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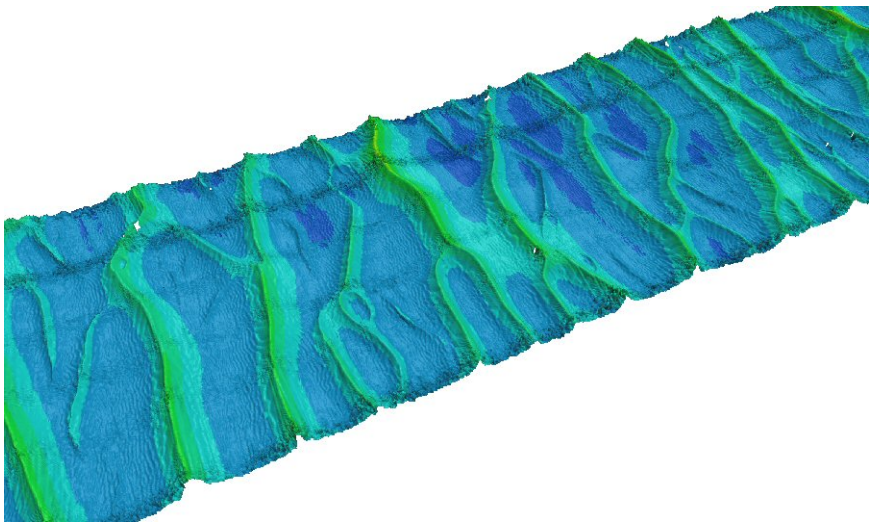
Outer Bristol Channel Marine Habitat Study – 2003 Investigations and Results

Coastal Geoscience Programme

Commissioned Report CR/04/054N



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COMMISSIONED REPORT CR/04/054N

Outer Bristol Channel Marine Habitat Study – 2003 Investigations and Results

JWC James, SL Philpott, G Jenkins, ASY Mackie, T Darbyshire and EIS Rees

Key words

Bristol Channel, marine habitats, bedforms, sand waves.

Front cover

Multibeam data example from Outer Bristol Channel illustrating sand wave field

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This publication, and references within it to any methodology, process, service, manufacturer, or company do not constitute its endorsement or recommendation by the Office of the Deputy Prime Minister or the Minerals Industry Research Organisation

Contents

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Glossary

BGS	British Geological Survey
NMGW	National Museums and Galleries of Wales
SES	Sonar Equipment Services
SSS	Sidescan sonar
SBP	Sub bottom profiler
MBES	Multibeam echosounder
ES	Echosounder
BMAPA	British Marine Aggregate Producers Association
MIRO	Mineral Industry Research Organisation
ODPM	Office of the Deputy Prime Minister
ALSF	Aggregate Levy Sustainability Fund
MCA	Maritime and Coast Guard Agency

1 Introduction

This report describes the investigations undertaken by the British Geological Survey (BGS) and the National Museums and Galleries of Wales (NMGW) during 2003 for the Outer Bristol Channel Marine Habitat Study, and the results and interpretations completed by March 2004 for the elements of the study funded by the Sustainable Land Won and Marine Dredged Aggregate Minerals Programme of the Office of the Deputy Prime Minister.

The complete study is a three year programme which is planned to end in March 2006. The other principal funder of the study is the Aggregate Levy Sustainability Fund for Wales, which is administered by the Welsh Assembly Government. The Crown Estate and the British Marine Aggregate Producers Association have also supported the study with some funding and contributions of data.

Pressure on marine resources in the Bristol Channel continues to develop with a number of issues including aggregates, fisheries and wind farm developments. There are also legislative obligations with regard to marine conservation, in a European context with the *Habitats Directive* and in national initiatives such as the designation of Carmarthen Bay, the Pembrokesire Coast and Lundy as candidate Special Areas of Conservation (cSACs).

To inform the policy and decision making process in terms of developments in the marine environment requires knowledge of its current physical state. This includes the morphology, geology, biology and sediments of the seabed. Baseline information on these is essential for strategic management and the conservation of biological diversity. Responsible stewardship requires an understanding of the way the marine environment functions and how the sea may respond to human activity. It also means involving stakeholders as an integral part of policy making.

The Bristol Channel Marine Aggregates: Resources and Constraints Research Project (Posford Duvivier & ABP Research, 2000), indicated significant gaps in the biological and geological data available for the Outer Bristol Channel area. The only comprehensive study of the benthic invertebrates (Warwick & Clark 1977) was carried out in 1972-1973 and British Geological Survey maps of the area were based on surveys undertaken from 1971 to 1976.

2 Aims and objectives

The aim of the Outer Bristol Channel Marine Habitat Study is to address the lack of broad-scale biological and geological data for the Outer Bristol Channel as well as providing information, through innovative media, to the public at large.

The principal objectives of the study are:

- To undertake a marine geophysical survey utilising multibeam, sidescan sonar and sub-bottom seismic reflection systems
- To undertake a sediment and benthic fauna survey
- Through co-operation with other organisations, actively seek to include within the study any multibeam, geophysical and biological data within the outer Bristol Channel
- Integrate new and archive geophysical, geological and biological survey data to produce comprehensive interpretations of marine species, habitats and biodiversity distributions within the study area

- Provide geophysical, geological and biological data as baseline criteria for the sustainable development of seabed resources including fisheries, aggregates and wind farms, and to inform the planning and regulatory process with regard to marine conservation, and national and EU legislation.
- In addition to providing data and interpretations through maps, reports and scientific publications, the project aims to make its results available to a wider audience through a bilingual multimedia CD-Rom, web pages, museum exhibition, and outreach awareness sessions at educational institutions, societies and interest groups.

3 Study area

The area covered by the Outer Bristol Channel Marine Habitat Study (Figure 1) includes approximately 2400 km^2 of the sea bed from Carmarthen Bay in the north to Lundy Island 60 km to the south. Its western limit is a line drawn from St Govan's Head in Pembrokeshire to Lundy Island. The planned eastern limit extends from Worms Head on the Gower to Bull Point on the North Devon coast. During the geophysical survey in November 2003 some of the lines were continued to the east of this planned limit (Map 1) to confirm the extent of the sand waves within the Nobel Sands.

The Nobel Sands is the major sand wave field which dominates the central section of the study area to the south-west of Worms Head (Figure 2). This sand wave field is also known as Nobel Banks. We prefer to use the noun Sands rather than Banks because the Nobel area does not contain any sand banks. The linear accumulations of sand, which can be seen on the multibeam lines in Map 1, are all sand waves. This distinction is important because the major banks in the Bristol Channel, such as Helwick Bank and Nash Bank, are generally singular, long linear features in relatively shallow water whose crests are aligned along the dominant path of the tidal currents which ebb and flow through the Bristol Channel. Sand wave crests are normally aligned across the path of tidal currents, they are generally numerous and form sand wave fields, as is the case in the Nobel Sands area. Sand banks and sand waves are unique and distinctive features with their own particular modes of formation and responses to the processes which control them.

4 Regional Setting

The Bristol Channel is situated between the coastlines of South Wales and North Devon and Somerset. It is a major submarine embayment that connects the estuary of the River Severn in the east to the Celtic Sea in the west. In the Outer Bristol Channel the sea bed reaches depths of 50-60m, shallowing eastwards to 10-20m in the Inner Bristol Channel. The present sea bed morphology of the Bristol Channel formed following marine inundation associated with sea level rise after the last glaciation.

4.1 SEDIMENT TRANSPORT AND HYDRODYNAMICS

The Bristol Channel is noted for having one of the highest tidal ranges in the world. The area is macrotidal with a maximum tidal range of 14.8m at Avonmouth in the eastern end of the estuary, and a mean springs range of 12.3m (Allen, 1990). In the outer Bristol Channel, around the Nobel Sands, the mean springs range is about 8m. It is an area of strong tidal currents which exceed $1ms^{-1}$ over wide areas and for long periods, consequently the waters of the system are well stirred. The Bristol Channel is south-west facing and open to the Atlantic Ocean and prevailing

south-westerly winds and storms. There is a long fetch to the south-west and the area can be subject to substantial storm surges (Lennon, 1963).

Extensive research has taken place on the sedimentology and sediment transport in the Severn Estuary and Bristol Channel over the past 30 years, including investigations by the Severn Tidal Power Group, the Institute of Oceanographic Sciences SKER project in Swansea Bay, the Bristol Channel Marine Aggregates: Resources and Constraints Project and numerous scientific papers. The majority of studies have focused on investigating sediment transport in the Central Bristol Channel, Inner Bristol Channel and lower Severn Estuary. There are relatively few studies covering the Outer Bristol Channel.

Two principal models have been proposed to explain sediment transport in the Bristol Channel. These are the "bedload parting" model and the "mutually evasive" model. A bedload parting zone has been proposed to exist at the boundary between the Inner Bristol Channel and the Severn Estuary (Kenyon & Stride, 1970, Stride & Belderson, 1990) with sand wave orientation indicating sand transport east of this zone into the Severn Estuary. To the west of the zone sand transport is ebb dominant and out into the Bristol Channel.

The "mutually evasive" transport model (Harris and Collins, 1991) concludes that tidal conditions have varying effects on sediment transport pathways. Within the mid channel where ebb tidal currents are dominant sand transport is to the west. However they believed there are narrow zones of flood dominant sediment transport adjacent to the coastline along both the northern and southern margins of the Bristol Channel. Local circulation eddies exist around the larger sandbanks (Helwick, Nash and Scarweather). These sandbanks play an important role in sediment circulation, by interacting with the tidal flow and wave propagation.

Modelling for the Bristol Channel Marine Aggregates: Resources and Constraints Project (Posford Duvivier & ABP Research, 2000) provides evidence to support the "mutually evasive" model. However, it also appeared to confirm the existence of sediment parting zones in the Inner Bristol Channel.

5 Survey Planning

A primary aim of the study was to gather high resolution data on the character and nature of the of the sea bed through deployment of state of the art geophysical equipment and techniques, including multibeam and multi-pulse digital sidescan. These provide sub-metre resolution swath images across the sea bed as the survey vessel proceeds along a survey line. The width of sea bed covered by each multibeam survey line varies with water depth, the shallower the water the narrower the swath width. In water depths of 50 m typical swath widths are around 150m. In 15 m water depth it can narrow to <50 m.

Multibeam and digital sidescan surveys are expensive. To provide complete sea bed coverage for the 2400 km^2 of the study area would be prohibitive for the funds available. The budget allowed a maximum of 12 days of 24 hour geophysical survey. Following an initial interpretation of the geology of the area (Figure 2) a survey strategy was devised to provide high-resolution data married to coverage of the study area at a regional scale. The strategy was to survey eleven kilometre wide corridors with complete multibeam and sidescan coverage (Figure 3). The planned corridors were 25 to 40 km long with centre lines at approximately 5 km spacing. They were aligned roughly parallel to the predominant tidal stream and at right angles to the regional trend of the sand wave crest lines in the Nobel Sands.

A boomer sub-bottom reflection seismic line was planned to run down the centre of each corridor to provide data on the thickness of sediment beneath the sea bed, including the volume

and extent of sand within the sand wave fields. Also where sediment was thin or non-existent the nature of the rock or other deposits exposed in these areas.

One of the study aims was to actively seek to include any multibeam, geophysical and biological data within the outer Bristol Channel. Therefore, prior to the survey work commencing, data, where readily available, were collated and compiled using a GIS and used to inform the survey protocol. This included:

- Sediment data from samples collected by BGS, NMGW and other sources (Figure 4)
- Geophysical records from BGS archives
- Multibeam data from the Maritime and Coastguard Agency
- United Kingdom Hydrographic Office data relating to bathymetry, sediments and bedforms
- Geophysical data made available by members of the British Marine Aggregate Producers Association (BMAPA)

The National Museum and Galleries of Wales had already planned and booked to undertake a biological survey cruise in July 2003 as part of their on-going survey programme. This survey cruise became the biological survey for the Outer Bristol Channel Marine Habitat Study. Unfortunately because of the timing of funding, the ideal scenario of a geophysical survey being completed before the biological cruise to allow location of biological sample sites based on the interpretation of new multibeam and sidescan data was not possible.

However a reasonable amount of data was available for planning and siting the survey corridors and proposed sample stations. Following an initial interpretation it was proposed that sample stations would be located at approximately 4km intervals along the centre of the survey corridors. Some stations were located for comparison purposes where samples had been collected during previous surveys. In addition, a further 24 proposed sample stations were located in areas of particular interest such as across major sand wave crests or in sand wave troughs (Figure 3).

During the biological cruise it was also planned to undertake video and still camera surveys at twelve sites (Figure 5). Their locations were chosen to provide sea bed images of diverse sea bed character including sand waves, megaripples, sand sheets and rock.

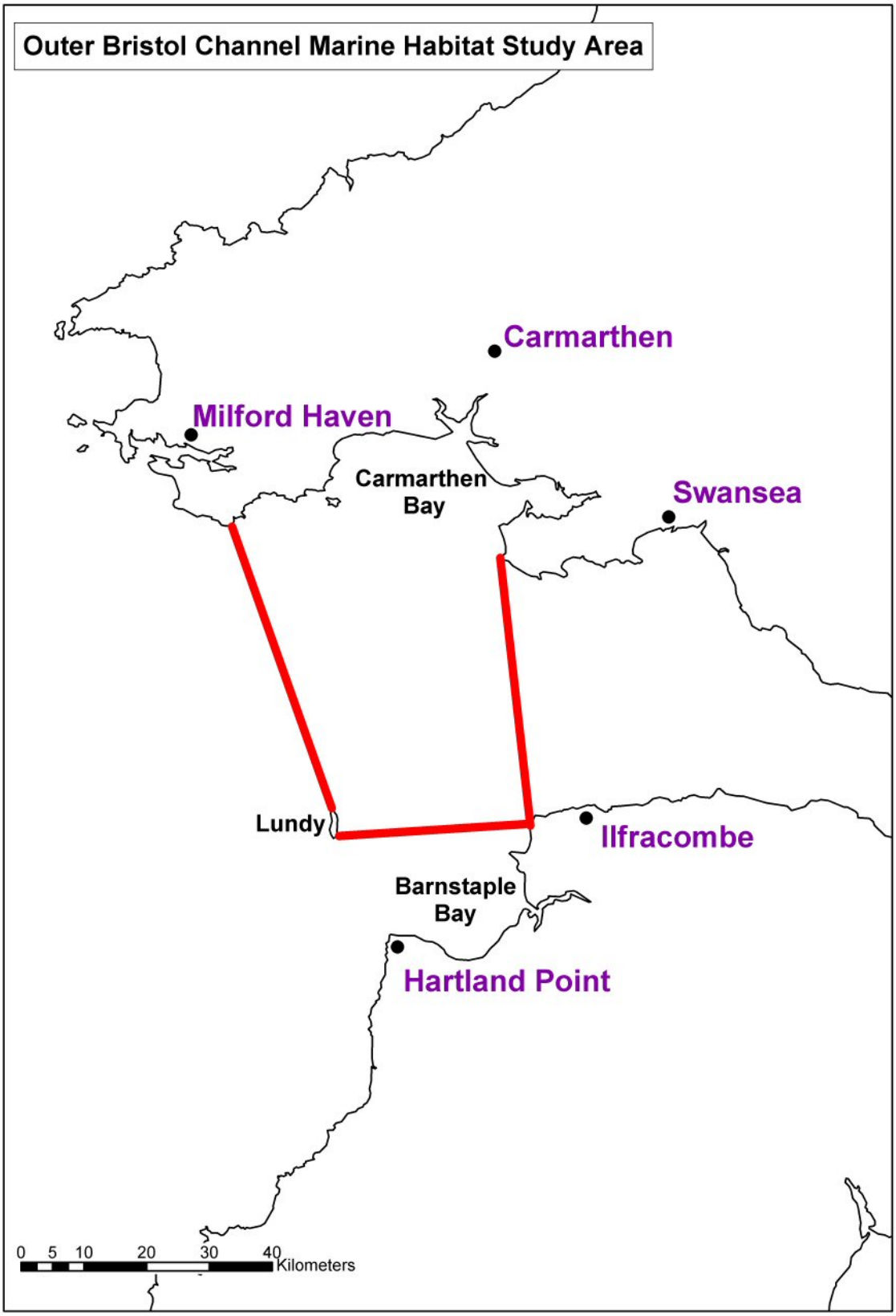


Figure 1. Location of study area

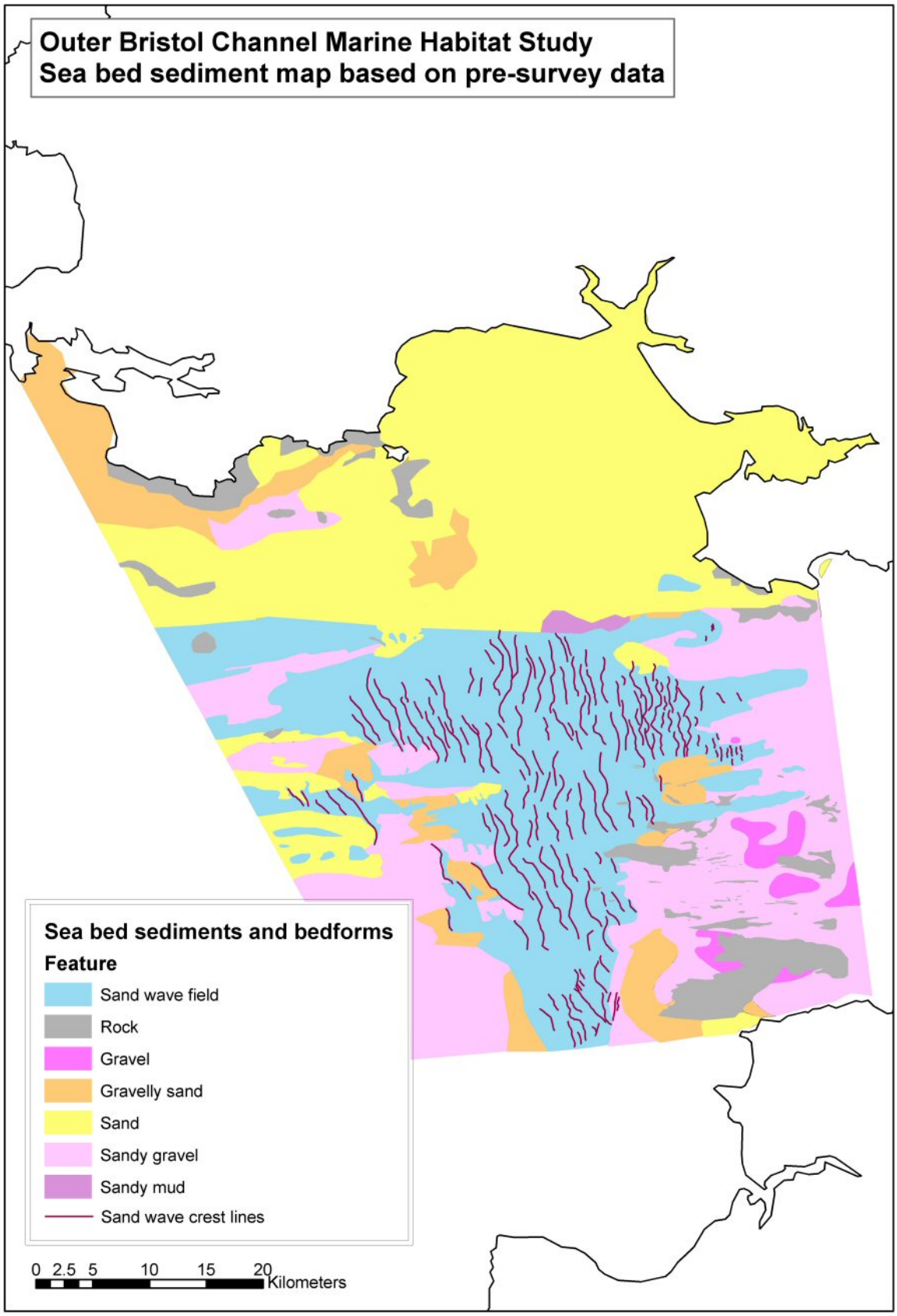


Figure 2. Survey planning – sea bed sediments and sand waves based on BGS 1:250,000 Sea Bed Sediments map and other sources

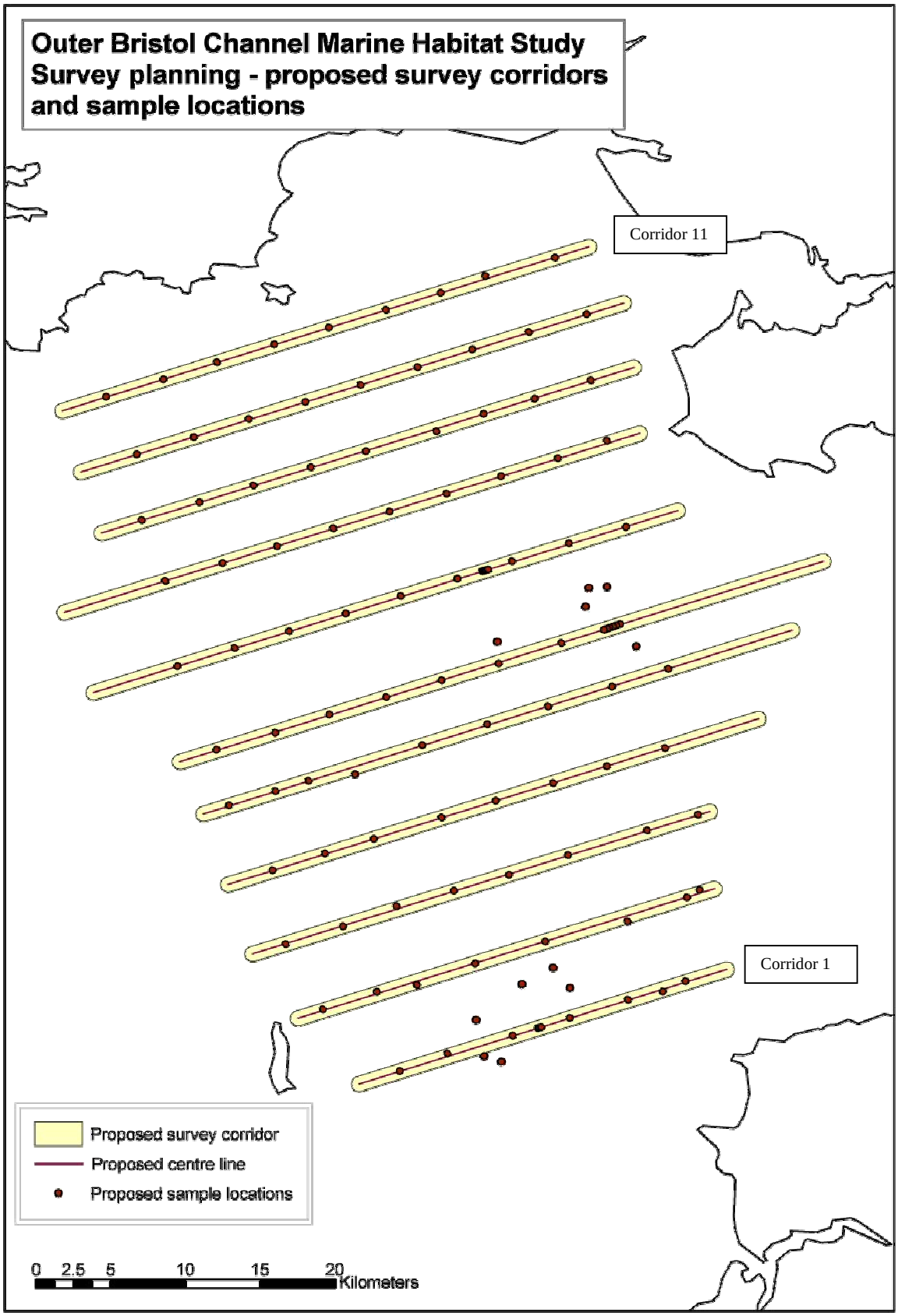


Figure 3. Location of proposed survey corridors and sample locations

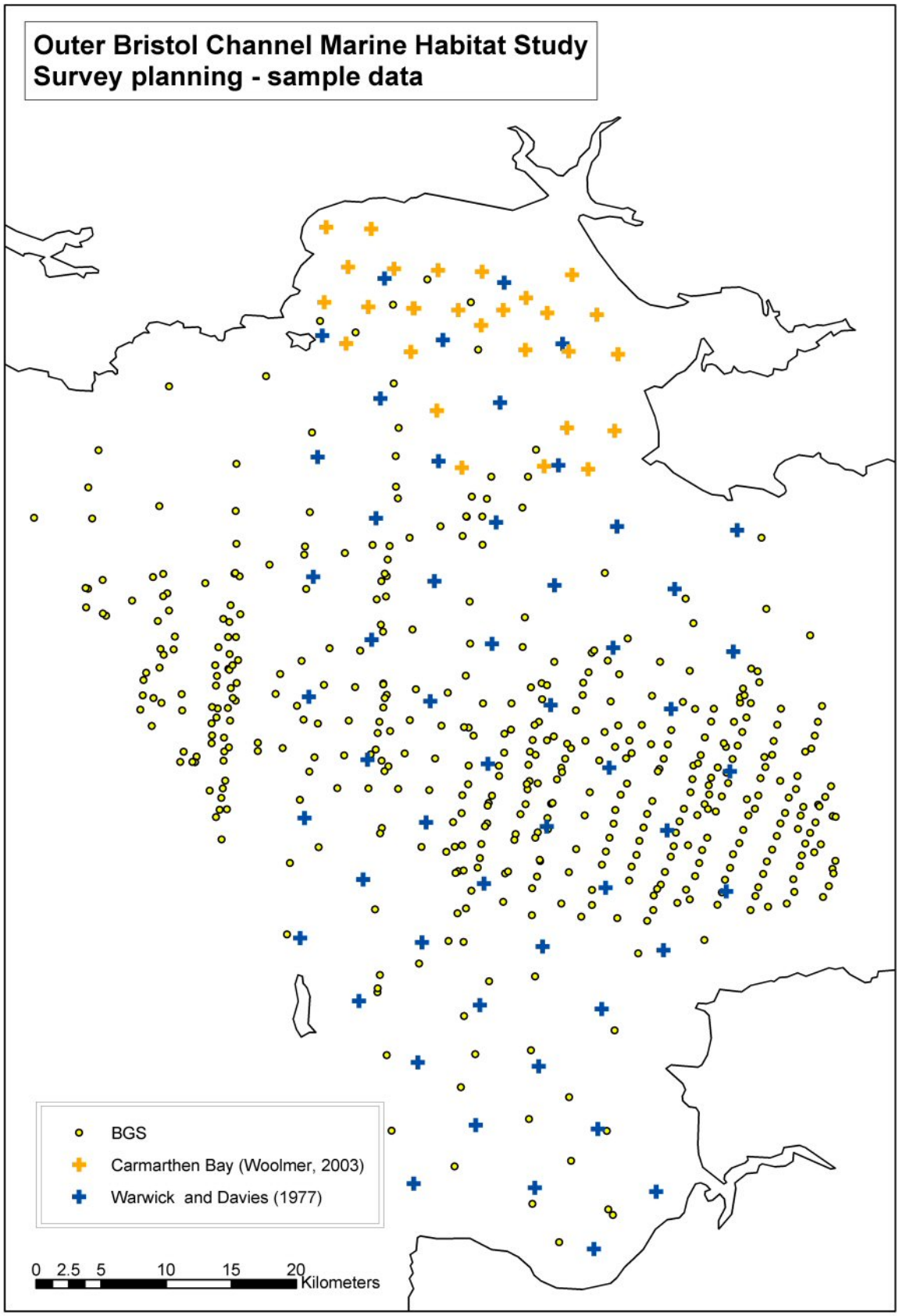


Figure 4. Survey planning – sample data from BGS archives and other sources.

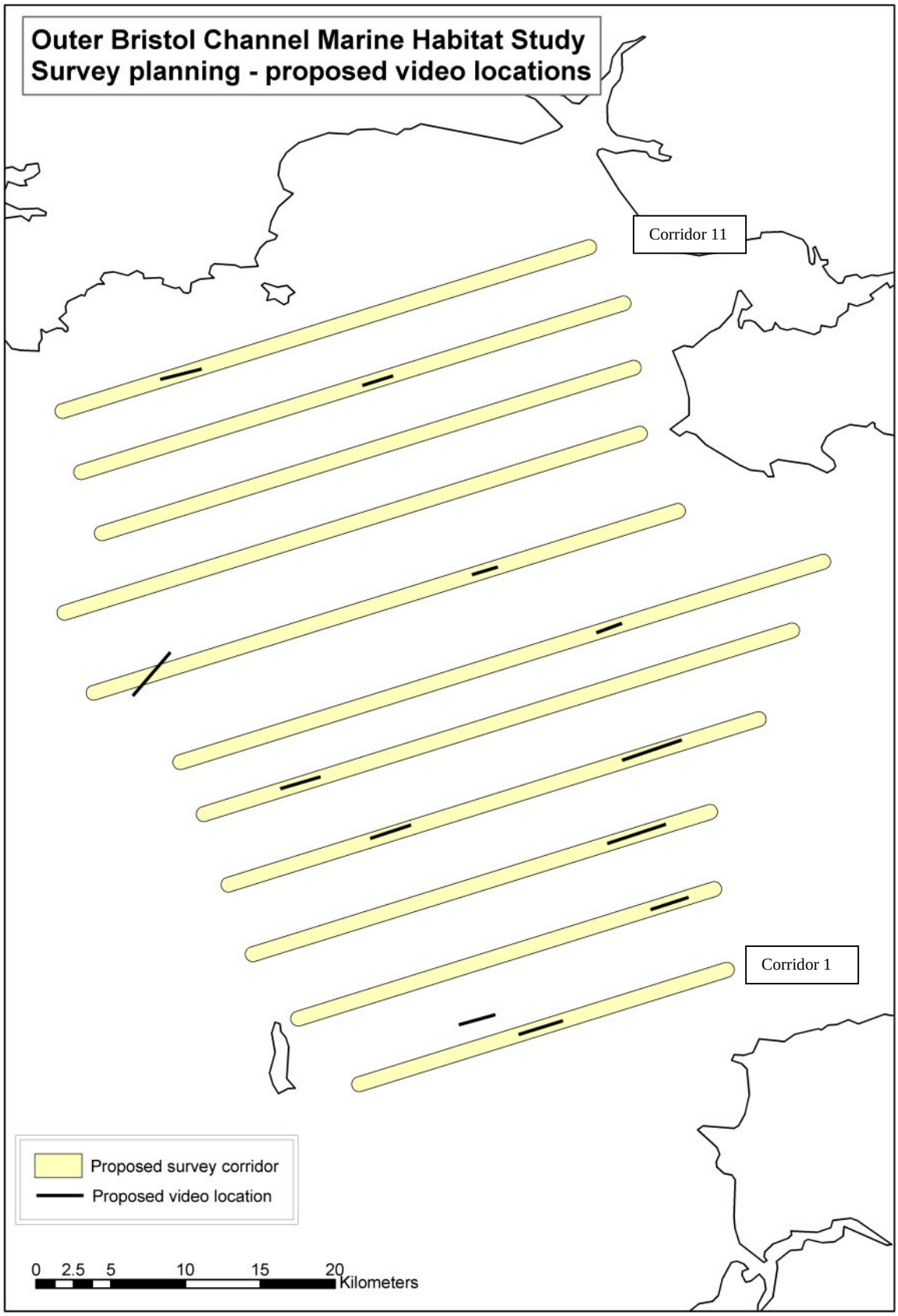


Figure 5. Proposed video and camera tow locations

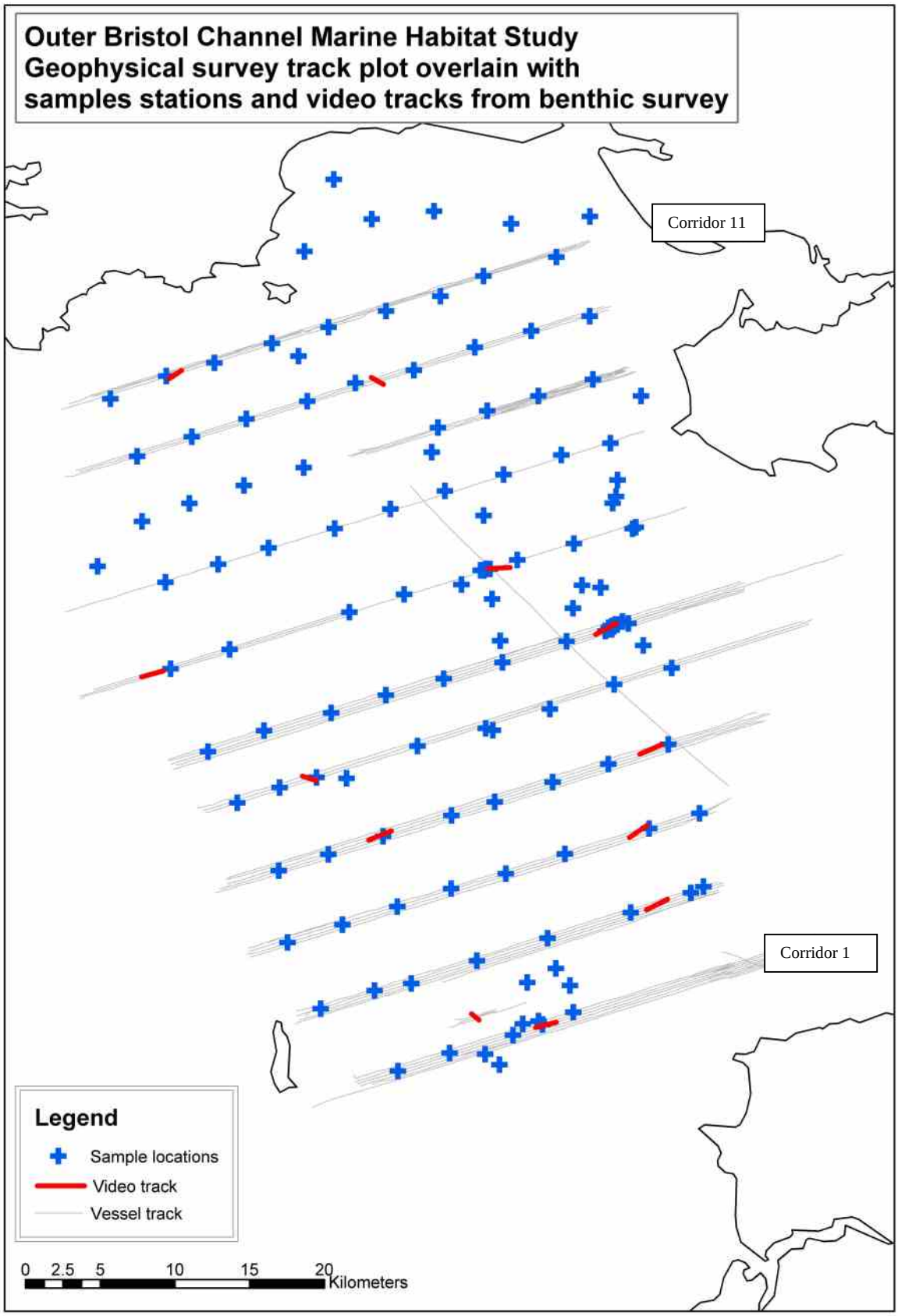


Figure 6. Sample stations visited during the biological survey, July 2003. The vessel track represents the coverage of data from the November 2003 geophysical survey.

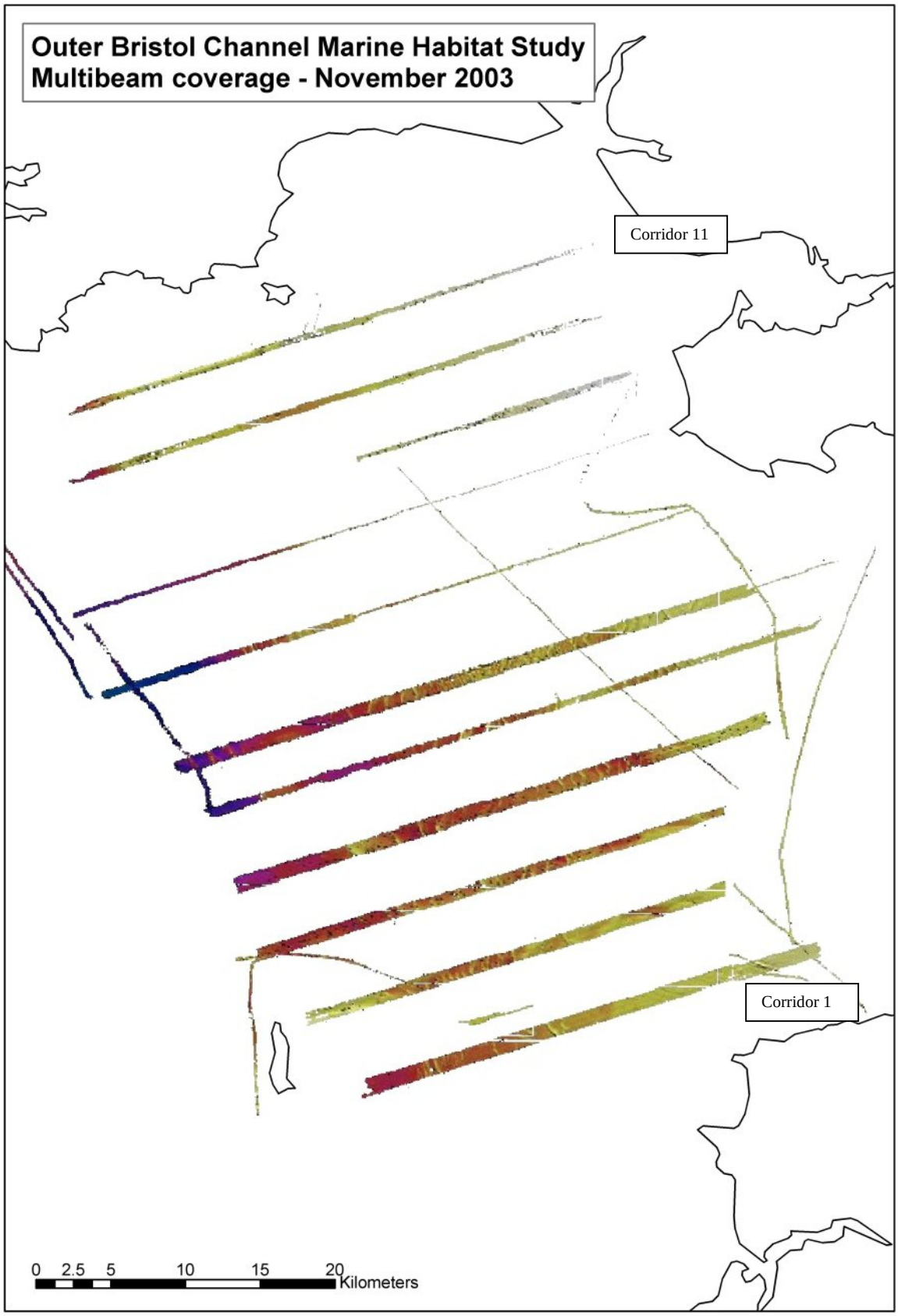


Figure 7. Coverage of multibeam data acquired during the geophysical survey, November 2003

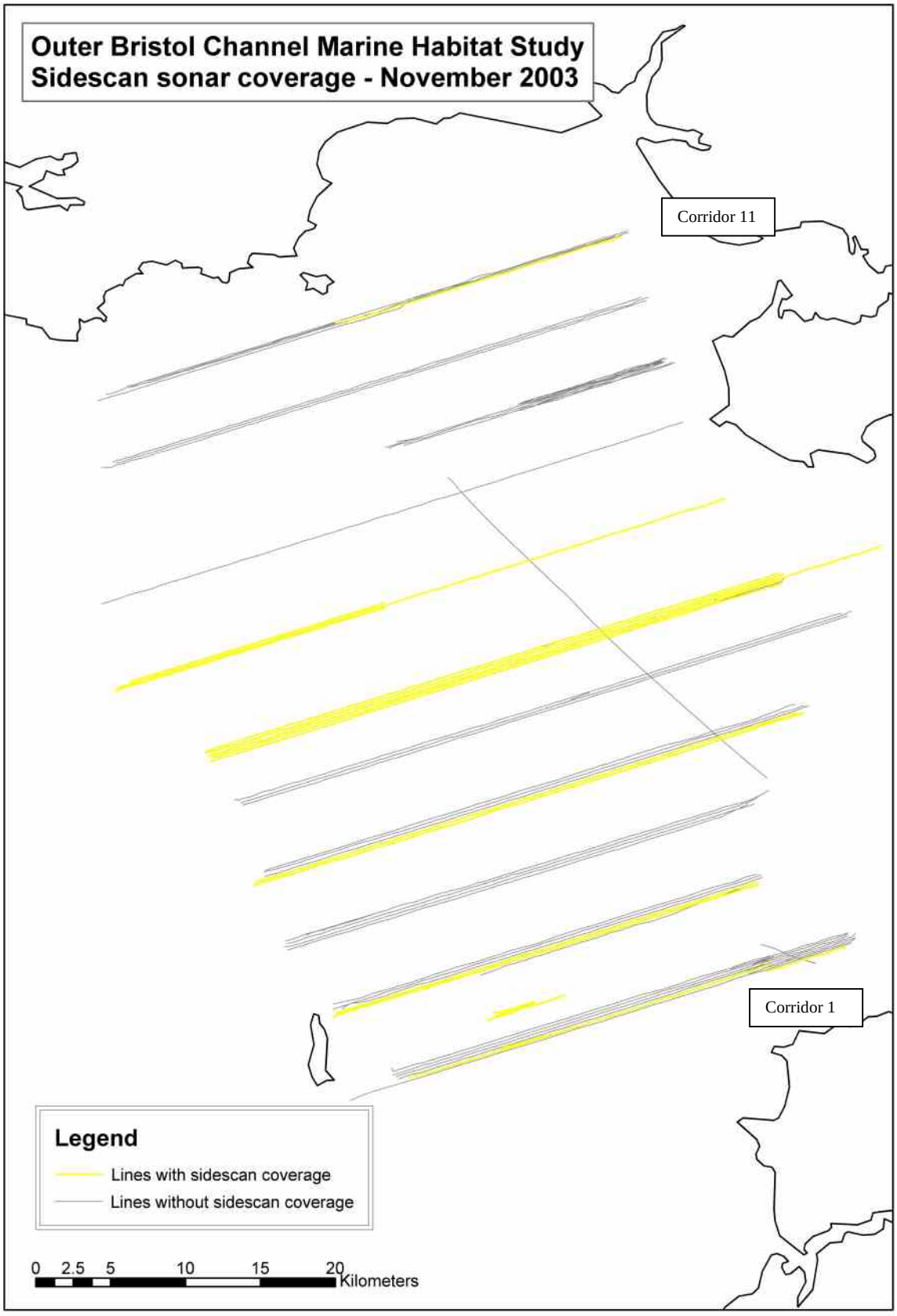


Figure 8. Coverage of sidescan sonar data acquired during the geophysical survey, November 2003.

