time
FK 1	53.64932	0.2182	08/06/2010	17:00	09/06/2010	17:30
FK 2	53.65362	0.22324	08/06/2010	17:41	09/06/2010	18:15
FK 3	53.65599	0.22579	08/06/2010	18:30	09/06/2010	19:00
FK 4	53.65948	0.22891	08/06/2010	19:16	09/06/2010	19:48

Weather conditions: Overcast and breezy with showers

Photos of the catch from each of the deployed fyke nets are presented in Annex 3. The abundance of each species, within each fyke net is presented in Table 14.

Table 14: Abundance data for each of the four intertidal double ended fyke nets (west and east).

MCS Code		Taxon	Common Name	Fyke Net 1		Fyke Net 2		Fyke Net 3		Fyke Net 4	
				West	East	West	East	West	East	West	East
S	1594	*Carcinus maenas*	Shore crab							5	
ZG	111	*Ciliata mustela*	Fiver-beard rockling					1			
ZG	136	*Pollachius virens*	Pollock							1	
ZG	479	*Pomatoschistus minutus*	Sand goby								1
ZG	576	*Platichthys flesus*	European flounder	2			3	3		4	10
ZG	591	*Solea solea*	Common sole							6	3
			Total Taxa	1	0	0	1	2	0	4	3
			Total Abundance	2	0	0	3	4	0	16	14

Table 15 over page, presents the raw length data (in mm) of each species caught, per fyke net.

Table 15: Raw length data (in mm) for each of the fish species caught in the intertidal surveys.

MCS Code		Taxon	Common Name	1		2		3		4	
				West	East	West	East	West	East	West	East
S	1594	*Carcinus maenas*	Shore crab	-	-	-	-		-	55	-
				-	-	-	-		-	57	-
				-	-	-	-		-	66	-
				-	-	-	-		-	59	-
				-	-	-	-		-	60	-
ZG	111	*Ciliata mustela*	Five-beard rockling	-	-	-	-	143	-	-	-
ZG	136	*Pollachius virens*	Pollock	-	-	-	-		-	232	-
ZG	479	*Pomatoschistus minutus*	Sand goby	-	-	-	-		-	-	70
ZG	576	*Platichthys flesus*	European flounder	212	-	-	155	183	-	228	188
				235	-	-	205	160	-	161	176
				-	-	-	272	215	-	232	249
				-	-	-	-	-	-	198	240
				-	-	-	-	-	-	-	178
				-	-	-	-	-	-	-	168
				-	-	-	-	-	-	-	132
				-	-	-	-	-	-	-	230
				-	-	-	-	-	-	-	116
				-	-	-	-	-	-	-	235
ZG	591	*Solea solea*	Common sole	-	-	-	-	-	-	110	103
				-	-	-	-	-	-	93	83
				-	-	-	-	-	-	111	286
				-	-	-	-	-	-	105	-
				-	-	-	-	-	-	114	-
				-	-	-	-	-	-	110	-

3.4 Subtidal fish and shellfish survey

The locations of the subtidal trawls are presented in Figure 3 (above). Further details regarding the subtidal fish sampling, including start and end positions, date, time in and out, water depth, sea state and weather conditions, can be seen in Table 16 below.

Table 16: Survey log for the subtidal fish survey.

Trawl No.	Start Position		End Position		Date	Time in	Time Out	Water depth (m)	Sea state
	Lat	Long	Lat	Long					
T 1	53.66217	0.22750	53.65800	0.22300	05/05/2010	09:00	09:10	12	Calm
T 2	53.65017	0.21383	53.65517	0.21833	05/05/2010	09:17	09:30	11.3	Calm
T 3	53.65667	0.21583	53.65217	0.21133	05/05/2010	09:42	09:53	10.2	Calm
T 4	53.66017	0.22383	53.65850	0.22050	05/05/2010	10:01	10:13	12.1	Calm
T 5	53.67117	0.22133	53.66700	0.21667	05/05/2010	10:26	10:36	12.2	Calm
T 6	53.67233	0.22533	53.67783	0.23133	05/05/2010	10:45	10:55	10	Calm
T 7	53.68217	0.24217	53.67750	0.23883	05/05/2010	11:01	11:10	8.9	Calm
T 8	53.68817	0.25183	53.68350	0.24750	05/05/2010	11:20	11:29	8.3	Calm

Weather conditions: Dry with sunny spells and light breeze

Photos of each sample, both on board the survey vessel and in the laboratory are presented in Annex 4.

