SCOTTISH NATURAL HERITAGE

COMMISSIONED REPORT

Commissioned Report No. 155

Site condition monitoring – the sublittoral sandbanks of the Solway Firth

(ROAME No. F02AA409)

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Summary

Site condition monitoring – the sublittoral sandbanks of the Solway Firth

Commissioned Report No. 155 (ROAME No. F02AA409)
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Background

The Solway Firth is one of the most important and least industrialised estuarine areas in the UK and EU and has been selected as a candidate Special Area of Conservation (cSAC). The site has been selected for the Annex 1 habitats 'estuaries', 'mudflats and sandflats not covered by seawater at low tide' and 'sandbanks which are slightly covered by seawater all of the time'. The latter forms the focus of interest for the current study.

The purpose of the current study is to initiate the monitoring of the Solway Firth cSAC. There are two principal objectives of the survey:

- establish an appropriate baseline biological dataset that will facilitate the assessment of the 'favourable condition' status of the interest features of the sites on future monitoring surveys;
- gather sufficient data for SNH to form a judgement on the current condition of the interest features of the sites.

Main findings

- All sites were classified as sand according to the Folk system (greater than 80%).
- Five biotopes were recognised: **SS.SSa.IFiSa.NcirBat**, **SS.SSa.SSaVS.NcirMac**, **SS.SSa.SSaVS**, **SS.SBR.PoR.SalvMx**, **SS.SBR.SMus.MytSS**.
- The distribution of biotopes is described and their characteristic species outlined.
- *Sabellaria* reef with high abundance of both *Sabellaria alveolata* and *Mytilus edulis* was discovered in the Silloth Channel.
- Based on comparisons with the few previous studies of the area there was no evidence to suggest that any marked changes have been taking place in the sediment type and biotope distribution. The greater amount of data collated from this study has led to a more detailed understanding of the biotope distribution within the Solway Firth than previously.
- Recommendations are made regarding future site condition monitoring of the cSAC.

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Contents

List of Figures

List of Tables

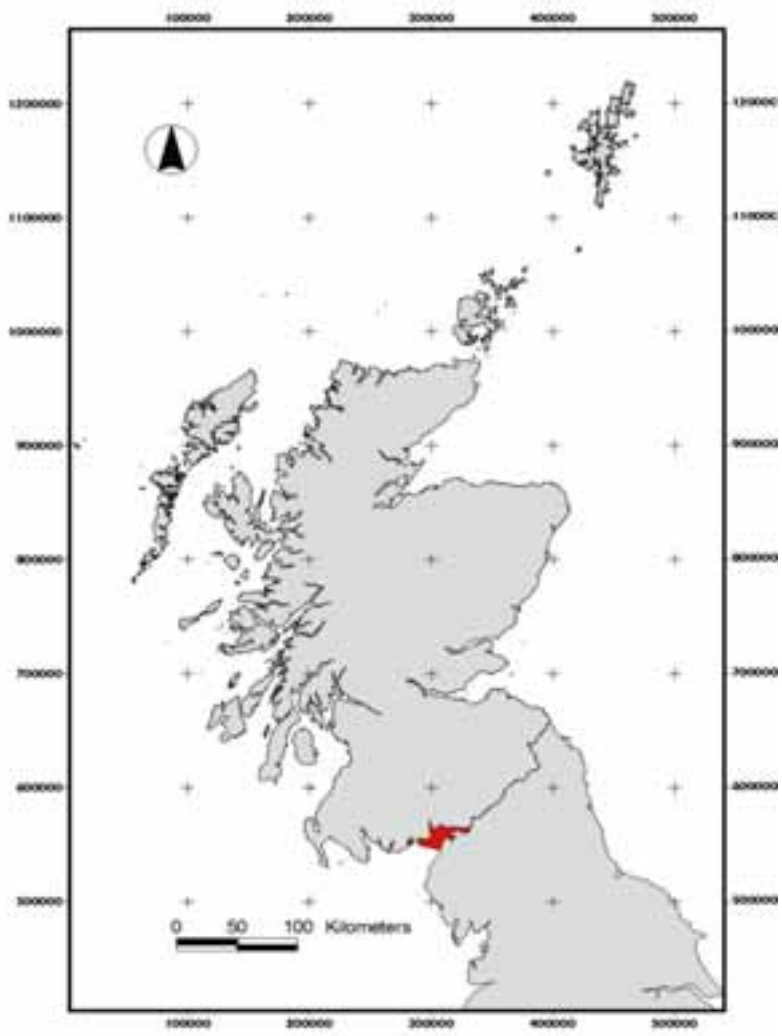
1 INTRODUCTION

1.1 Background

Scottish Natural Heritage (SNH) in association with the other country agencies has established a series of common standards for the monitoring of sites of nature conservation interest (Anon, 1998). These common standards apply to statutory sites designated as Sites of Special Scientific Interest (SSSIs) and to areas designated as part of the Natura 2000 series including Special Areas of Conservation (SAC) together with Ramsar sites designated under the convention on Wetlands of International Importance. The purpose of site monitoring is to determine whether the desired condition of the feature of interest for which the site was designated is being achieved. This can enable judgements to be made about whether the management of the site is appropriate, or whether changes are necessary.

The Solway Firth is one of the most important and least industrialised estuarine areas in the UK and EU. The site has been selected for the Annex 1 habitats 'estuaries', 'mudflats and 'sandflats not covered by seawater at low tide' and ' sandbanks which are slightly covered by seawater all of the time'. The latter forms the focus of interest for the current study.

Figure 1.1 Location of the Solway Firth cSAC (shown in red)



The Solway Firth contains one of the largest continuous areas of inshore sublittoral and littoral habitats in Britain (Figure 1.1). The sublittoral sediment sandbanks (characteristic of the area as a whole) of the Inner Solway are separated by six river channels and are extremely dynamic and mobile reflecting the complex hydrodynamic regime of the Firth (Cutts and Hemingway, 1996; LIFE, 2000). The shallow sublittoral sediments of the Inner Solway Firth are included in the cSAC. They are important for fisheries in the Solway and also as spawning and nursery grounds for the Irish Sea in general (SFP, 1996). The sublittoral sediment communities of the inner estuary are typically sparse but become richer towards the outer estuary due to less extreme environmental conditions and a more varied substrate (Perkins and Williams, 1966; Perkins, 1968; Cutts and Hemingway, 1996; LIFE, 2000).

The total area of the Solway Firth cSAC is 43,636ha, as measured from satellite imagery using the spatial analyst module in ArcView. The boundary of the site extends across the Scottish-English border and is therefore under joint responsibility of Scottish Natural Heritage (SNH) and English Nature (EN). Under a memorandum of Agreement with EN, SNH is leading the "2004 sandbanks which are slightly covered by seawater all of the time" monitoring programme.

Sandbanks slightly covered by seawater all of the time are defined as:

'Sublittoral sandbanks permanently submerged. Water depth is seldom more than 20m below chart datum. Non-vegetated sandbanks or sandbanks with vegetation belonging to the *Zosteretum marinae* and *Cymodoceion nodosae*' (EC, 1999).

A number of older studies report low abundance and species diversity within the estuary with an increase in species diversity towards the Irish Sea (Perkins and Williams, 1966; Perkins, 1968; Ove Arup and Partners, 1993a and b; Rendall and Bell, 1993). The subtidal benthic invertebrate populations were described as being 'typical' and no rare or uncommon subtidal species were found (Ove Arup and Partners, 1993b). The subtidal community was described in more general terms by one author as being dominated by *Bathyporeia, Haustorius* and *Macoma* (Ove Arup and Partners, 1993a) while others described it in more detail depending on the sediment present where muddy sands were dominated by *Nephtys* spp. and various bivalve molluscs and the medium sands were dominated by polychaetes (eg *Lanice conchilega*) and crustaceans (eg *Crangon crangon*) (eg Perkins, 1968). The Solway Firth was also described as containing important nursery grounds for several commercially important fish species (Williams *et al.*, 1965; Ove Arup and Partners, 1993a; Lancaster, 1999).

More recently, Cutts and Hemingway (1996) conducted a broad scale habitat mapping project of both the intertidal and subtidal areas of the Solway Firth to draw on existing data and collect new data regarding the extent and variety of habitats within the Firth. Using a combination of Roxann, video ground-truthing and grab sampling (16 subtidal sites), the sublittoral habitat was seen to be dominated by fine to medium sands with areas of coarser sediment existing in the channels. The areas of fine and medium sands were found to have low species diversity dominated by *Nephtys cirrosa, Magelona mirabilis* and *Bathyporeia pelagica* at abundances of approximately 20–25 individuals/0.1m^2. The coarser sediment was found to have even lower abundance and species diversity. These sediments are dominated by *Nephtys cirrosa* with *Gastrosaccus spinifer* being present in low numbers. These results were similar to a much earlier study by Williams *et al.* (1965). In addition, nine new biotopes were identified within the survey area but, as the survey was carried out prior to the JNCC biotope classification scheme introduced in 1997, re-classification of these sites will be required to allow reliable comparisons with later studies.

As part of the Marine Nature Conservation Review (MNCR) programme, area summaries between Liverpool Bay and the Solway Firth were prepared by Covey (1998). This study reported the presence of two main biotopes (Mob; NcirBat) within the Solway Firth but some caution may be needed as these biotopes appear to be based on sampling mainly in the inner Firth. In addition, little detailed information is available with regards to the boundaries of these biotopes. However, the inner Firth was described as being dominated by infralittoral sand with a sparse community dominated by Bathyporeia pelagica, B. pilosa and Haustorius arenarius. The outer Firth was described to support a sparse epifauna (**Mob**; **NcirBat**) while the deeper sediments had a more stable community.

The purpose of the current study is to initiate the monitoring of the Solway Firth cSAC. There are two principal objectives of the survey:

- establish an appropriate baseline biological dataset that will facilitate the assessment of the 'favourable condition' status of the interest features of the sites on future monitoring surveys;
- gather sufficient data for SNH to form a judgment on the current condition of the interest features of the sites.

The approach taken to achieve these objectives is to establish, where possible, a series of relocatable survey stations at locations that reflect the biological and environmental diversity of the interest feature of the sites. Selection of survey stations and the general survey strategy is to be guided by the requirements set out for the creation of Site Attribute Tables (SAT) (Table 1.1).

Table 1.1 Generic SAT that should be used to define the condition of sublittoral sediment features in site condition monitoring

Attribute	**Target**
Extent of identified inshore sublittoral sediments	No change.
Topography	No alteration in topography of the inshore sublittoral sediment, allowing for natural responses to hydrodynamic regime.
Sediment character	No change in composition of sediment types across the feature.
Distribution of biotopes	Maintain distribution of biotopes.
Extent of sub-feature	No change in extent of sublittoral sediment biotopes.
Species composition	No decline in biotope quality as a result of reduction or removal of notable species.
Species population measures – population structure of a species – presence or abundance of specified species	Maintain age/size class structure. Maintain presence or abundance of positive indicator species. No increase in presence or abundance of negative indicator species.

1.2 Human uses and impacts on the Solway Firth

The most densely populated part of the Solway Firth coastal zone is centred around the three historic, industrial and port towns of Whitehaven, Workington and Maryport. Much of the Inner Solway is undeveloped and predominantly rural. The northern shores are more developed than the southern bank, with Dumfries, Gretna and Annan all in close proximity to the firth. The economy of the region has a high dependence on a limited number of sectors, principally agriculture, forestry, food-related manufacturing, transport and tourism. The marine and coastal zone supports a significant commercial fishery (Solway Firth Partnership, 1996).

The Solway Firth Strategy was published in 1998 by the Solway Firth Partnership. The strategy discusses the key issues affecting the Solway Firth within seven topic areas (Solway Firth Partnership):

Fisheries

The principal impact on the sublittoral habitat of the area by man relates to fishing. Most of the fishing fleet around the Solway is involved in the shellfish fishery employing techniques including suction dredging, trawling and dredging for mussels. Commercially important species include scallops, queen scallops, cockles, whelks, mussels and brown shrimp. The effects of commercial fishing depend on the type of gear used, substrate types and nature of the resident fauna.

The harvesting of cockles by mechanical means was prohibited in November 1994 in the interest of the long-term viability of cockle stocks. In the ensuing years stocks recovered to a point that hand-harvesting of cockles became commercially viable. In 2001 the FRS (Fisheries Research Services) cockle survey showed a marked decrease in cockle biomass. In January 2002 the existing order prohibiting mechanical harvesting was extended to prohibit cockle harvesting by any method. Following the closure, shore based surveys have continued, and have shown that stocks on the Scottish side have recovered sufficiently that, providing suitable management provisions are in place, responsible exploitation can be resumed in 2005 (Davis *et al.*, 2004).

The Solway is an important spawning and nursery ground for many species of commercially important fish (Lancaster, 1999). Both pelagic and demersal species are fished including *Pleuronectes platessa* (plaice) (the most common commercially caught flatfish), *Solea solea* (sole), *Melanogrammus aeglefinus* (haddock), *Pollachius virens* (saithe) and *Merlangius merlangus* (whiting).

A small-scale lobster and crab industry exists, and a shrimp fishing industry is based on the migration of shrimp from and to Dumroof Bank and Skinburness Bank. The shrimp industry is important to the local economy and despite the high by-catch (c.60% by weight) with a high discard mortality of fish including the commercially important fish species (see above), the shrimp fishery in the Solway Firth is not believed to significantly influence the fin fish fishery (Lancaster, 1999).

The Inner estuary is also fished for *Salmo salar* (Atlantic salmon) using stake and haafnets on the Scottish side of the border, and drift nets on the English side.

Coastal protection

Activities affecting natural coastal processes include sea defences, flood protection works, land claim and structures such as breakwaters/sea walls. Coastal protection works range from simple wooden groynes installed on beaches to major engineering works, eg breakwaters and embankments. It is the threat to important residential, commercial and agricultural sites that leads to intervention to defend the coastline.

Landscape and cultural heritage

The numerous designated areas and sites within the Solway are indicative of its high value as a national and regional resource resulting from the combination of landscapes and cultural heritage.

Land use, development and transport

Areas around the Solway Firth are used for a wide range of purposes. Farms are largely dairy, beef and sheep enterprises with only small areas of arable cropping. Forestry and sites of high value environmental interest also share the landscape with industrial, military and tourist activities.

There are eight principle ports and harbours in the area, the most significant commercial harbours being Silloth and Workington. Kirkcudbright, Maryport and Whitehaven are the most important fishing ports and also have significant leisure use.

Tourism and recreation

Tourism is one of the area's major economic activities and supports a large number of communities across the region. It is the wide range of activities and attractions available and good accommodation combined with the quality of the area's natural environment that forms the basis for present and future expansion on the coastal strips of Cumbria and Dumfries & Galloway. Tourism and recreational activities are based around Powfoot, Southerness, Sandyhills and Rough Firth.

Wildlife and habitats

The Inner Solway holds the third largest continuous intertidal habitat in the UK. The size and location make the Solway a vital resting and wintering area for birds migrating along the Eastern Atlantic Seaboard. In winter the area supports 10 species in internationally important numbers and a further 11 species in nationally important numbers.

Water quality and pollution

Contaminants can enter the marine environment from a variety of sources, including:

- point source discharges – sewage and industrial discharges;
- diffuse source discharges – The most common sources of diffuse discharges are agricultural run-off and afforestation (particularly in SW Scotland) leading to acidification of rivers and siltation;
- thermal discharges – BNFL Chapelcross nuclear power station;
- disposal of sewage sludge and dredged materials at sea.

Other known or potential impacts on the sublittoral habitat of the Solway include a variety of activities that affect the water quality of the Solway by pollution, contamination or by organic enrichment of the water. There are also the continuous threats of accidental oil, or chemical, spills associated with shipping and navigation. Dredging and spoil disposal, necessary to maintain the shipping channels, will affect the sediment and hydrodynamic regime of the estuary (Elliott, 1998).

2 METHOD

2.1 General

2.1.1 Attributes addressed

In the planning stages of the survey the sampling strategy was discussed between SNH and SeaStar Survey. The aim was to assess the subtidal sandbank features with a combination of drop-down video and grab sampling. The survey was to be initiated by a drop-down video survey at a series of point locations giving broad spatial coverage of the Solway cSAC. This data was to be used to characterise the sediments across the site and for the selection of stations for subsequent grab sampling. The video unit to be used, supplied by SNH, was a small, portable self-contained system that was deployed by hand over the starboard side of the survey vessel.

2.1.1.1 Extent of sublittoral sandbanks

Elliot (1998) reported that the area and extent of sublittoral sediments is dictated by the physical conditions, particularly the physiography and underlying geology, together with the hydrodynamic regime which dictates where and how much sediment is deposited. The extent of the sublittoral sandbanks was estimated using the spatial analyst module in ArcView on a satellite image that was acquired from the U.S. Geological Survey (USGS).

2.1.1.2 Topography

Topography is defined as the depth and distribution of the sediment. This has a direct influence on associated fauna. The topography generally reflects the prevailing energy conditions and overall stability of the feature. To aid the assessment of the topography depth was recorded along 9 vessel transits during the survey.

2.1.1.3 Sediment character

The sediment type reflects all of the physical processes acting on a feature. Sediment type is also a key factor determining the biological composition of the sediment community. To address this attribute, sediment samples were collected using a 0.1m^2 Day grab for particle size analysis (PSA).

2.1.1.4 Distribution of biotopes

The biological character of inshore sublittoral sediments depends on their structure and may consist of one or many biotopes. The links between physical parameters of the sediment and the associated infaunal and epifaunal communities are strong. Therefore, the nature of the system will affect the biotope distribution.

Biotope distribution was to be evaluated by surveying the sublittoral epibiota using a drop-down video sledge. This proved unsuccessful due to the high current regimes and high levels of suspended sediments, problems also encountered by Lancaster (1999) when attempting to study the brown shrimp (*Crangon crangon*). After discussions with the nominated officer at SNH, epibenthic trawling was decided on as an alternative for surveying the sublittoral epibiota.

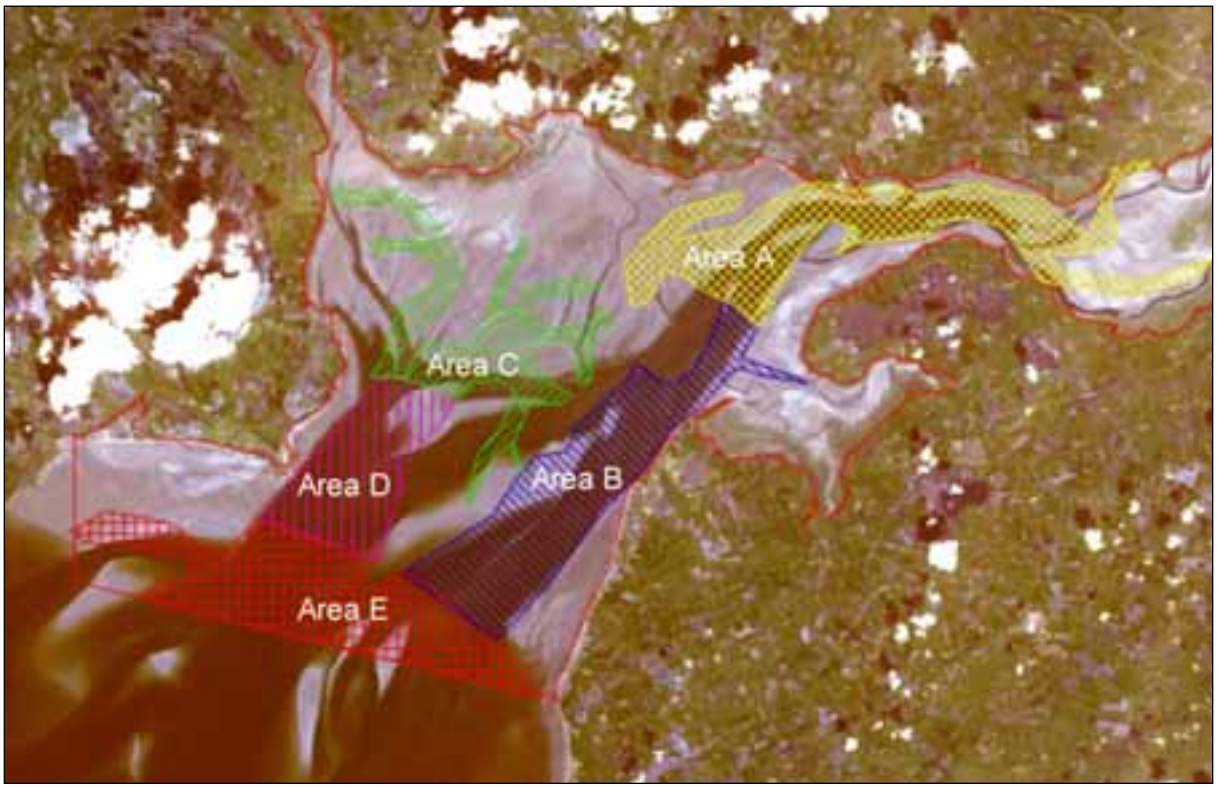
2.1.1.5 Species composition

Species composition is an important contributor to the structure of a biotope. A determination of species composition gives an indication of the quality of the biotope, and a change in composition may be indicative of a cyclic change in sediment communities. Analysis of species composition was carried out by biological analysis of sediment grab samples, collected using a 0.1m^2 stainless steel Day grab.

2.1.2 Sample sites

Two hundred and twenty five sites were selected throughout the cSAC for drop-down video work, from which 75 sites were to be selected for subsequent sediment sampling. The locations were selected to ensure spatial coverage of the Solway cSAC. Point locations from previous studies (Cutts and Hemingway, 1996) were selected as video/grab stations for repeat monitoring (Appendix A3). Once previous stations had been identified the rest of the sites were selected using stratified random sampling to ensure broad coverage of the area and also to ensure that regions of potential anthropogenic disturbance (Dumfries, Silloth) were monitored. The Inner Solway was split into 5 regions (Figure 2.1), each area having a set number of grabs, assigned proportionally to its size, to be completed within that area, to ensure complete spatial coverage. The area of each block was estimated using ArcView software. The survey blocks were designed using maps of the sandbanks from 1996 as the 2001 satellite image was not available at that time. This explains the discrepancy between the locations of sandbanks and blocks in Figure 2.1. A degree of flexibility is therefore required with site selection due to the mobile nature of the environment. Once in the field it became evident that some sampling stations could not be reached due to insufficient water depth. In these instances the station was re-located to eliminate the risk of running aground. The co-ordinates for these grab sites were inserted into Hypack Max v2.12a survey software.

Figure 2.1 Solway Firth showing the 5 survey blocks



2.1.3 Field conditions and equipment

All survey operations were conducted from SeaStar Survey's Vessel 'Mariner'. SV 'Mariner' is a purpose built dedicated survey vessel and is fully compliant with MCA category 2 code of practice for small work boats. Silloth was selected as the base port for the survey as it is within the Solway cSAC so transit times were minimised. Access to Silloth dock is only possible $1^1/_2$ hours before, and $^1/_2$ hour after high water. It is important to conduct survey operations within the Solway Firth over neap tides due to both the height of low water and also the tidal streams. In the upper reaches of the Solway, around Annan, tidal streams can reach 6 knots.

2.1.3.1 Horizontal and vertical control

The required geodetic parameters of the survey were UK National Grid – Ordnance Survey of Great Britain (1936) datum (OSGB36), Transverse Mercator projection and Airy Spheroid.

The horizontal control for the survey was achieved by using a Leica MX412B differential GPS, with the differential signal obtained from Point Lynas. The DGPS obtained a satellite derived position in WGS84 latitude and longitude, which was recorded using Hypack Max survey management software. The DGPS position was then converted to OSGB36, easting and northing within the survey management software. To achieve high quality within this data transformation, the appropriate local datum shift was applied.

A known position within Silloth Dock was obtained from the Ordnance Survey in OSGB36 grid coordinates. A navigation check was made against that known location before the start and at the end of each survey day to check the continued accuracy of the DGPS signal and correct entry of datum transformation and geodetic data.

Vertical control for the survey was achieved by the use of a hull mounted, Simrad, 200Khz survey echosounder. The depths recorded were reduced to chart datum using predicted tides for the area.

All data, including navigation checks, raw positions and grid positions were logged using HyPack Max v2.12A survey management software. Site relocation will rely on DGPS. Due to the highly mobile nature of the sublittoral sandbanks it may not be possible to reach some of the sample sites. In this instance it is recommended that the survey vessel positions itself as close as is safely possible to the original location.

2.1.4 Unfavourable weather and sea conditions

For health and safety reasons survey work was not conducted in sea conditions of more than 0.5m swell or wave height.

A maximum cut off for wind speed for all survey activities would normally be up to Beaufort Force 6 depending on the direction of the wind and the resulting sea state. Over a Force 6 even in relatively calm sea conditions, close inshore, vessel manoeuvring becomes more difficult and holding station is much harder. Within the Solway Firth, however, it became evident that due to high tidal streams the sea state can deteriorate rapidly in a wind against tide situation (Cutts and Hemingway, 1996 described a NE 4 as marginal). A westerly wind, above a Force 4 can rapidly make the sea state unworkable with a westerly flowing ebb tide. However, some shelter could be found from a westerly wind on the northern side of Silloth Bank around Dumfries. The restrictions to Silloth dock also make a favourable weather forecast vital as the vessel is committed to 12 hours on site once leaving the dock.

The whole region of the Upper Solway is unsurveyed, which led to difficulties in navigation. The sublittoral sandbanks are so mobile that without up-to-date satellite images navigation is slow due to the uncertainty of the precise location of the channels. This lack of navigation information led to the vessel running aground whilst transiting back to Silloth.

Careful planning regarding which sites to survey was required each day to ensure that survey time was not wasted waiting for the tide. One of the main sandbanks, Silloth Bank, divides the Solway and could only be crossed within 1½ hour of high water. As many sites were close to the sandbanks careful planning was required with regards to ensuring that the sites were completed in an order that would minimise time waiting on tide heights and minimise crossing tracks.

2.2 Satellite imagery

2.2.1 Image acquisition

A Landsat TM image was obtained directly from the U.S. Geological Survey (USGS) and processed to address the extent attribute of the site condition monitoring of the sublittoral sandbanks of the Solway Firth.

Landsat TM images are directly available from the U.S. Geological Survey (USGS) (http://edc.usgs.gov/products/satellite/tm.html) at a cost of $425–625 per scene. Their low cost and large coverage (the approximate size of a single scene is 170 x 183km) make this spaceborne system a cost effective tool for extent estimates of several habitats in the coastal environment, particularly of the intertidal zone.

The online Landsat TM archive of USGS was searched for a suitable image that combined the following characteristics: minimum contamination from cloud cover, obtained during low water tidal conditions, and acquired when sun elevation was high to minimise sun glint. The most suitable image found was one obtained on the 1 May 2001 which, although not concurrent with the monitoring visit, could be used since it was acquired within the present monitoring cycle. The image was obtained by the Landsat 7 Enhanced Thematic Mapper (ETM+) sensor, and was acquired at a time of relatively low water (1.3m above Chart Datum).

The full characteristics of the image obtained are given in Table 2.1. The image was virtually cloud free in the marine areas, particularly for the area of interest, and showed a good range of brightness values for the estuarine area. As well as covering the Solway Firth cSAC and outer areas, it also covered the full extent of Luce Bay cSAC, and Cree estuary marine SSSI.

The ETM+ sensor obtains data in 6 optical bands at 28.5m spatial resolution, 1 thermal band at 57m resolution and an additional panchromatic band at approximately 15m spatial resolution. Characteristics of the spectral bands for this sensor are given in Table 2.2.

Table 2.1 Acquisition characteristics and tidal conditions during acquisition of the Landsat 7 ETM+ image used in this study

Product Type	L1G
Spacecraft Id	Landsat 7 ETM+
Acquisition Date	01.05.2001
Acquisition Time	11:06 am (GMT)
Tide Height at date and time of acquisition at Annan Port (above Chart Datum)	1.3m
High Water Level at date of acquisition at Annan Port (above Chart Datum)	5.1m
Low Water Level at date of acquisition at Annan Port (above Chart Datum)	0.3m
WRS Path and Row	205, 022
Band Combination	123456678
Product Upper Left Corner Coordinates	55.5110748 N –5.4804813 W
Product Lower Right Corner Coordinates	53.5193506 N –3.5067340 W
Sun Azimuth	154.5766004
Sun Elevation	48.4633141
Reference_Datum	WGS84
Reference_Ellipsoid	WGS84
Map_Projection	UTM
Zone	030
Pixel Size_Panchromatic	14.250
Pixel Size Thermal band	57.000
Pixel Size Optical bands	28.500

Table 2.2 Characteristics of the Landsat 7 ETM+ wavebands

Waveband	**Location**	**Location (nm)**
1	Blue	450–520
2	Green	520–600
3	Red	630–690
4	Near Infrared	760–900
5	Middle Infrared	1550–1750
7	Middle Infrared	2080–2350
6	Thermal	10400–12500
Panchromatic	Visible/Nir	–

2.2.2 Pre-processing/geocorrection

The raw data products were supplied "Systematically Corrected" by USGS, which includes both a radiometric and geometric correction. They were georeferenced to the Universal Transverse Mercator map

projection (UTM, zone 030), using the WGS84 Reference Datum. The image was supplied by USGS as a series of separate files in GeoTIFF format, one for each band. These files were used to build a multilayer composite image using the "stacklayer" function in ERDAS Imagine (version 8.7). The composite image was then re-projected to the British Grid (Datum 1936, Airy Spheroid, Transverse Mercator) and further geocorrected to the OS LandLine (1:1250 scale) dataset by manual methods.

Since the dataset was not envisaged for detailed classification there was no atmospheric correction undertaken to the Landsat data to convert the DN values to percent ground reflectance. Finally, the composite image was subsetted to the area of interest to cover the Solway Firth SAC.

2.2.3 Masking

The geocorrected Landsat TM subset was subsequently masked to eliminate all land areas from the image using the digitised Solway Firth SAC boundary supplied by SNH. Masking is a useful technique in coastal studies to eliminate bright pixels from land such that interpretation can be focussed on the generally darker coastal water features. The resultant masked dataset was used for all the subsequent analysis.

2.2.4 Density slicing

The subsequent masked image was used to better display the contrast of sediments in the Firth using density slicing techniques applied to the band 2 (green region) spectral band. However since the focus of this study is the sublittoral sandbanks of the Solway Firth SAC no further analysis was undertaken for the intertidal sandbanks of the SAC.

2.2.5 Extent estimate of sublittoral sandbanks

Following the results of the fieldwork, which revealed some grab and trawl stations to be on sandbanks, it was concluded that the extent of sublittoral areas within the SAC would be a good proxy for the sublittoral sandbanks. To estimate their extent a simple model was constructed within the Spatial Modeller of ERDAS Imagine based on the near infra-red band and the green visible band of the Landsat TM image, to classify the water submerged areas of the Solway SAC subset. The produced binary raster image (submerged and non-submerged areas) was then imported into ArcView (version 3.2) and converted into a vector image. Finally, using the spatial analyst module of ArcView the aerial extent of the sublittoral sandbanks was estimated.

2.3 Drop-down survey

On the 28 June 2004 equipment and personnel were mobilised to Silloth for the drop-down video element of the survey. On the neap tide of the 29 June the vessel transited to Annan to commence the drop-down video survey. No clear images of the seabed were obtained due to the camera streaming resulting from the strong tidal streams. The strong tidal streams also resulted in poor visibility due to high levels of suspended sediments. Thirteen deployments were attempted over a period of 4½ hours leading up to 'slack water', with no video captured as because of the inability of the video to reach the seabed and the high levels of suspended sediment.

As a result of the problems experienced it was decided that drop-down video survey was not a feasible method for characterising the sediment or assessing the epifauna in the Inner Solway. Having had the

opportunity of working near to Annan, and around the upper reaches of the firth it was felt that the area does not have any subtidal sandbanks, but is an area of littoral sandbanks with a few, small, shallow channels, which constantly move. After discussions with the nominated officer from SNH it was felt that this region did not fit into the remit of this particular survey. More importantly, the risks associated with running aground due to the lack of navigation information and the mobile nature of the sandbanks, particularly in an area with such tidal streams, were considered too great. For these reasons it was decided to exclude this region, around Annan, from the survey. Other survey methods should be considered for this area.

2.4 Grab survey

2.4.1 Field sampling

After further discussions with SNH a new survey plan was drawn up comprising of sediment sampling using a 0.1m^2 Day grab, with a 0.1m^2 Van Veen grab carried as reserve, (85 grab site locations) and a 2m Beam trawl to assess the epifauna (60 trawl lines).

At each of the 85 grab stations (Figure 2.2/Appendix A1) the boat was manoeuvred over the site. Once over the site location the Day grab was lowered to the seabed over the stern of the survey vessel 'Mariner'. Once back on deck the sample was assessed as to whether it was a good sample. To be accepted the grab had to be closed properly without obstructions in the jaws, the lids closed and a minimum of 2.5 litres of sediment retrieved. If the grab was unsuccessful for any reason it was re-deployed. Upon commencement of the sediment grab sampling survey it became evident that obtaining an adequate sample was to be problematic. Having conducted up to ten unsuccessful deployments at a single site it became evident that to obtain sufficient sediment for biological analysis it was necessary to pool sediment from multiple grab samples. This was due to the well-sorted, very compact sand of the sublittoral environment and the high current regimes present in the area. This method was discussed, and agreed upon, with SNH before continuing. The amount of sediment processed was estimated based on the fullness of the grab (eg ½, ¾, full etc). A full grab holds 10 litres of sediment.

It was decided with SNH that to combine samples from 2 grabs the grab locations should be within 5m of each other, and be visually identical. If there were any differences in the sediment, or they were more than 5m apart, they were not combined, and the grab was re-deployed.

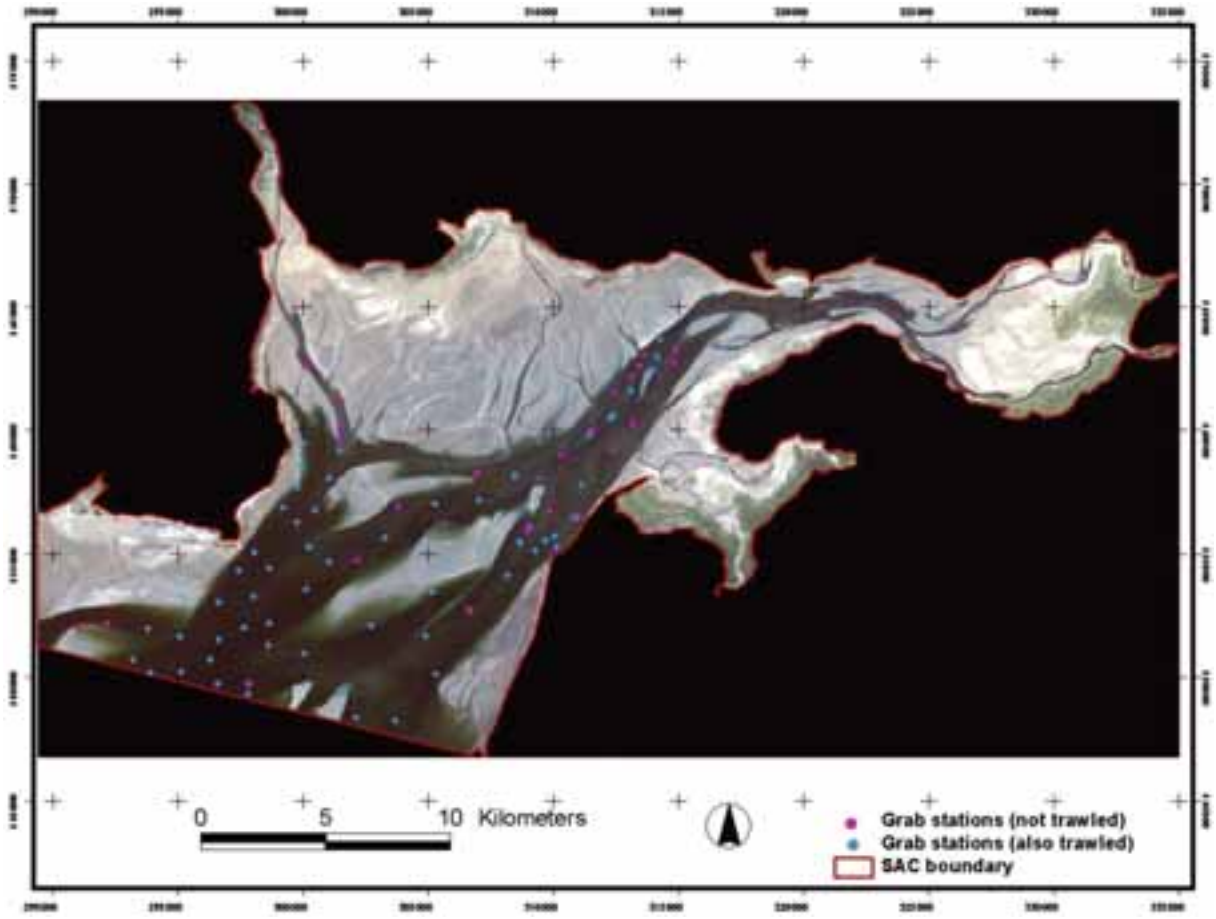
Grab samples were photographed prior to being sieved through a 1mm mesh and all photographs were logged (Appendix 12). The retained sample was preserved in a borax buffered, 10% formalin-seawater solution for subsequent biological identification.

At each grab location a sub-sample was taken from the day grab for subsequent Particle Size Analysis (PSA).

Each deployment of the Day grab was recorded in a deck log with time, location number, sediment description, depth, position and whether it was successful or not (Appendix 11).

There were numerous occasions when the grab sites were unreachable due to the shifting sandbanks. In this scenario the vessel was positioned as close as possible to the desired location, without risking running aground and the actual grab location logged as normal.

Figure 2.2 Satellite image of the Solway Firth showing cSAC boundary and grab sites completed



2.4.2 Laboratory analysis

2.4.2.1 Particle size analysis (PSA)

Methods followed standard National Marine Biological Analytical Quality Control Scheme (NMBAQC). The PSA was required to follow the sediment grades used by the MNCR. Those are described below:

Pebble – medium	(>8mm)
Pebble – small	(4–8mm)
Granule	(2–4mm)
Sand very coarse	(1000–2000μm)
Sand coarse	(500–1000μm)
Sand medium	(250–500μm)
Sand fine	(125–250μm)
Sand very fine	(63–125μm)
Silt and clay (mud)	(<63μm)

The dry weight of the whole sediment sample was determined and any muddy samples were disaggregated using a suitable method (eg sodium hexametaphosphate). The sample was wet sieved on a 63μm mesh then dried and re-weighed to establish the weight percentage of the sub 63μm fraction. The remainder of the

sample was dry sieved with an appropriate sequence of mesh sizes to yield weight percentage data for particle size fractions at half phi intervals (Appendix A4). This was done from a minimum sieve size of 63μm to a maximum sieve size of 16mm.

2.4.2.2 Invertebrate analysis

The faunal analysis of all the sediment samples was undertaken by the environmental laboratory at Fugro Surveys Ltd, based in Great Yarmouth. Analysis work was carried out to the standards of the NMBAQC scheme.

Fauna were described to lowest practical level (generally species), and identifications checked against a comprehensive taxonomic library and specimen collection. A full list of taxa encountered and abundances per sample are recorded on a standard species/sample matrix (Appendix A6). Species reference numbers as cited in the Marine Conservation Society Species Directory (Howson and Picton, 1997) have been included to avoid problems in species nomenclature. Encrusting or colonial taxa (predominantly sponges, bryozoans and hydroids) were recorded as present on the SACFOR scale. All stages of the process were carried out to the standards of the NMBAQC.

The invertebrate specimens collected were separated by species and by station, preserved in alcohol, and stored in glass sample vials with polyethylene closures to facilitate their incorporation into the collections of The National Museum of Scotland.

2.4.2.3 Data analysis

Ecological interpretation of results has been carried out by reference to the JNCC Marine Nature Conservation Review Biotope Classification (Connor *et al.*, 1997), and the presence of rare or unusual species identified against the list in Sanderson (1996). Calculation of diversity indices and multivariate analysis of results have been achieved using PRIMER (Plymouth Routines in Multivariate Ecological Research) v 5.2.0 (Clarke and Warwick, 1994).

All the identified and enumerated benthic macrofauna were used in the analysis apart from the planktonic fauna, which were excluded. Encrusting or colonial taxa (predominantly sponges, bryozoans and hydroids) were non-enumerated but these were used in the presence/absence analysis to assess any structures present within the distribution of the fauna. The abundance data are given in individuals/0.1m^2 as well as in the SACFOR scale (see Connor *et al.*, 2004).