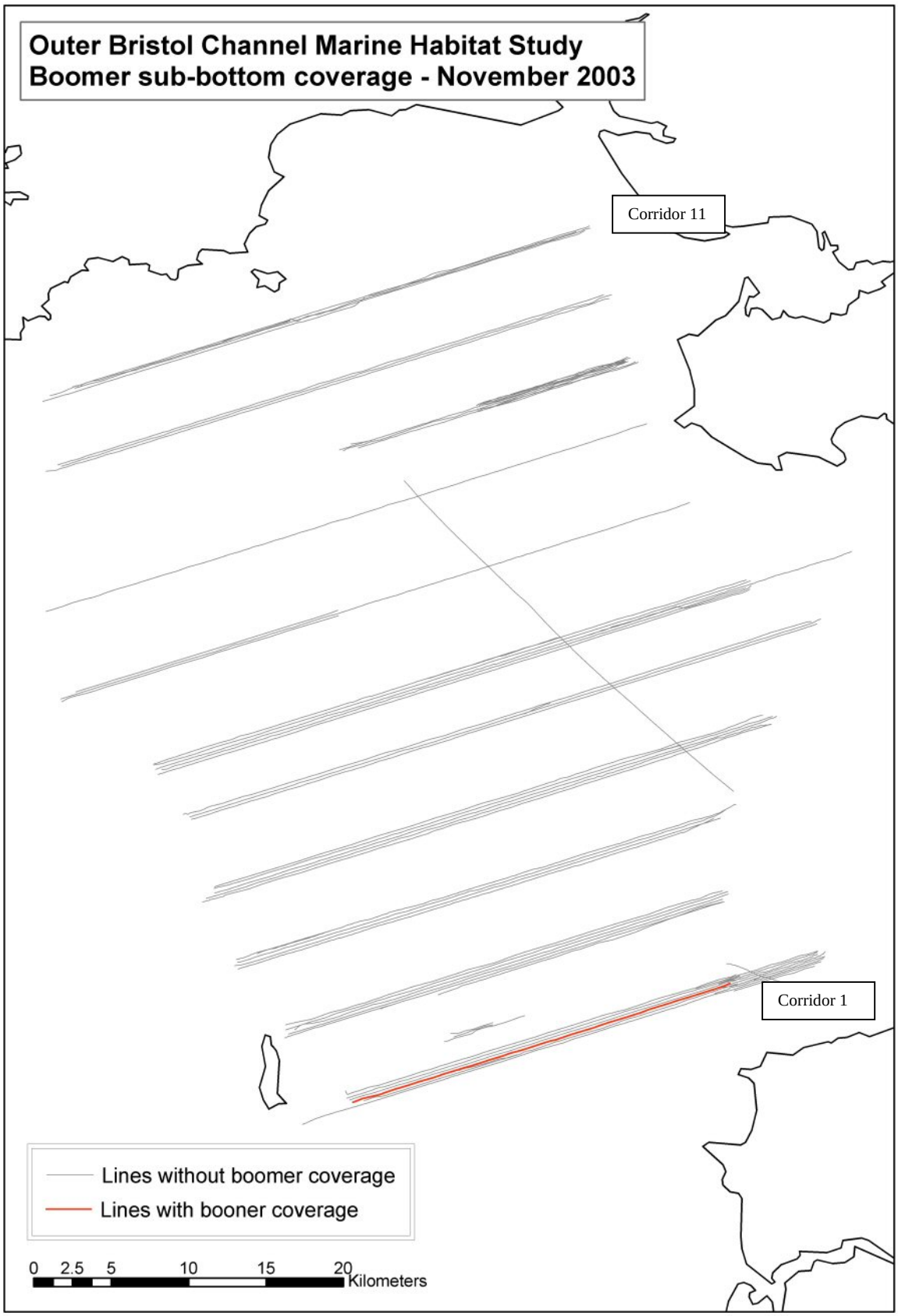


Figure 9. Coverage of surface tow boomer data acquired during the geophysical survey, November 2003

6 Biological & Geophysical Survey

6.1 BIOLOGICAL SURVEY

The biological survey was conducted during a 2 week cruise from the 6 to 18 July 2003 using the RV *Prince Madog* (University of Wales Bangor - UWB). 131 sites were visited (Figure 6) within the study area for macrobenthic invertebrate fauna and/or sediment characterisation. The biological survey was very successful with good weather and sea conditions enabling all the planned sites to be visited. A fuller description and log of the biological survey is given in Appendix 1.

Twelve camera tows were made during the biological survey (Figure 6). Photographs and videos of the sea bed were successfully taken at eleven of the camera tow sites. A description of the equipment deployed is given in (Appendix 2) and some of the results are outlined below in section 7.3.

6.2 GEOPHYSICAL SURVEY

The geophysical survey was conducted between 30 October and 14 November 2003, again using the RV *Prince Madog*. The survey was planned to run along eleven 1 km wide corridors across the study area (Figure 3), using three geophysical systems: Multibeam, Sidescan, and Boomer sub-bottom seismic reflection. A description of the geophysical systems deployed during the survey can be found in Appendix 3

The weather during the geophysical survey was generally windy to stormy with a large swell in open waters. The multibeam was able to collect data in challenging sea conditions and although full 100% coverage was not possible in all eleven corridors, multibeam lines were run down ten and a half corridors with sea bed coverage of about 65% of the survey area (Figure 7)

The sidescan was not as robust, initially, as the multibeam. The towing arm broke, which necessitated the transport of a replacement from the USA. Once repaired the sidescan was deployed as often as possible given the sea conditions, and ran down five and a half corridors, thus giving sidescan sea bed coverage for about 40% of the survey area (Figure 8)

The boomer requires relatively calm condition to produce acceptable data. Unfortunately, during the survey this type of condition only prevailed for enough time to enable the boomer to be run down a single corridor covering about 9% of the survey area (Figure 9).

6.2.1 Multibeam

The multibeam data collected during the geophysical survey were fully processed by NetSurvey and the data supplied to BGS in the form of gridded XYZ files and processed .SD files for use in Fledermaus visualisation software. The processing procedure is detailed in NetSurvey (2003).

GEODETIC PARAMETERS

The following parameters were used for the geophysical survey:

Ellipsoid WGS 84	Semi major axis 6 378 137m
Projection UTM zone 30	Central Meridian -30°

All bathymetry were initially reduced to Lowest Astronomic Tide (LAT) using predicted tides. Whilst on board, co-tidal parameters using Swansea Standard Port were used. Following

completion of the survey, predicted tides were applied using an algorithm within CARIS HIPS which takes any number of tidal stations and calculates the correct tidal level for each individual sounding. Local predicted tides were used from the following tidal stations:

- Ilfracombe
- Milford Haven
- Mumbles

The processed data will be adjusted for actual tidal readings at the stations above when the data becomes freely available.

SYSTEM CALIBRATION

Prior to commencing the survey, a full calibration of the multibeam system was undertaken in a series of stages. The POS MV was calibrated as the vessel left the pier at Menai Bridge through a simple process of the vessel turning a series of figures of eight. Calibrations for roll, navigation time error, pitch and static yaw were undertaken near the survey area after deploying the transducer pole.

QUALITY CONTROL AND PROCESSING

Sounding accuracy was specified to be in accordance with Land Information NZ (LINZ) MB-2 requirements. The sounding data throughout this survey were well within these requirements (NetSurvey 2003), both in the horizontal and vertical directions. Artefacts, however, can be observed in the data. There are two reasons for this:

- The use of predicted tides. This will be remedied when observed tidal data for the November survey period becomes available in April 2003
- There was evidence of movement of the pole on which the multibeam transducer was mounted which resulted in the observed artefact

6.2.2 Sidescan Sonar

Digital sidescan data were recorded on board the survey vessel using a CODA DA2000 system, saved in a proprietary CODA format, and placed onto a combination of DVD-RAM disks and DAT tapes (Smith, 2003). Post survey, the data were transferred onto BGS servers for archiving and processing.

BGS has begun processing and mosaicing the sidescan data using CODA Geosurvey software. Each corridor of data has to be treated individually during processing due to the large quantities of digital data produced by the Edgetech MP-X sidescan

6.3 PLANNED SURVEY OUTCOMES

The original survey plan was to concentrate effort within the eleven corridors for the biological and geophysical survey (Figure 3 & 5). The outcome of the biological survey in July 2003 (see 6.1 and Appendix 1) was virtually a total success in terms of data collected (Figure 6). However as outlined above in 6.2, data collection during the November 2003 geophysical survey was not as successful (Figure 7, 8 &. 9). The tabulated data below compares planned data coverage with actual surveyed data coverage and also lists some of the principal bedforms observed on multibeam data within the corridors.

CORRIDOR 1	SURVEY OUTCOMES - 2003	
	Planned	**Surveyed**
Multibeam		
Corridor length	25.5 km	25.5 km
Corridor width	1000 m	950-1200 m
Number of lines	Depth dependant	6
Sidescan sonar		
Corridor length	25.5 km	25.5 km
Corridor width	1000 m	300 m
Number of lines	5	1
Surface-tow boomer		
Corridor length	25.5	25.5 km
Number of lines	1	1
Sample stations	12	9
Video tows	1	1

Principal bedforms observed from initial multibeam interpretation:

Sand waves (height = 1-12 m, wavelength = 50-500 ml)

Rock outcrop

CORRIDOR 2	SURVEY OUTCOMES - 2003	
	Planned	**Surveyed**
Multibeam		
Corridor length	29.5 km	29.5 km
Corridor width	1000 m	850-1000 m
Number of lines	Depth dependant	6
Sidescan sonar		
Corridor length	29.5 km	25.5 km
Corridor width	1000 m	400-500 m
Number of lines	-	1
Surface-tow boomer		
Corridor length	29.5 km	No data
Number of lines	1	No data
Sample stations	8	8
Video tows	1	1

Principal bedforms observed from initial multibeam interpretation:

Sand waves (height = 1-9 m, wavelength = 100-60 m)

Rock outcrop

CORRIDOR 3	SURVEY OUTCOMES - 2003	
	Planned	**Surveyed**
Multibeam		
Corridor length	32.0 km	32.5 km
Corridor width	1000 m	850-850 m
Number of lines	Depth dependant	4
Sidescan sonar		
Corridor length	32.0 km	No data
Corridor width	1000 m	No data
Number of lines	-	No data
Surface-tow boomer		
Corridor length	25.5 km	No data
Number of lines	1	No data
Sample stations	8	8
Video tows	1	1

Principal bedforms observed from initial multibeam interpretation:

Sand waves (height = 1-9m, wavelength = 500-1800 m)

Rock outcrop

CORRIDOR 4	SURVEY OUTCOMES - 2003	
	Planned	**Surveyed**
Multibeam		
Corridor length	37.5 km	38.0 km
Corridor width	1000 m	800-1100 m
Number of lines	Depth dependant	5
Sidescan sonar		
Corridor length	37.5 km	38.0 km
Corridor width	1000 m	350-500 m
Number of lines	-	1
Surface-tow boomer		
Corridor length	37.5 km	No data
Number of lines	1	No data
Sample stations	8	8
Video tows	1	1

Principal bedforms observed from initial multibeam interpretation:

Sand waves (height = 1.5-11 m, wavelength = 50-1000 m)

Rock outcrop

CORRIDOR 5	SURVEY OUTCOMES - 2003	
	Planned	**Surveyed**
Multibeam		
Corridor length	41.5 km	42.0 km
Corridor width	1000 m	500-700 m
Number of lines	Depth dependant	3
Sidescan sonar		
Corridor length	41.5 km	No data
Corridor width	1000 m	No data
Number of lines	-	No data
Surface-tow boomer		
Corridor length	41.5 km	No data
Number of lines	1	No data
Sample stations	9	10
Video tows	1	1

Principal bedforms observed from initial multibeam interpretation:

Sand waves (height = 0.5-16 m, wavelength = 50-1800 m)

CORRIDOR 6	SURVEY OUTCOMES - 2003	
	Planned	**Surveyed**
Multibeam		
Corridor length	45.0 km	40.0 km (46 km on one line)
Corridor width	1000 m	1000-1100 m
Number of lines	Depth dependant	5
Sidescan sonar		
Corridor length	45.0 km	45.0 km
Corridor width	1000 m	1000-1100 m
Number of lines	-	5
Surface-tow boomer		
Corridor length	45.0 km	No data
Number of lines	1	No data
Sample stations	13	14
Video tows	2	2

Principal bedforms observed from initial multibeam interpretation:

Sand waves (height = 1-14 m, wavelength = 50-1000 m)

CORRIDOR 7	SURVEY OUTCOMES - 2003	
	Planned	**Surveyed**
Multibeam		
Corridor length	41.0 km	18.0 km
Corridor width	1000 m	500 m
Number of lines	Depth dependant	3
Sidescan sonar		
Corridor length	41.0 km	18.0 km
Corridor width	1000 m	600 m
Number of lines	-	3
Surface-tow boomer		
Corridor length	41.0km	No data
Number of lines	1	0
Sample stations	14	14
Video tows	2	2

Principal bedforms observed from initial multibeam interpretation:

Sand waves (height = 1.5 to 12 m, wavelength = 100-1000 m)

CORRIDOR 8	SURVEY OUTCOMES - 2003	
	Planned	**Surveyed**
Multibeam		
Corridor length	40.5 km	40.5 km
Corridor width	1000 m	140-250 m
Number of lines	Depth dependant	1
Sidescan sonar		
Corridor length	40.5 km	No data
Corridor width	1000 m	No data
Number of lines	-	No data
Surface-tow boomer		
Corridor length	45.0 km	No data
Number of lines	1	No data
Sample stations	9	9
Video tows	0	0

CORRIDOR 9	SURVEY OUTCOMES - 2003	
	Planned	**Surveyed**
Multibeam		
Corridor length	37.0 km	10.3 km
Corridor width	1000 m	650 m
Number of lines	Depth dependant	9
Sidescan sonar		
Corridor length	37.0 km	No data
Corridor width	1000 m	No data
Number of lines	-	No data
Surface-tow boomer		
Corridor length	37.0 km	No data
Number of lines	1	No data
Sample stations	9	9
Video tows	0	0

CORRIDOR 10	SURVEY OUTCOMES - 2003	
	Planned	**Surveyed**
Multibeam		
Corridor length	38.0 km	37.0 km
Corridor width	1000 m	450-550 m
Number of lines	Depth dependant	3
Sidescan sonar		
Corridor length	38.0 km	No data
Corridor width	1000 m	No data
Number of lines	-	No data
Surface-tow boomer		
Corridor length	45.0 km	No data
Number of lines	1	No data
Sample stations	9	9
Video tows	1	1

Principal bedforms observed from initial multibeam interpretation:

1 Sand wave (height = 7 m)

CORRIDOR 11	SURVEY OUTCOMES - 2003	
	Planned	**Surveyed**
Multibeam		
Corridor length	37.0 km	37.0 km
Corridor width	1000 m	300-600 m
Number of lines	Depth dependant	4
Sidescan sonar		
Corridor length	37.0 km	20.0 km
Corridor width	1000 m	300m
Number of lines	-	1
Surface-tow boomer		
Corridor length	37.0 km	No data
Number of lines	1	No data
Sample stations	9	9
Video tows	1	1

Principal bedforms observed from initial multibeam interpretation:

Sand waves (height = 3 to 7m, wavelengths = 130-300m)

Rock outcrop

7 Results

7.1 PARTICLE SIZE ANALYSIS OF SEDIMENT SAMPLES

During the biological cruise, sediment was recovered for particle size analysis from 127 of the 131 stations visited in the Outer Bristol Channel Marine Habitat study area (Figure 6).

At each sample station, three grab samples were acquired, using a Van Veen grab. The first two samples recovered were sieved through 2mm, 1mm and 0.5mm sieves to separate all the biota from the sediment, which were then stored in buckets, and preserved with formalin. The third sample recovered was then collected directly from the grab and stored in 2 litre sample bottles for subsequent particle size analysis.

Particle size analysis (PSA) was undertaken on the samples using the sieve mesh sizes given in Table 1:The divisions are based on the Wentworth scale modified with the addition of three sieve divisions at 20, 10 and 5mm. These three divisions have been taken from grading limits for fine and coarse aggregate described in BS 882:1992.

The sand and gravel fractions have also been analysed for their carbonate ($CaCO_3$) content. This was undertaken through acid digestion of carbonate in the sand fraction, and hand picking of carbonate, which is usually shell material, in the gravel fraction. The purpose of assessing the carbonate content of sediment is not only to derive its origin, but also for aggregate quality. $CaCO_3$ is prone to dissolution, and is therefore not desirable in large quantities for use in construction aggregate. The upper limits for shell carbonate in British Standards 882 are 20% in the 5-10mm range and 8% in fractions greater than 10mm

Millimetres	Phi	Wentworth Scale	BS 882:1992
64	-6	Pebble	Gravel
20*			
16	-4		
10*			
5*			Sand
4	-2	Granule	
2.00	-1		
1.41	-0.5	Very coarse sand	
1.00	0.0		
0.71	0.5	Coarse sand	
0.50	1		
0.35	1.5	Medium sand	
0.25	2		
0.177	2.5	Fine sand	
0.125	3		
0.088	3.5	Very fine sand	
0.0625	4		
		Mud	Mud

Table 1. BGS Coastal Geoscience – Grain size scale. *Numbers in bold are taken from BS 882:1992.

The result of the particle size analysis for each of the samples is given in Appendix 4.

7.2 MULTIBEAM AND SIDESCAN

The initial processing of the multibeam data has provided swath images of the morphology and bedforms within the surveyed corridors. Map 1 illustrates the complete coverage of swath that was run in the November geophysical cruise. Even though the map is drawn at a relatively small scale of 1:100,000, what is immediately apparent are the crest lines of the large sand waves which lie within the major sand wave field of the Nobel Sands. These are large scale bedforms. The highest sand wave found during the November survey was 16 m high on corridor 5, UKHO survey data elsewhere in this area notes sand waves with maximum heights of 19 m. Wavelengths of these sand waves are also large with maximum lengths of 1800 m.

7.2.1 Sea bed profiles

Figure 10, 11 and 12 are sea bed profiles along the line of all corridors with multibeam data. The profiles have a common vertical scale based on depth in metres below lowest astronomical tide (LAT). The profiles have been plotted to fit the printed page, and because they vary in length from 10 km for corridor 9 to over 40 km for corridors 5, 6 and 8, they are therefore not drawn to a common horizontal scale, although the units are in metres. However, the profiles, particularly those for corridors 1 to 7 well illustrate the distinctive peaked crests of the numerous large sand waves in the Nobel Sands. The high vertical exaggeration of these profile figures makes it difficult to verify the asymmetry of these sand waves, although a number in corridor 4 have steeper westward facing lee slopes. During acquisition and initial processing of the multibeam and sidescan data, westward facing asymmetrical sand waves appeared to be the most common form in the Nobel Sands. This accords with previously published information on sand wave asymmetry in this area.

7.2.2 Multibeam and sidescan interpretation

An example of the type of information which can be acquired from multibeam and sidescan data is shown in Figure 13. Here the same area of sand wave field is illustrated by both methods. The multibeam has the advantage of being positionally correct and the main sand waves which are 2 to 7 m high are well seen. However although the sidescan has the disadvantage of not being as positionally accurate as the multibeam it has been able to resolve the sea bed to a greater detail with the small megaripples and ripple associated with the sand waves shown on the record. To distinguish these secondary bedforms is particularly important in understanding the processes that control and maintain large sand wave fields.

In central corridors 5, 6 and 7 the crests of the large sand waves in the shallowest water lie at depths of around –35m LAT, elsewhere their crests can lie at depths down to –45m LAT and at the western end of corridor 6 crest depth is at –50 m LAT. Within the Nobel Sands the ambient sea bed declines to the west from about –37 m LAT at the eastern margin of the area to below –55 m LAT. The profiles indicate there are distinctive platforms and breaks of slope in the sea bed which do not appear to be related to the distribution of the sand waves. These could be due to variations in the underlying geology because of changes in rock type, thickness of sediment or differential erosion. These issues should be resolved with boomer sub-bottom reflection seismic data which will allow us to interpret the sediments and rock beneath the sea bed.

Sand wave frequency decreases to the south, and in corridor 1 and 2 the majority of sand wave crests lie in water depths of about –40 m LAT with a relatively flat sea bed around –45 m LAT. In both corridors rock is believed to be at or near the sea bed over extensive areas. Figure 14 illustrates isolated sand waves on multibeam and boomer sub-bottom records from corridor 1 with thin sediment in the troughs between the waves. The sand waves have an asymmetry down the channel to the west. Further east in corridor 1 Devonian rocks underlie the sea bed. These well bedded sandstones and siltstones are relatively steeply dipping and because of differential

erosion the more resistant rocks are exposed as narrow linear ridges on the sea bed. Faults and small scale flexures are well developed and can be readily seen in plan view on sidescan record in Figure 15a and the multibeam record in Figure 16. The large linear mass in the centre of Figure 16 is Horseshoe Rocks, a dolerite dyke which has intruded into the surrounding Devonian strata and now forms a rock shoal at a depth of about –12m. The effect of the strong tidal currents can be seen by the two narrow sand ridges which are streaming north-eastward away from the rocks.

Sand wave frequency also decreases to the north of the Nobel Sands. The three corridors in the area of Carmarthen Bay, 9, 10 and 11, appear to be devoid of large sand waves. There may be one at the eastern end of corridor 11, and the peaks on corridor 11 are thought to be associated with outcrops of rock. Small-scale bedforms have been noted on some of the geophysical records in Carmarthen Bay and further processing is required to asses the data. Detailed analysis of all the multibeam and sidescan data will continue in the next stage of the study to provide a comprehensive interpretation of the sand waves and bedforms.

7.3 VIDEO INTERPRETATION, MULTIBEAM AND SIDESCAN

An important element in undertaking surveys and interpretations of marine habitats is the ground truthing of data acquired through remote geophysical methods such as multibeam, sidescan and sub-bottom seismics. Ground truthing includes the physical sampling of the sea bed with grabs and cores and the analysis in the laboratory of the sediments that are recovered. A very important and valuable method of ground truthing is the capturing of colour images of the sea bed using cameras and videos.

Camera tows were made on the biological survey in July 2003 at twelve video stations (Figure 6). Photographs and videos of the sea bed were successfully taken at eleven of the video stations. The camera and video equipment, and the methodology used for the tows are described in Appendix 2. During the geophysical survey in November 2003 multibeam data was collected over ten of the successful video stations. The line of the camera tows and their relationship to the swath coverage is shown on Map 1. There is less sidescan coverage over the study area (Figure 8) and not all the sidescan data has been processed so the number of video stations covered by sidescan imagery cannot be confirmed; we estimate it to be four video stations.

We have undertaken a preliminary interpretation of the sea bed at two video stations, V1b and V7, using the multibeam and sidescan data in conjunction with the camera and video imagery

7.3.1 VIDEO STATION V1B

Video station V1b is not located on one of the principal survey corridors, it lies between corridor 1 and 2 to the east of Lundy (Map 1) in water depths around –40 m to –45 m LAT. It is an area of well developed megaripples which are about a metre high, with wavelengths varying from <20 m to 100 m. Their sinuous and inter fingering crest lines can be seen on the multibeam image in Figure 17a. The crest lines have a general NW-SE trend. The megaripples are asymmetrical with a steep westerly facing lee slopes. The multibeam image covers an area of sea bed of about 700 m by 500 m. The multibeam indicates there are some minor waveforms on the longer stoss slopes of the megaripples. These small wave forms which are only decimetres in height are well resolved with the sidescan image in Figure 17b. They lie at an angle to the megaripple crest lines and have wavelengths of less than 10 m.

The line of the camera tow from its start to end point is drawn on the multibeam and sidescan images in Figure 17. The line, although not at right angles to the major crest lines does cross a few of the larger megaripples, however its primary coverage is of the sea bed on the stoss slope of the megaripples.

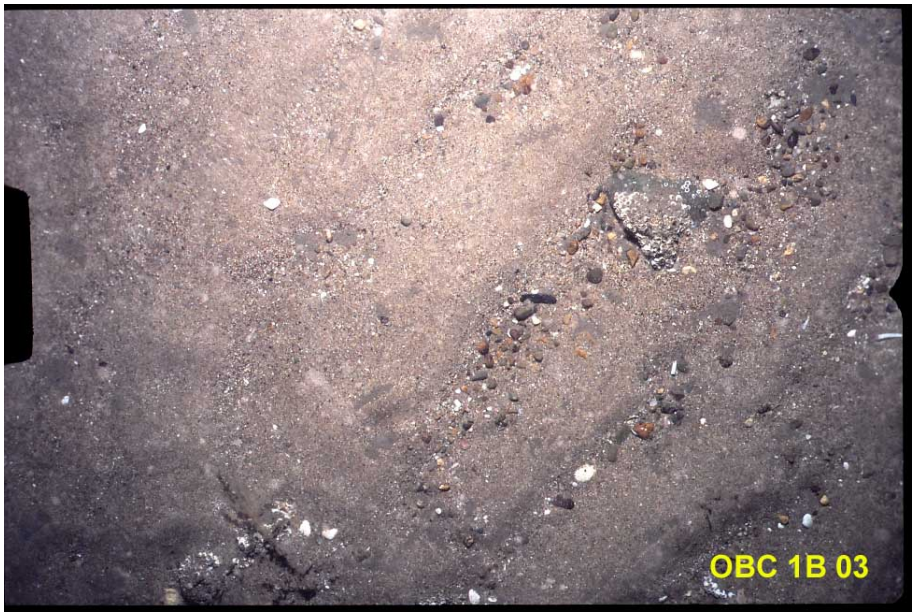
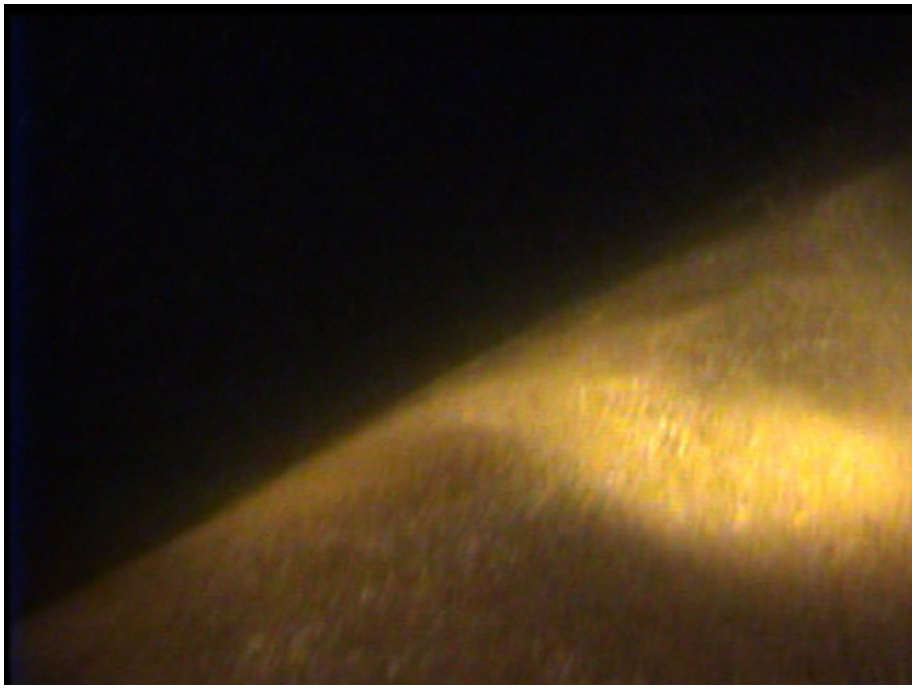


Photo **OBC 1B.03** shows a type of seabed that was very widespread in the video stations in the Outer Bristol Channel. The view is looking vertically down and the width of the image is about 45 cm. It shows a gravel horizon on the seabed that is partly overlain by a very thin layer of rippled sand. On the gravel surface there is some well worn shell hash mainly composed of broken relatively heavy shell species such as *Spisula solida*. This image has a stone with dead barnacles on it (mid upper right). There is also a sea fir (hydroid) colony attached to a stone (mid lower left).



This image is an example of a megaripple crest, one of several mega-ripples with sharp asymmetrical crests which were seen on the video.

Throughout the length of this tow the video showed that the thickness of the overlying sand was variable. In places there was complete cover of the mobile sand and at others the gravel horizon

was completely exposed. It was apparent that there was a sequence of rather low relief mega-ripples. The sharp crested ones were probably only about 1 metre high, while other were only detectable as sand part of the sequence of sand accumulations that were probably less than 0.4m thick. These probably mobile accumulations of sand which would have been enough to overwhelm most of the attached epifaunal species on the gravel. There was much less hydroid at this station than at others in this southern area.

Rather little fauna was visible at this station. There were a few hermit crabs (Pagurus bernhardus). These appeared to be occupying shells of Polianus catena. Probably owing to sand scour even the shells occupied by hermit crabs had little associated fauna on them.

The large spider crab (Maia squinado) on the frontispiece of Appendix 2 was seen crawling over one of the mega-ripples at Station V1B.

The observations from the video tow confirm the presence of the primary megaripples seen on the multibeam and sidescan with the smaller waveforms of less than 0.4 m equating to those seen on the stoss slopes in the sidescan

7.3.2 VIDEO STATION V7

Video station V7 is located on corridor 6 in the large sand wave field at the western end of Nobel Sands. The ambient inter-wave sea bed is at a depth of –38 m to –42 m LAT. Figure 18a and 18b are multibeam and sidescan images of the sea bed around V7. They cover an area of 2500 m by 1000 m and include four large sand waves. These vary in height from 3 m to 10 m. with wavelengths of 150m to 350 m. They are asymmetrical with steeper lee slopes facing west. Some have developed double, bifurcated crests along some parts of their crest lines. The sand waves appear to be isolated features, the area between the sand waves are relatively flat with a width of about 250 m to 450 m. There are a few sandy wave forms in the inter wave area but it is dominantly flat. The sidescan imagery shows some darker reflective tones, an indication of possibly coarser sediments in these inter wave areas.

The sequence of still frames from station V7 (OBC7.04 , .07, .10 and .16) shows the varying but probably quite thin and rippled sand overlying a gravel and shell hash horizon. In this case the

ephemeral deposits of aggregated fine particulate material are clearly visible in the hollows of the sand ripples and as disturbance clouds to the side of some frames. This “marine snow” was bound up into aggregates that are visible on the films and videos. This indicates that at this season in July 2003 there was organic matter from bacterial action binding the material together, which probably originated in the breakdown of phytoplankton.

The gravel horizon has much more shell hash than at Station V1B. Again the shells nearly all look well worn suggesting they do not represent a recent facies that has suffered abnormal mortality. Some of the shells have mineral coatings, which also supports the view that they are not recent. In addition to *Spisula* sp. there are considerable numbers of razor shells (*Ensis ?arcuatus*).

7.3.3 VIDEO INTERPRETATION - PRELIMINARY CONCLUSIONS

- At least in calm neap tide summer conditions such as prevailed in the July biological survey it is possible to get photographic images and video from the Outer Bristol Channel, though it cannot be guaranteed.
- The amount of aggregated fines visible in V7 confirms that the area is on the edge of the very turbid water area of the Bristol Channel / Severn Estuary.
- The settling of this particulate material has an influence on the attached epifauna and other forms associated with it.
- At the two stations examined here the superficial and mobile sand deposits appeared to be thin over large areas of the sea bed
- The mobility of this sand has inhibited colonisation of the gravel through scour and intermittently overwhelming it
- Some of the habitats visible on photographs and video can be allocated to specific biotopes in the MNCR and EUNIS schemes. In other cases there are complex mosaics that could only be mapped as biotope complexes.

8 Conclusions and further research

1. The study has collected a considerable amount of new sea bed data in the Outer Bristol Channel during the two surveys conducted in 2003. The initial results from these surveys have been described in this report and provide an interpretation of the morphology and character of the sea bed.
2. The biological cruise in July 2003 was conducted by NMGW. 131 sites were sampled using the RV *Prince Madog* (University of Wales Bangor – UWB) and a series of 12 underwater video/photographic tows. Excellent weather meant that all planned stations were sampled. The biological analysis of these samples is continuing through 2004.
3. The analysis of sediment particle size for the samples collected on the biological cruise have been completed and the results are published in this report
4. The geophysical survey was conducted in November 2003, again using the RV *Prince Madog*. The survey was planned to run along eleven 1 km wide corridors across the study area, using three geophysical systems: Multibeam, Sidescan, and Boomer sub-bottom seismic reflection. The multibeam and sidescan systems deployed were modern state of the art systems and the results published in this report indicate the high level of detail that these provide for the mapping and interpretation of bedforms and the character of the seabed
5. The weather during the geophysical survey was generally windy to stormy with a large swell in open waters. The multibeam was able to collect data in challenging sea conditions. The sea state did create problems with the creation of noise and artefacts on the records and although full 100% coverage was not possible in all eleven corridors, multibeam lines were run down ten and a half corridors with a sea bed coverage of about 65% of the survey area.

   The sidescan was not as robust as the multibeam in the prevailing sea states. It was deployed in five and a half corridors, giving sidescan sea bed coverage for about 40% of the survey area.

   The boomer requires relatively calm condition to produce acceptable data. Unfortunately, during the survey this type of condition only prevailed for enough time to enable the boomer to be run down a single corridor covering about 9% of the survey area.

6. The poor boomer coverage is an issue, because it means we lack information on the form and thickness of sediment and rock beneath the sea bed. This, along with the incomplete multibeam and sidescan coverage will have a bearing on our ability to fully understand and interpret marine habitats in the study area.

7. The project is funded to conduct one major biological survey and one geophysics survey. The biological survey has provided almost complete coverage of the study area, whereas there are serious deficiencies in the multibeam and geophysics coverage. These are detrimental to the study's overall objectives and outputs, and the quality of its science. To provide the multibeam and geophysical data we require we are planning to run a further survey in the summer of 2004. Applications have been made for further funding and for ship time on the Prince Madog.