Table 17 presents the raw abundance data, from each of the 8 beam trawls. For the fish species, the mean length data (in mm) and abundance (n) is presented in Table 18.

Table 17: Raw abundance data for the subtidal trawl survey.

MCS Code		Taxon	Common name	Trawl Number							
				1	2	3	4	5	6	7	8
S	44	*Gastrosaccus spinifer*	Opossum shrimp			1			6	1	
S	76	*Neomysis integer*	Opossum shrimp	14		6		144	7	2	7
S	82	*Praunus flexuosus*	Chameleon shrimp	1			3	8	2		1
S	86	*Schistomysis kervillei*	Mysid shrimp	25	6	35	50	696	86	19	28
S	89	*Schistomysis spiritus*	Mysid shrimp	3		2	5	96	3	1	7
S	415	*Dexamine spinosa*	Gammarid amphipod	1	2	5	4				1
S	483	*Gammarus zaddachi*	Gammarid amphipod					8	3		2
S	939	*Idotea linearis*	Isopod						1		
S	1253	*Diastylis rathkei*	A cumacean				1				
S	1318	*Palaemon longirostris*	Delta prawn			4	1				
S	1385	*Crangon crangon*	Common shrimp	68	19	84	77	87	103	17	84
S	1594	*Carcinus maenas*	Shore crab	1		1		1	3		1
ZE	11	*Lampetra fluviatilis*	River lamprey			1					
ZG	111	*Ciliata mustela*	Fivebeard rockling		4						
ZG	123	*Merlangius merlangus*	Whiting			1		3			
ZG	143	*Trisopterus luscus*	Bib					2	1		
ZG	244	*Syngnathus rostellatus*	Nilsson's pipefish	1		1					
ZG	296	*Liparis liparis*	Sea snail						1		
ZG	479	*Pomatoschistus minutus*	Sand goby	10	15	4	8	30	7		4
ZG	576	*Platichthys flesus*	European flounder				1				
ZG	591	*Solea solea*	Common sole	2	6			2	3	1	2
			Total taxa	**10**	**6**	**12**	**9**	**11**	**13**	**6**	**10**
			Total abundance	**126**	**52**	**145**	**150**	**1077**	**226**	**41**	**137**

Table 18: Raw length data (in mm) for each of the fish species caught in the subtidal trawls.

Taxa		Trawl 1		Trawl 2		Trawl 3		Trawl 4	
		Mean length	n	Mean length	n	Mean length	n	Mean length	n
Lampetra fluviatilis	River lamprey					125	1		
Ciliata mustela	Fivebeard rockling			89	4				
Merlangius merlangus	Whiting					152	1		
Trisopterus luscus	Bib								
Syngnathus rostellatus	Nilsson's pipefish	74	1			132	1		
Liparis liparis	Sea snail								
Pomatoschistus minutus	Sand goby	54	10	49	15	56	4	51	8
Platichthys flesus	European flounder							265	1
Solea solea	Common sole	192	2	931	6				
Carcinus maenas	Shore crab	30	1			49	1		

Taxa		Trawl 5		Trawl 6		Trawl 7		Trawl 8	
		Mean length	n	Mean length	n	Mean length	n	Mean length	n
Lampetra fluviatilis	River lamprey								
Ciliata mustela	Fivebeard rockling								
Merlangius merlangus	Whiting	199	3						
Trisopterus luscus	Bib	83	2	52	1				
Syngnathus rostellatus	Nilsson's pipefish								
Liparis liparis	Sea snail			16	1				
Pomatoschistus minutus	Sand goby	46	30	49	7			47	4
Platichthys flesus	European flounder								
Solea solea	Common sole	170	2	235	3	265	1	247	2
Carcinus maenas	Shore crab	51	1	53	3			52	1

4. SUMMARY OF FINDINGS

4.1 Benthos

4.1.1 INTERTIDAL

- The most commonly occurring species were the oligochaete *Tubificoides benedii*, Nematoda, the polychaete *Streblospio shrubsolii* and the amphipod crustacean *Corophium volutator*. These species were present in most of the samples and were present at higher abundances than all other species throughout the survey area. The bivalve *Macoma balthica* was widespread and the polychaete *Hediste diversicolor* was present at most of the upper shore stations.
- *T. benedii* was the dominant species at the upper and mid shore stations. *S. shrubsolii* was dominant at the lower shore stations where the sediments were presumably sandier.
- Species richness (number of species recorded) ranged from 2-9 species/sample. Abundance (number of individuals/sample) ranged from 5-197. There were no immediately obvious spatial patterns in these parameters in the raw data set.
- Biomass ranged from <0.001 to 1.37g / sample and was generally higher at stations where *H. diversicolor* was recorded.
- All species found from the survey are typical for the intertidal area of the middle region of the Humber Estuary. There are no species of particular conservation importance although many of those present are important prey species for birds.