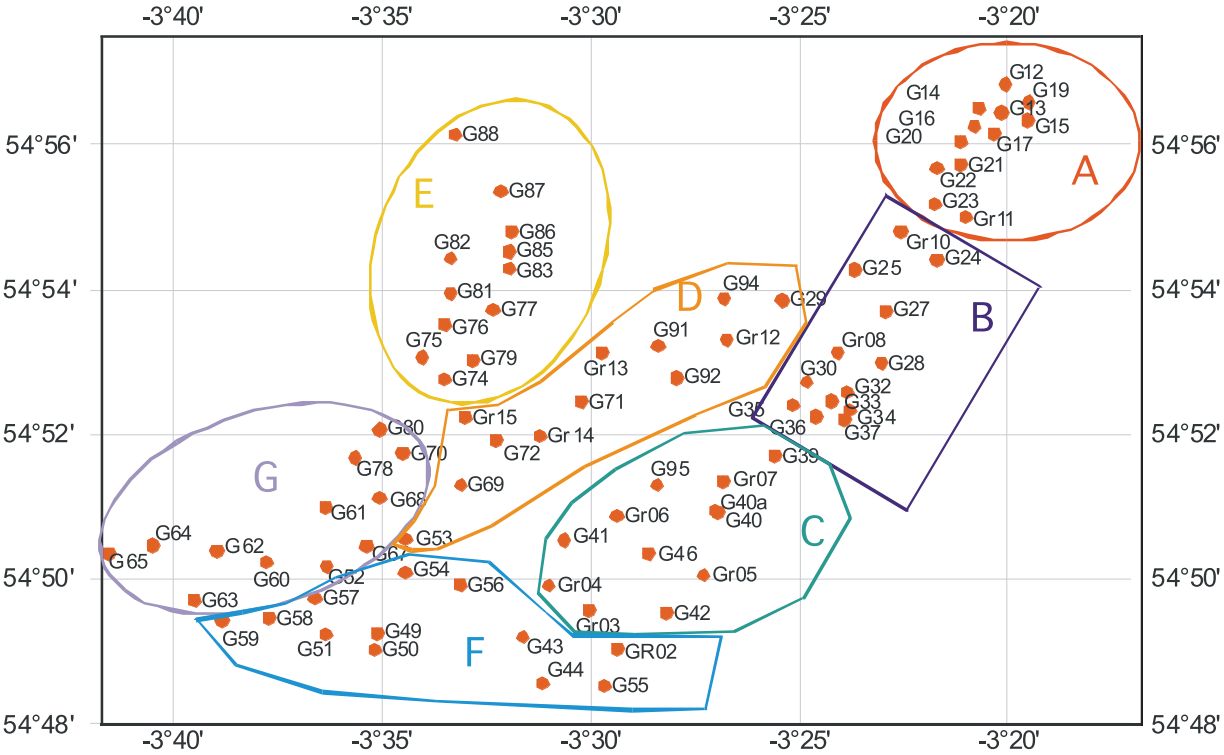
The faunal analysis of the samples from the 85 sites comprised both univariate and multivariate analyses all of which were calculated using Primer version 5 (Clarke and Warwick, 1994). The univariate analysis included species diversity where the Shannon-Wiener (H'), Pielou's (J) and Margalef's (d) diversity indices (see eg Gage and Tyler, 1991; Fowler and Cohen, 1992; Clarke and Warwick, 1994) were used with the natural log (loge) being the chosen parameter in the case of the Shannon-Wiener diversity index. The multi-variate analysis was carried out using cluster analysis and ordination (non-metric multi-dimensional scaling, MDS) where the abundance data (individuals/0.1m^2) were transformed to fourth root to down-weigh the importance of common types of macrofauna in relation to rarer types. The transformed data were then analysed using the Bray-Curtis similarity coefficient (using Primer v.5) followed by a cluster analysis where the sites were group averaged and the resultant dendrogram plotted. Non-metric multi-dimensional scaling (MDS) was then carried out to further assess the presence of any similarities between sites (Clarke and Warwick, 1994). Spearman's rank correlation coefficient (see eg Fowler and Cohen, 1992) was then used to assess any geographical trends using the MDS x and y ordinates.

Some of the results needed further analysis as the results of individual sites were not conclusive and there were differences between sites within the same region (ie the results were not representative of all the sites within a particular region). The data from the 85 different sites were therefore pooled into seven groups (A–G) to assess whether the identified differences between individual sites were present in the pooled groups. The sites in each group were selected with the aim to represent different regions within the survey area to assess any potential differences between these regions and assess any geographical variations (including variations with distance from the head to the mouth of the estuary). The groups were largely selected to represent the survey blocks as discussed above (see Figure 2.1) and allow a similar number of sites in each group. The sites within each group are given in Table 2.3 and Figure 2.3. The total abundance in each group was used to carry out species diversity and multi-variate analyses as described above using Primer v.5 (Clarke and Warwick, 1994).

Table 2.3 The Day grab sampling sites within the Solway Firth pooled into different groups

Groups	Site identification
A	G12, G13, G14, G14, G15, G16, G17, G19, G20, G21, G22, G23, GR11
B	G24, G25, G27, G28, G30, G32, G33, G34, G35, G36, G37, GR08, GR10
C	G39, G40, G40a, G41, G42, G46, G95, GR03, GR04, GR05, GR06, GR07
D	G29, G53, G69, G71, G72, G91, G92, G94, GR12, GR13, GR14, GR15
E	G74, G75, G76, G77, G79, G81, G82, G83, G85, G86, G87, G88
F	G43, G44, G49, G50, G51, G54, G55, G56, G57, G58, G59, GR02
G	G52, G60, G61, G62, G63, G64, G65, G67, G68, G70, G78, G80

Figure 2.3 The Day grab sampling sites within the Solway Firth pooled into different groups



All these analysis techniques were then used, together with the original data set, to classify all the Day grab sites into biotopes according to Connor *et al*. (2004). SIMPER (SIMilarity PERcentages) analyses (Clarke and Warwick, 1994) were carried out to aid this classification and identify the most important and characteristic species for each biotope.

2.5 Epibenthic trawling

The Marine Monitoring Handbook (Davis, 2001) suggests suction sampling and epibenthic trawling as alternatives to video monitoring as methods of measuring species composition/richness. The beam trawl was selected as it is less destructive than suction dredging.

Following the attempted drop-down video work SNH, in consultation with SeaStar Survey, decided on epibenthic trawling to replace video work for epifaunal analysis.

Sixty of the grab sites were selected for epibenthic trawling. Trawl lines were selected to ensure spatial coverage of the Solway cSAC and to ensure that trawls were completed over all sediment types identified from the grab samples to allow comprehensive biotope classification. The trawl lines were 200m long using the grab location as the centre point. A 2m beam trawl with a 5mm cod-end was utilised for the survey. The beam trawl was lowered to the seabed over the stern of the vessel paying out approximately three times the water depth of cable to allow the trawl to reach the seabed. Vibrations can be felt on the wire when the trawl is being towed along the seabed. Logging commenced when the trawl reached the seabed. Information inserted into the log includes Start of line position, depth, boat heading and speed and end of line position and depth. The lines were run at between 1.5–2 knots speed over the ground into the tide, which allowed greater control of the boat speed. Once the trawl had been towed for 200m the vessel was slowed and the net recovered to deck. Once on deck the catch was emptied into a fish tray with a 5mm mesh. All organisms were identified and logged. In addition all fish were measured before being returned to the sea. The trawl log can be seen in Appendix A9. Any specimens that weren't identifiable in the field were preserved in 10% formalin – seawater solution for later identification in the laboratory. The fauna present in the trawls were used to aid the classification of sites into biotopes as some of the characteristic fauna (ie fauna characteristic of a particular biotope) collected in the trawls were not present in the Day grab samples. The two sets of data from the Day grab and trawl sampling made a more complete assessment possible and the classification of sites into particular biotopes more reliable.

Finally, observations were made with regard to the trawling data and comparisons between this data set and previous studies were made.

2.6 Depth survey

To address the topography of the region, vertical control was achieved by the use of a SIMRAD CA42/50 dual frequency (50 and 200kHz) echosounder. Data from the echosounder's high frequency (200kHz) were logged digitally using Hypack Max v2.1a survey management software along nine transits through the survey period.

The echosounder transducer was hull mounted approximately 1.0m below the water line. The DGPS was mounted above the transducer to remove the need for offsets.

Depth data were reduced to chart datum using admiralty predicted tide tables for the Solway Firth.

3 RESULTS

A total of 85 sites were sampled using the Day grab (see Appendix A1) out of which 60 sites were also sampled using the beam trawl (Appendix A2) where the grab site formed the mid-point of the trawl transect.

3.1 Sediment distribution

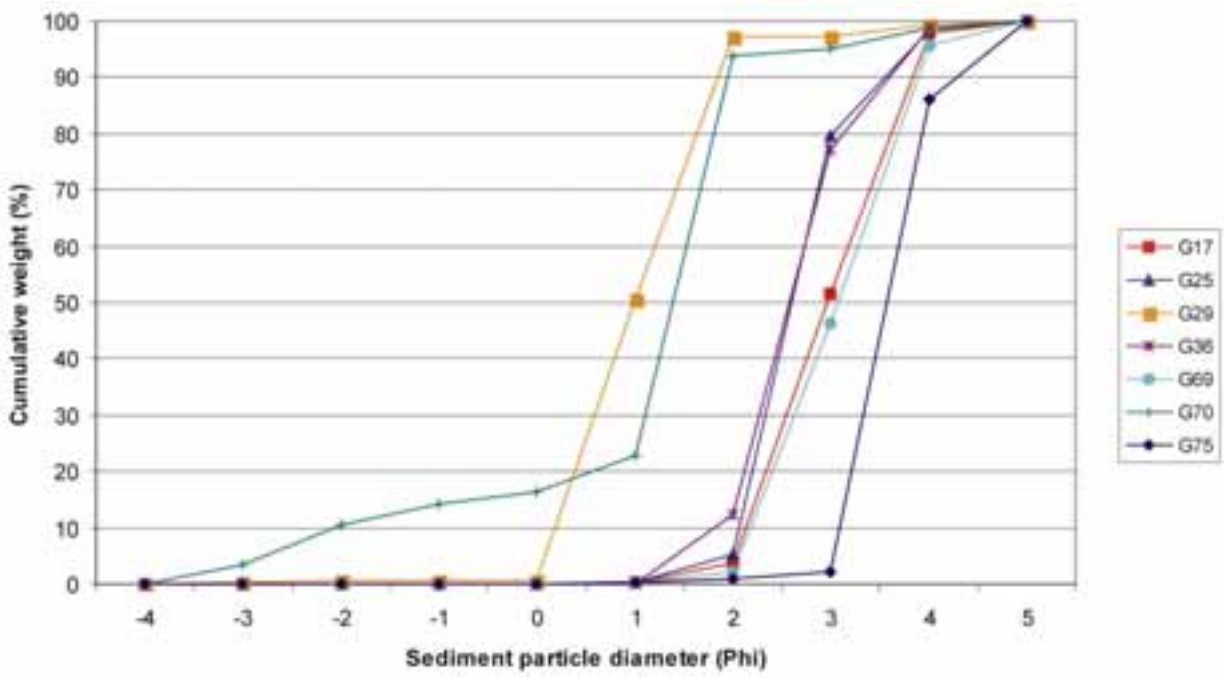
The results from the particle size analysis from the Day grab samples are given in Appendix A4 with a summary in Table 3.1 (sand, silt and clay (mud) and pebbles refer to all size fractions within each category). The results illustrate that the vast majority of sites (81.2%) consist of >95% sand with a small fraction (a few percent) of silt and clay (mud) and 97.6% (83 of 85) of the sites consist of >85% sand (Table 3.1). A few sites have slightly higher percentages of silt and clay (mud) (see Table 3.1), while a few sites have a slightly more mixed sediment with a small fraction of coarser material (see Table 3.1). Overall, however, and the most important aspect of these results is that sand represents more than 80% of the sediment at all the 85 sites (see Table 3.1). All 85 sites are therefore classified as "sand" (see Appendix A5) according to the modified Folk triangle (Folk, 1954) classification system as adapted by the JNCC (Connor *et al.*, 2004). In addition, in terms of the sediment present, all 85 sites could therefore also classify as **SS.SSa** (sublittoral sediment, sublittoral sands and muddy sands) but as both the sediment type and fauna have to be considered when classifying a site as a particular biotope according to the JNCC Marine Nature Conservation Review Biotope Classification (Connor *et al.*, 2004) system, some of the sites are classified as different biotopes (see below).

Table 3.1 Overall sediment composition among the sub-tidal sites (85 sites in total) in the Solway Firth (sand, mud and pebbles refer to all size fractions within each category (see methods) where 'mud' is the same as 'silt and clay' as described in the methods section)

Sediment composition	Number of sites	Percentage of sites	Site identification
<95% sand	16	18.8%	See Appendix A4
<90% sand	5	5.9%	G67, G70, G75, G82, GR05
<85% sand	2	2.4%	G82, G70
<80% sand	0	0%	
>10% mud	2	2.4%	G75, G82
>5% mud	11	12.9%	G37, G40, G62, G64, G65, G67, G75, G76, G77, G81, G82
>3% mud	20	23.5%	See Appendix A4
>10% pebble	1	1.2%	G70
>5% pebble	2	2.4%	G70, GR05
>3% pebble	6	7.1%	G57, G61, G67, G70, GR02, GR05

The 'sand' size class can be further divided according to the sediment size classification based on the Wentworth scale (see eg Leeder, 1982). Further analysis of the data shows that the vast majority (81) of the sites are dominated by fine or very fine sand with only four sites (G22, G27, G29 and G91) with medium sand as the dominant size fraction. A few examples of the sediment size distributions at a few sites within the Solway Firth are given in Figure 3.1. The sediment size distribution of sites G17, G25, G36 and G69 are typical of the majority of the sites.

Figure 3.1 Sediment size distributions at a few representative sites within the Solway Firth (cumulative weight of sediment retained on sieves)



3.2 Macrofaunal distribution

A total number of 26,434 individuals and 72 taxa were identified among the benthic macrofauna in the grab samples within the Solway Firth. Overall the macrofauna is dominated by Annelida (53.4%) and Mollusca (41.7%), representing 95.1% of the identified fauna. The Crustacea and Echinodermata comprise 4.0% and 0.9% of the macrofauna respectively while the remaining groups (Cnidaria, Nemertea and Ascidiacea) represent less than 0.04%. It should, however, be noted that a large proportion (nearly 88%) of the 26434 identified and enumerated individuals was found at one site (G40) consisting of *Sabellaria alveolata* (48.1%) and *Mytilus edulis* (39.7%). If these two taxa at G40 are excluded from the analysis, the composition of the macrofauna changes and overall the fauna is dominated by Annelida (42.9%), Crustacea (33.3%) and Mollusca (16.4%). The Echinodermata comprise 7.1% while the remaining groups (Cnidaria, Nemertea and Ascidiacea) represent less than 0.3% of the macrofauna.

3.2.1 Abundance

The abundance (density) values for the different Day grab sites within the Solway Firth are given in Appendix A6 and the transferred values into the SACFOR scale are given in Appendix A7. These results show that the majority of sites (83.5%) have 50 or less individuals per site. In fact, 51 sites have ≤20 individuals per site and at 27 sites ≤10 individuals were found. Only eight sites have counts of 51–100 individuals and six sites were found to have 100 individuals, or more, per site. Considering these overall low abundance values, the densities at site G40 are of particular note. Here very high densities of both *Sabellaria alveolata* (12,736 individuals/0.1m^2) and *Mytilus edulis* (10,504 individuals/0.1m^2) have been found.

In geographical distribution terms, the density values appear to indicate lower abundance in the area towards Annan, in the northeast of the survey area, compared to other areas, although there are sites in

other parts of the survey area with equally low values. To test this pattern further, the results were pooled (see methods) into seven groups (A–G) and the results are given in Table 3.2.

Table 3.2 Abundance (individuals/0.1m^2), standard deviation, the 95% confidence interval (using the *t*-distribution) and the total number of individuals in the groups of the pooled data for sites within the Solway Firth (*see eg Fowler and Cohen, 1992)

Groups	A	B	C	D	E	F	G
Mean abundance	11.4	35.4	2019.4	36.3	23.6	30.2	43.7
Standard deviation	± 8.3	± 37.2	± 1932.1	± 21.0	± 11.0	± 17.6	± 26.8
95% confidence interval*	6.2–16.2	13.1–57.7	804.1–3234.8	23.1–49.4	16.7–30.5	19.1–41.2	26.8–60.5
Number of individuals	137	460	24233	435	283	362	524

The results further indicate that the sites nearest Annan (group A) have the lowest abundance values and the 95% confidence interval is significantly different from all groups apart from group B. Group E (Dumfries Channel) also has slightly lower abundance values compared to the other groups but the abundance here is not significantly different from the other groups. Group C has particularly high abundance and the confidence interval shows a significant difference from the other groups, a result linked to the high number of *Sabellaria alveolata* and *Mytilus edulis* at site G40.

3.2.2 Species diversity

The results from the species diversity analyses of all the sites sampled by Day grab are given in Appendix A8 with a summary of the sites with the highest and lowest species diversity in Table 3.3 (note (in both Table 3.3 and Appendix A8) sites G62, G76, G80 and GR05 with high diversity and sites G24, G29 and GR11 with low species diversity using both diversity indices). These results indicate overall low species diversity throughout the sublittoral zone within the Solway Firth (see Appendix A8). In addition, there is some geographical variation within the area (see Figure 3.2) and there is evidence of an increase in diversity (both the Shannon-Wiener diversity index and species richness) from the northeast (the area nearest Annan) towards the southwest. It should, however, be noted that not all sites conform to this overall pattern and some sites within the Annan Channel have higher diversity values than the others.

There is no apparent evidence of a geographical pattern within the western region of the survey area. Species diversity values within the Dumfries Channel are found to be similar to those in the south/southwest of the survey area.

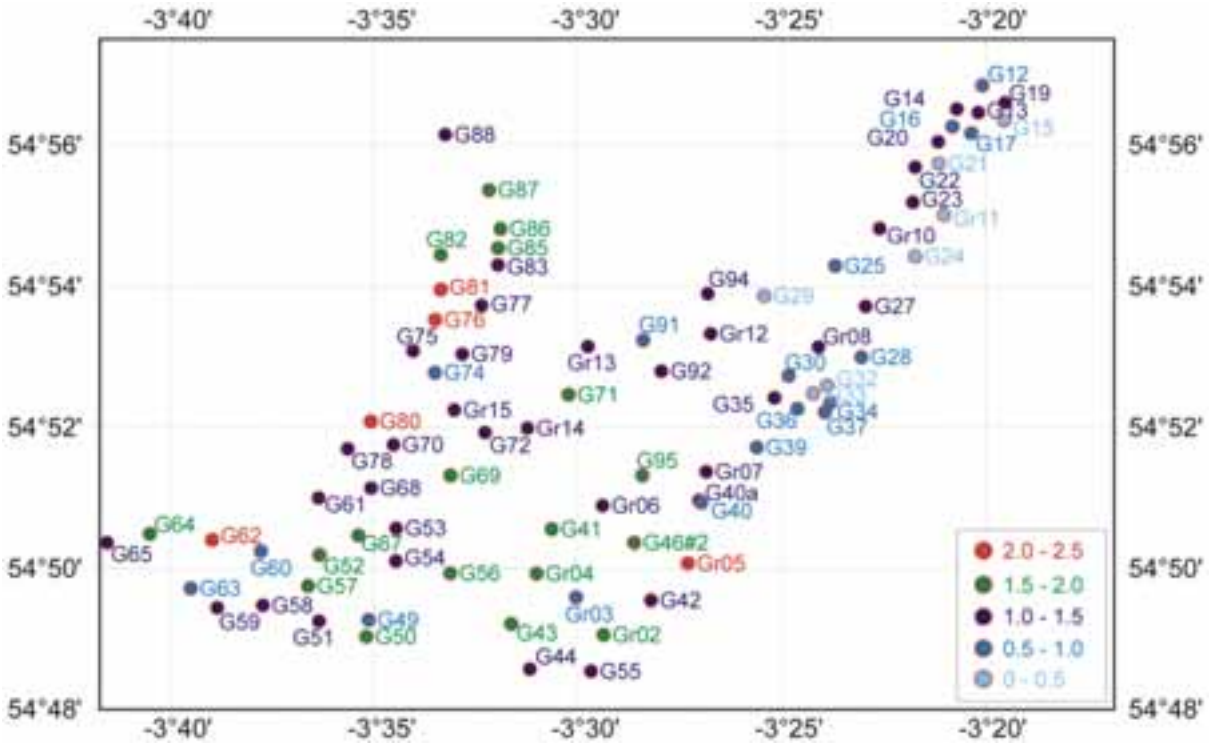
No apparent geographic distribution pattern is evident within the equitability values, although it should be noted that high evenness is found at almost all the sites within the Dumfries Channel, indicating a more stable environment. In addition, evenness is ≥0.8 at 44 sites and only two sites have values of ≤0.25, indicating that dominance is low throughout the sites within the Solway Firth.

Some caution is needed with regards to the interpretation of all these species diversity results because of the low numbers of individuals (n) present at many of the sites and replicate sampling may be required to assess these patterns fully.

Table 3.3 The subtidal sites with the highest and lowest species diversity (for Shannon-Wiener (H') and Margalef (d) species diversity indices)

Sites with highest species diversity				Sites with lowest species diversity			
Shannon-Wiener (H')		Margalef (d)		Shannon-Wiener (H')		Margalef (d)	
G76	2.47	GR05	4.11	G15	0	G24	0
GR05	2.40	G76	3.64	G24	0	G29	0.35
G81	2.05	G62	2.92	G33	0.17	GR11	0.36
G80	2.03	GR02	2.73	GR11	0.23	G30	0.43
G62	2.03	G82	2.73	G21	0.27	G32	0.56

Figure 3.2 Shannon-Wiener diversity index values of the Day grab sites within the Solway Firth



3.2.3 Macrofaunal composition

The results of the cluster analysis and ordination are given in Figures 3.3 and 3.4. Overall, the patterns are somewhat difficult to discern because of the large number of sites in this survey (note the black dotted line indicating the approximate level at which the cluster analysis is reliable). However, site G40 has clearly been clustered separately from the other sites both in the dendrogram and in the MDS. The second clustered group consists of five sites (G82, G81, G88, G19 and G34; coloured blue in the dendrogram) and according to the SIMPER analysis, these sites include individuals of the genus *Macoma* but the remaining fauna is very similar to the largest clustered group (also in blue). A third group (brown) is also clustered together, although these sites have not been so clearly grouped together in the MDS. The fourth group that

can be discerned both in the dendrogram (red) and the MDS (red) consists of many of the sites close to Annan. The dotted red line consists of sites associated to the sites grouped as 'red' and these sites are linked together for other reasons (see below). Beyond these groups, further clustering of sites may be unreliable, although the cluster in light blue has been high-lighted as a result of the large numbers of *Echinocardium cordatum* found at these sites (see below).

Additional analyses of 10 sites forming a transect from Annan down towards Silloth were carried out to assess whether these exhibited any geographical trends (table 3.4). The sites are G12, G14, G16, G20, G21, G22, GR10, GR08, G30 and G35 and multi-variate analyses were carried out as described above. The MDS x and y ordinates of these sites were then used to assess any correlation with latitude and longitude using the Spearman's rank correlation coefficient (r_s) (see eg Fowler and Cohen, 1992) but no significant ($p<0.10$) correlations were found.

Table 3.4 Spearman's rank correlation coefficient analyses between the MDS ordinates and two geographic parameters using a transect with 10 sites from Annan towards Silloth

Parameters	**Latitude**	**Longitude**
MDS x	–0.273	0.285
MDS y	0.082	–0.039
Levels of significance (two-tailed test: from Fowler and Cohen, 1992)	*Tabulated value*	*Significance level*
	0.648	0.05
	0.564	0.10

As with species diversity indices, some caution is needed with regards to the clustering and ordination results because of the low numbers of individuals (n) present at many of the sites (see dotted black line (Figure 3.3) indicating the reliability level of the analysis). In addition, the stress value (ordination) of 0.21 for the main MDS analysis (Figure 3.4) is within a range where "too much reliance should not be placed on the detail of the plot" (Clarke and Warwick, 1994). However, by pooling the data (see methods above), further analysis is possible and the results of the clustering and ordination of these groups are given in Figures 3.5 and 3.6.

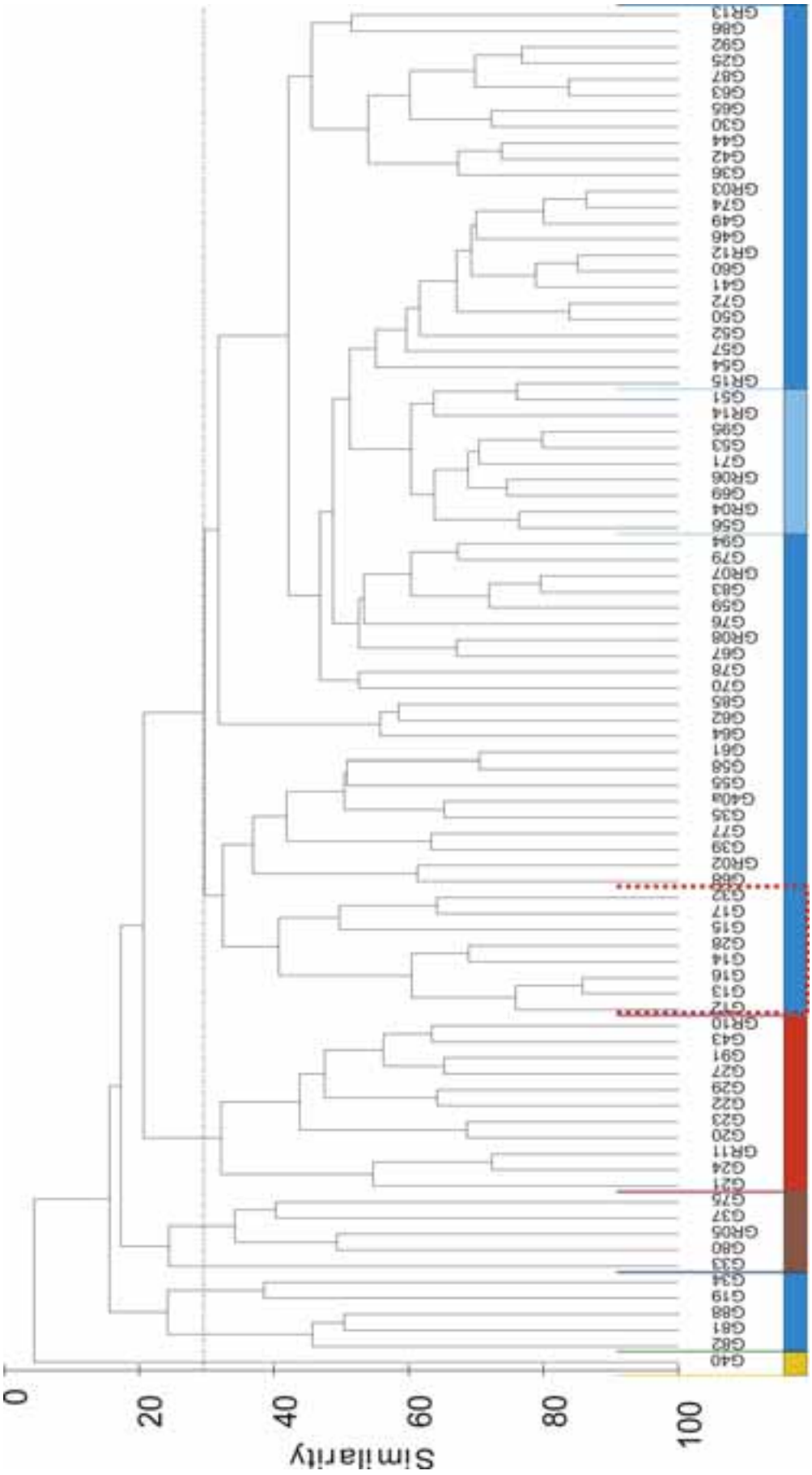


Figure 3.3 Cluster analysis of the Day grab sites within the Solway Firth

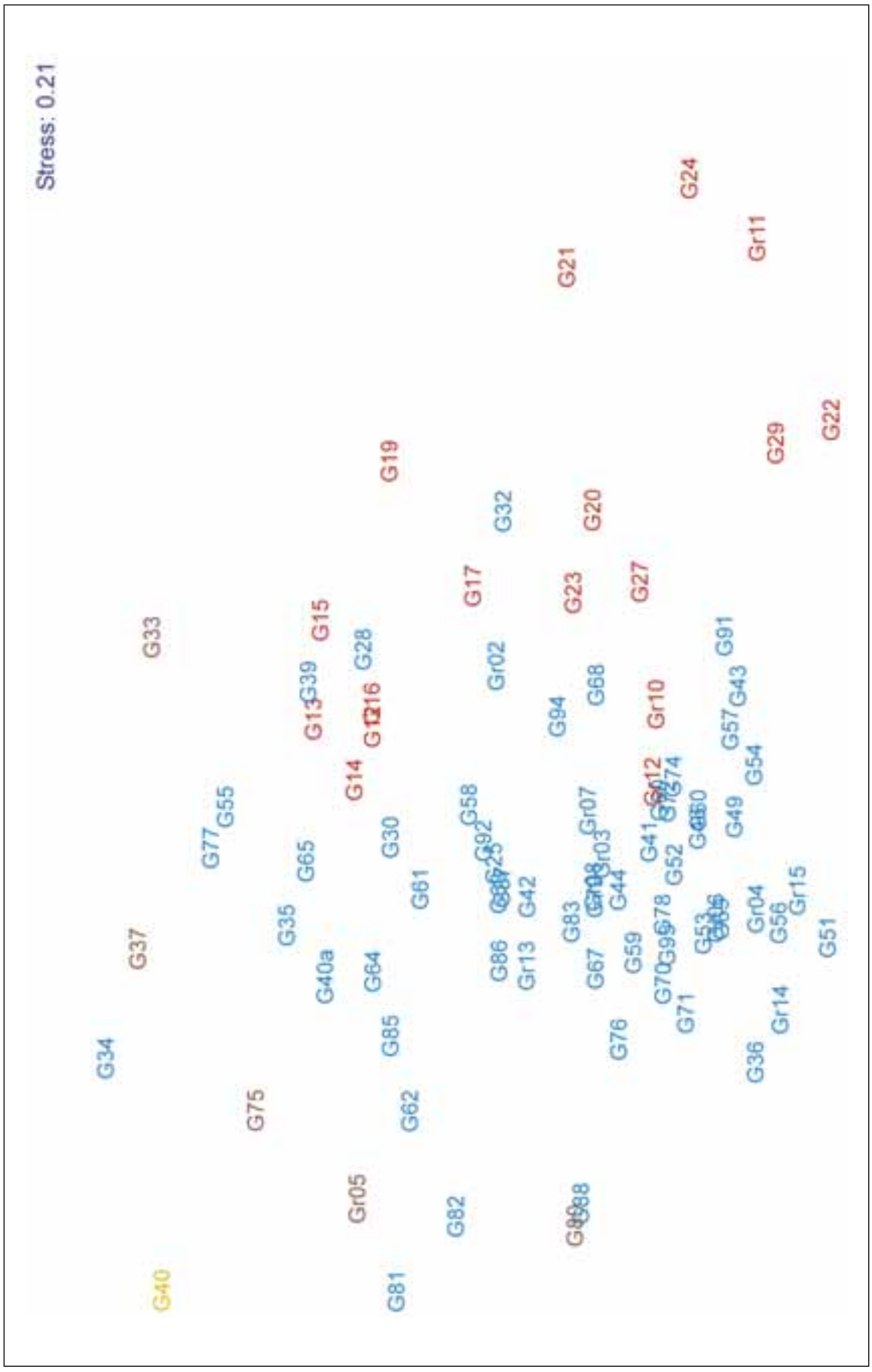


Figure 3.4 Ordination (non-metric multi-dimensional scaling) of the Day grab sites within the Solway Firth

Figure 3.5 Clustering of the pooled data (based on total abundance for each group) for the Day grab sites in the Solway Firth

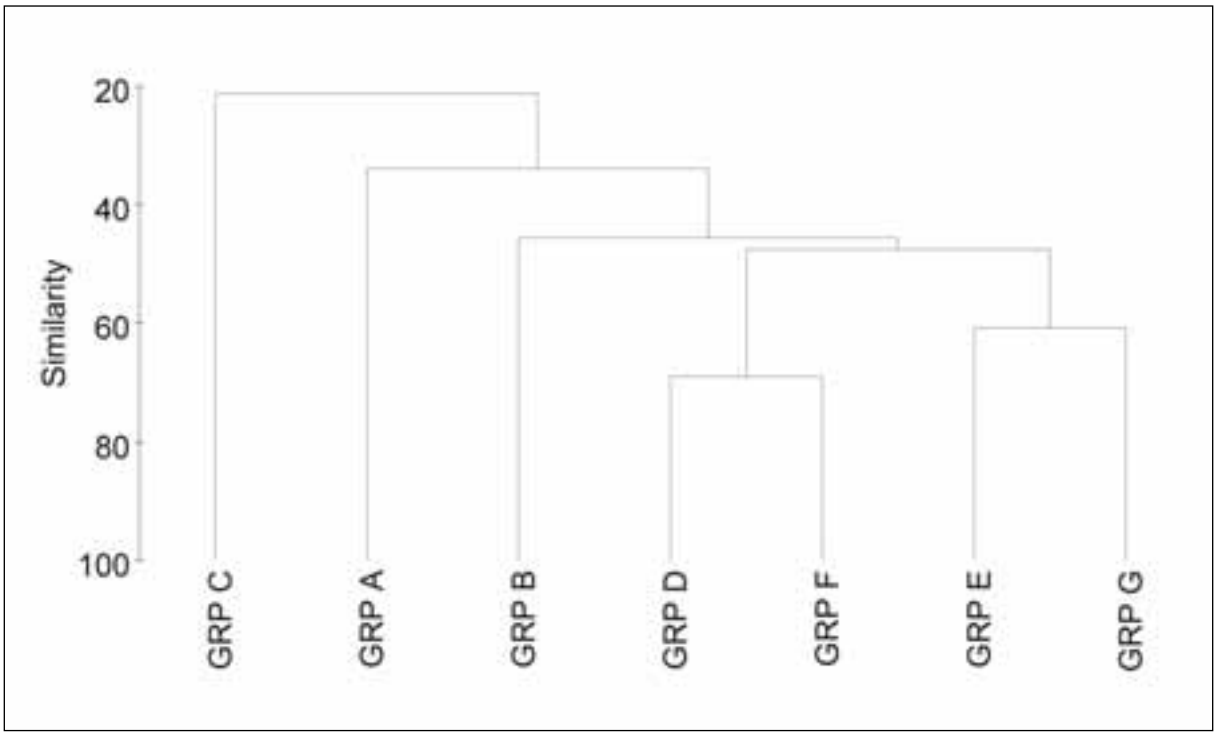
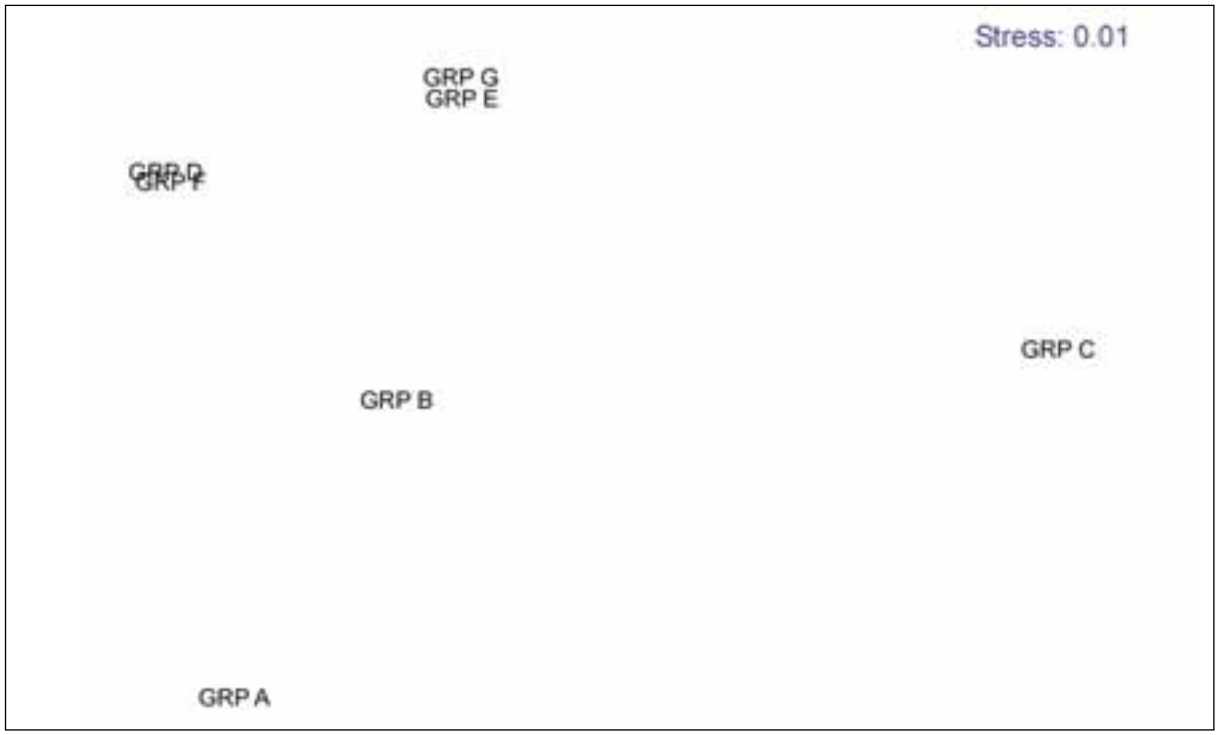


Figure 3.6 Ordination of the pooled data (based on total abundance for each group) for the Day grab sites in the Solway Firth



The results from the pooling of the data show that groups D, E, F and G are grouped relatively closely together while groups A and C have been clustered and ordered away from the other groups. Group B has been clustered and ordered in between the other groups. The level of stress (0.01) on the analysis indicates an "excellent representation of the data with no prospect of misinterpretation" (Clarke and Warwick, 1994). A SIMPER analysis (Table 3.5) shows the characteristic species in each group as well as the individual contribution of each species to the overall similarity within the data set.

Table 3.5 Results from the SIMPER analysis of the pooled groups within the Solway Firth

Group	% contribution of characteristic species	
	% contribution	**Characteristic species**
A	50.72 28.07 11.06	*Nephtys cirrosa* *Haustorius arenarius* *Bathyporeia pelagica*
B	51.36 18.15 12.51	*Nephtys cirrosa* *Haustorius arenarius* *Crangon crangon*
C	52.47 25.68 6.73	*Nephtys cirrosa* *Bathyporeia elegans* *Gastrosaccus spinifer*
D	35.66 24.57 14.16	*Nephtys cirrosa* *Bathyporeia elegans* *Echinocardium cordatum*
E	33.46 25.73 15.27	*Nephtys cirrosa* *Crangon crangon* *Bathyporeia elegans*
F	41.82 37.86 7.72	*Nephtys cirrosa* *Bathyporeia elegans* *Pontocrates altamarinus*
G	53.61 27.91 6.07	*Nephtys cirrosa* *Bathyporeia elegans* *Mytilus edulis*

3.3 Biotope classification

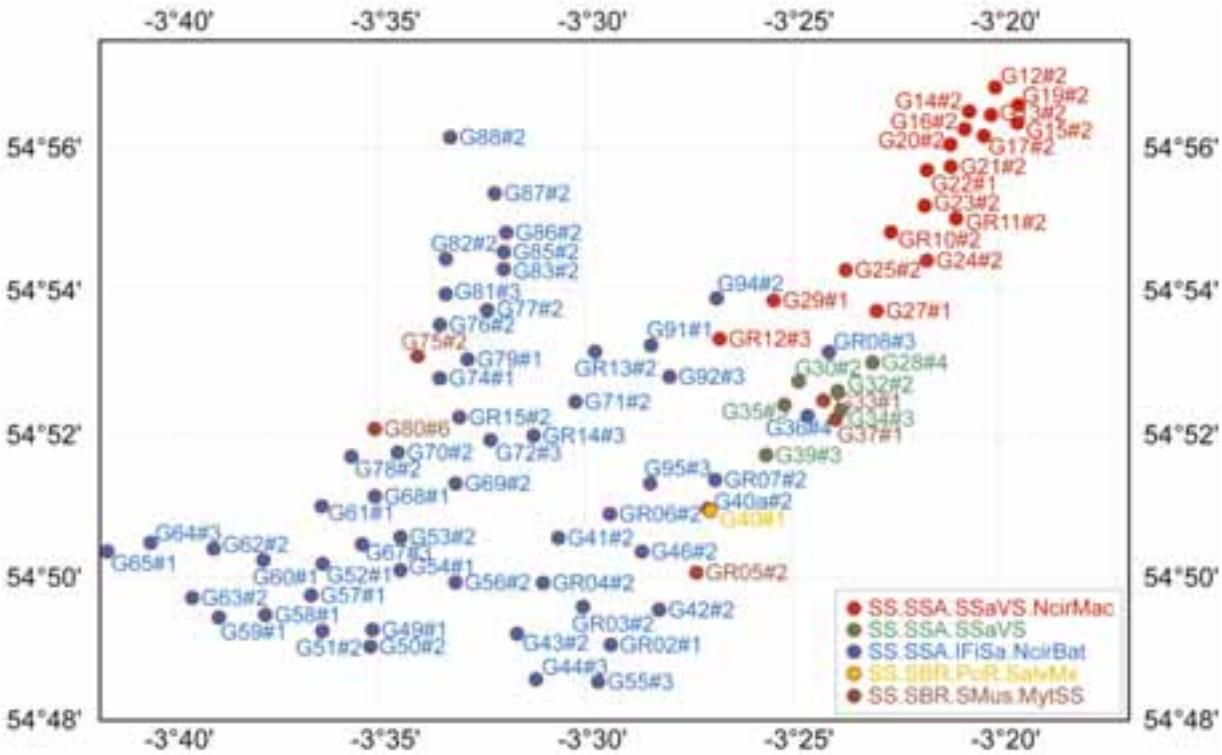
The classification of the 85 sites into a designated biotope has revealed a total of five biotopes within this survey area (Table 3.6 and Figure 3.7). All sites are found at depths of 14m, or less (see Appendix A4), and they are therefore found within the infra- or circalittoral zones. Based purely on the sediment present (see above), all the sites could in a low level, top-down classification be classified as sublittoral sediment, sublittoral sands and muddy sands (**SS.SSa**), but because of the presence of certain fauna and the fact that a biotope is designated using the sediment, depth and the fauna present (Connor *et al.*, 2004), a few of the sites have been assigned more appropriate biotope classifications.