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Figure 10

Sea bed profiles along the centre of Corridors 1-4; based on multibeam data

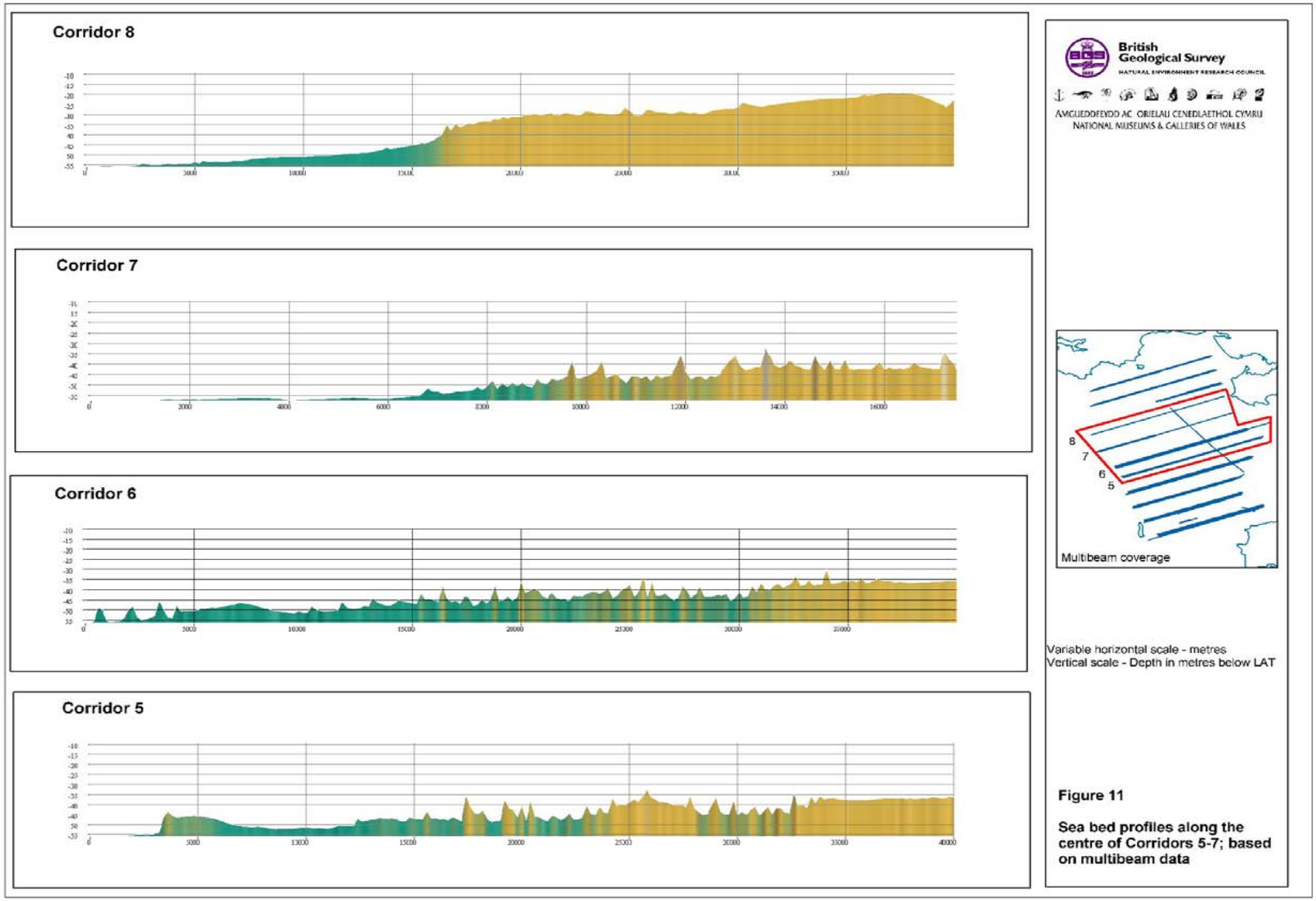


Figure 11

Sea bed profiles along the centre of Corridors 5-7; based on multibeam data

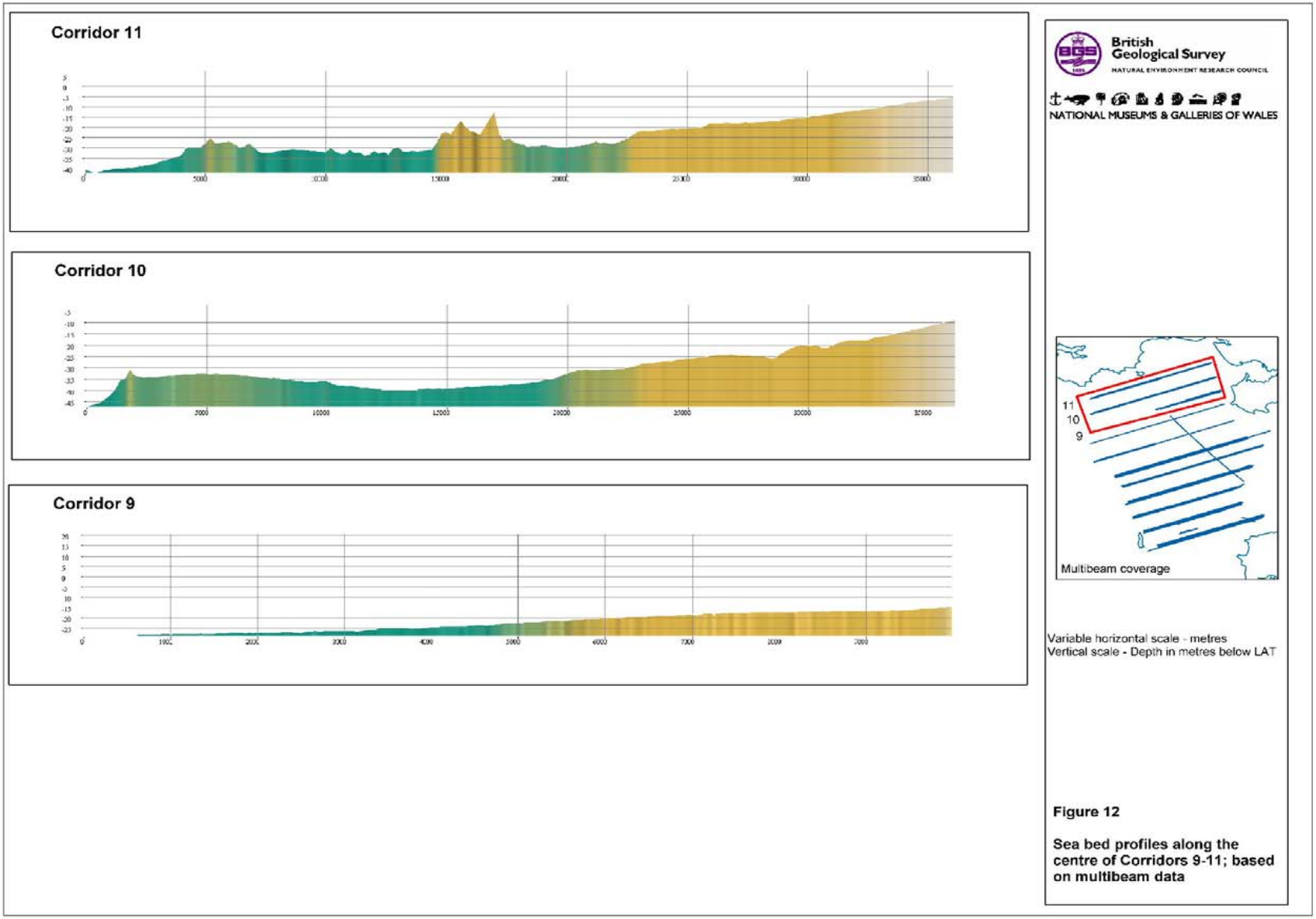
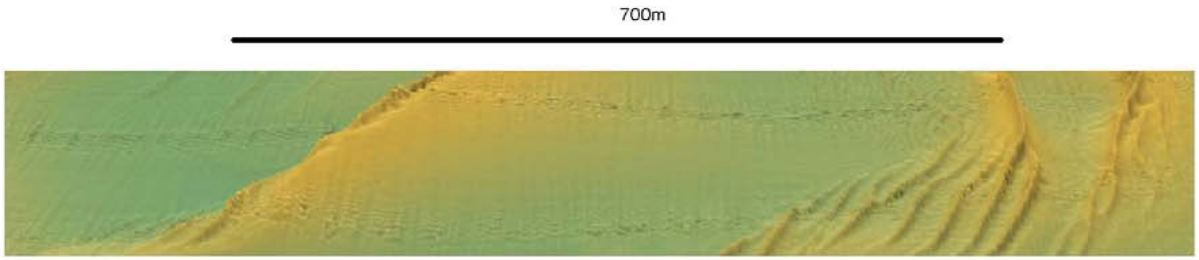


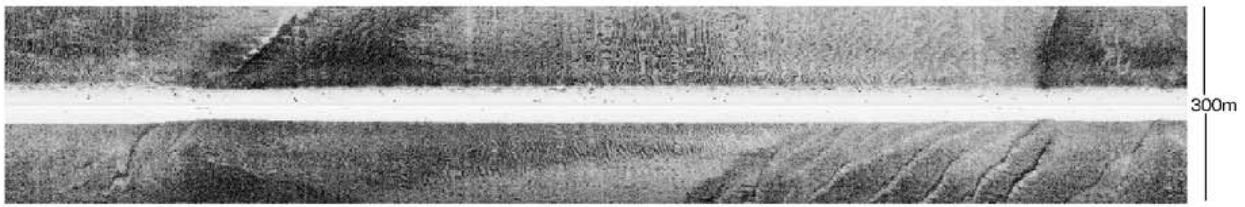
Figure 12

Sea bed profiles along the centre of Corridors 9-11; based on multibeam data

a) Multibeam data illustrating sand waves on Corridor 6



b) Sidescan sonar data illustrating sand waves on Corridor 6



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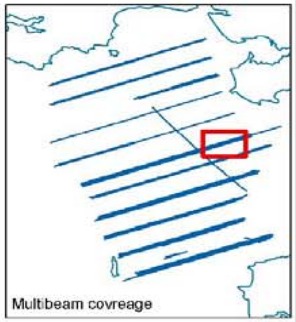


Figure 13

Multibeam and sidescan sonar data illustrating sand waves on Corridor 6

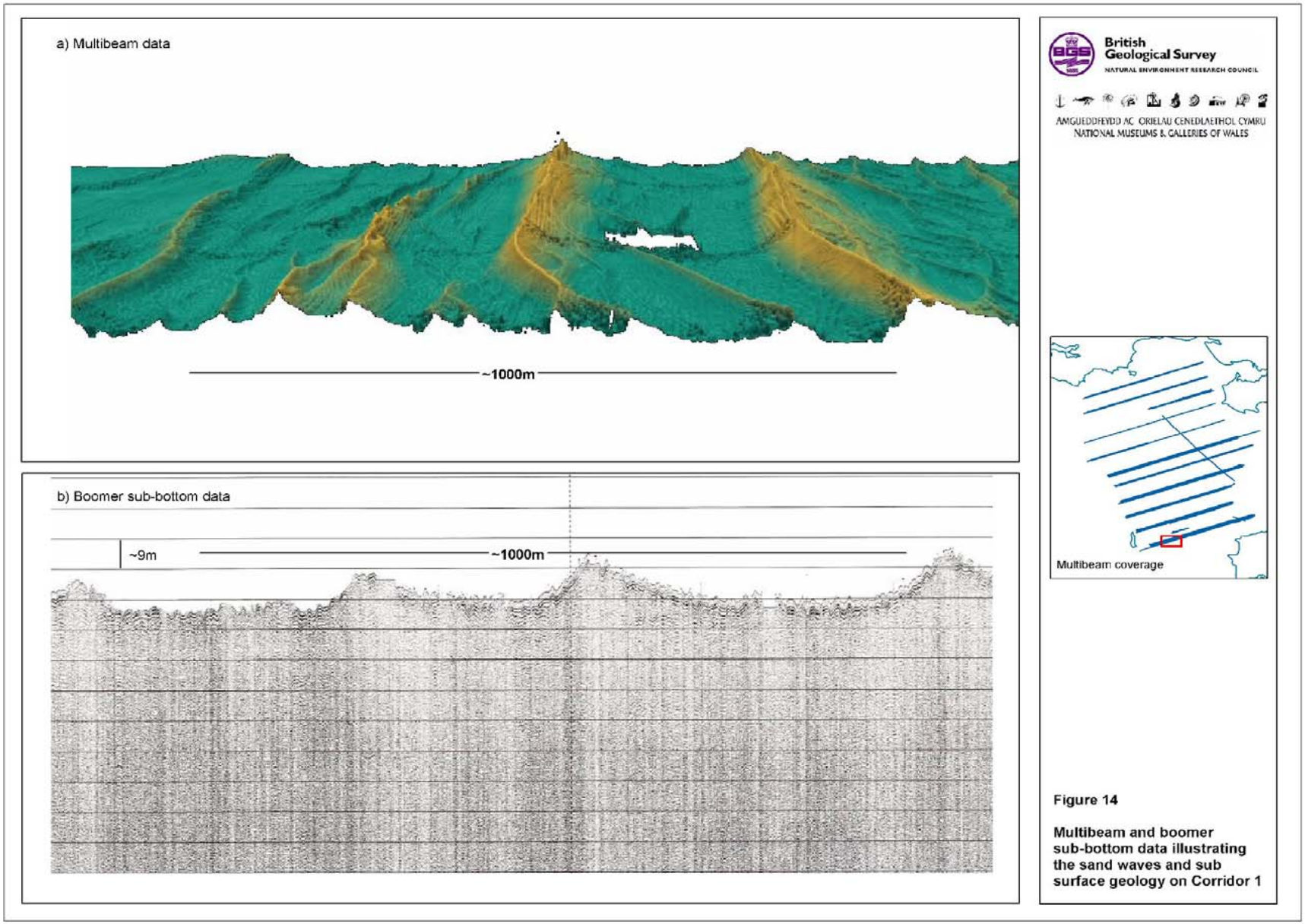


Figure 14

Multibeam and boomer sub-bottom data illustrating the sand waves and sub surface geology on Corridor 1

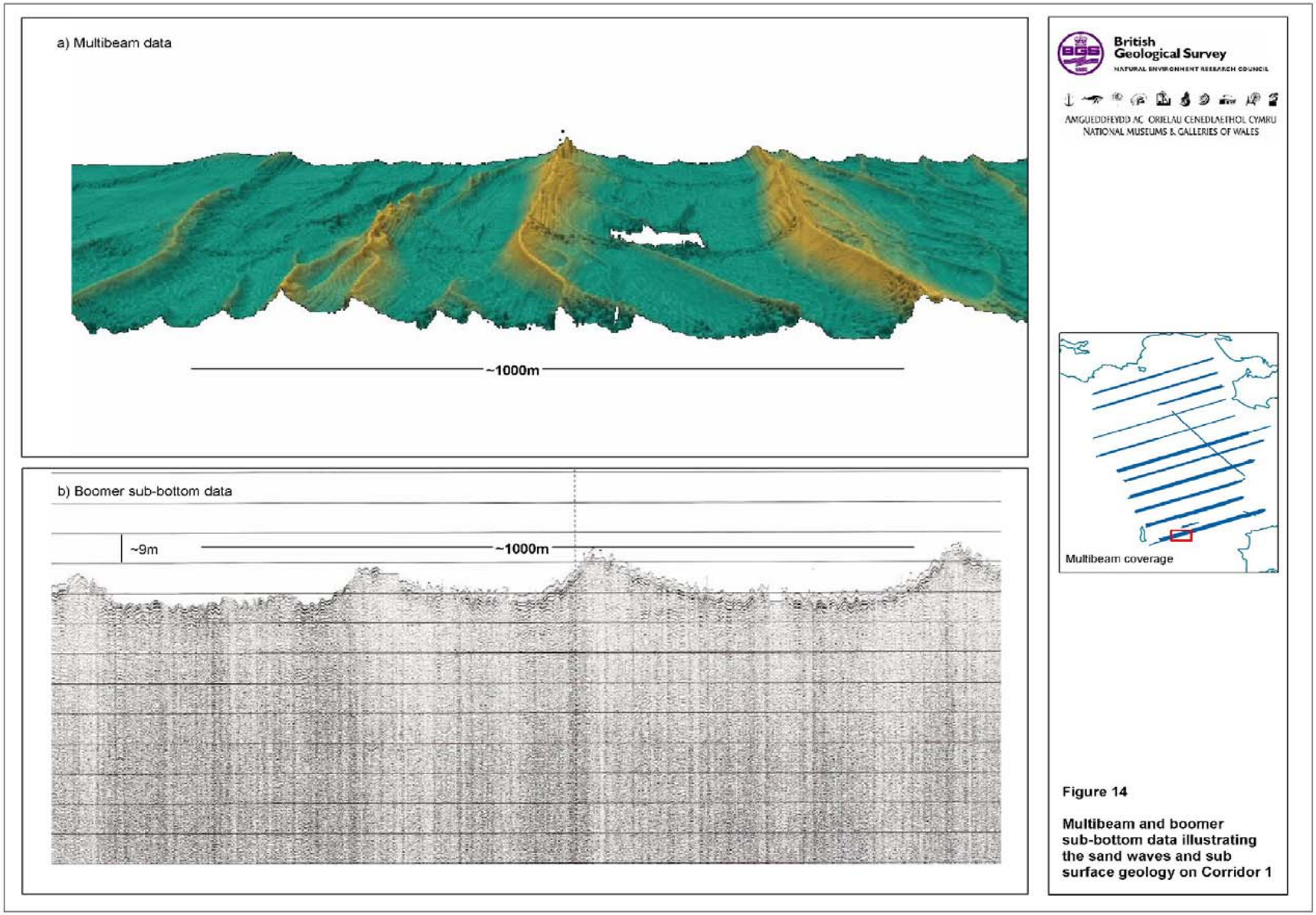


Figure 14

Multibeam and boomer sub-bottom data illustrating the sand waves and sub surface geology on Corridor 1

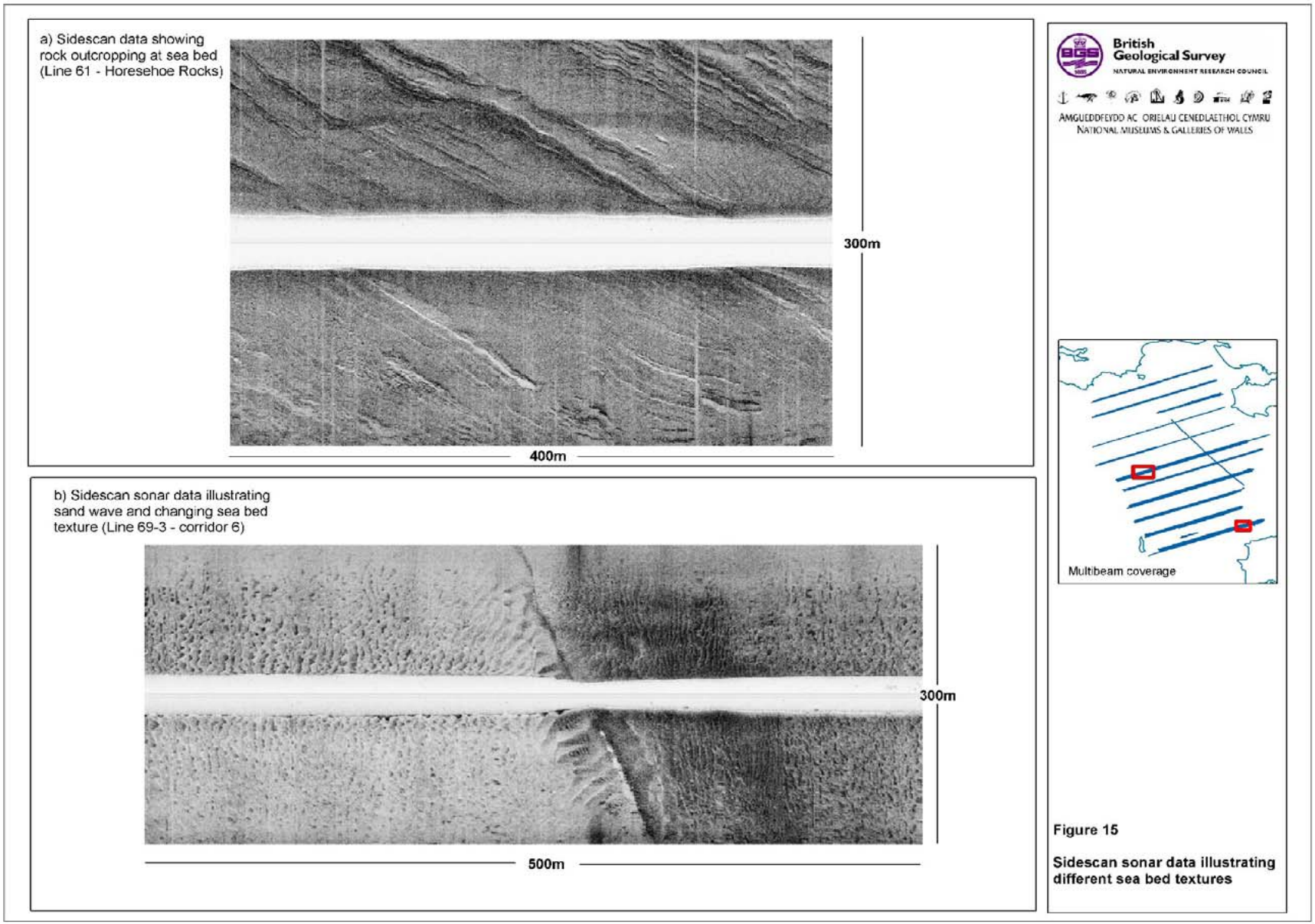


Figure 15

Sidescan sonar data illustrating different sea bed textures

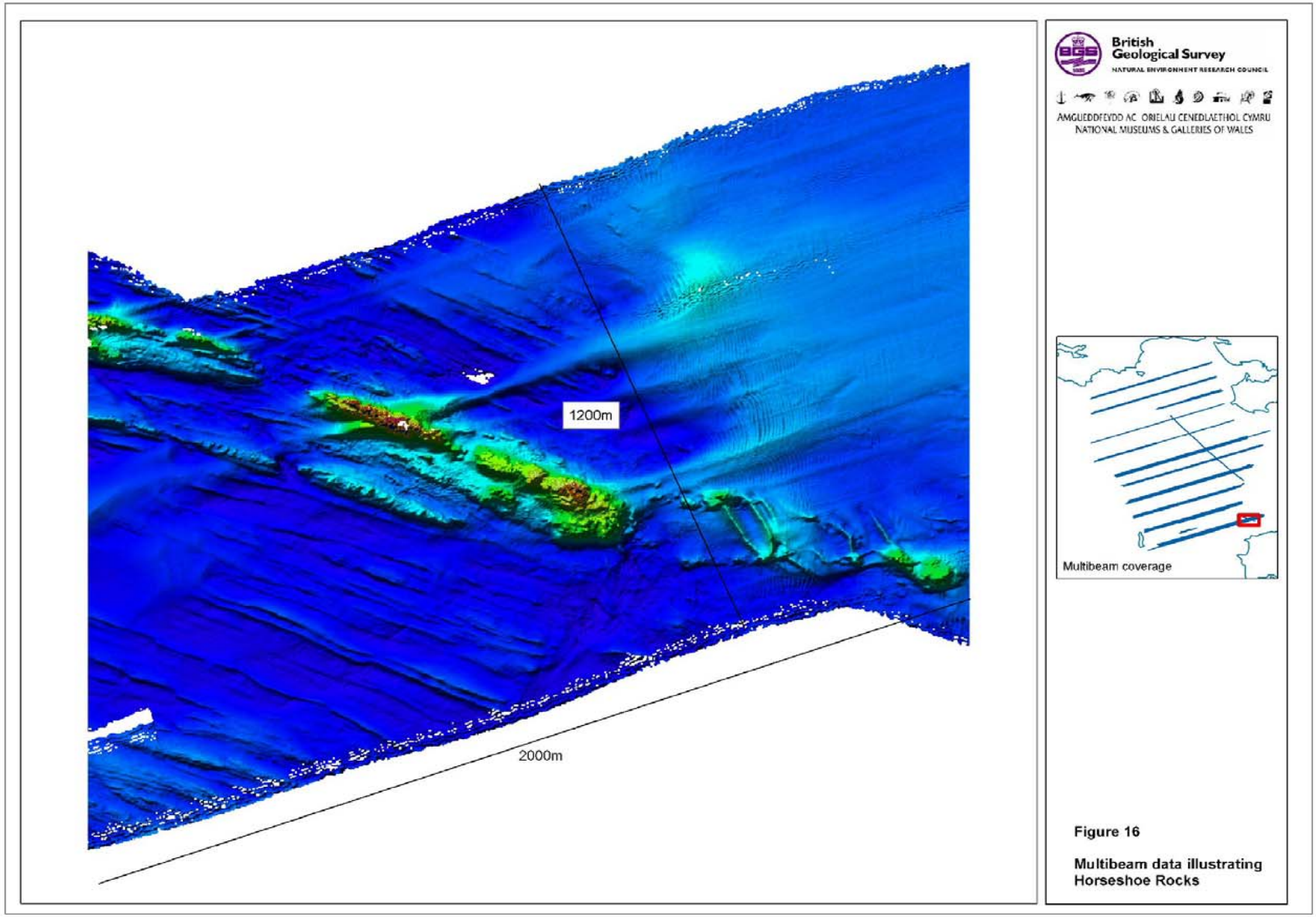
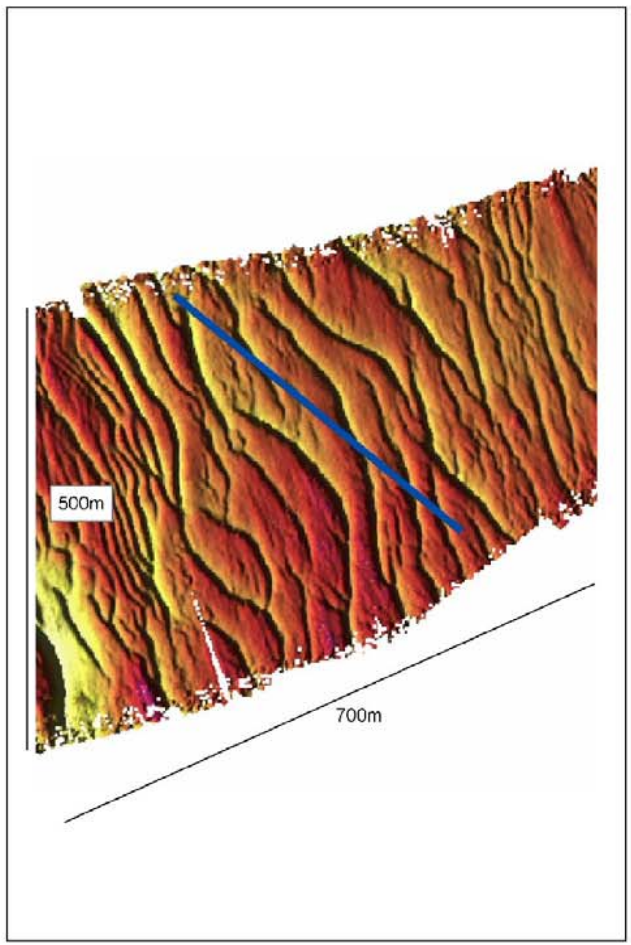
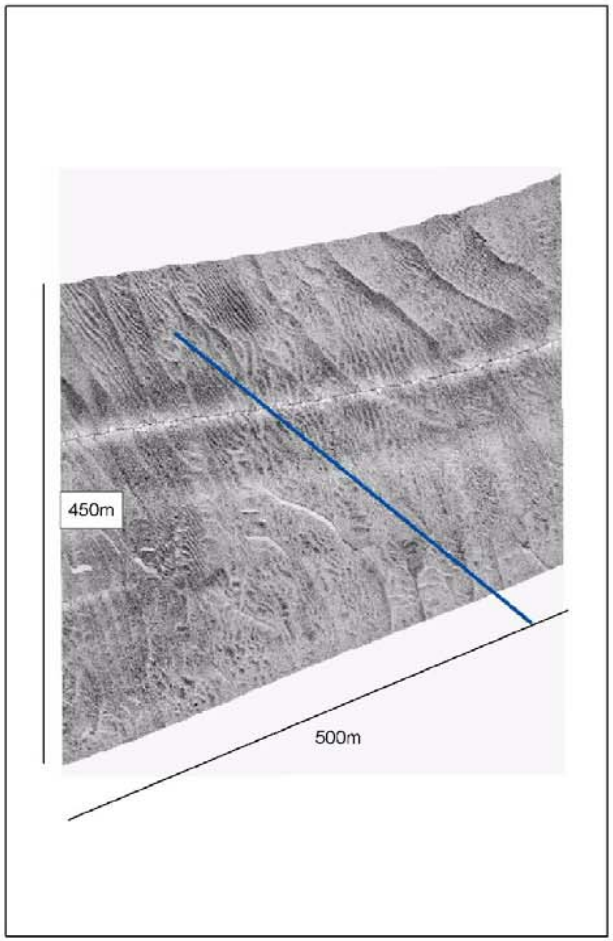


Figure 16

Multibeam data illustrating Horseshoe Rocks



a) Multibeam data



b) Sidescan sonar mosaic

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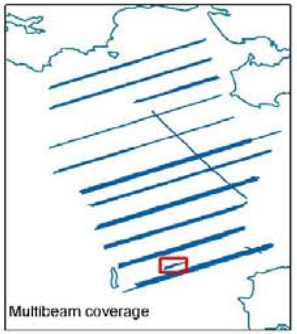
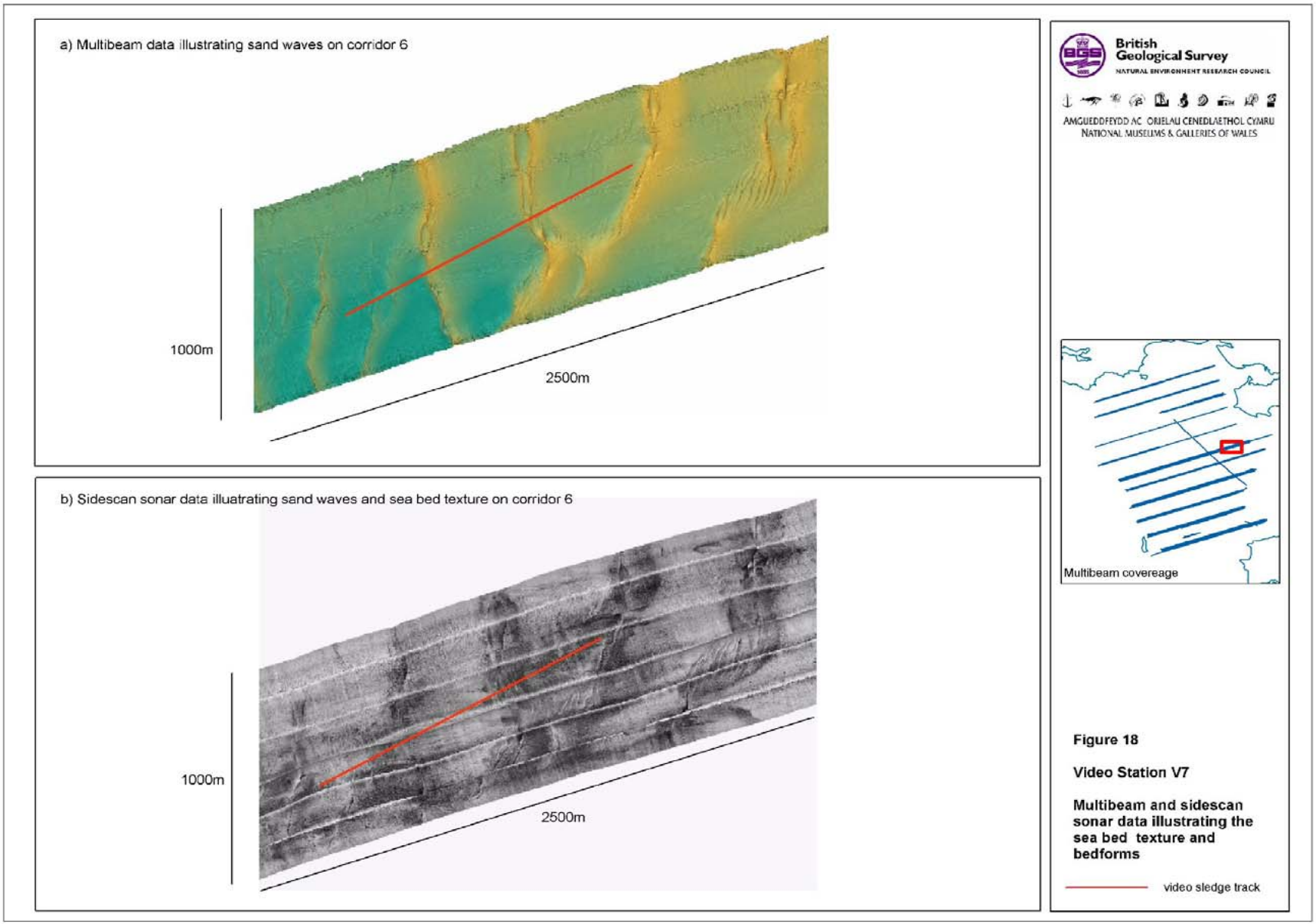


Figure 17

Video Station V1b

Multibeam and sidescan sonar data illustrating the sea bed texture and bedforms

video sledge track


a) Multibeam data illustrating sand waves on corridor 6
1000m
2500m
b) Sidescan sonar data illuatrating sand waves and sea bed texture on corridor 6
1000m
2500m
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Multibeam covereage
Figure 18
Video Station V7
Multibeam and sidescan sonar data illustrating the sea bed texture and bedforms
video sledge track

Appendix 1

Biological Survey July 2003

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The Outer Bristol Channel Marine Habitat Study

Biological Report 2003-2004

Andrew S. Y. Mackie & Teresa Darbyshire

National Museums & Galleries of Wales
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Biological work commenced in June 2003.

Biological sampling

The sample area was bounded by Worm's Head – St. Govan's Head in the north, and Lundy and Bull Point in the south. Previous Museum surveys around Wales are also shown (Fig.1) for reference.

On a 2 week cruise (July 6-18) using the RV *Prince Madog* (University of Wales Bangor - UWB), we sampled 136 sites (Fig. 2) for macrobenthic invertebrate fauna and/or sediment characterisation. Five out-of-area stations were taken: Stn 1 (Red Wharf Bay, Anglesey), Stns 2 & 3 (off Cardiff), Stn 135 (SW of Stackpole Head) and Stn 136 (SW of Anglesey). Of these five, only Stns 1 and 135 were quantitative.

In addition, a series of underwater video and photographic tows were executed by Ivor Rees, University of Wales, Bangor. For operational reasons the sampling in the area commenced on July 8 and, because of deteriorating weather conditions, ended on July 16.

For the fauna, duplicate 92 kg 0.1 m^2 modified Van Veen grab (Mackie in prep) samples were taken at each quantitative station. A further grab sample was collected for sediment analysis. Where quantitative samples could not be obtained, small or incomplete grabs were pooled as a qualitative sample or a Tjärnö dredge was deployed. Sample volume was determined for each grab, with the aim of obtaining (where possible) at least 5 litres of sediment–equivalent to a sampling depth across the subrectangular grab bite of 5 cm. A full chronological account of the sampling is provided in the log of the cruise (Appendix).

In anticipation of the difficulties presented by sieving (0.5 mm mesh) the predominantly coarse sediments of the study area, two sieving teams of 4–5 scientists were used simultaneously, working in parallel. Sieving fractionation procedures and sample treatments were as detailed in previous Museum surveys (e.g.,Mackie & Darbyshire 2001, Mackie & Oliver 1996). Sampling was restricted to no more than 13 hrs per day.

In summary, the sampling accounted for:

114 biological stations
121 sediment stations
12 underwater video and photographic tows

A total of 848 sample containers, comprising 509 buckets and 339 pots, resulted from the sieving process.

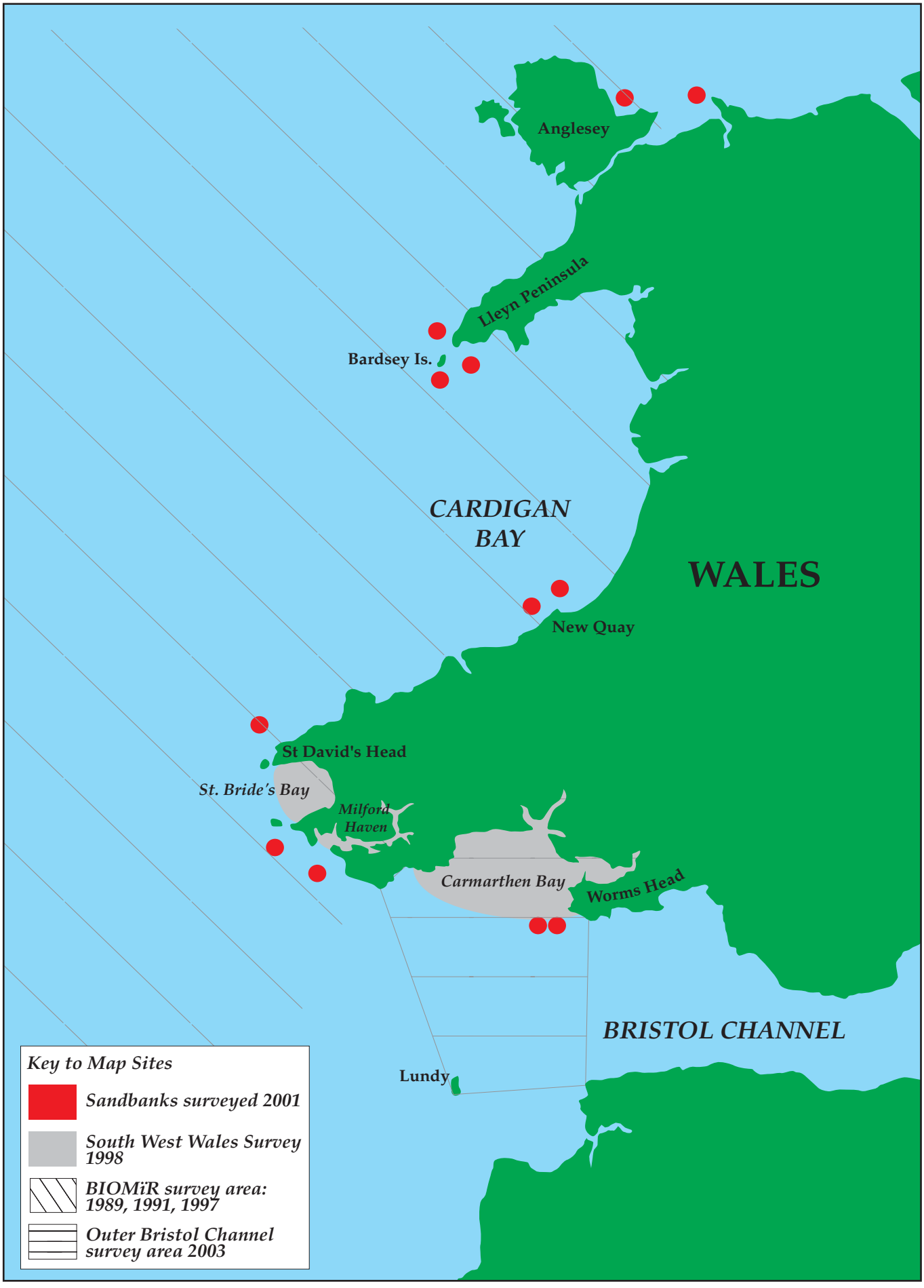

Figure 1. Benthic surveys carried out by the National Museum of Wales and partners 1989–2003.

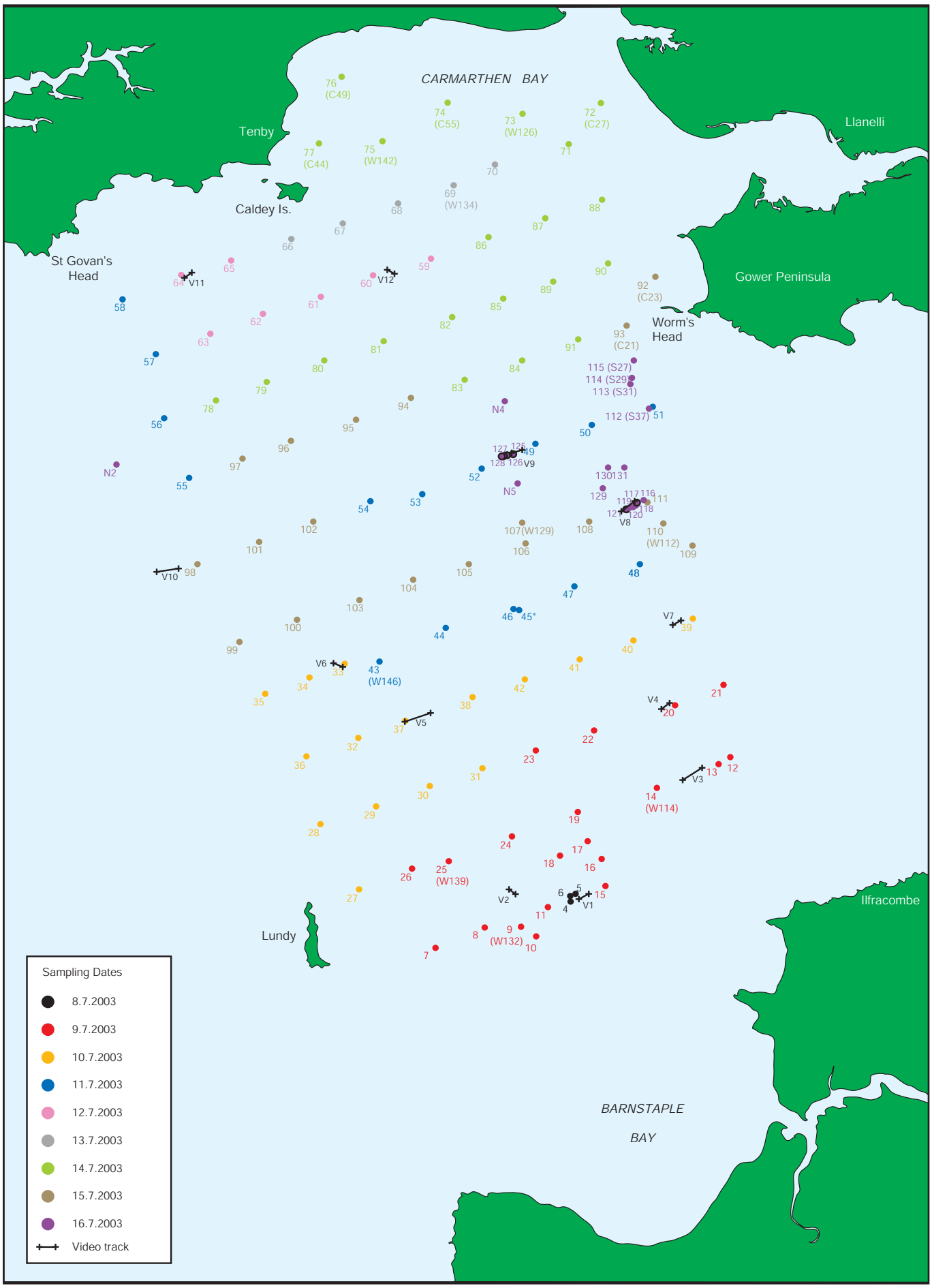

Figure 2. Biological sampling stations and video tracks in the outer Bristol Channel.

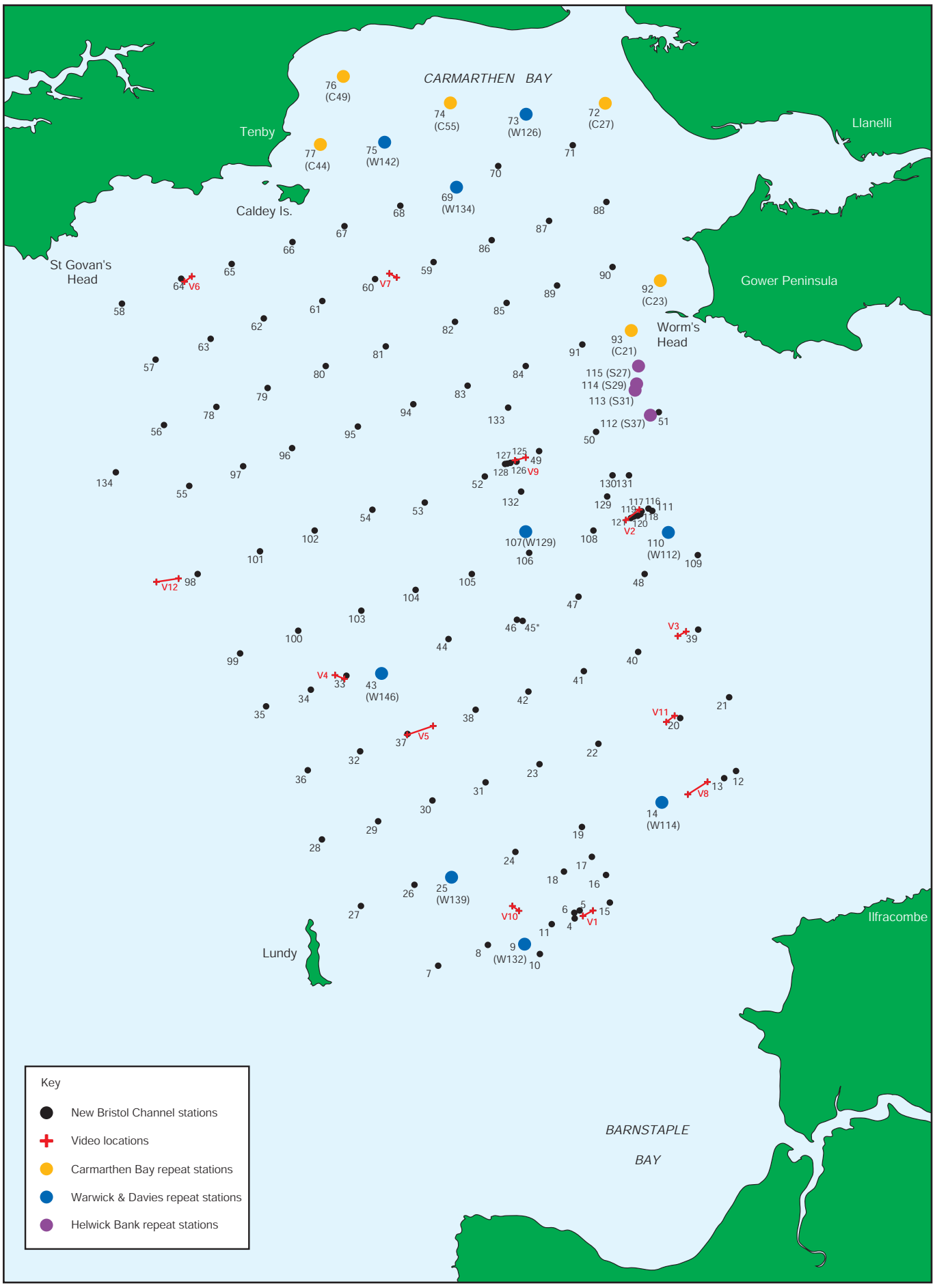

Figure 3. Biological sampling stations and video tracks in the outer Bristol Channel showing stations in common with earlier surveys.