4.1.2 SUBTIDAL

- Species richness ranged from 0-17 (including colonial taxa) with values of 5 or less being recorded from all but 2 stations. The most widespread species (occurring in the greatest number of samples) was the polychaete *Capitella* capitata with the barnacles *Balanus improvisus* and *Elminius modestus* being the most abundant species.
- Abundance ranged from 0-184 individuals/sample with abundance in most samples being less than 20.
- The highest species richness and abundance values were recorded from station 21 where high numbers of barnacles were found together with Actiniaria (Anthozoa), *Hartlaubella gelatinosa* (Hydrozoa), the polychaetes *Polydora cornuta* and *Arenicola marina*, *Mytilus edulis* (Bivalvia) and the bryozoans *Electra crustulenta, E. monostachys* and *Flustra foliacea.*
- The species recorded from station 21 (many epifaunal, colonial and sedentary species) are consistent with a coarse sediment substratum. It should be noted that whilst the sediment type is described as muddy sand (Table 8), three attempts were required to collect an acceptable grab sample. The particle size data may misrepresent the sediment characteristics at this station.
- Biomass ranged from <0.001 to 15.5 g/sample (station 21) with values at most stations being <0.05 g.

- Considering the whole dataset, the barnacle *B. improvisus* is the dominant species, together with *Arenicola marina* and *Streblospio shrubsolii.* However, the distribution of *B. improvises* is patchy (relating to availability of suitable substratum) and should not be considered a characterising species for the survey area as a whole.

4.2 Fish & Shellfish

- Fish communities in the middle and lower reaches of the Humber Estuary are dominated by small bodied demersal gobid species of the genus *Pomatoschistus* and juvenile stages of larger species that use the estuary as a nursery ground (especially shallow areas and the intertidal zone). This latter component is often the most commonly recorded with typically 80% or more of the total abundance. Typical examples are flounder (*Platichthys flesus*), plaice (*Pleuronectes platessa*), sole (*Solea solea*), whiting (*Merlangius merlangus*), spratt (*Sprattus sprattus*), seabass (*Dicentrarchus labrax*), cod (*Gadus morhua*), herring (*Clupea harengus*), lesser weaver fish (*Echiichthys vipera*), and pollock (*Pollachious virens*).
- In addition to this large group of mostly demersal or benthic juveniles (exceptions are sprat and herring juveniles that are pelagic), the Humber Estuary features a number of estuarine residents, and diadromous fish species which use the estuary for passage to or from fresh water areas. The most common examples of the resident group are flounder, 5-bearded rockling (*Ciliata mustela*), pogee (*Agonus cataphractus*), sea snail (*Liparis sp*.), Nilsson's pipefish (*Syngnathus rostellatus*) and 3-spined stickleback (*Gasterosteus aculeatus*). Smelt (*Osmerus eperlanus*), eel (*Anguilla anguilla*) and river lamprey (*Lampreta fluviatilis*) are the most common of the diadromous species. Some of these species are listed under Annex 2 of the Habitats and Species Directive, or have other high conservation value.
- Finally a number of marine species appear occasionally in catches, most of them following a marked seasonality with higher probability of capture in the summer and early autumn. Of relevance for this last group are sand eels (*Ammodites sp.),* lumpsucker (*Cyclopterus lumpus*), witch (*Glyptocephalus cynoglossus*), dab (*Limanda limanda*), grey mullets (*Liza sp*.), brill (*Scopthalmus rhombus*), short-spined sea scorpion (*Taurulus bubalis*), bib (*Trisopterus luscus*), and dragonet (*Callionymus lyra*).
- Crustaceans (Decapods) are the most abundant of all the invertebrate groups in the southern North Sea. Shellfish species present in the Humber area include edible crab (*Cancer pagurus*), velvet crab (*Necora puber*) lobster (*Homarus gammarus*) and pink (*Pandalus spp*.) and brown shrimp (*Crangon spp*.) which are particularly abundant in the coastal area. Large seasonal abundances are also recorded for small crustacean groups like mysis and euphausiids (krill or opossum shrimp).