The classification of the sites into different biotopes is based on the sediment, characteristic fauna, depth (see Appendix A4 and Covey, 1998), species diversity and the results from the clustering and ordination analyses with caution given to the results from both the diversity and multivariate analyses.

Table 3.6 Biotope classification of the Day grab sites within the Solway Firth (previous (1997) biotope code in brackets)

Biotope	Site identification
SS.SSa.IFiSa.NcirBat (IGS.FaS.NcirBat)	G36, G40a, G41, G42, G43, G44, G46, G49, G50, G51, G52, G53, G54, G55, G56, G57, G58, G59, G61, G62, G63, G64, G65, G67, G68, G69, G70, G71, G72, G74, G75, G76, G77, G78, G79, G80, G81, G82, G83, G85, G86, G87, G88, G91, G94, G95, GR02, GR03, GR04, GR05, GR06, GR07, GR08, GR10, GR11, GR12, GR13, GR14, GR15
SS.SSa.SSaVS.NcirMac (IGS.EstGS.Ncir)	G12, G13, G14, G15, G16, G17, G19, G20, G21, G22, G23, G24, G25, G27, G29, GR10, GR11, GR12
SS.SSa.SSaVS (IGS.EstGS)	G28, G30, G32, G34, G35, G39
SS.SBR.PoR.SalvMx (New)	G40
SS.SBR.SMus.MytSS (IMX.EstMx.MytV in part)	G33, G37, G75, G80, GR05

Figure 3.7 Biotope classification of the Day grab sites within the Solway (red: **SS.SSa.SSaVS.NcirMac**; blue: **SS.SSa.IFiSa.NcirBat**; green: **SS.SSa.SSaVS**; brown: **SS.SBR.SMus.MytSS**; and yellow: **SS.SBR.PoR.SalvMx**).



In the habitat classification (Connor *et al.*, 2004), **SS.SSa.IFiSa.NcirBat** (sublittoral sediment, sublittoral sands and muddy sands, infralittoral fine sand, *Nephtys cirrosa* and *Bathyporeia* sp.) is described as a fully marine environment (salinity of 30–35ppt) with medium to very fine sands which is subject to physical

disturbance (wave and tidal currents). Characteristic fauna include *Nephtys cirrosa, N. hombergii* and *Bathyporeia elegans* as well as actively-swimming amphipods (including *Pontocrates* spp.) and overall reduced species diversity. All these habitat characteristics describe the selected sites in this biotope very well, with supporting evidence from both the univariate (species diversity) and multivariate (clustering and ordination) analyses. The SIMPER analyses (characteristic species at these sites, Table 3.7) further support the selection of these sites as **SS.SSa.IFiSa.NcirBat**.

SS.SSa.SSaVS.NcirMac (sublittoral sediment, sublittoral sands and muddy sands, sublittoral sand in variable salinity, *Nephtys cirrosa* and *Macoma balthica*) is described (Connor *et al.*, 2004) as mobile sand (medium to very fine) in "variable salinity conditions where tidal currents create unstable shifting habitats". The fauna is characterised by *Nephtys cirrosa, Bathyporeia pelagica* and *Haustorius arenarius*, with *B. pelagica* being particularly characteristic in the Solway Firth samples (see Table 3.7). This biotope furthermore contains relatively few species in low to moderate abundance (Connor *et al.*, 2004) corresponding well to the results from the species diversity analyses (see above) indicating low species diversity in the area nearest Annan, supporting the classification of the selected sites as **SS.SSa.SSaVS.NcirMac**. The lack of salinity data makes it difficult to assess this aspect but the presence of the characteristic species including *Bathyporeia pelagica* puts these sites in this biotope. Some of the sites included in this biotope were clustered and grouped with **SS.SSa.IFiSa.NcirBat**, but because of the location of the sites (close to Annan), the low numbers of individuals found (particularly lack of characteristic taxa) and the relative species diversity results, these sites have been classified as **SS.SSa.SSaVS.NcirMac**.

SS.SSa.SSaVS (sublittoral sediment, sublittoral sands and muddy sands, sublittoral sand in variable salinity) is described as clean sands that occur in the upper reaches of estuaries characterized by brackish-water tolerant fauna, particularly amphipods, polychaetes and shrimps. These sites (see Table 3.6 and Figure 3.7) may belong to another biotope but because of the particularly low numbers of individuals caught in the samples and the location of the sites in relation to the other biotopes, a definitive sub-feature classification is difficult to make. These sites may belong in either **SS.SSa.IFiSa.NcirBat** or **SS.SSa.SSaVS.NcirMac** but this can only be tested when further sampling has been carried out.

Only one site (G40) has been classified as **SS.SBR.PoR.SalvMx** (sublittoral sediment, sublittoral biogenic reefs on sediment, polychaete worm reefs, *Sabellaria alveolata* on variable salinity sublittoral mixed sediment). This site is very distinct with very high abundance (density) values as well as one of the highest numbers of taxa (S) present, although overall species diversity is low. The presence of 12,736 individuals of *Sabellaria alveolata* has lead to the classification of this site as a biogenic reef and more specifically **SS.SBR.PoR.SalvMx** but this site also contains many other characteristic taxa for this biotope at high abundances (eg *Eulalia ornate* and *Pygospio elegans*). However, there are also a number of other species found at this site (eg *Mytilus edulis, Eteone longa, Nereis* spp. and *Gammarus salinus*) that are closely associated with **SS.SBR.SMus.MytSS** (sublittoral sediment, sublittoral biogenic reefs on sediment. sublittoral mussel beds, *Mytilus edulis* beds on sublittoral sediment). It is possible that this site forms a transitional area between the two biotopes or that these two taxa compete for space (Muffat, 1999) but because of the biological importance (eg older reefs may increase biodiversity and stability; Muffat, 1999) and protection of *Sabellaria alveolata* (cSAC in the Solway Firth), this site has been classified as **SS.SBR.PoR.SalvMx**.

The **SS.SBR.SMus.MytSS** biotope exists in fully marine (or sometimes variable salinity conditions), sublittoral mixed sediments in the outer regions of estuaries and it is characterised by beds of the common mussel

Mytilus edulis (see Table 3.7). Other characterising taxa found at these sites include oligochaetes of the genus *Tubificoides*, the polychaete *Pomatoceros* and encrusting taxa such as *Triticella, Conopeum* and *Electra*. It should be noted that a small number of individuals of *Sabellaria alveolata* were found at sites G80 and GR05 and it is possible that small reefs exist here as well but because of the relatively larger abundance values of *M. edulis*, these sites have been classified as **SS.SBR.SMus.MytSS**.

Table 3.7 Results from the SIMPER analysis showing % contribution to the overall similarity of the characteristic species present in each biotope

Biotope	% contribution of characteristic species	
	% contribution	**Characteristic species**
SS.SSa.IFiSa.NcirBat (IGS.NcirBat)	43.23 31.62 7.11 5.71 3.46	*Nephtys cirrosa* *Bathyporeia elegans* *Crangon crangon* *Gastrosaccus spinifer* *Pontocrates altamarinus*
SS.SSa.SSaVS.NcirMac (Ncir)	46.00 32.02 8.96 6.75	*Nephtys cirrosa* *Haustorius arenarius* *Gastrosaccus spinifer* *Bathyporeia pelagica*
SS.SSa.SSaVS (IGS.EstGS)	85.51 14.49	*Nephtys cirrosa* *Crangon crangon*
SS.SBR.SMus.MytSS (IMX.MytV)	77.06 16.39	*Mytilus edulis* *Nephtys cirrosa*
SS.SBR.PoR.SalvMx (None)	n/a	Only one site (SIMPER analysis not possible)

Overall it should also be noted that the overlap and similarity of several different biotopes makes the decision to classify some sites into particular biotopes difficult. For example, it is difficult to determine the exact position of boundary (here classified as **SS.SSa.SSaVS**) between **SS.SSa.IFiSa.NcirBat** and **SS.SSa.SSaVS.NcirMac** with any high degree of certainty largely as a result of the lack of the characteristic fauna found in the samples from this region of the survey area but also because of the lack of salinity data.

In addition, there are a number of sites (G51, G53, G56, G69, G71, G95, GR04, GR06, GR14, GR15) where *Echinocardium cordatum* is present in high numbers. These sites are all classified as **SS.SSa.IFiSa.NcirBat** but they could equally be classified as **SS.SSa.IMuSa.EcorEns** considering the high abundance of *E. cordatum*. However, because of the statements in Connor *et al.*, (2004) including: "*E. cordatum* have a wide distribution and are not necessarily the best choice for a characteristic taxa" and "this biotope…needs further consideration", these sites have been classified as **SS.SSa.IFiSa.NcirBat**. Further consideration to these biotopes may be required once a fuller examination of this biotope has been carried out by the JNCC.

3.4 Trawl observations

A total of 60 sites were sampled using the 2m beam trawl. Multi-variate analysis of the data did not illustrate any clear similarities (neither clusters nor groups in MDS) with the grab-sample data but this data did aid in the classification of the biotopes. Some characteristic species were collected in the trawls (fauna that were

absent in the grab samples) and therefore made the biotope classification easier to complete. The fauna collected in the trawls (see Appendix A9) furthermore illustrate the presence of a number of commercially important species including brown shrimp (*Crangon crangon*), plaice (*Pleuronectes platessa*), sole (Sol*ea solea*), flounder (*Platichthys flesus*), dab (*Limanda limanda*) and whiting (*Merlangius merlangus*) but many other species (eg harbour swimming crab (*Liocarcinus depurator*), lesser weever fish (*Echiichthys vipera*) and the common starfish (*Asterias rubens*) were also collected in the trawls.

The brown shrimp (*Crangon crangon*) was found throughout the survey area and was only absent from five sites. In many cases 100, or more, individuals were collected per site. The variation in the numbers present in the trawls may partly be attributed to the time of day as *Crangon crangon* is known to bury in the sediment at low tide (Lancaster, 1999). Whiting (*Merlangius merlangus*) was found at 45 sites with no particular geographical pattern and appeared to be present throughout the survey area. Most of them were small in size (c.10cm) and up to about 30–35 individuals were found in each trawl. Plaice (*Pleuronectes platessa*) was found at 54 sites (not absent from any particular region) where most were small individuals. A maximum of 68 found at one trawl site (TR7) but most trawls contained 20–30 individuals per site. Dab was found at 16 of the 60 sites with numbers typically being less than five per site, although 165 individuals were recorded at one site (T36). The sizes of dab varied and many were not juveniles. Sole (*Solea solea*) was found at only eight trawl sites (T52, T59, T63, T67, T68, T70, T71 and T86) near Southerness Point. In most cases only one or two individuals were found per site and the specimens caught in the trawls were small (a few centimetres).

Many of the fish species caught in the trawls are small (Table 3.8), including many individuals of plaice, sole and flounder; indicating that the Solway Firth serves as a nursery ground. None of the fish species of particular nature conservation significance (see SFP, 1996) was, however, found in this survey.

Table 3.8 Mean lengths (cm) with the standard deviations (S.D.) of some of the commercial fish species present in the trawl samples within the Solway Firth (*from Hayward and Ryland, 1995)

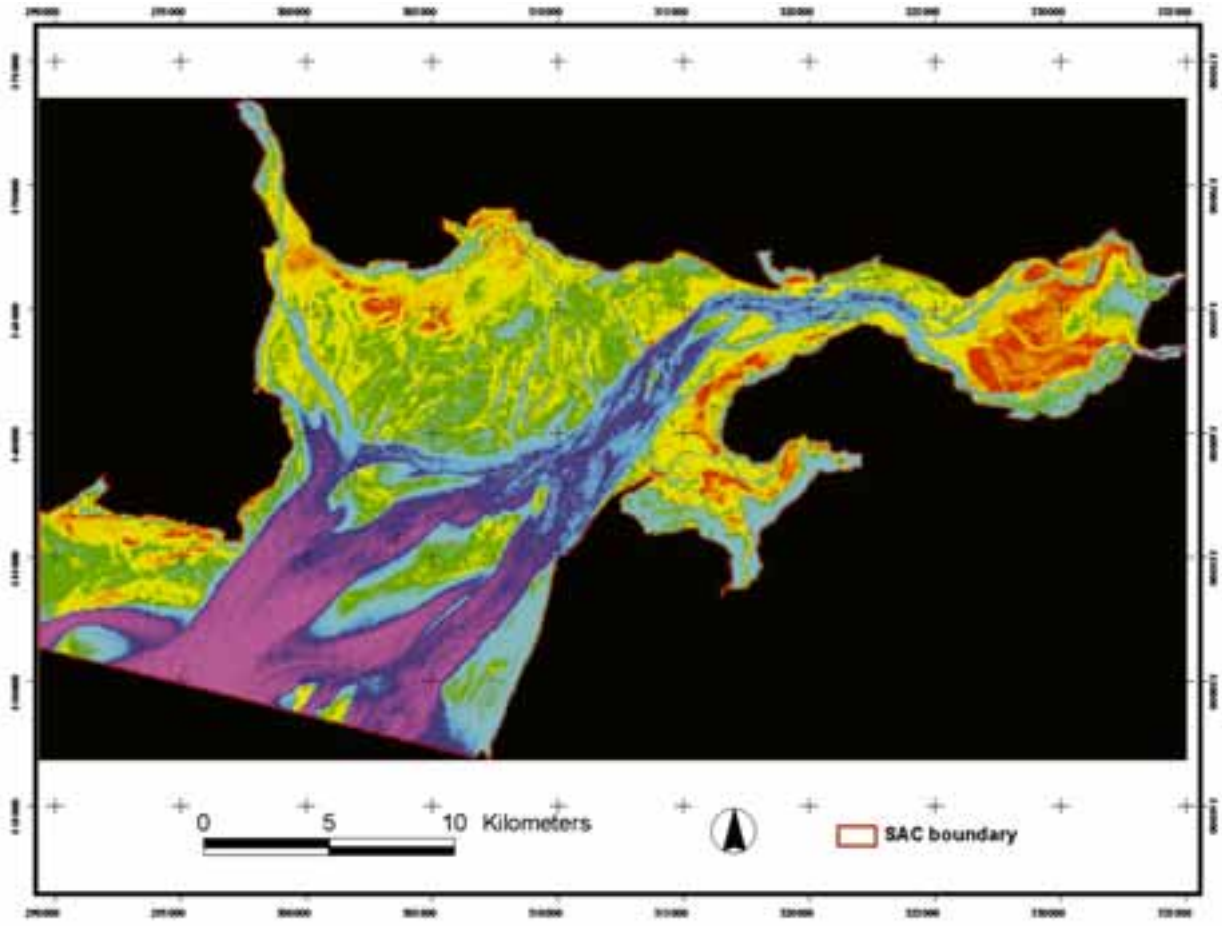
Taxa	Plaice	Sole	Flounder	Whiting
Length (mean)	5.8	7.9	9.2	7.8
S.D. (±)	2.6	2.7	2.8	1.3
Adult size*	Up to 50	Up to 66	Up to 50	Up to 70

3.5 Extent estimate and topography

3.5.1 Mapping overall sediment distribution

The results of the density slice of the raw brightness values of Band 2 (green waveband) in the masked image are shown in Figure 3.8. It shows visible variations in the sediment brightness. Colours vary from purples and blues indicating inundated areas through green, yellow and red indicating increasing sediment brightness and reduced water content. The variation in brightness of the sediments can be interpreted to reflect the size of the particles they consist of. The density slice is thus a crude form of classification of sediment particle size distribution, reflecting the hydrodynamics operating in the estuary.

Figure 3.8 Masked Landsat 7 ETM+ image over Solway Firth SAC dating 01.05.01, density sliced to show variations in sediment brightness



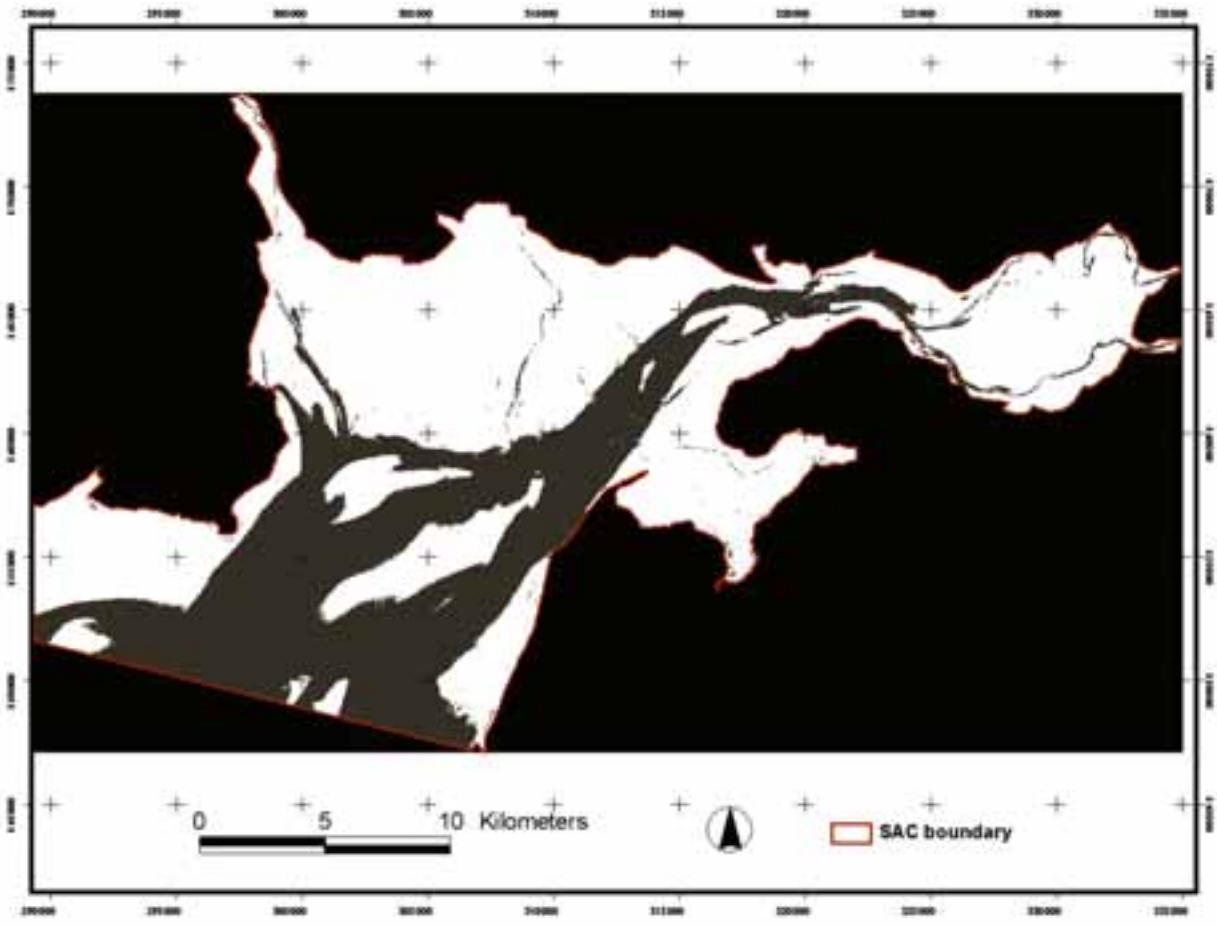
3.5.2 Estimating extent of subtidal sediment and distribution

The classified binary image showing intertidal and submerged areas is shown in Figure 3.9 overleaf. Intertidal areas are shown as white while subtidal areas are shown as dark grey.

Using the spatial analyst module in ArcView the total extent of the sublittoral sandbanks was estimated to be 15,043.38ha or 150.43km^2. Although the extent estimate includes one known small area of rocky reef, the results are considered accurate as the reef would occupy a very small percentage of the overall area.

It should also be considered for future studies that the aerial estimates reported here are somewhat overestimated given that the image was not acquired at the lowest tide. If further images are analysed in the future for extent monitoring they should be acquired at similar tidal conditions for consistency.

Figure 3.9 Binary raster image of Solway Firth SAC dating 01.05.01, showing the intertidal areas as white and the subtidal as dark grey

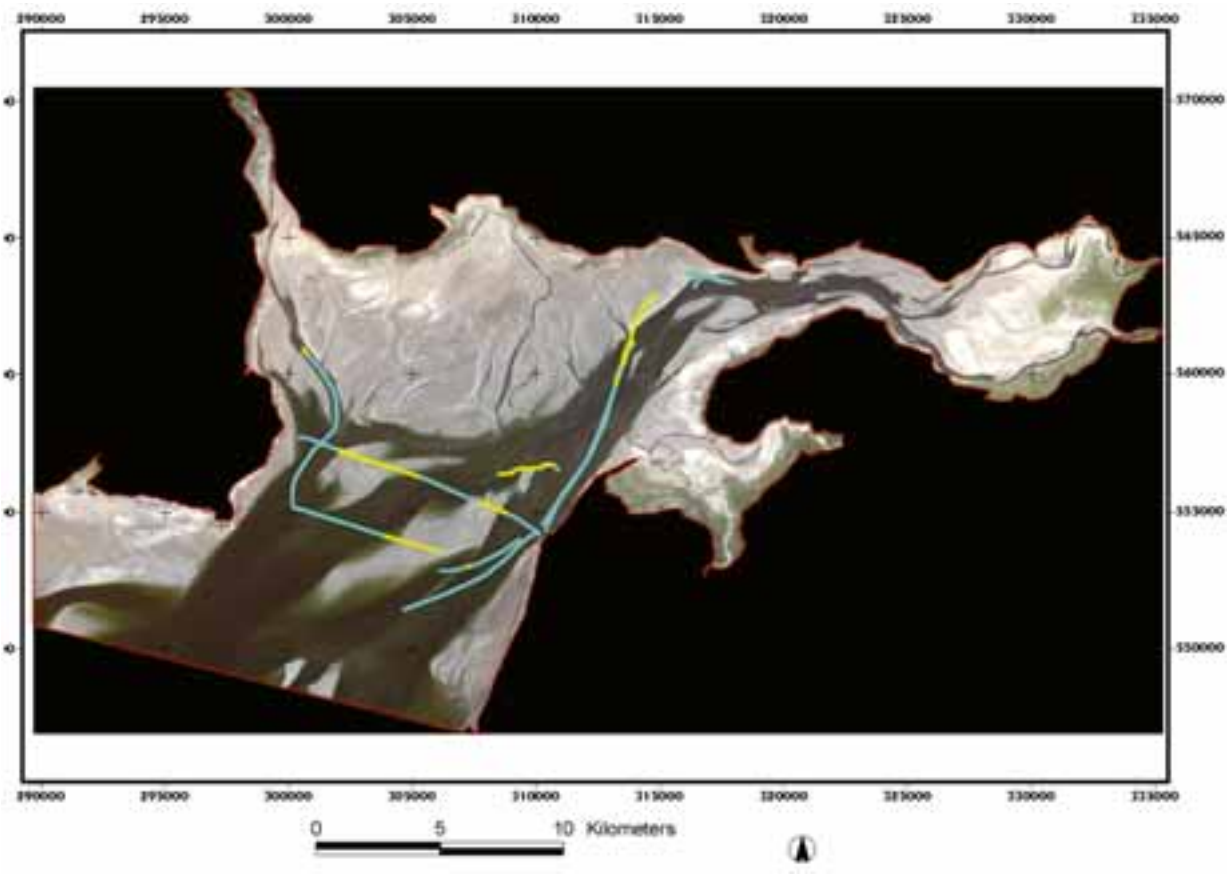


3.5.3 Topography

Depth was logged during some transects in the field to give an indication of topography of the sandbanks. These data have been supplied to SNH as a series of text tab delimited files after having been corrected to Chart Datum. The transects can be seen in Figure 3.10.

Following corrections to adjust the actual depth measurements to those at the same point of the tidal cycle as when the Landsat image was acquired, the summer 2004 transects were overlaid on the 2001 Landsat ETM+ image. To facilitate comparisons, subtidal regions were coloured blue and intertidal regions were coloured yellow (Figure 3.10). The figure shows a slight increase in the area of the intertidal sandbanks along the transects covered from 2001–2004.

Figure 3.10 Depth transects showing regions of subtidal (blue) and intertidal (yellow) sandbanks when surveyed in 2004, superimposed upon 2001 Landsat ETM+ image of Solway Firth SAC



4 DISCUSSION

4.1 Comparisons with previous studies

There is very little published information, particularly concerning the macrofauna, with regards to the sublittoral regions of the Solway Firth. In addition, the available information sometimes lacks a full description of the methodology of the surveys and analysis techniques used (including the statistical techniques), making comparisons between the data sets difficult.

The subtidal area within the Solway Firth has been described as being dominated by mobile sediments brought into the area from the Irish Sea (Cutts and Hemingway, 1996; LIFE, 2000). The sediments consist of sand (although silt and clay and coarse sands were also components) forming constantly shifting sandbanks separated by a number of channels, the latter of which play an important role in maintaining a sediment balance within the estuary (Cutts and Hemingway, 1996; Covey, 1998; LIFE, 2000). These observations coincide with the results of this study and although the positions of the sandbanks continuously change and some coarse material was found at some of the sites (see Appendix A4), the sand component of the sediment is still dominant (classified as 'sand' according the adapted Folk classification system; Connor *et al.*, 2004).

Abundance and species diversity have both been reported to be low within the Solway Firth (Cutts and Hemingway, 1996; SFP, 1996; Covey, 1998; LIFE, 2000) and there have also been reports of an increase in diversity with distance from the head of the estuary (Perkins and Williams, 1966; Perkins, 1968; Cutts and Hemingway, 1996; SFP, 1996; LIFE, 2000). In the present study, apart from one site (G40) where abundance was found to be particularly high, overall species diversity and abundance have been shown to be low throughout the survey area. In addition the area nearest Annan has the lowest abundance and species diversity with values increasing towards the south/southwest. These generally low density and diversity values in the northeast are most likely a reflection of the estuarine conditions with variable salinity, strong tidal currents and some wave action (see Tait, 1982; SFP, 1996) but it may also potentially be some reflection of the difficulties experienced during sampling in this area. Penetration of the Day grab into the sediment was not always satisfactory as a result of the compact sediment. In addition, strong tidal currents forced the Day grab away from the vessel leading to sampling at a slight angle in some cases (unless it was slack water, weak currents or shallow depths). This leads to sampling where the two scoops are not entirely flat on the sediment when the grab is retrieved and a smaller sample is collected. A heavier grab might have improved the results but it would not be practical in the field as well as being more dangerous and heavy to handle. The Day grab is nevertheless considered the most appropriate sampling gear under these conditions and as long as the current, wave and weather conditions are favourable and subsequent sampling is carried out in a similar manner, comparisons of the data will be possible.

The type and distribution of biotopes in this study, particularly the two main biotopes (**SS.SSa.IFiSa.NcirBat** and **SS.SSa.SSaVS.NcirMac**), largely coincide with those of Covey (1998). Although only two biotopes (**Mob**; **NcirBat**) were identified within the sublittoral zone in that study, there is no information about boundaries between these two biotopes and the biotope classifications seem to be based mainly on sampling towards the inner reaches of the estuary by Annan (Covey, 1998). The survey by Cutts and Hemingway (1996) was carried out a year before the first biotope classification scheme was published (Connor *et al.*, 1997) and perhaps the suggested nine new biotopes in 1996 may now easily be classified according to the new rules. The identified fauna (Cutts and Hemingway, 1996) is very similar to the

identified fauna in this study and if the sites sampled in 1996 were reclassified, an easier comparison would be possible (the lack of a detailed map of the sublittoral site locations in the report also makes comparisons difficult). A total of 16 subtidal sites were sampled by Cutts and Hemingway (1996) with a total of 702 individuals and 37 taxa. Only four subtidal sites correspond directly with sites in this present survey (Table 4.1 and Appendix A3), partly because only 16 subtidal sites were included in the survey of 1994 and the sampling programmes were slightly different but presumably also as a result of the mobility of the sediment in the Solway Firth leading to some areas becoming intertidal. The fauna at these four sites are largely similar, although the number of different taxa and the number of individuals are small overall. *Nephtys cirrosa* is the dominant taxon at most sites and in both surveys. However, while *Magelona mirabilis* is present at all sites in 1994, it was not recorded in the same areas in 2004, although individuals were found in samples classified as this biotope at other sites. Sites G50, G52 and G68 seem very similar to those of 1994, although the low numbers of species and individuals present make definite conclusions difficult to make. Site G35 does, however, appear to have changed slightly, particularly considering the presence of *Mytilus edulis* in 2004, a species not present in 1994.

Further direct comparisons between the two surveys are more difficult. However, overall the fauna present in the two surveys are similar with *Nephtys* spp., *Bathyporeia* spp. and *Magelone mirabilis* being present at many sites. The number of individuals per site (abundance) appears to be fairly similar while (allowing for the difference in the total number of sites sampled in 1994 and 2004) slightly higher numbers of different taxa and individuals appear to have been recorded in 2004 compared to 1994. This could be attributed to the use of two different grab types (Day grab in 2004 and van Veen grab in 1994) but perhaps other differences in sampling methodology exist as well and variations in the number of individuals recorded within the Solway Firth have been noted before (Ove Arup and Partners, 1993a). One additional difference between 1994 and 2004 is the presence of *Mytilus edulis* at several sites in 2004, while *Modiolus modiolus* was recorded at a number of sites in 1994. This difference is most likely a result of the fact that the sites of the two surveys were at different locations as both species have been identified in previous studies within the Solway Firth (Williams *et al.*, 1965; Perkins, 1968; 1986).

Some earlier studies (Williams *et al.*, 1965; Perkins, 1968; Ove Arup and Partners, 1993a) reported similar fauna present within the Solway Firth as those seen in this study but direct comparisons are very difficult to make. The subtidal community described in general terms as being dominated by *Bathyporeia, Haustorius* and *Macoma* (Ove Arup and Partners, 1993a) does not appear to exactly reflect the results in this study. However, all three species are present in this study and *Bathyporeia* is still an important genus in terms of numbers of individuals present but also as an indicator of particular biotopes.

Table 4.1 The species present at sites from Cutts and Hemingway (1996) in 1994 corresponding to sites in the present (2004) survey (all identified and enumerated taxa (S) and the number of individuals (N) for the 1994 survey are in this table while for the present survey additional taxa and individuals were also recorded – see Appendix A6) (Full biotope descriptions in * = Connor *et al.*, 2004 and + = Cutts and Hemingway, 1996)

Identified taxa	Survey sites 2004	N	Survey sites 1994	N
Nephtys cirrosa	**G50**	5	**S94/04is**	17
Magelona mirabilis	(N=22; S=7)	0	(N=25; S=4)	1
Bathyporeia elegans	SS.SSa.IFiSa.NcirBat	8	SSND.NEP.MG.A	6
Pontocrates altamarinus		4		1
Nephtys cirrosa	**G35**	2	**S94/12is**	15
Magelona mirabilis	(N=9; S=4)	0	(N=17; S=3)	1
Haustorius arenarius	SS.SSa.SSaVS	0	SSND.NEP.MG.A	1
Mytilus edulis		6		0
Nephtys cirrosa	**G52**	6	**S94/14is**	4
Magelona mirabilis	(N=26; S=7)	0	(N=5; S=2)	1
Gastrosaccus spinifer	SS.SSa.IFiSa.NcirBat	4	SSND.P.IMP	0
Bathyporeia elegans		10		0
Nephtys cirrosa	**G68**	6	**S94/16is**	2
Magelona mirabilis	(N=15; S=5)	0	(N=4; S=3)	1
Bathyporeia elegans	SS.SSa.IFiSa.NcirBat	4	SSND.P.IMP	1
Cerastoderma edule		3		0
Biotopes	**SS.SSa.IFiSa.NcirBat*** Sublittoral (infralittoral) sands and muddy sands. Fauna dominated by *Nephtys cirrosa.* and *Bathyporeia* spp.		**SSND.P.IMP+** Sublittoral medium sand with impoverished fauna dominated by *Nephtys* sp.	
	SS.SSa.SSaVS* Sublittoral sands and muddy sands in variable salinity. Fauna dominated by brackish-water tolerant amphipods, polychaetes (*Nephtys cirrosa*) and mysid shrimps		**SSND.NEP.MG.A+** Sublittoral fine sand. Fauna dominated by *Nephtys* spp., *Magelona mirabilis* and amphipods	

Williams *et al.*, (1965) and Perkins (1968) described the fauna in some detail and described communities depending on the sediment present. Perkins (1968) reported that muddy sands were dominated by *Nephtys* spp. and various bivalve molluscs while the medium sands were dominated by polychaetes (eg *Lanice conchilega*) and crustaceans (eg *Crangon crangon*). Williams *et al.*, (1965) noted that *Nephtys* spp. inhabited the coarser sand towards the channels while *Bathyporeia* spp. were found mainly on the lower part of the shore. All these taxonomic groups are still important indicating that the macrofauna within the Solway Firth is similar to earlier studies, although changes have most likely taken place as a result of the mobility of the sediment and any direct comparisons are difficult to make as the locations of the sampling sites are different.

This survey has furthermore revealed the presence of the reef building honeycomb worm (*Sabellaria alveolata*) leading to classifying the biotope as **SS.SBR.PoR.SalvMx**. Occurrences of these worms have been reported in previous studies (Perkins, 1986; SFP, 1996; Covey, 1998) on the 'scar' grounds in Maryport Roads and Allonby Bay south of the present study area. These were not recorded during the

sublittoral survey within the survey area in 1996, although an intertidal colonisation of scar grounds near Powfoot was recorded in the same study (Cutts and Hemingway, 1996). The reef discovered in the present survey (site G40) may form part of the northernmost point of the scar grounds within the Silloth Channel but the extent of the reef is still unknown and further sampling is required to assess this fully. Other reefs may furthermore be present, particularly since several individuals of *Sabellaria alveolata* were found at other sites (**SS.SBR.SMus.MytSS**) where they may be competing for space with *Mytilus edulis* as suggested by Perkins (1986) and Muffat (1999) and these biotopes may also need further investigation with regards to both their extent and importance.

The trawling data revealed the presence of many juvenile fish of commercially important species such as plaice, flounder and sole and these data aided in the identification of the macrofaunal biotopes. Some of the species caught in the trawls (taxa absent in the grab samples) added to the weight of certain types of biotopes (eg *Ammodytes* sp. and *Liocarcinus depurator* when classifying **SS.SSa.IFiSa.NcirBat**). Trawling is therefore a useful additional tool not only to assess fish stocks but also to help in the biotope classification. It should, however, be noted that the timing of beam trawling will have an effect on the catch. Lancaster (1999) reports on different catches of brown shrimp (*Crangon crangon*) within the Solway Firth as a result of varying seasonal and tidal behaviour patterns (over-wintering offshore and coming inshore during the summer and burial in the sand during low tide). Some less brackish-water tolerant species such as *Pagarus bernhardus* and *Sepiola atlantica* are also likely to be affected by the season as they are known to penetrate further up the estuary during the summer when the salinity increases (Perkins, 1968). Similar effects and reactions to variations in the environmental parameters may be present for other fauna and survey work should, if possible, therefore take place at the same time of year.

Although the beam trawl may at best be semi-quantitative with regards to catching brown shrimp (Lancaster, 1999), it would still be the preferred option in these types of studies. The Day grab allows quantitative sampling while the trawl data give estimates of both fish and shrimp (and a few other species not caught in the grab) catches by collecting the benthic fauna at the very uppermost layer of the sediment as well as the demersal fish yet causing little damage to the seabed (Lancaster, 1999). An alternative could be to use a dredge but a sizeable vessel would be required for its operation (Tait, 1982) and a large vessel is not suitable within the shallow, turbid waters of the Solway Firth. In addition, dredging bites deeply into the sediment collecting more infauna but also more sediment. This quickly fills the sampler while only a short distance is covered during sampling. The collected fauna could potentially get damaged and, in any case, dredging is more likely to harm the seabed.

4.2 Conservation interests within the cSAC

The Solway Firth has been described as one of the largest, least industrialised and most natural sandy estuaries in Europe (Brown *et al.*, 1997; Covey, 1998) and it has been selected as a cSAC as it supports five Annex I habitats as part of the European Union's Habitats Directive (LIFE, 2000). This study includes one of these habitats; "sandbanks which are slightly covered by seawater at all times" (commonly known as subtidal sandbanks) and, in fact, the results (see above) indicate that this type of habitat covers large parts of the survey area. The depths recorded during grab sampling as well as the study by Covey (1998) suggest that all sites are at depths of ≤20m. However, the total extent of the sandbanks is not apparent from this study as the Day grab and trawl sampling provide data from particular sites, and transects respectively, and not the area as a whole. The sediment analysis showing the presence of sand (>80% sand at all sites)

indicates that sandbanks may be present throughout the survey area. However, a broad scale survey using for example sidescan sonar in conjunction with grab sampling would be required to assess this fully. Such a study was carried out by Cutts and Hemingway (1996) in 1994 with the claim that the intertidal sandbanks cover 50% of the total area of the Solway Firth. A similar survey, extended to cover the subtidal areas combined with the use of satellite imagery, is required to assess and verify the present extent of the sandbanks within the Solway Firth.

The results showing that large numbers of small fish were collected in the trawl samples support suggestions that these sediments provide spawning and nursery grounds for fish (SFP, 1996; Lancaster, 1999; LIFE, 2000) and may well be important for invertebrates and shrimps as well (LIFE, 2000). The continued protection of these areas is therefore of conservation interest.

In addition, this survey has revealed the presence of the reef building honeycomb worm (*Sabellaria alveolata*) within the cSAC. This biotope (**SS.SBR.PoR.SalvMx**) therefore presents an additional feature of conservation interest and additional investigation is required to assess the extent of these reefs within the Solway Firth and the cSAC in particular. The honeycomb worm was found at a number of other sites (classified as **SS.SBR.SMus.MytSS**) and there may be a need to study these sites as well.

4.3 Monitoring site attributes

On the basis of the current information available, SNH has proposed a site attribute table for the intertidal feature of the Solway Firth cSAC (see Appendix A10). Comments and recommendations concerning measurement of the attributes are provided below.

Extent

The monitoring exercise initiated by this survey can be used to assess the extent of the subtidal sandbanks slightly covered by the seawater at all times. Encroachment or cut-back of subtidal biotopes could be quantified by returning to previously sampled sites every 6 years. Transects across or along the estuary could also be introduced and monitored over the same time intervals particularly with regards to macrofaunal abundance, species diversity and biotope distribution but also with regards to organic anthropogenic input. An understanding of likely changes in extent could be gained by periodic review of activities and events with the potential to cause variation in the extent of the feature, such as land reclamation, shoreline redevelopment and dredging operations, all of which may change the erosion and accretion patterns within the estuary. Confirmation of changes could be achieved by acquiring satellite imagery at 2 year intervals, imagery that could also aid site selection during the planning stage and navigation during the survey. Satellite imagery is a cost-effective and efficient method for both littoral and sublittoral monitoring with regards to aspects such as aerial estimates (littoral and sublittoral), sediment classification (littoral), navigation (sublittoral) and survey planning (littoral and sublittoral).

Topography

As a result of the mobility of the sediment present within the Solway Firth, confirmation of changes to this attribute could be attained by analysing satellite imagery at 2 year intervals. This imagery would also be valuable for site selection during the planning stage and for navigation during the survey work. The recording of depths by carrying out depth transects within the survey area would allow additional assessments of changes in topography.

Sediment character

The sediment composition could be assessed using the same methodology as in this survey to allow continuity of analysis and monitoring. Sediment sampling using a 0.1m^2 stainless steel Day grab should be carried out at 6 year intervals. Chemical sampling (total organic carbon, heavy metals and hydrocarbons) could also be added to enable continued assessments of any changes in anthropogenic inputs and impacts.

Distribution of biotopes

This attribute could be assessed by monitoring the spatial extent of the different biotopes within the cSAC simply by monitoring the identity of the biotopes at the existing sampling stations. Sampling of infauna and epifauna using a 0.1m^2 stainless steel Day grab and 2m Beam trawl should be carried out every 6 years. Monitoring of the presence and abundance of characteristic species for each biotope should be carried out but it would also be useful for future monitoring to continue to attempt to identify biotope boundaries using broad scale techniques (eg sidescan sonar) so that at least very conspicuous changes will become apparent. In addition to faunal identification, salinity measurements should be taken to aid in the classification of biotopes.