Reference Stations

As the study area has been sampled previously, for example, by the Museum and the Countryside Council for Wales (Helwick Bank, Carmarthen Bay: Darbyshire, *et al*. 2002, Woolmer 2003) and Plymouth Marine Laboratory (Bristol Channel survey: Warwick & Davies 1977) a number of coincident stations were selected to provide some degree of reference and perhaps allow examination of temporal change. These stations (Fig.3) were:

9 stations in common with the Warwick & Davies Bristol Channel survey (W-prefix)
4 stations in common with the NMGW-CCW Sandbanks survey (Helwick: S-prefix)
6 stations in common with the NMGW-CCW Carmarthen Bay survey (C-prefix)
1 station outside the area (Stn 1; Red Wharf Bay, Anglesey) in common with BIOMÔR Stn 34 (Mackie, *et al*. 1995).

Sampling Efficiency

The success of benthic grab sampling is dependent on many factors including design and weight of grab, winch operation, 'hardness' of the sediment, and weather.

As expected from previous experience, the grab performed best on the softer or looser sediments and poorest on the harder, more compacted, ones (Fig.4). The overall success (good samples) from 452 grab deployments was 74.6% and the failure rate was 20.4%.

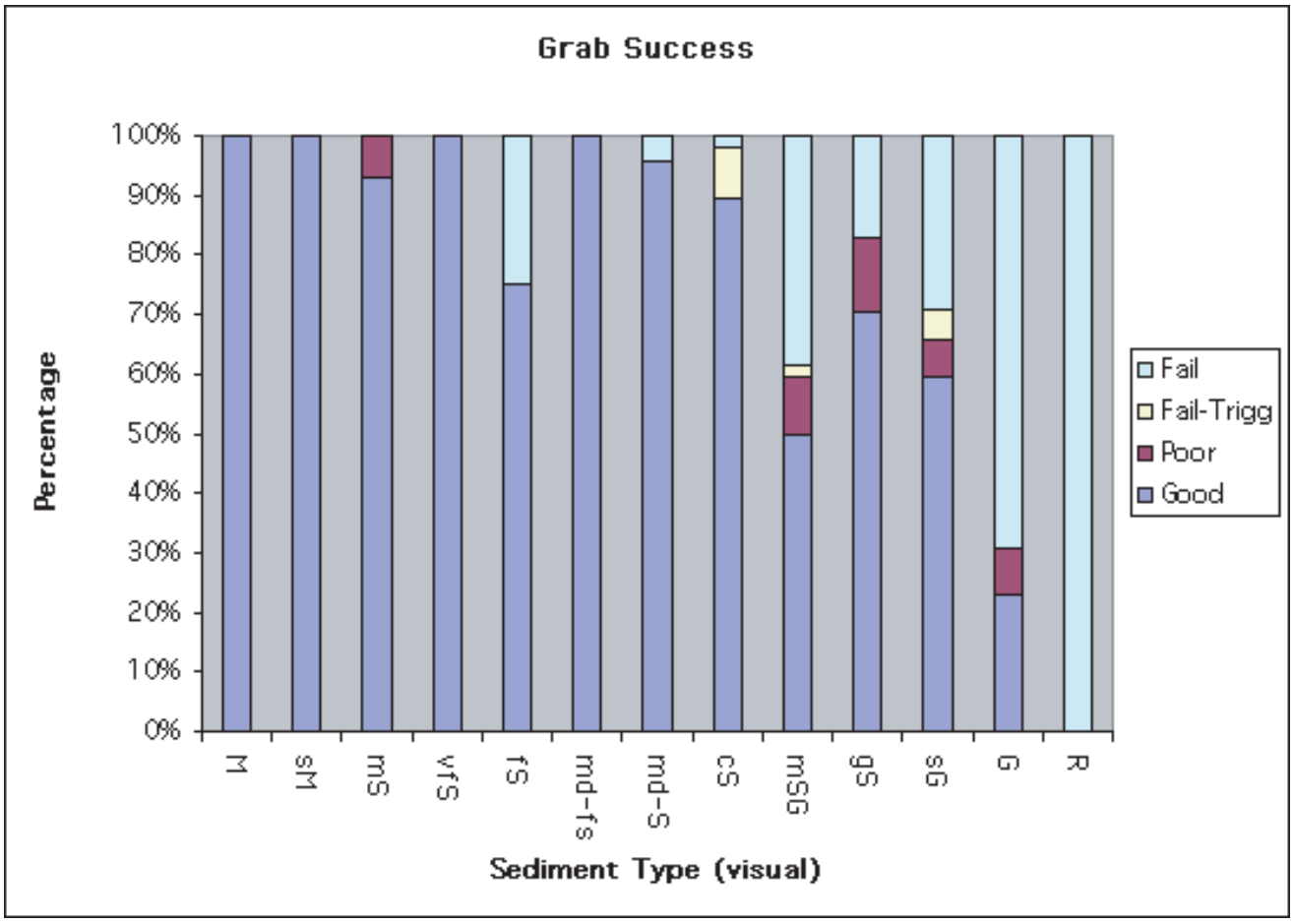

Figure 4. Success rate of the 92 kg modified Van Veen grab (Fail-Trigg = grab trigger failure).

The tri-modal pattern of volume of sediment collected (Fig.5) agreed with our other studies in Welsh, Irish and Seychelles waters (Mackie in prep.). The grab does not dig so deeply in very fine sand, mud-sand-gravel and gravel. Note that, at the time of writing, actual grain-size data from the sediments is unavailable and the sediment categories are visual assessments only. Such assessments commonly overestimate the mud content of the finer sands and the gravel content of the coarser sands. The mean volumes of the 246 good and poor grabs measured were 8.97 and 3.93 litres respectively.

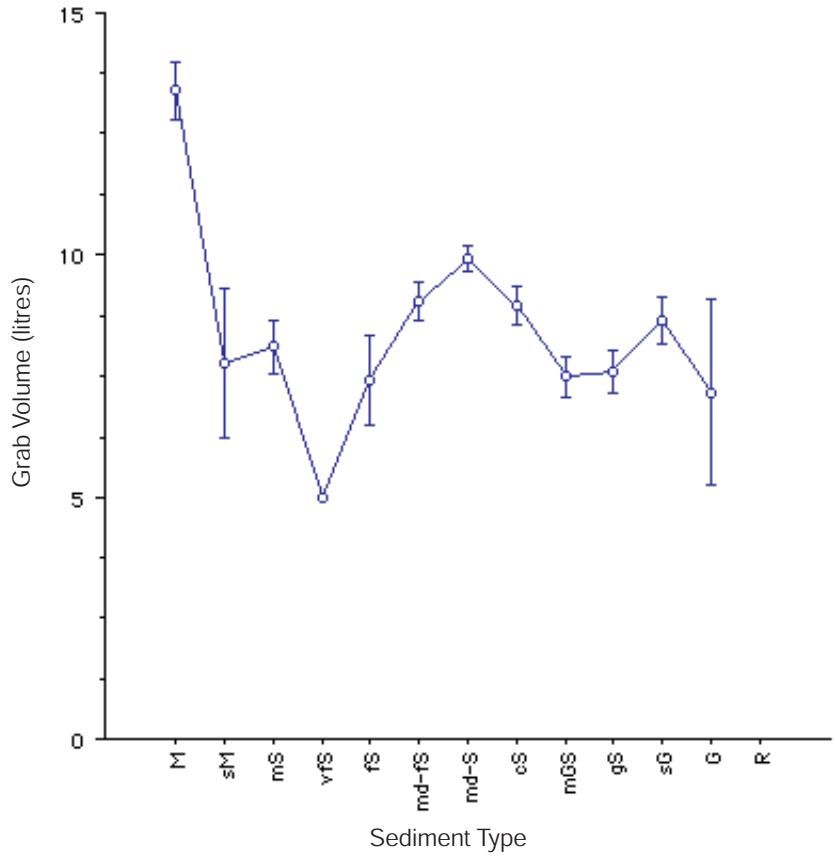

Figure 5. Grab volume (± 1SE) for each sediment category. (M, mud; sM, sandy mud; mS, muddy sand; vfS, very fine sand; fs, fine sand; md-fS, medium to fine sand; md-S, medium sand; cS, coarse sand; mGS, muddy gravelly sand; gS, gravelly sand; sG, sandy gravel; G, gravel; R, rock).

Sample Processing

Sample buckets and pots were removed from the R.V. *Prince Madog* at the 'half-way' sampling crew changeover in Milford Haven on July 14 and at the end of the cruise in Menai Bridge on July 18.

On return to the Museum, work commenced on washing out the formalin and salt from the decanted first fractions ('animal fraction') of the samples. After washing, the samples were stored in 80% alcohol (with 1% propylene glycol). The sieved sediment fractions were securely stored outside at the NMGW Nant Garw collections centre.

In August, job advertisements for four sorters and a sorting supervisor/identifier were publicised. Job interviews were held in September and the successful applicants started work during October.

From October to December, the sorters (Catalena Angele, Rhian Bowen, Amy Critchlow and Sylvia Noorbhai) and supervisor (Dr Dawn Powell), split their time between washing the sieved sediments and sorting the animals from the samples. Since January 2004, the sorting has been full-time. Some 40 samples have been fully sorted to date. Preliminary identifications on the crustacea, echinoderms and the 'minor' groups has begun.

Timetable (2004–2005)

Sorting will continue though to March/April 2005.

Identifications will continue through to March/April 2005, with polychaete identifications commencing in April/May 2004.

Some small-scale (up to 5 or 6 stations) targeted benthic sampling is now scheduled for late summer, following a projected second Geology cruise. This sampling would focus on an area selected from the geophysical results and would be accompanied by additional underwater video and photography by Ivor Rees. The sampling would make use of the University of Wales Swansea R.V. *Noctiluca* (subject to availability).

By early 2005 work will have commenced on the groundwork and planning of the final outreach aspects of the project (exhibition, CD-ROM, publication etc.), and the post for the Exhibition/education facilitator will be advertised.

Steering Group (First meeting: December 2003)

A short Powerpoint® presentation was made together with a video summarising the sampling, sample processing and laboratory sorting currently underway.

Outreach

An article was published in the Autumn 2003 issue of *Natur Cymru* (A Review of Wildlife in Wales) and included mention of the *Outer Bristol Channel Marine Habitat Study* in the context of seabed investigations around Wales (Mackie 2003).

An account of the study (A. Mackie), life on the research vessel (K. Mortimer) and individual (self-written) profiles of all five new *Outer Bristol Channel Marine Habitat Study* staff appeared in the November 2003 issue of *The Symbiont* [News from the Department of Biodiversity & Systematic Biology (BioSyB)]. This 50 page newsletter is distributed widely throughout the National Museums & Galleries of Wales.

An account of the study has been prepared for the coming issue of *Amgueddfa* — the collections, research, exhibition and interpretation yearbook published by the National Museums & Galleries of Wales

A short press office article entitled 'Marine biodiversity survey of the Outer Bristol Channel' appeared in issue 4 (January 2004) of *Premier* [News from the National Museums & Galleries of Wales] — a publication aimed at Museum sponsors, patrons, Assembly members and interested parties.

The paper describing the new modified Van Veen grab (Mackie in prep.), its benefits, operation and efficiency is being written and will be submitted to a peer-reviewed scientific journal after incorporation of the sediment analysis data from the OBCMHS.

Ceri James and Andrew Mackie are currently discussing other publicity outlets including scientific publications, the press and conference posters.

The possibilty of hosting the exhibition phase of the project in the new *National Waterfront Museum Swansea* (due to open in summer 2005) has been raised by Dr Carolyn Heeps (The Crown Estate Marine Environment and Policy Manager) and, within the Museum, by Dr Mackie. Further internal Museum discussions will shortly take place on this matter.

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Log of the 2003 Prince Madog *biological survey of the Outer Bristol Channel*

Outer Bristol Channel Marine Habitat Study

Log of the 2003 Prince Madog cruise

Ship: R.V. *Prince Madog* (University of Wales, Bangor)

Personnel aboard ship: *NMGW*: T. Darbyshire, K. Mortimer, A.S.Y. Mackie, E.IS. Rees, H. Wood, J. Turner, M. Lambert, B. Rowson, R. Bowen, D. Cowell, K. Vint, H. Kerbey; *BGS*: G. Jenkins; *UCG*: B. Barrett

Samples sorted by: A. Critchlow, R. Bowen, C. Angele, S. Noorbhai; **Supervisor:** D. Powell

Specimens identified by: A.S.Y. Mackie & T. Darbyshire (Annelida); D. Powell (all other groups)

Sediment analysed by: John Malcolm, Sediment Analysis Services

Repeat Stations

During the survey, some stations coincided with previous survey station locations, some repeat stations were added to allow greater comparison to earlier surveys from the area and a few new stations were sampled to fill in gaps in area coverage. Previous surveys alluded to are:

Warwick & Davies (1977)
BIOMÔR 1 (1989, 1991)
Welsh Sandbanks Survey 2001
See end for survey references.

South West Wales (1998, unpublished)
- includes Carmarthen Bay (Woolmer 2003)

Station numbers

Original station numbers (OBC) from the planning stage are also included with each station

6/07/2003

Stn. 001: Red Wharf Bay, Anglesey (53° 19.476' N, 4° 08.996' W), 10.6 m
muddy sand & dead Abra shell, Ophiuroids, *Abra, Nucula, Lagis* (1 only), Solenette, *Peachia*

1250–1250 Very Good (A - 14 litres)
1252–1252 Very Good (B - 14 litres)
1254–1254 Very Good (C - sediment sample)
Pholoe; Malmgrenia; Phyllodoce mucosa, P. groenlandica; Melinna; Nephtys; Scalibregma; Capitellidae; *Owenia*; *Galathowenia*; Terebellidae; *Nucula; Abra; Cultellus*; Spiny cockle; *Echinocardium cordatum*
Note: Notable lack of *Lagis koreni*. *Repeat of BIOMÔR Stn 34*

8/07/2003

Stn. 002: One Fathom Bank, dredging area south of Cardiff (51° 21.599' N, 03° 10.014' W), 33.9 m
coarse sandy shelly gravel

1505–1507 Stone in jaws
1508–1509 Slight gap in jaws (A - 13 litres)
1511–1513 Slight leak (C - sediment sample)
1517–1518 Stone in jaws
1519–1520 Scraping only
1522–1523 Scraping only
1525–1526 Scraping only
1535–1537 Scraping only
1538–1539 Poor
1541–1542 Poor
1543–1544 Good (B - 11 litres)
Note: Problem due to constant stones & pebbles in jaws. Sample B had some leakage but was retained due to size & no. of grabs. Ship repositioned between grabs 7 & 8.

Stn. 003: One Fathom Bank, (dredging area south of Cardiff (51° 20.803' N, 03° 13.628' W) 23.6 m
coarse sand gravel pebbles & *Sabellaria* reef, *Sabellaria alveolata*

1559–1601 Stone in jaws
1602–1603 Stone in jaws
Sabellaria alveolata; Eulalia tripunctata; Eupolymnia (nesidensis?)
Note: Station abandoned due to time con straints for reaching next station. Reef chunk retained and analysed for fauna.
NO SEDIMENT SAMPLE

Stn. 004: OBC 115 (51° 12.158' N, 04° 24.787' W) 39.7 m
coarse sandy gravel

2021–2023 Good (A - 10 litres)
2027–2029 Good (B - 9.5 litres)
2030–2032 Good (C - sediment sample)

Stn. 005: OBC 114 (51° 12.260' N, 04° 25.004' W) 39.8 m
coarse 'sandy' gravel (less sand than stn 4)

2037–2039 Very Good (A - 12.5 litres)
2040–2042 Very Good (B - 13 litres)
2101–2103 Very Good (C - sediment sample)
Note: Sample C accidentally missed. Returned to it after stn 6, but sediment sample will be much sandier than the previous samples.

Video 1: E of Lundy (OBC Video 1) 39.5 m

1937 Photosled in (51° 16.555' N, 04° 18.734' W)
2004 Photosled out (51° 16.899' N, 04° 17.630' W)

Stn. 006: OBC 113 (51° 12.166' N, 04° 25.111' W) 45.6 m
silty gravelly sand

2048–2050 Fair (A - 6.5 litres)
2052–2054 Fair (B - 6.5 litres)
2056–2058 Fair (C - sediment sample)

9/07/2003

Stn. 007: OBC 86 (51° 10.329' N, 04° 32.902' W) 50.5 m
coarse - medium gravelly sand & hydroid; some shells/fragments, *Hydrallmania; Nephtys; Macropodia*

0700–0702 Good (A - 6.5 litres)
0704–0706 Fair (B - 4.5 litres), *Macropodia*
0708–0710 Good (C - sediment sample)

Stn. 008: OBC 87 (51° 11.019' N, 04° 30.097' W) 47.3 m
medium sand (finer than stn 7, no hydroid)

0726–0728 Good (A - 8 litres)
0729–0731 Poor (C - sediment sample)
0733–0736 Scraping only
0737–0739 Scraping only
0744–0746 Very Good (B - 12 litres)
Note: *Velella velella* (jellyfish) sighted

Stn. 009: OBC 109 (51° 11.014' N, 04° 27.990' W) 46.2 m
coarse sand

0758–0801 Good (A - 8 litres)
0802–0804 Good (B - 8 litres)
0805–0808 Good (C - sediment sample)
Note: Leatherback turtle sighted
Repeat of Warwick & Davies Stn 132

Stn. 010: OBC 108 (51° 10.717' N, 04° 27.082' W) 46.6 m
coarse sand, *Thia scutellata, Spatangus, Montacuta*

0815–0817 Very Good (A - 10 litres), *Spatangus* + commensal bivalve *Montacuta sub-striata*
0820–0821 Good (B - 9 litres)
0823–0825 Stone in jaws
0826–0828 Good (C - sediment sample)
Note: Some of sample B spilt during processing

Stn. 011: OBC 88 (51° 11.752' N, 04° 26.388' W) 43.1 m
medium - coarse sand

0839–0841 Very Good (A - 13 litres)
0842–0844 Good (B - 9 litres)
0845–0847 Good (C - sediment sample)

Video 2: NW of Horseshoe Rocks (OBC Video 8) 42.9 m

0920 Photosled in (51° 16.555' N, 04° 18.734' W)
0953 Photosled out (51° 16.899' N, 04° 17.630' W)

Stn. 012: OBC 107 51° 17.300' N, 04° 15.832' W) 42.0 m
till with thin gravel veneer

1012–1014 Stone in jaws
1015–1017 Stone in jaws
1018–1020 Stone in jaws
Note: No quantitative sample obtained so samples pooled as one qualitative sample.
NO SEDIMENT SAMPLE

Stn. 013: OBC 79 (51° 17.064' N, 04° 16.582' W) 41.5 m
till - gravel, stones, *Sabellaria* reef

1028–1030 Gap in jaws (sediment sample)
1032–1033 Poor (A - 3.5 litres)
1035–1036 Stone in jaws
1037–1039 Stone in jaws
1039–1041 Stone in jaws
1042–1044 Empty
1044–1045 Stones
Note: Qualitative station, only 1 small sample

Stn. 014: OBC 80 (51° 16.179' N, 04° 20.096' W) 43.5 m
sandy gravel

1108–1110 Empty
1110–1112 Stone

1112–1114 Good (A - 6 litres)
1114–1115 Good (B - 8 litres)
1116–1117 Good (C - sediment sample)
Note: *Repeat of Warwick & Davies Stn 114*

Stn. 015: OBC 89 (51° 12.584' N, 04° 23.066' W)
46.6 m
fine sand shell hydroid

1154–1156 Scraping only
1157–1158 Poor (A - 5 litres)
1201–1202 Scraping only
1203–1204 Stones
1205–1207 Fair (B - 6 litres)
1208–1209 Fair (C - sediment sample)

Stn. 016: OBC 112 (51° 13.585' N, 04° 23.322' W)
47.6 m
Sabellaria reef, sandy gravel

1220–1222 Fair (A - 5 litres)
1224–1225 Stones
1227–1228 Poor (C - sediment sample)
1232–1234 Fair (B - 4.5 litres); Pectinariid; decapod

Stn. 017: OBC 111 (51° 14.196' N, 04° 24.182' W)
47.3 m
sandy gravel

1245–1247 Good (A - 6 litres)
1248–1250 Very Good (B - 9 litres)
1252–1254 Good (C - sediment sample)

Stn. 018: OBC 110 (51° 13.682' N, 04° 25.811' W)
47.3 m
gravelly sand, *Buccinum*

1308–1310 Good (A - 5.5 litres)
1312–1314 Good (B - 6.5 litres)
1315–1316 Good (C - sediment sample)

Stn. 019: OBC 81 (51° 15.318' N, 04° 24.668' W)
48.6 m
muddy gravelly sand, *Buccinum*, *Psammechinus*

1333–1335 Shell in jaws (B - 4 litres)
1337–1339 Stones
1340–1342 Fair (A - 7 litres)
1343–1345 Stones
1346–1347 Poor (C - sediment sample)
1348–1350 Stones
Note: Slight leakage from 1st grab but accepted as sample due to quality of later samples

Video 3: NW of Horseshoe Rocks (OBC Video 11)
49.2 m

1434 Photosled in (51° 19.332' N, 04° 19.515' W)
1455 Photosled out (51° 19.146' N, 04° 19.911' W)

Stn. 020: OBC 77 (51° 19.366' N, 04° 19.014' W)
47.1 m
muddy gravelly sand & rocks, *Macropodia Xantho, Pisidia*

1521–1523 Trigger failed
1523–1525 Scraping only
1526–1528 Fair (A - 6.5 litres)
1529–1531 Gap in jaws (C - sediment sample)
1535–1537 Fair (B - 6.5 litres)
Xantho pilipes, Pisidia longicornis; Echinoid

Stn. 021: OBC 78 (51° 19.990' N, 04° 16.243' W)
48.2 m
muddy sandy gravel, Terebellidae, Sipuncula, *Inachus, Macropodia, Liocarcinus*

1553–1555 Scraping only
1556–1558 Stones
1558–1600 Stones (sediment sample), Terebellidae
1614 Tjarno dredge deployed (51° 20.040' N, 04° 16.318' W)
1620 Tjarno dredge retrieved (51° 19.939' N, 04° 16.168' W)
Note: Qualitative only

Stn. 022: OBC 76 (51° 18.370' N, 04° 23.728' W)
49.8 m
gravelly mud

1653–1655 Good (A - 7 litres)
1657–1659 Good (B - 9 litres)
1700–1702 Good (C - sediment sample)
Note: Sediment sample sandier than quantitative samples

Stn. 023: OBC 75 (51° 17.585' N, 04° 27.164' W)
49.4 m
medium sand shell gravel, some mud

1716–1717 Good (A - 6.5 litres)
1719–1721 Gap in jaws
1722–1724 Slight gap in jaws (C - sediment sample)
1725–1726 Good (B - 7 litres)

Stn. 024: OBC 82 (51° 14.439' N, 04° 28.566' W)
46.6 m
medium-coarse sand

1748–1750 Very Good (A - 11 litres)
1751–1753 Very Good (B - 10 litres)
1754–1756 Very Good (C - sediment sample)

Stn. 025: OBC 83 (51° 13.472' N, 04° 32.270' W)
48.1 m
gravelly sand (medium-coarse), some mud

1805–1806 Good (A - 7 litres)
1810–1811 Good (B - 8 litres)
1813–1814 Stone
1816–1817 Good (C - sediment sample)
Note: *Repeat of Warwick & Davies Stn 139*

Stn. 026: OBC 84 (51° 13.191' N, 04° 34.370' W)
42.3 m
medium-coarse sand

1829–1832 Very Good (A - 10 litres)
1833–1835 Very Good (B - 12.5 litres)
1836–1837 Very Good (C - sediment sample)

Video 4: E of Lundy (OBC Video 10) 47.5 m

2110 Photosled in (51° 12.293' N, 04° 28.516' W)
2137 Photosled out (51° 12.441' N, 04° 28.810' W)

10/07/2003

Stn. 027: OBC 85 (51° 12.487' N, 04° 37.499' W)
43.0 m
very coarse sand

0659–0701 Very Good (A - 14 litres)
0703–0705 Very Good (B - 13.5 litres)
0705–0706 Very Good (C - sediment sample)

Stn. 028: OBC 71 (51° 14.838' N, 04° 39.651' W)
51.1 m
muddy sandy gravel, *Pisidia, Porcellana, Sabellaria*, Serpulidae, whelks, bivalve

0724–0726 Stone in jaws
0726–0728 Stone
0729–0730 Stone
0736 Tjarno dredge deployed (51° 14.852' N, 04° 39.781' W)
0745 Tjarno dredge retrieved
Note: Scrapings from grab samples pooled.
NO SEDIMENT SAMPLE

Stn. 029: OBC 72 (51° 15.498' N, 04° 36.407' W)
50.9 m
muddy sandy gravel

0805–0807 Good (A - 8 litres)
0808–0811 Stone in jaws
0812–0814 Good (B - 8 litres)
0815–0817 Good (C - sediment sample)

Stn. 030: OBC 73 (51° 16.260' N, 04° 33.298' W)
45.5 m
coarse sandy gravel

0835–0837 Very Good (A - 10 litres)
0838–0839 Very Good (B - 10.5 litres)
0840–0841 Very Good (C - sediment sample)

Stn. 031: OBC 74 (51° 16.951' N, 04° 30.223' W)
45.6 m
coarse gravelly sand

0859–0901 Good (A - 7 litres)
0902–0903 Good (B - 7 litres)
0904–0905 Good (C - sediment sample), *Malmgrenia*

Stn. 032: OBC 69 (51° 18.065' N, 04° 37.467' W)
49.1 m
coarse sandy gravel

0938–0940 Very Good (A - 12.5 litres)
0941–0943 Very Good (B - 11 litres)
0944–0946 Very Good (C - sediment sample)

Video 5: NW of Lundy (OBC Video 5) 46.5 m

0956 Photosled in (51° 18.691' N, 04° 34.852' W)
1023 Photosled out (51° 18.982' N, 04° 33.770' W)

Video 6: N of Lundy (OBC Video 4) 52.8 m

1058 Photosled in (51° 20.725' N, 04° 38.407' W)
1121 Photosled out (51° 20.821' N, 04° 38.947' W)

Stn. 033: OBC 56 (51° 20.803' N, 04° 38.328' W)
52.6 m
muddy sandy gravel & shell

1137–1139 Stones & leakage (C - sediment sample)
1142–1144 Stone in jaws
1145–1146 Stone in jaws
1147–1149 Scraping only
1150–1152 Stones
Note: Qualitative, all samples pooled.

Stn. 034: OBC 55 (51° 20.367' N, 04° 40.385' W)
48.8 m
sandy gravel

1209–1210 Fair (A - 4.5 litres)
1212–1213 Fair (C - sediment sample)
1215–1216 Fair (B - 4.5 litres)

Stn. 035: OBC 54 (51° 19.761' N, 04° 42.899' W)
59.1 m
gravelly sand

1240–1243 Stone in jaws
1244–1247 Fair (A - 6.5 litres)
1248–1251 Fair (B - 5.5 litres)
1252–1255 Fair (C - sediment sample)

Stn. 036: OBC 70 (51° 17.387' N, 04° 40.482' W)
54.5 m
muddy sandy gravel

1314–1317 Scraping only
1318–1320 Fair (A - 6.5 litres)
1322–1324 Fair (B - 5.5 litres)
1325–1327 Fair (C - sediment sample)
Sabellid (*Jasmineira/Chone*?)

Stn. 037: OBC 68 (51° 18.739' N, 04° 34.761' W)
48.9 m
sandy gravel (A & C), gravelly sand/ sand (B)

1349–1351 Good (A - 7 litres)
1352–1354 Stone in jaws (C - sediment sample)
1355–1357 Stones
1358–1400 Stones
1402–1404 Trigger failed
1404–1406 Trigger failed
1407–1409 Trigger failed
1410–1412 Good (B - 6.5 litres)

Stn. 038: OBC 67 (51° 19.567' N, 04° 30.841' W)
51.5 m
gravelly sand

1424–1426 Good (A - 8 litres)
1427–1428 Sediment leaking
1430–1432 Good (B - 8 litres)
1433–1435 Good (C - sediment sample)
Laonice?, *Phyllodoce longipes*

Video 7: NW of Ilfracombe (OBC Video 3) 50.0 m

1526 Photosled in (51° 22.298' N, 04° 18.866' W)
1551 Photosled out (51° 22.170' N, 04° 19.243' W)

Stn. 039: OBC 63 (51° 22.398' N, 04° 18.121' W)
47.3 m
gravelly sand

1613–1615 Stone in jaws
1616–1618 Fair (A - 5 litres)
1619–1621 Scraping only
1622–1624 Stones
1624–1626 Empty
1627–1629 Good (B - 8 litres)
1630–1632 Sediment leaking
1632–1633 Sediment leaking (C - sediment sample)
Eurynome

Stn. 040: OBC 64 (51° 21.637' N, 04° 21.511' W)
52.8 m
gravelly muddy sand (black anoxic mud)

1650–1652 Shell in jaws
1653–1655 Scraping only
1656–1658 Poor (C - sediment sample)
1703–1705 Fair (A - 6.5 litres)
1706–1708 Fair (B - 6 litres)

Stn. 041: OBC 65 (51° 20.958' N, 04° 24.599' W)
45.8 m
gravelly sand (granules well rounded)

1723–1725 Very Good (A - 12.5 litres)
1726–1728 Very Good (B - 12 litres)
1728–1731 Very Good (C - sediment sample)

Stn. 042: OBC 66 (51° 20.196' N, 04° 27.867' W)
47.7 m
gravelly muddy sand (B&C), medium-coarse sand (A&D)

1744–1746 Very Good (A - 12 litres)
1748–1750 Stone in jaws
1751–1753 Stone
1757–1759 Scraping only
1759–1801 Fair (B - 6 litres, qualitative)
Hesionidae; *Magelona alleni*; Terebellidae
1803–1805 Fair (C - sediment sample)
1810–1812 Good (D - 9 litres)
Note: Sediment type changed following sample A. Ship repositioned after grab 3 to try to relocate but sediment type remained different. Sediment sample was taken from the 2nd sediment type as sample B. Sample D is a comparable sediment type to sample A.

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Stn. 043: OBC 57 (51° 20.933' N, 04° 36.309' W)
53.8 m
medium well sorted quartz sand, some pebbles, rare shells

0752–0755 Stone in jaws
0755–0758 Very Good (A - 13 litres)
0759–0801 Stone
0801–0803 Very Good (B - 11 litres)
0804–0806 Stone
0807–0809 Very Good (C - sediment sample)
Note: *Repeat of Warwick & Davies Stn 146*

Stn. 044: OBC 58 (51° 22.096' N, 04° 32.419' W)
49.1 m
well sorted medium-coarse sand underlain by pebbly gravel, low shell content, hydroid clumps

0833–0835 Good (A - 6 litres)
0836–0838 Good (B - 5.5. litres); Pycnogonid
0839–0841 Good (C - sediment sample)

Stn. 045: nr OBC 59 (51° 22.734' N, 04° 28.192' W) 40.8 m
well sorted medium sand overlying hydroid-bound pebbles, low shells

0901–0903 Qualitative, sediment sample taken
Note: Ship not on station so moved on. Sediment sample taken, therefore rest sieved as qualitative.

Stn. 046: OBC 59 (51° 22.855' N, 04° 28.515' W) 48.8 m
moderate sorted gravelly sand (B&D); A - sandier

0911–0913 Very Good (A - 10.5 litres; qualitative)
0914–0916 Stone
0917–0919 Very Good (B - 10 litres)
0920–0922 Very Good (D - 10 litres)
0923–0925 Very Good (C - sediment sample)
Note: Sediment type changed after sample A, so sampling continued until 2 samples the same had been obtained.

Stn. 047: OBC 60 (51° 23.611' N, 04° 24.893' W) 41.6 m
moderate sorted coarse gravelly sand

0944–0946 Very Good (A - 9.5 litres)
0947–0949 Very Good (B - 13 litres)
0950–0952 Very Good (C - sediment sample)

Stn. 048: OBC 61 (51° 24.457' N, 04° 21.310' W) 45.0 m
well sorted medium-coarse sand, low shell content black anoxic mud in sample B

1009–1011 Very Good (C - sediment sample)
1013–1015 Very Good (A - 13.5 litres)
1016–1018 Very Good (B - 10 litres)

Video 8: S of Helwick Bank (OBC Video 2) 45.5 m

1034 Photosled in (51° 26.383' N, 04° 22.304' W)
1059 Photosled out (51° 26.660' N, 04° 21.464' W)

Video 9: SW of Helwick Bank (OBC Video 9) 39.9 m

1140 Photosled in (51° 28.633' N, 04° 27.967' W)
1205 Photosled out (51° 28.583' N, 04° 28.555' W)

Stn. 049: OBC 43 (51° 28.910' N, 04° 27.266' W) 40.7 m
moderately well sorted coarse sand, low shell content

1240–1242 Very Good (A - 11 litres)
1243–1245 Very Good (B - 8 litres)
1246–1248 Very Good (C - sediment sample)

Stn. 050: OBC 44 (51° 29.593' N, 04° 24.105' W) 37.7 m
poorly sorted coarse sandy gravel, high shell content

1306–1307 Good (A - 8.5 litres)
1308–1310 Good (B - 8 litres)
1312–1313 Trigger failed
1313–1315 Good (C - sediment sample)

Stn. 051: OBC 45 (51° 30.207' N, 04° 20.524' W) 39.7 m
coarse sand underlain by pebbles; moderate shell content; balls of very dark grey mud

1327–1328 Stone in jaws
1329–1331 Very Good (A - 11 litres)
1332–1334 Stones
1335–1336 Very Good (B - 11 litres)
1337–1338 Very Good (C - sediment sample)

Stn. 052: OBC 42 (51° 27.985' N, 04° 30.472' W) 45.1 m
sediment as 51 (sandy gravel?); B more gravelly than A

1433–1435 Very Good (A - 10.5 litres)
1436–1438 Very Good (B - 8 litres); *Pandalus*?
1440–1442 Very Good (C - sediment sample)

Stn. 053: OBC 41 (51° 27.017' N, 04° 33.780' W) 48.2 m
coarse well sorted shelly sand

1501–1503 Good (A - 7 litres)
1504–1506 Good (B - 9 litres)
1507–1509 Good (C - sediment sample); *Echinocardium* (not *cordatum*), *Spisula solida*

Stn. 054: OBC 40 (51° 26.801' N, 04° 36.871' W) 42.3 m
well sorted medium - coarse sand, low shell content

1529–1531 Very Good (A - 13 litres)
1532–1534 Very Good (B - 10 litres)
1535–1537 Very Good (C - sediment sample)

Video 10: S of Manorbier (OBC Video 12) 63.4 m

1632 Photosled in (51° 24.354' N, 04° 47.920' W)
1655 Photosled out (51° 24.251' N, 04° 48.383' W)

Stn. 055: OBC 36 (51° 27.667' N, 04° 47.380' W)
58.4 m
fine-medium well sorted sand, no shells, underlain by black organic clay

1734–1736 Very Good (A - 9.5 litres); Ophiuroid
1738–1740 Very Good (B - 11 litres)
1741–1743 Very Good (C - sediment sample)

Stn. 056: OBC 19 (51° 29.866' N, 04° 48.837' W)
51.0 m
sediment as 55, *Abra*

1801–1803 Very Good (A - 10.5 litres)
1805–1807 Very Good (B - 10.5 litres)
1808–1809 Very Good (C - sediment sample)

Stn. 057: OBC 18 (51° 32.212' N, 04° 49.224' W)
39.8 m
as 55 but slightly finer

1830–1832 Good (C - sediment sample)
1834–1835 Good (A - 10 litres)
1836–1838 Good (B - 9.5 litres)

Stn. 058: OBC 1 (51° 34.233' N, 04° 51.198' W)
43.4 m
shelly gravelly muddy sand

1855–1857 Good (A - 7 litres)
1858–1859 Scraping only
1900-1902 Good (B – 6 litres); scaleworm
1903-1904 Good (C – sediment sample)

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Video 11: S of Manorbier (OBC Video 6) 38.4 m

0611 Photosled in (51° 35.214' N, 04° 47.183' W)
0620 Photosled out (51° 35.061' N, 04° 47.536' W)
Note: Camera tow aborted due to lack of visibility

Video 12: SE of Caldey Island (OBC Video 7)
37.3 m

? Photsled in (51° 35.245' N, 04° 35.725' W)
0751 Photosled out (51° 35.164' N, 04° 35.451' W)

Stn. 059: OBC 13 (51° 35.722' N, 04° 33.365' W)
32.6 m
fine-medium sand, moderately sorted, moderate shell content

0816–0818 Good (A - 9 litres)
0819–0821 Good (B - 8.5 litres)
0822–0824 Good (C - sediment sample)

Stn. 060: OBC 14 (51° 35.075' N, 04° 36.707' W)
39.1 m
moderately sorted medium sand, moderate shell content

0836–0838 Good (A - 8 litres)
0839–0840 Good (B - 9 litres)
0841–0842 Good (C - sediment sample)

Stn. 061: OBC 15 (51° 34.352' N, 04° 39.661' W)
41.1 m
muddy sandy gravel, moderate shells, organic content

0857–0859 Sediment leaking (C - sediment sample)
0900–0902 Stone in jaws
0903–0904 Good (A - 7 litres)
0905–0906 Stone in jaws
0907–0908 Very Good (B - 10 litres)

Stn. 062: OBC 16 (51° 33.666' N, 04° 42.969' W)
40.6 m
mud

0924–0925 Very Good (A - 14 litres)
0927–0929 Very Good (B - 11 litres)
0932–0933 Very Good (C - sediment sample)

Stn. 063: OBC 17 (51° 32.960' N, 04° 46.131' W)
40.6 m
muddy sand

0947–0949 Very Good (A - 11 litres)
0950–0951 Good (B - 7 litres)
0952–0953 Good (C - sediment sample)

Stn. 064: OBC 2 (51° 35.084' N, 04° 47.731' W)
36.2 m
coarse sandy gravel (A, D & C); muddy gravel (B)

1013–1015 Very Good (A - 12.5 litres)
1016–1018 Scraping only
1018–1020 Stone in jaws
1021–1024 Fair (B - 5 litres)
1025–1026 Scraping only
1026–1027 Very Good (D - 11.5 litres)
1028–1029 Stones
1030–1031 Stones
1031–1032 Good (C - sediment sample)
Note: Sediment changed after A sample then reverted back after 5th grab. Samples A & D were the same sediment type as was the sediment sample from sample C. Sample B was discarded.

Stn. 065: OBC 3 (51° 35.620' N, 04° 44.957' W)
34.0 m
moderately sorted very coarse sand (B–D)

1048–1051 Very Good (A - 9 litres)

1052–1053 Very Good (B - 10 litres)
1054–1055 Very Good (D - 10 litres)
1056–1057 Very Good (C - sediment sample)
Note: Sediment changed after A sample. The following samples B–D were all the same sediment type, so sample A was discarded.

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Stn. 066: OBC 4 (51° 36.431' N, 04° 41.452' W) 33.7 m
rock platform (A: muddy shelly sand)

1841–1842 Empty
1843–1844 Stone
1845–1846 Stone in jaws
1847–1848 Very Good (A - 10 litres)
1850–1851 Stones
1852–1853 Empty
1859 Tjarno dredge deployed
1904 Tjarno dredge retrieved: empty (!)
Note: Rock platform with occasional pock ets of sand leading to one grab of sand and an empty dredge! Stones retained & pooled into 1 sample. Station is qualitative. NO SEDIMENT SAMPLE.