4.2.1 INTERTIDAL

- Given the background information available for the Humber Estuary and adjacent coastal area, and the gear selectivity profile of fyke nets, the fish and shellfish assemblage found during the summer survey is considered normal. However, the

abundance was low compared to previous survey programs (e.g. the HARBASINS Report Chapter 4[11].

- The catch is dominated by benthic flatfishes (flounder and sole) most probably 1+ flounder (born the year before) and mostly 0+ sole, which highlights the role of the area (typical mudflat) as a flatfish nursery. Sand goby (*Pomatoschistus minutus*) was recorded but due to the small size of this fish, it is normally misrepresented in fyke net catches. Same gear effect probably confounded the shellfish assessment resulting in the recording of large shore crabs only.

4.2.2 SUBTIDAL

- Similarly to the intertidal assessment, the subtidal assemblage is consistent with previous survey results for the area with a real dominance of sand goby. Interestingly flounder (the more abundant species in the intertidal catch) was recorded only once. This observation suggests the greater importance of the intertidal zone for flounder.
- Sole caught in the subtidal assessment were substantially larger that those found in the fyke nets. This is remarkable and clearly shows a segregation of sole year classes and indicates a distinct habitat dependency between 0+ sole and older juveniles.
- The remaining species recorded are common but as with the intertidal assessment; these were recorded at somewhat lower abundances than expected. This effect, found to be consistent across the two surveys, may be associated with natural fluctuations of fish stocks as a consequence of recruitment failure.
- Crustacean catches were dominated by the common shrimp (*Crangon crangon*), a species of economical importance in the east coast. Occasional large catches of mysids and euphausiids were also recorded although the mesh size used in the beam trawl was too large to provide a truly quantitative assessment. It is likely, however, that these organisms are present in large numbers throughout and represent the base of the local food chain leading to the subtidal fish fauna recorded in this assessment.

4.3 Annex 1 Habitats & Annex 2 Species

- During the intertidal and subtidal survey works, no Annex 1 species were recorded. However, the intertidal mudflats and sandflats which were surveyed are classed as Annex 1 Habitats that are a primary reason for site selection as a Special Area of Conservation (SAC).
- Similarly, the Humber is designated as an SAC for its 'Estuarine' habitat (an Annex 1 habitat), which is present throughout the survey area.
- Saltmarsh communities were also identified within the survey area. These communities included constituents of the Atlantic Salt Meadow community, which is classified as an Annex 1 habitat under the Habitats Directive. However, although

11 (http://www.harbasins.org/fileadmin/inhoud/pdf/Final_Products/WP2/Integration_Report/CHAPTER04-HabitatUse.pdf).

present as a qualifying feature, these saltmarsh communities are not a primary reason for site selection. The extent of these features in relation to the survey area are identified in Figure 5.

- No Annex 2 species were recorded from the survey area.

