JNCC Report No. 471

Analysis of seabed imagery from the 2011 survey of the Firth of Forth Banks Complex, the 2011 IBTS Q4 survey and additional deep-water sites from Marine Scotland Science surveys (2012)

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September 2014

ISSN 0963 8091

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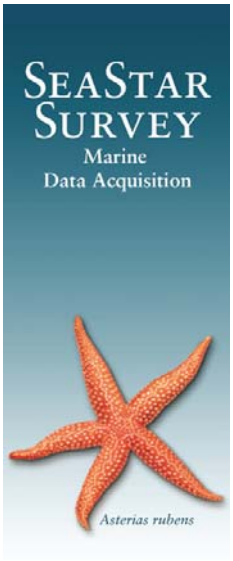
This report should be cited as:

Axelsson, M., Dewey, S. & Allen, C. 2014. Analysis of seabed imagery from the 2011 survey of the Firth of Forth banks complex, the 2011 IBTS Q4 survey and additional deep-water sites from Marine Scotland Science surveys (2012). *JNCC Report*, No 471.

Acknowledgements

This report was prepared from analysis conducted in 2012.



Certificate Number 3647
ISO 9001, ISO 14001 and OHSAS18001

Summary

The Scottish MPA Project is a joint project between Marine Scotland (Scottish Government), Scottish Natural Heritage (SNH), the Joint Nature Conservation Committee (JNCC) and Historic Scotland with the aim of providing advice to Scottish Ministers on the selection of Marine Protected Areas (MPAs) under the Marine (Scotland) Act and the Marine and Coastal Access Act in the seas around Scotland.

Nature Conservation MPAs will be selected using a science-based approach, under-pinned by the presence of Search Features. The Nature Conservation MPAs will recognise features which are considered to be key and threatened and/or declining, and/or representing the range of features within Scotland's seas.

As part of the process of identifying areas with Search Features, the JNCC commissioned Seastar Survey Ltd. in 2012 to undertake the taxonomic analysis of video footage and still photographs acquired from two surveys undertaken in 2011 and from a selection of Marine Scotland Science (MSS) deep-water survey stations:

- The 2011 survey to the banks complex adjacent to the Firth of Forth aboard the *NLV Pole Star*.
- The 2011 Quarter 4 International Bottom Trawl Survey (IBTS Q4) to the north and west of Scotland (shelf and slope) aboard the *FRV Scotia.*
- A selection of MSS towed video datasets from surveys on the Hebridean slope, Rosemary Bank and Rockall Bank aboard the *FRV Scotia*.

Main Findings

Firth of Forth Banks Complex

The main findings from analysis of the stills and video analysis collected during the 2011 survey to the banks complex adjacent to the Firth of Forth aboard the *NLV Pole Star* were:

- A total of 31 stations with 10 hours and 36 minutes of video and 649 still photographs were analysed from the Firth of Forth Banks Complex survey area.
- A total of 12 shallow-water biotopes have been recorded with SS.SSa.CMuSa being the most commonly recorded.
- Four Scottish MPA Search Features were observed from the Firth of Forth footage; 'Offshore subtidal sands and gravels', 'offshore deep sea muds', 'burrowed mud' and 'Horse mussel beds'.
- The Annex I 'stony reef' habitat was recorded at four sites (HG005_Stn80, HG007_Stn85, HG060_Stn064 and HG071_Stn082) with a further three potential sites classified in the category but additional data will be required to assess these fully.

IBTS Q4 survey

The main findings from the analysis of the footage collected during the 2011 Quarter 4 International Bottom Trawl Survey (IBTS Q4) to the north and west of Scotland (shelf and slope) aboard the *FRV Scotia* were:

- Video and still photographs from a total seven sites from the IBTS Q4 were analysed.
- A combination of shallow-water (Connor *et al* 2004) and deep-sea (Howell 2010) biotopes were used to classify the habitats present.

- A total of three shallow-water biotopes were identified (SS.CSC.OCS, SS.SMx.OMx and SS.SSA.OSa) with one potential new biotope (coarse sand and *Ditrupa arietina*).
- Three Level 3 deep sea biotopes were identified with two sites being classified as Level 4 "Bioherm Upper slope - *Lophelia pertusa* reefs - Highly sediment draped scattered coral framework" and "Atlantic upper slope sand - *Caryophyllia smithii* & *Actinauge richardi* on sand/gravelly sand".
- The Offshore MPA Search Feature "Offshore subtidal sands and gravels" was identified along all seven of the IBTS Q4 survey lines.
- One Annex I habitat ('reef') and the PMF 'cold-water coral reef' were identified along survey lines 2a and 2b.

MSS deep-water sites

The main findings from the analysis of videos from the MSS towed video datasets from surveys on the Hebridean slope, Rosemary Bank and Rockall Bank aboard the *FRV Scotia* were:

- The imagery from six drop-down camera lines were analysed.
- A total of five different Level 3 deep sea biotopes (as per Howell 2010) were identified with a further three potential Level 4 biotopes.
- Three MPA Search Features ("Offshore subtidal sands and gravels", "Burrowed mud" and "Offshore deep sea muds") were identified at five ("Burrowed mud" at Rockall Bank 2007 and 2009, "Offshore deep sea muds" on the Hebridean Slope; and "Offshore subtidal sands and gravels" at Rosemary Bank sites 1 and 4) of the six locations in the MSS survey area.
- The Annex I "reef" habitat was identified at two locations (Rosemary Bank site 1 and 3).

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1.1 Background and objectives

1.1.1 Background

The Marine (Scotland) Act 2010 and the UK marine Coastal Access Act include new powers for Scottish Ministers to designate Marine Protected Areas (MPAs) in the sea around Scotland as part of a range of measures to manage and protect Scotland's seas for current and future generations.

The Scottish MPA Project is a joint project between Marine Scotland (Scottish Government), Scottish Natural Heritage (SNH), the Joint Nature Conservation Committee (JNCC) and Historic Scotland.

The aim of the project is to provide advice to Scottish Ministers on the selection of MPAs under the Marine (Scotland) Act and the Marine and Coastal Access Act in the seas around Scotland. These Acts provide a framework to help balance competing demands on the maritime environment, integrating the economic growth of industry with the need to protect Scotland's seas. Provisions under these new pieces of marine legislation will enable the establishment of an ecologically coherent network of well-managed MPAs. The MPA network in Scottish waters will be comprised of existing protected areas, primarily European Marine Sites (e.g. Special Areas of Conservation - SACs and Special Protection Areas - SPAs), as well as those regions that are subject to other types of area-based management. These existing areas will be combined with MPAs designated under the new legislation, termed Nature Conservation MPAs. Marine Scotland is leading the Scottish MPA Project, SNH is leading advice concerning designation of MPAs within Scottish territorial waters and JNCC is leading advice concerning designation of MPAs in offshore adjacent to Scotland.

Nature Conservation MPAs will be selected using a science-based approach, under-pinned by the presence of MPA Search Features. MPA Search Features, identified by SNH and JNCC, represent species, habitats and natural features of conservation importance for which spatial measures are thought to be an appropriate conservation measure (Scottish Government 2011). Search Features are a subset of the list of Priority Marine Features (PMFs), which consist of species and habitats of conservation importance for which action will be prioritised via a three-pillar approach i.e. species measures, site-based measures and wider seas policies and measures (Scottish Government 2011). The Nature Conservation MPAs will recognise features which are considered to be key and threatened and/or declining, and/or representing the range of features within Scotland's seas. A list of Search Features is given in Appendix 1[1].

As part of the process of identifying areas with Search Features, the JNCC commissioned Seastar Survey Ltd. in 2012 to undertake the taxonomic analysis of video footage and still photographs acquired from two surveys undertaken in 2011 and from a selection of Marine Scotland Science (MSS) deep-water survey stations:

- The 2011 survey to the banks complex adjacent to the Firth of Forth aboard the *NLV Pole Star*.
- The 2011 Quarter 4 International Bottom Trawl Survey (IBTS Q4) to the north and west of Scotland (shelf and slope) aboard the *FRV Scotia*.
- A selection of MSS towed video datasets from surveys on the Hebridean slope, Rosemary Bank and Rockall Bank aboard the *FRV Scotia*.

[1] Scottish MPA Project's Site Selection Guidelines available online: http://www.scotland.gov.uk/Resource/Doc/295194/0114024.pdf

1.1.2 Principle objectives

The principle objective of the contract is to identify the fauna and characterise the habitats from the video and stills images, concluding with the assignment of biotopes in accordance with Connor *et al* (2004). Where this classification scheme is not appropriate, i.e. off the shelf in deep waters, then it was suggested that the proposed scheme of Howell *et al* (2010) be used. This would tie in with the work currently being undertaken at JNCC to further the classification scheme of Connor *et al* (2004). The analysis should also confirm the presence of any Scottish MPA project search features and Annex I reef habitats in the areas of survey.

The surveys in the current study include shelf (including coastal, shallow waters), slope and off-shelf areas. Search Features identified in the different surveys will therefore be reported in these different physical regions. The Search Features, as listed within the Scottish MPA Project's Site Selection Guidelines, are given in Appendix 1 with the exception of the large-scale features.

1.2 Surveys

1.2.1 NLV Pole Star survey of the Firth of Forth Banks Complex

The JNCC undertook a dedicated broad-scale environmental survey on the Banks Complex (an area of shallow banks and troughs) east of the Firth of Forth (Figure 1.1) (hereafter referenced simply as Firth of Forth sites) in October 2011 on the *NLV Pole Star*. The survey was carried out to ground-truth and characterise an area habitat mapped from acoustic image interpretation. This report will focus on the analysis of the still photographs and video footage acquired during the survey to assess the presence of any Scottish MPA project Search Features and Annex I reefs.

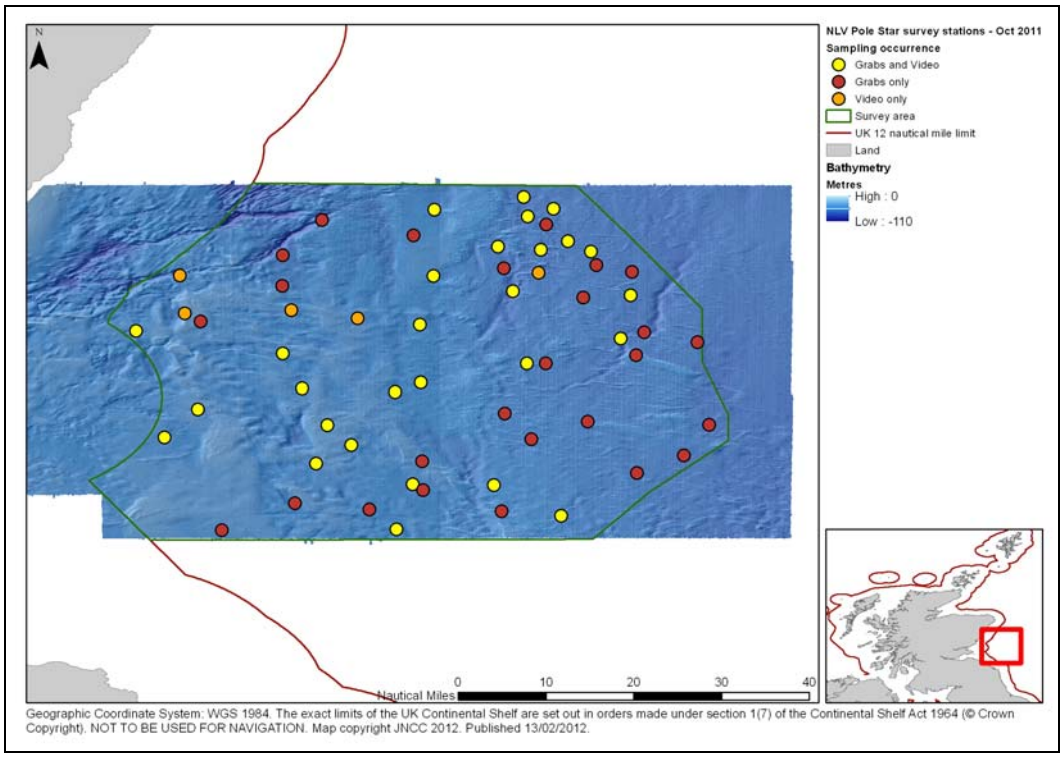

Figure 1.1 The stations in the Firth of Forth Banks Complex survey area (the NLV Pole Star survey in October 2011).

1.2.2 IBTS Quarter 4, 2011, to the north and west of Scotland

The JNCC joined MSS on the FRV Scotia for the IBTS Q4 survey in the Atlantic waters west and north of Scotland in November 2011 (Figure 1.2). Video and still photographs were collected opportunistically during the IBTS survey downtime with the aim of locating Search Features. This report will focus on the analysis of the still photographs and video footage acquired during the survey to assess the presence of any Scottish MPA project Search Features and Annex I reefs.

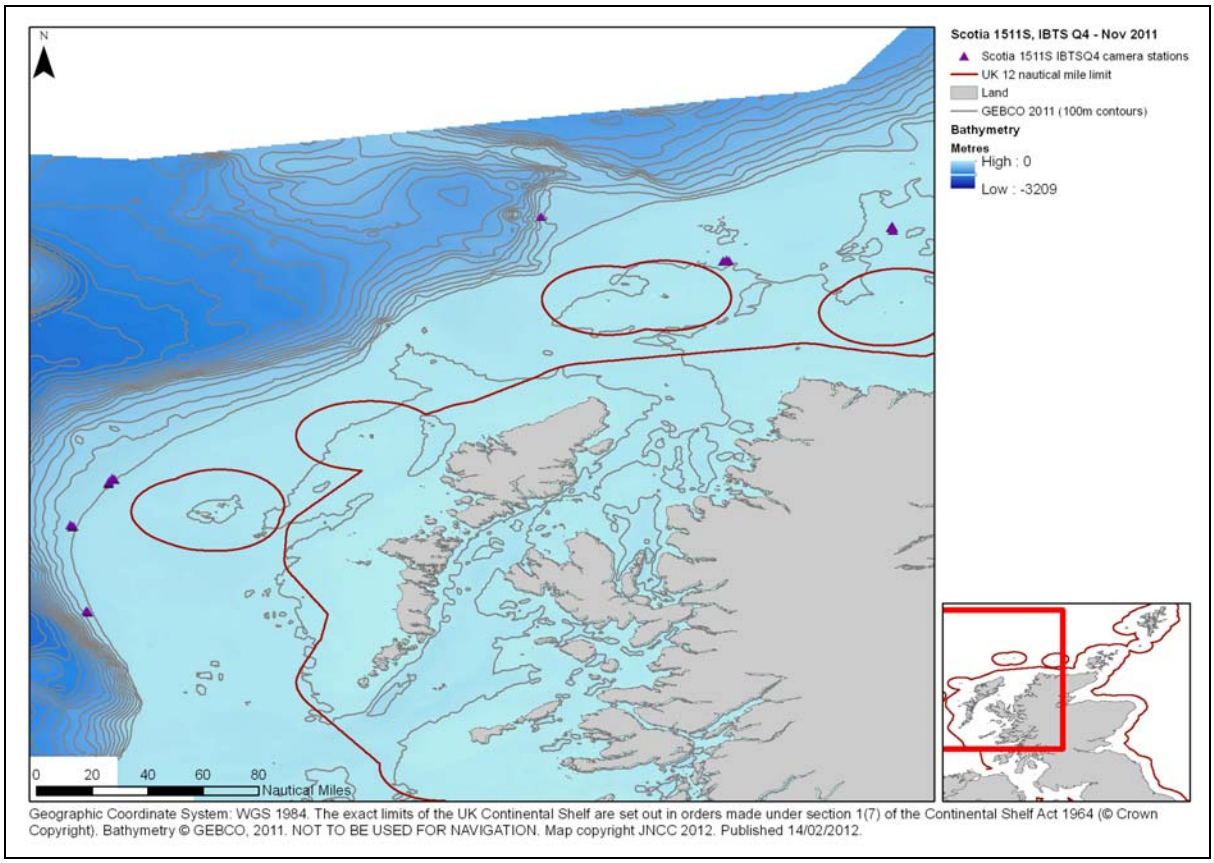

Figure 1.2 The stations of the IBTS Q4 survey (November 2011).

1.2.3 Selected MSS deep-water datasets on the Hebridean Slope, Rosemary Bank and Rockall Bank

MSS completed towed video surveys at stations along the Hebridean Slope, on Rockall Bank and on Rosemary Bank in the Atlantic waters west of Scotland in 2007 and 2009 (Figure 1.3). The main aim of these surveys was to assess the stocks of various fish species, *Nephrops* and the presence of deep-water coral. A selection of stations was chosen for further detailed analysis on account of presence of recorded key and characterising epifauna. This report will focus on the analysis of the still photographs and video footage acquired during these surveys to assess the presence of any Scottish MPA project Search Features and Annex I reefs.

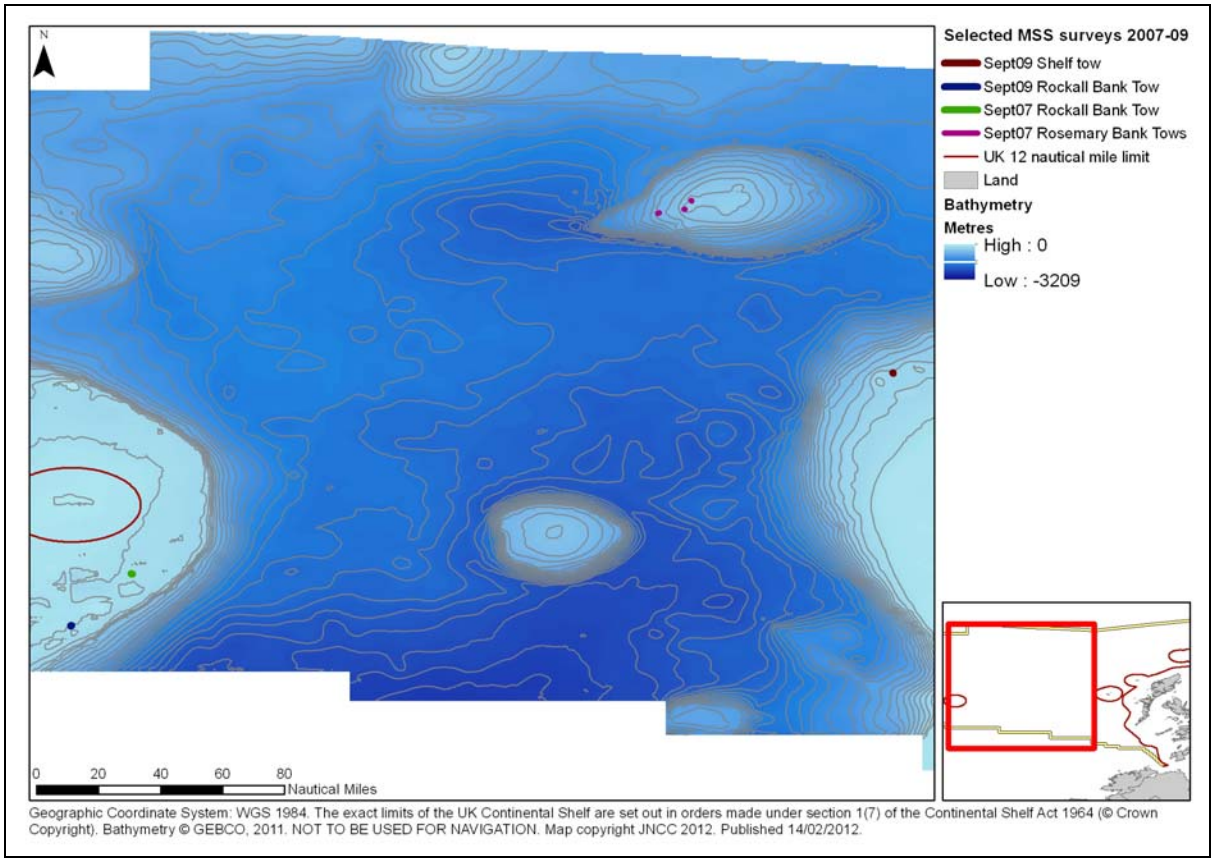

Figure 1.3 Hebridean Slope, Rockall Bank and Rosemary Bank towed video sites.