Extent of sub-feature

The extent of biologically important biotopes such as the Sabellaria reef (potentially including the mussel beds) is unknown. Immediate investigations into the extent and distribution of these features within the cSAC should be carried out. The use of sidescan sonar and drop-down video for ground-truthing during favourable weather conditions and slack water is suggested along with continued monitoring at 6 year intervals and enforcement of exclusion zones around protected sites.

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Appendix 1 Completed grab sample locations

Positions are in WGS84, Lat/Long, Decimal Degrees and OSGB36 Eastings and Northings
Corrected Depths are reduced to Chart Datum (LAT) using admiralty prediced tide tables for Silloth

Sample Location	Drop #	Date	Time (GMT)	Grab/ Type	Depth (m)	Predicted Tide (m)	Corrected Depth (m)	Sample Type	Photo Taken	Latitude °N (Decimal Deg)	Longitude °W (Decimal Deg)	Eastings (m)	Northings (m)
G12	1	13/7/04	909	Day	4.8	7.0	–2.2	PSA	✓	54.94758	3.33445	314625.65	562250.85
G12	2	13/7/04	915	Day	5.0	7.0	–2.0	⅔ full BIO		54.94750	3.33445	314625.44	562239.72
G13	1	13/7/04	951	Day	4.4	6.7	–2.3	PSA		54.94108	3.33623	314497.62	561529.78
G13	2	13/7/04	956	Day	4.4	6.7	–2.3	½ full BIO	✓	54.94110	3.33618	314500.83	561529.72
G14	1	13/7/04	1005	Day	4.7	6.6	–1.9	PSA	✓	54.94193	3.33625	314498.25	561618.82
G14	2	13/7/04	1010	Day	4.6	6.5	–1.9	½ full BIO		54.94193	3.34502	313936.70	561629.57
G15	1	13/7/04	936	Day	4.1	6.8	–2.7	PSA	✓	54.93917	3.32562	315173.69	561305.44
G15	2	13/7/04	943	Day	4.0	6.8	–2.8	<½ full BIO		54.93918	3.32550	315181.16	561305.30
G16	1	13/7/04	1019	Day	5.3	6.5	–1.2	PSA	✓	54.93783	3.33643	314477.80	561162.84
G16	2	13/7/04	1029	Day	5.2	6.3	–1.1	⅔ full BIO	✓	54.93782	3.34678	313814.76	561175.55
G17	1	13/7/04	1032	Day	4.0	6.3	–2.3	PSA	✓	54.93630	3.33912	314302.71	560999.22
G17	2	13/7/04	1036	Day	4.0	6.3	–2.3	½ full BIO		54.93622	3.33908	314304.63	560988.05
G19	1	13/7/04	924	Day	4.1	6.9	–2.8	PSA		54.94442	3.32510	315217.74	561883.41
G19	2	13/7/04	929	Day	4.1	6.9	–2.8	½ full BIO	✓	54.94340	3.32518	315210.30	561772.24
G20	2	13/7/04	1048	Day	5.2	6.1	–0.9	¾ full PSA/BIO	✓	54.93415	3.35257	313436.52	560782.13
G21	1	13/7/04	1101	Day	4.5	5.9	–1.4	PSA	✓	54.92903	3.35238	313437.09	560203.31
G21	2	13/7/04	1107	Day	4.4	5.6	–1.2	½ full BIO	✓	54.92902	3.35238	313437.09	560203.31
G22	1	13/7/04	1114	Day	8.7	5.6	3.1	¾ full PSA/BIO	✓	54.92817	3.36203	312817.02	560126.28
G23	2	13/7/04	1131	Day	8.0	5.4	2.6	⅔ full PSA/BIO	✓	54.91992	3.36293	312741.37	559203.88
G24	1	13/7/04	1141	Day	5.7	5.2	0.5	PSA		54.90713	3.36203	312771.34	557778.53
G24	2	13/7/04	1147	Day	5.7	5.2	0.5	⅔ full BIO	✓	54.90712	3.36202	312772.41	557778.51

Appendix 1 *(continued)*

Sample Location	Drop #	Date	Time (GMT)	Grab/ Type	Depth (m)	Predicted Tide (m)	Corrected Depth (m)	Sample Type	Photo Taken	Latitude °N (Decimal Deg)	Longitude °W (Decimal Deg)	Eastings (m)	Northings (m)
G25	1	26/7/04	555	Day	8.0	7.5	0.5	PSA	✓	54.90492	3.39463	310676.16	557578.61
G25	2	26/7/04	601	Day	8.0	7.5	0.5	½ full Bio	✓	54.90490	3.39478	310666.50	557576.58
G27	1	9/7/04	1458	Day	8.8	5.1	3.7	Full PSA & BIO	✓	54.89528	3.38232	311445.05	556491.06
G28	2	9/7/04	627	Day	9.2	6.8	2.4	PSA		54.88327	3.38442	311283.98	555158.52
G28	4	9/7/04	640	Day	9.6	6.8	2.8	½ full BIO	✓	54.88325	3.38402	311309.42	555146.89
G29	1	10/7/04	1618	Day	8.9	5.4	3.5	Full PSA/BIO	✓	54.89782	3.42377	308792.55	556822.49
G30	1	9/7/04	1428	Day	6.1	4.4	1.7	PSA		54.87907	3.41357	309404.63	554728.56
G30	2	9/7/04	1432	Day	6.3	4.4	1.9	½ full BIO	✓	54.87888	3.41378	309390.28	554706.58
G32	1	9/7/04	532	Day	11.8	7.5	4.3	PSA		54.87637	3.39837	310373.78	554408.56
G32	2	9/7/04	540	Day	11.7	7.5	4.2	½ full BIO	✓	54.87655	3.39803	310395.61	554430.39
G33	1	9/7/04	554	Day	13.0	7.2	5.8	⅔ full BIO/PSA	✓	54.87473	3.40377	310023.53	554226.34
G34	2	9/7/04	708	Day	7.5	5.9	1.6	PSA		54.87205	3.39747	310421.98	553928.96
G34	3	9/7/04	715	Day	7.6	5.9	1.7	½ full BIO		54.87247	3.39672	310470.99	553972.51
G35	1	9/7/04	819	Day	6.3	4.2	2.1	PSA		54.87357	3.41968	308999.81	554124.53
G35	3	9/7/04	827	Day	6.1	4.2	1.9	½ full BIO	✓	54.87373	3.41955	309008.59	554135.48
G36	2	9/7/04	740	Day	12.5	5.5	7.0	PSA		54.87107	3.41063	309574.89	553834.63
G36	4	9/7/04	750	Day	12.5	5.2	7.3	½ full BIO	✓	54.87105	3.41017	309604.61	553822.90
G37	1	9/7/04	722	Day	9.1	5.5	3.6	¾ full PSA/BIO	✓	54.87028	3.39900	310319.59	553730.65
G39	1	9/7/04	840	Day	11.6	3.9	7.7	PSA		54.86193	3.42670	308523.08	552831.87
G39	3	9/7/04	907	Day	11.2	3.5	7.7	½ full BIO	✓	54.86197	3.42687	308512.61	552843.21
G40	1	9/7/04	921	Day	11.5	3.3	8.2	PSA & BIO	✓	54.84885	3.44948	307030.65	551404.31
G40a	1	9/7/04	932	Day	9.5	3.1	6.4	PSA		54.84938	3.45017	306988.16	551471.98
G40a	2	9/7/04	938	Day	9.2	3.1	6.1	½ full BIO	✓	54.84942	3.45038	306974.25	551472.27
G41	1	9/7/04	1240	Day	4.0	2.1	1.9	PSA	✓	54.84247	3.51057	303093.85	550786.19

Appendix 1 *(continued)*

Sample Location	Drop #	Date	Time (GMT)	Grab/ Type	Depth (m)	Predicted Tide (m)	Corrected Depth (m)	Sample Type	Photo Taken	Latitude °N (Decimal Deg)	Longitude °W (Decimal Deg)	Eastings (m)	Northings (m)
G41	2	9/7/04	1245	Day	4.2	2.3	1.9	½ full BIO	✓	54.84257	3.51067	303087.67	550797.46
G42	1	9/7/04	1025	Day	4.8	2.2	2.6	PSA	✓	54.82577	3.47025	305643.68	548873.01
G42	2	9/7/04	1029	Day	4.8	2.2	2.6	⅔ full BIO	✓	54.82577	3.47008	305654.39	548872.78
G43	1	9/7/04	1156	Day	2.1	1.8	0.3	PSA		54.82023	3.52725	301968.50	548328.24
G43	2	9/7/04	1159	Day	2.0	1.9	0.1	⅔ full BIO	✓	54.82022	3.52732	301964.22	548328.33
G44	1	9/7/04	1131	Day	4.5	1.8	2.7	PSA		54.80977	3.51928	302455.26	547159.97
G44	3	9/7/04	1137	Day	4.6	1.8	2.8	½ full BIO	✓	54.80953	3.51968	302428.83	547127.15
G46	1	9/7/04	959	Day	6.5	2.6	3.9	PSA		54.83927	3.47700	305241.73	550384.19
G46	2	9/7/04	1007	Day	6.4	2.6	3.8	½ full BIO	✓	54.83937	3.47700	305241.96	550395.32
G49	1	10/7/04	735	Day	9.6	6.4	3.2	⅔ PSA & BIO	✓	54.82107	3.58567	298217.68	548511.73
G50	1	10/7/04	744	Day	10.4	6.1	4.3	PSA	✓	54.82107	3.58657	298159.86	548513.04
G50	2	10/7/04	750	Day	10.5	6.1	4.4	½ full BIO	✓	54.81722	3.58662	298146.82	548079.19
G51	1	10/7/04	806	Day	16.7	6.0	10.7	PSA		54.82062	3.60570	296929.36	548485.40
G51	2	10/7/04	811	Day	16.7	5.9	10.8	½ full BIO	✓	54.82078	3.60595	296913.81	548508.02
G52	1	10/7/04	1009	Day	14.9	3.8	11.1	¾ full PSA/BIO	✓	54.83650	3.60577	296965.62	550254.57
G53	1	10/7/04	656	Day	13.2	6.8	6.4	PSA		54.84280	3.57440	298995.76	550909.81
G53	2	10/7/04	709	Day	13.2	6.8	6.4	½ full BIO	✓	54.84277	3.57440	298995.76	550909.81
G54	1	10/7/04	721	Day	7.3	6.6	0.7	⅔ PSA & BIO	✓	54.83513	3.57453	298967.94	550053.28
G55	3	9/7/04	1103	Day	2.7	1.9	0.8	¾ PSA/BIO	✓	54.80897	3.49473	304031.04	547037.04
G56	1	27/7/04	909	Day	8.2	5.8	2.4	PSA	✓	54.83220	3.55220	300394.55	549700.11
G56	2	27/7/04	916	Day	8.2	5.8	2.4	Bio	✓	54.83218	3.55230	300388.08	549698.03
G57	1	10/7/04	829	Day	18.4	5.3	13.1	¾ PSA & BIO	✓	54.82915	3.61053	296640.58	549438.25
G58	1	10/7/04	841	Day	10.0	5.1	4.9	Full PSA & BIO	✓	54.82455	3.62890	295449.21	548964.85
G59	1	10/7/04	855	Day	8.0	5.0	3.0	¾ full PSA & BIO	✓	54.82400	3.64772	294238.87	548926.35

Appendix 1 *(continued)*

Sample Location	Drop #	Date	Time (GMT)	Grab/ Type	Depth (m)	Predicted Tide (m)	Corrected Depth (m)	Sample Type	Photo Taken	Latitude °N (Decimal Deg)	Longitude °W (Decimal Deg)	Eastings (m)	Northings (m)
G60	1	10/7/04	951	Day	9.1	3.9	5.2	Full PSA/BIO	✓	54.83737	3.62973	295428.80	550390.24
G61	1	10/7/04	1050	Day	11.6	3.0	8.6	¾ full PSA/BIO	✓	54.85002	3.60618	296973.29	551757.22
G62	1	10/7/04	929	Day	5.7	4.2	1.5	PSA	✓	54.84005	3.64977	294149.10	550709.63
G62	2	10/7/04	935	Day	5.7	4.1	1.6	½ full BIO	✓	54.84013	3.64968	294154.71	550720.63
G63	1	10/7/04	903	Day	6.0	4.8	1.2	PSA	✓	54.82860	3.65827	293573.25	549454.14
G63	2	10/7/04	911	Day	5.9	4.5	1.4	½ full BIO	✓	54.82863	3.65835	293567.90	549454.26
G64	1	12/7/04	1054	Day	2.8	5.0	–2.2	PSA		54.84153	3.67528	292514.55	550915.40
G64	3	12/7/04	1101	Day	2.8	5.0	–2.2	½ full BIO	✓	54.84152	3.67523	292517.76	550915.32
G65	1	12/7/04	1111	Day	2.4	4.7	–2.3	PSA & BIO	✓	54.83940	3.69273	291388.41	550708.69
G67	2	10/7/04	1027	Day	16.0	3.2	12.8	PSA	✓	54.84107	3.58997	297991.92	550743.24
G67	3	10/7/04	1033	Day	15.8	3.2	12.6	⅔ full BIO	✓	54.84112	3.58993	297994.06	550743.19
G68	1	10/7/04	1103	Day	13.4	2.9	10.5	¾ full PSA/BIO	✓	54.85228	3.58468	298359.36	551981.69
G69	1	10/7/04	633	Day	11.2	7.1	4.1	PSA	✓	54.85503	3.55215	300454.52	552235.35
G69	2	10/7/04	640	Day	11.2	7.1	4.1	½–⅔ full BIO		54.85533	3.55223	300449.91	552268.85
G70	1	10/7/04	1132	Day	10.9	2.5	8.4	PSA	✓	54.86255	3.57537	298982.98	553103.09
G70	2	10/7/04	1137	Day	10.8	2.4	8.4	Full BIO	✓	54.86263	3.57552	298973.60	553114.43
G71	1	10/7/04	1509	Day	6.8	3.9	2.9	PSA	✓	54.87440	3.50380	303604.54	554326.18
G71	2	10/7/04	1514	Day	6.9	4.0	2.9	½ full BIO	✓	54.87442	3.50380	303604.54	554326.18
G72	3	10/7/04	1455	Day	9.1	3.6	5.5	⅔ full PSA/BIO		54.86550	3.53807	301384.21	553383.68
G74	1	10/7/04	1359	Day	10.3	2.7	7.6	½ full PSA/BIO	✓	54.87963	3.55845	300111.02	554981.41
G75	2	10/7/04	1325	Day	5.8	2.5	3.3	¾ full PSA/BIO	✓	54.88480	3.56753	299541.25	555572.99
G76	1	11/7/04	1054	Day	2.5	4.0	–1.5	PSA		54.89212	3.55833	300149.45	556372.05
G76	2	11/7/04	1058	Day	2.4	4.0	–1.6	½ full BIO		54.89212	3.55838	300146.24	556372.12
G77	1	11/7/04	1034	Day	9.0	4.5	4.5	PSA	✓	54.89547	3.53950	301365.60	556723.63

Appendix 1 *(continued)*

Sample Location	Drop #	Date	Time (GMT)	Grab/ Type	Depth (m)	Predicted Tide (m)	Corrected Depth (m)	Sample Type	Photo Taken	Latitude °N (Decimal Deg)	Longitude °W (Decimal Deg)	Eastings (m)	Northings (m)
G77	2	11/7/04	1039	Day	8.8	4.2	4.6	½ full BIO		54.89550	3.53942	301370.95	556723.51
G78	2	10/7/04	1120	Day	12.1	2.8	9.3	Full PSA/BIO		54.86157	3.59422	297770.92	553030.32
G79	1	10/7/04	1348	Day	5.5	2.6	2.9	½ full PSA/BIO	✓	54.88397	3.54727	300839.27	555455.07
G80	6	10/7/04	1203	Day	11.7	2.3	9.4	¾ full PSA/BIO	✓	54.86813	3.58480	298391.65	553739.82
G81	2	11/7/04	950	Day	3.2	5.2	–2.0	PSA	✓	54.89925	3.55615	300307.28	557170.03
G81	3	11/7/04	953	Day	3.2	5.0	–1.8	½ full BIO		54.89930	3.55610	300310.48	557169.96
G82	2	11/7/04	941	Day	3.8	5.2	–1.4	⅔ full PSA/BIO	✓	54.90752	3.55605	300333.97	558082.26
G83	1	11/7/04	1007	Day	5.8	5.0	0.8	PSA		54.90502	3.53258	301832.29	557770.91
G83	2	11/7/04	1014	Day	5.6	4.7	0.9	⅔ full BIO	✓	54.90507	3.53268	301826.12	557782.18
G85	1	11/7/04	923	Day	5.1	5.6	–0.5	PSA		54.90908	3.53272	301833.73	558227.28
G85	2	11/7/04	927	Day	5.0	5.6	–0.6	½ full BIO	✓	54.90912	3.53265	301838.00	558227.19
G86	1	11/7/04	902	Day	4.7	6.0	–1.3	PSA	✓	54.91348	3.53180	301903.20	558715.56
G86	2	11/7/04	908	Day	4.6	5.7	–1.1	½ full BIO		54.91355	3.53172	301908.79	558726.57
G87	1	11/7/04	846	Day	5.4	6.2	–0.8	PSA	✓	54.92283	3.53625	301640.67	559756.58
G87	2	11/7/04	852	Day	5.2	6.2	–1.0	½ full BIO		54.92280	3.53638	301632.13	559756.77
G88	1	11/7/04	825	Day	3.6	6.4	–2.8	PSA	✓	54.93592	3.55433	300514.19	561239.73
G88	2	11/7/04	830	Day	3.6	6.4	–2.8	½ full BIO		54.93593	3.55433	300514.19	561239.73
G91	1	10/7/04	1530	Day	9.6	4.5	5.1	Full PSA/BIO	✓	54.88730	3.47330	305591.66	555719.92
G92	2	10/7/04	1542	Day	5.0	4.7	0.3	PSA	✓	54.88000	3.46585	306052.51	554897.65
G92	3	10/7/04	1545	Day	5.2	4.8	0.4	½ full BIO	✓	54.88000	3.46587	306051.44	554897.67
G94	1	10/7/04	1601	Day	6.8	5.1	1.7	PSA		54.89828	3.44688	307311.35	556908.51
G94	2	10/7/04	1605	Day	6.8	5.1	1.7	½ full BIO	✓	54.89828	3.44693	307308.15	556908.58
G95	2	9/7/04	1342	Day	4.0	3.4	0.6	PSA	✓	54.85542	3.47067	305686.04	552167.00
G95	3	9/7/04	1347	Day	4.0	3.4	0.6	½ full BIO		54.85533	3.47368	305492.16	552159.95

Appendix 1 *(continued)*

Sample Location	Drop #	Date	Time (GMT)	Grab/ Type	Depth (m)	Predicted Tide (m)	Corrected Depth (m)	Sample Type	Photo Taken	Latitude °N (Decimal Deg)	Longitude °W (Decimal Deg)	Eastings (m)	Northings (m)
GR02	1	26/7/04	1145	Day	4.3	2.2	2.1	PSA/Bio	✓	54.81757	3.48960	304380.64	547985.05
GR03	1	26/7/04	1201	Day	5.1	2.1	3.0	PSA	✓	54.82652	3.50087	303677.85	548996.31
GR03	2	26/7/04	1206	Day	5.0	2.0	3.0	Bio		54.82652	3.50080	303682.34	548996.22
GR04	1	26/7/04	1325	Day	1.7	2.2	–0.5	PSA	✓	54.83213	3.51678	302669.34	549642.63
GR04	2	26/7/04	1330	Day	1.7	2.2	–0.5	Bio		54.83213	3.51687	302663.56	549642.63
GR05	1	26/7/04	1117	Day	5.4	2.5	2.9	PSA	✓	54.83453	3.45527	306625.59	549825.76
GR05	2	26/7/04	1122	Day	5.4	2.5	2.9	Bio	✓	54.83450	3.45517	306631.94	549822.29
GR06	1	26/7/04	1355	Day	5.2	2.5	2.7	PSA	✓	54.84822	3.48987	304435.80	551395.67
GR06	2	26/7/04	1402	Day	5.2	2.5	2.7	Bio	✓	54.84823	3.48993	304431.97	551396.87
GR07	1	26/7/04	1053	Day	3.0	2.9	0.1	PSA	✓	54.85625	3.44753	307172.62	552232.14
GR07	2	26/7/04	1100	Day	2.9	2.8	0.1	Bio	✓	54.85615	3.44745	307177.53	552220.91
GR08	1	26/7/04	527	Day	9.0	7.5	1.5	PSA	✓	54.88572	3.40158	310187.81	555451.19
GR08	3	26/7/04	538	Day	9.0	7.5	1.5	Bio	✓	54.88572	3.40163	310184.60	555451.25
GR10	1	26/7/04	616	Day	7.6	7.4	0.2	PSA	✓	54.91372	3.37687	311834.09	558535.23
GR10	2	26/7/04	621	Day	7.6	7.3	0.3	Bio	✓	54.91370	3.37660	311851.35	558532.66
GR11	1	26/7/04	635	Day	3.5	7.3	–3.8	PSA	✓	54.91708	3.35015	313554.05	558875.73
GR11	2	26/7/04	639	Day	3.5	7.2	–3.7	Bio		54.91692	3.35025	313547.30	558858.05
GR12	2	27/7/04	722	Day	7.6	7.2	0.4	PSA		54.88880	3.44570	307364.85	555851.42
GR12	3	27/7/04	726	Day	7.6	7.2	0.4	Bio	✓	54.88880	3.44567	307366.77	555851.38
GR13	1	27/7/04	748	Day	6.9	7.1	–0.2	PSA	✓	54.88585	3.49582	304143.20	555590.70
GR13	2	27/7/04	752	Day	6.9	7.1	–0.2	Bio	✓	54.88582	3.49588	304139.28	555587.45
GR14	2	27/7/04	810	Day	9.2	6.8	2.4	PSA	✓	54.86650	3.52065	302503.78	553472.04
GR14	3	27/7/04	814	Day	9.2	6.8	2.4	Bio	✓	54.86648	3.52067	302502.45	553469.84
GR15	1	27/7/04	831	Day	9.2	6.6	2.6	PSA	✓	54.87078	3.55065	300589.12	553990.46
GR15	2	27/7/04	837	Day	9.2	6.5	2.7	Bio	✓	54.87078	3.55063	300590.40	553990.43

Appendix 2 Completed beam trawl logs

Positions are in WGS84, Lat/Long, Decimal Degrees and OSGB36 Eastings and Northings
Corrected Depths are reduced to Chart Datum (LAT) using admiralty prediced tide tables for Silloth

Sample Location	Drop #	Date	Time (GMT)	Grab/ Type	Depth (m)	Predicted Tide (m)	Corrected Depth (m)	Time Trawled (mins)	Trawl Distance (m)	Trawl Heading (degrees) True	Latitude °N (Decimal Degrees)	Longitude °W (Decimal Degrees)	Eastings (m)	Northings (m)
T12	SOL	26/7/04	709	Trawl	4.3	6.8	–2.5	5.0	201.4	060	54.94705	3.33730	314441.39	562194.63
T12	EOL	26/7/04	714	Trawl	4.3	6.8	–2.5				54.94805	3.33468	314611.31	562302.70
T13	SOL	26/7/04	726	Trawl	5.5	6.5	–1.0	6.0	208.3	055	54.94027	3.33990	314260.42	561443.42
T13	EOL	26/7/04	732	Trawl	5.5	6.5	–1.0				54.94133	3.33722	314434.35	561558.08
T17	SOL	26/7/04	744	Trawl	3.0	6.3	–3.3	5.0	204.9	040	54.93547	3.34162	314140.00	560911.44
T17	EOL	26/7/04	749	Trawl	3.0	6.3	–3.3				54.93692	3.33965	314269.30	561070.36
T21	SOL	26/7/04	801	Trawl	5.5	6.0	–0.5	7.0	282.5	030	54.92735	3.35457	313292.87	560023.92
T21	EOL	26/7/04	808	Trawl	5.5	6.0	–0.5				54.92968	3.35282	313410.01	560281.01
T23	SOL	26/7/04	820	Trawl	8.0	5.4	2.6	7.0	201.6	010	54.91887	3.36453	312636.25	559092.77
T23	EOL	26/7/04	827	Trawl	8.0	5.4	2.6				54.92067	3.36417	312663.23	559292.60
T27	SOL	13/7/04	1211	Trawl	8.0	4.7	3.3	6.0	202.4	030	54.89452	3.38257	311427.26	556402.37
T27	EOL	13/7/04	1217	Trawl	8.0	4.7	3.3				54.89602	3.38078	311544.91	556567.01
T28	SOL	26/7/04	940	Trawl	6.0	3.9	2.1	7.0	170.2	020	54.88288	3.38578	311195.04	555155.02
T28	EOL	26/7/04	947	Trawl	6.0	3.9	2.1				54.88445	3.38417	311301.77	555287.66
T29	SOL	27/7/04	1643	Trawl	8.0	4.7	3.3	8.0	201.9	240	54.89835	3.42365	308800.72	556885.04
T29	EOL	27/7/04	1651	Trawl	8.0	4.7	3.3				54.89758	3.42650	308616.22	556803.08
T30	SOL	26/7/04	1005	Trawl	4.8	3.6	1.2	5.0	205.6	020	54.87840	3.41562	309270.76	554654.83
T30	EOL	26/7/04	1010	Trawl	4.8	3.6	1.2				54.87990	3.41375	309394.10	554819.31
T32	SOL	12/7/04	1842	Trawl	10.0	6.2	3.8	7.0	192.2	200	54.87725	3.39788	310406.57	554496.95
T32	EOL	12/7/04	1849	Trawl	10.0	6.2	3.8				54.87565	3.39937	310308.07	554331.96

Appendix 2 *(continued)*

Sample Location	Drop #	Date	Time (GMT)	Grab/ Type	Depth (m)	Predicted Tide (m)	Corrected Depth (m)	Time Trawled (mins)	Trawl Distance (m)	Trawl Heading (degrees) True	Latitude °N (Decimal Degrees)	Longitude °W (Decimal Degrees)	Eastings (m)	Northings (m)
T33	SOL	13/7/04	1247	Trawl	10.0	4.2	5.8	9.0	200.4	005	54.87380	3.40385	310016.18	554126.31
T33	EOL	13/7/04	1256	Trawl	10.0	4.0	6.0				54.87560	3.40375	310026.61	554326.46
T34	SOL	27/7/04	1738	Trawl	8.3	6.0	2.3	5.0	203.4	225	54.87322	3.39703	310451.92	554054.52
T34	EOL	27/7/04	1743	Trawl	8.3	6.0	2.3				54.87202	3.39942	310295.90	553924.06
T35	SOL	26/7/04	1023	Trawl	4.5	3.1	1.4	7.0	202.4	050	54.87310	3.42222	308835.36	554073.70
T35	EOL	26/7/04	1030	Trawl	4.5	3.1	1.4				54.87430	3.41985	308990.14	554204.13
T36	SOL	27/7/04	1756	Trawl	12.9	6.2	6.7	7.0	201.8	230	54.87175	3.41048	309585.62	553908.26
T36	EOL	27/7/04	1803	Trawl	12.9	6.2	6.7				54.87037	3.41252	309451.63	553757.35
T39	SOL	13/7/04	1702	Trawl	12.0	3.5	8.5	10.0	199.7	235	54.86230	3.42558	308595.66	552874.91
T39	EOL	13/7/04	1712	Trawl	12.0	3.7	8.3				54.86128	3.42817	308427.59	552767.03
T41	SOL	13/7/04	1858	Trawl	6.0	5.7	0.3	6.0	203.0	200	54.84328	3.51002	303131.08	550874.44
T41	EOL	13/7/04	1904	Trawl	6.0	5.7	0.3				54.84170	3.51153	303029.86	550698.52
T42	SOL	26/7/04	1506	Trawl	7.5	3.9	3.6	8.0	202.8	235	54.82647	3.47045	305631.84	548949.32
T42	EOL	26/7/04	1514	Trawl	7.5	3.9	3.6				54.82538	3.47298	305466.77	548831.46
T43	SOL	11/7/04	1703	Trawl	5.0	5.5	–0.5	5.0	212.3	200	54.82112	3.52655	302015.66	548427.40
T43	EOL	11/7/04	1708	Trawl	5.0	5.5	–0.5				54.81948	3.52835	301896.13	548251.90
T44	SOL	11/7/04	1643	Trawl	6.0	5.2	0.8	4.0	206.6	220	54.81050	3.51920	302462.30	547237.74
T44	EOL	11/7/04	1647	Trawl	6.0	5.2	0.8				54.80872	3.51998	302407.62	547038.56
T46	SOL	13/7/04	1816	Trawl	9.0	4.8	4.2	11.0	313.6	210	54.84005	3.47590	305314.01	550460.59
T46	EOL	13/7/04	1827	Trawl	9.0	5.1	3.9				54.83882	3.47148	305594.83	550321.11
T50	SOL	11/7/04	1459	Trawl	8.0	3.4	4.6	5.0	223.5	180	54.81825	3.58658	298151.48	548190.40
T50	EOL	11/7/04	1504	Trawl	8.0	3.4	4.6				54.81615	3.58690	298126.10	547968.34
T51	SOL	12/7/04	1237	Trawl	15.0	3.4	11.6	4.0	201.5	040	54.82007	3.60720	296831.72	548431.98

Appendix 2 *(continued)*

Sample Location	Drop #	Date	Time (GMT)	Grab/ Type	Depth (m)	Predicted Tide (m)	Corrected Depth (m)	Time Trawled (mins)	Trawl Distance (m)	Trawl Heading (degrees) True	Latitude °N (Decimal Degrees)	Longitude °W (Decimal Degrees)	Eastings (m)	Northings (m)
T51	EOL	12/7/04	1241	Trawl	15.0	3.4	11.6				54.82140	3.60502	296975.30	548573.41
T52	SOL	12/7/04	1536	Trawl	15.0	3.3	11.7	4.0	203.4	230	54.83718	3.60508	297011.29	550331.45
T52	EOL	12/7/04	1540	Trawl	15.0	3.3	11.7				54.83615	3.60773	296838.55	550224.09
T53	SOL	27/7/04	1042	Trawl	10.7	4.1	6.6	4.0	207.0	095	54.84288	3.57672	298846.43	550923.56
T53	EOL	27/7/04	1046	Trawl	10.7	4.1	6.6				54.84310	3.57352	299052.45	550943.42
T54	SOL	11/7/04	1434	Trawl	4.0	3.0	1.0	3.0	200.2	230	54.83555	3.57390	299009.62	550096.87
T54	EOL	11/7/04	1437	Trawl	6.0	3.0	3.0				54.83435	3.57637	298848.45	549978.04
T55	SOL	11/7/04	1622	Tawl	6.0	4.9	1.1	4.0	201.8	190	54.80988	3.49475	304032.10	547137.20
T55	EOL	11/7/04	1626	Trawl	6.0	4.9	1.1				54.80807	3.49513	304003.19	546937.45
T56	SOL	27/7/04	929	Trawl	7.8	5.5	2.3	6.0	203.6	080	54.83198	3.55380	300291.25	549677.91
T56	EOL	27/7/04	935	Trawl	7.8	5.5	2.3				54.83198	3.55063	300494.85	549673.40
T57	SOL	12/7/04	1301	Trawl	16.0	3.3	12.7	5.0	206.8	040	54.82842	3.61157	296572.41	549361.90
T57	EOL	12/7/04	1306	Trawl	16.0	3.3	12.7				54.82980	3.60945	296711.95	549514.54
T58	SOL	27/7/04	1007	Trawl	9.2	4.9	4.3	6.0	202.5	030	54.82395	3.63095	295315.28	548897.09
T58	EOL	27/7/04	1013	Trawl	9.2	4.9	4.3				54.82555	3.62945	295415.78	549072.87
T59	SOL	12/7/04	1209	Trawl	6.0	3.8	2.2	6.0	203.3	040	54.82335	3.64852	294185.65	548849.67
T59	EOL	12/7/04	1215	Trawl	6.0	3.8	2.2				54.82473	3.64648	294319.93	549002.37
T60	SOL	12/7/04	1324	Trawl	8.0	3.0	5.0	3.0	72.4	035	54.83693	3.63040	295384.69	550335.61
T60	EOL	12/7/04	1327	Trawl	8.0	3.0	5.0				54.83717	3.62940	295449.69	550367.49
T61	SOL	12/7/04	1008	Trawl	15.0	5.7	9.3	5.0	212.2	040	54.84963	3.60720	296907.00	551714.22
T61	EOL	12/7/04	1013	Trawl	15.0	5.7	9.3				54.85092	3.60478	297065.47	551855.30
T61	2 SOL	12/7/04	1021	Trawl	14.0	5.4	8.6	5.0	200.2	050	54.84938	3.60777	296870.11	551692.80
T61	2 EOL	12/7/04	1026	Trawl	14.0	5.4	8.6				54.85053	3.60530	297031.28	551811.56

Appendix 2 *(continued)*

Sample Location	Drop #	Date	Time (GMT)	Grab/ Type	Depth (m)	Predicted Tide (m)	Corrected Depth (m)	Time Trawled (mins)	Trawl Distance (m)	Trawl Heading (degrees) True	Latitude °N (Decimal Degrees)	Longitude °W (Decimal Degrees)	Eastings (m)	Northings (m)
T62	SOL	12/7/04	1350	Trawl	4.0	2.8	1.2	4.0	203.0	280	54.84017	3.64987	294143.20	550732.03
T62	EOL	12/7/04	1354	Trawl	4.0	2.8	1.2				54.84047	3.65298	293943.85	550770.13
T63	SOL	12/7/04	1141	Trawl	6.0	4.2	1.8	4.0	197.6	010	54.82775	3.65853	293554.02	549365.53
T63	EOL	12/7/04	1145	Trawl	6.0	4.2	1.8				54.82940	3.65720	293643.87	549541.52
T67	SOL	12/7/04	1554	Trawl	15.0	3.5	11.5	6.0	201.2	240	54.84127	3.58833	298097.30	550763.11
T67	EOL	12/7/04	1600	Trawl	15.0	3.5	11.5				54.84035	3.59105	297920.58	550666.93
T68	SOL	12/7/04	1615	Trawl	15.0	3.7	11.3	5.0	203.3	235	54.85285	3.58333	298447.29	552035.37
T68	EOL	12/7/04	1620	Trawl	15.0	3.7	11.3				54.85185	3.58598	298274.65	551927.95
T69	SOL	11/7/04	1409	Trawl	6.0	2.9	3.1	4.0	200.2	230	54.85582	3.55130	300511.06	552323.15
T69	EOL	11/7/04	1413	Trawl	6.0	2.9	3.1				54.85467	3.55377	300350.01	552204.27
T70	SOL	12/7/04	1636	Trawl	12.0	3.9	8.1	6.0	199.8	240	54.86315	3.57370	299091.44	553167.44
T70	EOL	12/7/04	1642	Trawl	12.0	3.9	8.1				54.86238	3.57657	298905.71	553093.70
T71	SOL	12/7/04	1723	Trawl	7.0	5.0	2.0	5.0	202.5	250	54.87470	3.50177	303735.72	554356.76
T71	EOL	12/7/04	1728	Trawl	7.0	5.0	2.0				54.87423	3.50480	303539.90	554305.31
T71	2 SOL	12/7/04	1737	Trawl	7.0	5.2	1.8	9.0	199.1	270	54.87450	3.50285	303665.73	554336.00
T71	2 EOL	12/7/04	1746	Trawl	7.0	5.2	1.8				54.87425	3.50593	303467.43	554318.00
T72	SOL	12/7/04	1700	Trawl	10.0	4.4	5.6	6.0	203.0	250	54.86547	3.53723	301437.69	553382.51
T72	EOL	12/7/04	1706	Trawl	10.0	4.4	5.6				54.86458	3.53998	301259.00	553286.24
T74	SOL	11/7/04	1343	Trawl	10.0	2.7	7.3	4.0	260.0	060	54.87912	3.55970	300029.59	554927.57
T74	EOL	11/7/04	1347	Trawl	10.0	2.7	7.3				54.88037	3.55633	300248.78	555067.40
T75	SOL	12/7/04	920	Trawl	14.0	6.3	7.7	4.0	199.8	020	54.88307	3.56813	299498.53	555384.70
T75	EOL	12/7/04	924	Trawl	11.0	6.3	4.7				54.88482	3.56713	299566.91	555572.42
T76	SOL	12/7/04	902	Trawl	6.0	6.7	–0.7	5.0	205.5	030	54.89090	3.55922	300089.83	556239.79

Appendix 2 *(continued)*

Sample Location	Drop #	Date	Time (GMT)	Grab/ Type	Depth (m)	Predicted Tide (m)	Corrected Depth (m)	Time Trawled (mins)	Trawl Distance (m)	Trawl Heading (degrees) True	Latitude °N (Decimal Degrees)	Longitude °W (Decimal Degrees)	Eastings (m)	Northings (m)
T76	EOL	12/7/04	907	Trawl	6.0	6.7	–0.7				54.89263	3.55797	300174.20	556427.15
T77	SOL	11/7/04	1216	Trawl	8.0	3.1	4.9	3.0	215.3	040	54.89447	3.54075	301282.99	556614.13
T77	EOL	11/7/04	1219	Trawl	8.0	3.1	4.9				54.89568	3.53812	301454.80	556743.93
T78	SOL	27/7/04	1112	Trawl	12.8	3.5	9.3	6.0	202.2	060	54.86110	3.59753	297556.44	552981.04
T78	EOL	27/7/04	1118	Trawl	12.8	3.5	9.3				54.86192	3.59472	297738.86	553068.16
T79	SOL	27/7/04	1157	Trawl	8.0	2.8	5.2	3.0	204.7	120	54.88437	3.54953	300694.44	555500.94
T79	EOL	27/7/04	1200	Trawl	8.0	2.8	5.2				54.88340	3.54682	300865.89	555389.18
T80	SOL	12/7/04	945	Trawl	15.0	6.1	8.9	5.0	208.3	030	54.86742	3.58585	298322.51	553663.46
T80	EOL	12/7/04	950	Trawl	15.0	6.1	8.9				54.86898	3.58417	298434.55	553839.04
T81	SOL	12/7/04	843	Trawl	5.0	6.8	–1.8	5.0	211.5	005	54.89805	3.55598	300314.75	557025.15
T81	EOL	12/7/04	848	Trawl	5.0	6.8	–1.8				54.89987	3.55595	300321.59	557236.51
T82	SOL	12/7/04	826	Trawl	6.0	6.9	–0.9	5.0	200.4	355	54.90647	3.55570	300353.93	557970.50
T82	EOL	12/7/04	831	Trawl	6.0	6.9	–0.9				54.90828	3.55578	300353.04	558170.89
T83	SOL	11/7/04	1146	Trawl	5.0	3.4	1.6	6.0	267.9	050	54.90465	3.53287	301813.15	557726.80
T83	EOL	11/7/04	1152	Trawl	5.0	3.4	1.6				54.90615	3.52960	302026.23	557889.12
T86	SOL	11/7/04	1125	Trawl	2.4	3.6	–1.2	5.0	222.6	005	54.91325	3.53123	301938.80	558681.39
T86	EOL	11/7/04	1130	Trawl	2.4	3.6	–1.2				54.91520	3.53123	301943.66	558903.92
T91	SOL	27/7/04	1504	Trawl	7.3	2.6	4.7	5.0	175.1	240	54.88697	3.47307	305605.08	555684.39
T91	EOL	27/7/04	1509	Trawl	7.3	2.6	4.7				54.88697	3.47580	305429.98	555688.07
T95	SOL	26/7/04	1603	Trawl	4.0	5.3	–1.3	6.0	201.4	230	54.85590	3.47410	305466.26	552228.77
T95	EOL	26/7/04	1609	Trawl	4.0	5.3	–1.3				54.85495	3.47677	305292.64	552126.68
TR03	SOL	26/7/04	1536	Trawl	7.6	4.6	3.0	6.0	201.3	265	54.82655	3.49915	303788.41	548997.28
TR03	EOL	26/7/04	1542	Trawl	7.6	4.6	3.0				54.82647	3.50228	303587.15	548992.69

Appendix 2 *(continued)*

Sample Location	Drop #	Date	Time (GMT)	Grab/ Type	Depth (m)	Predicted Tide (m)	Corrected Depth (m)	Time Trawled (mins)	Trawl Distance (m)	Trawl Heading (degrees) True	Latitude °N (Decimal Degrees)	Longitude °W (Decimal Degrees)	Eastings (m)	Northings (m)
TR05	SOL	26/7/04	1425	Trawl	6.8	3.2	3.6	6.0	200.2	220	54.83522	3.45425	306692.69	549901.17
TR05	EOL	26/7/04	1431	Trawl	6.8	3.2	3.6				54.83385	3.45627	306559.79	549751.44
TR06	SOL	26/7/04	1417	Trawl	5.3	3.0	2.3	7.0	202.1	220	54.84890	3.48892	304498.40	551470.03
TR06	EOL	26/7/04	1424	Trawl	5.3	3.0	2.3				54.84763	3.49117	304350.94	551331.80
TR07	SOL	26/7/04	1623	Trawl	5.6	5.6	0.0	8.0	202.5	230	54.85698	3.44582	307284.07	552311.10
TR07	EOL	26/7/04	1631	Trawl	5.6	5.6	0.0				54.85580	3.44822	307127.30	552182.99
TR10	SOL	26/7/04	846	Trawl	5.2	5.1	0.1	8.0	202.8	030	54.91282	3.37768	311780.19	558436.11
TR10	EOL	26/7/04	854	Trawl	5.2	5.1	0.1				54.91425	3.37572	311908.96	558592.75
TR12	SOL	27/7/04	1617	Trawl	4.3	4.0	0.3	8.0	199.7	240	54.88928	3.44362	307499.36	555902.07
TR12	EOL	27/7/04	1625	Trawl	4.3	4.0	0.3				54.88845	3.44638	307320.43	555813.38
TR15	SOL	27/7/04	1417	Trawl	5.2	2.2	3.0	4.0	204.4	230	54.87152	3.54953	300662.81	554071.20
TR15	EOL	27/7/04	1421	Trawl	5.2	2.2	3.0				54.87025	3.55183	300512.10	553933.16

Appendix 3 Previously surveyed sites

Table showing sites previously surveyed and corresponding sites from present study.