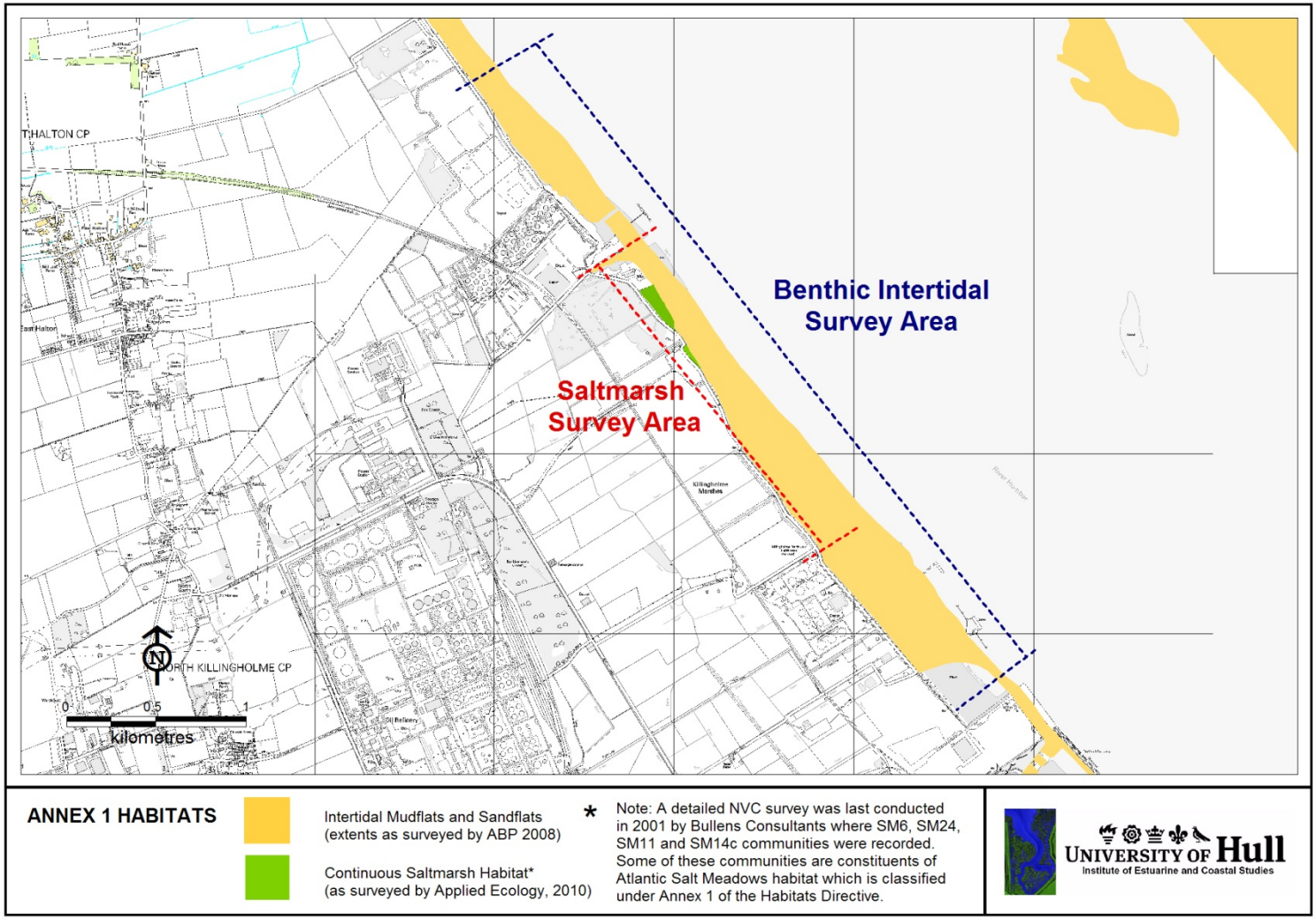


Figure 5. Annex 1 Habitats identified within the proposed survey area, Humber estuary.

ANNEX 1. INTERTIDAL BENTHIC SURVEY PHOTOS

Transect 1 – view from the lower shore

Transect 1 Upper

Transect 1 Middle

Transect 1 Lower

Transect 2 – view from the lower shore

Transect 2 Upper

Transect 2 Middle

Transect 2 Lower

Transect 3 – view from the lower shore

Transect 3 Upper

Transect 3 Middle

Transect 3 Lower

Transect 4 – view from the lower shore

Transect 4 Upper

Transect 4 Middle

Transect 4 Lower

Transect 5 – view from the lower shore

Transect 5 Upper

Transect 5 Middle

Transect 5 Lower

Transect 6 – view from the lower shore

Transect 6 Upper

Transect 6 Middle

Transect 6 Lower

Transect 7 – view from the lower shore

Transect 7 Upper

Transect 7 Middle

Transect 7 Lower

Transect 8 – view from the lower shore

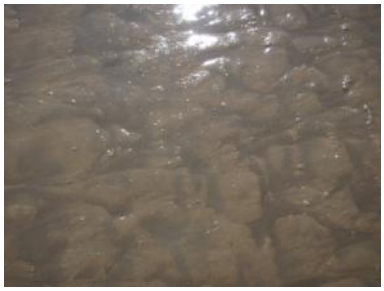
Transect 8 Upper

Transect 8 Middle

Transect 8 Lower

Transect 9 – view from the lower shore

Transect 9 Upper



Transect 9 Middle

Transect 9 Lower

Transect 10 – view from the lower shore

Transect 10 Upper

Transect 10 Middle

Transect 10 Lower

Transect 11 – view from the lower shore

Transect 11 Upper

Transect 11 Middle

Transect 11 Lower

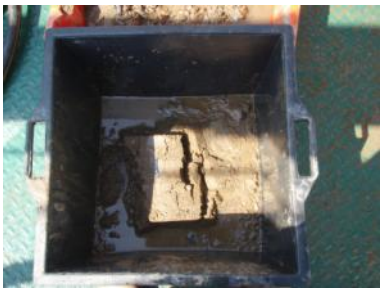
Transect 12 – view from the middle shore