Stn. 067: OBC 5 (51° 37.070' N, 04° 38.516' W) 36.3 m
rock platform overlain by thin gravelly shelly sandy mud

1920–1921 Stone in jaws (3 litres)
1922–1923 Stone
1924–1925 Stone
Note: Qualitative station, samples pooled. Large rock in last grab of old red sandstone.
NO SEDIMENT SAMPLE.

Stn. 068: OBC 6 (51° 37.723' N, 04° 35.178' W) 36.3 m
very fine muddy sand

1943–1945 Good (A - 7 litres)
1946–1948 Good (B - 7 litres)
1949–1950 Good (C - sediment sample); Spiny cockle

Stn. 069: OBC 7 (51° 38.362' N, 04° 31.998' W) 36.3 m
very coarse shelly sand

2005–2006 Very Good (A - 10 litres)
2007–2008 Very Good (B - 9 litres)
2009–2010 Very Good (C - sediment sample)
Note: *Repeat of Warwick & Davies Stn 134*

Stn. 070: OBC 8 (51° 39.115' N, 04° 29.583' W) 21.7 m
sandy mud, quartz rich

2024–2025 Good (A - 8 litres); *Corystes*
2026–2027 Good (B - 8 litres)
2028–2029 Good (C - sediment sample)

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Stn. 071: OBC 9 (51° 39.903' N, 04° 25.418' W) 15.0 m
quartz rich muddy sand

0719–0720 Good (A - 6 litres)
0721–0722 Good (B - 7 litres)
0723–0724 Good (C - sediment sample); *Venus*?

Stn. 072: Carmarthen Bay (51° 41.373' N, 04° 23.543' W) 15.0 m
quartz rich muddy sand

0736–0737 Fair (A - 5.5 litres)
0738–0739 Fair (B - 5 litres)
0740–0741 Fair (C - sediment sample)
Note: *Repeat of South West Wales Stn 27*

Stn. 073: Carmarthen Bay (51° 41.029' N, 04° 28.095' W) 15.0 m
quartz rich muddy sand

0752–0753 Fair (A - 5 litres)
0755–0756 Fair (B - litres)
0759–0800 Fair (C - sediment sample); *Venus*?
Note: *Repeat of Warwick & Davies Stn 126*

Stn. 074: Carmarthen Bay (51° 41.385' N, 04° 32.593' W) 15.0 m
muddy sand (not quartz rich)

0819–0820 Fair (A - 5 litres)
0821–0822 Fair (B - 5 litres)
0823–0824 Fair (C - sediment sample); *Venus*?
Note: *Repeat of South West Wales Stn 55*

Stn. 075: Carmarthen Bay (51° 40.016' N, 04° 36.167' W) 15.0 m
muddy sand (not quartz rich)

0838–0839 Good (A - 6 litres)
0840–0841 Good (B - 5 litres)
0842–0843 Good (C - sediment sample)
Note: *Repeat of Warwick & Davies Stn 142*

Stn. 076: Carmarthen Bay (51° 42.429' N, 04° 38.490' W) 11.1 m
sandy mud

0857–0858 Good (A - 6 litres)
0859–0859 Good (B - 5 litres)
0900–0900 Good (C - sediment sample)
Note: *Repeat of South West Wales Stn 49*

Stn. 077: Carmarthen Bay (51° 39.799' N, 04° 40.040' W) 13.9 m
muddy shelly sand

0921–0922 Scraping only (C - sediment sample)
0923–0924 Poor (A - 4.5 litres)
0924–0925 Poor (B - 4.5 litres)
Note: *Repeat of South West Wales Stn 44*

Stn. 078: OBC 20 (51° 30.549' N, 04° 45.759' W) 48.0 m
coarse shelly sand & soft grey mud (finer A–C)

1036–1038 Good (A - 8 litres)
1039–1041 Good (B - 8.5 litres)
1042–1044 Good (C - sediment sample)

Stn. 079: OBC 21 (51° 31.232' N, 04° 42.821' W) 43.5 m
slightly muddy moderately sorted coarse quartz sand

1112–1114 Good (A - 8 litres)
1115–1117 Very Good (B - 12 litres)
1118–1120 Good (C - sediment sample)

Stn. 080: OBC 22 (51° 31.959' N, 04° 39.489' W) 39.4 m
slightly muddy very coarse gravelly sand

1149–1151 Very Good (A - 10.5 litres)
1151–1153 Good (B - 8 litres)
1154–1156 Good (C - sediment sample)

Stn. 081: OBC 23 (51° 32.696' N, 04° 36.154' W) 35.4 m
well sorted medium-coarse sand & quartz sand

1220–1221 Very Good (A - 10.5 litres)
1222–1224 Very Good (B - 10.5 litres)
1225–1226 Very Good (C - sediment sample)

Stn. 082: OBC 24 (51° 33.539' N, 04° 31.590' W) 31.2 m
fine moderately sorted sandy mud underlain by soft grey clay

1311–1312 Good (A - 8 litres)
1313–1315 Very Good (B - 12 litres)
1316–1317 Very Good (C - sediment sample)

Stn. 083: OBC 31 (51° 31.277' N, 04° 31.386' W) 28.7 m
well sorted quartz sand underlain by grey clay, many juvenile Pectinariidae

1334–1336 Very Good (A - 12.5 litres)
1337–1339 Very Good (B - 11 litres)
1339–1341 Very Good (C - sediment sample)

Stn. 084: OBC 30 (51° 31.965' N, 04° 28.091' W) 24.8 m
well sorted medium sand

1358–1359 Very Good (A - 10 litres)
1400–1401 Very Good (B - 10 litres)
1402–1403 Very Good (C - sediment sample)

Stn. 085: OBC 25 (51° 34.227' N, 04° 29.143' W) 29.0 m
slightly muddy well sorted fine sand

1419–1421 Good (A - 8 litres)
1422–1424 Very Good (B - 11 litres)
1424–1426 Very Good (C - sediment sample)

Stn. 086: OBC 12 (51° 36.523' N, 04° 30.016' W) 25.9 m
slightly muddy fine-coarse sand, moderately sorted

1500–1501 Good (A - 8 litres)
1502–1503 Good (B - 8 litres)
1505–1506 Good (C - sediment sample)

Stn. 087: OBC 11 (51° 37.188' N, 04° 26.761' W) 23.0 m
moderately sorted shelly coarse sand

1538–1539 Fair (A - 5 litres)
1540–1541 Good (B - 7.5 litres)
1541–1542 Good (C - sediment sample)

Stn. 088: OBC 10 (51° 37.856' N, 04° 23.436' W) 15.1 m
very fine muddy sand, well sorted

1620–1621 Fair
1623–1624 Fair (A - 5 litres)
1625–1626 Fair (B - 5 litres)
1627–1628 Fair (C - sediment sample)
Note: 1 grab door found to be unlatched when 1st grab retrieved so sample discarded.

Stn. 089: OBC 26 (51° 34.829' N, 04° 26.244' W) 29.0 m
medium-coarse slightly muddy sand

1704–1705 Very Good (A - 11 litres)
1706–1707 Very Good (B - 9.5 litres)
1708–1709 Good (C - sediment sample)

Stn. 090: OBC 27 (51° 35.520' N, 04° 23.111' W) 22.9 m
slightly muddy medium sand

1733–1734 Good (A - 6 litres)
1735–1736 Good (B - 6 litres)
1736–1737 Good (C - sediment sample)

Stn. 091: OBC 29 (51° 32.759' N, 04° 24.819' W) 28.5 m
well sorted medium sand

1817–1818 Good (A - 8 litres)
1820–1821 Very Good (B - 10 litres)
1823–1824 Good (C - sediment sample)

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Stn. 092: Carmarthen Bay (51° 34.968' N, 04° 20.338' W) 19.5 m
well sorted medium quartz sand

0650–0651 Good (A - 8 litres)
0652–0653 Good (B - 7.5 litres)
0654–0655 Good (C - sediment sample); Mactra corallina?
Note: *Repeat of South West Wales Stn 23*

Stn. 093: OBC 28 (51° 33.268' N, 04° 21.975' W) 26.1 m
well sorted medium quartz sand, some mud

0713–0714 Very Good (A - 10.5 litres)
0715–0716 Very Good (B - 10 litres)
0717–0718 Very Good (C - sediment sample)
Note: *Repeat of South West Wales Stn 21*

Stn. 094: OBC 32 (51° 30.585' N, 04° 34.552' W) 36.6 m
muddy fine-coarse sand

0810–0811 Good (A - 6 litres)
0813–0814 Very Good (B - 10 litres)
0816–0817 Very Good (C - sediment sample)

Stn. 095: OBC 33 (51° 29.826' N, 04° 37.723' W) 38.5 m
muddy medium quartz sand, well sorted

0835–0837 Very Good (A - 11 litres)
0837–0839 Very Good (B - 12 litres)
0840–0842 Very Good (C - sediment sample)

Stn. 096: OBC 34 (51° 29.049' N, 04° 41.384' W) 52.6 m
slightly sandy organic mud

0901–0903 Very Good (A - 14 litres)
0905–0907 Very Good (B - 14 litres)
0909–0911 Very Good (C - sediment sample)

Stn. 097: OBC 35 (51° 28.386' N, 04° 44.214' W) 55.9 m
poorly sorted gravelly sandy mud

0926–0928 Very Good (A - 12 litres)
0929–0931 Very Good (B - 11 litres)
0932–0934 Very Good (C - sediment sample)

Stn. 098: OBC 37 (51° 24.552' N, 04° 46.828' W) 60.7 m
very poorly sorted shelly gravelly medium coarse sand

1008–1011 Poor
1012–1014 Good (A - 6 litres)
1015–1017 Poor (B - 4.5 litres)
1019–1021 Poor (C - sediment sample)

Stn. 099: OBC 53 (51° 21.606' N, 04° 44.377' W) 58.6 m
coarse-very coarse shelly sand

1056–1058 Fair (A - 5 litres)
1100–1102 Good (B - 8 litres)
1103–1105 C, sediment sample

Stn. 100: OBC 52 (51° 22.432' N, 04° 41.006' W) 49.8 m
coarse shelly pebbly sand

1144–1145 Poor (C - sediment sample)
1146–1148 Fair (A - 5.5 litres)
1150–1152 Scraping only
1152–1154 Stone in jaws
1155–1157 Poor (B - 4 litres)

Stn. 101: OBC 38 (51° 25.325' N, 04° 43.417' W) 48.2 m
well sorted medium sand

1218–1220 Good (A - 7 litres)
1221–1223 Good (B - 7.5 litres)
1224–1226 Good (C - sediment sample)

Stn. 102: OBC 39 (51° 26.044' N, 04° 40.143' W) 42.6 m
very well sorted medium sand

1247–1249 Good (A - 9 litres)
1250–1252 Good (B - 8 litres)
1252–1254 Good (C - sediment sample)

Stn. 103: OBC 51 (51° 23.167' N, 04° 37.488' W) 50.1 m
very well sorted medium-coarse quartz sand

1318–1320 Very Good (A - 10 litres)
1321–1323 Very Good (B - 10.5 litres)
1324–1326 Very Good (C - sediment sample)

Stn. 104: OBC 50 (51° 23.885' N, 04° 34.331' W) 46.9 m
very well sorted medium-coarse quartz sand (slightly coarser than 103)

1347–1349 Good (A - 9.5 litres)
1350–1352 Good (B - 9 litres)

1354–1356 Stone in jaws
1356–1358 Good (C - sediment sample)

Stn. 105: OBC 49 (51° 24.505' N, 04° 31.069' W) 45.6 m
very well sorted medium quartz sand

1420–1421 Very Good (A - 10.5 litres)
1422–1424 Very Good (B - 12.5 litres)
1425–1427 Very Good (C - sediment sample)

Stn. 106: OBC 48 (51° 25.199' N, 04° 27.735' W) 44.1 m
very well sorted medium-coarse quartz sand

1452–1454 Very Good (A - 9 litres)
1455–1457 Very Good (B - 11 litres)
1457–1459 Very Good (C - sediment sample)

Stn. 107: OBC 105 (51° 25.957' N, 04° 27.983' W) 42.3 m
very well sorted medium-coarse quartz sand

1534–1536 Very Good (A - 10.5 litres)
1537–1538 Very Good (B - 10.5 litres)
1539–1541 Very Good (C - sediment sample)
Note: *Repeat of Warwick & Davies Stn 129*

Stn. 108: OBC 47 (51° 26.044' N, 04° 24.178' W) 33.8 m
moderately sorted medium-coarse quartz sand

1605–1607 Very Good (A - 11 litres)
1607–1609 Very Good (B - 11 litres)
1610–1612 Very Good (C - sediment sample)

Stn. 109: OBC 62 (51° 25.174' N, 04° 18.073' W) 36.8 m
very coarse shelly pebbly sand,poorly sorted

1642–1644 Good (A - 8 litres)
1645–1647 Very Good (B - 10 litres)
1648–1650 Very Good (C - sediment sample)
Stn. 110: OBC 106 (51° 25.960' N, 04° 19.797' W) 45.9 m
very coarse shelly gravelly sand

1715–1717 Fair (A - 5.5 litres)
1718–1720 Very Good (B - 11.5 litres)
1720–1722 Very Good (C - sediment sample)
Note: *Repeat of Warwick & Davies Stn 112*

Stn. 111: OBC 46 (51° 26.741' N, 04° 20.745' W) 43.7 m
moderately sorted very coarse shelly gravel

1805–1807 Good (A - 8 litres)
1808–1810 Very Good (B - 10 litres)
1811–1813 Very Good (C - sediment sample)

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Stn. 112: Helwick Bank (51° 30.190' N, 04° 20.595' W) 39.1 m
well sorted very coarse shelly sand

0715–0717 Good (A - 8.5 litres)
0718–0719 Very Good (B - 10 litres)
0720–0721 Very Good (C - sediment sample)
Note: *Repeat of Sandbanks Stn 37*

Stn. 113: Helwick Bank (51° 31.085' N, 04° 21.760' W) 38.4 m
moderately sorted coarse-very coarse moderately shelly sand, occasional mud

0733–0735 Very Good (A - 9.5 litres)
0736–0738 Very Good (B - 10 litres)
0739–0741 Very Good (C - sediment sample)
Note: *Repeat of Sandbanks Stn 31*

Stn. 114: Helwick Bank (51° 31.360' N, 04° 21.589' W) 18.4 m
well sorted medium sand

0747–0748 Very Good (A - 12.5 litres)
0749–0750 Very Good (B - 13 litres)
0752–0753 Very Good (C - sediment sample)
Note: *Repeat of Sandbanks Stn 37*

Stn. 115: Helwick Bank (51° 31.893' N, 04° 21.473' W) 18.4 m
well sorted medium quartz sand

0802–0804 Very Good (A - 11 litres)
0805–0806 Good (B - 7 litres)
0807–0808 Very Good (C - sediment sample)
Note: *Repeat of Sandbanks Stn 27*

Stn. 116: OBC 100 (51° 26.803' N, 04° 20.943' W) 44.0 m
very shelly coarse sand, rare pebbles

0845–0847 Very Good
Note: OBC Eastern Transect - Sediment only

Stn. 117: OBC 101 (51° 26.720' N, 04° 21.264' W) 46.9 m
well sorted shelly very coarse sand with medium pebbles

0855–0857 Very Good
Note: OBC Eastern Transect - Sediment only

Stn. 118: OBC 102 (51° 26.642' N, 04° 21.403' W) 48.4 m

moderately sorted pebbly very coarse sand

0858–0900 Very Good
Note: OBC Eastern Transect - Sediment only

Stn. 119: OBC 103 (51° 26.607' N, 04° 21.556' W)
46.9 m
very coarse pebbly shelly sand

0904–0906 Very Good
Note: OBC Eastern Transect - Sediment only

Stn. 120: OBC 104 (51° 26.553' N, 04° 21.724' W)
49.3 m
medium-coarse shelly quartz sand, well sorted

0909–0911 Very Good
Note: OBC Eastern Transect - Sediment only

Stn. 121: OBC 105 (51° 26.472' N, 04° 21.893' W)
50.9 m
slightly muddy coarse-very coarse shelly quartz sand

0913–0915 Very Good
Note: OBC Eastern Transect - Sediment only

Stn. 122: OBC 104 (51° 26.558' N, 04° 21.603' W)
45.5 m
well sorted very coarse sandy gravel

0925–0926 Good (A - 9 litres)
0927–0929 Very Good (B - 11 litres)
0930–0931 Good (C - sediment sample)
Note: OBC Eastern Transect - repeat of stn 120 for fauna

Stn. 123: OBC 103 (51° 26.564' N, 04° 21.486' W)
45.2 m
very coarse pebbly gravelly sand
0939–0941 Very Good (A - 10 litres)
0942–0943 Very Good (B - 11.5 litres)
0944–0945 Very Good (C - sediment sample)
Note: OBC Eastern Transect: repeat of stn 119 for fauna

Stn. 124: OBC 102 (51° 26.710' N, 04° 21.298' W)
44.0 m
very coarse pebbly gravelly sand

0953–0955 Good (A - 9.5 litres)
0956–0958 Good (B - 10 litres)
0959–1001 Very Good (C - sediment sample)
Note: OBC Eastern Transect: repeat of stn 118 for fauna

Stn. 125: OBC 96 (51° 28.546' N, 04° 28.662' W)
41.9 m
moderately sorted pebbly very coarse sand

1024–1026 Very Good
Note: OBC Western Transect - sediment only

Stn. 126: OBC 95 (51° 28.533' N, 04° 28.892' W)
33.8 m
poorly sorted medium-very coarse shelly quartz sand

1028–1030 Very Good
Note: OBC Western Transect - sediment only

Stn. 127: OBC 93 (51° 28.520' N, 04° 29.033' W)
44.4 m
well sorted medium-coarse quartz sand
1030–1032 Very Good
Note: OBC Western Transect - sediment only

Stn. 128: OBC 92 (51° 28.517' N, 04° 29.198' W)
43.0 m
well sorted medium-coarse quartz sand

1034–1036 Very Good
Note: OBC Western Transect - sediment only

Stn. 129: OBC 97 (51° 28.046' N, 04° 22.059' W)
43.8 m
medium-very coarse sand, some pebbles

1114–1116 Very Good (A - 10 litres)
1117–1119 Good (B - 6 litres)
1119–1121 Good (C - sediment sample)

Stn. 130: OBC 98 (51° 28.033' N, 04° 23.028' W)
43.8 m
slightly muddy fine-medium sand
1126–1128 Good (A - 8 litres)
1129–1131 Good (B - 6 litres)
1132–1134 Good (C - sediment sample)

Stn. 131: OBC 99 (51° 27.266' N, 04° 23.356' W)
40.0 m
coarse-very coarse moderately sorted sand

1142–1144 Good (A - 9 litres)
1145–1146 Trigger failed
1146–1148 Trigger failed
1150–1152 Trigger failed
1152–1154 Trigger failed
1154–1156 Good (B - 6 litres)
1157–1159 Good (C - sediment sample)

Stn. 132: Noble Banks (New 5)
(51° 27.482' N, 04° 28.367' W) 41.9 m
coarse sandy gravel, moderately sorted

1302–1302 Very Good (**A** - 10 litres)
1305–1307 Very Good (B - 10 litres)
1307–1308 Very Good (C - sediment sample)

Stn. 133: Noble Banks (New 4)
(51° 30.500' N, 04° 29.088' W) 28.4 m,
muddy fine-medium sand (mud overlaying sand?)

1329–1330 Very Good (**A** - 10.5 litres)
1331–1332 Very Good (B - 12 litres)
1333–1334 Very Good (C - sediment sample)

Stn. 134: S of Stackpole Head (New 2)
(51° 28.153' N, 04° 51.501' W) 53.8 m,
sandy gravelly mud

1448–1450 Very Good (**A** - 12 litres)
1451–1453 Very Good (B - 10 litres)
1455–1457 Very Good (C - sediment sample)

Stn. 135: SW of St. Govan's Head (New 3)
(51° 27.165' N, 05° 05.090' W) 54.8 m,
muddy sand
1546–1548 Good (**A** - 7.5 litres)
1548–1550 Good (B - 8 litres)
1552–1554 Good (C - sediment sample)

17/07/2003

Stn. 136: Caernarfon Bay, SW of Holy Island
(53° 09.844' N, 04° 53.555' W) 51.6 m,
sandy gravel, hydroid & *Flustra*

0123 Tjarno dredge deployed
0128 Tjarno dredge retrieved
Note: Station for fauna only, no sediment sample
Repeat of BIOMÔR Stn 5

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Appendix 2

Biological Survey – Videos and Photos

(Methods and Equipment Used)

July 2003

E. Ivor S. Rees

School of Ocean Sciences, University of Wales Bangor,
Menai Bridge, Anglesey LL61 5AB

METHODS

For the present work, video and still film cameras were mounted together on a sledge (Fig. 1) The still camera was a Photosea 1000 system. This comprises a 35mm camera with a Nikor water corrected lens mounted vertically on the forward part of the sledge frame. In this position the lens would have been 0.7m above the seabed when the skids of the sledge were flat on the bottom. The strobe was mounted behind and at an angle of 60^{o} to the camera. It is rated at 150 watts. Photographs were taken at 42 second intervals using an electronic timer mounted in a separate housing. The film used was Fujichrome Sensia 200 daylight transparency film in 36 shot cassettes. Owing to the configuration by which the film runs though the special underwater camera, more frames get exposed on the leader than with conventional cameras. With automatic firing at 42 second intervals, 2 or 3 exposures would be in mid water during deployment. The number of interpretable seabed images from each successful deployment was usually about 25 to 28, varying slightly with the depth and the time taken to reach the bottom

The video system uses a Rovtech colour camera mounted behind and below the Photosea strobe so as to look obliquely forward towards the same part of the seabed as the still camera. Lighting was by two 20 watt 12 volt lights mounted to either side of the forward part of the sledge. The video signal was recorded on the ship using a Sony digital recorder and digital 8 mini 60 minute tapes.

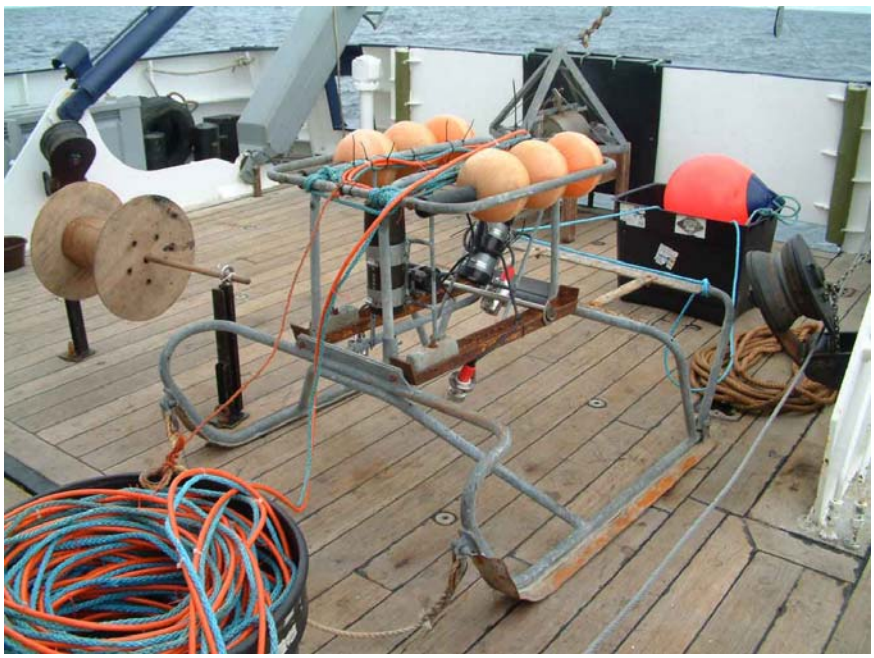


FIGURE 1 Camera sledge with Photosea still camera system (black housings), and Rovtech video camera and lights (red plug retainers). The umbilical cable is coiled in the tub on the left and the tail rope buoy is to the right.

Towing was on a 12mm wire with a ball swivel between the sledge bridles and the wire. Tow lengths used were about twice the water depth. The 250 m umbilical cable was supported on a braided rope and handled separately from the towing wire. A tail rope with a surface buoy was streamed behind the sledge. The tail rope served the purpose of providing drag to pull the sledge clear of the ship in a stable manner and to provide a back-up means of recovery should the tow break.

The sledge was towed over the bottom with the ship heading into the tidal current at times near to slack water. The speeds over the ground usually aimed for were around 0.2 to 0.4 kts. Heading into the current helps to maintain steerage for the ship at such slow speeds and it helps ensure that any fine sediment cloud stirred up by the sledge is carried away from the field of view of the cameras. Tow durations aimed to get 20 minutes of seabed record so that in practice the gear was on the ground for 22 to 25 minutes. Typically the distance covered by the sledge in this time would have been about 160 - 220 metres.

Twelve camera tows were made in the period 6th to 12th July 2003 from RV *Prince Madog*, on charter from VT Ocean Sciences The camera work was a subsidiary part of a cruise primarily devoted to collecting benthos and sediment samples by grab. The video and still camera equipment used belongs to School of Ocean Sciences, University of Wales Bangor.

When the 35mm still photographic slides come back from processing they are coded according to the station and the sequential number in which they are taken after the sledge lands on the bottom. Thus a code of "OBC 7.12 " refers to the twelfth frame taken at Outer Bristol Channel video station 7. The images on the slides are then digitally scanned for archiving using a dedicated slide scanner.

The videos have been copied to both SVHS tapes and to DVD formats to provide archive back-up and to allow editing and the taking of freeze-frame images.

Appendix 3

Geophysical Survey November 2003

Survey Equipment

GEOPHYSICAL SURVEY NOVEMBER 2003

The sea bed and its underlying geology can be mapped remotely by means of multibeam swath systems, sidescan-sonar and high-resolution seismic-reflection profiling. These systems, when used in combination, can provide a relatively sophisticated picture of the sea bed and underlying geology by transmitting a series of acoustic pulses that are reflected off the sea bed, and various layers in the subsurface, and received by a hydrophone receiving device. Multibeam bathymetric survey techniques provide a rapid means of determining the morphology of the sea bed, whereas the sidescan sonar surveys offer images of the sea bed surface and texture. Seismic reflection profiles are analogous to two-dimensional geological cross-sections, and provide a picture of the sub-surface geology.

A complete description of the equipment mobilised during the survey can be found in Smith (2004). A summary of this is presented in the sections below.

SURVEY VESSEL

The RV Prince Madog, a state-of-the-art, purpose built research vessel, commissioned by the University of Wales, Bangor, and managed and operated by Vosper Thornycroft [UK] Ltd, was used as the survey vessel for both the benthic survey and the geophysical survey.

The RV Prince Madog (photo Ivor Rees)

MULTIBEAM

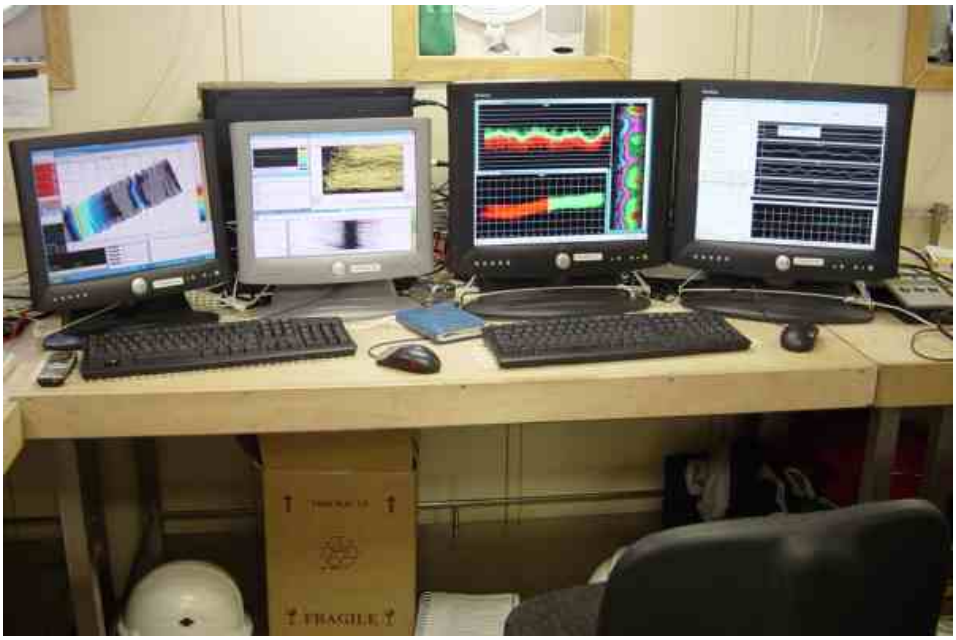
Multibeam bathymetric survey techniques provide a rapid means of determining the morphology and nature of the sediments on the sea bed. A multi-element transducer provides many (30-150) individual soundings of the water depth and echo strength for each ping of sound transmitted. Depth and echo strength is subsequently determined for each transducer element, corrected for transducer motion, and a geographic co-ordinate calculated for each individual sounding.

Multibeam systems enable a wide swath (up to 7 times the water depth) to be surveyed in a single pass through an area. The data are used to generate high resolution images which contain information about the morphology of the seabed. These techniques have detected features that are not always detected by ordinary bathymetric soundings.

NetSurvey Ltd, a specialist multibeam service company, supplied the multibeam package and two engineers to mobilise/demobilise the equipment and operate the multibeam system during the survey. The bathymetry data were acquired using the following systems:

Multibeam echosounder	Reson Seabat 8101 (pole mounted)
Multibeam power supply and transceiver	Reson 81-P
Motion sensor	Applanix POS MV 320 ; TSS DMS-05
Sound velocity probe	Navtronics SVP15
Differential GPS corrections	BGS Trimble NT300D receiver
Acquisition software	QPS QINSy 7.1
QC and post processing software	CARIS HIPS/SIPS
3D visualisation software	Fledermaus

QINSy 7.1 was used as the acquisition package as it is renowned for its accurate time tagging and allows the logging of 'Snippets' backscatter data. The combined bathymetry and backscatter data has been exported as XTF files for import into CARIS HIPS/SIPS. HIPS is used worldwide and is regarded as the most complete and accomplished multibeam processing package available today. 3D visualisation of the data has been provided by the Fledermaus software package, which can also be used to drape the backscatter and sidescan data over the bathymetric DTM



Reson 8101 transducer mounted on the pole (left). Multibeam data acquisition and processing set-up during geophysical survey (top). Photos Dave Smith, BGS.

SIDESCAN SONAR

Sidescan sonar is a carefully engineered sonar designed to look sideways and at a downward angle from both sides of a towed unit, called a "towfish". The bottom and any objects in the water above the bottom reflect sound waves back to the towed array and from this information an image is produced. Using this type of system, very large areas of the sea bed can be mapped quickly and easily. The intensity of sound received by the sidescan-sonar tow vehicle from the sea floor (backscatter) provides information as to the general distribution and characteristics of the surficial sediment.

Two sidescan sonar systems were mobilised for the project; a hired Edgetech MP-X and the BGS Waverley 3000. Both systems are detailed below.

Edgetech MP-X

The Edgetech sidescan sonar system comprised:

Towfish	Edgetech MP-X
Transceiver	Edgetech Starmux
Processor	Edgetech processor running discover software
Acquisition	CODA DA200 with MP-X interface
Navigation	BGS Trac C

The MP-X was chosen as the preferred towfish due to its ability to acquire data at the same high vessel speeds at which the multibeam system can operate (up to 9 knots). Further details on this system can be found in Smith, 2004.

The Edgetech MP-X towfish (Dave Smith, BGS)

Deploying the MP-X towfish (Dave Smith, BGS)

Waverley Sonar 3000

The Waverley system comprised:

Towfish	Sonar 3000
Transceiver	Waverley
Acquisition	BGS CODA DA200
Navigation	BGS Trac C

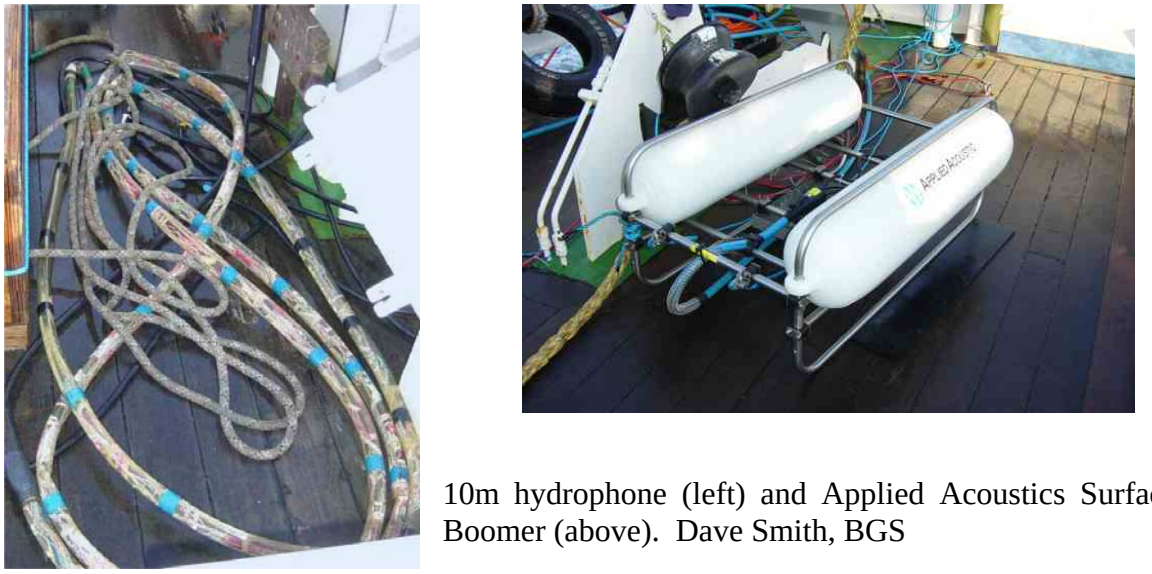
This system, owned by BGS, was taken as a backup to the MP-X. Although it was deployed on one occasion, after the towing bracket on the MP-X failed, the Waverley towfish was not used routinely. The priority was to acquire multibeam data that was collected at speeds of up to 9 knots and this survey speed is outside the capabilities of the Waverley.

SURFACE TOW BOOMER

Seismic reflection profiling is accomplished by towing a sound source that emits acoustic energy in timed intervals behind a research vessel. The transmitted acoustic energy is reflected from boundaries between the water-sediment interface and between geological units. The reflected acoustic signal is received by a ship-towed hydrophone, or array of hydrophones.

The surface tow boomer system comprised:

Source 1	BGS catamaran and RG&G 500J plate
Source 2	Applied Acoustics catamaran and plate
Receiver	Teledyne 7 channel hydrophone
Power source	Applied Acoustics CSP3000
Signal Conditioning	BGS amplifier and filter unit
Recording system	CODA DA200



10m hydrophone (left) and Applied Acoustics Surface Tow Boomer (above). Dave Smith, BGS

Due to the adverse weather conditions encountered for much of the survey, the boomer was only deployed for one line of data acquisition.

Appendix 4

Particle Size Analysis –Summary of Results

The samples were analysed by John Malcolm of Sediment Analysis Services

LOCATION OF SAMPLE STATIONS

Sample Number	BGS No.	Latitude Degrees North	Longitude Degrees West	Uncorrected Depth m
OBC2		51º 21.60	3º 10.01	33.9
OBC3		51º 20.80	3º 13.63	23.6
OBC4	+51-05 1197	51º 12.20	4º 24.79	39.5
OBC5	+51-05 1198	51º 12.28	4º 25.01	39.1
OBC6	+51-05 1199	51º 12.19	4º 25.90	45.6
OBC7	+51-05 1200	51º 10.32	4º 32.98	50.5
OBC8	+51-05 1201	51º 11.05	4º 30.06	46.8
OBC9	+51-05 1202	51º 11.03	4º 28.02	46.2
OBC10	+51-05 1203	51º 10.70	4º 27.15	46.6
OBC11	+51-05 1204	51º 11.73	4º 26.43	43.1
OBC12	+51-05 1205	51º 17.34	4º 15.80	42.1
OBC13	+51-05 1206	51º 17.11	4º 16.52	41.2
OBC14	+51-05 1207	51º 16.32	4º 19.91	43.5
OBC15	+51-05 1208	51º 12.66	4º 23.01	46.6
OBC16	+51-05 1209	51º 13.61	4º 23.29	47.6
OBC17	+51-05 1210	51º 14.23	4º 24.10	47.3
OBC18	+51-05 1211	51º 13.70	4º 25.73	47.3
OBC19	+51-05 1212	51º 15.32	4º 24.67	48.7
OBC20	+51-05 1213	51º 19.37	4º 19.01	47.1
OBC21	+51-05 1214	51º 19.98	4º 16.14	48.7
OBC22	+51-05 1215	51º 18.36	4º 23.82	49.8
OBC23	+51-05 1216	51º 17.58	4º 27.17	49.4
OBC24	+51-05 1217	51º 14.41	4º 28.70	46.6
OBC25	+51-05 1218	51º 13.47	4º 32.41	48.1
OBC26	+51-05 1219	51º 13.18	4º 34.48	42.3
OBC27	+51-05 1220	51º 12.50	4º 37.58	43.0
OBC28	+51-05 1221	51º 14.83	4º 39.60	51.1
OBC29	+51-05 1222	51º 15.51	4º 36.48	50.9
OBC30	+51-05 1223	51º 16.27	4º 33.34	45.5
OBC31	+51-05 1224	51º 16.96	4º 30.27	45.6
OBC32	+51-05 1225	51º 18.08	4º 37.43	49.1
OBC33	+51-05 1226	51º 20.81	4º 38.30	52.6
OBC34	+51-05 1227	51º 20.37	4º 40.40	48.8
OBC35	+51-05 1228	51º 19.81	4º 42.75	59.1
OBC36	+51-05 1229	51º 17.42	4º 40.28	54.5
OBC37	+51-05 1230	51º 18.77	4º 34.32	48.9
OBC38	+51-05 1231	51º 19.61	4º 30.39	51.5
OBC39	+51-05 1232	51º 22.44	4º 18.07	55.2
OBC40	+51-05 1233	51º 21.63	4º 21.48	52.8
OBC41	+51-05 1234	51º 20.96	4º 24.67	45.8
OBC42	+51-05 1235	51º 20.18	4º 27.94	47.7
OBC43	+51-05 1236	51º 20.84	4º 36.53	53.8
OBC44	+51-05 1237	51º 22.05	4º 32.53	49.1
OBC45	+51-05 1238	51º 22.73	4º 28.19	48.8
OBC46	+51-05 1239	51º 22.80	4º 28.64	48.8
OBC47	+51-05 1240	51º 23.58	4º 24.94	41.6
OBC48	+51-05 1241	51º 24.51	4º 21.30	45.0

Sample Number	BGS No.	Latitude Degrees North	Longitude Degrees West	Uncorrected Depth m
OBC49	+51-05 1242	51º 28.92	4º 27.13	40.7
OBC50	+51-05 1243	51º 29.60	4º 23.90	37.7
OBC51	+51-05 1244	51º 30.21	4º 20.31	39.7
OBC52	+51-05 1245	51º 27.98	4º 30.29	45.1
OBC53	+51-05 1246	51º 27.53	4º 33.59	48.2
OBC54	+51-05 1247	51º 26.81	4º 36.74	42.3
OBC55	+51-05 1248	51º 27.67	4º 47.37	58.4
OBC56	+51-05 1249	51º 29.82	4º 48.87	51.0
OBC57	+51-05 1250	51º 32.17	4º 49.31	39.8
OBC58	+51-05 1251	51º 34.19	4º 51.00	43.4
OBC59	+51-05 1252	51º 35.63	4º 33.48	32.6
OBC60	+51-05 1253	51º 35.07	4º 36.82	39.1
OBC61	+51-05 1254	51º 34.36	4º 39.59	41.1
OBC62	+51-05 1255	51º 33.65	4º 43.10	40.6
OBC63	+51-05 1256	51º 32.94	4º 46.20	40.6
OBC64	+51-05 1257	51º 35.10	4º 47.80	31.7
OBC65	+51-05 1258	51º 35.62	4º 45.03	34.0
OBC66	+51-05 1259	51º 36.44	4º 41.78	33.7
OBC67	+51-05 1260	51º 37.07	4º 38.54	36.3
OBC68	+51-05 1261	51º 37.72	4º 35.22	36.3
OBC69	+51-05 1262	51º 38.35	4º 32.08	36.3
OBC70	+51-05 1263	51º 39.10	4º 29.64	21.7
OBC71	+51-05 1264	51º 39.92	4º 25.44	15.0
OBC72	+51-05 1265	51º 41.38	4º 23.57	15.0
OBC73	+51-05 1266	51º 41.05	4º 28.14	15.0
OBC74	+51-05 1267	51º 41.39	4º 32.63	15.0
OBC75	+51-05 1268	51º 41.03	4º 36.22	15.0
OBC76	+51-05 1269	51º 42.43	4º 38.51	11.1
OBC77	+51-05 1270	51º 39.76	4º 40.08	13.9
OBC78	+51-05 1271	51º 30.53	4º 46.19	48.0
OBC79	+51-05 1272	51º 31.24	4º 43.10	43.5
OBC80	+51-05 1273	51º 31.95	4º 39.67	39.4
OBC81	+51-05 1274	51º 32.71	4º 32.26	35.4
OBC82	+51-05 1275	51º 33.57	4º 31.99	31.2
OBC83	+51-05 1276	51º 31.30	4º 31.45	28.7
OBC84	+51-05 1277	51º 31.98	4º 28.10	24.8
OBC85	+51-05 1278	51º 34.27	4º 29.13	29.0
OBC86	+51-05 1279	51º 36.55	4º 30.00	25.9
OBC87	+51-05 1280	51º 37.22	4º 26.73	23.0
OBC88	+51-05 1281	51º 37.78	4º 23.41	15.1
OBC89	+51-05 1282	51º 34.83	4º 26.19	29.0
OBC90	+51-05 1283	51º 35.54	4º 23.07	22.9
OBC91	+51-05 1284	51º 32.77	4º 24.77	28.5
OBC92	+51-05 1285	51º 34.95	4º 20.30	19.5
OBC93	+51-05 1286	51º 33.25	4º 21.95	26.1
OBC94	+51-05 1287	51º 30.59	4º 34.57	36.6
OBC95	+51-05 1288	51º 29.82	4º 37.75	38.5
OBC96	+51-05 1289	51º 29.01	4º 41.49	52.6
OBC97	+51-05 1290	51º 28.35	4º 44.37	55.9

Sample Number	BGS No.	Latitude Degrees North	Longitude Degrees West	Uncorrected Depth m
OBC98	+51-05 1291	51º 24.52	4º 46.90	60.7
OBC99	+51-05 1292	51º 21.61	4º 44.58	58.6
OBC100	+51-05 1293	51º 22.44	4º 41.39	49.8
OBC101	+51-05 1294	51º 25.32	4º 43.56	48.2
OBC102	+51-05 1295	51º 36.02	4º 40.20	42.6
OBC103	+51-05 1296	51º 23.15	4º 37.55	50.1
OBC104	+51-05 1297	51º 23.90	4º 34.46	46.9
OBC105	+51-05 1298	51º 24.52	4º 31.11	45.6
OBC106	+51-05 1299	51º 25.22	4º 27.76	44.1
OBC107	+51-05 1300	51º 25.98	4º 27.96	42.3
OBC108	+51-05 1301	51º 26.06	4º 24.12	33.8
OBC109	+51-05 1302	51º 25.21	4º 18.00	26.8
OBC110	+51-05 1303	51º 25.97	4º 19.70	45.9
OBC111	+51-05 1304	51º 26.76	4º 20.60	42.6
OBC112	+51-05 1305	51º 30.18	4º 20.49	39.1
OBC113	+51-05 1306	51º 31.08	4º 21.73	38.4
OBC114	+51-05 1307	51º 31.34	4º 21.52	18.4
OBC115	+51-05 1308	51º 31.89	4º 21.45	18.4
OBC116	+51-05 1309	51º 26.80	4º 20.94	44.0
OBC117	+51-05 1310	51º 26.72	4º 21.26	46.9
OBC118	+51-05 1311	51º 26.64	4º 21.40	48.4
OBC119	+51-05 1312	51º 26.61	4º 21.56	46.9
OBC120	+51-05 1313	51º 26.55	4º 21.72	49.3
OBC121	+51-05 1314	51º 26.47	4º 21.89	50.9
OBC122	+51-05 1315	51º 26.53	4º 21.64	49.3
OBC123	+51-05 1316	51º 26.54	4º 21.51	45.2
OBC124	+51-05 1317	51º 26.69	4º 21.33	44.0
OBC125	+51-05 1318	51º 28.55	4º 28.66	41.9
OBC126	+51-05 1319	51º 28.53	4º 28.89	33.8
OBC127	+51-05 1320	51º 28.52	4º 29.03	44.4
OBC128	+51-05 1321	51º 28.52	4º 29.20	43.0
OBC129	+51-05 1322	51º 28.03	4º 22.27	43.8
OBC130	+51-05 1323	51º 28.07	4º 23.31	43.8
OBC131	+51-05 1324	51º 27.21	4º 23.81	40.0
OBC132	+51-05 1325	51º 27.48	4º 28.51	41.9
OBC133	+51-05 1326	51º 30.50	4º 29.16	28.4
OBC134	+51-05 1327	51º 28.14	4º 51.33	53.8
OBC135	+51-05 1328	51º 27.17	5º 05.05	54.8

Explanation of Particle Size Analysis (PSA) results

Sample Number:

OBC4 is the station number designation used by NMGW

[+51-05 1197] is the number allocated to OBC4 in the BGS National Geoscience Database. All sample stations have been allocated numbers in the BGS database.