2 Methodology

2.1 Data collection

The still photographs and video footage acquired during the Firth of Forth banks complex survey were collected by JNCC and CEFAS staff. The footage from the IBTS survey was collected by JNCC and MSS staff and the footage collected from the deep water in the Rockall area were collected by MSS. The underwater footage was collected using drop-down cameras 'flown' a few metres above the seabed but occasionally landed to take a still photograph.

2.2 Data analysis

The analysis of the still photographs and video records was carried out 'blind' (i.e. without any prior knowledge of the sites). An initial assessment of each site was carried out by first looking through the photographs and film to quickly to get a brief understanding of the substratum, flora and fauna present at each location.

2.2.1 Video analysis

The video analysis of a deployment started with an initial assessment to get a broad understanding of the substratum, geological features and fauna present, as well as the identification of any different biotopes/habitats on the seabed.

The boundaries of the different biotopes/habitats were then identified along with the positions of these boundaries using the time codes related back to the navigation data. Where multiple habitats were present on individual video tows these would be divided into discrete sections of the footage (video clips) and treated as individual samples. A detailed analysis of each video clip was then completed, consisting of a general seabed description and identification of any fauna to the lowest practical level. General descriptions of the fauna were made, including the presence of any Scottish MPA search features and Annex 1 reef. Any other features of interest, such as trawl marks, were also recorded.

The abundance data were recorded using the SACFOR scale. A list of the encountered fauna were produced for each site using species reference numbers as cited in the Marine Conservation Society Species Directory (Howson and Picton 1997). Species were named with nomenclature according to the World Registry of Marine Species (WoRMS; Appeltans *et al* 2012). The sections or deployments were subsequently classified into designated biotopes according to Connor *et al* (2004).

2.2.2 Still photograph analysis

The still photography analysis was carried out using a personal computer with a large screen. The methodology was in large parts similar to the video analysis methodology but with the added advantage of using the results of the video analysis as a source for Quality Control in terms of the habitats, species and other features seen in the video analysis.

A general seabed description was included for each stills image, where the substrata were described according to the Wentworth scale (see Leeder 1982). In addition, a visual assessment of the sediment composition of the substratum was made, recording the percentage cover of the field of view for each sediment type (using MNCR categories).

All fauna present were identified to the lowest practical taxonomic level using nomenclature according to WoRMS (Appeltans *et al* 2012) and their abundance recorded using the SACFOR scale. The presence and location of Scottish MPA search features and Annex 1 reef were recorded, along with the presence of any other features of interest. Each still photograph was subsequently classified into designated biotopes according to Connor *et al* (2004) wherever possible. Examples of still photographs are given in Figure 2.1.

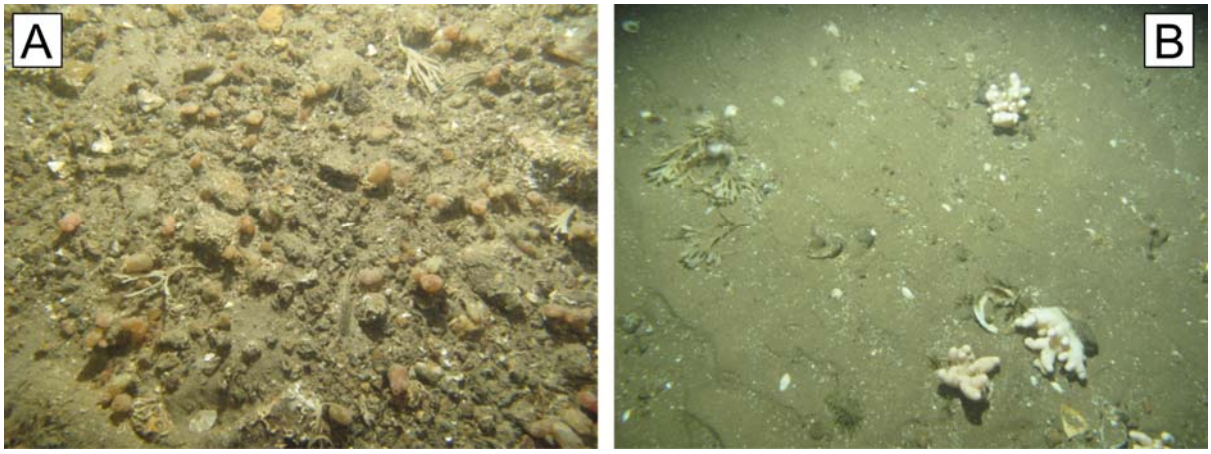

Figure 2.1. Examples of still photographs from the Firth of Forth Banks Complex survey (A – HG007_Stn085#002; B – HG050_Stn065#008).

2.3 Biotope classification

The habitats in all the surveys have been classified into biotopes. The Firth of Forth habitats have been classified according to Connor *et al* (2004). The IBTS sites have been classified using a combination of the shallow water biotopes (Connor *et al* 2004) and the deep sea biotopes as proposed by Howell (2010) and the JNCC (2012). The deep sea sites have all been classified as deep sea biotopes.

All of the Firth of Forth sites were classified as circalittoral biotopes rather than offshore habitats. This is believed to be justified as the depth range of these sites is 40–72m which is within the circalittoral range (< 80m; see Connor *et al* 2004). The epifauna identified in the footage furthermore supports this argument as these taxa characterise the fauna in the circalittoral biotopes rather than those in the offshore biotopes.

The deep sea biotopes refer to habitats below 200m. This classification system is currently being developed (Howell 2010; JNCC 2012) and changes to the final version are likely. Some caution may therefore be needed in the interpretation of these habitats. For each habitat descriptions have been made in addition to the classification and these should be accounted for when analysing the results.

The IBTS survey sites are located at the boundary between the shallow water biotopes and the deep sea biotopes. A combination of the two systems has therefore been used but further detail and delineation of these habitats may be required once the deep sea biotope classification system has been fully developed.

2.4 MPA Search Features and Annex I habitats

The habitats identified on the seabed imagery in the three different survey areas have been assessed against Scottish MPA Search Features (Appendix 1) and potential Annex I habitats in the Habitats Directive (see Johnston *et al* 2002).

For clarification, the Scottish MPA project is seeking to represent the geographic range and ecological variation of 'offshore subtidal sands and gravels' and 'offshore deep sea mud' in offshore waters (Appendix 1) by considering the components on the shelf, slope and off-shelf environments. Therefore, note that the components listed under these search features are key biotopes to represent where possible but this is not an exhaustive list. 'Offshore subtidal sands and gravels' encompasses coarse sediment (unstable cobbles and pebbles, gravels and coarse sands), sands and muddy sands, and mixed sediment. Any offshore habitats consisting of SaMu (sandy mud) or Mu (mud) in those same three environments in offshore waters are represented by the MPA search feature 'offshore deep sea muds'.

2.5 Quality Control

Quality Control (QC) is an important part of any analytical work. The QC of faunal/floral identification, habitat/biotope classification and data entry are all completed and agreed prior to finalisation of the results. This process can be lengthy, particularly if the habitats are unusual or the footage is of poor quality. The QC typically involves a re-assessment of 10% of the data but in this study approximately 30% of the data were re-assessed and agreed.

2.6 Marine Recorder data entry

As with most contracts with Governmental organisations the results from the analysis work requires entry into Marine Recorder. For most of the results in this study this process is uncomplicated. However, there are no deep sea biotopes in the current Marine Recorder version. The biotope cells in the spread sheets being prepared for Marine Recorder will therefore have to be left empty.

3 Results

3.1 NLV Pole Star survey of the Firth of Forth Banks Complex

A total of 10 hours and 36 minutes of video and 649 still photographs were analysed from the 31 stations sampled during the Firth of Forth Banks Complex survey (Table 3.1 with more detail in Appendix 2). The locations of the still photographs and video transects are given in Figure 3.1.

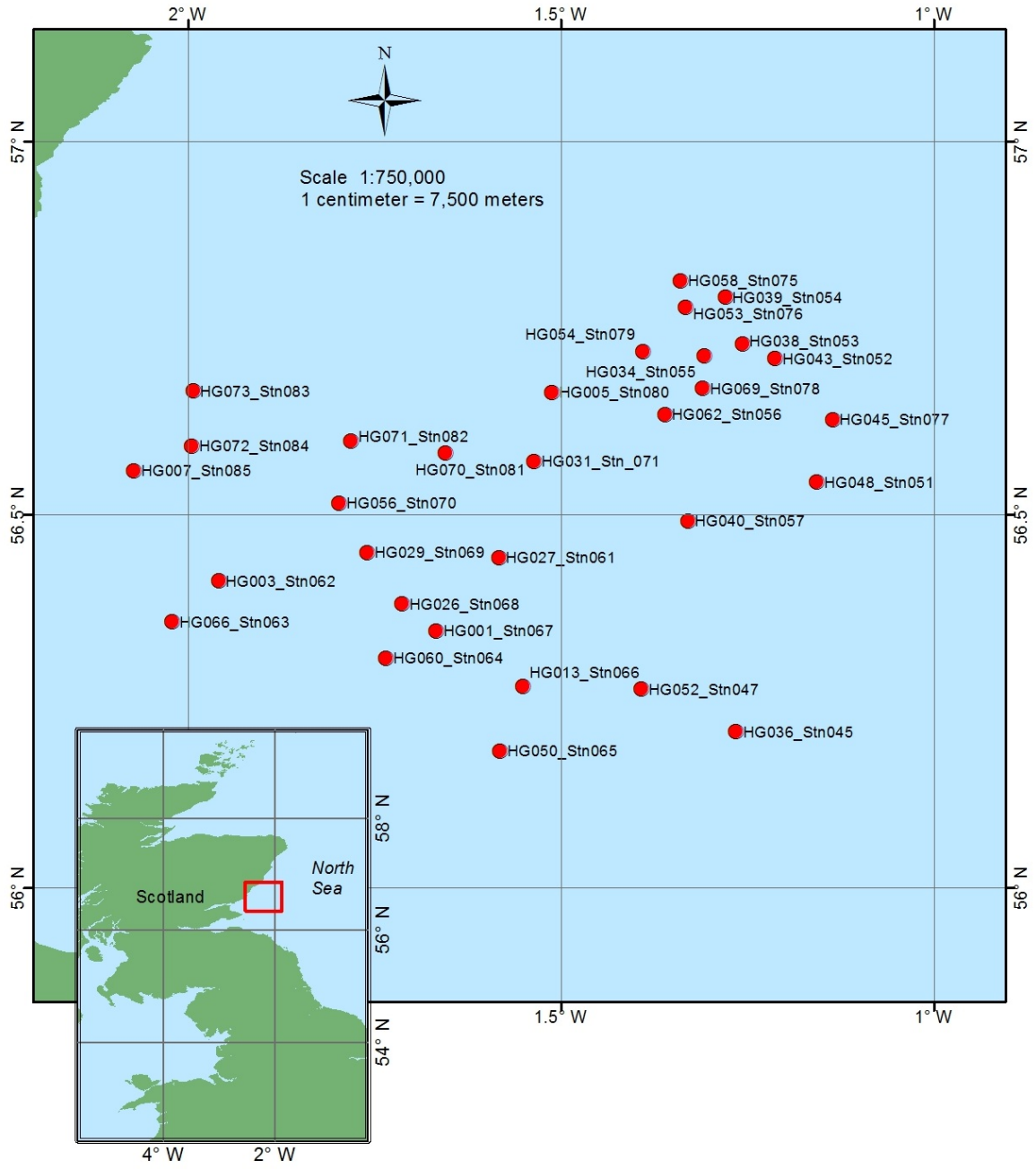

Figure 3.1 Sample locations in the Firth of Forth Banks Complex survey.

Table 3.1 Video and still photographs analysed as part of the Firth of Forth Banks Complex survey (recorded depth from the start of the line; * = depth unknown).

Station number	Station Code	Date	Depth (m)	Number of Stills	Video length (minutes)
45	HG036	10/10/2011	-*	25	00:25:00
46	HG052	10/10/2011	55	31	00:29:00
51	HG048	10/10/2011	70	24	00:26:00
52	HG043	10/10/2011	69.5	22	00:24:00
53	HG038	10/10/2011	69	21	00:22:00
54	HG039	10/10/2011	67	19	00:19:00
55	HG034	10/10/2011	65	20	00:20:00
56	HG062	10/10/2011	72	19	00:18:00
57	HG040	10/10/2011	61	15	00:18:00
61	HG027	11/11/2011	55.8	19	00:19:00
62	HG003	11/11/2011	49	23	00:21:00
63	HG066	11/11/2011	55	22	00:20:00
64	HG060	11/11/2011	48	22	00:20:00
65	HG050	11/11/2011	53	17	00:17:00
66	HG013	11/11/2011	56	24	00:22:00
67	HG001	11/11/2011	46	23	00:22:00
68	HG026	11/11/2011	43.3	17	00:19:00
69	HG029	11/11/2011	54	18	00:18:00
70	HG056	11/11/2011	55	19	00:17:00
71	HG031	11/11/2011	57.5	17	00:17:00
75	HG058	11/11/2011	67	19	00:17:00
76	HG053	11/11/2011	-*	18	00:17:00
77	HG045	11/11/2011	69	15	00:17:00
78	HG069	11/11/2011	67	18	00:18:00
79	HG054	11/11/2011	66.5	19	00:18:00
80	HG005	12/11/2011	54	19	00:17:00
81	HG070	12/11/2011	54	17	00:18:00
82	HG071	12/11/2011	51	21	00:21:00
83	HG073	12/11/2011	65	23	00:21:00
84	HG072	12/11/2011	61	41	00:39:00
85	HG007	12/11/2011	49	22	00:20:00
Totals				**649**	**10 hrs 36 min**

3.1.1 The habitats in the Firth of Forth banks complex survey area

The habitats identified from the underwater footage collected during the Firth of Forth Banks Complex survey are summarised in Table 3.2 (with more detail and photographic examples given in Appendix 3) and illustrated in Figures 3.2 and 3.3. Some of the details are not legible in these figures as a result of the large scale of the survey area versus the small scale of the individual photographs or sample points but additional detail of the MPA Search Features and Annex I habitats are highlighted in a separate figure below.

The sites observed from the video and still photography analyses fall under 3 broad habitat types or represent transitions between them; 1) soft sediments with ripples; 2) mixed sediment; and 3) coarse sediments with some rocky outcrops.

The first broad habitat is exemplified by large expanses of soft sediment formed into ripples, with some shell debris in the troughs of the ripples (northeast area in Figures 3.2 and 3.3). Dead *Flustra* was frequently present on these sites. These sites had varying amounts of gravel present, grading up to a mixed sediment habitat. The amount of gravel increased at some sites to coarse sediment, where very little to no soft sediment was present.

The habitats characterised by mixed sediment consist of gravel, sand and mud with some shell material (southeast area in Figure 3.2). These sediments are in places dominated by different fauna including ophiuroids (*Ophiothrix fragilis* and *Ophiocomina nigra*), *Flustra foliacea* or the bivalve *Modiolus modiolus*.

The coarse sediments are characterised by a mixture of gravel, pebbles and cobbles overlying finer sediments (centrally in Figure 3.2). The soft coral *Alcyonium digitata* and ascidians are commonly identified in these habitats.

Table 3.2 Summary of substrata, fauna and biotopes present along each survey transect in the Firth of Forth Banks Complex survey area (* depth unknown).

Line	Habitat/faunal summary	Depth (m)	Biotope(s)
HG001_stn067	Slightly muddy, gravelly sand with occasional cobbles with *Ophiothrix fragilis* and *Ophiocomina nigra* or *M. modiolus* Gravelly, muddy sand Sandy rock	46	SS.SMx.CMx.OphMx SS.SBR.SMus.ModMx SS.SMx.CMx.(OphMx) SS.SSa.CMuSa CR.MCR.EcCr.FaAlCr.Adig
HG003_stn062	Muddy, sandy gravel. Muddy sand with shell material.	49	SS.SMx.CMx SS.SSa.CMuSa
HG005_stn080	Gravelly sand with shell material Gravelly sand Sandy gravel with cobbles and shell material, *Flustra foliacea* and ascidians	54	SS.SSa.CMuSa SS.SMx.CMx SS.SCS.CCS CR.HCR.XFa.FluCoAs.X
HG007_stn085	Muddy, sandy gravel with cobbles and *F. foliacea* and ascidians	49	CR.HCR.XFa.FluCoAs.X
HG013_stn066	Sandy mud	56	SS.SMu.CSaMu
HG026_stn068	Muddy, sandy gravel with *F. foliacea* and ascidians Muddy, sandy gravel with *O. nigra*	43.3	CR.HCR.XFa.FluCoAs.X SS.SMx.CMx.OphMx
HG027_stn061	Muddy sand with shell material	55.8	SS.SSa.CMuSa
HG029_stn069	Sand with shell material	54	SS.SSa.CMuSa
HG031_stn071	Gravelly, muddy sand Gravelly, muddy sand with shell material and *F. foliacea* Muddy sand with shell material	57.5	SS.SMx.CMx SS.SMx.CMx.(FluHyd) SS.SSa.CMuSa
HG034_stn055	Muddy sand	65	SS.SSa.CMuSa
HG036_stn045	Muddy sand Gravelly muddy sand	-*	SS.SSa.CMuSa SS.SMx.CMx.(FluHyd)

Line	Habitat/faunal summary	Depth (m)	Biotope(s)
HG038_stn053	Muddy sand	69	SS.SSa.CMuSa
HG039_stn054	Muddy sand with shell material	67	SS.SSa.CMuSa
HG040_stn057	Muddy sand with shell material	61	SS.SSa.CMuSa
HG043_stn052	Muddy sand	69.5	SS.SSa.CMuSa
HG045_stn077	Muddy sand with shell fragments Slightly gravelly muddy sand with shell fragments, *Flustra foliacea* and *A. digitatum*	69	SS.SSa.CMuSa SS.SMx.CMx(FluHyd)
HG048_stn051	Muddy sand	70	SS.SSa.CMuSa
HG050_stn065	Gravelly, muddy sand Slightly gravelly, muddy sand Gravelly, muddy sand with *Flustra foliacea* and *Alcyonium digitatum*	53	SS.SMx.CMx SS.SSa.CMuSa SS.SMx.CMx.(FluHyd)
HG052_stn047	Gravelly, muddy sand Gravelly, muddy sand with occasional cobbles, *Flustra foliacea* and *A. digitatum* Muddy sand with shell material	55	SS.SMx.CMx SS.SMx.CMx.(FluHyd) SS.SSa.CMuSa
HG053_stn076	Muddy sand with shell material	-*	SS.SSa.CMuSa
HG054_stn079	Slightly muddy sand with shell material	66.5	SS.SSa.CMuSa
HG056_stn070	Gravelly sand with shell material Gravelly sand with shell material, *Flustra foliacea* and Ascidians	55	SS.SMx.CMx CR.HCR.XFa.(FluCoAs.X) CR.HCR.XFa.FluCoAs.X
HG058_stn075	Muddy sand with shell material	67	SS.SSa.CMuSa
HG060_stn064	Sandy gravel will shell material, *Flustra foliacea* and Ascidians Sandy gravel will shell material	48	CR.HCR.XFa.FluCoAs.X CR.HCR.XFa.(FluCoAs.X) SS.SMx.CMx
HG062_stn056	Muddy sand	72	SS.SSa.CMuSa
HG066_stn063	Sandy mud Sandy mud with *Pennatula phosphorea*	55	SS.SMu.CSaMu SS.SMu.CFiMu.SpnMeg
HG069_stn078	Muddy sand with shell material Muddy sand and boulders with *Flustra foliacea* and *Alcyonium digitatum*	67	SS.SSa.CMuSa CR.MCR.EcCr.FaAlCr.Flu
HG070_stn081	Gravel with shell material and *Pomatoceros* sp. Transition between PomB / FluCoAs.X	54	SS.SCS.CCS.PomB
HG071_stn082	Sandy gravel with shell material	51	CR.HCR.XFa.FluCoAs.X
HG072_stn084	Muddy sand with shell material Gravelly, muddy sand Gravelly, muddy sand with occasional cobbles, *F. foliacea* and A*.digitatum*	61	SS.SSa.CMuSa SS.SMx.CMx SS.SMx.CMx.(FluHyd)
HG073_stn083	Slightly muddy sand	65	SS.SSa.CMuSa