Survey Site	Previous Survey Site	Survey
G29	S176	RSPB foreshore sediment sites*
G35	S94/12is	Cutts & Hemingway (1996)
G42	763.19	1994 Solway Firth Mapping Project
G49	763.2	1994 Solway Firth Mapping Project
G50	S94/04is	Cutts & Hemingway (1996)
G51	763.1	1994 Solway Firth Mapping Project
G52	S94/14is	Cutts & Hemingway (1996)
G53	763.7	1994 Solway Firth Mapping Project
G65	S106	RSPB foreshore sediment sites*
G68	S94/16is	Cutts & Hemingway (1996)
G71	S190	RSPB foreshore sediment sites

* Site-coordinate data provided by Scottish Natural Heritage.

Appendix 4 Sediment compositions

All positions are given as WGS84 Latitude and Longitude decimal degrees
Depths are corrected relative to chart datum using predicted tides – negative values = drying heights

Location	Drop	Depth (m)	Lat °N (Decimal Degree)	Long °W (Decimal Degree)	Silt & Clay %	Sand %	Granule %	Pebble %
G12	1	–2.2	54.94758	3.33445	2.20	97.73	0.01	0.01
G13	1	–2.3	54.94108	3.33623	3.05	96.92	0.00	0.00
G14	1	–1.9	54.94193	3.33625	2.56	97.43	0.00	0.00
G15	1	–2.7	54.93917	3.32562	1.88	98.11	0.00	0.00
G16	1	–1.2	54.93783	3.33643	1.87	98.13	0.00	0.00
G17	1	–2.3	54.93630	3.33912	2.27	97.71	0.00	0.00
G19	1	–2.8	54.94442	3.32510	2.23	97.77	0.00	0.00
G20	2	–0.9	54.93415	3.35257	0.92	98.76	0.19	0.13
G21	1	–1.4	54.92903	3.35238	1.49	98.50	0.00	0.01
G22	1	3.1	54.92817	3.36203	0.56	96.41	0.90	2.12
G23	2	2.6	54.91992	3.36293	0.71	98.81	0.30	0.17
G24	1	0.5	54.90713	3.36203	1.03	98.97	0.00	0.00
G25	1	0.5	54.90492	3.39463	1.58	98.41	0.01	0.00
G27	1	3.7	54.89528	3.38232	0.53	97.92	0.70	0.85
G28	2	2.4	54.88327	3.38442	1.11	98.89	0.00	0.00
G29	1	3.5	54.89782	3.42377	0.65	98.79	0.06	0.47
G30	1	1.7	54.87907	3.41357	1.43	98.56	0.00	0.00
G32	1	4.3	54.87637	3.39837	1.54	98.46	0.00	0.00
G33	1	5.8	54.87473	3.40377	0.84	97.63	0.55	0.96
G34	2	1.6	54.87205	3.39747	0.96	99.04	0.00	0.00
G35	1	2.1	54.87357	3.41968	2.45	97.44	0.01	0.10
G36	2	7.0	54.87107	3.41063	1.29	98.68	0.03	0.00
G37	1	3.6	54.87028	3.39900	9.08	90.86	0.04	0.01
G39	1	7.7	54.86193	3.42670	1.79	98.20	0.00	0.00
G40	1	8.2	54.84885	3.44948	8.04	91.78	0.06	0.12
G40a	1	6.4	54.84938	3.45017	1.17	98.25	0.03	0.00
G41	1	1.9	54.84247	3.51057	1.21	98.78	0.00	0.00
G42	1	2.6	54.82577	3.47025	1.34	98.65	0.00	0.00
G43	1	0.3	54.82023	3.52725	1.33	98.63	0.03	0.00
G44	1	2.7	54.80977	3.51928	1.34	98.65	0.00	0.00
G46	1	2.6	54.83927	3.47700	1.68	98.30	0.01	0.00
G49	1	3.2	54.82107	3.58567	1.32	98.68	0.00	0.00
G50	1	4.3	54.82107	3.58657	1.53	98.47	0.00	0.00
G51	1	10.7	54.82062	3.60570	2.20	97.77	0.02	0.00
G52	1	11.1	54.83650	3.60577	2.01	97.76	0.16	0.05

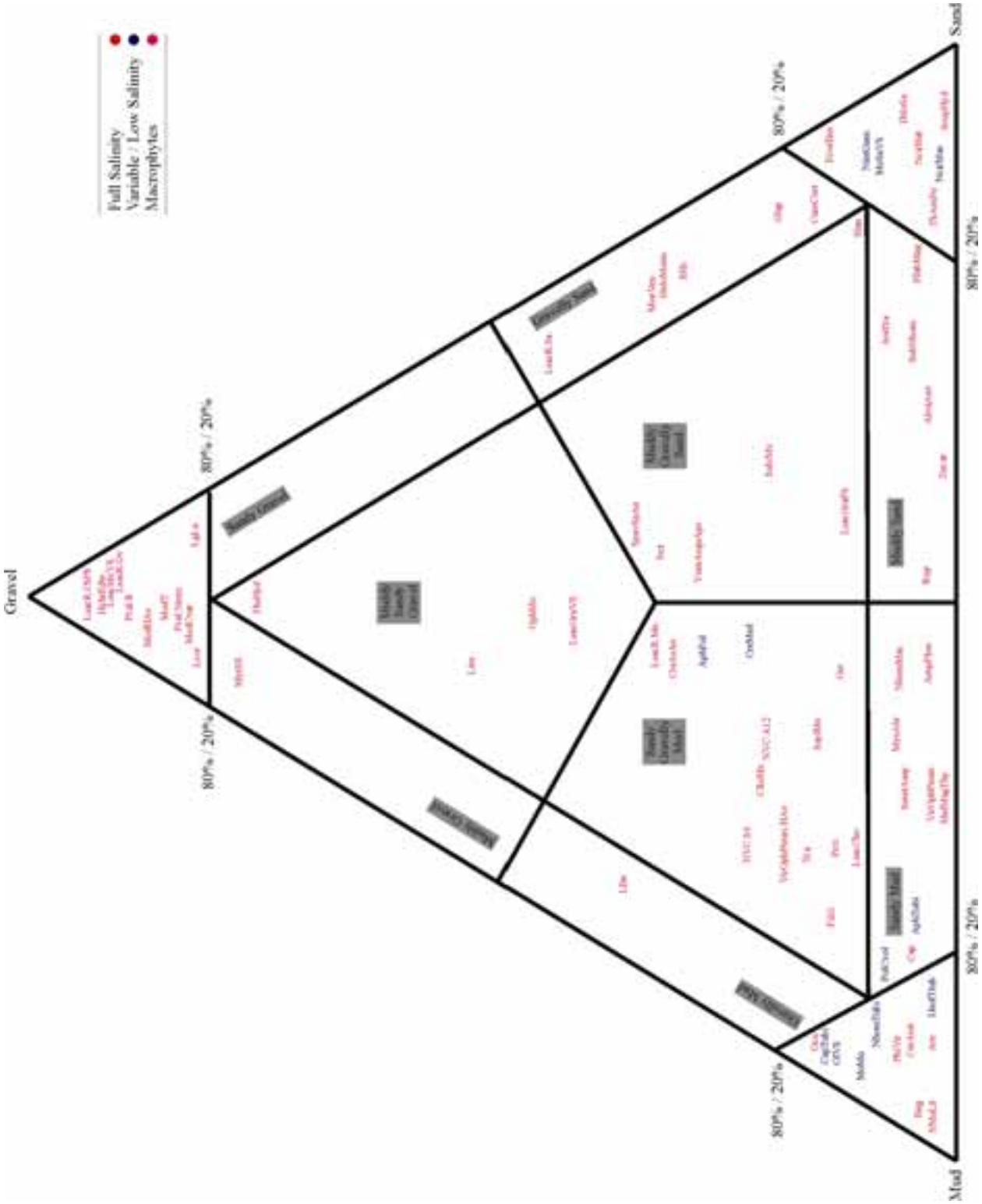
Appendix 4 *(continued)*

Location	Drop	Depth (m)	Lat °N (Decimal Degree)	Long °W (Decimal Degree)	Silt & Clay %	Sand %	Granule %	Pebble %
G53	1	6.4	54.84280	3.57440	3.38	96.53	0.00	0.00
G54	1	0.7	54.83513	3.57453	1.56	98.32	0.08	0.03
G55	3	0.8	54.80897	3.49473	1.61	96.03	1.34	1.03
G56	1	2.4	54.83220	3.55220	2.44	97.56	0.00	0.00
G57	1	13.1	54.82915	3.61053	1.04	93.72	1.52	3.72
G58	1	4.9	54.82455	3.62890	0.99	98.92	0.05	0.04
G59	1	3.0	54.82400	3.64772	1.05	98.92	0.03	0.00
G60	1	5.2	54.83737	3.62973	1.04	98.94	0.01	0.00
G61	1	8.6	54.85002	3.60618	3.71	91.18	1.30	3.81
G62	1	1.5	54.84005	3.64977	8.59	91.39	0.02	0.00
G63	1	1.2	54.82860	3.65827	4.46	95.52	0.02	0.00
G64	1	–2.2	54.84153	3.67528	5.11	94.89	0.00	0.00
G65	1	–2.3	54.83940	3.69273	5.47	94.52	0.00	0.00
G67	2	12.8	54.84107	3.58997	7.01	87.94	0.52	4.52
G68	1	10.5	54.85228	3.58468	1.93	97.96	0.07	0.03
G69	1	4.1	54.85503	3.55215	4.43	95.64	0.01	0.00
G70	1	8.4	54.86255	3.57537	1.32	84.63	3.54	10.51
G71	1	2.9	54.87440	3.50380	1.72	98.27	0.00	0.00
G72	3	5.5	54.86550	3.53807	2.15	97.82	0.01	0.01
G74	1	7.6	54.87963	3.55845	4.75	95.10	0.09	0.05
G75	2	3.3	54.88480	3.56753	13.78	86.19	0.02	0.00
G76	1	–1.5	54.89212	3.55833	8.12	91.85	0.02	0.00
G77	1	4.5	54.89547	3.53950	5.12	94.88	0.00	0.00
G78	2	9.3	54.86157	3.59422	1.14	98.08	0.23	0.50
G79	1	2.9	54.88397	3.54727	1.73	98.26	0.01	0.00
G80	6	9.4	54.86813	3.58480	1.54	95.34	0.43	2.68
G81	2	–2.0	54.89925	3.55615	9.73	90.27	0.00	0.00
G82	2	–1.4	54.90752	3.55605	16.40	83.59	0.00	0.00
G83	1	0.8	54.90502	3.53258	2.40	97.59	0.01	0.00
G85	1	–0.5	54.90908	3.53272	3.43	96.46	0.02	0.09
G86	1	–1.3	54.91348	3.53180	2.82	97.17	0.00	0.00
G87	1	–0.8	54.92283	3.53625	2.87	97.12	0.00	0.00
G88	1	–2.8	54.93592	3.55433	4.48	95.42	0.00	0.00
G91	1	5.1	54.88730	3.47330	0.85	98.90	0.13	0.11
G92	2	0.3	54.88000	3.46585	1.20	98.97	0.00	0.00
G94	1	1.7	54.89828	3.44688	2.12	97.88	0.00	0.00
G95	2	0.6	54.85542	3.47067	2.39	97.60	0.00	0.00
GR02	1	2.1	54.81757	3.48960	1.07	94.07	1.38	3.47

Appendix 4 *(continued)*

Location	Drop	Depth (m)	Lat °N (Decimal Degree)	Long °W (Decimal Degree)	Silt & Clay %	Sand %	Granule %	Pebble %
GR03	1	3.0	54.82652	3.50087	1.60	98.39	0.01	0.00
GR04	1	–0.5	54.83213	3.51678	1.74	98.25	0.00	0.00
GR05	1	2.9	54.83453	3.45527	2.62	86.80	3.03	7.55
GR06	1	2.7	54.84822	3.48987	1.76	98.22	0.01	0.00
GR07	1	0.1	54.85625	3.44753	2.33	97.64	0.02	0.01
GR08	1	1.5	54.88572	3.40158	2.27	97.72	0.01	0.00
GR10	1	0.2	54.91372	3.37687	2.08	97.90	0.02	0.00
GR11	1	–3.8	54.91708	3.35015	1.17	98.83	0.00	0.00
GR12	2	0.4	54.88875	3.44572	1.63	98.37	0.00	0.00
GR13	1	–0.2	54.88585	3.49582	2.16	97.83	0.02	0.00
GR14	2	2.4	54.86650	3.52065	3.70	96.30	0.00	0.00
GR15	1	2.6	54.87078	3.55065	2.62	97.38	0.00	0.00

Appendix 5 FOLK Sediment Classification Triangle as adapted by JNCC (Connor *et al.*, 2004)



Appendix 6 Macrofaunal abundance individuals per 0.1m^2

Ref	MCS alpha	MCS num	Genus	Species	Authority	G12	G13	G14	G15	G16	G17	G19	G20	G21	G22	G23	G24	G25	G27	G28	G29	G30	G32	G33	G34	G35
87	D	00273	Hydractinia	echinata	(Fleming, 1828)																					
54	D	00583	Anthozoa	indet.																						
66	E	00001	Ctenophora	indet. (planktonic)																						
46	G	00001	Nemertea	indet.																						
32	P	00104	Sigalion	mathildae	Audouin & Milne-Edwards in Cuvier, 1830																					
61	P	00109	Sthenelais	limicola	(Ehlers, 1864)																					
40	P	00118	Eteone	longa	(Fabricius, 1780)																					
69	P	00142	Anaitides	lineata	(Claparède, 1870)																					
80	P	00156	Eulalia	ornata	Saint-Joseph, 1888																					
67	P	00260	Glycera	lapidum	Quatrefages, 1866																					
23	P	00265	Glycera	tridactyla	Schmarda, 1861																			1		
62	P	00333	Microphthalmus	similis	Bobretzky, 1870																					
49	P	00434	Autolytus	spp.	Grube, 1850																					
79	P	00475	Nereis	longissima	Johnston, 1840																					
83	P	00494	Nephtys	juv.	Cuvier, 1817																					1
1	P	00498	Nephtys	cirrosa	Ehlers, 1868	4	3	4	1	4	9					1		11	1	3		8	1			1
33	P	00499	Nephtys	hombergii	Savigny, 1818																					
39	P	00672	Scoloplos	armiger	(O F Müller, 1776)																					
25	P	00776	Pygospio	elegans	Claparède, 1863								1													
31	P	00783	Scolelepis	squamata	(Abildgaard, 1806)																			1		
41	P	00791	Spio	martinensis	Mesnil, 1896																					
43	P	00794	Spiophanes	bombyx	(Claparède, 1870)																					
42	P	00803	Magelona	(johnstoni)	F Müller, 1858																					
58	P	00803	Magelona		F Müller, 1858																					
7	P	00807	Magelona	mirabilis	(Johnston, 1865)						1															
30	P	00999	Ophelia	borealis	Quatrefages, 1866																					
38	P	01098	Owenia	fusiformis	Chiaje, 1842																					

Appendix 6 *(continued)*

Ref	MCS alpha	MCS num	Genus	Species	Authority	G36	G37	G39	G40	G40a	G41	G42	G43	G44	G46	G49	G50	G51	G52	G53	G54	G55	G56	G57	G58	G59
87	D	00273	Hydractinia	echinata	(Fleming, 1828)												+									
54	D	00583	Anthozoa	indet.			1																			
66	E	00001	Ctenophora	indet. (planktonic)																						
46	G	00001	Nemertea	indet.									1							1						
32	P	00104	Sigalion	mathildae	Audouin & Milne-Edwards in Cuvier, 1830																					
61	P	00109	Sthenelais	limicola	(Ehlers, 1864)																					
40	P	00118	Eteone	longa	(Fabricius, 1780)				66																	
69	P	00142	Anaitides	lineata	(Claparède, 1870)																		1			
80	P	00156	Eulalia	ornata	Saint-Joseph, 1888				201																	
67	P	00260	Glycera	lapidum	Quatrefages, 1866																					
23	P	00265	Glycera	tridactyla	Schmarda, 1861			1																1		
62	P	00333	Microphthalmus	similis	Bobretzky, 1870																					
49	P	00434	Autolytus	spp.	Grube, 1850																					
79	P	00475	Nereis	longissima	Johnston, 1840				11																	
83	P	00494	Nephtys	juv.	Cuvier, 1817		1																			1
1	P	00498	Nephtys	cirrosa	Ehlers, 1868		21	3		2	5	9	1	7	2	1	5	15	6	10	5	4	13	4	4	6
33	P	00499	Nephtys	hombergii	Savigny, 1818																		1			1
39	P	00672	Scoloplos	armiger	(O F Müller, 1776)																					
25	P	00776	Pygospio	elegans	Claparède, 1863				434																	
31	P	00783	Scolelepis	squamata	(Abildgaard, 1806)																			1		
41	P	00791	Spio	martinensis	Mesnil, 1896																					
43	P	00794	Spiophanes	bombyx	(Claparède, 1870)					1																
42	P	00803	Magelona	(johnstoni)	F Müller, 1858					1					3											1
58	P	00803	Magelona		F Müller, 1858													1								
7	P	00807	Magelona	mirabilis	(Johnston, 1865)																					
30	P	00999	Ophelia	borealis	Quatrefages, 1866																	4		4		
38	P	01098	Owenia	fusiformis	Chiaje, 1842																					

Appendix 6 *(continued)*

Ref	MCS alpha	MCS num	Genus	Species	Authority	G12	G13	G14	G15	G16	G17	G19	G20	G21	G22	G23	G24	G25	G27	G28	G29	G30	G32	G33	G34	G35
36	P	01107	Lagis	koreni	(Malmgren, 1866)																					
44	P	01116	Sabellaria	alveolata	(Linnaeus, 1767)																					
16	P	01120	Melinna		Malmgren, 1866										1											
48	P	01195	Lanice	conchilega	(Pallas, 1766)																					
47	P	01340	Pomatoceros	lamarcki	(Quatrefages, 1866)																					
22	P	01490	Tubificoides	benedii	(Udekem, 1855)																					
20	R	00068	Elminius	modestus	Darwin, 1854																					
74	R	00077	Balanus	crenatus	Brugière, 1789																					
56	S	00025	MYSIDACEA															1								
9	S	00044	Gastrosaccus	spinifer	(Goës, 1864)								3		3	1			3		15			3		
3	S	00086	Schistomysis	kervillei	(G O Sars, 1885)	1	1			1									1							
82	S	00085	Schistomysis	juv.	(G O Sars, 1864)																					
81	S	00133	Pontocrates	altamarinus	(Bate & Westwood, 1862)																					
71	S	00410	Atylus	falcatus	Metzger, 1871																					
29	S	00412	Atylus	swammerdamei	(H Milne-Edwards, 1830)																					
27	S	00452	Bathyporeia	elegans	Watkin, 1938													1								5
2	S	00456	Bathyporeia	pelagica	(Bate, 1856)		1	1		1			7	1		9				1						
24	S	00458	Bathyporeia	sarsi	Watkin, 1938			1																		
6	S	00462	Haustorius	arenarius	(Slabber, 1769)						1	1	6	31	4	5	8		5		3		5			
8	S	00481	Gammarus	salinus	Spooner, 1947							2														
14	S	00854	Eurydice	pulchra	Leach, 1815										2											
13	S	00870	Sphaeroma	monodi	Bocquet Hoestlandt & Levi, 1954											2			1					1		
65	S	01334	Hippolytidae	juv.	(Leach, 1817)																					
4	S	01385	Crangon	crangon	(Linnaeus, 1758)			1				1	1			1		1				2			1	1
78	S	01457	Pagurus	bernhardus	(Linnaeus, 1758)																					
73	S	01580	Liocarcinus	depurator	(Linnaeus, 1758)																					

Appendix 6 *(continued)*

Ref	MCS alpha	MCS num	Genus	Species	Authority	G36	G37	G39	G40	G40a	G41	G42	G43	G44	G46	G49	G50	G51	G52	G53	G54	G55	G56	G57	G58	G59
36	P	01107	Lagis	koreni	(Malmgren, 1866)																					
44	P	01116	Sabellaria	alveolata	(Linnaeus, 1767)				12736															1		
16	P	01120	Melinna		Malmgren, 1866										1											
48	P	01195	Lanice	conchilega	(Pallas, 1766)				8																	
47	P	01340	Pomatoceros	lamarcki	(Quatrefages, 1866)																					
22	P	01490	Tubificoides	benedii	(Udekem, 1855)		4																			
20	R	00068	Elminius	modestus	Darwin, 1854		+																			
74	R	00077	Balanus	crenatus	Brugière, 1789		+																			
56	S	00025	MYSIDACEA																							
9	S	00044	Gastrosaccus	spinifer	(Goës, 1864)						8		5		1	2	2		4	3	3		1	6		
3	S	00086	Schistomysis	kervillei	(G O Sars, 1885)															1			1			1
82	S	00085	Schistomysis	juv.	(G O Sars, 1864)								1									1				
81	S	00133	Pontocrates	altamarinus	(Bate & Westwood, 1862)	3					5	1		3	1	2	4	4	1	1	5		1	1		1
71	S	00410	Atylus	falcatus	Metzger, 1871														1							
29	S	00412	Atylus	swammerdamei	(H Milne-Edwards, 1830)																					
27	S	00452	Bathyporeia	elegans	Watkin, 1938	5					10	1	5	5	3	17	8	34	10	4			13	10	2	9
2	S	00456	Bathyporeia	pelagica	(Bate, 1856)						1															
24	S	00458	Bathyporeia	sarsi	Watkin, 1938																					
6	S	00462	Haustorius	arenarius	(Slabber, 1769)								1				1							18		
8	S	00481	Gammarus	salinus	Spooner, 1947				2																	
14	S	00854	Eurydice	pulchra	Leach, 1815																					
13	S	00870	Sphaeroma	monodi	Bocquet Hoestlandt & Levi, 1954																					
65	S	01334	Hippolytidae	juv.	(Leach, 1817)																					
4	S	01385	Crangon	crangon	(Linnaeus, 1758)	1			1	3	1	1		2			1			1						
78	S	01457	Pagurus	bernhardus	(Linnaeus, 1758)								1				1									
73	S	01580	Liocarcinus	depurator	(Linnaeus, 1758)				2											1	1					

Appendix 6 *(continued)*

Ref	MCS alpha	MCS num	Genus	Species	Authority	G12	G13	G14	G15	G16	G17	G19	G20	G21	G22	G23	G24	G25	G27	G28	G29	G30	G32	G33	G34	G35
35	S	01596	Portumnus	latipes (juv.)	(Pennant, 1777)																					
72	S	01596	Portumnus	latipes																						
52	W	00385	Hydrobia	ulvae	(Pennant, 1777)																					
75	W	01569	Nucula	nitidosa	Winckworth, 1930																					
85	W	01695	Mytilus	edulis	Linnaeus, 1758								1											200		6
11	W	01961	Cerastoderma	edule	(Linnaeus, 1758)									1												
51	W	01972	Mactra	stultorum	(Linnaeus, 1758)																					
63	W	01975	Spisula	elliptica	(Brown, 1827)																					
59	W	01978	Spisula	subtruncata	(da Costa, 1778)																					
86	W	02007	Bivalvia	indet.																						
45	W	02012	Angulus	tenuis	(da Costa, 1778)																					
70	W	02019	Fabulina	fabula	(Gmelin, 1791)																					
5	W	02029	Macoma	balthica	(Linnaeus, 1758)		1																		1	
50	Y	00118	Triticella	sp. indet.	Dalyell, 1848																					
77	Y	00172	Conopeum	reticulum	(Linnaeus, 1767)																					
76	Y	00177	Electra	monostachys	(Busk, 1854)																					
55	Y	00178	Electra	pilosa	(Linnaeus, 1767)																					
64	ZB	00100	Asterias	rubens	Linnaeus, 1758																					
34	ZB	00223	Echinocardium	cordatum (juvs.)	(Pennant, 1777)																					
53	ZD	00120	Dendrodoa	grossularia	(van Beneden, 1846)																					
				Total no.indiv.		**5**	**6**	**7**	**1**	**6**	**11**	**4**	**19**	**33**	**10**	**19**	**8**	**14**	**11**	**4**	**18**	**10**	**6**	**206**	**2**	**9**

Appendix 6 *(continued)*

Ref	MCS alpha	MCS num	Genus	Species	Authority	G36	G37	G39	G40	G40a	G41	G42	G43	G44	G46	G49	G50	G51	G52	G53	G54	G55	G56	G57	G58	G59
35	S	01596	Portumnus	latipes (juv.)	(Pennant, 1777)									1									1			
72	S	01596	Portumnus	latipes																					1	
52	W	00385	Hydrobia	ulvae	(Pennant, 1777)		1																			
75	W	01569	Nucula	nitidosa	Winckworth, 1930																					
85	W	01695	Mytilus	edulis	Linnaeus, 1758		105		10504	12		2						2			9			1		
11	W	01961	Cerastoderma	edule	(Linnaeus, 1758)																					
51	W	01972	Mactra	stultorum	(Linnaeus, 1758)																		1			
63	W	01975	Spisula	elliptica	(Brown, 1827)																					
59	W	01978	Spisula	subtruncata	(da Costa, 1778)																					
86	W	02007	Bivalvia	indet.																						
45	W	02012	Angulus	tenuis	(da Costa, 1778)													2								
70	W	02019	Fabulina	fabula	(Gmelin, 1791)												2									
5	W	02029	Macoma	balthica	(Linnaeus, 1758)		9																		1	
50	Y	00118	Triticella	sp. indet.	Dalyell, 1848																					
77	Y	00172	Conopeum	reticulum	(Linnaeus, 1767)		+														+					
76	Y	00177	Electra	monostachys	(Busk, 1854)																					
55	Y	00178	Electra	pilosa	(Linnaeus, 1767)		+																			
64	ZB	00100	Asterias	rubens	Linnaeus, 1758																					
34	ZB	00223	Echinocardium	cordatum (juvs.)	(Pennant, 1777)												63		45			21				
53	ZD	00120	Dendrodoa	grossularia	(van Beneden, 1846)		1																			
				Total no.indiv.		**9**	**143**	**4**	**23965**	**19**	**30**	**14**	**15**	**18**	**10**	**22**	**22**	**119**	**26**	**67**	**14**	**18**	**54**	**44**	**8**	**19**

Appendix 6 *(continued)*

Genus	Species	G60	G61	G62	G63	G64	G65	G67	G68	G69	G70	G71	G72	G74	G75	G76	G77	G78	G79	G80	G81	G82	G83	G85	G86	G87	G88	G91	G92	G94	G95	GR02	GR03	GR04	GR05	GR06	GR07	GR08	GR10	GR11	GR12	GR13	GR14	GR15	Total no. ind.
Hydractinia	echinata																																												
Anthozoa	indet.																																												1
Ctenophora	indet. (planktonic)														1																														1
Nemertea	indet.			1		1				1		1								2																									8
Sigalion	mathildae																																1												1
Sthenelais	limicola										1																																		1
Eteone	longa																			4															1										71
Anaitides	lineata																																												1
Eulalia	ornata																																												201
Glycera	lapidum															2																													2
Glycera	tridactyla			4													1			1		1													5										14
Microphthalmus	similis										9																																		9
Autolytus	spp.																			11																									11
Nereis	longissima																																												11
Nephtys	juv.														1	1					5						9								5										23
Nephtys	cirrosa	8	3	16	11	7	1	11	6	7	5	3	5	2	4	3	2	4	9	17			14	10	5	3		1	1	3	7	2	2	4	14	7	5	12	3		4	5	10	15	425
Nephtys	hombergii			1								1				1		1		1	5	1	1		2		5				1			1								2	1		26
Scoloplos	armiger					1															1													5	1									7
Pygospio	elegans																			1		1												2										439
Scolelepis	squamata																														1													2
Spio	martinensis							1							2		1				1			1										2										8
Spiophanes	bombyx			1																	3			2										1				1				1		10
Magelona	(johnstoni)		1	4											1	4			1	2			1	3						1				1		1								25
Magelona																									1																			2
Magelona	mirabilis																	1																2								1		5
Ophelia	borealis								1		7																					1												17
Owenia	fusiformis						1																											1								1		3
Lagis	koreni														1					4	1	1												1										8
Sabellaria	alveolata																			9														1										12747
Melinna																																												1
Lanice	conchilega																			1																									9

Appendix 6 *(continued)*

Genus	Species	G60	G61	G62	G63	G64	G65	G67	G68	G69	G70	G71	G72	G74	G75	G76	G77	G78	G79	G80	G81	G82	G83	G85	G86	G87	G88	G91	G92	G94	G95	GR02	GR03	GR04	GR05	GR06	GR07	GR08	GR10	GR11	GR12	GR13	GR14	GR15	Total no. ind.
Pomatoceros	lamarcki																			22																									22
Tubificoides	benedii																																												4
Elminius	modestus																																												0
Balanus	crenatus																																		+										0
MYSIDACEA																																													1
Gastrosaccus	spinifer	2						3		6	4		1	2		2		3	1				1					53			1		1	1		4	2	8	3		1	3		4	169
Schistomysis	kervillei			2	1	1		2			1					1					3		1	1		1				2			1			1	2							27
Schistomysis	juv.																																												2
Pontocrates	altamarinus	1								2	1	18	3			2															1			5		1				1		2	5	75
Atylus	falcatus							1																																					2
Atylus	swammerdamei							4							3	3		1													1														12
Bathyporeia	elegans	32	1		1			7	4	29	78	6	19	16		1		37	22	31		1	2		1	2	2	2	1	2	8	1	13	5	1	30	1	5	1		1		17	6	523
Bathyporeia	pelagica	2																							1																	3				28
Bathyporeia	sarsi																																												1
Haustorius	arenarius								1				2															3		1		1							1	15				113
Gammarus	salinus																																		1										5
Eurydice	pulchra																																												2
Sphaeroma	monodi																											2																	6
Hippolytidae	juv.														1																														1
Crangon	crangon			2	4	1	2	9		4	1	5	1			3			1		3	3	1	4	3	3	4		1		3		1			1		1				1			82
Pagurus	bernhardus																																												2
Liocarcinus	depurator			1																																									5
Portumnus	latipes (juv.)																																	1		1			1	1					6
Portumnus	latipes																																												1
Hydrobia	ulvae																																												1
Nucula	nitidosa			2																																									2
Mytilus	edulis		5	2		1					5				51		4	5		41		2									2			5										10965
Cerastoderma	edule							1	3															1	1	1																			8
Mactra	stultorum															2																												2	5
Spisula	elliptica										1																																		1
Spisula	subtruncata																											1																	1

Appendix 6 *(continued)*

Genus	Species	G60	G61	G62	G63	G64	G65	G67	G68	G69	G70	G71	G72	G74	G75	G76	G77	G78	G79	G80	G81	G82	G83	G85	G86	G87	G88	G91	G92	G94	G95	GR02	GR03	GR04	GR05	GR06	GR07	GR08	GR10	GR11	GR12	GR13	GR14	GR15	Total no. ind.
Bivalvia	indet.									1																																			1
Angulus	tenuis			7		1									1	2			1		1			1						1						1						3			21
Fabulina	fabula														2																														1	5
Macoma	balthica																				3	3												1												18
Triticella	sp. indet.														+					+																										0
Conopeum	reticulum																			+											+			+											0
Electra	monostachys																			+														+											0
Electra	pilosa																																													0
Asterias	rubens												1																																	1
Echinocardium	cordatum (juvs.)									7		7																			22			1		4						28	29	227
Dendrodoa	grossularia																																												1
	Total no.indiv.	45	10	43	17	13	4	39	15	57	113	41	32	20	68	27	8	52	35	147	25	13	21	23	14	10	20	62	3	8	45	9	17	20	49	50	10	29	9	16	10	14	61	62	26435

Appendix 7 Macrofaunal abundance SACFOR scale (the size scale refers to the classification (Connor *et al.*, 2004) of taxa into different size groups to aid SACFOR scale allocation)

Ref	Genus	Species	Size class	G12	G13	G14	G15	G16	G17	G19	G20	G21	G22	G23	G24	G25	G27	G28	G29	G30	G32	G33	G34	G35	G36	G37	G39	G40	G40a	G41	G42	G43	G44	G46	G49	G50	G51	G52	G53	G54	G55	G56	G57	G58	G59	G60	G61
87	Hydractinia	echinata	aa																																	P										
54	Anthozoa	indet.	aa																							F																				
46	Nemertea	indet.	bb																													C							C							
32	Sigalion	mathildae	bb																																											
61	Sthenelais	limicola	bb																																											
40	Eteone	longa	bb																									A																		
69	Anaitides	lineata	bb																																							C					
80	Eulalia	ornata	cc																									S																		
67	Glycera	lapidum	cc																																											
23	Glycera	tridactyla	cc																			A					A																		
62	Microphthalmus	similis	bb																																										
49	Autolytus	spp.	bb																																											
79	Nereis	longissima	cc																									S																		
83	Nephtys	juv.	aa																					F		F																				
1	Nephtys	cirrosa	bb	C	C	C	C	C	C					C		A	C	C		C	C			C		A	C		C	C	C	C	C	C	C	C	A	C	A	C	C	A	C	C	C	C	C
33	Nephtys	hombergii	bb																																							C			C		
39	Scoloplos	armiger	cc																																											
25	Pygospio	elegans	bb								C																	S																		
31	Scolelepis	squamata	bb																			C																								
41	Spio	martinensis	bb																																											
43	Spiophanes	bombyx	bb																										C																	
42	Magelona	(johnstoni)	cc																										A					A										A		A
58	Magelona		cc																																		A									
7	Magelona	mirabilis	cc						A																																					
30	Ophelia	borealis	bb																																						C		C				
38	Owenia	fusiformis	cc																																											
36	Lagis	koreni	bb																																											
44	Sabellaria	alveolata	bb																									S															C			
16	Melinna		bb										C																																	

Appendix 7 *(continued)*

Ref	Genus	Species	Size class	G12	G13	G14	G15	G16	G17	G19	G20	G21	G22	G23	G24	G25	G27	G28	G29	G30	G32	G33	G34	G35	G36	G37	G39	G40	G40a	G41	G42	G43	G44	G46	G49	G50	G51	G52	G53	G54	G55	G56	G57	G58	G59	G60	G61
48	Lanice	conchilega	cc																									A																		
47	Pomatoceros	lamarcki	bb																																												
22	Tubificoides	benedii	bb																							C																					
20	Elminius	modestus	aa																							P																					
74	Balanus	crenatus	aa																							P																					
56	MYSIDACEA		aa													F																															
9	Gastrosaccus	spinifer	aa								F		F	F			F		C			F								F		F		F	F	F		F	F	F		F	F			F	
3	Schistomysis	kervillei	aa	F	F			F									F																						F			F			F		
82	Schistomysis	juv.	aa																													F									F						
81	Pontocrates	altamarinus	aa																						F					F	F		F	F	F	F	F	F	F	F		F	F		F	F	
71	Atylus	falcatus	aa																																			F									
29	Atylus	swammerdamei	aa																																											
27	Bathyporeia	elegans	aa													F									F					C	F	F	F	F	C	F	C	C	F			C	C	F	F	C	F
2	Bathyporeia	pelagica	aa		F	F		F			F	F		F				F												F															F	
24	Bathyporeia	sarsi	aa			F																																								
6	Haustorius	arenarius	aa						F	F	F	C	F	F	F		F		F		F											F				F						C				
8	Gammarus	salinus	aa							F																		F																		
14	Eurydice	pulchra	aa										F																																		
13	Sphaeroma	monodi	aa											F			F					F																									
65	Hippolytidae	juv.	bb																																											
4	Crangon	crangon	cc			A				A	A			A		A				A			A	A	A			A	A	A	A		A			A			A							
78	Pagurus	bernhardus	cc																													A				A										
73	Liocarcinus	depurator	cc																									A											A	A						
35	Portumnus	latipes (juv.)	bb																													C									C					
72	Portumnus	latipes	bb																																							C				
52	Hydrobia	ulvae	aa																							F																				
75	Nucula	nitidosa	aa																																											
85	Mytilus	edulis	bb								C											S		C		S		S	A		C						C			C			C			C
11	Cerastoderma	edule	bb									C																																			
51	Mactra	stultorum	bb																																							C				
63	Spisula	elliptica	bb																																										

Appendix 7 *(continued)*

Ref	Genus	Species	Size class	G12	G13	G14	G15	G16	G17	G19	G20	G21	G22	G23	G24	G25	G27	G28	G29	G30	G32	G33	G34	G35	G36	G37	G39	G40	G40a	G41	G42	G43	G44	G46	G49	G50	G51	G52	G53	G54	G55	G56	G57	G58	G59	G60	G61
59	Spisula	subtruncata	bb																																											
86	Bivalvia	indet.	bb																																											
45	Angulus	tenuis	bb																																		C									
70	Fabulina	fabula	bb																																	C									
5	Macoma	balthica	bb		C																		F			F																		
50	Triticella	sp. indet.	crust																																										
77	Conopeum	reticulum	crust																							P															P				
76	Electra	monostachys	crust																																										
55	Electra	pilosa	crust																							P																		
64	Asterias	rubens	cc																																										
34	Echinocardium	cordatum (juvs.)	cc																																	S		S			S				
53	Dendrodoa	grossularia	bb																							C																		

Appendix 7 *(continued)*

Ref	Genus	Species	Size class	G62	G63	G64	G65	G67	G68	G69	G70	G71	G72	G74	G75	G76	G77	G78	G79	G80	G81	G82	G83	G85	G86	G87	G88	G91	G92	G94	G95	GR02	GR03	GR04	GR05	GR06	GR07	GR08	GR10	GR11	GR12	GR13	GR14	GR15
87	Hydractinia	echinata	aa																																									
54	Anthozoa	indet.	aa*																																										
46	Nemertea	indet.	bb	C		C				C		C								C																								
32	Sigalion	mathildae	bb																														C											
61	Sthenelais	limicola	bb								C																																	
40	Eteone	longa	bb#																	C														C										
69	Anaitides	lineata	bb*																																									
80	Eulalia	ornata	cc																																									
67	Glycera	lapidum	cc													A																												
23	Glycera	tridactyla	cc	A													C			C		C													A									
62	Microphthalmus	similis	bb*								C																																	
49	Autolytus	spp.	bb																	A																								
79	Nereis	longissima	cc																																									
83	Nephtys	juv.	aa												F	F					F						F								F									
1	Nephtys	cirrosa	bb	A	A	C	C	A	C	C	C	C	C	C	C	C	C	C	C	A			A	A	C	C		C	C	C	C	C	C	C	A	C	C	A	C		C	C	A	A
33	Nephtys	hombergii	bb	C								C				C		C		C	C	C	C		C		C				C			C								C	C	
39	Scoloplos	armiger	cc			A																													A	A								
25	Pygospio	elegans	bb																	C		C													C									
31	Scolelepis	squamata	bb																												C												
41	Spio	martinensis	bb					C							C		C				C			C											C									
43	Spiophanes	bombyx	bb	C																	C			C											C				C				C	
42	Magelona	(johnstoni)	cc	A											A	A			A	A			A	A						A					A		A							
58	Magelona		cc																						A																			
7	Magelona	mirabilis	cc															A																	A								A	
30	Ophelia	borealis	bb						C		C																					C											
38	Owenia	fusiformis	cc				A																												A								A	
36	Lagis	koreni	bb												C					C	C	C													C									
44	Sabellaria	alveolata	bb																	C															C									
16	Melinna		bb																																									
48	Lanice	conchilega	cc																	A																								
47	Pomatoceros	lamarcki	bb																	A																								