Headings:

W.mm	Wentworth grade scale with diameter in mm
Phi	Phi grade scale (phi = $-\log_2$diam.m)
wt.gms	weight retained in the specified sieve size
wt.%	percentage total of total weight (first figure is also the first cum.%)
cum.%	cumulative wt.% for statistical calculations
W.gr %	Wentworth grades %

$CaCO_3$	Calcium Carbonate

F&W	Folk and Ward

mean	the average size
dev	deviation – spread or dispersion around the mean
skew	skewness – asymmetry of sorting
kurt	kurtosis – as skewness but also provides a ratio of the difference between the central distribution and the coarse and fine tails

Outer Bristol Channel Marine Habitat Study - Particle Size Analysis

SAMPLE		OBC2				OBC4 [+51-05 1197]				OBC5 [+51-05 1198]				OBC6 [+51-05 1199]			
W.gr.mm	Phi	wt.gms	wt.%	cum.%	W.gr.%	wt.gms	wt.%	cum.%	W.gr.%	wt.gms	wt.%	cum.%	W.gr.%	wt.gms	wt.%	cum.%	W.gr.%
	-6.00																
20.00		35.01															
	-4.00	14.63															
10.00		75.17								3.86							
5.00		60.72				5.80				3.62				12.29			
4.00	-2.00	8.67				3.74				3.14				8.45			
2.00	-1.00	21.60				66.21				8.68				23.96			
Total gravel		215.80	52.73			75.75	55.46			19.30	26.14			44.70	49.81		
vcs	-0.50	9.80	5.08			27.82	45.73			3.40	6.27			2.59	5.92		
1.00	0.00	10.92	5.66	10.73	10.73	13.00	21.37	67.11	67.11	2.27	4.18	10.45	10.45	2.21	5.05	10.97	10.97
cs	0.50	17.76	9.20	19.93		7.92	13.02	80.12		2.63	4.85	15.30		4.71	10.76	21.73	
0.50	1.00	39.76	20.59	40.52	29.79	6.31	10.37	90.50	23.39	5.21	9.60	24.90	14.45	8.41	19.21	40.94	29.97
ms	1.50	28.80	14.92	55.44		2.19	3.60	94.10		4.73	8.72	33.62		4.78	10.92	51.86	
0.25	2.00	25.36	13.13	68.57	28.05	0.85	1.40	95.50	5.00	10.44	19.24	52.87	27.96	4.73	10.81	62.67	21.73
fs	2.50	53.16	27.53	96.11		1.50	2.47	97.96		18.21	33.57	86.43		10.02	22.89	85.56	
0.13	3.00	7.12	3.69	99.79	31.22	1.13	1.86	99.82	4.32	6.99	12.88	99.32	46.45	5.82	13.30	98.86	36.19
vfs	3.50	0.36	0.19	99.98		0.09	0.15	99.97		0.34	0.63	99.94		0.41	0.94	99.79	
0.063	4.00	0.04	0.02	100.00	0.21	0.02	0.03	100.00	0.18	0.03	0.06	100.00	0.68	0.09	0.21	100.00	1.14
Total sand		193.08				60.83				54.25				43.77			
Total mud <0.063	<4.00	0.40	0.10			0.00	0.00		0.00	0.28	0.38		0.38	1.27	1.42		1.42
Total sample		409.28				136.58				73.83				89.74			
gravel %			52.73			55.46				26.14				49.81			
sand %			47.17			44.54				73.48				48.77			
mud %			0.10			0.00				0.38				1.42			
$CaCO_3$ gravel %			6			3				5				10			
$CaCO_3$ sand %			13			3				19				18			
F & W mean			1.28														
F & W dev.			0.92														
F & W skew.			-0.16														
F & W kurt.			0.83														
Inman mean			1.26							1.50				1.37			
Inman dev.			0.95							0.96				1.09			
Inman skew.			-0.08							-0.45				-0.07			
Inman kurt.			0.58														
Percentile	5		-0.51														
	16		0.31							0.54				0.28			
	25		0.62														
Median	50		1.33			-0.39				1.92				1.44			
	75		2.09														
	84		2.20							2.45				2.45			
	95		2.47														

Outer Bristol Channel Marine Habitat Study - Particle Size Analysis

SAMPLE		OBC7 [+51-05 1200]				OBC8 [+51-05 1201]				OBC9 [+51-05 1202]				OBC10 [+51-05 1203]			
W.gr.mm	Phi	wt.gms	wt.%	cum.%	W.gr.%	wt.gms	wt.%	cum.%	W.gr.%	wt.gms	wt.%	cum.%	W.gr.%	wt.gms	wt.%	cum.%	W.gr.%
	-6.00																
20.00		10.70												22.91			
	-4.00	0.00												8.74			
10.00		13.89												9.59			
5.00		9.53												17.46			
4.00	-2.00	1.51			0.00				0.00	0.04			0.00	3.79			0.00
2.00	-1.00	6.36			0.00	0.02			0.00	0.85			0.00	9.39			0.00
Total gravel		41.99	35.01			0.02	0.09			0.89	2.70			71.88	35.96		
vcs	-0.50	2.62	3.41			0.02	0.09			1.52	4.75			1.56	1.22		
1.00	0.00	2.26	2.94	6.34	6.34	0.11	0.51	0.60	0.60	2.29	7.15	11.90	11.90	1.24	0.97	2.19	2.19
cs	0.50	2.40	3.12	9.46		0.40	1.86	2.46		3.73	11.65	23.55		2.40	1.88	4.07	
0.50	1.00	3.88	5.04	14.50	8.16	1.52	7.06	9.52	8.91	6.99	21.83	45.38	33.48	5.56	4.35	8.41	6.22
ms	1.50	7.56	9.83	24.33		7.33	34.03	43.55		5.46	17.05	62.43		18.80	14.70	23.12	
0.25	2.00	30.76	39.98	64.31	49.81	11.10	51.53	95.08	85.56	7.53	23.52	85.95	40.57	64.44	50.39	73.51	65.09
fs	2.50	16.38	21.29	85.60		0.84	3.90	98.98		2.82	8.81	94.75		28.00	21.90	95.40	
0.13	3.00	9.88	12.84	98.44	34.13	0.20	0.93	99.91	4.83	1.57	4.90	99.66	13.71	5.52	4.32	99.72	26.21
vfs	3.50	1.02	1.33	99.77		0.02	0.09	100.00		0.09	0.28	99.94		0.28	0.22	99.94	
0.063	4.00	0.18	0.23	100.00	1.56	0.00	0.00	100.00	0.09	0.02	0.06	100.00	0.34	0.08	0.06	100.00	0.28
Total sand		76.94				21.54				32.02				127.88			
Total mud <0.063	<4.00	1.02	0.85		0.85	0.00	0.00		0.00	0.00	0.00		0.00	0.15	0.08		0.08
Total sample		119.95				21.56				32.91				199.91			
gravel %			35.01				0.09				2.70				35.96		
sand %			64.14				99.91				97.30				64.04		
mud %			0.85				0.00				0.00				0.08		
$CaCO_3$ gravel %			12				100				20				17		
$CaCO_3$ sand %			19				17				13				19		
F & W mean			1.80				1.50				1.10				1.76		
F & W dev.			0.80				0.35				0.89				0.50		
F & W skew.			-0.21				-0.21				-0.06				-0.16		
F & W kurt.			1.70				1.11				1.01				1.53		
Inman mean			1.79				1.49				1.09				1.75		
Inman dev.			0.69				0.34				0.88				0.44		
Inman skew.			-0.06				-0.16				-0.05				-0.08		
Inman kurt.			1.16				0.82				0.70				1.15		
Percentile	5		-0.19				0.77				-0.46				0.62		
	16		1.10				1.15				0.21				1.31		
	25		1.51				1.28				0.53				1.52		
Median	50		1.83				1.54				1.13				1.78		
	75		2.23				1.73				1.74				2.02		
	84		2.48				1.82				1.96				2.18		
	95		2.79				1.99				2.52				2.49		

Outer Bristol Channel Marine Habitat Study - Particle Size Analysis

SAMPLE		OBC11 [+51-05 1204]				OBC13 [+51-05 1206]				OBC14 [+51-05 1207]				OBC15 [+51-05 1208]			
W.gr.mm	Phi	wt.gms	wt.%	cum.%	W.gr.%	wt.gms	wt.%	cum.%	W.gr.%	wt.gms	wt.%	cum.%	W.gr.%	wt.gms	wt.%	cum.%	W.gr.%
	-6.00																
20.00						203.44				16.98				14.85			
	-4.00					55.23				0.00				5.90			
10.00		1.25				27.47				14.08				39.88			
5.00		3.53				73.63				112.98				45.11			
4.00	-2.00	2.80			0.00	24.41			0.00	27.49			0.00	8.15			0.00
2.00	-1.00	23.62			0.00	51.78			0.00	49.57			0.00	20.18			0.00
Total gravel		31.20	29.67			435.96	73.50			221.10	69.86			134.07	43.77		
vcs	-0.50	9.12	12.33			6.16	4.41			12.40	13.17			5.60	3.40		
1.00	0.00	2.80	3.79	16.12	16.12	10.40	7.44	11.85	11.85	12.22	12.98	26.15	26.15	4.56	2.76	6.16	6.16
cs	0.50	2.92	3.95	20.06		15.24	10.90	22.75		16.36	17.38	43.53		3.60	2.18	8.34	
0.50	1.00	9.74	13.17	33.23	17.12	27.84	19.91	42.66	30.82	16.86	17.91	61.43	35.28	4.84	2.93	11.28	5.12
ms	1.50	16.84	22.77	56.00		28.40	20.31	62.98		10.04	10.66	72.10		8.00	4.85	16.13	
0.25	2.00	24.30	32.86	88.86	55.62	12.80	9.16	72.13	29.47	3.84	4.08	76.18	14.74	23.92	14.50	30.63	19.35
fs	2.50	6.34	8.57	97.43		17.88	12.79	84.92		8.70	9.24	85.42		79.32	48.10	78.73	
0.13	3.00	1.82	2.46	99.89	11.03	18.20	13.02	97.94	25.81	12.04	12.79	98.20	22.03	32.60	19.77	98.50	67.86
vfs	3.50	0.06	0.08	99.97		2.32	1.66	99.60		1.48	1.57	99.78		2.00	1.21	99.71	
0.063	4.00	0.02	0.03	100.00	0.11	0.56	0.40	100.00	2.06	0.21	0.22	100.00	1.80	0.48	0.29	100.00	1.50
Total sand		73.96				139.80				94.15				164.92			
Total mud <0.063	<4.00	0.00	0.00		0.00	17.35	2.93		2.93	1.22	0.39		0.39	7.32	2.39		2.39
Total sample		105.16				593.11				316.47				306.31			
gravel %			29.67			73.50				69.86				43.77			
sand %			73.33			23.57				29.75				53.84			
mud %			0.00			2.93				0.39				2.39			
$CaCO_3$ gravel %			12			2				2				4			
$CaCO_3$ sand %			20			26				13				17			
F & W mean						1.29								2.08			
F & W dev.						1.05								0.73			
F & W skew.						0.07								-0.40			
F & W kurt.						0.85								1.71			
Inman mean			0.95			1.34				1.02				2.04			
Inman dev.			0.96			1.12				1.39				0.55			
Inman skew.			-0.45			0.13				0.23				-0.23			
Inman kurt.						0.45								1.75			
Percentile 5						-0.42								-0.19			
16			-0.01			0.22				-0.37				1.49			
25						0.56								1.73			
Median 50			1.38			1.19				0.70				2.16			
75						2.11								2.45			
84			1.91			2.45				2.41				2.58			
95						2.81								2.81			

Outer Bristol Channel Marine Habitat Study - Particle Size Analysis

SAMPLE		OBC16 [+51-05 1209]				OBC17 [+51-05 1210]				OBC18 [+51-05 1211]				OBC19 [+51-05 1212]			
W.gr.mm	Phi	wt.gms	wt.%	cum.%	W.gr.%	wt.gms	wt.%	cum.%	W.gr.%	wt.gms	wt.%	cum.%	W.gr.%	wt.gms	wt.%	cum.%	W.gr.%
	-6.00																
20.00		2.00				7.94				13.80				265.07			
	-4.00	24.19				0.00				0.00				12.44			
10.00		36.30				17.79				8.63				27.28			
5.00		36.18				15.41				25.88				96.40			
4.00	-2.00	10.43			0.00	6.08			0.00	8.25			0.00	21.40			0.00
2.00	-1.00	49.28			0.00	30.71			0.00	16.69			0.00	56.22			0.00
Total gravel		158.38	45.35			77.93	34.89			73.25	32.37			478.81	63.53		
vcs	-0.50	10.72	5.80			20.04	13.95			7.92	5.21			8.88	3.36		
1.00	0.00	7.80	4.22	10.03	10.03	17.72	12.33	26.28	26.28	8.00	5.26	10.48	10.48	14.40	5.44	8.80	8.80
cs	0.50	6.80	3.68	13.71		16.52	11.50	37.77		9.96	6.55	17.03		30.48	11.52	20.33	
0.50	1.00	8.48	4.59	18.30	8.27	24.00	16.70	54.47	28.20	18.72	12.32	29.35	18.87	51.20	19.36	39.69	30.88
ms	1.50	13.08	7.08	25.38		20.02	13.93	68.41		27.44	18.06	47.41		53.68	20.30	59.98	
0.25	2.00	23.24	12.58	37.97	19.67	10.36	7.21	75.62	21.14	24.56	16.16	63.57	34.22	32.80	12.40	72.38	32.70
fs	2.50	66.08	35.78	73.75		16.76	11.66	87.28		31.28	20.58	84.15		22.00	8.32	80.70	
0.13	3.00	44.84	24.28	98.03	60.06	16.40	11.41	98.69	23.08	22.32	14.69	98.84	35.27	43.36	16.39	97.10	24.71
vfs	3.50	3.24	1.75	99.78		1.56	1.09	99.78		1.64	1.08	99.92		6.56	2.48	99.58	
0.063	4.00	0.40	0.22	100.00	1.97	0.32	0.22	100.00	1.31	0.12	0.08	100.00	1.16	1.12	0.42	100.00	2.90
Total sand		184.68				143.70				151.96				264.48			
Total mud <0.063	<4.00	6.20	1.78		1.78	1.72	0.77		0.77	1.07	0.47		0.47	10.39	1.38		1.38
Total sample		349.26				223.35				226.28				753.68			
gravel %			45.35				34.89				32.37				63.53		
sand %			52.87				64.34				67.16				35.09		
mud %			1.78				0.77				0.47				1.38		
$CaCO_3$ gravel %			15				3				7				3		
$CaCO_3$ sand %			18				20				20				19		
F & W mean															1.38		
F & W dev.															1.03		
F & W skew.															0.09		
F & W kurt.															0.84		
Inman mean			1.69				0.96				1.47				1.45		
Inman dev.			0.93				1.37				1.02				1.11		
Inman skew.			-0.49				0.04				-0.13				0.17		
Inman kurt.															0.43		
Percentile	5														-0.29		
	16		0.76				-0.41				0.45				0.34		
	25														0.62		
Median	50		2.15				0.90				1.60				1.26		
	75														2.16		
	84		2.62		2.33						2.49				2.55		
	95														2.88		

Outer Bristol Channel Marine Habitat Study - Particle Size Analysis

SAMPLE		OBC20 [+51-05 1213]				OBC21 [+51-05 1214]				OBC22 [+51-05 1215]				OBC23 [+51-05 1216]			
W.gr.mm	Phi	wt.gms	wt.%	cum.%	W.gr.%	wt.gms	wt.%	cum.%	W.gr.%	wt.gms	wt.%	cum.%	W.gr.%	wt.gms	wt.%	cum.%	W.gr.%
	-6.00																
20.00		86.80				243.70								14.03			
	-4.00	5.38				80.68								9.30			
10.00		85.07				71.67								13.73			
5.00		133.20				66.88				1.19				36.68			
4.00	-2.00	15.55			0.00	16.02			0.00	0.28			0.00	11.05			0.00
2.00	-1.00	58.03			0.00	51.21			0.00	1.21			0.00	21.99			0.00
Total gravel		384.03	72.15			530.16	74.64			2.68	12.15			106.78	43.44		
vcs	-0.50	14.56	10.54			22.28	13.66			0.50	2.58			3.08	2.27		
1.00	0.00	14.24	10.31	20.85	20.85	18.00	11.03	24.69	24.69	0.53	2.73	5.31	5.31	2.04	1.51	3.78	3.78
cs	0.50	14.00	10.13	30.98		18.02	11.05	35.74		0.95	4.90	10.22		1.64	1.21	4.99	
0.50	1.00	14.20	10.28	41.26	20.41	21.12	12.95	48.68	23.99	4.44	22.91	33.13	27.81	5.44	4.01	9.00	5.22
ms	1.50	13.68	9.90	51.16		22.32	13.68	62.36		11.20	57.79	90.92		32.40	23.91	32.91	
0.25	2.00	14.56	10.54	61.70	20.44	20.80	12.75	75.11	26.43	1.59	8.20	99.12	66.00	64.04	47.26	80.17	71.16
fs	2.50	18.44	13.35	75.04		13.28	8.14	83.25		0.08	0.41	99.54		16.16	11.92	92.09	
0.13	3.00	28.80	20.85	95.89	34.19	21.08	12.92	96.18	21.06	0.07	0.36	99.90	0.77	9.24	6.82	98.91	18.74
vfs	3.50	4.76	3.45	99.33		5.20	3.19	99.36		0.02	0.10	100.00		1.32	0.97	99.88	
0.063	4.00	0.92	0.67	100.00	4.11	1.04	0.64	100.00	3.82	0.00	0.00	100.00	0.10	0.16	0.12	100.00	1.09
Total sand		138.16				163.14				19.38				135.52			
Total mud <0.063	<4.00	10.04	1.89		1.89	17.01	2.39		2.39	0.00	0.00		0.00	3.53	1.44		1.44
Total sample		532.23				710.31				22.06				245.83			
gravel %			72.15				74.64				12.15				43.44		
sand %			25.96				22.97				87.85				55.12		
mud %			1.89				2.39				0.00				1.44		
$CaCO_3$ gravel %			3				1				31				3		
$CaCO_3$ sand %			28				27				17				15		
F & W mean											1.06				1.67		
F & W dev.											0.44				0.55		
F & W skew.											-0.29				-0.04		
F & W kurt.											1.53				1.58		
Inman mean			1.23				1.06				1.03				1.68		
Inman dev.			1.42				1.45				0.37				0.47		
Inman skew.			-0.17				0.01				-0.22				0.01		
Inman kurt.											1.27				1.28		
Percentile	5										-0.03				0.51		
	16		-0.19				-0.39				0.66				1.21		
	25										0.86				1.38		
Median	50		1.46				1.04				1.11				1.67		
	75										1.31				1.93		
	84		2.64				2.51				1.40				2.14		
	95										1.65				2.63		

Outer Bristol Channel Marine Habitat Study - Particle Size Analysis

SAMPLE		OBC24 [+51-05 1217]				OBC25 [+51-05 1218]				OBC26 [+51-05 1219]				OBC27 [+51-05 1220]			
W.gr.mm	Phi	wt.gms	wt.%	cum.%	W.gr.%	wt.gms	wt.%	cum.%	W.gr.%	wt.gms	wt.%	cum.%	W.gr.%	wt.gms	wt.%	cum.%	W.gr.%
	-6.00																
20.00						1.11											
	-4.00					0.00											
10.00		2.40				10.91											
5.00		12.96				5.08											
4.00	-2.00	4.41			0.00	3.36			0.00				0.00				0.00
2.00	-1.00	5.29			0.00	13.39			0.00	0.90			0.00	1.17			0.00
Total gravel		25.06	27.20			33.85	29.40			0.90	2.53			1.17	3.76		
vcs	-0.50	6.04	9.01			7.76	9.63			2.91	8.39			1.78	5.95		
1.00	0.00	17.04	25.41	34.42	34.42	6.00	7.44	17.07	17.07	5.74	16.56	24.95	24.95	2.51	8.39	14.34	14.34
cs	0.50	13.80	20.58	55.00		4.51	5.59	22.66		6.15	17.74	42.69		3.10	10.36	24.70	
0.50	1.00	3.04	4.53	59.53	25.11	4.60	5.71	28.37	11.30	5.32	15.34	58.03	33.08	3.80	12.70	37.40	23.06
ms	1.50	9.58	14.29	73.81		5.47	6.78	35.15		4.51	13.01	71.04		8.44	28.21	65.61	
0.25	2.00	12.60	18.79	92.60	33.07	13.01	16.14	51.29	22.92	5.05	14.57	85.61	27.57	8.47	28.31	93.92	56.52
fs	2.50	2.80	4.18	96.78		21.57	26.76	78.05		2.61	7.53	93.14		1.39	4.65	98.56	
0.13	3.00	1.96	2.92	99.70	7.10	16.52	20.49	98.54	47.25	2.08	6.00	99.13	13.53	0.41	1.37	99.93	6.02
vfs	3.50	0.18	0.27	99.97		1.10	1.36	99.90		0.28	0.81	99.94		0.02	0.07	100.00	
0.063	4.00	0.02	0.03	100.00	0.30	0.08	0.10	100.00	1.46	0.02	0.06	100.00	0.87	0.00	0.00	100.00	0.07
Total sand		67.06				80.62				34.67				29.92			
Total mud <0.063	<4.00	0.00	0.00		0.00	0.67	0.58		0.58	0.04	0.11		0.11	0.00	0.00		0.00
Total sample		92.12				115.14				35.61				31.09			
gravel %			27.20				29.40				2.53				3.76		
sand %			72.80				70.02				97.36				96.24		
mud %			0.00				0.58				0.11				0.00		
$CaCO_3$ gravel %			12				9				42				68		
$CaCO_3$ sand %			11				18				21				21		
F & W mean																	
F & W dev.																	
F & W skew.																	
F & W kurt.																	
Inman mean			0.71				1.26				0.87				0.94		
Inman dev.			1.02				1.33				1.08				0.84		
Inman skew.			0.31				-0.54				0.11				-0.35		
Inman kurt.																	
Percentile 5																	
16			-0.31				-0.07				-0.21				0.10		
25																	
Median 50			0.39				1.98				0.75				1.23		
75																	
84			1.72				2.59				1.95				1.77		
95																	

Outer Bristol Channel Marine Habitat Study - Particle Size Analysis

SAMPLE		OBC29 [+51-05 1222]				OBC30 [+51-05 1223]				OBC31 [+51-05 1224]				OBC32 [+51-05 1225]			
W.gr.mm	Phi	wt.gms	wt.%	cum.%	W.gr.%	wt.gms	wt.%	cum.%	W.gr.%	wt.gms	wt.%	cum.%	W.gr.%	wt.gms	wt. %	cum. %	W.gr.%
	-6.00																
20.00		16.95															
	-4.00	0.00				33.40											
10.00		31.50				40.53				8.97				2.78			
5.00		33.24				55.19				5.94				8.68			
4.00	-2.00	13.89			0.00	15.48			0.00	1.40			0.00	3.18			0.00
2.00	-1.00	37.68			0.00	29.78			0.00	3.84			0.00	9.06			0.00
Total gravel		133.26	51.49			174.38	69.83			20.15	25.69			23.70	36.76		
vcs	-0.50	12.72	10.31			4.48	6.02			0.80	1.39			4.96	12.23		
1.00	0.00	8.80	7.13	17.44	17.44	3.40	4.57	10.60	10.60	1.00	1.73	3.12	3.12	4.05	9.99	22.21	22.21
cs	0.50	7.96	6.45	23.89		5.32	7.15	17.75		1.28	2.22	5.34		4.31	10.63	32.84	
0.50	1.00	10.64	8.62	32.51	15.07	12.60	16.94	34.70	24.10	4.40	7.62	12.96	9.84	7.75	19.11	51.95	29.73
ms	1.50	16.76	13.58	46.09		18.82	25.31	60.01		13.74	23.80	36.76		8.64	21.30	73.25	
0.25	2.00	25.48	20.65	66.74	34.23	16.16	21.73	81.74	47.04	22.80	39.50	76.26	63.31	6.82	16.81	90.06	38.12
fs	2.50	31.92	25.87	92.61		6.90	9.28	91.02		8.36	14.48	90.75		2.41	5.94	96.01	
0.13	3.00	7.92	6.42	99.03	32.29	5.56	7.48	98.49	16.76	4.56	7.90	98.65	22.38	1.18	2.91	98.92	8.85
vfs	3.50	1.08	0.88	99.90		1.00	1.34	99.84		0.70	1.21	99.86		0.38	0.94	99.85	
0.063	4.00	0.12	0.10	100.00	0.97	0.12	0.16	100.00	1.51	0.08	0.14	100.00	1.35	0.06	0.15	100.00	1.08
Total sand		123.40				74.36				57.72				40.56			
Total mud <0.063	<4.00	2.17	0.84		0.84	0.98	0.39		0.39	0.55	0.70		0.70	0.21	0.33		0.33
Total sample		258.83				249.72				78.42				64.47			
gravel %			51.49			69.83				25.69				36.76			
sand %			47.67			29.78				73.61				62.91			
mud %			0.84			0.39				0.70				0.33			
$CaCO_3$ gravel %			5			7				4				3			
$CaCO_3$ sand %			35			22				15				14			
F & W mean										1.65							
F & W dev.										0.62							
F & W skew.										-0.03							
F & W kurt.										1.32							
Inman mean			1.11			1.26				1.66				0.75			
Inman dev.			1.19			0.85				0.57				1.04			
Inman skew.			0.00			-0.07				0.01				-0.21			
Inman kurt.										0.99							
Percentile	5									0.44							
	16		-0.08			0.41				1.09				-0.29			
	25									1.29							
Median	50		1.10			1.31				1.65				0.97			
	75									1.99							
	84		2.29		2.10					2.22				1.79			
	95									2.69							

Outer Bristol Channel Marine Habitat Study - Particle Size Analysis

SAMPLE		OBC33 [+51-05 1226]				OBC34 [+51-05 1227]				OBC35 [+51-05 1228]				OBC36 [+51-05 1229]			
W.gr.mm	Phi	wt.gms	wt.%	cum.%	W.gr.%	wt.gms	wt.%	cum.%	W.gr.%	wt.gms	wt.%	cum.%	W.gr.%	wt.gms	wt.%	cum.%	W.gr.%
	-6.00																
20.00		96.54				95.70								1.38			
	-4.00	70.14				55.75								7.30			
10.00		56.57				95.50				12.67				17.59			
5.00		35.66				111.82				6.80				32.00			
4.00	-2.00	10.02			0.00	21.40			0.00	2.73			0.00	11.97			0.00
2.00	-1.00	15.65			0.00	41.40			0.00	9.60			0.00	34.59			0.00
Total gravel		284.58	59.84			421.57	64.33			31.80	27.87			104.83	44.06		
vcs	-0.50	3.28	1.72			8.64	3.70			5.28	6.41			8.40	6.55		
1.00	0.00	2.08	1.09	2.81	2.81	5.12	2.20	5.90	5.90	1.80	2.19	8.60	8.60	4.84	3.77	10.32	10.32
cs	0.50	1.68	0.88	3.69		3.92	1.68	7.58		1.48	1.80	10.40		5.00	3.90	14.22	
0.50	1.00	5.60	2.94	6.63	3.82	4.88	2.09	9.67	3.77	2.00	2.43	12.83	4.23	8.01	6.24	20.46	10.14
ms	1.50	72.08	37.83	44.46		14.40	6.17	15.85		3.56	4.33	17.15		14.40	11.22	31.69	
0.25	2.00	75.20	39.46	83.92	77.29	139.60	59.86	75.71	66.04	27.64	33.58	50.74	37.91	39.96	31.15	62.83	42.37
fs	2.50	28.24	14.82	98.74		50.80	21.78	97.50		37.76	45.88	96.61		34.68	27.03	89.87	
0.13	3.00	2.08	1.09	99.83	15.91	4.72	2.02	99.52	23.81	2.40	2.92	99.53	48.79	10.84	8.45	98.32	35.48
vfs	3.50	0.24	0.13	99.96		0.96	0.41	99.93		0.35	0.43	99.95		1.96	1.53	99.84	
0.063	4.00	0.08	0.04	100.00	0.17	0.16	0.07	100.00	0.48	0.04	0.05	100.00	0.47	0.20	0.16	100.00	1.68
Total sand		190.56				233.20				82.31				128.29			
Total mud <0.063	<4.00	0.40	0.08		0.08	0.53	0.08		0.08	0.00	0.00		0.00	4.83	2.03		2.03
Total sample		475.54				655.30				114.11				237.95			
gravel %			59.84				64.33				27.87				44.06		
sand %			40.08				35.59				72.13				53.91		
mud %			0.08				0.08				0.00				2.03		
$CaCO_3$ gravel %			4				3				5				8		
$CaCO_3$ sand %			10				11				14				18		
F & W mean			1.62				1.81										
F & W dev.			0.43				0.54										
F & W skew.			-0.19				-0.25										
F & W kurt.			1.10				2.69										
Inman mean			1.60				1.82				1.86				1.51		
Inman dev.			0.41				0.31				0.44				0.85		
Inman skew.			-0.17				0.05				-0.29				-0.34		
Inman kurt.			0.80				3.20										
Percentile	5		0.78				-0.18										
	16		1.19				1.51				1.42				0.66		
	25		1.31				1.60										
Median	50		1.67				1.80				1.98				1.80		
	75		1.86				1.99										
	84		2.01				2.12				2.29				2.36		
	95		2.26				2.38										

Outer Bristol Channel Marine Habitat Study - Particle Size Analysis

SAMPLE		OBC37 [+51-05 1230]				OBC38 [+51-05 1231]				OBC39 [+51-05 1232]				OBC40 [+51-05 1233]			
W.gr.mm	Phi	wt.gms	wt.%	cum.%	W.gr.%	wt.gms	wt.%	cum.%	W.gr.%	wt.gms	wt.%	cum.%	W.gr.%	wt.gms	wt.%	cum.%	W.gr.%
	-6.00																
20.00		68.60				1.63											
	-4.00	35.20				0.00				16.41							
10.00		72.18				7.00				14.21				2.66			
5.00		48.40				7.68				25.05				0.81			
4.00	-2.00	15.99			0.00	3.77			0.00	9.07			0.00	0.90			0.00
2.00	-1.00	38.12			0.00	16.98			0.00	23.32			0.00	0.46			0.00
Total gravel		278.49	71.72			37.06	26.89			88.06	49.22			4.83	12.40		
vcs	-0.50	6.32	5.76			6.80	6.78			9.92	11.14			0.58	1.70		
1.00	0.00	4.88	4.45	10.21	10.21	4.52	4.51	11.28	11.28	7.24	8.13	19.28	19.28	0.99	2.91	4.61	4.61
cs	0.50	7.60	6.93	17.13		5.28	5.26	16.55		7.26	8.16	27.43		2.60	7.64	12.25	
0.50	1.00	14.32	13.05	30.19	19.98	4.44	4.43	20.97	9.69	9.56	10.74	38.17	18.89	8.72	25.61	37.86	33.25
ms	1.50	19.00	17.32	47.50		5.24	5.22	26.20		9.80	11.01	49.18		14.11	41.44	79.30	
0.25	2.00	40.02	36.47	83.98	53.79	40.80	40.67	66.87	45.89	9.36	10.51	59.69	21.52	5.19	15.24	94.54	56.68
fs	2.50	15.80	14.40	98.38		28.36	28.27	95.14		20.08	22.56	82.25		1.51	4.43	98.97	
0.13	3.00	1.60	1.46	99.84	15.86	4.32	4.31	99.44	32.58	14.40	16.18	98.43	38.73	0.31	0.91	99.88	5.35
vfs	3.50	0.12	0.11	99.95		0.44	0.44	99.88		1.32	1.48	99.91		0.03	0.09	99.97	
0.063	4.00	0.06	0.05	100.00	0.16	0.12	0.12	100.00	0.56	0.08	0.09	100.00	1.57	0.01	0.03	100.00	0.12
Total sand		109.72				100.32				89.02				34.05			
Total mud <0.063	<4.00	0.08	0.02		0.02	0.42	0.30		0.30	1.84	1.03		1.03	0.08	0.21		0.21
Total sample		388.29				137.80				178.92				38.96			
gravel %			71.72				26.89				49.22				12.40		
sand %			28.26				72.81				49.75				87.39		
mud %			0.02				0.30				1.03				0.21		
$CaCO_3$ gravel %			1				10				11				10		
$CaCO_3$ sand %			10				14				22				17		
F & W mean															1.11		
F & W dev.															0.55		
F & W skew.															-0.07		
F & W kurt.															1.27		
Inman mean			1.21				1.35				1.18				1.11		
Inman dev.			0.80				0.88				1.35				0.51		
Inman skew.			-0.40				-0.52				-0.31				-0.05		
Inman kurt.															0.97		
Percentile 5															0.04		
16			0.41				0.47				-0.17				0.60		
25															0.78		
Median 50			1.53				1.80				1.59				1.13		
75															1.42		
84			2.01				2.22				2.52				1.61		
95															2.03		

Outer Bristol Channel Marine Habitat Study - Particle Size Analysis

SAMPLE		OBC41 [+51-05 1234]				OBC42 [+51-05 1235]				OBC43 [+51-05 1236]				OBC44 [+51-05 1237]			
W.gr.mm	Phi	wt.gms	wt.%	cum.%	W.gr.%	wt.gms	wt.%	cum.%	W.gr.%	wt.gms	wt.%	cum.%	W.gr.%	wt.gms	wt.%	cum.%	W.gr.%
	-6.00																
20.00						8.41											
	-4.00					22.98											
10.00						38.60				7.04				28.92			
5.00						35.89				1.88				23.02			
4.00	-2.00	0.84			0.00	3.99			0.00	0.00			0.00	3.30			0.00
2.00	-1.00	4.30			0.00	12.65			0.00	0.41			0.00	6.33			0.00
Total gravel		5.14	14.66			122.52	40.65			9.33	23.40			61.57	33.19		
vcs	-0.50	3.06	10.23			3.04	1.74			0.18	0.59			1.20	0.97		
1.00	0.00	2.30	7.69	17.92	17.92	1.60	0.91	2.65	2.65	0.28	0.92	1.51	1.51	0.96	0.78	1.75	1.75
cs	0.50	1.01	3.38	21.30		1.20	0.69	3.34		0.75	2.45	3.96		1.60	1.30	3.05	
0.50	1.00	2.72	9.09	30.39	12.47	6.00	3.43	6.77	4.12	4.93	16.14	20.10	18.59	15.52	12.60	15.66	13.90
ms	1.50	11.74	39.25	69.64		51.12	29.22	35.99		17.44	57.09	77.18		43.64	35.44	51.10	
0.25	2.00	7.28	24.34	93.98	63.59	76.08	43.48	79.47	72.70	5.47	17.91	95.09	74.99	40.16	32.61	83.71	68.05
fs	2.50	1.46	4.88	98.86		27.12	15.50	94.97		1.30	4.26	99.35		19.00	15.43	99.14	
0.13	3.00	0.30	1.00	99.87	5.88	7.28	4.16	99.13	19.66	0.14	0.46	99.80	4.71	0.88	0.71	99.85	16.14
vfs	3.50	0.03	0.10	99.97		1.28	0.73	99.86		0.04	0.13	99.93		0.16	0.13	99.98	
0.063	4.00	0.01	0.03	100.00	0.13	0.24	0.14	100.00	0.87	0.02	0.07	100.00	0.20	0.02	0.02	100.00	0.15
Total sand		29.91				174.96				30.55				123.14			
Total mud <0.063	<4.00	0.00	0.00		0.00	3.93	1.30		1.30	0.00	0.00		0.00	0.78	0.42		0.42
Total sample		35.05				301.41				39.88				185.49			
gravel %			14.66			40.65				23.40				33.19			
sand %			85.34			58.05				76.60				66.39			
mud %			0.00			1.30				0.00				0.42			
$CaCO_3$ gravel %			4			3				8				0			
$CaCO_3$ sand %			12			13				9				10			
F & W mean						1.66				1.28				1.50			
F & W dev.						0.48				0.39				0.49			
F & W skew.						0.03				0.02				-0.02			
F & W kurt.						1.24				1.29				0.97			
Inman mean			0.82			1.67				1.28				1.51			
Inman dev.			0.91			0.45				0.35				0.50			
Inman skew.			-0.48			0.06				0.03				0.04			
Inman kurt.						0.93				1.03				0.61			
Percentile	5					0.79				0.57				0.62			
	16		-0.09			1.22				0.93				1.01			
	25					1.36				1.04				1.16			
Median	50		1.26			1.64				1.27				1.49			
	75					1.93				1.49				1.84			
	84		1.73			2.11				1.63				2.01			
	95					2.51				1.99				2.23			