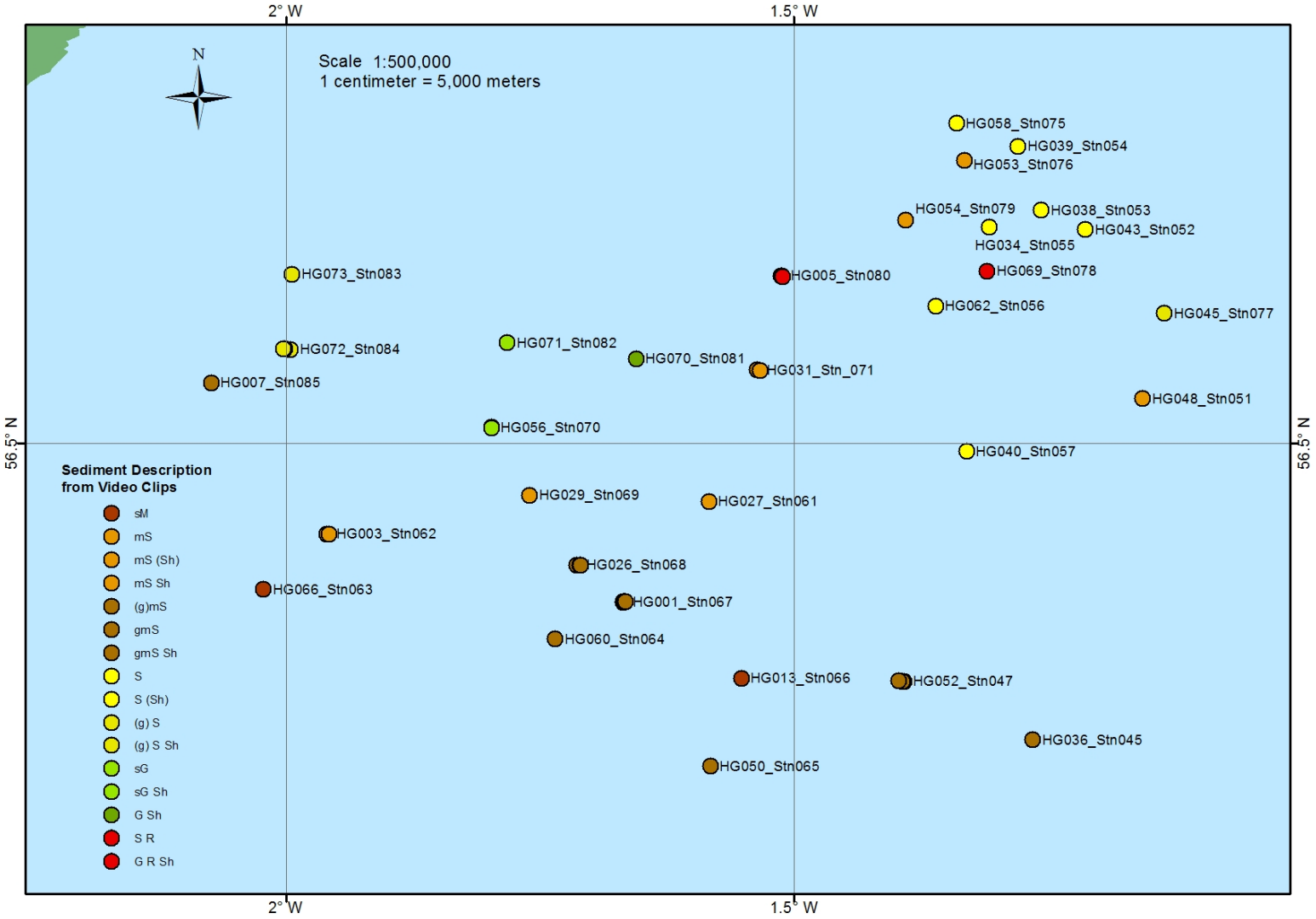

Figure 3.2 Sediment distribution of the Firth of Forth Banks Complex sampling stations (circles represent the starts of the video clip along each transect).

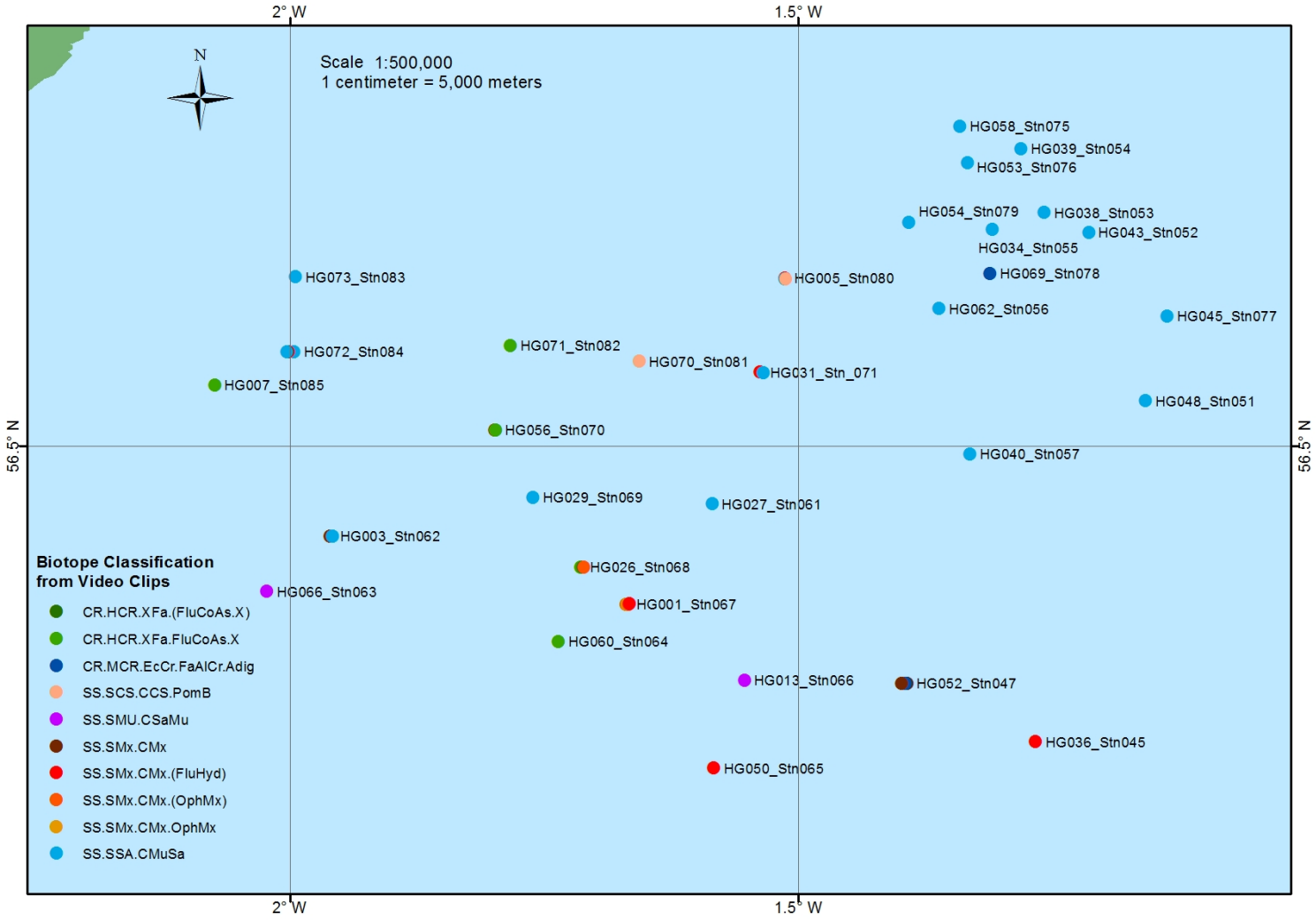

Figure 3.3 Biotope distribution of the Firth of Forth Banks Complex sampling stations (circles represent the starts of the video clip along each transect).

3.1.2 Summary of the biotopes in the Firth of Forth Banks Complex survey area

A total of 12 biotopes have been recorded in the Firth of Forth survey area (Table 3.3). At some locations the characteristic fauna were present or visible but only in low numbers or sparsely distributed. The sub-biotopes at these locations have therefore have been bracketed. For example, the SS.SMx.CMx.(OphMx) biotope was used were there where a high abundance of ophiuroids was present on mixed sediment, but not in the quantities that characterise the beds described by the biotope. Similarly, the SS.SMx.CMx.(FluHyd) biotope was used when only sparse clumps of *Flustra* were present on mixed sediment.

Table 3.3 Summary of biotopes (Connor *et al* 2004) recorded during Firth of Forth Banks Complex video analysis (with the number of records of each biotope from the video footage noted across the survey transects).

Biotope Name	Biotope Code	Records	Station(s)
Unstable circalittoral cobbles and pebbles	SS.SCS.CCS	1	HG005_stn080
Pomatoceros triqueter with barnacles and bryozoan crusts on unstable circalittoral cobbles and pebbles	SS.SCS.CCS.PomB	1	HG070_stn081
Circalittoral muddy sand	SS.SSa.CMuSa	23	See table 3.2
Circalittoral sandy mud	SS.SMu.CSaMu	2	HG013_stn066 HG066_stn063
Seapens and burrowing megafauna in circalittoral fine mud	SS.SMu.CFiMu.SpnMeg	1	HG066_stn063
Circalittoral mixed sediment	SS.SMx.CMx	8	See table 3.2
Flustra foliacea and *Hydrallmania falcata* on tide-swept circalittoral mixed sediment	SS.SMx.CMx.(FluHyd)	6	See table 3.2
Ophiothrix fragilis and/or *Ophiocomina nigra* brittlestar beds on sublittoral mixed sediment	SS.SMx.CMx.(OphMx) & SS.SMx.CMx.OphMx	3	HG001_stn067 HG026_stn068
Modiolus modiolus beds on open coast circalittoral mixed sediment	SS.SBR.SMus.ModMx	1	HG001_stn067
Flustra foliacea and colonial ascidians on tide-swept exposed circalittoral mixed substrata	CR.HCR.XFa.(FluCoAs.X) & CR.HCR.XFa.FluCoAs.X	8	See table 3.2
Alcyonium digitatum, *Pomatoceros triqueter*, algal and bryozoan crusts on wave-exposed circalittoral rock	CR.MCR.EcCr.FaAlCr.Adig	1	HG001_stn067
Flustra foliacea on slightly scoured silty circalittoral rock	CR.MCR.EcCr.FaAlCr.Flu	1	HG069_stn078

Of note is that the soft sediment biotope complexes (e.g. SS.SSa.CMuSa and SS.SMu.CSaMu) require infaunal data to allow a more detailed classification into biotopes. In addition, the classification of sediment grain size from photographic material is challenging and whether stations dominated by soft sediments should be classified as ‘muddy sand’ or ‘sandy mud’ requires particle size analysis. In general, those sites with smoother terrain

(i.e. flatter ripples) and a greater number of infaunal burrows were classified as sandy mud. These soft sediment sites tended to grade towards mixed sediment with relatively high amounts of gravel / broken shell material. The depth of these sites may also mean that the offshore circalittoral sand and mud biotopes may be more applicable. However, in order to properly distinguish between these biotopes infaunal data would be needed.

The CR.HCR.XFa.FluCoAs.X biotope occurred on mixed gravel beds with very high abundances of ascidians. This was the only biotope that adequately described the presence of ascidians on mixed substrata. The other rock biotope observed (CR.MCR.EcCr.FaAlCr.Adig) was found on large cobbles on areas of sand. Where *Alcyonium* was very abundant this biotope was assigned. These areas generally had 'low reefiness'.

The SS.SCS.CCS.PomB biotopes observed were very similar in sedimentary composition to the CR.HCR.XFa.FluCoAs.X biotope, but lacked very abundant ascidians. The ascidians appeared to have been replaced by high numbers of serpulid tube worms encrusting the mixed sediment.

In general many of the stations were transitions between two biotopes, usually soft sediment into mixed sediment. The biotope was assigned according to the characteristics of the sediment majority. For example, *Alcyonium* and *Flustra* was present on cobbles/pebbles at many of the SS.SSa.CMuSa sites, but occurred at low densities, so were defined as soft sediment biotopes rather than mixed sediment or rock biotopes.

3.1.3 Dominant and noteworthy biotopes

The SS.SSa.CMuSa biotope complex was the most widespread of all the biotopes/biotope complexes in the Firth of Forth survey area (see Table 3.3), and it was recorded along 23 transects. Other relatively common biotopes were CR.HCR.XFa.FluCoAs.X, SS.SMx.CMx, SS.SMx.CMx.(FluHyd) and SS.SMx.CMx.OphMx.

3.1.3.1 The SS.SSa.CMuSa biotope complex

The SS.SSa.CMuSa biotope complex is characterised by non-cohesive muddy sands but coarser sediment grain sizes might also be found in some locations (see Connor *et al*, 2004). The Firth of Forth locations were also characterised by sand ripples and some coarse material and shell in the troughs of the ripples (Figure 3.4).

This biotope complex is generally found in water depths in excess of 15-20m and it supports rich animal-dominated communities. There are two biotopes within this biotope complex, one dominated by *Abra alba* and *Nucula nitidosa,* and the second dominated by *Acrocnida brachiata* and *Astropecten irregularis*, but additional sediment sampling for infaunal analysis from the Firth of Forth will be required to assess these communities further.

Biotope complex characteristics

Depth range	10 – 50m
Sediment/substrata	Circalittoral non-cohesive muddy sands with a silt content between 5-20%
Dominant fauna/flora	Communities characterised by a wide variety of polychaetes, bivalves such as *Abra alba* and *Nucula nitidosa*, and echinoderms such as *Amphiura* spp and *Ophiura* spp., and *Astropecten irregularis*
Tidal streams	Moderately strong, weak, very weak
Wave exposure	Exposed, Moderately exposed
Other	Temporal variability in the dominant species

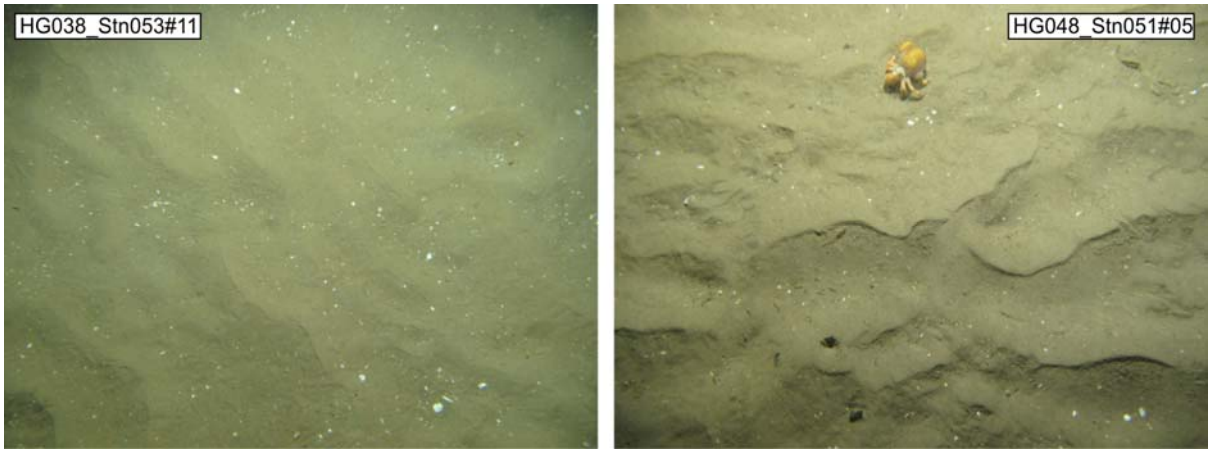

Figure 3.4 Photographic examples of SS.SSa.CMuSa.

3.1.3.2 The CR.HCR.XFa.FluCoAs.X sub-biotope

The Firth of Forth sites classified as CR.HCR.XFa.FluCoAs.X is characterised by coarse sediments with a high abundance of ascidians. These are all relatively small in size making identification of these taxa challenging (Figure 3.5). *Flustra foliacea* is also present throughout but perhaps at slightly lower abundance than would typically be the case. However, overall the description in Connor *et al* (2004) "*Flustra foliacea* and colonial ascidians on tide-swept exposed circalittoral mixed substrata" matches the habitats found in the Firth of Forth (Figure 3.5).

Biotope complex characteristics

Depth range	5 – 30m
Sediment/substrata	Boulders, cobbles and pebbles
Dominant fauna/flora	*Characterised by Flustra foliacea* and ascidians. Other potential fauna include *Nemertesia* spp., *Alcyonium digitatum, Stelligera* spp., *Cerianthus lloydii, Urticina* sp., *Pisidia longicornis, Cancer pagurus, Calliostoma zizyphinum*, *Gibbula cineraria Asterias rubens, and Ophiothrix fragilis*.
Tidal streams	Strong, Moderately strong, weak
Wave exposure	Extremely exposed, Very exposed, Exposed, Moderately exposed
Other	Found at wave exposed locations

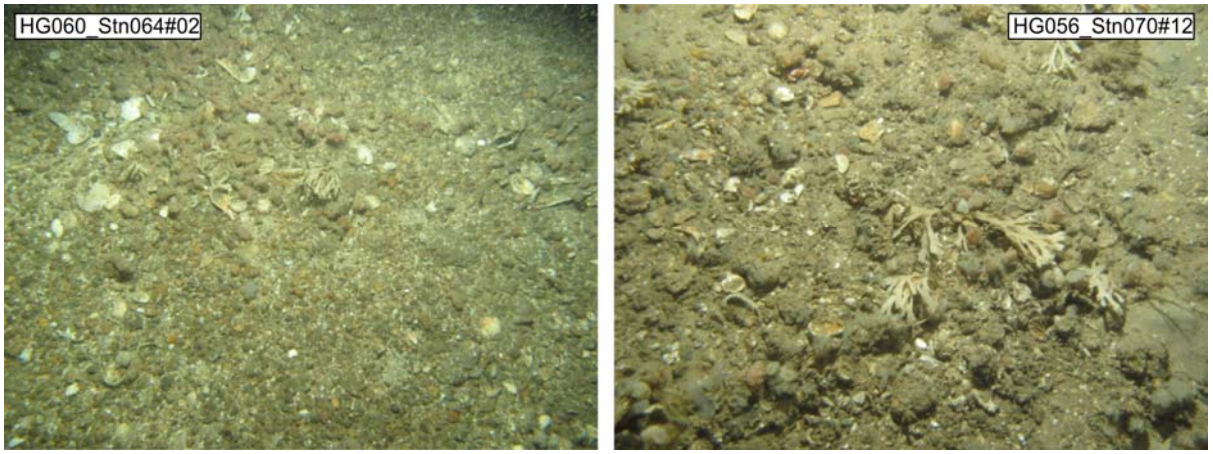

Figure 3.5 Photographic examples of CR.HCR.XFa.FluCoAs.X.

3.1.3.3 The SS.SMx.CMx.(FluHyd) biotope

This biotope is described as *Flustra foliacea* and *Hydrallmania falcata* on tide-swept circalittoral mixed sediment (see Connor *et al* 2004). The sediment description falls within the typical biotope description. However, all the stations in the Firth of Forth survey identified as this biotope have all been bracketed as the abundance of the characterising fauna is lower than perhaps would be expected in the typical biotope (Figure 3.6).

Connor *et al* (2004) describes this biotope as a transition between sand-scoured circalittoral rock, where the epifauna is conspicuous enough to be considered as a biotope, and a sediment biotope where an infaunal sample is required to characterise it and is possibly best considered an epibiotic overlay. This description fits well with the result of the current study as many still photographs are transitional in character with mixed sediment, finer (sandy) sediment and coarser, rocky sediments found together at many locations.