Appendix 7 *(continued)*

Ref	Genus	Species	Size class	G62	G63	G64	G65	G67	G68	G69	G70	G71	G72	G74	G75	G76	G77	G78	G79	G80	G81	G82	G83	G85	G86	G87	G88	G91	G92	G94	G95	GR02	GR03	GR04	GR05	GR06	GR07	GR08	GR10	GR11	GR12	GR13	GR14	GR15
22	Tubificoides	benedii	bb																																									
20	Elminius	modestus	aa																																									
74	Balanus	crenatus	aa																																P									
56	MYSIDACEA		aa																																									
9	Gastrosaccus	spinifer	aa					F		F	F		F	F		F		F	F				F					C			F		F	F		F	F	F	F		F	F		F
3	Schistomysis	kervillei	aa	F	F	F		F			F					F					F		F	F		F					F			F			F	F						
82	Schistomysis	juv.	aa																																									
81	Pontocrates	altamarinus	aa							F	F	C	F			F															F			F		F					F		F	F
71	Atylus	falcatus	aa					F																																				
29	Atylus	swammerdamei	aa					F							F	F		F														F											
27	Bathyporeia	elegans	aa		F			F	F	C	C	F	C	C		F		C	C	C		F	F		F	F	F	F	F	F	F	C	F	F	C	F	F	F		F		C	F
2	Bathyporeia	pelagica	aa																						F																F			
24	Bathyporeia	sarsi	aa																																									
6	Haustorius	arenarius	aa						F				F															F		F		F							F	C				
8	Gammarus	salinus	aa																																F									
14	Eurydice	pulchra	aa																																									
13	Sphaeroma	monodi	aa																									F																
65	Hippolytidae	juv.	bb												C																													
4	Crangon	crangon	cc	A	A	A	A	A		A	A	A	A			A			A		A	A	A	A	A	A	A		A		A		A			A		A			A		
78	Pagurus	bernhardus	cc																																									
73	Liocarcinus	depurator	cc	A																																								
35	Portumnus	latipes (juv.)	bb																															C		C			C	C				
72	Portumnus	latipes	bb																																									
52	Hydrobia	ulvae	aa																																									
75	Nucula	nitidosa	aa	F																																								
85	Mytilus	edulis	bb	C		C					C				A		C	C		A		C									C			C									
11	Cerastoderma	edule	bb					C	C															C	C	C																		
51	Mactra	stultorum	bb													C																												C
63	Spisula	elliptica	bb								C																																	
59	Spisula	subtruncata	bb																									C																
86	Bivalvia	indet.	bb*							C																																		

Appendix 7 *(continued)*

Ref	Genus	Species	Size class	G62	G63	G64	G65	G67	G68	G69	G70	G71	G72	G74	G75	G76	G77	G78	G79	G80	G81	G82	G83	G85	G86	G87	G88	G91	G92	G94	G95	GR02	GR03	GR04	GR05	GR06	GR07	GR08	GR10	GR11	GR12	GR13	GR14	GR15
45	Angulus	tenuis	bb	C		C									C	C			C		C			C					C						C						C		
70	Fabulina	fabula	bb												20																														C
5	Macoma	balthica	bb																		C	C													C									
50	Triticella	sp. indet.	crust*												P					P																									
77	Conopeum	reticulum	crust																	P											P			P										
76	Electra	monostachys	crust																	P														P										
55	Electra	pilosa	crust																																									
64	Asterias	rubens	cc										A																															
34	Echinocardium	cordatum (juvs.)	cc							A		A																		S			A		A						S	S
53	Dendrodoa	grossularia	bb																																								

Appendix 8 Species diversity measures and indices for the Day grab sites within the Solway Firth

Site	N	S	H'	d	J'
G12#2	5	2	0.50	0.62	0.72
G13#2	6	4	1.24	1.67	0.90
G14#2	7	4	1.15	1.54	0.83
G15#2	1	1	0.00		
G16#2	6	3	0.87	1.12	0.79
G17#2	11	3	0.60	0.83	0.55
G19#2	4	3	1.04	1.44	0.95
G20#2	19	6	1.49	1.70	0.83
G21#2	33	3	0.27	0.57	0.25
G22#1	10	4	1.28	1.30	0.92
G23#2	19	6	1.41	1.70	0.79
G24#2	8	1	0.00	0.00	
G25#2	14	4	0.75	1.14	0.54
G27#1	11	5	1.37	1.67	0.85
G28#4	4	2	0.56	0.72	0.81
G29#1	18	2	0.45	0.35	0.65
G30#2	10	2	0.50	0.43	0.72
G32#2	6	2	0.45	0.56	0.65
G33#1	206	5	0.17	0.75	0.10
G34#3	2	2	0.69	1.44	1.00
G35#3	9	4	1.00	1.37	0.72
G36#4	9	3	0.94	0.91	0.85
G37#1	143	8	0.92	1.41	0.44
G39#3	4	2	0.56	0.72	0.81
G40#1	23965	10	0.83	0.89	0.36
G40a#2	19	5	1.13	1.36	0.70
G41#2	30	6	1.54	1.47	0.86
G42#2	14	5	1.13	1.52	0.70
G43#2	15	7	1.64	2.22	0.84
G44#3	18	5	1.43	1.38	0.89
G46#2	10	5	1.50	1.74	0.93
G49#1	22	4	0.78	0.97	0.56
G50#2	22	7	1.65	1.94	0.85
G51#2	119	6	1.18	1.05	0.66
G52#1	26	7	1.64	1.84	0.84
G53#2	67	9	1.17	1.90	0.53
G54#1	14	4	1.25	1.14	0.90
G55#3	18	4	1.18	1.04	0.85
G56#2	54	10	1.57	2.26	0.68
G57#1	44	7	1.58	1.59	0.81
G58#1	8	4	1.21	1.44	0.88
G59#1	19	6	1.34	1.70	0.75

Site	N	S	H'	d	J'
G60#1	45	5	0.91	1.05	0.57
G61#1	10	4	1.17	1.30	0.84
G62#2	43	12	2.03	2.92	0.82
G63#2	17	4	0.96	1.06	0.69
G64#3	13	7	1.52	2.34	0.78
G65#1	4	3	1.04	1.44	0.95
G67#3	39	9	1.87	2.18	0.85
G68#1	15	5	1.40	1.48	0.87
G69#2	57	8	1.54	1.73	0.74
G70#2	113	11	1.23	2.12	0.51
G71#2	41	7	1.57	1.62	0.81
G72#3	32	7	1.32	1.73	0.68
G74#1	20	3	0.64	0.67	0.58
G75#2	67	10	1.04	2.14	0.45
G76#2	27	13	2.47	3.64	0.96
G77#2	8	4	1.21	1.44	0.88
G78#2	52	7	1.06	1.52	0.54
G79#1	35	6	1.05	1.41	0.58
G80#6	147	14	2.03	2.60	0.77
G81#3	25	9	2.05	2.49	0.93
G82#2	13	8	1.95	2.73	0.94
G83#2	21	7	1.22	1.97	0.63
G85#2	23	8	1.69	2.23	0.81
G86#2	14	7	1.73	2.27	0.89
G87#2	10	5	1.50	1.74	0.93
G88#2	20	4	1.26	1.00	0.91
G91#1	62	6	0.64	1.21	0.35
G92#3	3	3	1.10	1.82	1.00
G94#2	8	5	1.49	1.92	0.93
G95#3	45	8	1.52	1.84	0.73
GR02#1	9	7	1.89	2.73	0.97
GR03#2	17	4	0.79	1.06	0.57
GR04#2	20	9	1.91	2.67	0.87
GR05#2	49	17	2.40	4.11	0.85
GR06#2	50	9	1.38	2.04	0.63
GR07#2	10	5	1.36	1.74	0.84
GR08#3	29	6	1.44	1.48	0.80
GR10#2	9	5	1.46	1.82	0.91
GR11#2	16	2	0.23	0.36	0.34
GR12#3	10	5	1.42	1.74	0.88
GR13#2	14	5	1.49	1.52	0.93
GR14#3	61	8	1.39	1.70	0.67
GR15#2	62	7	1.48	1.45	0.76

N Number of individuals
S Number of species/taxa
H' Shannon-Wiener diversity index ($\log^e$)
d Species richness (Margalef, d)
J' Equitability (Pielou, J)

Appendix 9 Trawl species lists

Trawl log

Date	Trawl No	Species		Number	Size (mm)
		Latin Name	**Common Name**		
11/7/04	T86	*Carcinus maenas*	Shore Crab	2	
		Crangon vulgaris		>100	
		Pleuronectes platessa	Plaice	5	105, 80, 35, 40, 30
		Sepiola atlantica d'Orbigny	Little cuttlefish	1	
		Solea solea	Sole	2	35, 30
		Sprattus sprattus	Sprat	1	70
		Syngnathus acus	Greater Pipefish	1	80
		Trisopterus minutus	Poor Cod	1	50
11/7/04	T83	*Carcinus maenas*	Shore Crab	1	10
		Crangon vulgaris		about 40	
		Pleuronectes platessa	Plaice	2	45, 45
		Pleurobrachia pileus	Sea Gooseberries	100's	
11/7/04	T77	*Agonus cataphractus*	Pogge	2	35, 35
		Carcinus maenas	Shore Crab	2	50, 45
		Crangon vulgaris		15	
		Idotea linearis		1	
		Limanda limanda	Dab	1	195
		Liocarcinus depurator	Harbour Swimming Crab	3	40, 40, 45
		Pleuronectes platessa	Plaice	15	105, 125, 70, 75, 55, 45, 50, 50, 45, 40, 45, 35, 45, 40, 45
		Rhizostoma octopus		1	
		Sepiola atlantica d'Orbigny		1	
		Sprattus sprattus	Sprat	1	35
		Syngnathus acus	Greater Pipefish	1	115
		Pleurobrachia pileus	Sea Gooseberries	100's	
11/7/04	T74	*Asterias rubens*		1	60
		Pleuronectes platessa	Plaice	1	125
		Pleurobrachia pileus	Sea Gooseberries	2	
11/7/04	T69	*Crangon vulgaris*		7	
		Echiichthys vipera	Lesser Weever	1	85
		Pleuronectes platessa	Plaice	7	85, 65, 80, 75, 75, 65, 30
		Platichthys flesus	Flounder	1	80
11/7/04	T54	*Crangon vulgaris*		45	
		Echiichthys vipera	Lesser Weever	20	110, 50, 85, 70, 70, 55, 50, 60, 50, 55, 65, 50, 50, 55, 45, 60, 55, 50, 50, 40
		Liocarcinus depurator	Harbour Swimming Crab	3	50, 40, 50
		Pagurus bernhardus		1	
		Pleuronectes platessa	Plaice	12	75, 45, 50, 55, 65, 55, 80, 45, 45, 45, 45, 45
		Trisopterus minutus	Poor Cod	1	60
		Platichthys flesus	Flounder	1	95

Appendix 9 *(continued)*

Date	Trawl No	Species		Number	Size (mm)
		Latin Name	Common Name		
11/7/04	T50	*Crangon vulgaris*		7	
		Echiichthys vipera	Lesser Weever	2	55, 55
		Liocarcinus depurator	Harbour Swimming Crab	3	
		Pleuronectes platessa	Plaice	7	95, 80, 75, 75, 65, 55, 50
		Rhizostoma octopus		2	
		Sepiola atlantica d'Orbigny	Little cuttlefish	1	
		Syngnathus acus	Greater Pipefish	1	120
		Ammodytes tobianus	Lesser Sandeel	1	100
		Pleurobrachia pileus	Sea Gooseberries	5	
11/7/04	T55	*Asterias rubens*		6	≤60
		Carcinus maenas	Shore Crab	4	45, 60, 65, 65
		Crangon vulgaris		about 100	
		Echiichthys vipera	Lesser Weever	6	120, 110, 130, 80, 110, 55
		Pleuronectes platessa	Plaice	6	155, 170, 85, 185, 35, 50
		Sprattus sprattus	Sprat	2	80, 70
		Ammodytes tobianus	Lesser Sandeel	5	130, 115, 130, 150, 135
11/7/04	T44	*Agonus cataphractus*	Pogge	1	40
		Asterias rubens		1	50
		Crangon vulgaris		7	
		Echiichthys vipera	Lesser Weever	1	140
		Idotea linearis		3	
		Merlangius merlangus	Whiting	3	85, 70, 70
		Pleuronectes platessa	Plaice	1	50
		Rhizostoma octopus		3	≤150mm bell diameter
11/7/04	T43	*Asterias rubens*		4	45, 15, 15, 20
		Echiichthys vipera	Lesser Weever	4	110, 105, 55, 50
		Merlangius merlangus	Whiting	2	105, 55
		Pleuronectes platessa	Plaice	14	45, 70, 65, 80, 70, 65, 65, 45, 40, 50, 40, 50, 50, 45
		Sepiola atlantica d'Orbigny	Little cuttlefish	1	10
		Ammodytes tobianus	Lesser Sandeel	2	110, 95
12/7/04	T82	*Agonus cataphractus*	Pogge	3	40, 35, 30
		Carcinus maenas	Shore Crab	29	
		Crangon vulgaris		100's	
		Liocarcinus depurator	Harbour Swimming Crab	2	
		Merlangius merlangus	Whiting	1	80
		Pleuronectes platessa	Plaice	29	85, 45, 80, 105, 85, 40, 40, 45, 40, 45, 40, 40, 35, 55, 40, 40, 45, 40, 45, 40, 40, 45, 40, 45, 40, 35, 40, 40, 40
		Rhizostoma octopus		1	150
		Sepiola atlantica d'Orbigny	Little cuttlefish	3	15, 10, 15
		Ammodytes tobianus	Lesser Sandeel	1	110

Appendix 9 *(continued)*

Date	Trawl No	Species		Number	Size (mm)
		Latin Name	**Common Name**		
12/7/04	T81	*Carcinus maenas*	Shore Crab	7	
		Merlangius merlangus	Whiting	1	60
		Pleuronectes platessa	Plaice	9	40, 45, 45, 45, 40, 45, 40, 40, 45
		Rhizostoma octopus		1	
		Sepiola atlantica d'Orbigny	Little cuttlefish	1	10
		Sprattus sprattus	Sprat	1	50
		Syngnathus acus	Greater Pipefish	2	120, 65
12/7/04	T76	*Carcinus maenas*	Shore Crab	20	
		Crangon vulgaris		100's	
		Liocarcinus depurator	Harbour Swimming Crab	3	
		Merlangius merlangus	Whiting	4	75, 95, 85, 65
		Pleuronectes platessa	Plaice	22	150, 150, 50, 90, 50, 40, 50, 80, 45, 45, 45, 40, 45, 40, 45, 45, 40, 40, 40, 40, 45, 50
		Rhizostoma octopus		1	30
		Sepiola atlantica d'Orbigny	Little cuttlefish	3	15, 15, 15
		Sprattus sprattus	Sprat	1	65
12/7/04	T75	*Agonus cataphractus*	Pogge	2	75, 70
		Carcinus maenas	Shore Crab	4	
		Crangon vulgaris		70	
		Pleuronectes platessa	Plaice	12	70, 110, 45, 95, 90, 85, 70, 70, 45, 50, 45, 95
		Rhizostoma octopus		2	
		Sepiola atlantica d'Orbigny	Little cuttlefish	1	
12/7/04	T80	*Agonus cataphractus*	Pogge	2	75, 70
		Asterias rubens		1	
		Carcinus maenas	Shore Crab	8	
		Crangon vulgaris		about 50	
		Merlangius merlangus	Whiting	1	75
		Rhizostoma octopus		3	
12/7/04	T61	*Crangon vulgaris*		13	
		Echiichthys vipera	Lesser Weever	1	70
		Liocarcinus depurator	Harbour Swimming Crab	1	
		Pleuronectes platessa	Plaice	2	90, 50
		Rhizostoma octopus		4	
12/7/04	T63	*Agonus cataphractus*	Pogge	3	35, 35, 30
		Crangon vulgaris		100's	
		Echiichthys vipera	Lesser Weever	1	75
		Liocarcinus depurator	Harbour Swimming Crab	1	
		Pagurus bernhardus		2	
		Pleuronectes platessa	Plaice	20	85, 45, 45, 50, 45, 35, 50, 50, 35, 45, 45, 30, 40, 55, 45, 45, 50, 60, 55, 55
		Rhizostoma octopus		9	
		Sepiola atlantica d'Orbigny	Little cuttlefish	1	
		Solea solea	Sole	1	90
		Syngnathus acus	Greater Pipefish	2	135, 125
		Pleurobrachia pileus	Sea Gooseberries	2	

Appendix 9 *(continued)*

Date	Trawl No	Species		Number	Size (mm)
		Latin Name	**Common Name**		
12/7/04	T59	*Agonus cataphractus*	Pogge	3	30, 40, 20
		Crangon vulgaris		about 100	
		Echiichthys vipera	Lesser Weever	15	75, 80, 80, 75, 90, 85, 80, 60, 80, 65, 85, 75, 65, 65, 60
		Limanda limanda	Dab	1	80
		Liocarcinus depurator	Harbour Swimming Crab	1	
		Pagurus Bernhardus		3	
		Pleuronectes platessa	Plaice	39	60, 95, 55, 60, 90, 45, 90, 80, 70, 50, 55, 60, 25, 45, 55, 50, 50, 30, 60, 45, 55, 55, 60, 30, 35, 50, 60, 45, 50, 45, 55, 50, 50, 55, 40, 40, 30, 30, 25
		Solea solea	Sole	2	100, 50
			Gadoid ?	1	60
12/7/04	T51	*Crangon vulgaris*		10	
		Echiichthys vipera	Lesser Weever	2	75, 60
		Limanda limanda	Dab	1	180
		Merlangius merlangus	Whiting	2	60, 65
		Pagurus bernhardus		1	
		Pleuronectes platessa	Plaice	10	80, 80, 85, 75, 85, 80, 55, 45, 45, 55
		Rhizostoma octopus		3	
		Sepiola atlantica d'Orbigny	Little cuttlefish	1	20
12/7/04	T57	*Crangon vulgaris*		35	
		Echiichthys vipera	Lesser Weever	7	130, 100, 90, 90, 85, 70, 50
		Limanda limanda	Dab	1	65
		Liocarcinus depurator	Harbour Swimming Crab	1	
		Mactra corallina		1	
		Pagurus bernhardus		4	
		Pleuronectes platessa	Plaice	7	240, 50, 150, 90, 80, 80, 60
		Rhizostoma octopus		3	
		Spisula (?)		1	
		Ammodytes tobianus	Lesser Sandeel	2	100, 125
12/7/04	T60	*Asterias rubens*		1	
		Crangon vulgaris		about 100	
		Echiichthys vipera	Lesser Weever	1	45
		Liocarcinus depurator	Harbour Swimming Crab	3	
		Nephtys (?)		1	
		Pagurus bernhardus		5	
		Pleuronectes platessa	Plaice	4	80, 55, 45, 45
		Rhizostoma octopus		1	
		Pleurobrachia pileus	Sea Gooseberries	6	

Appendix 9 *(continued)*

Date	Trawl No	Species		Number	Size (mm)
		Latin Name	**Common Name**		
12/7/04	T62	*Agonus cataphractus*	Pogge	5	30, 30, 35, 35, 25
		Crangon vulgaris		about 150	
		Liocarcinus depurator	Harbour Swimming Crab	3	
		Pagurus bernhardus		3	
		Pandalus montagui	Aesop Prawn, Pink Shrimp	1	
		Pleuronectes platessa	Plaice	14	140, 130, 100, 90, 45, 40, 45, 40, 45, 45, 50, 35, 40, 30
		Rhizostoma octopus		4	
		Syngnathus acus	Greater Pipefish	3	60, 65, 60
		Pleurobrachia pileus	Sea Gooseberries	5	
12/7/04	T52	*Crangon vulgaris*		16	
		Echiichthys vipera	Lesser Weever	10	100, 85, 75, 60, 85, 60, 85, 85, 90, 80
		Liocarcinus depurator	Harbour Swimming Crab	1	
		Pagurus bernhardus		2	
		Pleuronectes platessa	Plaice	11	120, 70, 80, 65, 60, 55, 85, 80, 85, 85, 95
		Rhizostoma octopus		3	
		Solea solea	Sole	2	110, 65
		Ammodytes tobianus	Lesser Sandeel	1	125
		Pleurobrachia pileus	Sea gooseberries	30	
12/7/04	T67	*Agonus cataphractus*	Pogge	2	35, 30
		Callionymus lyra	Common Dragonet	2	100, 65
		Crangon vulgaris		8	
		Echiichthys vipera	Lesser Weever	16	50, 75, 70, 60, 75, 75, 65, 170, 95, 85, 80, 70, 130, 100, 95, 130
		Liocarcinus depurator	Harbour Swimming Crab	3	
		Pagurus bernhardus		12	
		Pleuronectes platessa	Plaice	8	80, 85, 85, 65, 50, 80, 55, 55
		Solea solea	Sole	3	80, 100, 100
		Limanda limanda	Dab	1	75
12/7/04	T68	*Agonus cataphractus*	Pogge	1	45
		Callionymus lyra	Common Dragonet	1	130
		Crangon vulgaris		15	
		Echiichthys vipera	Lesser Weever	10	90, 95, 105, 115, 115, 70, 75, 75, 55, 45
		Liocarcinus depurator	Harbour Swimming Crab	3	
		Pagurus bernhardus		1	
		Pleuronectes platessa	Plaice	12	90, 95, 70, 40, 80, 50, 45, 105, 115, 95, 65, 65
		Rhizostoma octopus		1	
		Solea solea	Sole	5	105, 115, 95, 65, 65
		Trigla lucerna	Tub Gurnard	1	145
		Ammodytes tobianus	Lesser Sandeel	1	130

Appendix 9 *(continued)*

Date	Trawl No	Species		Number	Size (mm)
		Latin Name	**Common Name**		
12/7/04	T70	*Asterias rubens*		1	50
		Callionymus lyra	Common Dragonet	1	60
		Carcinus maenas	Shore Crab	3	
		Crangon vulgaris		30	
		Echiichthys vipera	Lesser Weever	37	75, 70, 70, 90, 75, 95, 80, 80, 75, 85, 70, 90, 80, 80, 130, 50, 90, 100, 120, 90, 85, 120, 130, 90, 100, 105, 80, 100, 70, 70, 80, 65, 75, 80, 80, 70, 60
		Liocarcinus depurator	Harbour Swimming Crab	3	
		Merlangius merlangus	Whiting	3	65, 75, 80
		Ophelia rathkei		1	
		Pagurus bernhardus		7	
		Pleuronectes platessa	Plaice	12	150, 85, 80, 80, 45, 80, 85, 50, 80, 80, 75, 60
		Rhizostoma octopus		1	
		Solea solea	Sole	2	60, 110
		Syngnathus acus	Greater Pipefish	1	150
		Ammodytes tobianus	Lesser Sandeel	2	150, 145
		Pleurobrachia pileus	Sea Gooseberries	1	
12/7/04	T72	*Carcinus maenas*	Shore Crab	1	
		Crangon vulgaris		30	
		Echiichthys vipera	Lesser Weever	4	110, 120, 90, 80
		Liocarcinus depurator	Harbour Swimming Crab	1	
		Pleuronectes platessa	Plaice	5	90, 75, 70, 45, 50
		Rhizostoma octopus		1	
		Ammodytes tobianus	Lesser Sandeel	2	110, 115
		Pleurobrachia pileus	Sea Gooseberries	5	
12/7/04	T71	*Crangon vulgaris*		about 100	
		Cyanea capillata	Lions Mane Jelly	4	
		Idotea linearis		1	
		Liocarcinus depurator	Harbour Swimming Crab	1	
		Merlangius merlangus	Whiting	8	70, 95, 80, 75, 55, 60, 55, 70
		Pagurus bernhardus		1	
		Pleuronectes platessa	Plaice	15	35, 45, 45, 150, 50, 40, 35, 40, 45, 35, 40, 50, 50, 50, 45
		Psetta maxima	Turbot	1	155
		Rhizostoma octopus octopus		7	
		Solea solea	Sole	1	45
		Sprattus sprattus	Sprat	1	55
		Ammodytes tobianus	Lesser Sandeel	2	100, 50

Appendix 9 *(continued)*

Date	Trawl No	Species		Number	Size (mm)
		Latin Name	**Common Name**		
12/7/04	T32	*Carcinus maenas*	Shore Crab	29	
		Crangon vulgaris		100's	
		Liocarcinus depurator	Harbour Swimming Crab	1	
		Merlangius merlangus	Whiting	23	115, 110, 90, 95, 85, 90, 80, 95, 70, 90, 80, 75, 80, 65, 55, 80, 80, 70, 70, 50, 75, 80, 50
		Pleuronectes platessa	Plaice	4	100, 45, 250, 120
		Ammodytes tobianus	Lesser Sandeel	7	135, 110, 135, 110, 110, 115, 115
13/7/04	T27	*Agonus cataphractus*	Pogge	1	35
		Carcinus maenas	Shore Crab	19	
		Crangon vulgaris		100's	
		Cyanea capillata	Lions Mane Jelly	1	
		Echiichthys vipera	Lesser Weeverfish	1	100
		Merlangius merlangus	Whiting	2	75, 60
		Pleuronectes platessa	Plaice	4	170, 170, 135, 55
		Ammodytes tobianus	Lesser Sandeel	17	130, 130, 120, 130, 120, 140, 95, 120, 125, 120, 135, 125, 110, 135, 110, 140, 120
13/7/04	T33	*Agonus cataphractus*	Pogge	3	145
		Asterias rubens		8	
		Carcinus maenas	Shore Crab	95	130
		Crangon vulgaris		100's	
		Merlangius merlangus	Whiting	1	70
		Pholis gunnellus	Butterfish	1	
		Ammodytes tobianus	Lesser Sandeel	1	90, 95, 35
13/7/04	T39	*Carcinus maenas*	Shore Crab	10	
		Crangon vulgaris		100's	
		Rhizostoma octopus		2	135
		Sprattus sprattus	Sprat	1	
		Syngnathus acus	Greater Pipefish	1	
		Ammodytes tobianus	Lesser Sandeel	1	
		Pleurobrachia pileus	Sea Gooseberries	100's	120
13/7/04	T46	*Asterias rubens*		1	
		Carcinus maenas	Shore Crab	2	
		Crangon vulgaris		100's	
		Echiichthys vipera	Lesser Weever	12	90, 75, 100, 75, 75, 80, 80, 75, 90, 70, 70, 75
		Idotea		1	
		Liocarcinus depurator	Harbour Swimming Crab	3	
		Merlangius merlangus	Whiting	29	70, 70, 75, 70, 60, 70, 110, 80, 60, 90, 70, 70, 70, 65, 70, 75, 85, 80, 65, 70, 75, 75, 55, 60, 85, 60, 55, 50, 60
		Pleuronectes platessa	Plaice	3	45, 45, 40
		Trisopterus minutus	Poor Cod	1	65

Appendix 9 *(continued)*

Date	Trawl No	Species		Number	Size (mm)
		Latin Name	**Common Name**		
13/7/04	T41	*Carcinus maenas*	Shore Crab	1	
		Crangon vulgaris		about 50	
		Cyanea capillata	Lions Mane Jelly	1	
		Echiichthys vipera	Lesser Weever	11	55, 60, 65, 75, 85, 75, 55, 55, 65, 55, 60
		Liocarcinus depurator	Harbour Swimming Crab	1	
		Merlangius merlangus	Whiting	1	80
		Pleuronectes platessa	Plaice	25	40, 85, 75, 180, 80, 50, 60, 45, 45, 50, 80, 55, 55, 55, 60, 50, 70, 50, 55, 60, 45, 50, 45, 20, 20
		Rhizostoma octopus		2	
		Sepiola atlantica d'Orbigny	Little cuttlefish	6	
		Syngnathus acus	Greater Pipefish	1	110
		Ammodytes tobianus	Lesser Sandeel	3	85, 80, 85
26/7/04	T12	*Crangon vulgaris*		about 100	
		Merlangius merlangus	Whiting	4	60, 65, 65, 65
		Pleuronectes platessa	Plaice	4	40, 40, 30, 35
		Sepiola atlantica d'Orbigny	Little cuttlefish	1	
		Sprattus sprattus	Sprat	3	70, 60, 65
		Syngnathus acus	Greater Pipefish	4	120, 130, 80, 90
		Pleurobrachia pileus	Sea Gooseberries	about 50	
26/7/04	T13	*Carcinus maenas*	Shore Crab	22	
		Crangon vulgaris		100's	
		Idotea linearis		1	
		Merlangius merlangus	Whiting	34	75, 90, 65, 75, 85, 75, 80, 70, 95, 80, 75, 70, 75, 70, 70, 70, 85, 85, 105, 70, 75, 65, 70, 70, 70, 50, 110, 80, 100, 75, 70, 75, 60, 90
		Pleuronectes platessa	Plaice	10	90, 50, 50, 40, 60, 60, 65, 50, 50, 50
		Sprattus sprattus	Sprat	8	65, 80, 75, 60, 65, 70, 70, 60
		Syngnathus acus	Greater Pipefish	3	130, 110, 130
		Pleurobrachia pileus	Sea Gooseberries	20	
26/7/04	T17	*Agonus cataphractus*	Pogge	3	35, 40, 40
		Carcinus maenas	Shore Crab	1	
		Crangon vulgaris		50	
		Liocarcinus depurator	Harbour Swimming Crab	1	
		Merlangius merlangus	Whiting	27	100, 80, 55, 70, 75, 70, 90, 80, 85, 75, 75, 70, 95, 65, 70, 70, 75, 75, 90, 70, 80, 80, 75, 80, 65, 80, 65
		Pleuronectes platessa	Plaice	5	45, 35, 40, 40, 45
		Sepiola atlantica d'Orbigny	Little cuttlefish	2	
		Sprattus sprattus	Sprat	17	60, 60, 55, 60, 100, 60, 60, 65, 60, 65, 65, 60, 65, 60, 60, 60, 60
		Syngnathus acus	Greater Pipefish	4	145, 130, 130, 75
		Ammodytes tobianus	Lesser Sandeel	1	100

Appendix 9 *(continued)*

Date	Trawl No	Species		Number	Size (mm)
		Latin Name	**Common Name**		
26/7/04	T21	*Agonus cataphractus*	Pogge	2	35, 40
		Carcinus maenas	Shore Crab	4	
		Crangon vulgaris		100's	
		Liocarcinus depurator	Harbour Swimming Crab	23 (≤30mm)	
		Merlangius merlangus	Whiting	35	90, 80, 85, 95, 70, 90, 70, 80, 85, 65, 95, 75, 75, 90, 85, 70, 90, 65, 65, 75, 60, 65, 85, 65, 75, 80, 70, 55, 70, 70, 65, 80, 65, 75, 70
		Pleuronectes platessa	Plaice	33	130, 45, 45, 45, 55, 45, 55, 40, 45, 40, 45, 45, 45, 45, 50, 50, 45, 45, 50, 35, 45, 45, 45, 50, 50, 45, 40, 45, 45, 40, 45, 50
		Sepiola atlantica d'Orbigny	Little cuttlefish	7	
		Syngnathus acus	Greater Pipefish	5	150, 120, 80, 65, 120
26/7/04	T23	*Agonus cataphractus*	Pogge	2	45, 45
		Carcinus maenas	Shore Crab	10	
		Crangon vulgaris		about 200	
		Echiichthys vipera	Lesser Weever	7	130, 100, 105, 90, 80, 75, 90
		Idotea linearis		1	
		Merlangius merlangus	Whiting	26	90, 80, 75, 95, 70, 70, 85, 90, 80, 75, 80, 60, 70, 65, 75, 70, 80, 80, 75, 80, 75, 85, 80, 80, 90, 70
		Pleuronectes platessa	Plaice	3	160, 40, 45
		Sepiola atlantica d'Orbigny	Little cuttlefish	3	
		Sprattus sprattus	Sprat	1	100
		Syngnathus acus	Greater Pipefish	8	65, 130, 10, 80, 70, 140, 135, 75
		Ammodytes tobianus	Lesser Sandeel	19	120, 110, 120, 120, 120, 130, 110, 110, 110, 120, 110, 120, 105, 110, 120, 90, 110, 50, 55
26/7/04	TR10	*Carcinus maenas*	Shore Crab	4	
		Crangon vulgaris		about 100	
		Echiichthys vipera	Lesser Weever	1	110
		Liocarcinus depurator	Harbour Swimming Crab	3	
		Merlangius merlangus	Whiting	19	85, 115, 85, 75, 80, 75, 85, 75, 95, 70, 100, 95, 80, 75, 80, 70, 75, 75, 80
		Pleuronectes platessa	Plaice	25	45, 45, 40, 40, 45, 50, 45, 45, 40, 45, 40, 45, 45, 65, 45, 40, 45, 45, 45, 45, 45, 40, 45, 40, 40
		Sprattus sprattus	Sprat	3	75, 80, 45
		Syngnathus acus	Greater Pipefish	2	110, 115
		Ammodytes tobianus	Lesser Sandeel	3	115, 90, 90
		Pleurobrachia pileus	Sea gooseberries	100's	

Appendix 9 *(continued)*

Date	Trawl No	Species		Number	Size (mm)
		Latin Name	**Common Name**		
26/7/04	T28	*Agonus cataphractus*	Pogge	4	35, 35, 40, 30
		Crangon vulgaris		about 100	
		Idotea linearis		5	
		Merlangius merlangus	Whiting	31	70, 75, 90, 75, 75, 90, 105, 80, 85, 85, 80, 75, 80, 80, 95, 85, 85, 90, 90, 75, 85, 70, 80, 70, 75, 75, 75, 75, 70, 80, 65
		Sepiola atlantica d'Orbigny	Little cuttlefish	4	
		Sprattus sprattus	Sprat	2	105, 85
		Syngnathus acus	Greater Pipefish	6	140, 120, 130, 13, 80, 75
		Ammodytes tobianus	Lesser Sandeel	2	120, 100
26/7/04	T30	*Carcinus maenas*	Shore Crab	3	
		Crangon vulgaris		48	
		Echiichthys vipera	Lesser Weever	4	120, 90, 85, 90
		Limanda limanda	Dab	1	120
		Merlangius merlangus	Whiting	7	90, 80, 95, 80, 85, 90, 85
		Pleuronectes platessa	Plaice	26	85, 95, 130, 80, 75, 85, 45, 45, 40, 75, 50, 45, 105, 45, 45, 40, 40, 40, 50, 40, 40, 45, 45, 45, 40, 40
		Sepiola atlantica d'Orbigny	Little cuttlefish	2	
		Ammodytes tobianus	Lesser Sandeel	1	75
26/7/04	T35	*Carcinus maenas*	Shore Crab	5	
		Crangon vulgaris		about 80	
		Echiichthys vipera	Lesser Weever	4	120, 75, 75, 55
		Merlangius merlangus	Whiting	4	100, 95, 95, 60
		Pleuronectes platessa	Plaice	23	155, 75, 65, 40, 45, 55, 45, 40, 70, 45, 50, 45, 50, 50, 50, 40, 55, 45, 35, 35, 45, 30, 40
		Pleurobrachia pileus	Sea Gooseberries	about 50	
26/7/04	TR6	*Crangon vulgaris*		about 50	
		Echiichthys vipera	Lesser Weever	7	105, 120, 80, 50, 50, 65, 75
		Liocarcinus depurator	Harbour Swimming Crab	6 (≤30mm)	
		Pleuronectes platessa	Plaice	16	75, 75, 85, 75, 80, 55, 75, 55, 60, 60, 50, 50, 70, 60, 55, 50
		Syngnathus acus	Greater Pipefish	3	135, 115, 115
		Ammodytes tobianus	Lesser Sandeel	1	105
		Pleurobrachia pileus	Sea Gooseberries	18	
26/7/04	TR5	*Agonus cataphractus*	Pogge	17	80, 35, 35, 30, 40, 40, 40, 35, 40, 40, 35, 30, 30, 30, 35, 35, 35
		Asterias rubens		2	
		Carcinus maenas	Shore Crab	9	
		Crangon vulgaris		100's	
		Limanda limanda	Dab	2	190, 155
		Liocarcinus depurator	Harbour Swimming Crab	38	
		Merlangius merlangus	Whiting	10	95, 110, 70, 120, 65, 70, 95, 80, 65, 85

Appendix 9 *(continued)*

Date	Trawl No	Species		Number	Size (mm)
		Latin Name	**Common Name**		
26/7/04	TR5	*Pleuronectes platessa*	Plaice	9	120, 95, 75, 50, 60, 45, 50, 55, 25
		Pomatoschistus minutus	Sand Goby	1	65
		Sepiola atlantica d'Orbigny	Little cuttlefish	9	
		Trigla lucerna	Tub Gurnard	1	185
		Trisopterus minutus	Poor Cod	3	75, 40, 45
26/7/04	T42	*Asterias rubens*		4	
		Carcinus maenas	Shore Crab	4	
		Crangon vulgaris		about 100	
		Idotea linearis		1	
		Limanda limanda	Dab	1	200
		Liocarcinus depurator	Harbour Swimming Crab	3	
		Sepiola atlantica d'Orbigny	Little cuttlefish	1	
		Platichthys flesus	Flounder	1	105
26/7/04	TR3	*Agonus cataphractus*	Pogge	1	30
		Crangon vulgaris		about 100	
		Cyanea capillata	Lions Mane Jellyfish	2	
		Echiichthys vipera	Lesser Weever	2	80, 90
		Limanda limanda	Dab	2	190, 105
		Liocarcinus depurator	Harbour Swimming Crab	7	
		Merlangius merlangus	Whiting	30	100, 75, 80, 75, 60, 80, 95, 75, 80, 70, 90, 90, 75, 70, 75, 65, 70, 85, 70, 70, 80, 80, 85, 70, 85, 80, 70, 75, 75, 70
		Pleuronectes platessa	Plaice	18	125, 60, 70, 70, 50, 40, 70, 45, 70, 45, 50, 50, 45, 45, 50, 45, 45, 50
		Sepiola atlantica d'Orbigny	Little cuttlefish	2	
		Syngnathus acus	Greater Pipefish	3	70, 120, 130
		Trigla lucerna	Tub Gurnard	1	205
		Trisopterus minutus	Poor Cod	1	70
26/7/04	T95	*Crangon vulgaris*		about 100	
		Echiichthys vipera	Lesser Weever	1	95
		Idotea linearis		1	
		Limanda limanda	Dab	2	170, 200
		Liocarcinus depurator	Harbour Swimming Crab	2	
		Merlangius merlangus	Whiting	16	85, 60, 80, 70, 60, 75, 80, 75, 70, 85, 65, 75, 75, 80, 85, 75
		Pleuronectes platessa	Plaice	26	50, 45, 50, 75, 80, 75, 40, 40, 40, 45, 40, 40, 55, 75, 45, 45, 40, 55, 50, 45, 45, 50, 40, 40, 55, 35
		Pomatoschistus minutus	Sand Goby	1	75
		Portumnus latipes		1	
		Sprattus sprattus	Sprat	2	65, 65
		Syngnathus acus	Greater Pipefish	2	125, 75
		Trigla lucerna	Tub Gurnard	1	150
		Ammodytes tobianus	Lesser Sandeel	3	110, 105, 85

Appendix 9 *(continued)*

Date	Trawl No	Species		Number	Size (mm)
		Latin Name	**Common Name**		
26/7/04	TR7	*Agonus cataphractus*	Pogge	3	45, 40, 45
		Crangon vulgaris		about 100	
		Echiichthys vipera	Lesser Weever	24	130, 120, 80, 130, 110, 110, 105, 75, 80, 60, 90, 90, 75, 80, 85, 65, 70, 75, 75, 80, 85, 70, 65, 60
		Liocarcinus depurator	Harbour Swimming Crab	7	
		Merlangius merlangus	Whiting	44	95, 70, 65, 80, 75, 95, 70, 65, 65, 70, 70, 65, 65, 75, 75, 60, 85, 85, 65, 65, 85, 75, 95, 85, 95, 65, 65, 105, 70, 75, 75, 85, 70, 80, 80, 65, 70, 80, 75, 70, 90, 75, 80, 75
		Pleuronectes platessa	Plaice	68	45, 45, 55, 50, 55, 50, 45, 50, 85, 55, 40, 50, 55, 40, 45, 50, 45, 45, 45, 50, 45, 45, 80, 40, 45, 40, 40, 45, 40, 40, 55, 40, 35, 65, 35, 45, 45, 50, 40, 50, 45, 45, 40, 35, 50, 60, 45, 45, 55, 50, 45, 50, 50, 50, 35, 50, 50, 40, 40, 55, 45, 45, 50, 50, 55, 40, 45, 40
		Portumnus latipes		1	
		Sepiola atlantica d'Orbigny	Little cuttlefish	9	
		Sprattus sprattus	Sprat	3	75, 70, 70
		Syngnathus acus	Greater Pipefish	2	120, 80
		Ammodytes tobianus	Lesser Sandeel	1	55
27/7/04	T56	*Carcinus maenas*	Shore Crab	1	
		Crangon vulgaris		about 50	
		Crangon vulgaris		5	
		Cyanea capillata	Lions Mane Jellyfish	2	
		Echiichthys vipera	Lesser Weever	3	100, 80, 80
		Echiichthys vipera	Lesser Weever	1	90
		Limanda limanda	Dab	1	35
		Liocarcinus depurator	Harbour Swimming Crab	4	
		Merlangius merlangus	Whiting	1	60
		Merlangius merlangus	Whiting	2	65, 60
		Pagurus bernhardus		2	
		Pagurus bernhardus		1	
		Pleuronectes platessa	Plaice	24	50, 70, 75, 70, 55, 60, 65, 50, 45, 50, 55, 75, 65, 50, 45, 75, 55, 75, 80, 45, 35, 40, 40, 30
27/7/04	T58	*Pleuronectes platessa*	Plaice	6	100, 80, 80, 85, 90, 50
		Rhizostoma		1	
		Sepiola atlantica d'Orbigny	Little cuttlefish	2	
		Syngnathus acus	Greater Pipefish	3	120, 80, 80
		Platichthys flesus	Flounder	1	