Outer Bristol Channel Marine Habitat Study - Particle Size Analysis

SAMPLE		OBC45 [+51-05 1238]				OBC46 [+51-05 1239]				OBC47 [+51-05 1240]				OBC48 [+51-05 1241]			
W.gr.mm	Phi	wt.gms	wt.%	cum.%	W.gr.%	wt.gms	wt.%	cum.%	W.gr.%	wt.gms	wt.%	cum.%	W.gr.%	wt.gms	wt.%	cum.%	W.gr.%
	-6.00																
20.00																	
	-4.00									8.47							
10.00		2.98								17.01							
5.00		4.31				0.39				53.13							
4.00	-2.00	1.82			0.00	0.22			0.00	10.90			0.00				0.00
2.00	-1.00	1.99			0.00	6.03			0.00	18.31			0.00				0.00
Total gravel		11.10	17.05			6.64	15.82			107.82	42.63			0.00	0.00		
vcs	-0.50	0.30	0.56			4.51	12.77			3.28	2.26			0.03	0.10		
1.00	0.00	0.40	0.74	1.30	1.30	2.19	6.20	18.96	18.96	1.88	1.30	3.56	3.56	0.24	0.80	0.90	0.90
cs	0.50	1.84	3.41	4.71		1.29	3.65	22.62		3.20	2.21	5.76		0.80	2.67	3.57	
0.50	1.00	9.40	17.44	22.15	20.85	5.39	15.26	37.87	18.91	12.72	8.77	14.53	10.97	7.72	25.75	29.32	28.42
ms	1.50	24.46	45.37	67.52		16.03	45.37	83.24		50.40	34.74	49.27		14.12	47.10	76.42	
0.25	2.00	14.48	26.86	94.38	72.23	4.91	13.90	97.14	59.27	62.28	42.93	92.20	77.67	5.93	19.78	96.20	66.88
fs	2.50	2.88	5.34	99.72		0.91	2.58	99.72		10.84	7.47	99.67		1.11	3.70	99.90	
0.13	3.00	0.12	0.22	99.94	5.56	0.08	0.23	99.94	2.80	0.32	0.22	99.89	7.69	0.02	0.07	99.97	3.77
vfs	3.50	0.03	0.06	100.00		0.02	0.06	100.00		0.12	0.08	99.97		0.01	0.03	100.00	
0.063	4.00	0.00	0.00	100.00	0.06	0.00	0.00	100.00	0.06	0.04	0.03	100.00	0.11	0.00	0.00	100.00	0.03
Total sand		53.91				35.33				145.08				29.98			
Total mud <0.063	<4.00	0.09	0.14		0.14	0.00	0.00		0.00	0.00	0.00		0.00	0.00	0.00		0.00
Total sample		65.10				41.97				252.90				29.98			
gravel %			17.05				15.82				42.63				0.00		
sand %			82.81				84.18				57.37				100.00		
mud %			0.14				0.00				0.00				0.00		
$CaCO_3$ gravel %			0				1				2				0		
$CaCO_3$ sand %			9				10				11				11		
F & W mean			1.31								1.46				1.22		
F & W dev.			0.44								0.46				0.40		
F & W skew.			-0.03								-0.26				0.03		
F & W kurt.			1.09								1.30				1.06		
Inman mean			1.31				0.65				1.43				1.23		
Inman dev.			0.43				0.86				0.40				0.40		
Inman skew.			-0.01				-0.55				-0.20				0.01		
Inman kurt.			0.78								1.14				0.71		
Percentile	5		0.52								0.38				0.58		
	16		0.88				-0.21				1.03				0.83		
	25		1.03								1.19				0.97		
Median	50		1.31				1.12				1.51				1.22		
	75		1.60								1.73				1.49		
	84		1.73				1.51				1.83				1.62		
	95		2.03								2.09				1.93		

Outer Bristol Channel Marine Habitat Study - Particle Size Analysis

SAMPLE		OBC49 [+51-05 1242]				OBC50 [+51-05 1243]				OBC51 [+51-05 1244]				OBC52 [+51-05 1245]			
W.gr.mm	Phi	wt.gms	wt.%	cum.%	W.gr.%	wt.gms	wt.%	cum.%	W.gr.%	wt.gms	wt.%	cum.%	W.gr.%	wt.gms	wt.%	cum.%	W.gr.%
	-6.00																
20.00																	
	-4.00									11.54				2.08			
10.00						11.70				10.35				31.76			
5.00		0.65				32.41				8.69				24.69			
4.00	-2.00	0.18				13.29				0.70				3.31			
2.00	-1.00	1.23				37.09				3.46				5.25			
Total gravel		2.06	6.73			94.49	53.08			34.74	43.29			67.09	30.26		
vcs	-0.50	0.70	2.45			10.72	12.84			0.86	1.91			3.36	2.18		
1.00	0.00	0.59	2.07	4.52	4.52	7.64	9.15	21.99	21.99	0.54	1.20	3.11	3.11	2.14	1.39	3.56	3.56
cs	0.50	1.13	3.96	8.47		9.76	11.69	33.68		1.12	2.49	5.59		2.00	1.29	4.86	
0.50	1.00	8.87	31.06	39.53	35.01	18.00	21.56	55.25	33.25	4.26	9.45	15.05	11.94	10.60	6.86	11.72	8.16
.	1.50	14.88	52.10	91.63		13.60	16.29	71.54		13.28	29.47	44.52		70.30	45.51	57.23	
0.25	2.00	2.12	7.42	99.05	59.52	11.24	13.46	85.00	29.76	19.48	43.23	87.75	72.70	51.06	33.06	90.29	78.57
fs	2.50	0.22	0.77	99.82		6.92	8.29	93.29		5.14	11.41	99.16		11.90	7.70	97.99	
0.13	3.00	0.04	0.14	99.96	0.91	3.44	4.12	97.41	12.41	0.30	0.67	99.82	12.07	2.60	1.68	99.68	9.39
vfs	3.50	0.01	0.04	100.00		1.80	2.16	99.57		0.06	0.13	99.96		0.40	0.26	99.94	
0.063	4.00	0.00	0.00	100.00	0.04	0.36	0.43	100.00	2.59	0.02	0.04	100.00	0.18	0.10	0.06	100.00	0.32
Total sand		28.56				83.48				45.06				154.46			
Total mud <0.063	<4.00	0.00	0.00		0.00	0.04	0.02		0.02	0.45	0.56		0.56	0.16	0.07		0.07
Total sample		30.62				178.01				80.25				221.71			
gravel %			6.73				53.08				43.29				30.26		
sand %			93.27				46.90				56.15				69.67		
mud %			0.00				0.02				0.56				0.07		
$CaCO_3$ gravel %			0				14				4				22		
$CaCO_3$ sand %			7				23				20				10		
F & W mean			1.05								1.50				1.46		
F & W dev.			0.41								0.50				0.45		
F & W skew.			-0.19								-0.24				0.02		
F & W kurt.			1.34								1.16				1.30		
Inman mean			1.04				0.83				1.48				1.47		
Inman dev.			0.35				1.13				0.46				0.39		
Inman skew.			-0.11				-0.05				-0.19				0.10		
Inman kurt.			1.20								0.97				1.19		
Percentile	5		0.11								0.40				0.52		
	16		0.69				-0.30				1.02				1.08		
	25		0.82								1.19				1.19		
Median	50		1.08				0.89				1.56				1.43		
	75		1.29								1.82				1.73		
	84		1.39				1.96				1.93				1.86		
	95		1.65								2.19				2.23		

Outer Bristol Channel Marine Habitat Study - Particle Size Analysis

SAMPLE		OBC53 [+51-05 1246]				OBC54 [+51-05 1247]				OBC55 [+51-05 1248]				OBC56 [+51-05 1249]			
W.gr.mm	Phi	wt.gms	wt.%	cum.%	W.gr.%	wt.gms	wt.%	cum.%	W.gr.%	wt.gms	wt.%	cum.%	W.gr.%	wt.gms	wt.%	cum.%	W.gr.%
	-6.00																
20.00																	
	-4.00																
10.00																	
5.00		0.62															
4.00	-2.00	0.41			0.00				0.00				0.00				0.00
2.00	-1.00	0.68			0.00	0.11			0.00	0.20			0.00	0.25			0.00
Total gravel		1.71	5.25			0.11	0.43			0.20	0.59			0.25	0.75		
vcs	-0.50	0.81	2.62			0.04	0.16			0.13	0.41			0.12	0.39		
1.00	0.00	0.58	1.88	4.50	4.50	0.12	0.47	0.63	0.63	0.39	1.22	1.63	1.63	0.13	0.42	0.81	0.81
cs	0.50	0.90	2.92	7.42		0.19	0.75	1.37		1.45	4.55	6.18		0.30	0.98	1.79	
0.50	1.00	3.20	10.37	17.79	13.29	0.67	2.63	4.00	3.38	5.30	16.62	22.80	21.17	3.30	10.75	12.54	11.72
ms	1.50	12.02	38.95	56.74		5.91	23.19	27.20		7.05	22.11	44.92		12.13	39.50	52.04	
0.25	2.00	10.92	35.39	92.13	74.34	14.89	58.44	85.64	81.63	8.52	26.73	71.64	48.84	10.86	35.36	87.40	74.86
fs	2.50	2.19	7.10	99.22		3.37	13.23	98.86		7.79	24.44	96.08		2.38	7.75	95.15	
0.13	3.00	0.21	0.68	99.90	7.78	0.25	0.98	99.84	14.21	0.95	2.98	99.06	27.42	0.78	2.54	97.69	10.29
vfs	3.50	0.02	0.06	99.97		0.03	0.12	99.96		0.21	0.66	99.72		0.51	1.66	99.35	
0.063	4.00	0.01	0.03	100.00	0.10	0.01	0.04	100.00	0.16	0.09	0.28	100.00	0.94	0.20	0.65	100.00	2.31
Total sand		30.86				25.48				31.88				30.71			
Total mud <0.063	<4.00	0.00	0.00		0.00	0.00	0.00		0.00	1.97	5.79		5.79	2.59	7.72		7.72
Total sample		32.57				25.59				34.05				33.55			
gravel %			5.25				0.43				0.59				0.75		
sand %			94.75				99.57				93.62				91.53		
mud %			0.00				0.00				5.79				7.72		
$CaCO_3$ gravel %			6				9				35				48		
$CaCO_3$ sand %			9				8				11				10		
F & W mean			1.39				1.67				1.55				1.50		
F & W dev.			0.52				0.34				0.64				0.52		
F & W skew.			-0.20				-0.08				-0.13				0.02		
F & W kurt.			1.36				1.15				0.86				1.33		
Inman mean			1.38				1.66				1.52				1.50		
Inman dev.			0.44				0.32				0.66				0.44		
Inman skew.			-0.09				-0.09				-0.12				0.02		
Inman kurt.			1.26				0.84				0.56				1.22		
Percentile	5		0.11				1.06				0.42				0.53		
	16		0.94				1.34				0.86				1.06		
	25		1.11				1.47				1.06				1.20		
Median	50		1.42				1.69				1.60				1.49		
	75		1.71				1.89				2.04				1.80		
	84		1.82				1.98				2.18				1.94		
	95		2.10				2.24				2.48				2.48		

Outer Bristol Channel Marine Habitat Study - Particle Size Analysis

SAMPLE		OBC57 [+51-05 1250]				OBC58 [+51-05 1251]				OBC59 [+51-05 1252]				OBC60 [+51-05 1253]			
W.gr.mm	Phi	wt.gms	wt.%	cum.%	W.gr.%	wt.gms	wt.%	cum.%	W.gr.%	wt.gms	wt.%	cum.%	W.gr.%	wt.gms	wt.%	cum.%	W.gr.%
	-6.00																
20.00						37.82											
	-4.00					0.00											
10.00						14.72											
5.00						39.74				0.22				0.48			
4.00	-2.00				0.00	11.09			0.00	0.02			0.00	0.31			0.00
2.00	-1.00				0.00	27.30			0.00	0.47			0.00	0.35			0.00
Total gravel		0.00	0.00			130.67	46.85			0.71	2.22			1.14	3.59		
vcs	-0.50					4.80	3.49			0.33	1.06			0.28	0.95		
1.00	0.00				0.00	3.04	2.21	5.70	5.70	0.62	1.99	3.04	3.04	0.31	1.05	2.01	2.01
cs	0.50	0.03	0.11			2.24	1.63	7.33		1.60	5.13	8.17		0.53	1.80	3.81	
0.50	1.00	0.18	0.67	0.78	0.78	1.96	1.42	8.75	3.05	6.02	19.29	27.46	24.42	1.85	6.29	10.10	8.10
ms	1.50	0.41	1.52	2.31		3.20	2.33	11.08		12.74	40.82	68.28		5.69	19.35	29.46	
0.25	2.00	6.01	22.35	24.66	23.88	20.28	14.74	25.82	17.07	6.65	21.31	89.59	62.13	12.10	41.16	70.61	60.51
fs	2.50	17.61	65.49	90.15		59.08	42.95	68.77		2.62	8.39	97.98		6.98	23.74	94.35	
0.13	3.00	2.36	8.78	98.92	74.27	30.16	21.92	90.69	64.87	0.52	1.67	99.65	10.06	1.20	4.08	98.44	27.82
vfs	3.50	0.26	0.97	99.89		11.08	8.05	98.75		0.09	0.29	99.94		0.37	1.26	99.69	
0.063	4.00	0.03	0.11	100.00	1.08	1.72	1.25	100.00	9.31	0.02	0.06	100.00	0.35	0.09	0.31	100.00	1.56
Total sand		26.89				137.56				31.21				29.40			
Total mud <0.063	<4.00	1.19	4.24		4.24	10.66	3.82		3.82	0.09	0.28		0.28	1.24	3.90		3.90
Total sample		28.08				278.89				32.01				31.78			
gravel %			0.00			46.85				2.22				3.59			
sand %			95.75			49.33				97.50				92.51			
mud %			4.25			3.82				0.28				3.90			
$CaCO_3$ gravel %			0			14				66				18			
$CaCO_3$ sand %			9			19				21				10			
F & W mean			2.16			2.27				1.30				1.72			
F & W dev.			0.30			0.77				0.57				0.55			
F & W skew.			-0.07			-0.26				-0.01				-0.12			
F & W kurt.			1.25			2.19				1.21				1.22			
Inman mean			2.16			2.26				1.30				1.71			
Inman dev.			0.28			0.55				0.53				0.52			
Inman skew.			-0.09			-0.06				0.02				-0.09			
Inman kurt.			0.89			2.04				0.87				0.87			
Percentile	5		1.63			-0.13				0.26				0.63			
	16		1.88			1.71				0.77				1.19			
	25		2.01			1.99				0.95				1.40			
Median	50		2.18			2.29				1.29				1.75			
	75		2.35			2.61				1.62				2.05			
	84		2.43			2.80				1.83				2.22			
	95		2.67			3.18				2.24				2.56			

Outer Bristol Channel Marine Habitat Study - Particle Size Analysis

SAMPLE		OBC61 [+51-05 1254]				OBC62 [+51-05 1255]				OBC63 [+51-05 1256]				OBC64 [+51-05 1257]			
W.gr.mm	Phi	wt.gms	wt.%	cum.%	W.gr.%	wt.gms	wt.%	cum.%	W.gr.%	wt.gms	wt.%	cum.%	W.gr.%	wt.gms	wt.%	cum.%	W.gr.%
	-6.00																
20.00																	
	-4.00	8.99															
10.00		46.38												7.30			
5.00		62.19												27.45			
4.00	-2.00	16.40			0.00				0.00				0.00	8.49			0.00
2.00	-1.00	41.80			0.00	0.04			0.00				0.00	24.40			0.00
Total gravel		175.76	59.02			0.04	0.13			0.00	0.00			67.64	54.51		
vcs	-0.50	13.88	15.33			0.02	0.10							6.52	11.65		
1.00	0.00	9.20	10.16	25.50	25.50	0.05	0.26	0.36	0.36	0.02	0.08		0.08	4.04	7.22	18.87	18.87
cs	0.50	6.72	7.42	32.92		0.11	0.57	0.94		0.03	0.12	0.20		3.42	6.11	24.98	
0.50	1.00	5.12	5.66	38.58	13.08	0.23	1.20	2.14	1.77	0.05	0.20	0.41	0.33	3.56	6.36	31.34	12.47
ms	1.50	2.20	2.43	41.01		0.59	3.08	5.21		0.14	0.57	0.98		3.58	6.40	37.74	
0.25	2.00	1.12	1.24	42.24	3.67	0.66	3.44	8.65	6.52	0.50	2.04	3.02	2.61	6.30	11.26	49.00	17.66
fs	2.50	3.20	3.54	45.78		1.60	8.34	17.00		4.51	18.38	21.39		12.88	23.02	72.02	
0.13	3.00	15.16	16.75	62.53	20.28	7.97	41.55	58.55	49.90	16.16	65.85	87.25	84.23	12.82	22.91	94.92	45.93
vfs	3.50	27.52	30.40	92.93		6.65	34.67	93.22		2.99	12.18	99.43		2.60	4.65	99.57	
0.063	4.00	6.40	7.07	100.00	37.47	1.30	6.78	100.00	41.45	0.14	0.57	100.00	12.75	0.24	0.43	100.00	5.08
Total sand		90.52				19.18				24.54				55.96			
Total mud <0.063	<4.00	31.50	10.58		10.58	10.99	36.38		36.38	0.80	3.16		3.16	0.49	0.39		0.39
Total sample		297.78				30.21				25.34				124.09			
gravel %			59.02			0.13				0.00				54.51			
sand %			30.40			63.49				96.84				45.10			
mud %			10.58			36.38				3.16				0.39			
$CaCO_3$ gravel %			7			0				0				20			
$CaCO_3$ sand %			33			27				17				37			
F & W mean										2.70							
F & W dev.										0.30							
F & W skew.										-0.08							
F & W kurt.										1.22							
Inman mean			1.41			2.89				2.70				1.26			
Inman dev.			1.89			0.43				0.28				1.43			
Inman skew.			-0.66			-0.06				-0.05				-0.52			
Inman kurt.										0.95							
Percentile	5									2.12							
	16		-0.48			2.46				2.42				-0.17			
	25									2.53							
Median	50		2.64			2.91				2.71				2.01			
	75									2.89							
	84		3.29			3.31				2.97				2.69			
	95									3.19							

Outer Bristol Channel Marine Habitat Study - Particle Size Analysis

SAMPLE		OBC65 [+51-05 1258]				OBC68 [+51-05 1261]				OBC69 [+51-05 1262]				OBC70 [+51-05 1263]			
W.gr.mm	**Phi**	**wt.gms**	**wt.%**	**cum.%**	**W.gr.%**	**wt.gms**	**wt.%**	**cum.%**	**W.gr.%**	**wt.gms**	**wt.%**	**cum.%**	**W.gr.%**	**wt.gms**	**wt.%**	**cum.%**	**W.gr.%**
	-6.00																
20.00																	
	-4.00																
10.00		0.25															
5.00		0.06								0.91							
4.00	**-2.00**	0.03			0.00				0.00	0.47			0.00				0.00
2.00	**-1.00**	0.58			0.00	0.09			0.00	4.10			0.00	0.09			0.00
Total gravel		0.92	3.10			0.09	0.34			5.48	9.58			0.09	0.31		
vcs	**-0.50**	0.71	2.48			0.10	0.40			2.96	5.72			0.09	0.32		
1.00	**0.00**	1.09	3.80	6.28	6.28	0.17	0.68	1.08	1.08	3.60	6.96	12.68	12.68	0.11	0.39	0.70	0.70
cs	**0.50**	1.86	6.49	12.77		0.25	1.00	2.07		4.28	8.28	20.96		0.09	0.32	1.02	
0.50	**1.00**	3.48	12.15	24.92	18.64	0.50	1.99	4.06	2.99	7.60	14.69	35.65	22.97	0.12	0.42	1.44	0.74
ms	**1.50**	5.80	20.24	45.17		0.98	3.90	7.96		13.80	26.68	62.34		0.62	2.17	3.61	
0.25	**2.00**	10.71	37.38	82.55	57.63	1.94	7.73	15.69	11.63	13.06	25.25	87.59	51.93	4.26	14.94	18.55	17.11
fs	**2.50**	3.31	11.55	94.10		8.26	32.90	48.59		4.48	8.66	96.25		6.29	22.05	40.60	
0.13	**3.00**	1.31	4.57	98.67	16.13	10.52	41.90	90.48	74.79	1.34	2.59	98.84	11.25	10.53	36.92	77.52	58.98
vfs	**3.50**	0.35	1.22	99.90		2.21	8.80	99.28		0.56	1.08	99.92		6.09	21.35	98.88	
0.063	**4.00**	0.03	0.10	100.00	1.33	0.18	0.72	100.00	9.52	0.04	0.08	100.00	1.16	0.32	1.12	100.00	22.48
Total sand		28.65				25.11				51.72				28.52			
Total mud <0.063	**<4.00**	0.09	0.30		0.30	1.16	4.40		4.40	0.02	0.03		0.03	0.55	1.89		1.89
Total sample		29.66				26.36				57.22				29.16			
gravel %			3.10				0.34				9.58				0.31		
sand %			96.60				95.26				90.39				97.80		
mud %			0.30				4.40				0.03				1.89		
$CaCO_3$ gravel %			89				0				100				100		
$CaCO_3$ sand %			30				16				32				14		
F & W mean			1.43				2.47										
F & W dev.			0.75				0.52										
F & W skew.			-0.27				-0.27										
F & W kurt.			1.26				1.39										
Inman mean			1.37				2.45				1.07				2.52		
Inman dev.			0.69				0.44				0.84				0.57		
Inman skew.			-0.28				-0.17				-0.25				-0.17		
Inman kurt.			0.96				1.30										
Percentile	5		-0.12				1.16										
	16		0.68				2.01				0.23				1.95		
	25		1.01				2.17										
Median	50		1.56				2.52				1.28				2.61		
	75		1.88				2.76										
	84		2.05				2.88				1.91				3.08		
	95		2.56				3.16										

Outer Bristol Channel Marine Habitat Study - Particle Size Analysis

SAMPLE		OBC71 [+51-05 1264]				OBC72 [+51-05 1265]				OBC73 [+51-05 1266]				OBC74 [+51-05 1267]			
W.gr.mm	Phi	wt.gms	wt.%	cum.%	W.gr.%	wt.gms	wt.%	cum.%	W.gr.%	wt.gms	wt.%	cum.%	W.gr.%	wt.gms	wt.%	cum.%	W.gr.%
	-6.00																
20.00																	
	-4.00																
10.00																	
5.00																	
4.00	-2.00				0.00	0.06			0.00				0.00	0.02			0.00
2.00	-1.00				0.00	0.05			0.00				0.00	0.08			0.00
Total gravel		0.00	0.00			0.11	0.44			0.00	0.00			0.10	0.38		
vcs	-0.50	0.02	0.09			0.02	0.08			0.02	0.08			0.12	0.47		
1.00	0.00	0.02	0.09	0.17	0.17	0.02	0.08	0.16	0.16	0.02	0.08	0.16	0.16	0.20	0.79	1.26	1.26
cs	0.50	0.02	0.09	0.26		0.02	0.08	0.25		0.04	0.16	0.33		0.38	1.50	2.76	
0.50	1.00	0.03	0.13	0.39	0.22	0.01	0.04	0.29	0.12	0.06	0.24	0.57	0.41	0.69	2.72	5.48	4.22
ms	1.50	0.04	0.17	0.56		0.03	0.12	0.41		0.10	0.41	0.98		0.74	2.92	8.40	
0.25	2.00	0.11	0.48	1.04	0.65	0.07	0.29	0.69	0.41	0.41	1.67	2.64	2.07	0.30	1.18	9.59	4.10
fs	2.50	0.24	1.04	2.08		0.21	0.86	1.55		1.28	5.20	7.85		1.06	4.18	13.77	
0.13	3.00	3.78	16.39	18.47	17.43	5.85	23.90	25.45	24.75	5.60	22.76	30.61	27.97	11.20	44.18	57.95	48.36
vfs	3.50	17.81	77.23	95.71		17.55	71.69	97.14		16.45	66.87	97.48		9.91	39.09	97.04	
0.063	4.00	0.99	4.29	100.00	81.53	0.70	2.86	100.00	74.55	0.62	2.52	100.00	69.39	0.75	2.96	100.00	42.05
Total sand		23.06				24.48				24.60				25.35			
Total mud <0.063	<4.00	0.42	1.79		1.79	0.18	0.73		0.73	0.41	1.64		1.64	0.87	3.31		3.31
Total sample		23.48				24.77				25.01				26.32			
gravel %			0.00				0.44				0.00				0.38		
sand %			98.21				98.83				98.36				96.31		
mud %			1.79				0.73				1.64				3.31		
$CaCO_3$ gravel %			0				100				0				100		
$CaCO_3$ sand %			15				14				15				20		
F & W mean			3.17				3.11				3.05				2.89		
F & W dev.			0.22				0.22				0.32				0.55		
F & W skew.			-0.16				-0.11				-0.33				-0.35		
F & W kurt.			1.21				1.09				1.43				2.07		
Inman mean			3.16				3.11				3.03				2.88		
Inman dev.			0.20				0.22				0.29				0.35		
Inman skew.			-0.10				-0.07				-0.26				-0.10		
Inman kurt.			1.00				0.79				1.02				2.59		
Percentile	5		2.69				2.68				2.30				0.93		
	16		2.96				2.89				2.74				2.53		
	25		3.03				2.99				2.91				2.64		
Median	50		3.18				3.12				3.10				2.91		
	75		3.30				3.28				3.24				3.13		
	84		3.36				3.32				3.31				3.22		
	95		3.49				3.45				3.45				3.41		

Outer Bristol Channel Marine Habitat Study - Particle Size Analysis

SAMPLE		OBC75 [+51-05 1268]				OBC76 [+51-05 1269]				OBC77 [+51-05 1270]				OBC78 [+51-05 1271]			
W.gr.mm	Phi	wt.gms	wt.%	cum.%	W.gr.%	wt.gms	wt.%	cum.%	W.gr.%	wt.gms	wt.%	cum.%	W.gr.%	wt.gms	wt. %	cum. %	W.gr.%
	-6.00																
20.00																	
	-4.00																
10.00																	
5.00										1.73							
4.00	-2.00				0.00				0.00	0.50			0.00	0.09			0.00
2.00	-1.00				0.00				0.00	2.40			0.00	0.68			0.00
Total gravel		0.00	0.00			0.00	0.00			4.63	18.31			0.77	2.33		
vcs	-0.50					0.02	0.15			0.82	4.02			0.39	1.27		
1.00	0.00	0.02	0.16		0.16	0.01	0.08	0.23	0.23	0.32	1.57	5.59	5.59	0.38	1.24	2.51	2.51
cs	0.50	0.03	0.25	0.41		0.03	0.23	0.46		0.28	1.37	6.96		0.71	2.31	4.82	
0.50	1.00	0.04	0.33	0.74	0.58	0.04	0.31	0.77	0.54	0.20	0.98	7.94	2.35	2.01	6.55	11.37	8.86
ms	1.50	0.08	0.66	1.40		0.04	0.31	1.07		0.20	0.98	8.92		7.33	23.88	35.26	
0.25	2.00	0.26	2.14	3.54	2.80	0.12	0.92	1.99	1.22	0.71	3.48	12.40	4.46	14.51	47.28	82.54	71.16
fs	2.50	1.85	15.24	18.78		0.64	4.90	6.89		7.33	35.93	48.33		3.71	12.09	94.62	
0.13	3.00	6.53	53.79	72.57	69.03	5.00	38.26	45.14	43.15	9.20	45.10	93.43	81.03	1.02	3.32	97.95	15.41
vfs	3.50	3.08	25.37	97.94		6.48	49.58	94.72		1.20	5.88	99.31		0.46	1.50	99.45	
0.063	4.00	0.25	2.06	100.00	27.43	0.69	5.28	100.00	54.86	0.14	0.69	100.00	6.57	0.17	0.55	100.00	2.05
Total sand		12.14				13.07				20.40				30.69			
Total mud <0.063	<4.00	1.29	9.61		9.61	0.68	4.95		4.95	0.26	1.03		1.03	1.60	4.84		4.84
Total sample		13.43				13.75				25.29				33.06			
gravel %			0.00			0.00				18.31				2.33			
sand %			90.39			95.05				80.66				92.83			
mud %			9.61			4.95				1.03				4.84			
$CaCO_3$ gravel %			0			100				96				40			
$CaCO_3$ sand %			22			27				21				23			
F & W mean			2.80							2.48				1.61			
F & W dev.			0.36							0.67				0.54			
F & W skew.			-0.08							-0.41				-0.11			
F & W kurt.			1.20							2.60				1.41			
Inman mean			2.80			3.00				2.46				1.60			
Inman dev.			0.34			0.32				0.37				0.47			
Inman skew.			-0.04			-0.11				-0.16				-0.12			
Inman kurt.			0.93							3.36				1.18			
Percentile	5		2.09							-0.15				0.53			
	16		2.46			2.68				2.09				1.13			
	25		2.58							2.21				1.32			
Median	50		2.81			3.03				2.52				1.65			
	75		3.02							2.72				1.91			
	84		3.13			3.31				2.83				2.06			
	95		3.38							3.08				2.56			

Outer Bristol Channel Marine Habitat Study - Particle Size Analysis

SAMPLE		OBC79 [+51-05 1272]				OBC80 [+51-05 1273]				OBC81 [+51-05 1274]				OBC82 [+51-05 1275]			
W.gr.mm	Phi	wt.gms	wt.%	cum.%	W.gr.%	wt.gms	wt.%	cum.%	W.gr.%	wt.gms	wt.%	cum.%	W.gr.%	wt.gms	wt.%	cum.%	W.gr.%
	-6.00																
20.00																	
	-4.00																
10.00																	
5.00		0.08				4.90											
4.00	-2.00	0.00			0.00	1.51			0.00	0.07			0.00	0.16			0.00
2.00	-1.00	0.21			0.00	12.10			0.00	0.23			0.00	0.03			0.00
Total gravel		0.29	0.96			18.51	29.62			0.30	1.03			0.19	0.69		
vcs	-0.50	0.12	0.40			4.91	11.54			0.42	1.47			0.03	0.12		
1.00	0.00	0.23	0.77	1.18	1.18	4.92	11.56	23.10	23.10	0.49	1.71	3.18	3.18	0.05	0.20	0.32	0.32
cs	0.50	0.71	2.39	3.57		6.11	14.36	37.45		0.80	2.79	5.97		0.03	0.12	0.44	
0.50	1.00	2.08	7.00	10.57	9.39	8.20	19.27	56.72	33.62	2.68	9.35	15.32	12.14	0.08	0.32	0.76	0.44
ms	1.50	5.01	16.86	27.42		7.48	17.58	74.30		7.05	24.60	39.92		0.27	1.08	1.83	
0.25	2.00	10.70	36.00	63.43	52.86	8.03	18.87	93.16	36.44	11.42	39.85	79.76	64.45	4.70	18.75	20.58	19.82
fs	2.50	8.85	29.78	93.20		2.30	5.40	98.57		4.93	17.20	96.96		14.19	56.60	77.18	
0.13	3.00	1.49	5.01	98.22	34.79	0.32	0.75	99.32	6.16	0.65	2.27	99.23	19.47	4.92	19.63	96.81	76.23
vfs	3.50	0.40	1.35	99.56		0.20	0.47	99.79		0.19	0.66	99.90		0.70	2.79	99.60	
0.063	4.00	0.13	0.44	100.00	1.78	0.09	0.21	100.00	0.68	0.03	0.10	100.00	0.77	0.10	0.40	100.00	3.19
Total sand		29.72				42.56				28.66				25.07			
Total mud <0.063	<4.00	0.19	0.63		0.63	1.42	2.27		2.27	0.13	0.45		0.45	2.21	8.05		8.05
Total sample		30.20				62.49				29.09				27.47			
gravel %			0.96				29.62				1.03				0.69		
sand %			98.41				68.11				98.52				91.26		
mud %			0.63				2.27				0.45				8.05		
$CaCO_3$ gravel %			83				15				40				100		
$CaCO_3$ sand %			11				15				9				11		
F & W mean			1.77								1.57				2.27		
F & W dev.			0.58								0.58				0.35		
F & W skew.			-0.15								-0.19				0.02		
F & W kurt.			1.16								1.18				1.10		
Inman mean			1.75				0.72				1.55				2.27		
Inman dev.			0.55				0.99				0.54				0.34		
Inman skew.			-0.12				-0.13				-0.14				0.00		
Inman kurt.			0.84								0.91				0.78		
Percentile	5		0.62								0.36				1.69		
	16		1.20				-0.27				1.01				1.93		
	25		1.43								1.21				2.04		
Median	50		1.81				0.84				1.62				2.27		
	75		2.14								1.92				2.49		
	84		2.29				1.70				2.08				2.61		
	95		2.63								2.40				2.90		

Outer Bristol Channel Marine Habitat Study - Particle Size Analysis

SAMPLE		OBC83 [+51-05 1276]				OBC84 [+51-05 1277]				OBC85 [+51-05 1278]				OBC86 [+51-05 1279]			
W.gr.mm	Phi	wt.gms	wt.%	cum.%	W.gr.%	wt.gms	wt.%	cum.%	W.gr.%	wt.gms	wt.%	cum.%	W.gr.%	wt.gms	wt.%	cum.%	W.gr.%
	-6.00																
20.00																	
	-4.00																
10.00																	
5.00										0.08							
4.00	-2.00				0.00				0.00	0.00			0.00				0.00
2.00	-1.00				0.00				0.00	0.04			0.00	0.08			0.00
Total gravel		0.00	0.00			0.00	0.00			0.12	0.51			0.08	0.33		
vcs	-0.50									0.04	0.17			0.04	0.16		
1.00	0.00	0.01	0.04		0.04	0.01	0.04		0.04	0.06	0.26	0.43	0.43	0.12	0.49	0.66	0.66
cs	0.50	0.34	1.32	1.36		0.21	0.84	0.88		0.11	0.47	0.90		0.19	0.78	1.44	
0.50	1.00	4.08	15.84	17.20	17.16	2.35	9.43	10.31	10.27	0.29	1.24	2.14	1.71	0.34	1.40	2.84	2.18
ms	1.50	8.19	31.79	48.99		11.51	46.19	56.50		0.78	3.33	5.47		0.53	2.18	5.02	
0.25	2.00	8.59	33.35	82.34	65.14	6.52	26.16	82.66	72.35	4.53	19.35	24.82	22.68	1.38	5.68	10.71	7.87
fs	2.50	4.28	16.61	98.95		3.49	14.00	96.67		13.99	59.76	84.58		11.35	46.75	57.45	
0.13	3.00	0.24	0.93	99.88	17.55	0.77	3.09	99.76	17.09	3.36	14.35	98.93	74.11	9.70	39.95	97.41	86.70
vfs	3.50	0.02	0.08	99.96		0.05	0.20	99.96		0.23	0.98	99.91		0.55	2.27	99.67	
0.063	4.00	0.01	0.04	100.00	0.12	0.01	0.04	100.00	0.24	0.02	0.09	100.00	1.07	0.08	0.33	100.00	2.59
Total sand		25.76				24.92				23.41				24.28			
Total mud <0.063	<4.00	0.13	0.50		0.50	0.00	0.00		0.00	0.22	0.93		0.93	0.15	0.61		0.61
Total sample		25.89				24.92				23.75				24.51			
gravel %			0.00				0.00				0.51				0.33		
sand %			99.50				100.00				98.56				99.06		
mud %			0.50				0.00				0.93				0.61		
$CaCO_3$ gravel %			0				0				100				100		
$CaCO_3$ sand %			9				9				12				15		
F & W mean			1.50				1.51				2.17				2.41		
F & W dev.			0.49				0.47				0.36				0.37		
F & W skew.			-0.03				0.25				-0.14				-0.22		
F & W kurt.			0.85				1.02				1.33				1.34		
Inman mean			1.50				1.56				2.16				2.40		
Inman dev.			0.52				0.47				0.33				0.31		
Inman skew.			-0.03				0.27				-0.12				-0.10		
Inman kurt.			0.49				0.69				0.92				1.27		
Percentile	5		0.72				0.82				1.46				1.49		
	16		0.98				1.09				1.83				2.09		
	25		1.14				1.20				2.01				2.20		
Median	50		1.51				1.43				2.20				2.43		
	75		1.88				1.83				2.40				2.63		
	84		2.01				2.02				2.49				2.71		
	95		2.25				2.39				2.73				2.90		

Outer Bristol Channel Marine Habitat Study - Particle Size Analysis

SAMPLE		OBC87 [+51-05 1280]				OBC88 [+51-05 1281]				OBC89 [+51-05 1282]				OBC90 [+51-05 1283]			
W.gr.mm	Phi	wt.gms	wt.%	cum.%	W.gr.%	wt.gms	wt.%	cum.%	W.gr.%	wt.gms	wt.%	cum.%	W.gr.%	wt.gms	wt.%	cum.%	W.gr.%
	-6.00																
20.00																	
	-4.00																
10.00																	
5.00														0.24			
4.00	-2.00	0.20			0.00				0.00				0.00	0.00			0.00
2.00	-1.00	0.20			0.00				0.00				0.00	0.20			0.00
Total gravel		0.40	1.40			0.00	0.00			0.00	0.00			0.44	1.56		
vcs	-0.50	0.19	0.68			0.02	0.07			0.20	0.67			0.04	0.14		
1.00	0.00	0.28	1.00	1.67	1.67	0.04	0.15	0.22	0.22	0.22	0.74	1.42	1.42	0.09	0.33	0.47	0.47
cs	0.50	1.00	3.56	5.23		0.10	0.37	0.59		0.47	1.59	3.00		0.11	0.40	0.87	
0.50	1.00	7.32	26.06	31.29	29.62	0.39	1.44	2.03	1.81	1.33	4.49	7.49	6.07	0.35	1.26	2.13	1.66
ms	1.50	12.52	44.57	75.86		1.30	4.81	6.84		5.40	18.21	25.70		3.01	10.87	13.00	
0.25	2.00	3.64	12.96	88.82	57.53	1.92	7.10	13.94	11.90	11.27	38.01	63.71	56.22	11.83	42.72	55.72	53.59
fs	2.50	1.62	5.77	94.59		3.01	11.13	25.06		8.72	29.41	93.12		8.50	30.70	86.42	
0.13	3.00	1.12	3.99	98.58	9.75	8.78	32.46	57.52	43.59	1.70	5.73	98.85	35.14	3.08	11.12	97.54	41.82
vfs	3.50	0.36	1.28	99.86		10.91	40.33	97.86		0.32	1.08	99.93		0.64	2.31	99.86	
0.063	4.00	0.04	0.14	100.00	1.42	0.58	2.14	100.00	42.48	0.02	0.07	100.00	1.15	0.04	0.14	100.00	2.46
Total sand		28.09				27.05				29.65				27.69			
Total mud <0.063	<4.00	0.01	0.04		0.04	0.08	0.29		0.29	0.02	0.07		0.07	0.16	0.57		0.57
Total sample		28.50				27.13				29.67				28.29			
gravel %			1.40			0.00				0.00				1.56			
sand %			98.56			99.71				99.93				97.87			
mud %			0.04			0.29				0.07				0.57			
$CaCO_3$ gravel %			95			0				0				100			
$CaCO_3$ sand %			11			15				10				11			
F & W mean			1.26			2.74				1.79				1.99			
F & W dev.			0.56			0.59				0.52				0.47			
F & W skew.			0.23			-0.45				-0.09				0.10			
F & W kurt.			1.44			1.29				1.14				1.08			
Inman mean			1.29			2.66				1.79				2.01			
Inman dev.			0.51			0.56				0.50				0.46			
Inman skew.			0.17			-0.41				-0.05				0.12			
Inman kurt.			1.02			0.80				0.83				0.77			
Percentile	5		0.48			1.38				0.79				1.21			
	16		0.78			2.10				1.29				1.55			
	25		0.91			2.49				1.49				1.68			
Median	50		1.20			2.89				1.81				1.95			
	75		1.49			3.13				2.14				2.29			
	84		1.79			3.22				2.28				2.46			
	95		2.52			3.40				2.60				2.82			