Biotope complex characteristics

Depth range	5 – 50m
Sediment/substrata	Boulders, cobbles or pebbles with gravel and sand
Dominant fauna/flora	*Flustra foliacea*, *Hydrallmania falcata*, *Nemertesia antennina Iand Alcyonium digitatum*. Other species present include *Alcyonidium diaphanum*, *Vesicularia spinosa* and *Lanice conchilega*.
Tidal streams	Strong, Moderately strong
Wave exposure	Exposed, Moderately exposed
Other	Characterised by a bryozoan/hydroid turf with Dead Man's fingers

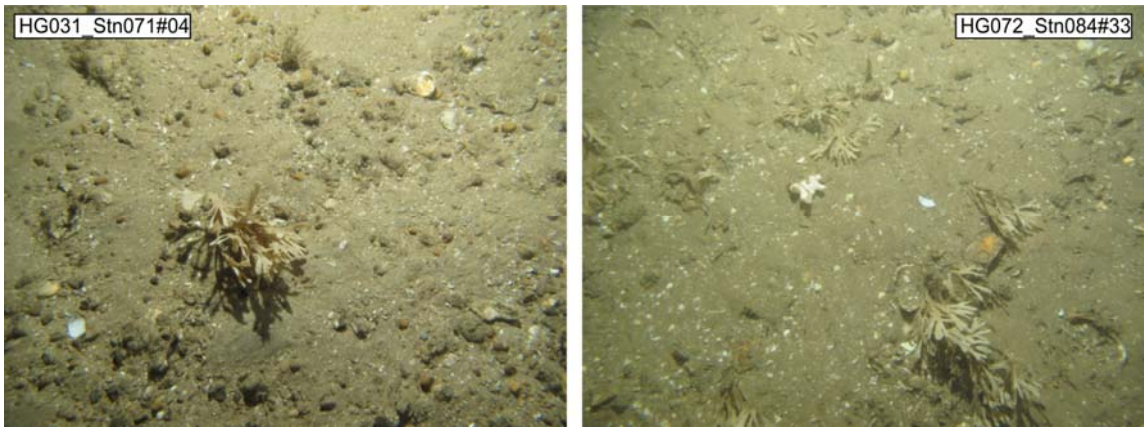

Figure 3.6 Photographic examples of SS.SMx.CMx.(FluHyd).

3.1.3.4 The SS.SMx.CMx.OphMx biotope

Habitats with the sediment dominated by brittlestars (hundreds or thousands m-2) forming dense beds belongs under the SS.SMx.CMx.OphMx biotope. The brittlestars live epifaunally on boulder, gravel or sedimentary substrata (Figures 3.7 and 3.8) and the beds can vary in size, with the largest extending over hundreds of square metres of sea floor. In the Firth of Forth analysis the dense aggregations and those of lower abundance were distinguished by bracketing the low abundance sites (cf. Figures 3.7 and 3.8).

The internal structure on the OphMx beds is usually patchy, with localized concentrations of higher animal density (Connor *et al* 2004). *Ophiothrix fragilis* or *Ophiocomina nigra* may dominate separately or there may be mixed populations of the two species. In the Firth of Forth study one station (HG001_Stn067) has a mixed population of both species whilst one is dominated by *Ophiocomina nigra* (HG026_Stn068). Of particular note is that the sediment

based beds, like those seen in the Firth of Forth, may contain a rich associated infaunal community but additional sampling will be required to assess this fully.

Biotope complex characteristics

Depth range	5 – 50m
Sediment/substrata	Mixed sediment often with cobbles and pebbles
Dominant fauna/flora	*Ophiothrix fragilis, Ophiocomina nigra, Nemertesia* spp., *Alcyonium digitatum,* Other species present include and edible crabs *Cancer pagurus*, swimming crabs *Necora puber*, *Liocarcinus* spp., and hermit crabs *Pagurus bernhardus* as well as *Echinus esculentus, Asterias rubens*, *Crossaster papposus* and *Luidia ciliaris.*
Tidal streams	Strong, Moderately strong, weak
Wave exposure	Moderately exposed, sheltered
Other	Characterised by the ophiurods *Ophiothrix* and *Ophiocomina*

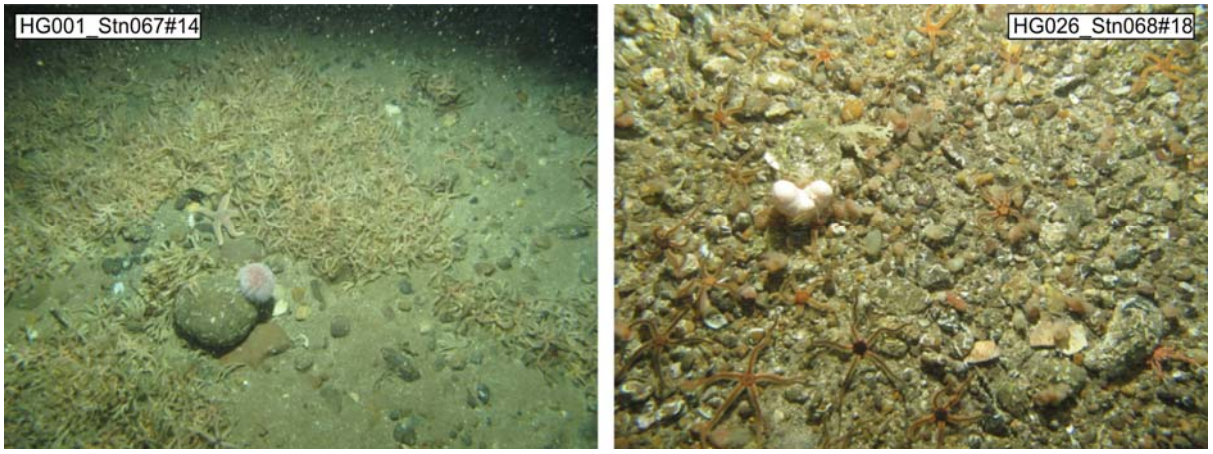

Figure 3.7 Photographic examples of SS.SMx.CMx.OphMx.

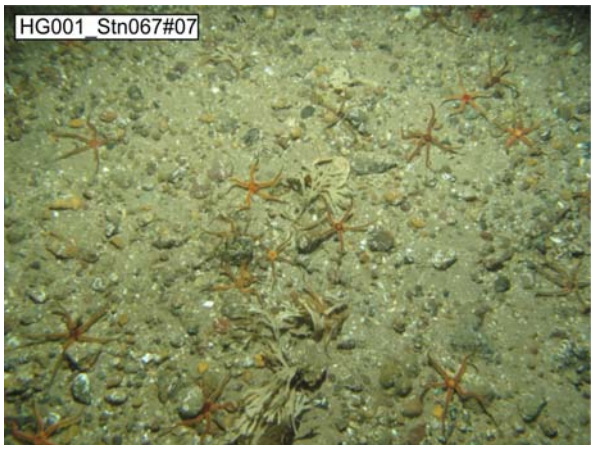

Figure 3.8 Photographic examples of SS.SMx.CMx.(OphMx).

3.1.3.5 The SS.SBR.SMus.ModMx biotope

The SS.SBR.SMus.ModMx is described as muddy gravels and coarse sands with beds of *Modiolus modiolus*. These beds occur in deeper water of continental seas with *M. modiolus* occurring in numbers of approximately 4 individuals/m^2, descriptions all similar to those seen in the Firth of Forth footage (Figure 3.9). These beds were not obvious from the video footage but there were several images revealing the presence of *M. modiolus* but only one

could be clearly classified as a *Modiolus* bed. However, there may be addition individuals present and there may be more extensive beds in the area, therefore supporting a very rich infaunal community with a high density of polychaete species as described below.

Biotope complex characteristics

Depth range	50 – 100m
Sediment/substrata	Muddy gravel and sand with shell and stones
Dominant fauna/flora	Dominated by *Modiolus modiolus*. Other fauna include a high density of polychaete species including *Glycera lapidum*, *Paradoneis lyra*, *Aonides paucibranchiata*, *Laonice bahusiensis*, *Protomystides bidentata*, *Lumbrineris* spp., *Mediomastus fragilis* and syllids such as *Exogone* spp. and *Sphaerosyllis* spp. Bivalves such as *Spisula elliptica*, *Timoclea ovata* and other venerid species are common together with the brittlestar *Amphipholis squamata*
Tidal streams	Moderately strong
Wave exposure	Sheltered
Other	Similar to the 'Deep Venus community'

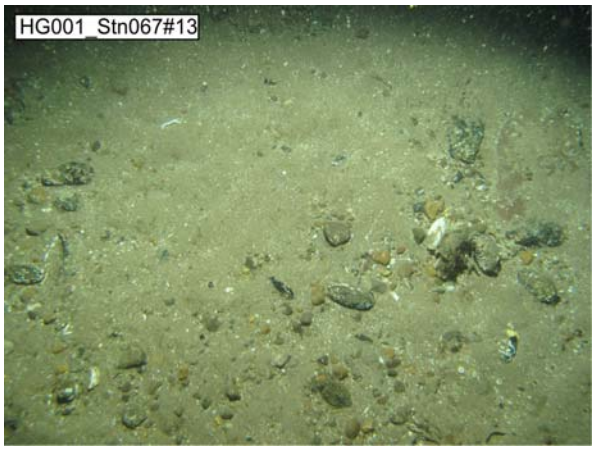

Figure 3.9 Photographic examples of SS.SBR.SMus.ModMx.

3.1.3.6 The SS.SMu.CFiMu.SpnMeg biotope

The SS.SMu.CFiMu.SpnMeg biotope is typified by plains of fine mud at depths greater than about 15m. These sediments may be heavily bioturbated by burrowing megafauna with burrows and mounds forming prominent features on the sediment surface. The fauna is characterised by conspicuous populations of seapens, typically *Virgularia mirabilis* and *Pennatula phosphorea*.

The seabed classified as SpnMeg in the Firth of Forth footage is described as sandy mud with some ripples with vertical burrows and polychaete faecal casts (Figure 3.10). The seapen *Pennatula phosphorea* is present throughout and this taxon was identified in both the video and the still photographs. However, many of the other fauna typically associated with this biotope (e.g. *Nephrops norvegicus, Cerianthus lloydii*) were not observed (see Connor *et al* 2004). The main associated fauna at the Firth of Forth site were anthozoans (e.g. *Alcyonium digitatum*), polychaetes, bryozoans (e.g. *Flustra foliacea*) and echinoderms (e.g. *Crossaster papposus*).

Biotope complex characteristics

Depth range	10 – 50m
Sediment/substrata	Mud
Dominant fauna/flora	*Virgularia mirabilis* and *Pennatula phosphorea* are characteristic. Other fauna include *Nephrops norvegicus, Cerianthus lloydii,* the polychaetes *Pholoe* spp., *Glycera* spp., *Nephtys* spp., spionids, *Pectinaria belgica* and *Terebellides stroemi*, the bivalves *Nucula sulcata*, *Corbula gibba* and *Thyasira flexuosa*, and the echinoderm *Brissopsis lyrifera*
Tidal streams	Weak, very weak
Wave exposure	Moderately exposed, sheltered, very sheltered
Other	Typically found in sealochs

Figure 3.10 Photographic examples of SS.SMu.CFiMu.SpnMeg.

3.1.4 MPA search features and ANNEX I habitats

3.1.4.1 MPA Search Features

Four Scottish MPA Search Features were observed from the Firth of Forth footage; 'offshore subtidal sands and gravels', 'offshore deep sea muds', 'burrowed mud' and 'Horse mussel beds' (Tables 3.2 and 3.4 as well as Figure 3.11). An area of circalittoral burrowed mud (**SS.SMu.CFiMu.SpnMeg** biotope) was observed at site HG066_Stn063, whilst the horse mussel *Modiolus modiolus* was seen at site HG001_Stn067. Although *M. modiolus* was mainly seen as individuals covered by the ophiuroid *Ophiothrix fragilis*, a small section of only mussel was seen with abundance sufficiently high (c. 4 individuals/m^2; see Connor *et al* 2004) to be characterised by the biotope **SS.SBR.SMus.ModMx** and qualify as a MPA Search Feature. However the search feature is a territorial water feature and this example lies in offshore waters.

Those samples of the biotope complex CCS, CMuSa or CMx are assignable to the MPA Search Feature 'Offshore subtidal sands and gravels'. It could also be argued that those samples classified as CR.HCR.XFa.FluCoAs.X should also be assigned to this search feature on account of the mixed sediment substrate. Further sediment sampling will be needed to assess the infaunal communities present to enable biotope assignment to a higher resolution for those remaining at the biotope complex level as it has not been possible from the photographic analysis of the sites. Those samples of the biotope complex circalittoral sandy mud, CSaMu, are assignable to the search feature 'offshore deep sea muds'.

Table 3.4 Summary of the MPA Search Features in the Firth of Forth Banks Complex survey area.

MPA Search Feature	Biotope Codes	Stations
"Offshore sands and gravels"	SS.SCS.CCS, SS.SMx.CMx, SS.SSa.SMuSa	HG001_stn067, HG003_stn062, HG005_stn080, HG013_stn066, HG026_stn068, HG027_stn061, HG029_stn069, HG031_stn071, HG034_stn055, HG036_stn045, HG038_stn053, HG039_stn054, HG040_stn057, HG043_stn052, HG045_stn077, HG048_stn051, HG050_stn065, HG052_stn047, HG053_stn076, HG054_stn079, HG056_stn070, HG058_stn075, HG060_stn064, HG062_stn056, HG069_stn078, HG070_stn081, HG072_stn084, HG073_stn083
"Offshore deep sea muds"	SS.SMu.CSaMu	HG013_stn066, HG066_stn063
"Burrowed mud"	SS.SMu.CFiMu.SpnMeg	HG066_stn063
"Horse mussel beds"	SS.SBR.SMus.ModMx	HG001_stn067

3.1.4.2 Annex I reefs

Several of the sites from the Firth of Forth Banks Complex could be classified as having 'low reefiness' or be a 'stony reef' according to the JNCC guidelines on rocky reef habitats (Irving, 2009) but no other Annex I habitats are present (see Johnston *et al* 2002) in the survey area (Figure 3.12). The habitats in the Firth of Forth survey area were therefore assessed on this basis (Table 3.5).

Table 3.5 Summary of rocky reef habitats in the Firth of Forth Banks Complex survey area (X - not a stony reef; √ potential stony reef; √ √ - classified as 'stony reef').

Biotope Name	Biotope Code	Station(s)	Stony Reef	Comments
Unstable circalittoral cobbles and pebbles	SS.SCS.CCS	HG005_stn080	X	Coarse sand
Pomatoceros triqueter with barnacles and bryozoan crusts on unstable circalittoral cobbles and pebbles	SS.SCS.CCS.PomB	HG070_stn081	√	Cobbles and pebbles but scale is unknown and topographically (in)distinct
Alcyonium digitatum, *Pomatoceros triqueter*, algal and bryozoan crusts on wave-exposed circalittoral rock	CR.MCR.EcCr.FaAlCr.Adig	HG001_stn067	X	Potentially a stony reef but the 'fine' sediment component is large and the size of the (underlying) bedrock unknown. Further sampling may reveal a reef feature
Flustra foliacea and colonial ascidians on tide-swept exposed circalittoral mixed substrata	CR.HCR.XFa.FluCoAs.X CR.HCR.XFa.(FluCoAs.X)	HG005_stn080 HG007_stn085 HG060_stn064 HG071_stn082	√√	Cobbles (and finer sediment) arising from the seafloor with high abundance of ascidians and other epifauna
		HG056_stn070	√	Cobbles and ascidians but mainly soft sediments
Flustra foliacea on slightly scoured silty circalittoral rock	CR.MCR.EcCr.FaAlCr.Flu	HG069_stn078	√	Small boulders with *A. digitata* and other epifaunal taxa but extent of bedrock and feature remains unknown

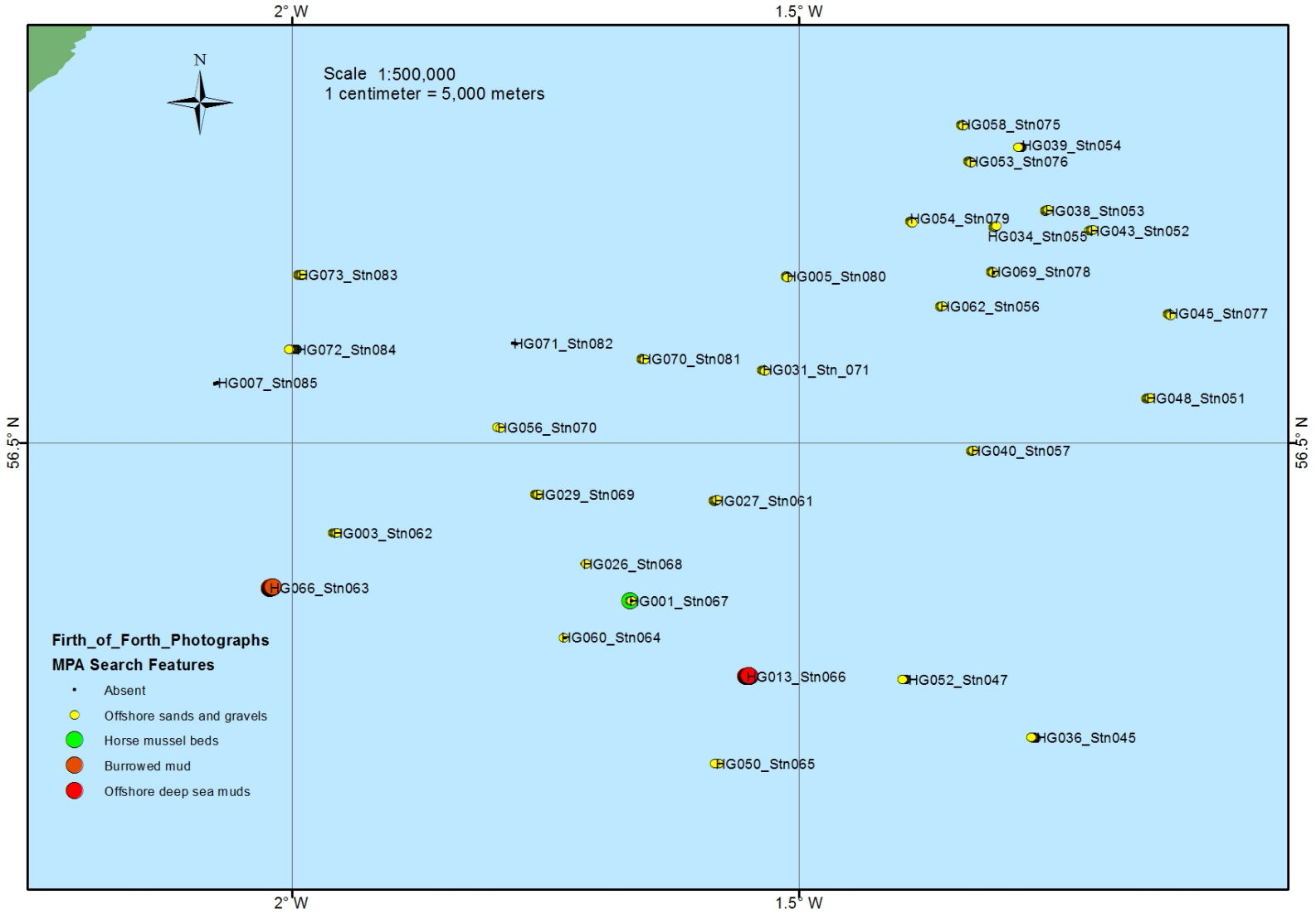

Figure 3.11 Scottish MPA Search Features in the Firth of Forth Banks Complex survey area (from photographs).