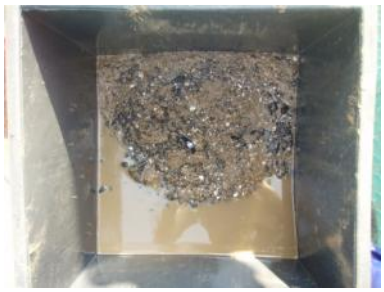
No photo taken

Transect 12 Upper	**Transect 12 Middle**	**Transect 12 Lower**

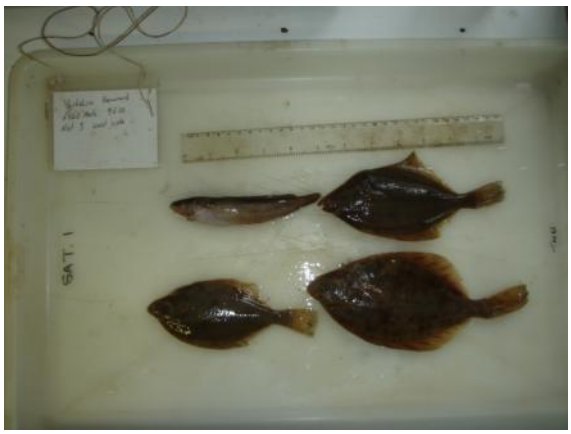
ANNEX 2. SUBTIDAL BENTHIC SAMPLE PHOTOS

		
Subtidal Sample 1	**Subtidal Sample 2**	**Subtidal Sample 3**
		
Subtidal Sample 4	**Subtidal Sample 5**	**Subtidal Sample 6**
		
Subtidal Sample 7	**Subtidal Sample 8**	**Subtidal Sample 9**
		
Subtidal Sample 10	**Subtidal Sample 11**	**Subtidal Sample 12**

		
Subtidal Sample 13	**Subtidal Sample 14**	**Subtidal Sample 15**
		
Subtidal Sample 16	**Subtidal Sample 17**	**Subtidal Sample 18**
		
Subtidal Sample 19	**Subtidal Sample 20**	**Subtidal Sample 21**
		
Subtidal Sample 22	**Subtidal Sample 23**	**Subtidal Sample 24**

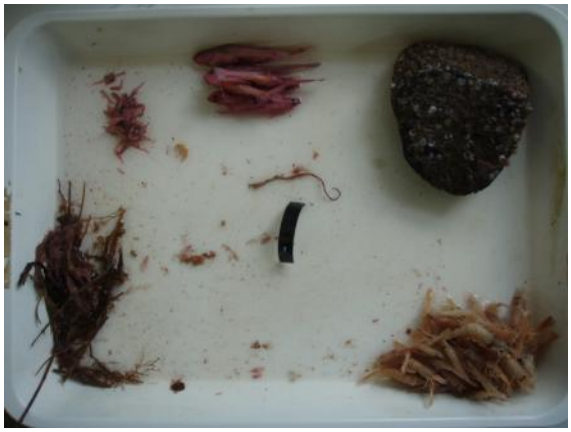
		
Subtidal Sample 25	**Subtidal Sample 26**	**Subtidal Sample 27**
		
Subtidal Sample 28	**Subtidal Sample 29**	**Subtidal Sample 30**

ANNEX 3. INTERTIDAL FISH SURVEY PHOTOS

No fish captured	
Fyke Net 1 East	**Fyke Net 1 West**
	**No fish captured**
Fyke Net 2 East	**Fyke Net 2 West**
No fish captured	
Fyke Net 3 East	**Fyke Net 3 West**

	
Fyke Net 4 East	**Fyke Net 4 West**

ANNEX 4. SUBTIDAL FISH SAMPLE PHOTOS

	
Subtidal Sample 1 (onboard)	**Subtidal Sample 1 (lab)**
	
Subtidal Sample 2 (onboard)	**Subtidal Sample 2 (lab)**
	
Subtidal Sample 3 (onboard)	**Subtidal Sample 3 (lab)**

	
Subtidal Sample 4 (onboard)	**Subtidal Sample 4 (lab)**
	
Subtidal Sample 5 (onboard)	**Subtidal Sample 5 (lab)**
	
Subtidal Sample 6 (onboard)	**Subtidal Sample 6 (lab)**

	
Subtidal Sample 7 (onboard)	**Subtidal Sample 7 (lab)**
	
Subtidal Sample 8 (onboard)	**Subtidal Sample 8 (lab)**