Outer Bristol Channel Marine Habitat Study - Particle Size Analysis

SAMPLE		OBC91 [+51-05 1284]				OBC92 [+51-05 1285]				OBC93 [+51-05 1286]				OBC94 [+51-05 1287]			
W.gr.mm	Phi	wt.gms	wt.%	cum.%	W.gr.%	wt.gms	wt.%	cum.%	W.gr.%	wt.gms	wt.%	cum.%	W.gr.%	wt.gms	wt.%	cum.%	W.gr.%
	-6.00																
20.00																	
	-4.00																
10.00																	
5.00																	
4.00	-2.00				0.00				0.00				0.00				0.00
2.00	-1.00	0.03			0.00				0.00	0.17			0.00				0.00
Total gravel		0.03	0.11			0.00	0.00			0.17	0.57			0.00	0.00		
vcs	-0.50	0.03	0.11							0.08	0.27						
1.00	0.00	0.04	0.15	0.25	0.25				0.00	0.10	0.34	0.61	0.61				0.00
cs	0.50	0.08	0.29	0.55		0.02	0.08			0.37	1.26	1.87		0.02	0.08		
0.50	1.00	0.61	2.22	2.77	2.51	0.10	0.38	0.45	0.45	2.11	7.17	9.04	8.43	0.61	2.47	2.55	2.55
ms	1.50	4.05	14.74	17.51		1.19	4.50	4.95		7.10	24.13	33.16		2.70	10.92	13.47	
0.25	2.00	7.66	27.88	45.39	42.63	7.87	29.74	34.69	34.24	16.10	54.71	87.87	78.83	10.56	42.70	56.17	53.62
fs	2.50	12.57	45.76	91.15		10.58	39.98	74.68		3.26	11.08	98.95		10.29	41.61	97.78	
0.13	3.00	2.30	8.37	99.53	54.13	3.41	12.89	87.57	52.87	0.29	0.99	99.93	12.06	0.43	1.74	99.51	43.35
vfs	3.50	0.11	0.40	99.93		3.09	11.68	99.24		0.02	0.07	100.00		0.09	0.36	99.88	
0.063	4.00	0.02	0.07	100.00	0.47	0.20	0.76	100.00	12.43	0.00	0.00	100.00	0.07	0.03	0.12	100.00	0.49
Total sand		27.47				26.46				29.43				24.73			
Total mud <0.063	<4.00	0.00	0.00		0.00	0.01	0.04		0.04	0.00	0.00		0.00	0.18	0.72		0.72
Total sample		27.50				26.47				29.60				24.91			
gravel %			0.11				0.00				0.57				0.00		
sand %			99.89				99.96				99.43				99.28		
mud %			0.00				0.04				0.00				0.72		
$CaCO_3$ gravel %			0				0				0				0		
$CaCO_3$ sand %			10				12				8				8		
F & W mean			1.97				2.26				1.60				1.90		
F & W dev.			0.45				0.52				0.40				0.35		
F & W skew.			-0.21				0.20				-0.17				-0.18		
F & W kurt.			1.00				1.13				1.16				1.12		
Inman mean			1.94				2.30				1.58				1.89		
Inman dev.			0.46				0.53				0.38				0.34		
Inman skew.			-0.21				0.21				-0.16				-0.13		
Inman kurt.			0.62				0.58				0.86				0.79		
Percentile	5		1.14				1.51				0.80				1.19		
	16		1.48				1.77				1.20				1.55		
	25		1.68				1.90				1.36				1.68		
Median	50		2.03				2.19				1.64				1.93		
	75		2.28				2.51				1.86				2.12		
	84		2.39				2.83				1.96				2.22		
	95		2.61				3.19				2.21				2.39		

Outer Bristol Channel Marine Habitat Study - Particle Size Analysis

SAMPLE		OBC95 [+51-05 1288]				OBC96 [+51-05 1289]				OBC97 [+51-05 1290]				OBC98 [+51-05 1291]			
W.gr.mm	Phi	wt.gms	wt.%	cum.%	W.gr.%	wt.gms	wt.%	cum.%	W.gr.%	wt.gms	wt.%	cum.%	W.gr.%	wt.gms	wt.%	cum.%	W.gr.%
	-6.00																
20.00																	
	-4.00																
10.00										0.81				4.17			
5.00						0.11				1.09				13.15			
4.00	-2.00					0.00				1.05				3.47			
2.00	-1.00					0.12				6.54				11.20			
Total gravel		0.00	0.00			0.23	0.90			9.49	19.36			31.99	56.96		
vcs	-0.50					0.23	1.25			2.60	8.32			1.52	6.46		
1.00	0.00				0.00	0.29	1.58	2.83	2.83	2.27	7.26	15.58	15.58	1.24	5.27	11.73	11.73
cs	0.50	0.01	0.04			0.42	2.29	5.11		2.31	7.39	22.97		0.76	3.23	14.96	
0.50	1.00	0.03	0.12	0.16	0.16	0.61	3.32	8.43	5.60	2.94	9.40	32.37	16.79	1.38	5.86	20.82	9.09
ms	1.50	0.69	2.74	2.90		0.71	3.86	12.30		2.88	9.21	41.59		1.59	6.76	27.58	
0.25	2.00	14.69	58.27	61.17	61.01	1.66	9.03	21.33	12.89	3.97	12.70	54.29	21.91	4.12	17.51	45.09	24.27
fs	2.50	9.47	37.56	98.73		9.66	52.56	73.88		8.36	26.74	81.03		9.93	42.20	87.29	
0.13	3.00	0.24	0.95	99.68	38.52	3.60	19.59	93.47	72.14	3.93	12.57	93.60	39.32	2.61	11.09	98.39	53.29
vfs	3.50	0.06	0.24	99.92		0.70	3.81	97.28		1.32	4.22	97.82		0.30	1.27	99.66	
0.063	4.00	0.02	0.08	100.00	0.32	0.50	2.72	100.00	6.53	0.68	2.18	100.00	6.40	0.08	0.34	100.00	1.61
Total sand		25.21				18.38				31.26				23.53			
Total mud <0.063	<4.00	0.40	1.56			6.82	26.82		0.00	8.28	16.89		16.89	0.64	1.14		1.14
Total sample		25.61				25.43				49.03				56.16			
gravel %			0.00			0.90				19.36				56.96			
sand %			98.44			72.28				63.75				41.90			
mud %			1.56			26.82				16.89				1.14			
$CaCO_3$ gravel %			0			65				31				26			
$CaCO_3$ sand %			8			15				18				15			
F & W mean			1.95			2.24											
F & W dev.			0.24			0.66											
F & W skew.			0.05			-0.27											
F & W kurt.			1.04			2.20											
Inman mean			1.95			2.22				1.31				1.52			
Inman dev.			0.24			0.50				1.29				0.93			
Inman skew.			0.04			-0.17				-0.43				-0.58			
Inman kurt.			0.65			1.72											
Percentile	5		1.57			0.47											
	16		1.71			1.72				0.02				0.59			
	25		1.80			2.03											
Median	50		1.94			2.30				1.86				2.06			
	75		2.11			2.53											
	84		2.19			2.71				2.59				2.45			
	95		2.36			3.16											

Outer Bristol Channel Marine Habitat Study - Particle Size Analysis

SAMPLE		OBC99 [+51-05 1292]				OBC100 [+51-05 1293]				OBC101 [+51-05 1294]				OBC102 [+51-05 1295]			
W.gr.mm	Phi	wt.gms	wt.%	cum.%	W.gr.%	wt.gms	wt.%	cum.%	W.gr.%	wt.gms	wt.%	cum.%	W.gr.%	wt.gms	wt.%	cum.%	W.gr.%
	-6.00																
20.00						5.08											
	-4.00					0.00											
10.00						22.00											
5.00		1.50				32.01											
4.00	-2.00	1.00			0.00	5.94			0.00				0.00				0.00
2.00	-1.00	2.92			0.00	14.30			0.00	0.04			0.00				0.00
Total gravel		5.42	15.87			79.33	47.35			0.04	0.16			0.00	0.00		
vcs	-0.50	0.46	1.60			3.76	4.26			0.05	0.20						
1.00	0.00	0.43	1.50	3.10	3.10	2.80	3.17	7.44	7.44	0.04	0.16	0.35	0.35	0.02	0.08		0.08
cs	0.50	0.53	1.85	4.95		2.52	2.86	10.29		0.09	0.35	0.71		0.12	0.46	0.53	
0.50	1.00	1.12	3.91	8.86	5.75	3.64	4.13	14.42	6.98	0.31	1.22	1.93	1.58	1.58	6.00	6.53	6.46
ms	1.50	4.18	14.57	23.43		5.12	5.80	20.23		2.82	11.12	13.05		9.65	36.65	43.18	
0.25	2.00	12.81	44.67	68.10	59.24	44.64	50.61	70.84	56.42	12.98	51.18	64.24	62.30	12.81	48.65	91.83	85.30
fs	2.50	8.65	30.16	98.26		23.48	26.62	97.46		8.38	33.04	97.28		2.10	7.98	99.81	
0.13	3.00	0.39	1.36	99.62	31.52	1.76	2.00	99.46	28.62	0.61	2.41	99.68	35.45	0.04	0.15	99.96	8.13
vfs	3.50	0.08	0.28	99.90		0.40	0.45	99.91		0.06	0.24	99.92		0.01	0.04	100.00	
0.063	4.00	0.03	0.10	100.00	0.38	0.08	0.09	100.00	0.54	0.02	0.08	100.00	0.32	0.00	0.00	100.00	0.04
Total sand		28.68				88.20				25.36				26.33			
Total mud <0.063	<4.00	0.05	0.15		0.15	0.00	0.00		0.00	0.02	0.08		0.08	0.00	0.00		0.00
Total sample		34.15				167.53				25.42				26.33			
gravel %			15.87				47.35				0.16				0.00		
sand %			83.98				52.65				99.76				100.00		
mud %			0.15				0.00				0.08				0.00		
$CaCO_3$ gravel %			20				10				0				0		
$CaCO_3$ sand %			11				11				10				8		
F & W mean			1.75				1.70				1.88				1.54		
F & W dev.			0.50				0.67				0.34				0.35		
F & W skew.			-0.27				-0.42				-0.07				-0.03		
F & W kurt.			1.39				2.29				1.12				1.03		
Inman mean			1.73				1.66				1.88				1.54		
Inman dev.			0.43				0.51				0.33				0.34		
Inman skew.			-0.16				-0.29				-0.02				0.00		
Inman kurt.			1.16				1.71				0.82				0.71		
Percentile	5		0.51				-0.34				1.22				0.93		
	16		1.30				1.15				1.55				1.20		
	25		1.52				1.56				1.66				1.31		
Median	50		1.80				1.80				1.88				1.54		
	75		2.07				2.05				2.09				1.77		
	84		2.16				2.16				2.20				1.88		
	95		2.37				2.40				2.40				2.09		

Outer Bristol Channel Marine Habitat Study - Particle Size Analysis

SAMPLE		OBC103 [+51-05 1296]				OBC104 [+51-05 1297]				OBC105 [+51-05 1298]				OBC106 [+51-05 1299]			
W.gr.mm	Phi	wt.gms	wt.%	cum.%	W.gr.%	wt.gms	wt.%	cum.%	W.gr.%	wt.gms	wt.%	cum.%	W.gr.%	wt.gms	wt.%	cum.%	W.gr.%
	-6.00																
20.00																	
	-4.00																
10.00																	
5.00																	
4.00	-2.00	0.17			0.00				0.00				0.00				0.00
2.00	-1.00	1.57			0.00	0.28			0.00	0.09			0.00				0.00
Total gravel		1.74	6.68			0.28	1.03			0.09	0.37			0.00	0.00		
vcs	-0.50	0.40	1.65			0.23	0.85			0.05	0.21			0.09	0.33		
1.00	0.00	0.31	1.28	2.92	2.92	0.43	1.60	2.45	2.45	0.03	0.12	0.33	0.33	0.09	0.33	0.66	0.66
cs	0.50	0.47	1.93	4.85		0.61	2.26	4.71		0.04	0.17	0.50		0.18	0.66	1.31	
0.50	1.00	1.16	4.77	9.63	6.71	1.29	4.79	9.50	7.05	0.39	1.62	2.12	1.79	1.69	6.15	7.47	6.81
ms	1.50	2.98	12.26	21.88		4.60	17.07	26.58		4.00	16.63	18.74		9.62	35.03	42.50	
0.25	2.00	16.22	66.72	88.61	78.98	16.79	62.32	88.90	79.40	17.74	73.73	92.48	90.36	13.11	47.74	90.24	82.77
fs	2.50	2.68	11.02	99.63		2.89	10.73	99.63		1.71	7.11	99.58		2.52	9.18	99.42	
0.13	3.00	0.08	0.33	99.96	11.35	0.09	0.33	99.96	11.06	0.09	0.37	99.96	7.48	0.13	0.47	99.89	9.65
vfs	3.50	0.01	0.04	100.00		0.01	0.04	100.00		0.01	0.04	100.00		0.02	0.07	99.96	
0.063	4.00	0.00	0.00	100.00	0.04	0.00	0.00	100.00	0.04	0.00	0.00	100.00	0.04	0.01	0.04	100.00	0.11
Total sand		24.31				26.94				24.06				27.46			
Total mud <0.063	<4.00	0.00	0.00		0.00	0.00	0.00		0.00	0.00	0.00		0.00	0.00	0.00		0.00
Total sample		26.05				27.22				24.15				27.46			
gravel %			6.68				1.03				0.37				0.00		
sand %			93.32				98.97				99.63				100.00		
mud %			0.00				0.00				0.00				0.00		
$CaCO_3$ gravel %			10				32				0				0		
$CaCO_3$ sand %			8				8				8				8		
F & W mean			1.66				1.63				1.69				1.56		
F & W dev.			0.41				0.42				0.25				0.37		
F & W skew.			-0.35				-0.35				-0.12				-0.11		
F & W kurt.			1.96				1.64				1.35				1.07		
Inman mean			1.64				1.60				1.68				1.55		
Inman dev.			0.33				0.37				0.22				0.36		
Inman skew.			-0.23				-0.26				-0.09				-0.10		
Inman kurt.			1.51				1.19				1.09				0.76		
Percentile	5		0.52				0.54				1.17				0.88		
	16		1.31				1.23				1.46				1.19		
	25		1.54				1.46				1.55				1.31		
Median	50		1.71				1.69				1.70				1.58		
	75		1.88				1.86				1.83				1.79		
	84		1.96				1.96				1.90				1.90		
	95		2.15				2.14				2.09				2.13		

Outer Bristol Channel Marine Habitat Study - Particle Size Analysis

SAMPLE		OBC107 [+51-05 1300]				OBC108 [+51-05 1301]				OBC109 [+51-05 1302]				OBC110 [+51-05 1303]			
W.gr.mm	Phi	wt.gms	wt.%	cum.%	W.gr.%	wt.gms	wt.%	cum.%	W.gr.%	wt.gms	wt.%	cum.%	W.gr.%	wt.gms	wt.%	cum.%	W.gr.%
	-6.00																
20.00																	
	-4.00																
10.00						0.18				1.50				15.79			
5.00						0.83				3.17				15.70			
4.00	-2.00				0.00	0.00			0.00	0.71			0.00	3.08			0.00
2.00	-1.00				0.00	0.27			0.00	3.18			0.00	7.12			0.00
Total gravel		0.00	0.00			1.28	4.27			8.56	22.47			41.69	43.87		
vcs	-0.50	0.09	0.33			0.12	0.42			1.46	4.95			2.49	4.67		
1.00	0.00	0.07	0.25	0.58	0.58	0.14	0.49	0.92	0.92	2.26	7.66	12.60	12.60	1.82	3.41	8.08	8.08
cs	0.50	0.09	0.33	0.90		0.34	1.20	2.12		3.41	11.55	24.15		3.82	7.16	15.24	
0.50	1.00	1.18	4.27	5.17	4.59	3.26	11.52	13.64	12.73	5.46	18.50	42.65	30.05	7.16	13.43	28.67	20.59
ms	1.50	9.77	35.32	40.49		11.30	39.94	53.59		2.89	9.79	52.44		15.02	28.16	56.83	
0.25	2.00	15.05	54.41	94.90	89.73	10.59	37.43	91.02	77.38	12.11	41.02	93.46	50.81	16.78	31.46	88.30	59.63
fs	2.50	1.27	4.59	99.49		2.29	8.09	99.12		1.80	6.10	99.56		5.98	11.21	99.51	
0.13	3.00	0.11	0.40	99.89	4.99	0.21	0.74	99.86	8.84	0.09	0.30	99.86	6.40	0.22	0.41	99.92	11.63
vfs	3.50	0.02	0.07	99.96		0.03	0.11	99.96		0.03	0.10	99.97		0.02	0.04	99.96	
0.063	4.00	0.01	0.04	100.00	0.11	0.01	0.04	100.00	0.14	0.01	0.03	100.00	0.14	0.02	0.04	100.00	0.08
Total sand		27.66				28.29				29.52				53.33			
Total mud <0.063	<4.00	0.00	0.00		0.00	0.41	1.37		1.37	0.02	0.05		0.05	0.00	0.00		0.00
Total sample		27.66				29.98				38.10				95.02			
gravel %			0.00				4.27				22.47				43.87		
sand %			100.00				94.36				77.48				56.13		
mud %			0.00				1.37				0.05				0.00		
$CaCO_3$ gravel %			0				32				4				7		
$CaCO_3$ sand %			8				10				16				13		
F & W mean			1.53				1.47				0.77				1.28		
F & W dev.			0.31				0.43				0.62				0.73		
F & W skew.			-0.09				-0.05				-0.32				-0.33		
F & W kurt.			1.00				1.08				0.87				1.24		
Inman mean			1.53				1.47				0.71				1.22		
Inman dev.			0.31				0.42				0.62				0.68		
Inman skew.			-0.08				-0.04				-0.30				-0.25		
Inman kurt.			0.67				0.75				0.67				0.89		
Percentile	5		0.99				0.71				-0.49				-0.41		
	16		1.22				1.05				0.09				0.54		
	25		1.32				1.19				0.24				0.89		
Median	50		1.55				1.48				0.89				1.39		
	75		1.74				1.74				1.21				1.74		
	84		1.83				1.88				1.32				1.90		
	95		2.01				2.16				1.57				2.16		

Outer Bristol Channel Marine Habitat Study - Particle Size Analysis

SAMPLE		OBC111 [+51-05 1304]				OBC112 [+51-05 1305]				OBC113 [+51-05 1306]				OBC114 [+51-05 1307]			
W.gr.mm	Phi	wt.gms	wt.%	cum.%	W.gr.%	wt.gms	wt.%	cum.%	W.gr.%	wt.gms	wt.%	cum.%	W.gr.%	wt.gms	wt.%	cum.%	W.gr.%
	-6.00																
20.00																	
	-4.00																
10.00																	
5.00						1.69											
4.00	-2.00				0.00	0.10			0.00				0.00				0.00
2.00	-1.00	1.68			0.00	1.06			0.00				0.00				0.00
Total gravel		1.68	5.48			2.85	9.23			0.00	0.00			0.00	0.00		
vcs	-0.50	2.81	9.69			0.41	1.46			0.03	0.12						
1.00	0.00	2.61	9.00	18.69	18.69	0.63	2.25	3.71	3.71	0.06	0.23	0.35	0.35				0.00
cs	0.50	1.39	4.79	23.48		1.30	4.64	8.35		0.07	0.27	0.62		0.02	0.08		
0.50	1.00	2.95	10.17	33.66	14.97	5.18	18.47	26.82	23.11	0.39	1.51	2.12	1.78	0.08	0.33	0.41	0.41
ms	1.50	8.49	29.28	62.93		7.70	27.46	54.28		8.36	32.29	34.41		1.32	5.37	5.77	
0.25	2.00	9.33	32.17	95.10	61.45	9.88	35.24	89.51	62.70	14.68	56.70	91.12	88.99	12.50	50.83	56.61	56.20
fs	2.50	1.30	4.48	99.59		2.57	9.17	98.68		2.11	8.15	99.27		10.39	42.25	98.86	
0.13	3.00	0.11	0.38	99.97	4.86	0.25	0.89	99.57	10.06	0.17	0.66	99.92	8.81	0.25	1.02	99.88	43.27
vfs	3.50	0.01	0.03	100.00		0.10	0.36	99.93		0.02	0.08	100.00		0.02	0.08	99.96	
0.063	4.00	0.00	0.00	100.00	0.03	0.02	0.07	100.00	0.43	0.00	0.00	100.00	0.08	0.01	0.04	100.00	0.12
Total sand		29.00				28.04				25.89				24.59			
Total mud <0.063	<4.00	0.00	0.00		0.00	0.00	0.00		0.00	0.03	0.12		0.12	0.00	0.00		0.00
Total sample		30.68				30.89				25.92				24.59			
gravel %			5.48				9.23				0.00				0.00		
sand %			94.52				90.77				99.88				100.00		
mud %			0.00				0.00				0.12				0.00		
$CaCO_3$ gravel %			6				15				0				0		
$CaCO_3$ sand %			14				20				10				10		
F & W mean							1.36				1.62				1.95		
F & W dev.							0.59				0.30				0.26		
F & W skew.							-0.18				0.01				-0.15		
F & W kurt.							1.06				1.03				1.04		
Inman mean			0.84				1.34				1.62				1.94		
Inman dev.			0.94				0.57				0.30				0.26		
Inman skew.			-0.49				-0.15				-0.02				-0.15		
Inman kurt.							0.79				0.71				0.71		
Percentile	5						0.19				1.13				1.47		
	16		-0.10				0.77				1.32				1.68		
	25						0.97				1.41				1.77		
Median	50		1.29				1.42				1.62				1.98		
	75						1.75				1.81				2.12		
	84		1.77				1.90				1.91				2.20		
	95						2.21				2.14				2.36		

Outer Bristol Channel Marine Habitat Study - Particle Size Analysis

SAMPLE		OBC115 [+51-05 1308]				OBC116 [+51-05 1309]				OBC117 [+51-05 1310]				OBC118 [+51-05 1311]			
W.gr.mm	Phi	wt.gms	wt.%	cum.%	W.gr.%	wt.gms	wt.%	cum.%	W.gr.%	wt.gms	wt.%	cum.%	W.gr.%	wt.gms	wt.%	cum.%	W.gr.%
	-6.00																
20.00						3.71											
	-4.00					5.29											
10.00						12.90											
5.00						12.97				1.63				4.81			
4.00	-2.00				0.00	3.78			0.00	0.08			0.00	2.80			0.00
2.00	-1.00				0.00	4.52			0.00	2.86			0.00	3.53			0.00
Total gravel		0.00	0.00			43.17	22.95			4.57	12.58			11.14	20.04		
vcs	-0.50					0.68	0.47			2.20	6.93			0.54	1.24		
1.00	0.00				0.00	0.68	0.47	0.94	0.94	1.93	6.08	13.01	13.01	0.28	0.64	1.88	1.88
cs	0.50					1.32	0.91	1.85		2.71	8.54	21.54		0.48	1.10	2.97	
0.50	1.00	0.07	0.27		0.27	10.12	6.98	8.83	7.89	6.70	21.10	42.65	29.64	2.40	5.49	8.46	6.59
ms	1.50	0.26	0.99	1.25		38.16	26.32	35.15		9.77	30.77	73.42		8.46	19.35	27.81	
0.25	2.00	4.81	18.25	19.50	19.23	70.92	48.92	84.08	75.25	6.70	21.10	94.52	51.87	25.28	57.82	85.64	77.17
fs	2.50	20.57	78.03	97.53		20.44	14.10	98.18		1.56	4.91	99.43		5.80	13.27	98.90	
0.13	3.00	0.63	2.39	99.92	80.42	2.40	1.66	99.83	15.76	0.16	0.50	99.94	5.42	0.42	0.96	99.86	14.23
vfs	3.50	0.02	0.08	100.00		0.20	0.14	99.97		0.02	0.06	100.00		0.04	0.09	99.95	
0.063	4.00	0.00	0.00	100.00	0.08	0.04	0.03	100.00	0.17	0.00	0.00	100.00	0.06	0.02	0.05	100.00	0.14
Total sand		26.36				144.96				31.75				43.72			
Total mud <0.063	<4.00	0.00	0.00		0.00	0.00	0.00		0.00	0.00	0.00		0.00	0.74	1.33		1.33
Total sample		26.36				188.13				36.32				55.60			
gravel %			0.00				22.95				12.58				20.04		
sand %			100.00				77.05				87.42				78.63		
mud %			0.00				0.00				0.00				1.33		
$CaCO_3$ gravel %			0				39				4				8		
$CaCO_3$ sand %			9				14				13				14		
F & W mean			2.15				1.61								1.64		
F & W dev.			0.20				0.42								0.41		
F & W skew.			-0.13				-0.11								-0.23		
F & W kurt.			1.20				1.10								1.39		
Inman mean			2.15				1.60				0.96				1.62		
Inman dev.			0.18				0.40				0.75				0.37		
Inman skew.			-0.06				-0.11				-0.22				-0.19		
Inman kurt.			1.03				0.87								1.01		
Percentile	5		1.72				0.82								0.74		
	16		1.97				1.20				0.21				1.25		
	25		2.03				1.35								1.44		
Median	50		2.16				1.64				1.12				1.69		
	75		2.28				1.90								1.88		
	84		2.33				1.99				1.70				1.99		
	95		2.45				2.30								2.23		

Outer Bristol Channel Marine Habitat Study - Particle Size Analysis

SAMPLE		OBC119 [+51-05 1312]				OBC120 [+51-05 1313]				OBC121 [+51-05 1314]				OBC122 [+51-05 1315]			
W.gr.mm	Phi	wt.gms	wt.%	cum.%	W.gr.%	wt.gms	wt.%	cum.%	W.gr.%	wt.gms	wt.%	cum.%	W.gr.%	wt.gms	wt. %	cum. %	W.gr.%
	-6.00																
20.00																	
	-4.00					1.59											
10.00		16.36				11.93				5.29							
5.00		11.20				10.68				18.20				0.39			
4.00	-2.00	7.52			0.00	3.20			0.00	6.70			0.00	0.00			0.00
2.00	-1.00	12.84			0.00	3.90			0.00	11.03			0.00	4.13			0.00
Total gravel		47.92	38.40			31.30	34.58			41.22	43.04			4.52	12.34		
vcs	-0.50	2.08	2.71			0.44	0.75			0.64	1.18			7.39	23.01		
1.00	0.00	2.44	3.18	5.90	5.90	0.42	0.71	1.46	1.46	0.22	0.41	1.59	1.59	8.51	26.49	49.50	49.50
cs	0.50	4.04	5.27	11.17		1.08	1.83	3.28		0.54	1.00	2.58		7.48	23.29	72.79	
0.50	1.00	6.44	8.40	19.57	13.67	3.10	5.25	8.53	7.08	1.76	3.25	5.83	4.25	5.12	15.94	88.73	39.23
ms	1.50	15.08	19.67	39.24		7.26	12.29	20.83		5.78	10.67	16.51		2.10	6.54	95.27	
0.25	2.00	30.48	39.76	79.00	59.43	33.68	57.03	77.85	69.32	22.50	41.54	58.05	52.22	1.33	4.14	99.41	10.68
fs	2.50	14.56	18.99	97.99		11.76	19.91	97.76		19.94	36.82	94.87		0.17	0.53	99.94	
0.13	3.00	1.44	1.88	99.87	20.87	1.16	1.96	99.73	21.88	2.36	4.36	99.22	41.17	0.02	0.06	100.00	0.59
vfs	3.50	0.08	0.10	99.97		0.12	0.20	99.93		0.38	0.70	99.93		0.00	0.00	100.00	
0.063	4.00	0.02	0.03	100.00	0.13	0.04	0.07	100.00	0.27	0.04	0.07	100.00	0.78	0.00	0.00	100.00	0.00
Total sand		76.66				59.06				54.16				32.12			
Total mud <0.063	<4.00	0.22	0.18		0.18	0.16	0.18		0.18	0.40	0.42		0.42	0.00	0.00		0.00
Total sample		124.80				90.52				95.78				36.64			
gravel %			38.40				34.58				43.04				12.34		
sand %			61.42				65.24				56.54				87.66		
mud %			0.18				0.18				0.42				0.00		
$CaCO_3$ gravel %			11				9				4				8		
$CaCO_3$ sand %			15				15				14				14		
F & W mean			1.51				1.74				1.90						
F & W dev.			0.69				0.44				0.44						
F & W skew.			-0.34				-0.20				-0.15						
F & W kurt.			1.27				1.61				1.20						
Inman mean			1.45				1.72				1.89						
Inman dev.			0.64				0.38				0.40						
Inman skew.			-0.27				-0.13				-0.05						
Inman kurt.			0.91				1.17				1.01						
Percentile	5		-0.12				0.72				0.91						
	16		0.81				1.34				1.49						
	25		1.14				1.56				1.62						
Median	50		1.62				1.77				1.91				0.01		
	75		1.93				1.98				2.17						
	84		2.09				2.10				2.29						
	95		2.33				2.37				2.52						

Outer Bristol Channel Marine Habitat Study - Particle Size Analysis

SAMPLE		OBC123 [+51-05 1316]				OBC124 [+51-05 1317]				OBC125 [+51-05 1318]				OBC126 [+51-05 1319]			
W.gr.mm	Phi	wt.gms	wt.%	cum.%	W.gr.%	wt.gms	wt.%	cum.%	W.gr.%	wt.gms	wt.%	cum.%	W.gr.%	wt.gms	wt.%	cum.%	W.gr.%
	-6.00																
20.00																	
	-4.00																
10.00																	
5.00		7.83				5.52				4.93							
4.00	-2.00	3.99			0.00	4.92			0.00	2.32			0.00				0.00
2.00	-1.00	10.97			0.00	6.11			0.00	13.69			0.00	0.15			0.00
Total gravel		22.79	35.46			16.55	28.98			20.94	37.80			0.15	0.44		
vcs	-0.50	5.73	13.81			1.16	2.86			2.19	6.36			0.54	1.60		
1.00	0.00	4.78	11.52	25.34	25.34	1.18	2.91	5.77	5.77	0.98	2.84	9.20	9.20	2.76	8.19	9.79	9.79
cs	0.50	4.40	10.61	35.95		1.26	3.11	8.88		1.19	3.45	12.66		6.11	18.13	27.91	
0.50	1.00	6.35	15.31	51.25	25.92	3.02	7.45	16.32	10.55	6.20	18.00	30.65	21.45	9.91	29.40	57.31	47.52
ms	1.50	9.35	22.54	73.79		8.38	20.66	36.98		15.90	46.15	76.81		9.66	28.66	85.97	
0.25	2.00	7.87	18.97	92.77	41.51	20.70	51.04	88.02	71.70	6.96	20.20	97.01	66.36	4.53	13.44	99.41	42.09
fs	2.50	2.68	6.46	99.23		4.44	10.95	98.96		0.82	2.38	99.39		0.16	0.47	99.88	
0.13	3.00	0.28	0.68	99.90	7.14	0.36	0.89	99.85	11.83	0.17	0.49	99.88	2.87	0.03	0.09	99.97	0.56
vfs	3.50	0.03	0.07	99.98		0.04	0.10	99.95		0.03	0.09	99.97		0.01	0.03	100.00	
0.063	4.00	0.01	0.02	100.00	0.10	0.02	0.05	100.00	0.15	0.01	0.03	100.00	0.12	0.00	0.00	100.00	0.03
Total sand		41.48				40.56				34.45				33.71			
Total mud <0.063	<4.00	0.00	0.00		0.00	0.00	0.00		0.00	0.00	0.00		0.00	0.00	0.00		0.00
Total sample		64.27				57.11				55.39				33.86			
gravel %			35.46				28.98				37.80				0.44		
sand %			64.54				71.02				62.20				99.56		
mud %			0.00				0.00				0.00				0.00		
$CaCO_3$ gravel %			5				3				4				0		
$CaCO_3$ sand %			14				14				10				11		
F & W mean							1.51								0.86		
F & W dev.							0.59								0.60		
F & W skew.							-0.40								-0.11		
F & W kurt.							1.55								0.91		
Inman mean			0.67				1.46				1.12				0.85		
Inman dev.			1.06				0.47				0.50				0.63		
Inman skew.			-0.28				-0.32				-0.19				-0.07		
Inman kurt.							1.46								0.52		
Percentile	5						-0.10								-0.20		
	16		-0.39				0.99				0.62				0.22		
	25						1.23								0.43		
Median	50		0.97				1.61				1.21				0.89		
	75						1.84								1.29		
	84		1.73				1.93				1.61				1.47		
	95						2.21								1.70		

Outer Bristol Channel Marine Habitat Study - Particle Size Analysis

SAMPLE		OBC127 [+51-05 1320]				OBC128 [+51-05 1321]				OBC129 [+51-05 1322]				OBC130 [+51-05 1323]			
W.gr.mm	**Phi**	**wt.gms**	**wt.%**	**cum.%**	**W.gr.%**	**wt.gms**	**wt.%**	**cum.%**	**W.gr.%**	**wt.gms**	**wt.%**	**cum.%**	**W.gr.%**	**wt.gms**	**wt.%**	**cum.%**	**W.gr.%**
	-6.00																
20.00																	
	-4.00																
10.00																	
5.00														2.48			
4.00	**-2.00**				0.00				0.00				0.00	1.97			0.00
2.00	**-1.00**	0.31			0.00	0.21			0.00	0.20			0.00	3.42			0.00
Total gravel		0.31	1.21			0.21	0.74			0.20	0.76			7.87	23.13		
vcs	**-0.50**	0.14	0.55			0.08	0.29			0.16	0.61			4.83	18.64		
1.00	**0.00**	0.25	0.99	1.54	1.54	0.21	0.75	1.04	1.04	0.14	0.54	1.15	1.15	0.56	2.16	20.80	20.80
cs	**0.50**	0.76	3.00	4.54		0.67	2.39	3.43		0.38	1.46	2.60		0.38	1.47	22.27	
0.50	**1.00**	3.40	13.42	17.96	16.42	3.56	12.71	16.14	15.10	2.78	10.65	13.25	12.10	0.60	2.32	24.59	3.78
ms	**1.50**	11.46	45.22	63.18		9.59	34.24	50.37		9.28	35.54	48.79		0.80	3.09	27.67	
0.25	**2.00**	7.90	31.18	94.36	76.40	11.50	41.06	91.43	75.29	8.17	31.29	80.08	66.83	2.82	10.88	38.56	13.97
fs	**2.50**	1.20	4.74	99.09		1.80	6.43	97.86		4.60	17.62	97.70		11.76	45.39	83.94	
0.13	**3.00**	0.19	0.75	99.84	5.49	0.48	1.71	99.57	8.14	0.58	2.22	99.92	19.84	3.91	15.09	99.04	60.48
vfs	**3.50**	0.03	0.12	99.96		0.10	0.36	99.93		0.02	0.08	100.00		0.21	0.81	99.85	
0.063	**4.00**	0.01	0.04	100.00	0.16	0.02	0.07	100.00	0.43	0.00	0.00	100.00	0.08	0.04	0.15	100.00	0.96
Total sand		25.34				28.01				26.11				25.91			
Total mud	**<0.063**	**<4.00**	0.00	0.00		0.00	0.00		0.00	0.00	0.00		0.00	0.25	0.73		0.73
Total sample			25.65				28.22				26.31				34.03		
gravel %			1.21				0.74				0.76				23.13		
sand %			98.79				99.26				99.24				76.14		
mud %			0.00				0.00				0.00				0.73		
$CaCO_3$ gravel %			25				0				0				3		
$CaCO_3$ sand %			10				8				12				14		
F & W mean			1.36				1.44				1.56						
F & W dev.			0.43				0.46				0.51						
F & W skew.			-0.05				-0.13				0.06						
F & W kurt.			1.17				1.06				0.98						
Inman mean			1.36				1.42				1.58						
Inman dev.			0.41				0.43				0.51						
Inman skew.			0.00				-0.16				0.11						
Inman kurt.			0.82				0.86				0.66						
Percentile	5		0.54				0.61				0.69						
	16		0.95				0.99				1.07						
	25		1.11				1.14				1.21						
Median	50		1.36				1.49				1.52				2.11		
	75		1.63				1.76				1.91						
	84		1.77				1.85				2.08						
	95		2.03				2.21				2.37						

Outer Bristol Channel Marine Habitat Study - Particle Size Analysis

SAMPLE		OBC131 [+51-05 1324]				OBC132 [+51-05 1325]				OBC133 [+51-05 1326]				OBC134 [+51-05 1327]			
W.gr.mm	Phi	wt.gms	wt.%	cum.%	W.gr.%	wt.gms	wt.%	cum.%	W.gr.%	wt.gms	wt.%	cum.%	W.gr.%	wt.gms	wt.%	cum.%	W.gr.%
	-6.00																
20.00																	
	-4.00																
10.00																	
5.00						11.20											
4.00	-2.00				0.00	3.91			0.00	0.22			0.00	0.11			0.00
2.00	-1.00	0.20			0.00	15.96			0.00	0.09			0.00	0.48			0.00
Total gravel		0.20	0.66			31.07	43.64			0.31	1.03			0.59	1.91		
vcs	-0.50	0.32	1.06			7.94	19.89			0.09	0.30			0.50	1.70		
1.00	0.00	1.19	3.94	5.00	5.00	2.13	5.34	25.23	25.23	0.07	0.24	0.54	0.54	0.81	2.76	4.46	4.46
cs	0.50	2.43	8.04	13.04		1.08	2.71	27.94		0.19	0.64	1.18		1.70	5.79	10.26	
0.50	1.00	8.73	28.90	41.94	36.94	2.49	6.24	34.18	8.95	2.30	7.77	8.95	8.41	5.17	17.61	27.87	23.41
ms	1.50	11.14	36.88	78.81		9.51	23.83	58.01		6.95	23.48	32.43		4.27	14.55	42.42	
0.25	2.00	4.62	15.29	94.11	52.17	10.19	25.53	83.54	49.36	12.55	42.40	74.83	65.88	5.98	20.37	62.79	34.92
fs	2.50	1.37	4.53	98.64		5.01	12.55	96.09		6.69	22.60	97.43		8.39	28.59	91.38	
0.13	3.00	0.36	1.19	99.83	5.73	1.40	3.51	99.60	16.06	0.67	2.26	99.70	24.86	1.84	6.27	97.65	34.86
vfs	3.50	0.03	0.10	99.93		0.12	0.30	99.90		0.07	0.24	99.93		0.50	1.70	99.35	
0.063	4.00	0.02	0.07	100.00	0.17	0.04	0.10	100.00	0.40	0.02	0.07	100.00	0.30	0.19	0.65	100.00	2.35
Total sand		30.21				39.91				29.60				29.35			
Total mud <0.063	<4.00	0.00	0.00		0.00	0.21	0.29		0.29	0.31	1.03		1.03	0.92	2.98		2.98
Total sample		30.41				71.19				30.22				30.86			
gravel %			0.66				43.64				1.03				1.91		
sand %			99.34				56.07				97.94				95.11		
mud %			0.00				0.29				1.03				2.98		
$CaCO_3$ gravel %			0				4				0				100		
$CaCO_3$ sand %			10				10				10				20		
F & W mean			1.11								1.68				1.58		
F & W dev.			0.57								0.47				0.80		
F & W skew.			-0.04								-0.10				-0.23		
F & W kurt.			1.21								1.01				0.87		
Inman mean			1.11								1.67				1.52		
Inman dev.			0.52								0.47				0.81		
Inman skew.			0.00								-0.10				-0.23		
Inman kurt.			0.99								0.67				0.64		
Percentile	5		0.00								0.85				0.08		
	16		0.59								1.20				0.71		
	25		0.74								1.38				0.93		
Median	50		1.11				1.34				1.71				1.70		
	75		1.44								2.01				2.18		
	84		1.63								2.13				2.32		
	95		2.07								2.40				2.72		

Outer Bristol Channel Marine Habitat Study - Particle Size Analysis

SAMPLE		OBC135 [+51-05 1328]			
W.gr.mm	**Phi**	**wt.gms**	**wt.%**	**cum.%**	**W.gr.%**
	-6.00				
20.00					
	-4.00				
10.00					
5.00					
4.00	**-2.00**				0.00
2.00	**-1.00**	0.02			0.00
Total gravel		0.02	0.08		
vcs	**-0.50**	0.02	0.08		
1.00	**0.00**	0.05	0.20	0.28	0.28
cs	**0.50**	0.10	0.40	0.68	
0.50	**1.00**	0.31	1.24	1.92	1.64
ms	**1.50**	1.00	4.00	5.92	
0.25	**2.00**	10.13	40.49	46.40	44.48
fs	**2.50**	9.29	37.13	83.53	
0.13	**3.00**	2.99	11.95	95.48	49.08
vfs	**3.50**	0.91	3.64	99.12	
0.063	**4.00**	0.22	0.88	100.00	4.52
Total sand		25.02			
Total mud	**<0.063**	**<4.00**	0.74	2.87	2.87
Total sample		25.78			

gravel %	0.08
sand %	97.05
mud %	2.87

$CaCO_3$ gravel %	0
$CaCO_3$ sand %	13

F & W mean	2.08
F & W dev.	0.44
F & W skew.	0.20
F & W kurt.	1.11
Inman mean	2.11
Inman dev.	0.41
Inman skew.	0.19
Inman kurt.	0.91

Percentile	5	1.42
	16	1.70
	25	1.80
Median	50	2.03
	75	2.37
	84	2.51
	95	2.97