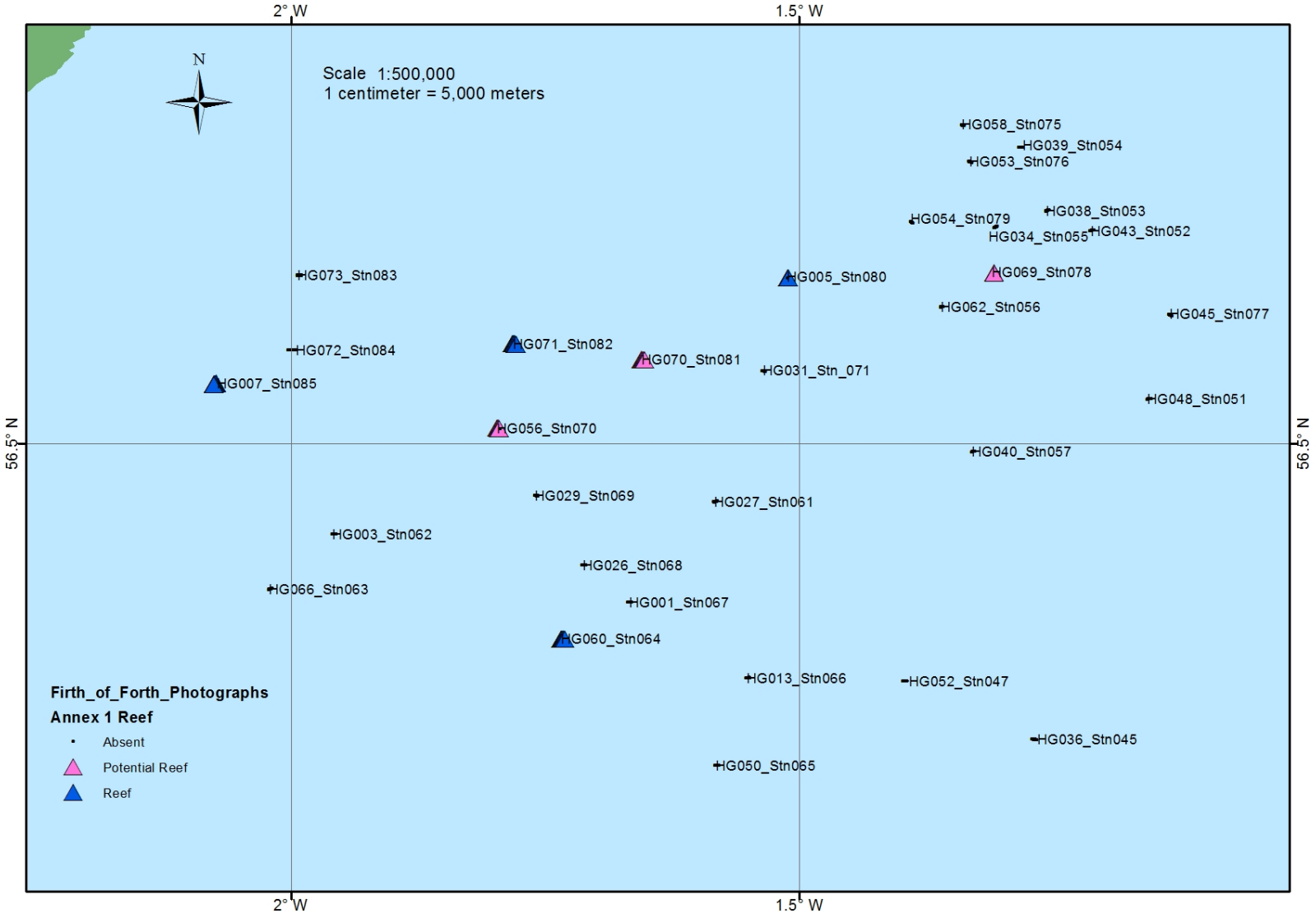

Figure 3.12 Scottish Annex I habitats in the Firth of Forth Banks Complex survey area (from photographs).

The analysis of the Firth of Forth data resulted in four 'stony reef' sites (Table 3.4). These should therefore be classified as 'reefs' under the Manual of European Habitats Annex I habitats and all sites classified as 'stony reefs' sub-type. The seabed environment at these locations were characterised by moderately large pebbles and cobbles on a matrix of muddy sand and gravel colonized by large aggregations of ascidians or *Alcyonium digitatum* (Figure 2.1). The Horse Mussel Beds MPA Search Feature (see Figure 3.11) also potentially qualifies as a 'reef' habitat, with 'biogenic reef' being the sub-type, but as this feature is only present in one still photograph it was considered too small to qualify as an Annex I 'reef' in this study (Figure 3.12).

There are three further sites that could potentially be classified as 'stony reefs' but further sampling will be required to assess fully as the topography was indistinct, the soft sediment component was too large or the extent was unknown (minimum requirement from Irving (2009) is 25 m^2) at these locations.

The sites within the SS.SCS.CCS biotope were dominated by sand and were therefore not classified as stony reef habitats. Sites from HG026_Stn068 (classified as CR.HCR.XFa.FluCoAs.X) were characterised by coarse sediments but not sufficiently large to be classified as a 'stony reef'.

3.1.5 Limitations

3.1.5.1 Infaunal data

The biotope classification system is based on both epi- and infaunal sample analysis. The analysis in the current study is based purely on camera footage. The addition of infaunal sample results would improve the quality of the results in the current study to ensure the habitats classified into biotopes are as detailed as possible.

3.2 IBTS Quarter 4, 2011, to the north and west of Scotland

A total of 3 hours and 36 minutes of video and 221 still photographs were analysed from the 7 stations sampled during the IBTS survey (Table 3.6 with more detail in Appendix 2). The locations of the still photographs and video transects are given in Figures 1.2 and 3.13.

Table 3.6 Video and still photographs analysed as part of the IBTS Q4 survey.

Area name	Stn no.	Date	Shoot time	Duration (mins)	No. of stills
Windsock East	1a	20/11/2011	21:16:00	00:29:00	30
Windsock West	2a	21/11/2011	02:24:00	00:29:00	30
Windsock West	2b	21/11/2011	03:49:00	00:28:00	30
Hebridean Slope South	4a	04/12/2011	23:38:00	00:31:00	34
Hebridean Slope North	5a	05/12/2011	21:05:00	00:31:00	31
Hebridean Slope North	5b	05/12/2011	22:36:00	00:31:00	31
Hebridean Slope Central	6a	06/12/2011	01:32:00	00:37:00	35
Totals				**3 hrs 36 mins**	**221**

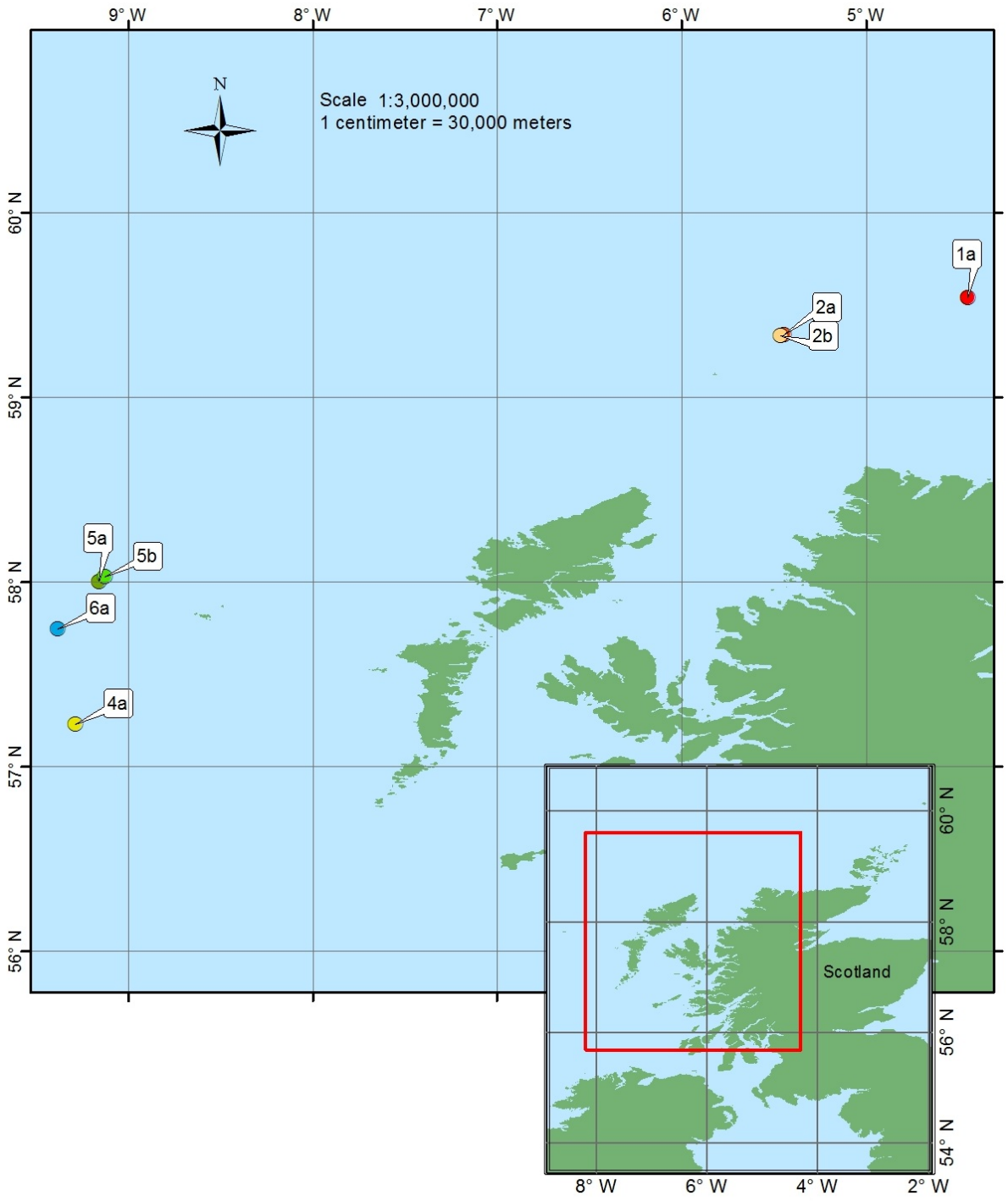

Figure 3.13 Sample locations in the IBTS Q4 survey area.

3.2.1 The main habitats in the IBTS survey area

The main habitats identified (from still photographs and video footage) in the IBTS survey area are summarised in Table 3.7 and illustrated in Figures 3.14 to 3.15 and in Appendix 04. Coarse sand is the dominant type of substratum across the IBTS survey transects. Muddy sand was present along lines 5a and 5b but all other transects (1a, 2a, 2b, 4a and 6a) were dominated by coarse sand. The dominant and characterising fauna in the coarse sand was *Ditrupa arietina* but small colonies of Scleractinian corals were also identified in these areas.

The muddy sand areas were characterised by the *Caryophyllia smithii* and *Actinauge richardi* anemones. *Pennatula phosphorea* were also found in some sections.

Table 3.7 Summary of substrata, fauna and biotopes present along each survey transect in the IBTS Q4 survey area.

Line	Habitat/faunal summary	Depth (m)	Biotope(s)
1a	Sandy gravel with shell material. Coarse sand with abundant *Ditrupa arietina.* Sand with shell material	98	SS.SCS.OCS SS.SCS.OCS.(Dar) SS.SSA.OSa
2a	Coarse sand with abundant *Ditrupa arietina.* Sand with gravel and shell material. Gravelly coarse sand and rock (cobbles / bedrock) with small colonies of hard corals (believed to be *Madrepora oculata* and *Lophelia pertusa*).	108	SS.SCS.OCS.(Dar) SS.SMx.OMx Highly sediment draped scattered coral framework
2b	Coarse sand with abundant *Ditrupa arietina.* Gravelly sand with cobbles. Gravelly coarse sand (veneer) and rock (cobbles / bedrock) with small colonies of hard corals (believed to be *Madrepora oculata* and *Lophelia pertusa*) surrounded by sand.	110	SS.SCS.OCS.(Dar) SS.SMx.OMx Highly sediment draped scattered coral framework
4a	Sandy gravel with shell material. Coarse sand with abundant *Ditrupa arietina.*	225	SS.SCS.OCS SS.SCS.OCS.(Dar)
5a	Slightly gravelly muddy sand, sometimes with higher percentage gravel, with *Caryophyllia smithii* and *Actinauge richardi* anemones. Some areas also with *Pennatula phosphorea*.	205	*Caryophyllia smithii* & *Actinauge richardi* on sand/gravelly sand
5b	Muddy sand with pebbles. Slightly gravelly muddy sand, sometimes with higher percentage gravel, with *Caryophyllia smithii* and *Actinauge richardi* anemones.	200	SS.SCS.OCS Atlantic Upper slope Sand *Caryophyllia smithii* & *Actinauge richardi* on sand/gravelly sand
6a	Gravelly sand, sometimes with cobbles, with sparse *Ditrupa arietina*. Gravelly coarse sand with abundant *Ditrupa arietina*.	215	SS.SCS.OCS SS.SCS.OCS.(Dar)

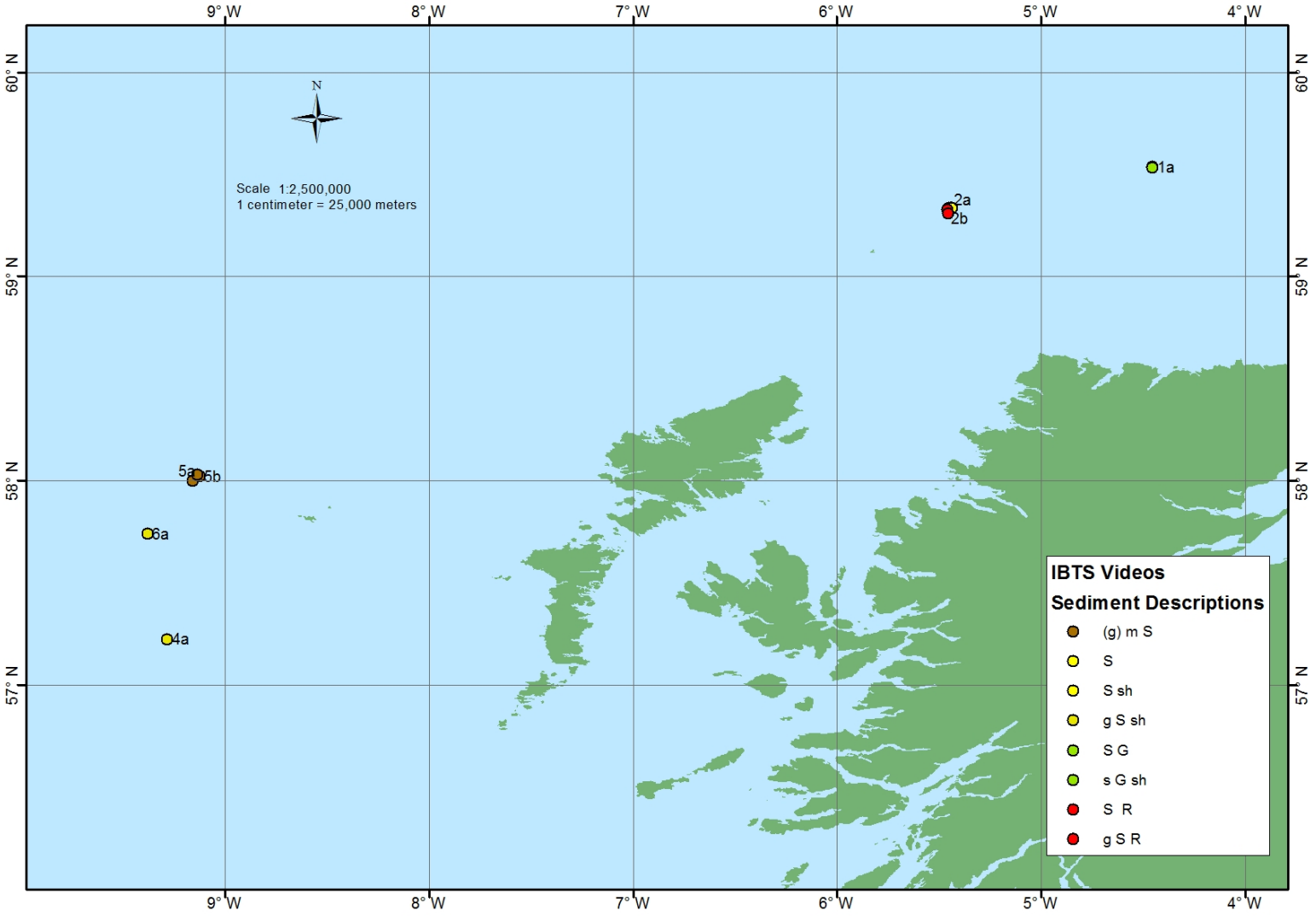

Figure 3.14 Sediment distribution in the IBTS Q4 survey area.

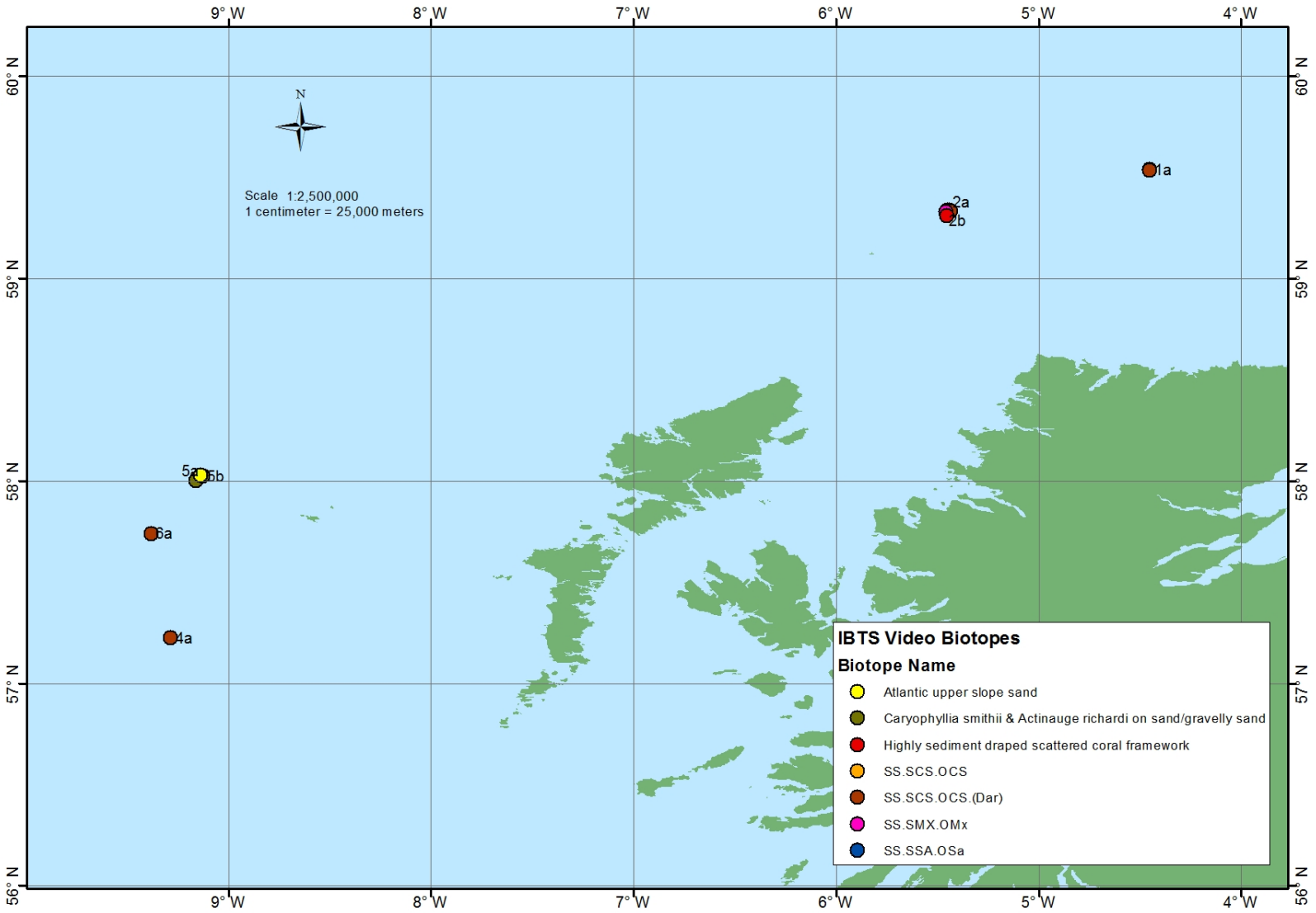

Figure 3.15 Biotope distribution in the IBTS Q4 survey area.

3.2.2 Summary of the biotopes in the IBTS survey area

A total of seven biotopes were identified along the IBTS Q4 survey transects (Table 3.8). Three of these are newly proposed (by Howell 2010), three belong to the shallow-water biotope classification system (Connor *et al* 2004) and one is a potential new biotope (SS.SCS.OCS.Dar).

Table 3.8 Summary of biotopes in the IBTS Q4 survey area.

Biotope name	Characterising taxa	Substratum	Supporting reference
SS.SCS.OCS	Robust infaunal polychaete and bivalve species	Coarse sands and gravel	Connor *et al* 2004
SS.SCS.OCS.(Dar)	*Ditrupa arietina*	Coarse sand	Potential New Biotope
SS.SSA.OSa	Little data available but likely to be a range of polychaetes, amphipods, bivalves and echinoderms	Fine sands or non-cohesive muddy sands	Connor *et al* 2004
SS.SMx.OMx	Little data available but likely to have highly diversity of infaunal polychaete and bivalve species	Sand with gravel and shell material	Connor *et al* 2004
Atlantic Upper Slope Sand	Unknown	Atlantic Upper Slope Sand	Howell 2010
Caryophyllia smithii and *Actinauge richardi* on sand/gravelly sand	*Caryophyllia smithii* and *Actinauge richardi* anemones	Atlantic Upper Slope Muddy sand/gravelly muddy sand	Newly proposed; JNCC 2012
Highly sediment draped scattered coral framework	*Lophelia pertusa*, other Scleractinian corals	Bioherm Upper slope *Lophelia pertusa* reefs	Howell 2010

3.2.2.1 Deep-sea biotopes

A new deep-sea biotope classification system is currently being developed by the JNCC. The newly proposed deep sea biotope classification system (Howell 2010), which JNCC is assessing as part of its own system development, is likely to grow and potentially change over the next few years but three of the proposed deep-sea biotopes were identified in the IBTS survey area (see Table 3.13).