Appendix 9 *(continued)*

Date	Trawl No	Species		Number	Size (mm)
		Latin Name	Common Name		
27/7/04	T53	*Crangon vulgaris*		15	
		Merlangius merlangus	Whiting	10	120, 75, 75, 75, 80, 105, 65, 75, 65, 85
		Pleuronectes platessa	Plaice	6	85, 55, 80, 75, 60, 60
		Sepiola atlantica d'Orbigny	Little cuttlefish	1	
		Platichthys flesus	Flounder	2	35, 105
27/7/04	T78	*Agonus cataphractus*	Pogge	19	80, 65, 70, 70, 50, 45, 40, 50, 40, 40, 35, 40, 40, 45, 45, 35, 30, 45, 35
		Carcinus maenas	Shore Crab	5	
		Crangon vulgaris		20	
		Echiichthys vipera	Lesser Weever	3	105, 115, 85
		Liocarcinus holsatus		1	
27/7/04	T79	*Agonus cataphractus*	Pogge	2	80, 30
		Carcinus maenas	Shore Crab	2	
		Crangon vulgaris		30	
		Cyanea capillata	Lions Mane Jellyfish	1	
		Echiichthys vipera	Lesser Weever	15	80, 75, 80, 95, 85, 80, 70, 80, 85, 75, 75, 70, 65, 75, 65
		Liocarcinus depurator	Harbour Swimming Crab	1	
		Merlangius merlangus	Whiting	7	60, 70, 80, 65, 65, 70, 70
		Pleuronectes platessa	Plaice	31	90, 110, 80, 75, 55, 85, 55, 70, 80, 55, 55, 55, 70, 50, 55, 50, 55, 55, 50, 55, 50, 45, 45, 25, 45, 45, 55, 55, 45, 50, 35
		Sprattus sprattus	Sprat	1	65
		Platichthys flesus	Flounder	5	120, 90, 100, 70, 75
		Pleurobrachia pileus	Sea Gooseberries	about 50	
27/7/04	TR15	*Crangon vulgaris*		5	
		Echiichthys vipera	Lesser Weever	4	120, 75, 70, 70
		Liocarcinus depurator	Harbour Swimming Crab	2	
		Merlangius merlangus	Whiting	2	50, 45
		Pleuronectes platessa	Plaice	7	75, 75, 80, 50, 55, 60, 55
		Sepiola atlantica d'Orbigny	Little cuttlefish	3	
		Syngnathus acus	Greater Pipefish	2	140, 120
		Platichthys flesus	Flounder	2	70, 110
27/7/04	T91	*Crangon vulgaris*		about 100	
		Echiichthys vipera	Lesser Weever	19	105, 135, 125, 145, 125, 130, 100, 105, 105, 120, 105, 85, 125, 95, 85, 90, 85, 70, 80
		Limanda limanda	Dab	3	130, 125, 90
		Liocarcinus depurator	Harbour Swimming Crab	2	
		Pagurus bernhardus		2	
		Pleuronectes platessa	Plaice	6	120, 95, 120, 55, 70, 75
		Sepiola atlantica d'Orbigny	Little cuttlefish	1	
		Syngnathus acus	Greater Pipefish	1	80
		Platichthys flesus	Flounder	1	155
		Ammodytes tobianus	Lesser Sandeel	9	120, 115, 155, 130, 120, 000, 000, 000, 000
		Pleurobrachia pileus	Sea Gooseberries	19	

Appendix 9 *(continued)*

Date	Trawl No	Species		Number	Size (mm)
		Latin Name	**Common Name**		
27/7/04	TR12	*Carcinus maenas*	Shore Crab	1	
		Echiichthys vipera	Lesser Weever	6	110, 130, 105, 115, 120, 000
		Liocarcinus depurator	Harbour Swimming Crab	2	
		Merlangius merlangus	Whiting	13	65, 90, 90, 70, 90, 75, 80, 95, 65, 75, 75, 95, 95
		Pleuronectes platessa	Plaice	17	45, 95, 40, 45, 85, 50, 50, 50, 50, 45, 50, 50, 40, 40, 50, 45, 40
		Sepiola atlantica d'Orbigny	Little cuttlefish	2	
		Syngnathus acus	Greater Pipefish	1	155
27/7/04	T29	*Carcinus maenas*	Shore Crab	5	
		Crangon vulgaris		about 100	
		Echiichthys vipera	Lesser Weever	6	110, 130, 105, 115, 120, 000
		Liocarcinus depurator	Harbour Swimming Crab	2	
		Merlangius merlangus	Whiting	13	65, 90, 90, 70, 90, 75, 80, 95, 65, 75, 75, 95, 95
		Pleuronectes platessa	Plaice	17	45, 95, 40, 45, 85, 50, 50, 50, 50, 45, 50, 50, 40, 40, 50, 45, 40
		Sepiola atlantica d'Orbigny	Little cuttlefish	2	
		Syngnathus acus	Greater Pipefish	1	155
27/7/04	T34	*Agonus cataphractus*	Pogge	1	30
		Carcinus maenas	Shore Crab	7	
		Crangon vulgaris		100–150	
		Liocarcinus depurator	Harbour Swimming Crab	11	
		Merlangius merlangus	Whiting	20	110, 105, 95, 105, 85, 90, 105, 110, 115, 75, 85, 85, 105, 85, 95, 90, 100, 75, 65, 75
		Pleuronectes platessa	Plaice	2	80, 45
		Sepiola atlantica d'Orbigny	Little cuttlefish	1	
		Ammodytes tobianus	Lesser Sandeel	6	110, 135, 125, 115, 100, 000
27/7/04	T36	*Carcinus maenas*	Shore Crab	7	
		Crangon vulgaris		100's	
		Dortumnus latipes		1	
		Idotea linearis		2	
		Limanda limanda	Dab	165	
		Liocarcinus depurator	Harbour Swimming Crab	5	
		Merlangius merlangus	Whiting	17	100, 95, 80, 105, 75, 110, 90, 70, 75, 105, 105, 80, 80, 85, 80, 75, 80
		Ammodytes tobianus	Lesser Sandeel	8	120, 110, 115, 155, 125, 115, 110, 95

Appendix 10 Site attribute tables for the Solway Firth cSAC

Reporting Category	**Interest Feature**	**Attribute**	**Target**	**Prescription**
Sublittoral sediment	Subtidal Sandbanks	Extent of identified sublittoral sediments	No change allowing for cyclical changes due to the hydrodynamic regime	At 2 year intervals review activities and events with the potential to reduce extent of feature such as dredging operations Satellite image to be acquired on a 2 year basis for monitoring purposes At 6 year intervals conduct monitoring survey of sublittoral sandbanks. Conducted using 0.1m^2 Stainless steel Day grab and 2m Beam trawl. Returning to previously sampled sites if possible
		Topography	No alteration in topography of the sublittoral sediment, allowing for natural responses to hydrodynamic regime	Satellite image to be acquired on a 2 year basis for monitoring purposes A satellite image should be obtained prior to planning a sampling survey to aid to aid site selection and navigation
		Sediment character	No change in composition of sediment types across the feature	Sediment sampling survey to be conducted every 6 years using 0.1m^2 Stainless steel Day grab. Sediment to be classified using Folk classification scheme Chemical sampling for TOC, heavy metal and hydrocarbons, to assess anthropogenic impact
		Distribution of biotopes	Maintain distribution of biotopes	Sampling for infauna and epifauna using 0.1m^2 Stainless steel Day grab and 2m Beam trawl to be conducted every 6 years. Survey should be conducted with effect of seasonality in mind at the planning stage Salinity measurements to be taken in addition to sabed sampling to aid verification of biotopes
		Extent of sub-feature	No change in extent of sublittoral sediment biotopes	Immediate investigation into the extent of identified *Sabellaria* reef and mussel beds. Suggested methods: sidescan sonar with drop-down video ground truthing. Good conditions and slack water critical Continued monitoring of sub-features on 6 yearly basis and enforcement of exclusion zones around protected habitats

Appendix 10 *(continued)*

Reporting Category	Interest Feature	Attribute	Target	Prescription
		Species composition	No decline in biotope quality as a result of reduction or removal of notable species.	At 6 year intervals conduct monitoring survey of sublittoral biotopes. Conducted using 0.1m^2 Stainless steel Day grab returning to previously sampled sites if possible Main Biotopes: **SS.SSA.SSaVS.NcirMac** monitor presence of *Bathyporeia pelagica* and *Haustorius arenarius* **SS.SSA.IFiSa.NcirBat** monitor presence of *Nephtys cirrosa* and *N. hombergii* and *Bathyporeia elegans* **SS.SBR.PoR.SalvMx** monitor presence of *Sabellaria alveolata*
		Species population measures	Maintain age/size class structure Maintain presence or abundance of positive indicator species No increase in presence or abundance of negative indicator species	At 6 year intervals conduct monitoring survey of sublittoral nursery grounds for commercially important fish species using 2m Beam trawl. Including: *Solea solea* *Pleuronectes platessa*

Appendix 11 Survey deck log

Environmental deck log

Client	**Scottish Natural Heritage**					**Job No**	**J/04/040**			
Location	**Inner Solway Firth**					**Vessel**	**Mariner**			
Survey	**Sublittoral Sandbank**					**Date**	**July 2004**			
Date	**Time (GMT)**	**Location**	**Grab/ Type**	**Drop**	**Sediment Description**	**Depth (m)**	**Photo**	**Bio sample**	**Fate**	**Lat/Long**
09/07/04	0513	G31	Day	1	Very compact, well sorted sand	9.2			NES	54 52 695N 3 23 21 96W
09/07/04	0516	G31	Day	2	Very compact, well sorted sand	8.9			NES	54 52 6597N 3 23 226W
09/07/04	0521	G31	Day	3	Very compact, well sorted sand	9.0			NES	54 52 681N 3 23 23W
09/07/04	0532	G32	Day	1	Fine – med sand	11.8		*	PSA	54 52 582N 3 23 902W
09/07/04	0540	G32	Day	2	Fine – med sand	11.7	Yes	**	½ full BIO	54 52 593N 3 23 882W
09/07/04	0554	G33	Day	1	Fine-med sand, gravel & shell fragments	13	Yes	✓	⅔ full BIO/ PSA	54 52 484N 3 24 226W
09/07/04	0607	G31	Day	4	Very compact, well sorted sand	8.3			NS	54 52 669N 3 23 241W
09/07/04	0611	G31	Day	5	Very compact, well sorted sand	8.4			NS	54 52 678N 3 23 245W
09/07/04	0622	G28	Day	1		10.0			NS	54 52 980N 3 23 035W
09/07/04	0627	G28	Day	2	Fine, well sorted sand	9.2		*	PSA	54 52 996N 3 23 065W
09/07/04	0634	G28	Day	3		9.8			NES	54 52 995N 3 23 049W
09/07/04	0640	G28	Day	4	Fine, well sorted sand	9.6	Yes	**	½ full BIO	54 52 995N 3 23 041W
09/07/04	0708	G34	Day	1		7.7			DNT	54 52 344N 3 23 819W
09/07/04	0708	G34	Day	2	Fine sand – well sorted	7.5		*	PSA	54 52 323N 3 23 848W
09/07/04	0715	G34	Day	3	Fine sand – well sorted	7.6		**	½ full BIO	54 52 348N 3 23 803W
09/07/04	0722	G37	Day	1	Fine sand overlaying thick black oily 'sludge'. Strong oily smell.	9.1	Yes	✓	¾ full PSA/ BIO	54 52 217N 3 23 940W
09/07/04	0737	G36	Day	1		13.00			DNT	54 52 240N 3 24 621W
09/07/04	0740	G36	Day	2	Fine well sorted sand	12.5		*	¼ full PSA	54 52 264N 3 24 638W
09/07/04	0746	G36	Day	3		12.4			NS	54 52 259N 3 24 637W

NES = Not Enough Sample. NS = No Sample. DNT = Did Not Trigger
Bio Sample: ✓ = total bio sample. * and ** = grab forms 1st or 2nd part of pooled bio sample.

Positions WGS84 Latitude and Longitude Degrees and Decimal Minutes

Appendix 11 *(continued)*

Client	**Scottish Natural Heritage**					**Job No**	**J/04/040**			
Location	**Inner Solway Firth**					**Vessel**	**Mariner**			
Survey	**Sublittoral Sandbank**					**Date**	**July 2004**			
Date	**Time (GMT)**	**Location**	**Grab/ Type**	**Drop**	**Sediment Description**	**Depth (m)**	**Photo**	**Bio sample**	**Fate**	**Lat/Long**
09/07/04	0750	G36	Day	4	Fine well sorted sand	12.5	Yes	**	½ full BIO	54 52 263N 3 24 610W
09/07/04	0757	G38	Day	1	Stones ≤1½ inch diameter. Barnacles present	14.2			SIJ	54 52 067N 3 24 879W
09/07/04	0802	G38	Day	2	Stones	14.0	Yes		SIJ	54 52 069N 3 24 876W
09/07/04	0806	G38	Day	3	Stones	14.0			SIJ	54 52 073N 3 24 883W
09/07/04	0819	G35	Day	1	Fine sand, few shell fragments	6.3		*	PSA	54 52 414N 3 25 181W
09/07/04	0824	G35	Day	2		6.1			SIJ	54 52 419N 3 25 179W
09/07/04	0827	G35	Day	3	Fine sand, few shell fragments	6.1	Yes	**	½ full BIO	54 52 424N 3 25 173W
09/07/04	0840	G39	Day	1	Fine well sorted sand	11.6		*	PSA	54 51 716N 3 25 602W
09/07/04	0902	G39	Day	2		11.3			NS	54 51 705N 3 25 611W
09/07/04	0907	G39	Day	3	Fine well sorted sand	11.2	Yes	**	½ full BIO	54 51 718N 3 25 612W
09/07/04	0921	G40	Day	1	*SABELLARIA REEF*	11.5	Yes		BIO	54 50 931N 3 26 969W
09/07/04	0932	G40a	Day	1	Fine sand	9.5		*	PSA	54 50 963N 3 27 010W
09/07/04	0938	G40a	Day	2	Fine sand. Evidence of oily 'sludge'	9.2	Yes	**	½ full BIO	54 50 965N 3 27 023W
09/07/04	0959	G46	Day	1	Fine sand	6.5	Yes	*	PSA	54 50 356N 3 28 620W
09/07/04	1007	G46	Day	2	Fine sand	6.4		**	½ full BIO	54 50 362N 3 28 620W
09/07/04	1025	G42	Day	1	Fine sand, some soft, black clay nodules	4.8	Yes	*	PSA	54 49 546N 3 28 215W
09/07/04	1029	G42	Day	2	Fine sand, some soft, black clay nodules	4.8	Yes	**	⅔ full BIO	54 49 546N 3 28 205W
09/07/04	1052	G55	Day	1		2.5			DNT	54 48 488N 3 29 676W
09/07/04	1056	G55	Day	2		2.4			NS	54 48 435N 3 29 685W
09/07/04	1103	G55	Day	3	Med-coarse sand, gravel & shell fragments	2.7	Yes	✓	? PSA/BIO	54 48 538N 3 29 684W
09/07/04	1131	G44	Day	1	Fine sand	4.5		*	PSA	54 48 586N 3 31 157W

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Bio Sample: ✓ = total bio sample. * and ** = grab forms 1st or 2nd part of pooled bio sample.

Positions WGS84 Latitude and Longitude Degrees and Decimal Minutes

Appendix 11 *(continued)*

Client	**Scottish Natural Heritage**					**Job No**	**J/04/040**			
Location	**Inner Solway Firth**					**Vessel**	**Mariner**			
Survey	**Sublittoral Sandbank**					**Date**	**July 2004**			
Date	**Time (GMT)**	**Location**	**Grab/ Type**	**Drop**	**Sediment Description**	**Depth (m)**	**Photo**	**Bio sample**	**Fate**	**Lat/Long**
09/07/04	1134	G44	Day	2		4.5	Yes		NS	54 48 587N 3 31 154W
09/07/04	1137	G44	Day	3	Fine sand	4.6		**	½ full BIO	54 48 572N 3 31 181W
09/07/04	1156	G43	Day	1	Fine sand	2.1		*	PSA	54 49 214N 3 31 635W
09/07/04	1159	G43	Day	2	Fine sand	2.0	Yes	**	⅔ full BIO	54 49 213N 3 31 639W
09/07/04	1240	G41	Day	1	Fine sand & some soft black clay	4.0	Yes	*	PSA	54 50 548N 3 30 634W
09/07/04	1245	G41	Day	2	Fine sand & some soft black clay	4.2	Yes	**	½ full BIO	54 50 554N 3 30 640W
09/07/04	1337	G95	Day	1		3.6			NS	54 51 327N 3 28 268W
09/07/04	1342	G95	Day	2	Fine sand	4.0	Yes	*	PSA	54 51 325N 3 28 240W
09/07/04	1347	G95	Day	3	Fine sand, few nodules of black sandy-clay	4.0		**	½ full BIO	54 51 320N 3 28 421W
09/07/04	1428	G30	Day	1		6.1		*	PSA	54 52 744N 3 24 814W
09/07/04	1432	G30	Day	2		6.3	Yes	**	½ full BIO	54 52 733N 3 24 827W
09/07/04	1458	G27	Day	1		8.8	Yes	✓	Full PSA & BIO	54 53 717N 3 22 939W
10/07/04	0633	G69	Day	1	Fine sand	11.2	Yes		PSA	54 51 302N 3 33 129W
10/07/04	0640	G69	Day	2	Fine sand, few worm casts	11.2		✓	½–⅔ full BIO	54 51 320N 3 33 134W
10/07/04	0656	G53	Day	1	Fine sand	13.2		*	PSA	54 50 568N 3 34 464W
10/07/04	0709	G53	Day	2	Fine sand	13.2	Yes	**	½ full BIO	54 50 566N 3 34 464W
10/07/04	0721	G54	Day	1	Fine – med sand	7.3	Yes	✓	⅔ PSA & BIO	54 50 108N 3 34 472W
10/07/04	0735	G49	Day	1		9.6	Yes	✓	⅔ PSA & BIO	54 49 264N 3 35 140W
10/07/04	0744	G50	Day	1	Fine sand	10.4	Yes	*	PSA	54 49 264N 3 35 194W
10/07/04	0750	G50	Day	2	Fine sand	10.5	Yes	**	½ full BIO	54 49 033N 3 35 197W
10/07/04	0806	G51	Day	1	Fine sand	16.7		*	PSA	54 49 237N 3 36 342W

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Bio Sample: ✓ = total bio sample. * and ** = grab forms 1st or 2nd part of pooled bio sample.

Positions WGS84 Latitude and Longitude Degrees and Decimal Minutes

Appendix 11 *(continued)*

Client	**Scottish Natural Heritage**					**Job No**	**J/04/040**			
Location	**Inner Solway Firth**					**Vessel**	**Mariner**			
Survey	**Sublittoral Sandbank**					**Date**	**July 2004**			
Date	**Time (GMT)**	**Location**	**Grab/ Type**	**Drop**	**Sediment Description**	**Depth (m)**	**Photo**	**Bio sample**	**Fate**	**Lat/Long**
10/07/04	0811	G51	Day	2	Fine sand	16.7	Yes	**	½ full BIO	54 49 247N 3 36 357W
10/07/04	0829	G57	Day	1	Med-coarse sand, gravel & shell	18.4	Yes	✓	½ PSA & BIO	54 49 749N 3 36 632W
10/07/04	0841	G58	Day	1	Med-coarse sand, shell	10.0	Yes	✓	Full PSA & BIO	54 49 473N 3 37 734W
10/07/04	0855	G59	Day	1	Med sand, some soft black clay nodules	8.0	Yes	✓	½ full PSA & BIO	54 49 440N 3 38 863W
10/07/04	0903	G63	Day	1	Fine sand	6.0	Yes	*	PSA	54 49 716N 3 39 496W
10/07/04	0911	G63	Day	2	Fine sand	5.9	Yes	**	½ full BIO	54 49 718N 3 39 501W
10/07/04	0929	G62	Day	1	Fine, well sorted sand	5.7	Yes	*	PSA	54 50 403N 3 38 986W
10/07/04	0935	G62	Day	2	Fine, well sorted sand	5.7	Yes	**	½ full BIO	54 50408N 3 38 981W
10/07/04	0951	G60	Day	1	Fine sand, nodules of soft silty-clay	9.1	Yes	✓	Full PSA/ BIO	54 50 242N 3 37 784W
10/07/04	1009	G52	Day	1	Med/coarse sand, shell, clay nodules and a few stones	14.9	Yes	✓	½ full PSA/ BIO	54 50 190N 3 36 346W
10/07/04	1025	G67	Day	1		15.5			DNT	54 50 458N 3 35 386W
10/07/04	1027	G67	Day	2	Fine-med sand, shells, some stones, stiff clay sub-layer	16.0	Yes	*	PSA	54 50 464N 3 35 398W
10/07/04	1033	G67	Day	3	Fine-med sand, shells, some stones, stiff clay sub-layer	15.8	Yes	**	⅔ full BIO	54 50 467N 3 35 396W
10/07/04	1050	G61	Day	1	Med sand, shell, high % stiff, sticky clay	11.6	Yes	✓	½ full PSA/ BIO	54 51 001N 3 36 371W
10/07/04	1103	G68	Day	1	Fine-med sand, shell	13.4	Yes	✓	½ full PSA/ BIO	54 51 137N 3 35 081W
10/07/04	1119	G78	Day	1		12.0	Yes		DNT	54 51 706N 3 35 631W
10/07/04	1120	G78	Day	2	Fine-med sand, shell, stiff black clay	12.1		✓	Full PSA/ BIO	54 51 694N 3 35 653W
10/07/04	1132	G70	Day	1	Med sand, gravel, shell, soft black clay	10.9	Yes		PSA	54 51 753N 3 34 522W
10/07/04	1137	G70	Day	2	Med sand, gravel, shell, soft black clay	10.8	Yes	✓	Full BIO	54 51 758N 3 34 531W
10/07/04	1148	G80	Day	1		11.6			SIJ	54 52 107N 3 35 095W

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Bio Sample: ✓ = total bio sample. * and ** = grab forms 1st or 2nd part of pooled bio sample.

Positions WGS84 Latitude and Longitude Degrees and Decimal Minutes

Appendix 11 *(continued)*

Client	**Scottish Natural Heritage**					**Job No**	**J/04/040**			
Location	**Inner Solway Firth**					**Vessel**	**Mariner**			
Survey	**Sublittoral Sandbank**					**Date**	**July 2004**			
Date	**Time (GMT)**	**Location**	**Grab/ Type**	**Drop**	**Sediment Description**	**Depth (m)**	**Photo**	**Bio sample**	**Fate**	**Lat/Long**
10/07/04	1151	G80	Day	2		11.6	Yes		SIJ	54 52 101N 3 35 087W
10/07/04	1154	G80	Day	3	Stones, gravel	11.6			NS	54 52 098N 3 35 092W
10/07/04	1156	G80	Day	4	Stones, gravel, mussel shells	11.8	Yes		NES	54 52 094N 3 35 085W
10/07/04	1201	G80	Day	5	Stones, gravel	11.6			SIJ	54 52 095N 3 35 097W
10/07/04	1203	G80	Day	6	Fine-med sand, mussel shells, soft clay	11.7	Yes	✓	½ full PSA/ BIO	54 52 088N 3 35 088W
10/07/04	1324	G75	Day	1		6.8			NES	54 53 077N 3 24 040W
10/07/04	1325	G75	Day	2	Fine silty-sand	5.8	Yes	✓	½ full PSA/ BIO	54 53 088N 3 34 052W
10/07/04	1348	G79	Day	1	Fine sand with soft clay nodules	5.5	Yes	✓	½ full PSA/ BIO	54 53 038N 3 32 836W
10/07/04	1359	G74	Day	1	Fine sand with soft clay nodules	10.3	Yes	✓	½ full PSA/ BIO	54 52 778N 3 33 507W
10/07/04	1415	G73	Day	1	Stones	9.6	Yes		SIJ	54 52 488N 3 34 813W
10/07/04	1418	G73	Day	2	Stones	9.9	Yes		SIJ	54 52 508N 3 34 792W
10/07/04	1421	G73	Day	3	Stones ≤ 80mm	10.0			SIJ	54 52 488N 3 34 810W
10/07/04	1426	G73	Day	4		10.8			SIJ	54 52 501N 3 34 760W
10/07/04	1429	G73	Day	5	Gravel & stones ≤ 70mm	10.4	Yes		SIJ	54 52 504N 3 34 761W
10/07/04	1448	G72	Day	1		9.3	Yes		NES	54 51 915N 3 32 295W
10/07/04	1453	G72	Day	2		9.2			NES	54 51 919N 3 32 294W
10/07/04	1455	G72	Day	3	Fine sand, few nodules of stiff clay	9.1		✓	⅔ full PSA/ BIO	54 51 930N 3 32 284W
10/07/04	1509	G71	Day	1	Fine sand	6.8	Yes	*	PSA	54 52 464N 3 30 228W
10/07/04	1514	G71	Day	2	Fine sand	6.9	Yes	**	½ full BIO	54 52 465N 3 30 228W
10/07/04	1530	G91	Day	1	Med/coarse sand, shell, some quite stiff clay	9.6	Yes	✓	Full PSA/ BIO	54 53 238N 3 28 398W
10/07/04	1541	G92	Day	1		5.3			DNT	54 52 806N 3 27 955W

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Positions WGS84 Latitude and Longitude Degrees and Decimal Minutes

Appendix 11 *(continued)*

Client	**Scottish Natural Heritage**					**Job No**	**J/04/040**			
Location	**Inner Solway Firth**					**Vessel**	**Mariner**			
Survey	**Sublittoral Sandbank**					**Date**	**July 2004**			
Date	**Time (GMT)**	**Location**	**Grab/ Type**	**Drop**	**Sediment Description**	**Depth (m)**	**Photo**	**Bio sample**	**Fate**	**Lat/Long**
10/07/04	1542	G92	Day	2	Fine sand	5.0	Yes	*	PSA	54 52 800N 3 27 951W
10/07/04	1545	G92	Day	3	Fine sand	5.2	Yes	**	½ full BIO	54 52 800N 3 27 952W
10/07/04	1601	G94	Day	1	Fine sand	6.8		*	PSA	54 53 897N 3 26 813W
10/07/04	1605	G94	Day	2	Fine sand	6.8	Yes	**	½ full BIO	54 53 897N 3 26 816W
10/07/04	1618	G29	Day	1	Med-coarse sand, shell	8.9	Yes	✓	Full PSA/ BIO	54 53 869N 3 25 426W
11/07/04	0825	G88	Day	1	Very fine silty-sand	3.6	Yes	*	PSA	54 56 155N 3 33 260W
11/07/04	0830	G88	Day	2	Very fine silty-sand	3.6		**	½ full BIO	54 56 156N 3 33 260W
11/07/04	0846	G87	Day	1	Fine sand, few shells	5.4	Yes	*	PSA	54 55 370N 3 32 175W
11/07/04	0852	G87	Day	2	Fine sand, few shells	5.2		**	½ full BIO	54 55 368N 3 32 183W
11/07/04	0902	G86	Day	1	Fine sand, few shells	4.7	Yes	*	PSA	54 54 809N 3 31 908W
11/07/04	0908	G86	Day	2	Fine sand, few shells	4.6		**	½ full BIO	54 54 813N 3 31 903W
11/07/04	0923	G85	Day	1	Fine sand	5.1		*	PSA	54 54 545N 3 31 963W
11/07/04	0927	G85	Day	2	Fine sand	5.0	Yes	**	½ full BIO	54 54 547N 3 31 959W
11/07/04	0940	G82	Day	1		3.9	Yes		DNT	54 54 451N 3 33 353W
11/07/04	0941	G82	Day	2	Fine sand overlaying thick mud	3.8		✓	⅔ full PSA/ BIO	54 54 451N 3 33 363W
11/07/04	0949	G81	Day	1		3.2			DNT	54 53 956N 3 33 350W
11/07/04	0950	G81	Day	2	Very fine sand & tube worm casts	3.2	Yes	*	PSA	54 53 955N 3 33 369W
11/07/04	0953	G81	Day	3	Very fine sand & tube worm casts	3.2		**	½ full BIO	54 53 958N 3 33 366W
11/07/04	1007	G83	Day	1	Fine sand	5.8		*	PSA	54 54 301N 3 31 955W
11/07/04	1014	G83	Day	2	Fine sand	5.6	Yes	**	⅔ full BIO	54 54 304N 3 31 961W
11/07/04		G84	Day	1					Unreachable	

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Positions WGS84 Latitude and Longitude Degrees and Decimal Minutes

Appendix 11 *(continued)*

Client	**Scottish Natural Heritage**					**Job No**	**J/04/040**			
Location	**Inner Solway Firth**					**Vessel**	**Mariner**			
Survey	**Sublittoral Sandbank**					**Date**	**July 2004**			
Date	**Time (GMT)**	**Location**	**Grab/ Type**	**Drop**	**Sediment Description**	**Depth (m)**	**Photo**	**Bio sample**	**Fate**	**Lat/Long**
11/07/04	1034	G77	Day	1	Fine sand	9.0	Yes	*	PSA	54 53 728N 3 32 370W
11/07/04	1039	G77	Day	2	Fine sand	8.8		**	½ full BIO	54 53 730N 3 32 365W
11/07/04	1054	G76	Day	1	Fine sand	2.5		*	PSA	54 53 527N 3 33 500W
11/07/04	1058	G76	Day	2	Fine sand	2.4		**	½ full BIO	54 53 527N 3 33 503W
11/07/04	1125	T86	Trawl	SOL		2.4			Heading 005	54 54 795N 3 31 874W
11/07/04	1130	T86	Trawl	EOL		2.4				54 54 912N 3 31 874W
11/07/04	1146	T83	Trawl	SOL		5.0			Heading 005	54 54 279N 3 31 972W
11/07/04	1152	T83	Trawl	EOL		5.0				54 54 369N 3 31 776W
11/07/04	1216	T77	Trawl	SOL		8.0			Heading 040	54 53 668N 3 32 445W
11/07/04	1219	T77	Trawl	EOL		8.0				54 53 741N 3 32 287W
11/07/04	1343	T74	Trawl	SOL		10.0			Heading 060	54 52 747N 3 33 582W
11/07/04	1347	T74	Trawl	EOL		10.0				54 52 822N 3 33 380W
11/07/04	1409	T69	Trawl	SOL		6.0			Heading 230	54 51 349N 3 33 078W
11/07/04	1413	T69	Trawl	EOL		6.0				54 51 280N 3 33 226W
11/07/04	1434	T54	Trawl	SOL		4.0			Heading 230	54 50 133N 3 34 434W
11/07/04	1437	T54	Trawl	EOL		6.0				54 50 061N 3 34 582W
11/07/04	1459	T50	Trawl	SOL		8.0			Heading 180	54 49 095N 3 35 195W
11/07/04	1504	T50	Trawl	EOL		8.0				54 48 969N 3 35 214W
11/07/04	1622	T55	Tawl	SOL		6.0			Heading 190	54 48 593N 3 29 685W
11/07/04	1626	T55	Trawl	EOL		6.0				54 48 484N 3 29 708W

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Positions WGS84 Latitude and Longitude Degrees and Decimal Minutes

Appendix 11 *(continued)*

Client	**Scottish Natural Heritage**					**Job No**	**J/04/040**			
Location	**Inner Solway Firth**					**Vessel**	**Mariner**			
Survey	**Sublittoral Sandbank**					**Date**	**July 2004**			
Date	**Time (GMT)**	**Location**	**Grab/ Type**	**Drop**	**Sediment Description**	**Depth (m)**	**Photo**	**Bio sample**	**Fate**	**Lat/Long**
11/07/04	1643	T44	Trawl	SOL		6.0			Heading 220	54 48 630N 3 31 152W
11/07/04	1647	T44	Trawl	EOL		6.0				54 48 523N 3 31 199W
11/07/04	1703	T43	Trawl	SOL		5.0			Heading 200	54 49 267N 3 31 593W
11/07/04	1708	T43	Trawl	EOL		5.0				54 49 169N 3 31 701W
12/07/04	0826	T82	Trawl	SOL		6.0			Heading 355	54 54 388N 3 33 342W
12/07/04	0831	T82	Trawl	EOL		6.0				54 54 497N 3 33 347W
12/07/04	0843	T81	Trawl	SOL		5.0			Heading 005	54 53 883N 3 33 359W
12/07/04	0848	T81	Trawl	EOL		5.0				54 53 992N 3 33 357W
12/07/04	0902	T76	Trawl	SOL		6.0			Heading 030	54 53 454N 3 33 553W
12/07/04	0907	T76	Trawl	EOL		6.0				54 53 558N 3 33 478W
12/07/04	0920	T75	Trawl	SOL		14.0			Heading 020	54 52 984N 3 34 088W
12/07/04	0924	T75	Trawl	EOL		11.0				54 53 089N 3 34 028W
12/07/04	0945	T80	Trawl	SOL		15.0			Heading 030	54 52 045N 3 35 151W
12/07/04	0950	T80	Trawl	EOL		15.0				54 52 139N 3 35 050W
12/07/04	1008	T61	Trawl	SOL		15.0			Heading 040	54 50 978N 3 36 432W
12/07/04	1013	T61	Trawl	EOL		15.0				54 51 055N 3 36 287W
12/07/04	1021	T61	Trawl	2 SOL		14.0			Heading 050	54 50 963N 3 36 466W
12/07/04	1026	T61	Trawl	2 EOL		14.0				54 51 032N 3 36 318W
12/07/04	1054	G64	Day	1	Fine sand	2.8		*	PSA	54 50 492N 3 40 517W
12/07/04	1058	G64	Day	2	Fine sand	2.8			NES	54 50 491N 3 40 513W
12/07/04	1101	G64	Day	3	Fine sand	2.8	Yes	**	½ full BIO	54 50 491N 3 40 514W

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Positions WGS84 Latitude and Longitude Degrees and Decimal Minutes

Appendix 11 *(continued)*

Client	**Scottish Natural Heritage**									
Location	**Inner Solway Firth**					**Vessel**	**Mariner**			
Survey	**Sublittoral Sandbank**					**Date**	**July 2004**			
Date	**Time (GMT)**	**Location**	**Grab/ Type**	**Drop**	**Sediment Description**	**Depth (m)**	**Photo**	**Bio sample**	**Fate**	**Lat/Long**
12/07/04	1111	G65	Day	1	Fine sand	2.4	Yes	✓	PSA/small BIO	54 50 364N 3 41 564W
12/07/04	1141	T63	Trawl	SOL		6.0			Heading 010	54 49 665N 3 39 512W
12/07/04	1145	T63	Trawl	EOL		6.0				54 49 764N 3 39 432W
12/07/04	1209	T59	Trawl	SOL		6.0			Heading 040	54 49 401N 3 38 911W
12/07/04	1215	T59	Trawl	EOL		6.0				54 49 484N 3 38 789W
12/07/04	1237	T51	Trawl	SOL		15.0			Heading 040	54 49 204N 3 36 432W
12/07/04	1241	T51	Trawl	EOL		15.0				54 49 284N 3 36 301W
12/07/04	1301	T57	Trawl	SOL		16.0			Heading 040	54 49 705N 3 36 694W
12/07/04	1306	T57	Trawl	EOL		16.0				54 49 788N 3 36 567W
12/07/04	1324	T60	Trawl	SOL		8.0			Heading 035	54 50 216N 3 37 824W
12/07/04	1327	T60	Trawl	EOL		8.0				54 50 230N 3 37 764W
12/07/04	1350	T62	Trawl	SOL		4.0			Heading 280	54 50 410N 3 38 992W
12/07/04	1354	T62	Trawl	EOL		4.0				54 50 428N 3 39 179W
12/07/04	1536	T52	Trawl	SOL		15			Heading 230	54 50 231N 3 36 305W
12/07/04	1540	T52	Trawl	EOL		15				54 50 169N 3 36 464W
12/07/04	1554	T67	Trawl	SOL		15			Heading 240	54 50 476N 3 35 300W
12/07/04	1600	T67	Trawl	EOL		15				54 50 421N 3 35 463W
12/07/04	1615	T68	Trawl	SOL		15			Heading 235	54 51 171N 3 35 000W
12/07/04	1620	T68	Trawl	EOL		15				54 51 111N 3 35 159W
12/07/04	1636	T70	Trawl	SOL		12			Heading 240	54 51 789N 3 34 422W
12/07/04	1642	T70	Trawl	EOL		12				54 51 743N 3 34 594W

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Positions WGS84 Latitude and Longitude Degrees and Decimal Minutes

Appendix 11 *(continued)*

Client	**Scottish Natural Heritage**					**Job No**	**J/04/040**			
Location	**Inner Solway Firth**					**Vessel**	**Mariner**			
Survey	**Sublittoral Sandbank**					**Date**	**July 2004**			
Date	**Time (GMT)**	**Location**	**Grab/ Type**	**Drop**	**Sediment Description**	**Depth (m)**	**Photo**	**Bio sample**	**Fate**	**Lat/Long**
12/07/04	1700	T72	Trawl	SOL		10			Heading 250	54 51 928N 3 32 234W
12/07/04	1706	T72	Trawl	EOL		10				54 51 875N 3 32 399W
12/07/04	1723	T71	Trawl	SOL		7			Heading 250	54 52 482N 3 30 106W
12/07/04	1728	T71	Trawl	EOL		7				5452 454N 3 30 288W
12/07/04	1737	T71	Trawl	2 SOL		7			Heading 270	54 52 470N 3 30 171W
12/07/04	1746	T71	Trawl	2 EOL		7				54 52 455N 3 30 356W
12/07/04	1842	T32	Trawl	SOL		10.0			Heading 200	54 52 635N 3 23 873W
12/07/04	1849	T32	Trawl	EOL		10.0				54 52 539N 3 23 962W
13/07/04	0909	G12	Day	1	Fine sand	4.8	Yes	*	PSA	54 56 855N 3 20 067W
13/07/04	0915	G12	Day	2	Fine sand	5.0		**	⅔ full BIO	54 56 850N 3 20 067W
13/07/04	0924	G19	Day	1	Fine sand	4.1		*	PSA	54 56 665N 3 19 506W
13/07/04	0929	G19	Day	2	Fine sand	4.1	Yes	**	½ full BIO	54 56 604N 3 19 511W
13/07/04	0936	G15	Day	1	Fine sand	4.1	Yes	*	PSA	54 56 350N 3 19 537W
13/07/04	0943	G15	Day	2	Fine sand	4.0		**	<½ full BIO	54 56 351N 3 19 530W
13/07/04	0951	G13	Day	1	Fine – med sand	4.4		*	PSA	54 56 465N 3 20 174W
13/07/04	0956	G13	Day	2	Fine – med sand	4.4	Yes	**	½ full BIO	54 56 466N 3 20 171W
13/07/04	1005	G14	Day	1	Fine sand	4.7	Yes	*	PSA	54 56 516N 3 20 175W
13/07/04	1010	G14	Day	2	Fine sand	4.6		**	½ full BIO	54 56 516N 3 20 701W
13/07/04	1019	G16	Day	1	Fine sand	5.3	Yes		PSA	54 56 270N 3 20 186W
13/07/04	1029	G16	Day	2	Fine sand	5.2	Yes	✓	⅔ full BIO	54 56 269N 3 20 807W
13/07/04	1032	G17	Day	1	Fine sand with worm casts	4.0	Yes	*	PSA	54 56 178N 3 20 347W

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Positions WGS84 Latitude and Longitude Degrees and Decimal Minutes