All of the new biotopes require additional and detailed habitat descriptions. Some of the biotopes, particularly level 4, do have some brief descriptions but there are currently no descriptions for level 3 habitats. For example, the 'Atlantic Upper Slope (200m – 750m) Sand' biotope has currently no described associated fauna. The classification of IBTS seabed areas within this biotope is therefore based purely on the depth and sediment characteristics found at these locations.

The '*Caryophyllia smithii* and *Actinauge richardi* on sand/gravelly sand' and the 'Highly sediment draped scattered coral framework' have brief descriptions of the sediment types and characterising fauna present (Figures 3.16 and 3.17) within these habitats (Howell 2010;

JNCC 2012). The classification of the habitats in the IBTS survey is therefore primarily based on these descriptions.

Figure 3.16 Example photographs of '*Caryophyllia smithii* and *Actinauge richardi* on sand/gravelly sand' (A – 5a#08; B – 5a#11).

Figure 3.17 Example photographs of 'Highly sediment draped scattered coral framework' (A – 2b#24; B –2b#14; C – 2b#25; D – 2a#26).

The '*Caryophyllia smithii* and *Actinauge richardi* on sand/gravelly sand' biotope is dominated by muddy sand with various amounts of gravel, cobbles and the occasional rocky outcrop (Figure 3.16). The fauna is characterised by *Caryophyllia smithii* and *Actinauge richardi* but other fauna are also found including Paguridae sp., *Porania pulvillus, Ophiura* sp. and *Pennatula phosphorea*. There were no bedforms but *lebensspuren* created by asteroids, ophiurods, crustaceans and fish were frequently seen.

The areas classified as 'Highly sediment draped scattered coral framework' biotopes consist of small (tens of centimetres across) colonies of Scleractinian corals (*Lophelia pertusa* and *Madrepora oculata*) found on cobbles, small boulders or rocky outcrops surrounded by coarse sand or gravel (Figure 3.17). Other fauna include *Polymastia* sp., *Axinella infundibuliformis* and *Securiflustra securifrons* as well as various hydroids (e.g. *Abietinaria abietina*).

Despite the small size of the corals, these colonies still qualify as the PMF cold-water coral reef and as an Annex I habitat (see below) as there is no lower limit on the size for an Annex I reef (see Johnston *et al* 2002). These features are discussed further below.

3.2.2.2 Offshore circalittoral habitats with coarse sands and gravel

The sediments classified as SS.SCS.OCS among the IBTS stations are dominated by coarse sand and gravel but coarse sand dominates most of the habitats across these sites (Figure 3.18). The SS.SCS.OCS biotope is described as 'offshore (deep) circalittoral habitats with coarse sands and gravel or shell' (see Connor *et al* 2004) and matches the habitats seen in the IBTS survey area. It has previously been speculated that this habitat might cover large areas of the offshore continental shelf although there is relatively little quantitative data available (see Bett 2000). Taking the results from other studies (e.g. Dyer *et al* 1982; Dyer *et al* 1983; Cranmer *et al* 1984) together with the results from the current study into consideration suggests that the original speculation is correct.

Figure 3.18 Example photographs of the SS.SCS.OCS biotope (A – 2a#05; B – 1a#11).

The SS.SCS.OCS.(Dar) biotope is a potential new biotope. The habitat is dominated by coarse sand and characterised by the presence of the polychaete *Ditrupa arietina* (Figure 3.19). Gravel is often present but to a lesser degree than in the SS.SCS.OCS habitats within the IBTS survey areas. In addition, whilst *D. arietina* is found at high abundance along the SS.SCS.OCS.(Dar), this taxon is infrequently found and at a lower abundance on the gravelly sediment types (SS.SCS.OCS) along the IBTS survey lines.

The coarse sand with *Ditrupa* biotope is widespread across the IBTS sample locations and appears to be a distinctive and characteristic feature on the shelf and slope west of Scotland (mainland Scotland, Hebrides and Shetland). Several other studies have recorded and noted the presence of this habitat (Dyer *et al* 1982; Dyer *et al* 1983; Cranmer *et al* 1984; Bett, 2000) but it does not appear to have been given a biotope classification to date. This new biotope could be referred to as SS.SCS.OCS.Dar or form part of the deep sea biotope system under, for example, 'Atlantic, Upper Slope, Sand', *Ditrupa arietina* on coarse sand'. Additional infaunal data will be required to assess the distinctness of this habitat further.

Figure 3.19 Example photographs of the SS.SCS.OCS.(Dar) biotope (A – 2a#14; – 1a#17).

3.2.3 MPA search features, PMFs and ANNEX I habitats in the IBTS survey area

3.2.3.1 Offshore subtidal sands and gravels MPA Search Feature

As mentioned above, coarse sandy habitats were common across all the IBTS Q4 survey lines in this study, which essentially include the SS.SCS.OCS, SS.SMx.OMx, SS.SSA.OSa and SS.SSA.CFiSa biotopes. In fact, this habitat was present at all (1a, 2a, 2b, 4a and 6a) but two of the lines (5a and 5b). However, as muddy sands (at stations 5a and 5b) also qualify the habitats along lines 5a and 5b therefore also qualify as MPA Search Features 'offshore sands and gravels' (Figure 3.20). The habitats within the IBTS Q4 survey area therefore all qualify as the 'offshore sands and gravels' MPA Search Feature.

3.2.3.2 The PMF 'cold-water coral reef' and Annex I habitat

Colonial corals were identified along two transects; 2a and 2b (Figure 3.21). These colonies were relatively small (tens of centimetres across) but several were recorded along these two lines and larger reef structures may be present nearby. The colonies were found on small rocky outcrops consisting of cobbles, small boulders or patches of bedrock appearing out of the surrounding soft sediment. There appear to be two species present, *Lophelia pertusa* and *Madrepora* oculata but note the difficulties in identifying corals from underwater footage as these species are very similar and collection of samples would be required to identify these individuals to a high certainty.

These colonies are small but are still considered as 'reefs' as there is no size limit of these features in terms of qualifying as Annex I reefs (see Johnston *et al* 2002). Presumably this is, at least in part, a result of that fact these 'patches' have been suggested to potentially give rise to a ring of young colonies which could eventually result in a large reef structure (Wilson 1979a). In addition, cold deep-water coral have been given 'threatened and

declining' status (Scottish Government 2011) and these features are therefore considered as important species in terms of conservation. These habitats in the IBTS survey area (Figures 3.20 and 21) therefore qualify as the PMF 'cold-water coral reef' (Scottish Government 2011) and as Annex I 'reef' habitats (Johnston *et al* 2002). In addition, these habitats also qualify as the Annex I sub-type 'biogenic reef' (Johnston *et al* 2002). Of note is the presence of the '*Caryophyllia smithii* and *Actinauge richardi* on sand/gravelly sand' biotope as this is believed to be related to the PMF deep-water coral reef search feature but excluded on the grounds of there being no coral identified along these transects.

3.2.4 Limitations

3.2.4.1 Positional data

Some of the metadata (e.g. still photograph positions) are missing for some of the photos in the survey area (e.g. position fixing failed at stations 2a and 2b from the IBTSQ4 survey). This will potentially limit the positional detail given in the results at the end of the study.

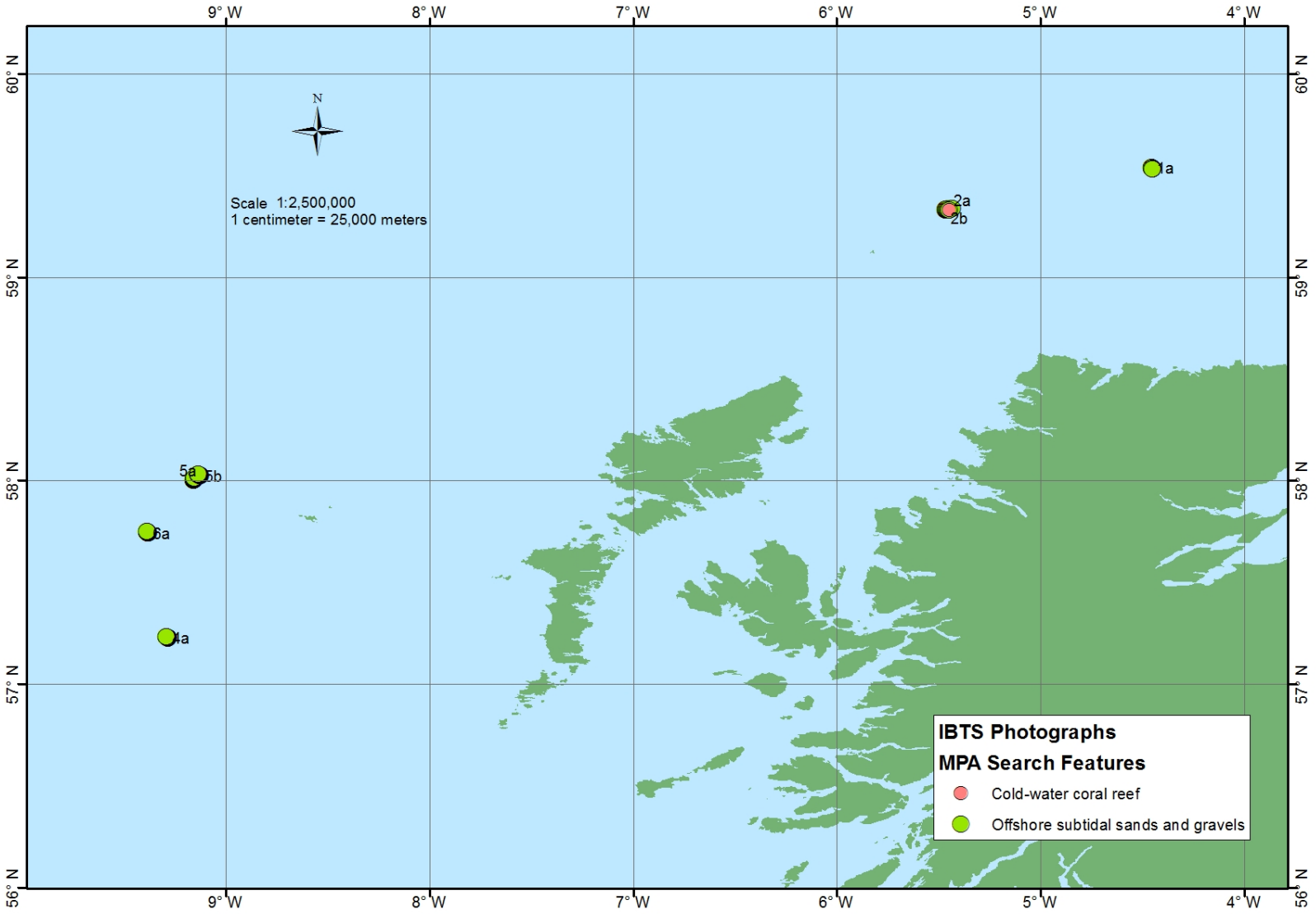

Figure 3.20 Scottish MPA Search Features in the IBTS Q4 survey area.

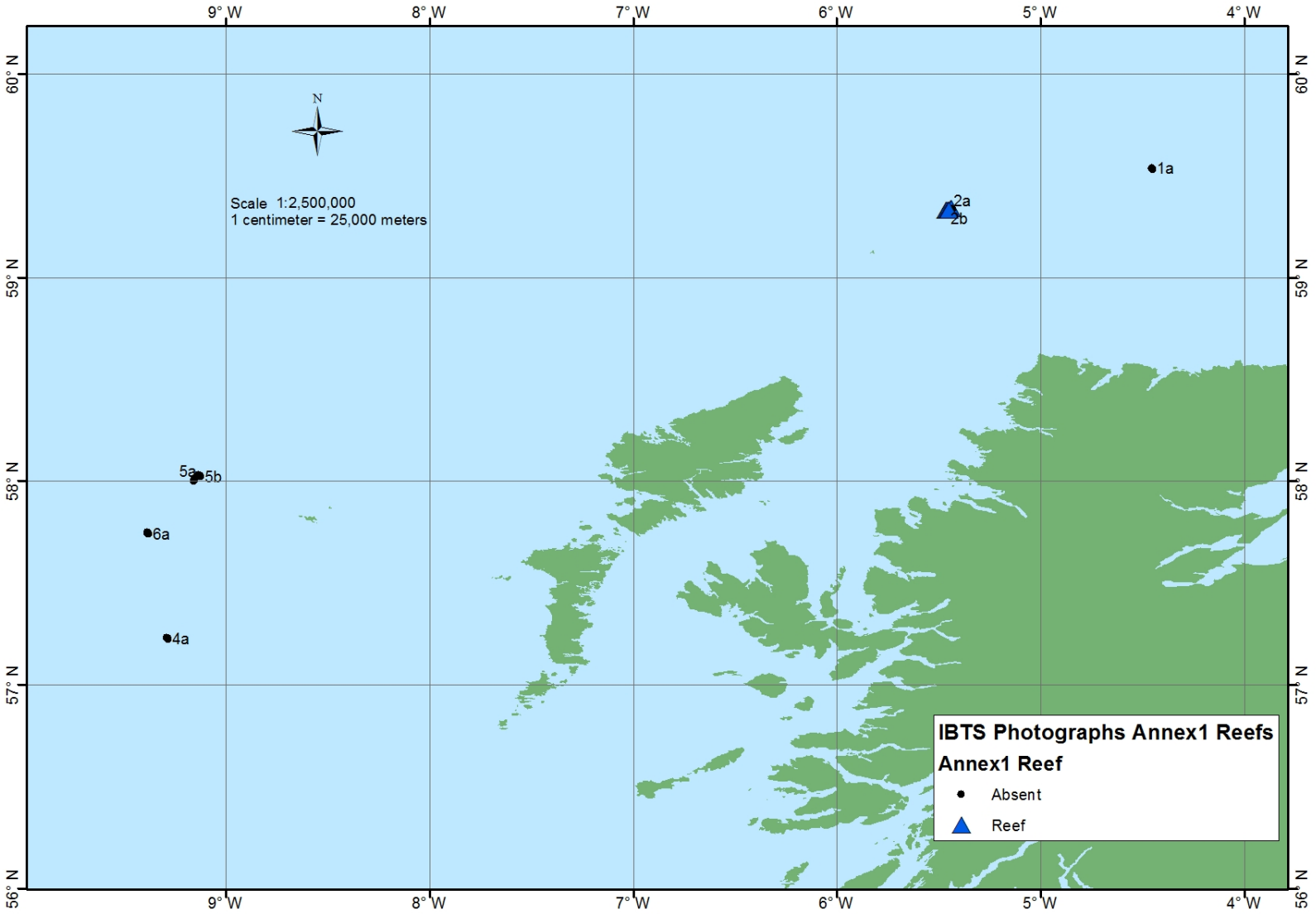

Figure 3.21 Annex I habitats in the IBTS Q4 survey area.

3.3 Selected MSS deep-water datasets on the Hebridean Slope, Rosemary Bank and Rockall Bank

The sites selected as part of the MSS deep-water datasets include two transects on Rockall Bank, one on the Hebridean Slope and three on Rosemary Bank (Figures 1.3 and 3.22).

Hebridean Slope potentially has Annex I reef habitats, particularly in the shallower sections of the slope where iceberg ploughmarks have been identified at depths ranging from 140 – 500 m (Belderson *et al* 1973). These are characterised by ridges made up by coarse sedimentary material (e.g. gravel, cobbles, small boulders) whilst the furrows are dominated by soft, fine material (Johnston *et al* 2002). The former may potentially qualify as Annex I habitats and as cobbles have been shown to dominate the substrata between 140m and 200m (Johnston *et al* 2002) these habitats may be widespread along the slope.

Rosemary Bank is a conically-shaped seamount which rises from around 1,830m deep to a doomed crest at around 370m (Johnston *et al* 2002). The underlying rock is basaltic, much of which is covered in a layer of sediment which predominantly sand with some gravel, cobbles and boulders. However, on the south-eastern flank of the seamount surveys have shown little or no sediment cover and rock dredges have brought up corals, bryozoans and sponges from a depth of c. 1,000m. Two samples of live *Lophelia pertusa* have been taken from the south flank of the bank (Wilson 1979b). Annex I reef habitats are likely to be patchy and may be confined to the flanks of the bank (Johnston *et al* 2002).

Rockall Bank is a large igneous rock feature which rises to the island of Rockall (Johnston *et al* 2002). Sediment cover is patchy with the western and south-western are of the plateau being devoid of sediment altogether. The sediment varies from sandy contourite and mud on the eastern flanks to cobbles and gravels on the western flanks. Exposed bedrock has been recorded on the north-west flank (potential Annex I habitat). *Lophelia pertusa* has been recorded as discrete patches around the bank and appearing to be fairly common at depths ranging from 130 to 400m (Wilson 1979b). Both *L. pertusa* and *Madrepora oculata* have been recorded on the south-east slope of Rockall Bank. Bedrock reef habitats may be present on the outer reaches of the Bank as well as around the island of Rockall and Helen's Reef. Potential stony reefs (Annex I reef habitats) are present to the north-west of the Bank (Johnston *et al* 2002) but further sampling will be required to assess these fully.

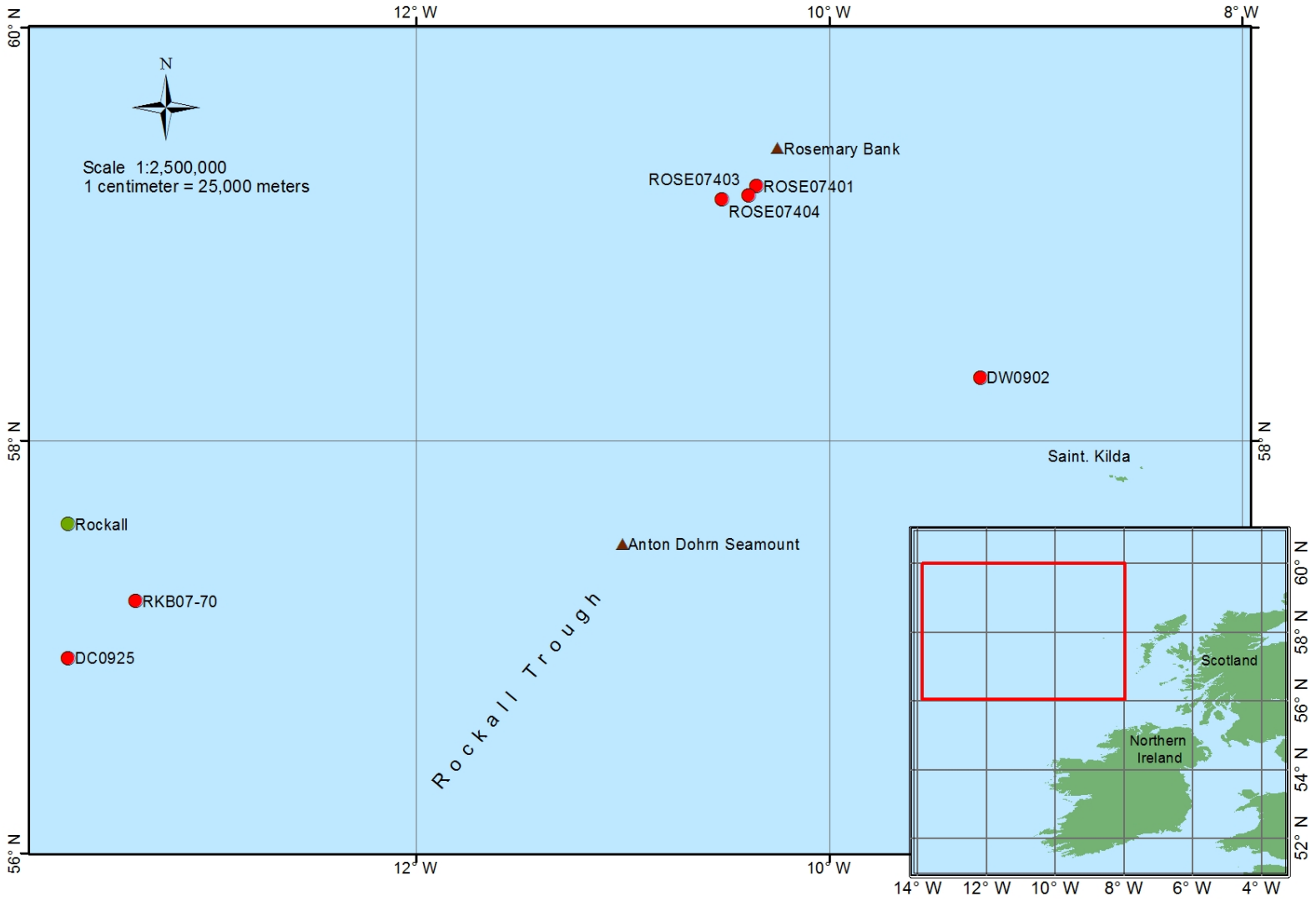

Figure 3.22 The positions of the Hebridean Slope, Rockall Bank and Rosemary Bank towed video sites.

3.3.1 The main habitats in the MSS survey area

3.3.1.1 Rockall Bank 2007 and 2009 survey habitats

The substratum along the Rockall Bank towed video sites from both 2007 and 2009 (RKB07-70 and DC0925) was made up primarily of muddy sand (medium to coarse) with some pebbles and shell material present on the seabed surface (Table 3.9 and Figure 3.23). The main characteristic fauna in the 2007 seabed footage was *Distichoptilum gracile* (see Appendix 05; Figures A and B). Echinoderms and Paguridae were also present but *D. gracile* was the most characteristic.

D. gracile colonies have been described as elongate, whip-like and up to 16cm in length (Lopez-Gonzalez *et al* 2001). This taxon has a cosmopolitan distribution with a wide bathymetric range of 793 to 4,300 m (Lopez-Gonzalez *et al* 2001; Williams 2011) but there is only limited information published about this taxon.

The 2009 Rockall Bank seabed footage was characterised by *Funiculina quadrangularis* together with *Pachycerianthus multiplicatus* and other anemones (Appendix 5; Figures C and D). Other identified fauna along this transect included Umbelluidae sp. and echinoderms.

The habitats in these two survey areas do not match any of the current deep-sea biotopes. The closest biotope is the 'Sagartiid anemones and juvenile pennatulids' but this habitat is found in muddy sediments which is not the case in the current study. There might therefore be a need to suggest these habitats as new deep sea biotopes, perhaps "Atlantic Upper bathyal Sand *Distichoptilum gracile* and other seapens on muddy sand" for RKB07-70 and "Atlantic Upper slope Sand *Funiculina quadrangularis* and other anthozoans on muddy sand" for DC0925 (Figure 3.24).

3.3.1.2 Hebridean Slope

The Hebrides Slope site consisted mainly of sandy mud with some empty shells and gravel (Table 3.9 and Figure 3.23). Two small sections of the video were found to have large boulders/bedrock but these were not sufficiently long (2-4m across maximum) to justify a classification change in the biotope assignment.

This area showed a higher level of bioturbation compared to the Rockall sites. These *lebensspuren* are exemplified by large feeding burrows. Tracks immediately around the burrows were also seen. A higher diversity of decapod taxa than the previous sites was also observed, however, no MPA search feature species was observed within this site. An artificial object (large oil drum) was identified along the transect.

Based on the observation of higher levels of bioturbation this site could be classified as the search feature "burrowed mud". However, the lack of visible characteristic benthic fauna (e.g. seapens), the lack of infaunal data together with the limited amount of burrowing within the sediment prevented these areas from qualifying as the "burrowed mud" Search Feature. Additional survey work would be required to assess this fully. However, based on the substrata this site may be classified as the 'offshore deep sea muds' MPA search feature.

This site was considered to fall within the newly proposed deep sea biotope classification system (see Howell 2010) as "Atlantic Upper slope Mud" (Figure 3.24). However, pebbles and shell material was present within the sediment (approximately 15% coverage over the entire transect). In addition, the lack of distinct epifaunal taxa prevents this habitat from falling within any of the newly proposed level 4 biotopes.

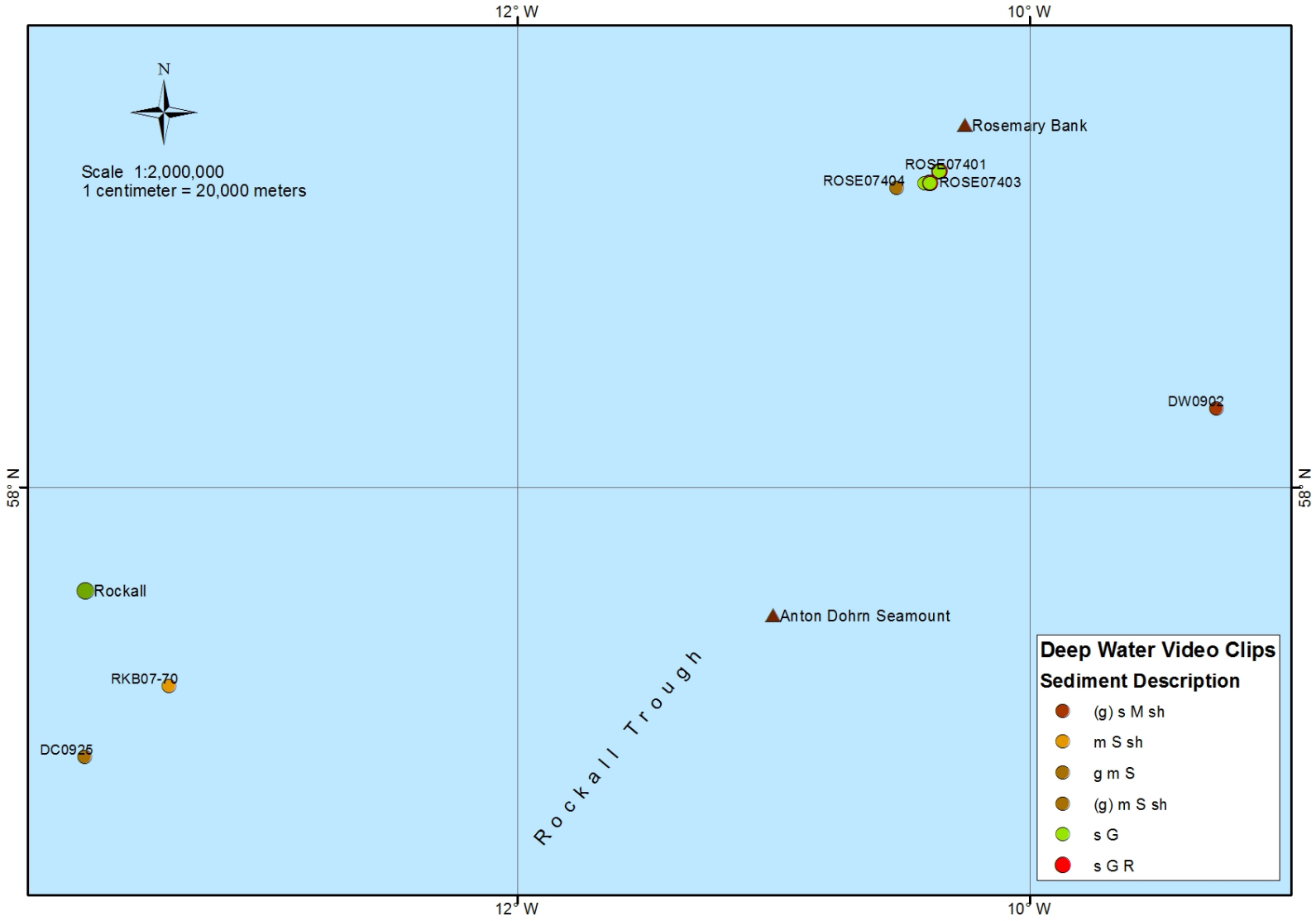

Figure 3.23 The sediment distribution at the Hebridean Slope, Rockall Bank and Rosemary Bank towed video sites.

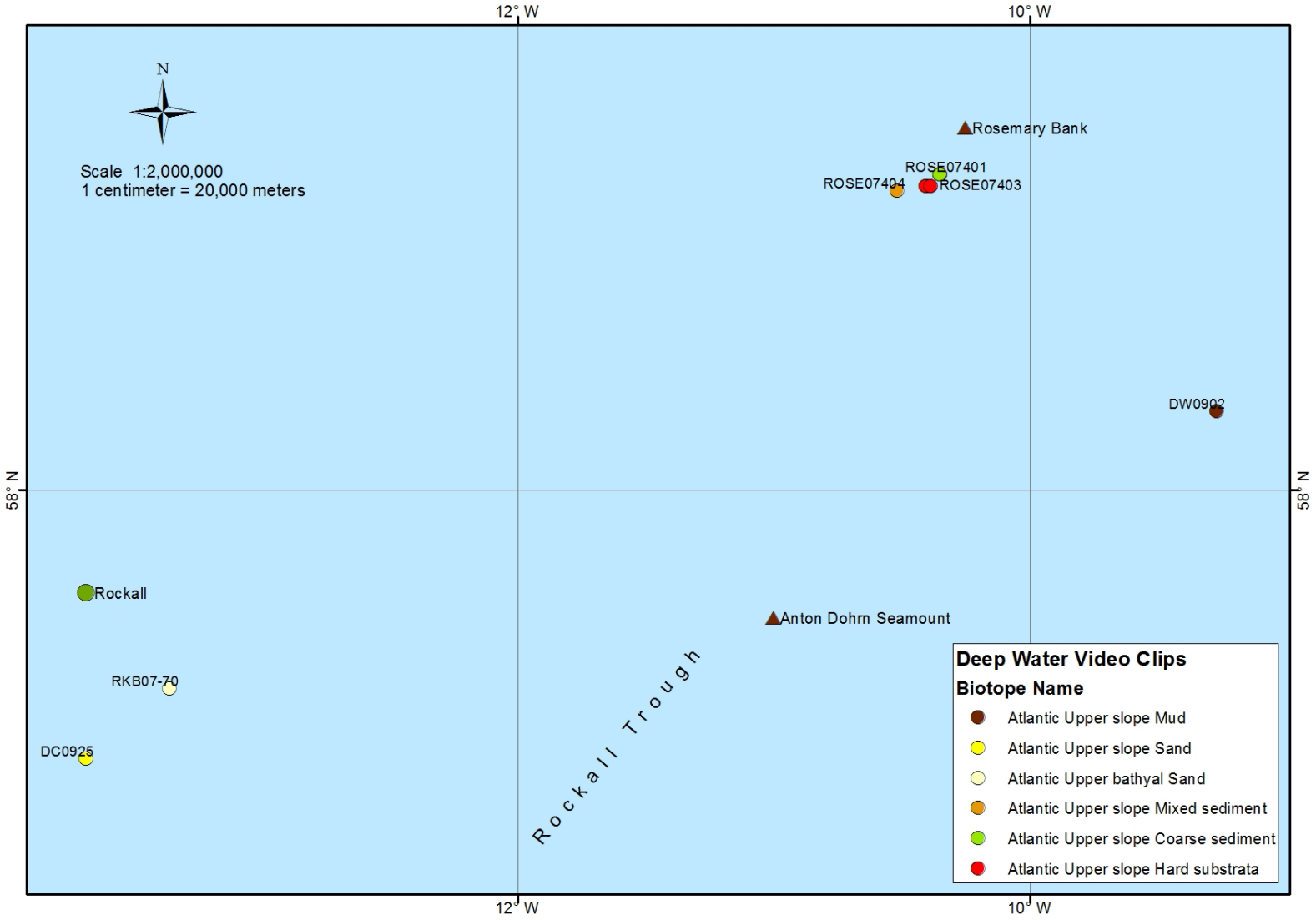

Figure 3.24 The biotope distribution at the Hebridean Slope, Rockall Bank and Rosemary Bank towed video sites.

3.3.1.3 Rosemary Bank

Site Rose07401

This transect was split into 6 distinct segments (see video analysis table) which were split between two deep sea biotopes 'Atlantic Upper slope Coarse sediment' and 'Atlantic Upper slope Hard substrata' (Table 3.9 and Figure 3.24).

The sections classified as 'Atlantic Upper slope Coarse sediment'' were characterised by sandy gravel with little visible fauna apart from *Cidaris cidaris* (Figure 3.23). The relative proportions of sand and gravel varied across the transect but gravel was the dominant sediment grain size overall.

The 'Atlantic Upper slope Hard substrata' biotope was characterised by a coarse substrata dominated by gravel, cobbles and small boulders. Anemones and sponges were seen on the cobbles and small boulders with decapods seen around the edges or underneath the rocks. *C cidaris* was also seen across the habitat. The identification of the anemones was particularly challenging as the camera was too far off the seabed or moving too fast but there appear to be several species with some within the Edwardsi or Halcampidae families.

Site Rose07403

This site was split into 5 different sections defined predominantly by the change in substrata (Figure 3.23). Essentially there were two main types of substrata: 1) coarse sandy gravel with cobbles and small boulders; and 2) an area defined by bedrock with cobbles, boulders surrounded by sandy gravel (Table 3.9). The fauna was similar in both areas, being characterised by encrusting white sponges, Hexactinellida sp., anemones (including Caryophyllids and unknown Actiniaria sp.), *Munida* sp. and *Cidaris cidaris*. Overall, *Munida* sp. and the encrusting white sponges were the most abundant across this site.

Both of these habitats were classified as "Atlantic Upper slope Hard substrata" (Figure 3.24). This was based on the large number of cobbles and small boulders throughout the transect. Within the areas of bedrock the classification becomes more obvious. The Caryophyllids were difficult to see on the video and could only be verified when the camera frame landed on the seabed. The actual abundance is therefore unknown, however, these anemones were present on many of the boulders and cobbles when the frame landed. Together with the high abundance of *Munida* sp. and the white encrusting sponges, these habitats could potentially qualify as the level 4 biotope "Caryophyllids, Munida and encrusting sponges on mixed substrata" but as a result of the difficulties in verifying the identity of the Caryophyllids along the entire transect the classification was left as "Atlantic Upper slope Hard substrata".

The habitat did vary slightly across the transect with small sections characterised by sandy gravel and sand and gravel but these sections were insufficiently large to justify a separate classification. None of these areas therefore qualify within the MPA Search Feature "offshore sub tidal sands and gravels".

Site Rose07404

The habitat at this site along the Rosemary Bank was similar throughout and therefore considered as one segment (Table 3.9). The site was deeper than the two previous sites and is characterised by gravelly sand (Figure 3.23). Some mud appears to be present, which is moved into suspension on landing of the camera frame. In addition, *lebensspuren were* present (e.g. feeding tracks, mounds and burrows) indicating the presence of mud but from the footage the substratum appeared to consist predominantly of coarse sediments.

The most abundant organism observed was Amphiuridae sp. (pink brittle star). It was seen on most landings of the camera frame but it was not visible whilst the frame was 'flying' above the seabed. Assessing the actual abundance was therefore challenging but it has been given an A (abundant) on the SACFOR scale as it was abundant on all landings throughout the transect. The highest densities of this taxon seemed to occur where there was an increase in pebbles within the substratum matrix. Other organisms included the rattail (Macrouridae sp.) and *Spatangus purpureus.*

The evidence of bioturbation in the form of burrows, mounds and tracks, created by the *Spatangus* urchins when moving along the sea bed, indicate low current speeds and reduced sediment disruption within this area.

None of the newly proposed biotopes (level 4) were observed at this site. It has therefore been classified as "Atlantic Upper slope Mixed sediment" (level 3; see Figure 3.24). Particle Size Analysis will be required to assess the exact sediment grain size distribution in this area. The high abundance of Amphiuridae sp. present here may result in the requirement for a new biotope but as this taxonomic group is difficult to identify additional footage and ideally infaunal samples will be required to assess this feature fully.

Table 3.9 Summary of substrata, fauna and biotopes present along each survey transect in the MSS survey area (approximate depth records; * depth unknown but deeper than 750m).

Line	Habitat/faunal summary	Depth (m)	Biotope(s)
Rockall Bank 2007	Muddy sandy (medium to coarse) sediment with occasional gravel and empty shells. The most abundant fauna was the seapen *Distichoptilum gracile*.	*	Atlantic Upper bathyal Sand (perhaps '*Distichoptilum gracile* and other seapens on muddy sand')
Rockall Bank 2009	Slightly gravelly muddy sand with some empty shells as well as pebbles. *Funiculina quadrangularis* and other anthozoans characterised the fauna.	208	Atlantic Upper slope Sand (perhaps '*Funiculina quadrangularis* and other anthozoans on muddy sand')
Hebridean Slope	Slightly gravelly sandy mud with shell material. Vertical burrows relatively common but not extensive. Characterising fauna included *Spatangus purpureus* and anemones.	440	Atlantic Upper slope Mud
Rosemary Bank site ROSE07401	Sandy gravel with *Cidaris cidaris* Sandy gravel and rock (cobbles and small boulders) with anemones, encrusting sponges, decapods and *C. cidaris.*	450	Atlantic Upper slope Coarse sediment Atlantic Upper slope Hard substrata
Rosemary Bank site ROSE07403	Sandy gravel, cobbles and small boulders with anemones (incl. Caryophyllids), encrusting sponges, Hexactinellid sponges, *Munida* sp. and *Cidaris cidaris*. Bedrock with cobbles, small boulders and sandy gravel (same taxa).	430	Atlantic Upper slope Hard substrata (perhaps 'Caryophyllids, Munida and encrusting sponges on mixed substrata')
Rosemary Bank site ROSE07404	Gravelly muddy sand (medium to coarse) with some *lebensspuren* in the form of feeding mounds, tracks and burrows. The high abundance of Amphiuridae sp. characterise the fauna.	760	Atlantic Upper slope Mixed sediment

3.3.2 Summary of the biotopes in the MSS survey area

The habitats within the MSS survey were all classified within Level 3 (Table 3.10 and Figure 3.23) of the newly proposed deep sea biotope classification system (Howell 2010). Additional information and two potential new biotopes have also been suggested for three of the transects (Rockall Bank 2007 and Rockall Bank 2009 and Rosemary Bank site 3) with the Rockall Bank sites potentially being two new seapen biotopes whilst Rosemary Bank site 3 could potentially be included under "Caryophyllids, Munida and encrusting sponges on mixed substrata". However, there is only limited information to base these on and further survey data would be required to fully assess and describe these habitats.

Table 3.10 Summary of the biotopes identified in the MSS survey imagery.

Biotope name	Characterising taxa	Substratum	Supporting reference
Atlantic Upper slope Mud	*Spatangus purpureus*	Slightly gravelly sandy mud but also with burrows of unknown origin	Howell 2010
Atlantic Upper slope Sand	*Hexactinellida* sp., polychaete spp. Paguridae spp. and Echinodermata spp.	Muddy sand with shell material. No burrows seen.	Howell 2010
Atlantic Upper bathyal Sand (perhaps '*Distichoptilum gracile* and other seapens on muddy sand)	*Distichoptilum gracile*	Slightly gravelly muddy sand. No burrowing or *lebensspuren*.	Potential New Biotope
Atlantic Upper slope Sand (perhaps '*Funiculina quadrangularis* and other anthozoans on muddy sand')	*Funiculina quadrangularis, Pachycerianthus multiplicatus,* anemones and Umbelluidae sp.	Slightly gravelly muddy sand (medium to coarse). No burrowing or *lebensspuren*.	Potential New Biotope
Atlantic Upper slope Mixed sediment	Amphiuridae sp. *Spatangus purpureus* and Macrouridae sp. (rattails)	Gravelly muddy sand	Howell 2010
Atlantic Upper slope Coarse sediment	*Cidaris cidaris*	Sandy gravel	Howell 2010
Atlantic Upper slope Hard substrata (perhaps '*Caryophyllids, Munida* and encrusting sponges on mixed substrata')	Anemones (e.g. Caryophyllids) , sponges, decapods, *Munida* sp., and *Cidaris cidaris*	Rock (cobbles, small boulders and bedrock) surrounded by sandy gravel	Howell 2010

3.3.3 MPA search features and Annex I habitats

3.3.3.1 Rockall Bank 2007 and 2009

As a result of the relatively high proportion of silt together with the characteristic seapens, these two transects have been classified as the MPA Search Feature "burrowed mud" (Figure 3.25). The DC0925 site contained two species within MPA Search Feature "Burrowed mud"; *Pachycerianthus multiplicatus* and *Funiculina quadrangularis*. These, together with a large number of other species (e.g. Umbelluidae sp.) present throughout the video, suggest that this habitat should be considered for inclusion in lists of Search Features.