Appendix 11 *(continued)*

Client	**Scottish Natural Heritage**					**Job No**	**J/04/040**			
Location	**Inner Solway Firth**					**Vessel**	**Mariner**			
Survey	**Sublittoral Sandbank**					**Date**	**July 2004**			
Date	**Time (GMT)**	**Location**	**Grab/ Type**	**Drop**	**Sediment Description**	**Depth (m)**	**Photo**	**Bio sample**	**Fate**	**Lat/Long**
13/07/04	1036	G17	Day	2	Fine sand with worm casts	4.0		**	½ full BIO	54 56 173N 3 20 345W
13/07/04	1047	G20	Day	1		5.8	Yes		DNT	54 56 061N 3 21 157W
13/07/04	1048	G20	Day	2	Fine/med sand, some gravel	5.2		✓	½ full PSA/ BIO	54 56 049N 3 21 154W
13/07/04	1101	G21	Day	1	Fine sand, gravel & shell	4.5	Yes	*	PSA	54 55 742N 3 21 143W
13/07/04	1107	G21	Day	2	Fine sand, gravel & shell	4.4	Yes	**	½ full BIO	54 55 741N 3 21 143W
13/07/04	1114	G22	Day	1	Coarse sand, gravel & shell	8.7	Yes	✓	½ full PSA/ BIO	54 55 690N 3 21 722W
13/07/04	1125	G23	Day	1					NS	54 55 275N 3 22 225W
13/07/04	1131	G23	Day	2	Med-coarse sand, gravel & shell	8.0	Yes	✓	⅔ full PSA/ BIO	54 55 195N 3 21 776W
13/07/04	1141	G24	Day	1	Fine sand	5.7		*	PSA	54 54 428N 3 21 722W
13/07/04	1147	G24	Day	2	Fine sand	5.7	Yes	**	⅔ full BIO	54 54 427N 3 21 721W
13/07/04	1211	T27	Trawl	SOL		8.0			Heading 030	54 53 671N 3 22 954W
13/07/04	1217	T27	Trawl	EOL		8.0				54 53 761N 3 22 847W
13/07/04	1247	T33	Trawl	SOL		10.0			Heading 005	54 52 428N 3 24 231W
13/07/04	1256	T33	Trawl	EOL		10.0				54 52 536N 3 24 225W
13/07/04	1702	T39	Trawl	SOL		12.0			Heading 235	54 51 738N 3 25 535W
13/07/04	1712	T39	Trawl	EOL		12.0				54 51 677N 3 25 690W
13/07/04	1816	T46	Trawl	SOL		9.0			Heading 210	54 50 403N 3 28 554N
13/07/04	1827	T46	Trawl	EOL		9.0				54 50 329N 3 28 289W
13/07/04	1858	T41	Trawl	SOL		6.0			Heading 200	54 50 597N 3 30 601W
13/07/04	1904	T41	Trawl	EOL		6.0				54 50 502N 3 30 692W

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Positions WGS84 Latitude and Longitude Degrees and Decimal Minutes

Appendix 11 *(continued)*

Client	**Scottish Natural Heritage**					**Job No**	**J/04/040**			
Location	**Inner Solway Firth**					**Vessel**	**Mariner**			
Survey	**Sublittoral Sandbank**					**Date**	**July 2004**			
Date	**Time (GMT)**	**Location**	**Grab/ Type**	**Drop**	**Sediment Description**	**Depth (m)**	**Photo**	**Bio sample**	**Fate**	**Lat/Long**
26/07/04	527	GR8	Day	1	Fine sand	9	Yes	*	PSA	54 53 143N 3 24 095W
26/07/04	534	GR8	Day	2		9			NES	54 53 138N 3 24 091W
26/07/04	538	GR8	Day	3	Fine sand	9	Yes	**	½ full BIO	54 53 138N 3 24 098W
26/07/04	555	G25	Day	1	Fine sand	8	Yes	*	PSA	54 54 295N 3 23 678W
26/07/04	601	G25	Day	2	Fine sand	8	Yes	**	½ full BIO	54 54.294N 3 23.687W
26/07/04	616	GR10	Day	1	Fine sand	7.6	Yes	*	PSA	54 54.823N 3 22.612W
26/07/04	621	GR10	Day	2	Fine sand	7.6	Yes	**	⅔ full BIO	54 54.822N 3 22.596W
26/07/04	635	GR11	Day	1	Fine sand	3.5	Yes	*	PSA	54 55.025N 3 21.009W
26/07/04	639	GR11	Day	2	Fine sand	3.5		**	½ full BIO	54 55.015N 3 21.015W
26/07/04	709	T12	Trawl	SOL		4.3			Heading 060	54 56.823N 3 20.238W
26/07/04	714	T12	Trawl	EOL		4.3				54 56.883N 3 20.081W
26/07/04	726	T13	Trawl	SOL		5.5			Heading 055	54 56.416N 3 20.394W
26/07/04	732	T13	Trawl	EOL		5.5				54 56 480N 3 20 233W
26/07/04	744	T17	Trawl	SOL		3			Heading 040	54 56 128N 3 20 497W
26/07/04	749	T17	Trawl	EOL		3				54 56 215N 3 20 379W
26/07/04	801	T21	Trawl	SOL		5.5			Heading 030	54 55 641N 3 21 274W
26/07/04	0808	T21	Trawl	EOL		5.5				54 55 781N 3 21 169W
26/07/04	0820	T23	Trawl	SOL		8			Heading 010	54 55 132N 3 21 872W
26/07/04	0827	T23	Trawl	EOL		8				54 55 240N 3 21 850W
26/07/04	0846	TR10	Trawl	SOL		5.2			Heading 030	54 54 769N 3 22 661W
26/07/04	0854	TR10	Trawl	EOL		5.2				54 54 855N 3 22 543W

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Positions WGS84 Latitude and Longitude Degrees and Decimal Minutes

Appendix 11 *(continued)*

Client	**Scottish Natural Heritage**					**Job No**	**J/04/040**			
Location	**Inner Solway Firth**					**Vessel**	**Mariner**			
Survey	**Sublittoral Sandbank**					**Date**	**July 2004**			
Date	**Time (GMT)**	**Location**	**Grab/ Type**	**Drop**	**Sediment Description**	**Depth (m)**	**Photo**	**Bio sample**	**Fate**	**Lat/Long**
26/07/04		T24							Unreachable	
26/07/04	0940	T28	Trawl	SOL		6			Heading 020	54 52 973N 3 23 147W
26/07/04	0947	T28	Trawl	EOL		6				54 53 067N 3 23 050W
26/07/04	1005	T30	Trawl	SOL		4.8			Heading 020	54 52 704N 3 24 937W
26/07/04	1010	T30	Trawl	EOL		4.8				54 52 794N 3 24 825W
26/07/04	1023	T35	Trawl	SOL		4.5			Heading 050	54 52 386N 3 25 333W
26/07/04	1030	T35	Trawl	EOL		4.5				54 52 458N 3 25 191W
26/07/04	1053	GR7	Day	1	Fine sand	3	Yes	*	PSA	54 51 375N 3 26 852W
26/07/04	1100	GR7	Day	2	Fine sand	2.9	Yes	**	<½ full BIO	54 51 369N 3 26 847W
26/07/04	1117	GR5	Day	1	Fine-med sand, gravel & shell	5.4	Yes		PSA	54 50 072N 3 27 316W
26/07/04	1122	GR5	Day	2	Fine-med sand, gravel & shell	5.4	Yes	✓	⅔ full BIO	54 50 070N 3 27 310W
26/07/04	1145	GR2	Day	1	Fine-med sand, gravel & shell, small stones. *SABELLARIA* PRESENT	4.3	Yes	✓	¾ full PSA/ BIO	54 49 054N 3 29 376W
26/07/04	1201	GR3	Day	1	Fine sand	5.1	Yes	*	PSA	54 49 591N 3 30 052W
26/07/04	1206	GR3	Day	2	Fine sand	5		**	½ full BIO	54 49 591N 3 30 048W
26/07/04	1325	GR4	Day	1	Fine sand	1.7	Yes	*	PSA	54 49 928N 3 31 007W
26/07/04	1330	GR4	Day	2	Fine sand	1.7		**	½ full BIO	54 49 928N 3 31 012W
26/07/04	1355	GR6	Day	1	Fine sand	5.2	Yes	*	PSA	54 50 893N 3 29 392W
26/07/04	1402	GR6	Day	2	Fine sand	5.2	Yes	**	½ full BIO	54 50 894N 3 29 396W
26/07/04	1417	TR6	Trawl	SOL		5.3			Heading 220	54 50 934N 3 29 335W
26/07/04	1424	TR6	Trawl	EOL		5.3				54 50 858N 3 29 470W
26/07/04	1425	TR5	Trawl	SOL		6.8			Heading 220	54 50 113N 3 27 255W

NES = Not Enough Sample. NS = No Sample. DNT = Did Not Trigger
Bio Sample: ✓ = total bio sample. * and ** = grab forms 1st or 2nd part of pooled bio sample.

Positions WGS84 Latitude and Longitude Degrees and Decimal Minutes

Appendix 11 *(continued)*

Client	**Scottish Natural Heritage**					**Job No**	**J/04/040**			
Location	**Inner Solway Firth**					**Vessel**	**Mariner**			
Survey	**Sublittoral Sandbank**					**Date**	**July 2004**			
Date	**Time (GMT)**	**Location**	**Grab/ Type**	**Drop**	**Sediment Description**	**Depth (m)**	**Photo**	**Bio sample**	**Fate**	**Lat/Long**
26/07/04	1451	TR5	Trawl	EOL		6.8				54 50 031N 3 27 376W
26/07/04	1506	T42	Trawl	SOL		7.5			Heading 235	54 49 588N 3 28 227W
26/07/04	1514	T42	Trawl	EOL		7.5				54 49 523N 3 28 379W
26/07/04	1536	TR3	Trawl	SOL		7.6			Heading 265	54 49 593N 3 29 949W
26/07/04	1542	TR3	Trawl	EOL		7.6				54 49 588N 3 30 137W
26/07/04	1603	T95	Trawl	SOL		4			Heading 230	54 51 354N 3 28 446W
26/07/04	1609	T95	Trawl	EOL		4				54 51 297N 3 28 606W
26/07/04	1623	TR7	Trawl	SOL		5.6			Heading 230	54 51 419N 3 26 749W
26/07/04	1631	TR7	Trawl	EOL		5.6				54 51 348N 3 26 893W
27/07/04	0721	GR12	Day	1		7.7	Yes		DNT	54 53 330N 3 26 735W
27/07/04	0722	GR12	Day	2	Fine sand	7.6			PSA	54 53 325N 3 26 743W
27/07/04	0726	GR12	Day	3	Fine sand	7.6	Yes	✓	2/3 full BIO	54 53 326N 3 26 740W
27/07/04	0748	GR13	Day	1	Fine sand	6.9	Yes	*	PSA	54 53 151N 3 29 749W
27/07/04	0752	GR13	Day	2	Fine sand	6.9	Yes	**	1/2 full BIO	54 53 149N 3 29 753W
27/07/04	0808	GR14	Day	1		9.1			DNT	54 51 984N 3 31 235W
27/07/04	0810	GR14	Day	2	Med sand	9.2	Yes	*	PSA	54 51 990N 3 31 239W
27/07/04	0814	GR14	Day	3	Med sand	9.1	Yes	**	1/2 full BIO	54 51 989N 3 31 240W
27/07/04	0831	GR15	Day	1	Fine sand	9.2	Yes	*	PSA	54 52 247N 3 33 039W
27/07/04	0837	GR15	Day	2	Fine sand	9.1	Yes	**	1/2 full BIO	54 52 247N 3 33 038W
27/07/04	0909	G56	Day	1	Fine sand	8.2	Yes	*	PSA	54 49 932N 3 33 132W
27/07/04	0916	G56	Day	2	Fine sand	8.1	Yes	**	1/2 full BIO	54 49 931N 3 33 140W

NES = Not Enough Sample. NS = No Sample. DNT = Did Not Trigger
Bio Sample: ✓ = total bio sample. * and ** = grab forms 1st or 2nd part of pooled bio sample.

Positions WGS84 Latitude and Longitude Degrees and Decimal Minutes

Appendix 11 *(continued)*

Client	**Scottish Natural Heritage**					**Job No**	**J/04/040**			
Location	**Inner Solway Firth**					**Vessel**	**Mariner**			
Survey	**Sublittoral Sandbank**					**Date**	**July 2004**			
Date	**Time (GMT)**	**Location**	**Grab/ Type**	**Drop**	**Sediment Description**	**Depth (m)**	**Photo**	**Bio sample**	**Fate**	**Lat/Long**
27/07/04	0929	T56	Trawl	SOL		7.8			Heading 080	54 49 919N 3 33 228W
27/07/04	0935	T56	Trawl	EOL		7.8				54 49 944N 3 33 038W
27/07/04	1007	T58	Trawl	SOL		9.2			Heading 030	54 49 437N 3 37 857W
27/07/04	1013	T58	Trawl	EOL		9.2				54 49 533N 3 37 767W
27/07/04	1042	T53	Trawl	SOL		10.7			Heading 095	54 50 573N 3 34 603W
27/07/04	1046	T53	Trawl	EOL		10.7				54 50 586N 3 34 411W
27/07/04	1112	T78	Trawl	SOL		12.8			Heading 060	54 51 666N 3 35 852W
27/07/004	1118	T78	Trawl	EOL		12.8				54 51 715N 3 35 683W
27/07/04	1157	T79	Trawl	SOL		8			Heading 120	54 53 062N 3 32 972W
27/07/04	1200	T79	Trawl	EOL		8				54 53 004N 3 32 809W
27/07/04	1417	TR15	Trawl	SOL		5.2			Heading 230	54 52 291N 3 32 972W
27/07/04	1421	TR15	Trawl	EOL		5.2				54 52 215N 3 33 110W
27/07/04	1504	T91	Trawl	SOL		7.3			Heading 240	54 53 218N 3 28 384W
27/07/04	1509	T91	Trawl	EOL		7.3				54 53 218N 3 28 548W
27/07/04	1617	TR12	Trawl	SOL		4.3			Heading 240	54 53 357N 3 26 617W
27/07/04	1625	TR12	Trawl	EOL		4.3				54 53 307N 3 26 783W
27/07/04	1643	T29	Trawl	SOL		8			Heading 240	54 53 901N 3 25 419W
27/07/04	1651	T29	Trawl	EOL		8				54 53 855N 3 25 590W
27/07/04	1738	T34	Trawl	SOL		8.3			Heading 225	54 52 393N 3 23 822W
27/07/04	1743	T34	Trawl	EOL		8.3				54 52 321N 3 23 965W
27/07/04	1756	T36	Trawl	SOL		12.9			Heading 230	54 52 305N 3 24 629W
27/07/04	1803	T36	Trawl	EOL		12.9				54 52 222N 3 24 751W

NES = Not Enough Sample. NS = No Sample. DNT = Did Not Trigger
Bio Sample: ✓ = total bio sample. * and ** = grab forms 1st or 2nd part of pooled bio sample.

Positions WGS84 Latitude and Longitude Degrees and Decimal Minutes

Appendix 12 Deck photograph log

Image No	Format	Label	Location NGR – Eastings	Location NGR – Northings	Specific or general	General location	Site	Site No	Subject	Title	Date	Photographer	Copyright	Digital copy?
G12#1	Digital	Yes	314625.65	562250.85	S	Solway	Inner Solway	G12#1	Day grab sample	Site Condition Monitoring: The Sublittoral Sandbanks Of The Solway Firth	13/07/2004	Andy Tourell	SNH	Yes
G13#2	Digital	Yes	314500.83	561529.72	S	Solway	Inner Solway	G13#2	Day grab sample	Site Condition Monitoring: The Sublittoral Sandbanks Of The Solway Firth	13/07/2004	Andy Tourell	SNH	Yes
G14#1	Digital	Yes	314498.25	561618.82	S	Solway	Inner Solway	G14#1	Day grab sample	Site Condition Monitoring: The Sublittoral Sandbanks Of The Solway Firth	13/07/2004	Andy Tourell	SNH	Yes
G15#1	Digital	Yes	315173.69	561305.44	S	Solway	Inner Solway	G15#1	Day grab sample	Site Condition Monitoring: The Sublittoral Sandbanks Of The Solway Firth	13/07/2004	Andy Tourell	SNH	Yes
G16#1	Digital	Yes	314477.80	561162.84	S	Solway	Inner Solway	G16#1	Day grab sample	Site Condition Monitoring: The Sublittoral Sandbanks Of The Solway Firth	13/07/2004	Andy Tourell	SNH	Yes
G16#2	Digital	Yes	313814.76	561175.55	S	Solway	Inner Solway	G16#2	Day grab sample	Site Condition Monitoring: The Sublittoral Sandbanks Of The Solway Firth	13/07/2004	Andy Tourell	SNH	Yes
G17#1	Digital	Yes	314302.71	560999.22	S	Solway	Inner Solway	G17#1	Day grab sample	Site Condition Monitoring: The Sublittoral Sandbanks Of The Solway Firth	13/07/2004	Andy Tourell	SNH	Yes
G19#2	Digital	Yes	315210.30	561772.24	S	Solway	Inner Solway	G19#2	Day grab sample	Site Condition Monitoring: The Sublittoral Sandbanks Of The Solway Firth	13/07/2004	Andy Tourell	SNH	Yes
G20#2	Digital	Yes	313436.52	560782.13	S	Solway	Inner Solway	G20#2	Day grab sample	Site Condition Monitoring: The Sublittoral Sandbanks Of The Solway Firth	13/07/2004	Andy Tourell	SNH	Yes
G21#1	Digital	Yes	313437.09	560203.31	S	Solway	Inner Solway	G21#1	Day grab sample	Site Condition Monitoring: The Sublittoral Sandbanks Of The Solway Firth	13/07/2004	Andy Tourell	SNH	Yes
G21#2	Digital	Yes	313437.09	560203.31	S	Solway	Inner Solway	G21#2	Day grab sample	Site Condition Monitoring: The Sublittoral Sandbanks Of The Solway Firth	13/07/2004	Andy Tourell	SNH	Yes
G22#1	Digital	Yes	312817.02	560126.28	S	Solway	Inner Solway	G22#1	Day grab sample	Site Condition Monitoring: The Sublittoral Sandbanks Of The Solway Firth	13/07/2004	Andy Tourell	SNH	Yes
G23#2	Digital	Yes	312741.37	559203.88	S	Solway	Inner Solway	G23#2	Day grab sample	Site Condition Monitoring: The Sublittoral Sandbanks Of The Solway Firth	13/07/2004	Andy Tourell	SNH	Yes
G24#2	Digital	Yes	312772.41	557778.51	S	Solway	Inner Solway	G24#2	Day grab sample	Site Condition Monitoring: The Sublittoral Sandbanks Of The Solway Firth	13/07/2004	Andy Tourell	SNH	Yes
G25#1	Digital	Yes	310676.16	557578.61	S	Solway	Inner Solway	G25#1	Day grab sample	Site Condition Monitoring: The Sublittoral Sandbanks Of The Solway Firth	26/07/2004	Andy Tourell	SNH	Yes
G25#2	Digital	Yes	310666.50	557576.58	S	Solway	Inner Solway	G25#2	Day grab sample	Site Condition Monitoring: The Sublittoral Sandbanks Of The Solway Firth	26/07/2004	Andy Tourell	SNH	Yes

Appendix 12 *(continued)*

Image No	Format	Label	Location NGR – Eastings	Location NGR – Northings	Specific or general	General location	Site	Site No	Subject	Title	Date	Photographer	Copyright	Digital copy?
G27#1	Digital	Yes	311445.05	556491.06	S	Solway	Inner Solway	G27#1	Day grab sample	Site Condition Monitoring: The Sublittoral Sandbanks Of The Solway Firth	07/09/04	Andy Tourell	SNH	Yes
G29#1	Digital	Yes	308792.55	556822.49	S	Solway	Inner Solway	G29#1	Day grab sample	Site Condition Monitoring: The Sublittoral Sandbanks Of The Solway Firth	07/10/04	Andy Tourell	SNH	Yes
G30#2	Digital	Yes	309390.28	554706.58	S	Solway	Inner Solway	G30#2	Day grab sample	Site Condition Monitoring: The Sublittoral Sandbanks Of The Solway Firth	07/09/04	Andy Tourell	SNH	Yes
G32#2	Digital	Yes	310395.61	554430.39	S	Solway	Inner Solway	G32#2	Day grab sample	Site Condition Monitoring: The Sublittoral Sandbanks Of The Solway Firth	07/09/04	Andy Tourell	SNH	Yes
G33#1	Digital	Yes	310023.53	554226.34	S	Solway	Inner Solway	G33#1	Day grab sample	Site Condition Monitoring: The Sublittoral Sandbanks Of The Solway Firth	07/09/04	Andy Tourell	SNH	Yes
G35#3	Digital	Yes	309008.59	554135.48	S	Solway	Inner Solway	G35#3	Day grab sample	Site Condition Monitoring: The Sublittoral Sandbanks Of The Solway Firth	07/09/04	Andy Tourell	SNH	Yes
G36#4	Digital	Yes	309604.61	553822.90	S	Solway	Inner Solway	G36#4	Day grab sample	Site Condition Monitoring: The Sublittoral Sandbanks Of The Solway Firth	07/09/04	Andy Tourell	SNH	Yes
G37#1	Digital	Yes	310319.59	553730.65	S	Solway	Inner Solway	G37#1	Day grab sample	Site Condition Monitoring: The Sublittoral Sandbanks Of The Solway Firth	07/09/04	Andy Tourell	SNH	Yes
G39#3	Digital	Yes	308512.61	552843.21	S	Solway	Inner Solway	G39#3	Day grab sample	Site Condition Monitoring: The Sublittoral Sandbanks Of The Solway Firth	07/09/04	Andy Tourell	SNH	Yes
G40#1	Digital	Yes	307030.65	551404.31	S	Solway	Inner Solway	G40#1	Day grab sample	Site Condition Monitoring: The Sublittoral Sandbanks Of The Solway Firth	07/09/04	Andy Tourell	SNH	Yes
G40a#2	Digital	Yes	306974.25	551472.27	S	Solway	Inner Solway	G40a#2	Day grab sample	Site Condition Monitoring: The Sublittoral Sandbanks Of The Solway Firth	07/09/04	Andy Tourell	SNH	Yes
G41#1	Digital	Yes	303093.85	550786.19	S	Solway	Inner Solway	G41#1	Day grab sample	Site Condition Monitoring: The Sublittoral Sandbanks Of The Solway Firth	07/09/04	Andy Tourell	SNH	Yes
G41#2	Digital	Yes	303087.67	550797.46	S	Solway	Inner Solway	G41#2	Day grab sample	Site Condition Monitoring: The Sublittoral Sandbanks Of The Solway Firth	07/09/04	Andy Tourell	SNH	Yes
G42#1	Digital	Yes	305643.68	548873.01	S	Solway	Inner Solway	G42#1	Day grab sample	Site Condition Monitoring: The Sublittoral Sandbanks Of The Solway Firth	07/09/04	Andy Tourell	SNH	Yes
G42#2	Digital	Yes	305654.39	548872.78	S	Solway	Inner Solway	G42#2	Day grab sample	Site Condition Monitoring: The Sublittoral Sandbanks Of The Solway Firth	07/09/04	Andy Tourell	SNH	Yes
G43#2	Digital	Yes	301964.22	548328.33	S	Solway	Inner Solway	G43#2	Day grab sample	Site Condition Monitoring: The Sublittoral Sandbanks Of The Solway Firth	07/09/04	Andy Tourell	SNH	Yes

Appendix 12 *(continued)*

Image No	Format	Label	Location NGR – Eastings	Location NGR – Northings	Specific or general	General location	Site	Site No	Subject	Title	Date	Photographer	Copyright	Digital copy?
G46#1	Digital	Yes	305241.73	550384.19	S	Solway	Inner Solway	G46#1	Day grab sample	Site Condition Monitoring: The Sublittoral Sandbanks Of The Solway Firth	07/09/04	Andy Tourell	SNH	Yes
G49#1	Digital	Yes	298217.68	548511.73	S	Solway	Inner Solway	G49#1	Day grab sample	Site Condition Monitoring: The Sublittoral Sandbanks Of The Solway Firth	07/10/04	Andy Tourell	SNH	Yes
G50#1	Digital	Yes	298159.86	548513.04	S	Solway	Inner Solway	G50#1	Day grab sample	Site Condition Monitoring: The Sublittoral Sandbanks Of The Solway Firth	07/10/04	Andy Tourell	SNH	Yes
G50#2	Digital	Yes	298146.82	548079.19	S	Solway	Inner Solway	G50#2	Day grab sample	Site Condition Monitoring: The Sublittoral Sandbanks Of The Solway Firth	07/10/04	Andy Tourell	SNH	Yes
G51#2	Digital	Yes	296913.81	548508.02	S	Solway	Inner Solway	G51#2	Day grab sample	Site Condition Monitoring: The Sublittoral Sandbanks Of The Solway Firth	07/10/04	Andy Tourell	SNH	Yes
G52#1	Digital	Yes	296965.62	550254.57	S	Solway	Inner Solway	G52#1	Day grab sample	Site Condition Monitoring: The Sublittoral Sandbanks Of The Solway Firth	07/10/04	Andy Tourell	SNH	Yes
G53#2	Digital	Yes	298995.76	550909.81	S	Solway	Inner Solway	G53#2	Day grab sample	Site Condition Monitoring: The Sublittoral Sandbanks Of The Solway Firth	07/10/04	Andy Tourell	SNH	Yes
G54#1	Digital	Yes	298967.94	550053.28	S	Solway	Inner Solway	G54#1	Day grab sample	Site Condition Monitoring: The Sublittoral Sandbanks Of The Solway Firth	07/10/04	Andy Tourell	SNH	Yes
G55#3	Digital	Yes	304031.04	547037.04	S	Solway	Inner Solway	G55#3	Day grab sample	Site Condition Monitoring: The Sublittoral Sandbanks Of The Solway Firth	07/09/04	Andy Tourell	SNH	Yes
G56#1	Digital	Yes	300394.55	549700.11	S	Solway	Inner Solway	G56#1	Day grab sample	Site Condition Monitoring: The Sublittoral Sandbanks Of The Solway Firth	27/07/2004	Andy Tourell	SNH	Yes
G56#2	Digital	Yes	300388.08	549698.03	S	Solway	Inner Solway	G56#2	Day grab sample	Site Condition Monitoring: The Sublittoral Sandbanks Of The Solway Firth	27/07/2004	Andy Tourell	SNH	Yes
G57#1	Digital	Yes	296640.58	549438.25	S	Solway	Inner Solway	G57#1	Day grab sample	Site Condition Monitoring: The Sublittoral Sandbanks Of The Solway Firth	07/10/04	Andy Tourell	SNH	Yes
G58#1	Digital	Yes	295449.21	548964.85	S	Solway	Inner Solway	G58#1	Day grab sample	Site Condition Monitoring: The Sublittoral Sandbanks Of The Solway Firth	07/10/04	Andy Tourell	SNH	Yes
G59#1	Digital	Yes	294238.87	548926.35	S	Solway	Inner Solway	G59#1	Day grab sample	Site Condition Monitoring: The Sublittoral Sandbanks Of The Solway Firth	07/10/04	Andy Tourell	SNH	Yes
G60#1	Digital	Yes	295428.80	550390.24	S	Solway	Inner Solway	G60#1	Day grab sample	Site Condition Monitoring: The Sublittoral Sandbanks Of The Solway Firth	07/10/04	Andy Tourell	SNH	Yes
G61#1	Digital	Yes	296973.29	551757.22	S	Solway	Inner Solway	G61#1	Day grab sample	Site Condition Monitoring: The Sublittoral Sandbanks Of The Solway Firth	07/10/04	Andy Tourell	SNH	Yes

Appendix 12 *(continued)*

Image No	Format	Label	Location NGR – Eastings	Location NGR – Northings	Specific or general	General location	Site	Site No	Subject	Title	Date	Photographer	Copyright	Digital copy?
G62#1	Digital	Yes	294149.10	550709.63	S	Solway	Inner Solway	G62#1	Day grab sample	Site Condition Monitoring: The Sublittoral Sandbanks Of The Solway Firth	07/10/04	Andy Tourell	SNH	Yes
G62#2	Digital	Yes	294154.71	550720.63	S	Solway	Inner Solway	G62#2	Day grab sample	Site Condition Monitoring: The Sublittoral Sandbanks Of The Solway Firth	07/10/04	Andy Tourell	SNH	Yes
G63#1	Digital	Yes	293573.25	549454.14	S	Solway	Inner Solway	G63#1	Day grab sample	Site Condition Monitoring: The Sublittoral Sandbanks Of The Solway Firth	07/10/04	Andy Tourell	SNH	Yes
G63#2	Digital	Yes	293567.90	549454.26	S	Solway	Inner Solway	G63#2	Day grab sample	Site Condition Monitoring: The Sublittoral Sandbanks Of The Solway Firth	07/10/04	Andy Tourell	SNH	Yes
G64#3	Digital	Yes	292517.76	550915.32	S	Solway	Inner Solway	G64#3	Day grab sample	Site Condition Monitoring: The Sublittoral Sandbanks Of The Solway Firth	07/12/04	Andy Tourell	SNH	Yes
G65#1	Digital	Yes	291388.41	550708.69	S	Solway	Inner Solway	G65#1	Day grab sample	Site Condition Monitoring: The Sublittoral Sandbanks Of The Solway Firth	07/12/04	Andy Tourell	SNH	Yes
G67#2	Digital	Yes	297991.92	550743.24	S	Solway	Inner Solway	G67#2	Day grab sample	Site Condition Monitoring: The Sublittoral Sandbanks Of The Solway Firth	07/10/04	Andy Tourell	SNH	Yes
G67#3	Digital	Yes	297994.06	550743.19	S	Solway	Inner Solway	G67#3	Day grab sample	Site Condition Monitoring: The Sublittoral Sandbanks Of The Solway Firth	07/10/04	Andy Tourell	SNH	Yes
G68#1	Digital	Yes	298359.36	551981.69	S	Solway	Inner Solway	G68#1	Day grab sample	Site Condition Monitoring: The Sublittoral Sandbanks Of The Solway Firth	07/10/04	Andy Tourell	SNH	Yes
G69#1	Digital	Yes	300454.52	552235.35	S	Solway	Inner Solway	G69#1	Day grab sample	Site Condition Monitoring: The Sublittoral Sandbanks Of The Solway Firth	07/10/04	Andy Tourell	SNH	Yes
G70#1	Digital	Yes	298982.98	553103.09	S	Solway	Inner Solway	G70#1	Day grab sample	Site Condition Monitoring: The Sublittoral Sandbanks Of The Solway Firth	07/10/04	Andy Tourell	SNH	Yes
G70#2	Digital	Yes	298973.60	553114.43	S	Solway	Inner Solway	G70#2	Day grab sample	Site Condition Monitoring: The Sublittoral Sandbanks Of The Solway Firth	07/10/04	Andy Tourell	SNH	Yes
G71#1	Digital	Yes	303604.54	554326.18	S	Solway	Inner Solway	G71#1	Day grab sample	Site Condition Monitoring: The Sublittoral Sandbanks Of The Solway Firth	07/10/04	Andy Tourell	SNH	Yes
G71#2	Digital	Yes	303604.54	554326.18	S	Solway	Inner Solway	G71#2	Day grab sample	Site Condition Monitoring: The Sublittoral Sandbanks Of The Solway Firth	07/10/04	Andy Tourell	SNH	Yes
G72#1	Digital	Yes	301384.21	553383.68	S	Solway	Inner Solway	G72#1	Day grab sample	Site Condition Monitoring: The Sublittoral Sandbanks Of The Solway Firth	07/10/04	Andy Tourell	SNH	Yes
G74#1	Digital	Yes	300111.02	554981.41	S	Solway	Inner Solway	G74#1	Day grab sample	Site Condition Monitoring: The Sublittoral Sandbanks Of The Solway Firth	07/10/04	Andy Tourell	SNH	Yes

Appendix 12 *(continued)*

Image No	Format	Label	Location NGR – Eastings	Location NGR – Northings	Specific or general	General location	Site	Site No	Subject	Title	Date	Photographer	Copyright	Digital copy?
G75#2	Digital	Yes	299541.25	555572.99	S	Solway	Inner Solway	G75#2	Day grab sample	Site Condition Monitoring: The Sublittoral Sandbanks Of The Solway Firth	07/10/04	Andy Tourell	SNH	Yes
G77#1	Digital	Yes	301365.60	556723.63	S	Solway	Inner Solway	G77#1	Day grab sample	Site Condition Monitoring: The Sublittoral Sandbanks Of The Solway Firth	07/11/04	Andy Tourell	SNH	Yes
G78#1	Digital	Yes	297770.92	553030.32	S	Solway	Inner Solway	G78#1	Day grab sample	Site Condition Monitoring: The Sublittoral Sandbanks Of The Solway Firth	07/10/04	Andy Tourell	SNH	Yes
G79#1	Digital	Yes	300839.27	555455.07	S	Solway	Inner Solway	G79#1	Day grab sample	Site Condition Monitoring: The Sublittoral Sandbanks Of The Solway Firth	07/10/04	Andy Tourell	SNH	Yes
G80#6	Digital	Yes	298391.65	553739.82	S	Solway	Inner Solway	G80#6	Day grab sample	Site Condition Monitoring: The Sublittoral Sandbanks Of The Solway Firth	07/10/04	Andy Tourell	SNH	Yes
G81#2	Digital	Yes	300307.28	557170.03	S	Solway	Inner Solway	G81#2	Day grab sample	Site Condition Monitoring: The Sublittoral Sandbanks Of The Solway Firth	07/11/04	Andy Tourell	SNH	Yes
G82#1	Digital	Yes	300333.97	558082.26	S	Solway	Inner Solway	G82#1	Day grab sample	Site Condition Monitoring: The Sublittoral Sandbanks Of The Solway Firth	07/11/04	Andy Tourell	SNH	Yes
G83#2	Digital	Yes	301826.12	557782.18	S	Solway	Inner Solway	G83#2	Day grab sample	Site Condition Monitoring: The Sublittoral Sandbanks Of The Solway Firth	07/11/04	Andy Tourell	SNH	Yes
G85#2	Digital	Yes	301838.00	558227.19	S	Solway	Inner Solway	G85#2	Day grab sample	Site Condition Monitoring: The Sublittoral Sandbanks Of The Solway Firth	07/11/04	Andy Tourell	SNH	Yes
G86#1	Digital	Yes	301903.20	558715.56	S	Solway	Inner Solway	G86#1	Day grab sample	Site Condition Monitoring: The Sublittoral Sandbanks Of The Solway Firth	07/11/04	Andy Tourell	SNH	Yes
G87#1	Digital	Yes	301640.67	559756.58	S	Solway	Inner Solway	G87#1	Day grab sample	Site Condition Monitoring: The Sublittoral Sandbanks Of The Solway Firth	07/11/04	Andy Tourell	SNH	Yes
G88#1	Digital	Yes	300514.19	561239.73	S	Solway	Inner Solway	G88#1	Day grab sample	Site Condition Monitoring: The Sublittoral Sandbanks Of The Solway Firth	07/11/04	Andy Tourell	SNH	Yes
G91#1	Digital	Yes	305591.66	555719.92	S	Solway	Inner Solway	G91#1	Day grab sample	Site Condition Monitoring: The Sublittoral Sandbanks Of The Solway Firth	07/10/04	Andy Tourell	SNH	Yes
G92#2	Digital	Yes	306052.51	554897.65	S	Solway	Inner Solway	G92#2	Day grab sample	Site Condition Monitoring: The Sublittoral Sandbanks Of The Solway Firth	07/10/04	Andy Tourell	SNH	Yes
G92#3	Digital	Yes	306051.44	554897.67	S	Solway	Inner Solway	G92#3	Day grab sample	Site Condition Monitoring: The Sublittoral Sandbanks Of The Solway Firth	07/10/04	Andy Tourell	SNH	Yes
G94#2	Digital	Yes	307308.15	556908.58	S	Solway	Inner Solway	G94#2	Day grab sample	Site Condition Monitoring: The Sublittoral Sandbanks Of The Solway Firth	07/10/04	Andy Tourell	SNH	Yes

Appendix 12 *(continued)*

Image No	Format	Label	Location NGR – Eastings	Location NGR – Northings	Specific or general	General location	Site	Site No	Subject	Title	Date	Photographer	Copyright	Digital copy?
G95#2	Digital	Yes	305686.04	552167.00	S	Solway	Inner Solway	G95#2	Day grab sample	Site Condition Monitoring: The Sublittoral Sandbanks Of The Solway Firth	07/09/04	Andy Tourell	SNH	Yes
GR10#1	Digital	Yes	311834.09	558535.23	S	Solway	Inner Solway	GR10#1	Day grab sample	Site Condition Monitoring: The Sublittoral Sandbanks Of The Solway Firth	26/07/2004	Andy Tourell	SNH	Yes
GR10#2	Digital	Yes	311851.35	558532.66	S	Solway	Inner Solway	GR10#2	Day grab sample	Site Condition Monitoring: The Sublittoral Sandbanks Of The Solway Firth	26/07/2004	Andy Tourell	SNH	Yes
GR11#1	Digital	Yes	313554.05	558875.73	S	Solway	Inner Solway	GR11#1	Day grab sample	Site Condition Monitoring: The Sublittoral Sandbanks Of The Solway Firth	26/07/2004	Andy Tourell	SNH	Yes
GR12#2	Digital	Yes	307364.85	555851.42	S	Solway	Inner Solway	GR12#2	Day grab sample	Site Condition Monitoring: The Sublittoral Sandbanks Of The Solway Firth	27/07/2004	Andy Tourell	SNH	Yes
GR12#3	Digital	Yes	307366.77	555851.38	S	Solway	Inner Solway	GR12#3	Day grab sample	Site Condition Monitoring: The Sublittoral Sandbanks Of The Solway Firth	27/07/2004	Andy Tourell	SNH	Yes
GR13#1	Digital	Yes	304143.20	555590.70	S	Solway	Inner Solway	GR13#1	Day grab sample	Site Condition Monitoring: The Sublittoral Sandbanks Of The Solway Firth	27/07/2004	Andy Tourell	SNH	Yes
GR13#2	Digital	Yes	304139.28	555587.45	S	Solway	Inner Solway	GR13#2	Day grab sample	Site Condition Monitoring: The Sublittoral Sandbanks Of The Solway Firth	27/07/2004	Andy Tourell	SNH	Yes
GR14#2	Digital	Yes	302503.78	553472.04	S	Solway	Inner Solway	GR14#2	Day grab sample	Site Condition Monitoring: The Sublittoral Sandbanks Of The Solway Firth	27/07/2004	Andy Tourell	SNH	Yes
GR14#3	Digital	Yes	302502.45	553469.84	S	Solway	Inner Solway	GR14#3	Day grab sample	Site Condition Monitoring: The Sublittoral Sandbanks Of The Solway Firth	27/07/2004	Andy Tourell	SNH	Yes
GR15#1	Digital	Yes	300589.12	553990.46	S	Solway	Inner Solway	GR15#1	Day grab sample	Site Condition Monitoring: The Sublittoral Sandbanks Of The Solway Firth	27/07/2004	Andy Tourell	SNH	Yes
GR15#2	Digital	Yes	300590.40	553990.43	S	Solway	Inner Solway	GR15#2	Day grab sample	Site Condition Monitoring: The Sublittoral Sandbanks Of The Solway Firth	27/07/2004	Andy Tourell	SNH	Yes
GR2#1	Digital	Yes	304380.64	547985.05	S	Solway	Inner Solway	GR2#1	Day grab sample	Site Condition Monitoring: The Sublittoral Sandbanks Of The Solway Firth	26/07/2004	Andy Tourell	SNH	Yes
GR3#1	Digital	Yes	303677.85	548996.31	S	Solway	Inner Solway	GR3#1	Day grab sample	Site Condition Monitoring: The Sublittoral Sandbanks Of The Solway Firth	26/07/2004	Andy Tourell	SNH	Yes
GR4#1	Digital	Yes	302669.34	549642.63	S	Solway	Inner Solway	GR4#1	Day grab sample	Site Condition Monitoring: The Sublittoral Sandbanks Of The Solway Firth	26/07/2004	Andy Tourell	SNH	Yes
GR5#1	Digital	Yes	306625.59	549825.76	S	Solway	Inner Solway	GR5#1	Day grab sample	Site Condition Monitoring: The Sublittoral Sandbanks Of The Solway Firth	26/07/2004	Andy Tourell	SNH	Yes

Appendix 12 *(continued)*

Image No	Format	Label	Location NGR – Eastings	Location NGR – Northings	Specific or general	General location	Site	Site No	Subject	Title	Date	Photographer	Copyright	Digital copy?
GR5#2	Digital	Yes	306631.94	549822.29	S	Solway	Inner Solway	GR5#2	Day grab sample	Site Condition Monitoring: The Sublittoral Sandbanks Of The Solway Firth	26/07/2004	Andy Tourell	SNH	Yes
GR6#1	Digital	Yes	304435.80	551395.67	S	Solway	Inner Solway	GR6#1	Day grab sample	Site Condition Monitoring: The Sublittoral Sandbanks Of The Solway Firth	26/07/2004	Andy Tourell	SNH	Yes
GR6#2	Digital	Yes	304431.97	551396.87	S	Solway	Inner Solway	GR6#2	Day grab sample	Site Condition Monitoring: The Sublittoral Sandbanks Of The Solway Firth	26/07/2004	Andy Tourell	SNH	Yes
GR7#1	Digital	Yes	307172.62	552232.14	S	Solway	Inner Solway	GR7#1	Day grab sample	Site Condition Monitoring: The Sublittoral Sandbanks Of The Solway Firth	26/07/2004	Andy Tourell	SNH	Yes
GR7#2	Digital	Yes	307177.53	552220.91	S	Solway	Inner Solway	GR7#2	Day grab sample	Site Condition Monitoring: The Sublittoral Sandbanks Of The Solway Firth	26/07/2004	Andy Tourell	SNH	Yes
GR8#1	Digital	Yes	310187.81	555451.19	S	Solway	Inner Solway	GR8#1	Day grab sample	Site Condition Monitoring: The Sublittoral Sandbanks Of The Solway Firth	26/07/2004	Andy Tourell	SNH	Yes
GR8#3	Digital	Yes	310184.60	555451.25	S	Solway	Inner Solway	GR8#3	Day grab sample	Site Condition Monitoring: The Sublittoral Sandbanks Of The Solway Firth	26/07/2004	Andy Tourell	SNH	Yes