The rkb07-70 site contained the seapen *Distichoptilum gracile* which is not a species included as a characteristic seapen for "burrowed mud". However, it would qualify under the 'seapens and burrowing megafauna in circalittoral fine mud'. This site has therefore also been assigned as "Burrowed mud" Search Feature. However, further research and image analysis may be required to assess the importance of this taxon in this area.

3.3.3.2 Hebridean Slope

As mentioned above, there was one MPA Search Feature taxa but no Annex I habitats along the Hebridean Slope photographic transect. The sediment make-up means this habitat has been classified as the "Offshore deep sea muds" MPA Search Feature (Figure 3.25). However, infaunal and sediment samples will be required to assess the biotope and grain size distribution in this location fully.

3.3.3.3 Rosemary Bank

There were three drop-down camera transects on Rosemary Bank as follows:

Site Rose07401

The habitats at site 01 were classified as two main habitat types; 'coarse sediment' and 'hard substrata'. The habitat within the 'coarse sediment' habitat type ('Atlantic Upper slope Coarse sediment' biotope) qualifies within the MPA Offshore Search Feature "Offshore subtidal sands and gravels" (Figures 3.25 and 3.26). The habitat classified as 'hard substrata' ('Atlantic Upper slope Hard substrata') biotope qualify as 'reefs' under the Habitats Directive Annex I habitats. However, these reefs would be in the "low resemblance" category as the area covered by this substratum type was small and the matrix had a large fraction of gravel which could be considered as fairly mobile.

Site Rose07403

The habitat along site ROSE07403 qualifies as the Annex I habitat "reef" but there were no MPA Search Features (Figures 3.25 and 3.26). Seapens (*Pennatula phosphorea*) were seen along this line but at very low abundance and it was not considered characteristic for the site as a whole. This therefore precluded the site from being classified as a MPA Search Feature but further survey effort in this area may change this classification.

The reefs features varied across the transect with two segments being characterised by bedrock with cobbles, boulder and sandy gravel whilst three segments lacked the bedrock substratum but were otherwise similar to the other two segments.

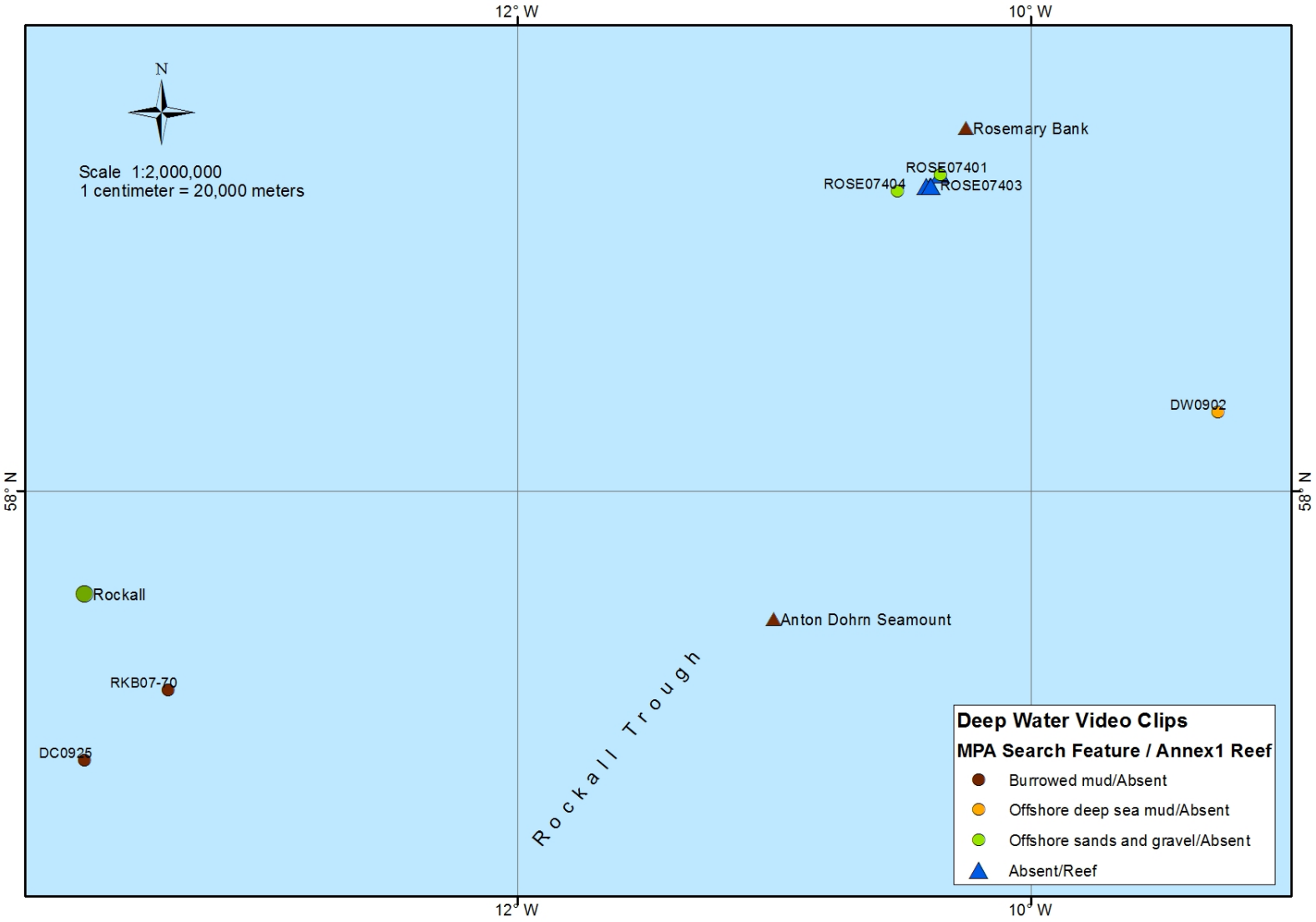

Figure 3.25 MPA Search Features and Annex I habitats at the Hebridean Slope, Rockall Bank and Rosemary Bank towed video sites.

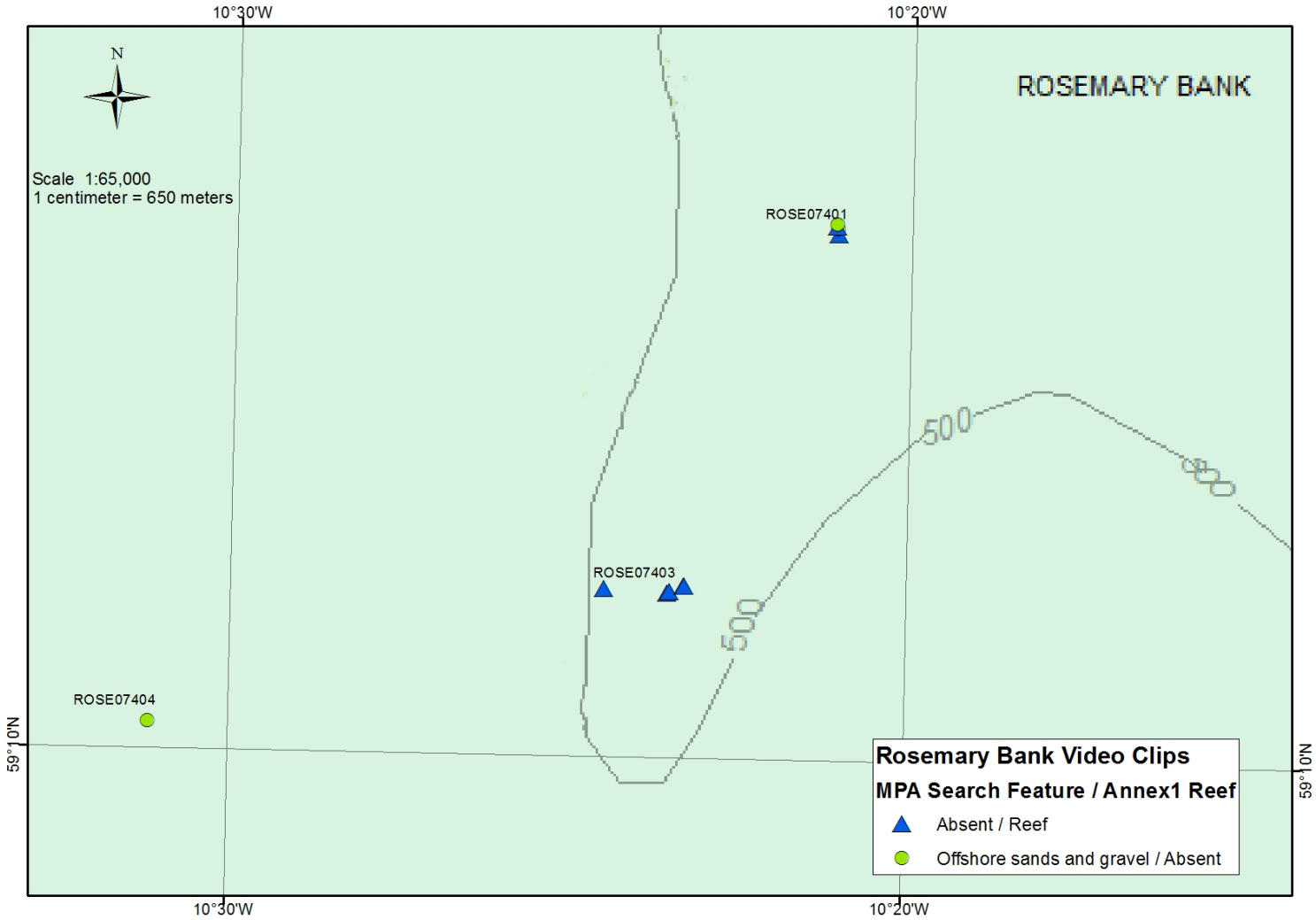

Figure 3.26 MPA Search Features and Annex I habitats at the Rosemary Bank towed video sites (blue triangle = reef; green circle = offshore subtidal sands and gravel).

Site Rose07404

There were no Annex I habitats present along this line but the habitat is considered to qualify as the "Offshore sands and gravels" MPA Search Feature, although the mud content may be too high (Figures 3.25 and 3.26). It is difficult to assess the proportion of mud present from video and further data collection will therefore be required to qualify this habitat as a MPA Search Feature with a higher degree of certainty.

3.3.4 Limitations

3.3.4.1 Quality of video footage

The use of underwater video and still photography is appropriate for the assessment of the presence and extent of biotopes (Sanderson and Holt 2001; Service and Golding 2001). However, it is acknowledged that there is some loss in the taxonomic resolution when using photography rather than biological sampling techniques (e.g. Stevens and Connolly 2005). The MSS footage is often high above the seabed and the detail only becomes apparent as the camera reaches the seabed. However, these moments are short and the identification of the fauna present was therefore particularly challenging. The detail in the identification is therefore not as high as perhaps was desired. It should be acknowledged that these MSS surveys were not designed for detailed habitat assessment.

3.3.4.2 Positional data

Some of the associated video metadata is missing. For the Rockall Bank 2009 and Hebridean Slope 2009 transects have start of line and end of line positional data only. There is furthermore no navigational data for the first few minutes of Rosemary Bank site 1, which has resulted in the lack of positions for the first two habitats along this transect.

3.4 Quality Control

The quality control process consists of two main phases; the continuous QC process and the QC re-assessments.

The continuous process involves the collaboration between scientists during the analytical stage to check and agree on the identifications of fauna and flora, biotope classifications and sediment descriptions. It also involves cross-checks between the video footage and the still photograph analyses should both be available, to ensure agreement in the identification and classification of the data agree.

The re-assessment process involves the selection of material for re-analysis. This is typically 10% of the analysed data but the percentage can be increased should the material be particularly challenging (unusual habitats, unusual fauna and flora or poor quality imaging). The re-assessment process involves an analyst going through the data in detail again to ensure consistency and agreement in the results. Of note is that the analysis of underwater footage is notoriously challenging and ultimately depend on the quality of the acquired footage. The higher the quality the footage the more likely the identification of the fauna and flora will be correct which in turn will improve the quality of the biotope, habitat and sediment classifications.

4 Summary and Conclusions

The JNCC commissioned Seastar Survey Ltd. in 2012 to undertake the taxonomic analysis of video footage and still photographs acquired from two surveys undertaken in 2011 and from a selection of Marine Scotland Science (MSS) deep-water survey stations:

Firth of Forth Banks Complex

The main findings from analysis of the stills and video analysis collected during the 2011 survey to the banks complex adjacent to the Firth of Forth aboard the *NLV Pole Star* were:

- A total of 31 stations with 10 hours and 36 minutes of video and 649 still photographs were analysed from the Firth of Forth Banks Complex survey area;
- A total of 12 shallow-water biotopes have been recorded with SS.SSa.CMuSa being the most commonly recorded;
- Four Scottish MPA Search Features were observed from the Firth of Forth footage; 'Offshore subtidal sands and gravels', 'offshore deep sea muds', 'burrowed mud' and 'Horse mussel beds';
- The Annex I 'stony reef' habitat was recorded at four sites (HG005_Stn80, HG007_Stn85, HG060_Stn064 and HG071_Stn082) with a further three potential sites classified in the category but additional data will be required to assess these fully.

IBTS Q4 survey

The main findings from the analysis of the footage collected during the 2011 Quarter 4 International Bottom Trawl Survey (IBTS Q4) to the north and west of Scotland (shelf and slope) aboard the *FRV Scotia* were:

- Video and still photographs from a total seven sites from the IBTS Q4 were analysed;
- A combination of shallow-water (Connor *et al* 2004) and deep-sea (Howell 2010) biotopes were used to classify the habitats present;
- A total of three shallow-water biotopes were identified (SS.CSC.OCS, SS.SMx.OMx and SS.SSA.OSa) with one potential new biotope (coarse sand and *Ditrupa arietina*);
- Three Level 3 deep sea biotopes were identified with two sites being classified as Level 4 "Bioherm Upper slope - *Lophelia pertusa* reefs - Highly sediment draped scattered coral framework " and "Atlantic upper slope sand - *Caryophyllia smithii* & *Actinauge richardi* on sand/gravelly sand";
- The Offshore MPA Search Feature "Offshore subtidal sands and gravels" was identified along all seven of the IBTS Q4 survey lines;
- One Annex I habitat ('reef') and the PMF 'cold-water coral reef' were identified along survey lines 2a and 2b.

MSS deep-water sites

The main findings from the analysis of videos from the MSS towed video datasets from surveys on the Hebridean slope, Rosemary Bank and Rockall Bank aboard the *FRV Scotia* were:

- The imagery from six drop-down camera lines were analysed;
- A total of five different Level 3 deep sea biotopes (as per Howell 2010) were identified with a further three potential Level 4 biotopes;

- Three MPA Search Features (“Offshore subtidal sands and gravels”, “Burrowed mud” and “Offshore deep sea muds”) were identified at five (“Burrowed mud“ at Rockall Bank 2007 and 2009, “Offshore deep sea muds“ on the Hebridean Slope; and “Offshore subtidal sands and gravels“ at Rosemary Bank sites 1 and 4) of the six locations in the MSS survey area;
- The Annex I “reef” habitat was identified at two locations (Rosemary Bank site 1 and 3).

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Appendix 1. List of MPA search features in Scottish seas

This annex includes four tables covering seabed habitats, low or limited mobility species, highly mobile species and large-scale features of functional importance to Scotland"s seas. The tables highlight whether the features are of particular interest in territorial or offshore waters (or both). Marine habitats and species for which area-based protection is appropriate but that have a direct Natura 2000 parallel (e.g. intertidal mudflats and sandflats or coastal lagoons) have been excluded from these tables.

MPA search features are those that are being used to underpin the selection of Nature Conservation MPAs but they are not the only interests which can be designated as protected features of MPAs. This list reflects our current knowledge and understanding at the time of publication. It is likely to be subject to periodic review to take account of the best available evidence. (T&D) denotes an OSPAR Threatened and/or Declining habitat or species.

Table 1. Seabed habitats being used to underpin the selection of Nature Conservation MPAs.

MPA search feature	Component habitats / species	Scottish marine area
[T&D]Blue mussel beds	*Mytilus edulis* beds on littoral sediments	Territorial waters
	Mytilus edulis and *Fabricia sabella* in littoral mixed sediment	Territorial waters
	Mytilus edulis beds on sublittoral sediment	Territorial waters
	Mytilus edulis beds on reduced salinity infralittoral rock	Territorial waters
[T&D]Burrowed mud	Seapens and burrowing megafauna in circalittoral fine mud	Both
	Burrowing megafauna and *Maxmuelleria lankesteri* in circalittoral mud	Both
	Tall seapen *Funiculina quadrangularis*	Both
	Fireworks anemone *Pachycerianthus multiplicatus*	Both
	Mud burrowing amphipod *Maera loveni*	Offshore waters
[T&D]Carbonate mound communities	Carbonate mound communities	Offshore waters
[T&D]Coral gardens	Coral gardens	Offshore waters
[T&D]Deep sea sponge aggregations	Deep sea sponge aggregations	Offshore waters
Flame shell beds	*Limaria hians* beds in tide-swept sublittoral muddy mixed sediment	Territorial waters

MPA search feature	Component habitats / species	Scottish marine area
T&D Horse mussel beds	*Modiolus modiolus* beds with hydroids and red seaweeds on tide-swept circalittoral mixed substrata	Territorial waters
	Modiolus modiolus beds on open coast circalittoral mixed sediment	Territorial waters
T&D Horse mussel beds *cont.*	*Modiolus modiolus* beds with fine hydroids and large solitary ascidians on very sheltered circalittoral mixed substrata	Territorial waters
	Modiolus modiolus beds with *Chlamys varia,* sponges, hydroids and bryozoans on slightly tide-swept very sheltered circalittoral mixed substrata	Territorial waters
Inshore deep mud with burrowing heart urchins	*Brissopsis lyrifera* and *Amphiura chiajei* in circalittoral mud	Territorial waters
Kelp and seaweed communities on sublittoral sediment	Kelp and seaweed communities on sublittoral sediment	Territorial waters
Low or variable salinity habitats	Faunal communities on variable or reduced salinity infralittoral rock	Territorial waters
	Kelp in variable or reduced salinity	Territorial waters
T&D Maerl beds	Maerl beds	Territorial waters
Maerl or coarse shell gravel with burrowing sea cucumbers	*Neopentadactyla mixta* in circalittoral shell gravel or coarse sand	Territorial waters
T&D Native oysters	*Ostrea edulis* beds on shallow sublittoral muddy mixed sediment	Territorial waters
	Native oyster *Ostrea edulis*	Territorial waters
Northern sea fan and sponge communities	*Caryophyllia smithii* and *Swiftia pallida* on circalittoral rock	Territorial waters
	Mixed turf of hydroids and large ascidians with *Swiftia pallida* and *Caryophyllia smithii* on weakly tide-swept circalittoral rock	Territorial waters
	Deep sponge communities (circalittoral)	Territorial waters
	Northern sea fan *Swiftia pallida*	Both
Offshore deep sea muds	*Ampharete falcata* turf with *Parvicardium ovale* on cohesive muddy sediment near margins of deep stratified seas	Offshore waters
	Foraminiferans and *Thyasira* sp. in deep circalittoral fine mud	Offshore waters

MPA search feature	Component habitats / species	Scottish marine area
	Levinsenia gracilis and *Heteromastus filifirmis* in offshore circalittoral mud and sandy mud	Offshore waters
	Paramphinome jeffreysii, *Thyasira* spp. and *Amphiura filiformis* in offshore circalittoral sandy mud	Offshore waters
	Myrtea spinifera and polychaetes in offshore circalittoral sandy mud	Offshore waters
Offshore subtidal sands and gravels	*Glycera lapidum*, *Thyasira* spp. and *Amythasides macroglossus* in offshore gravelly sand	Offshore waters
	Hesionura elongata and *Protodorvillea kefersteini* in offshore coarse sand	Offshore waters
Offshore subtidal sands and gravels *cont.*	*Echinocyamus pusillus*, *Ophelia borealis* and *Abra prismatica* in circalittoral fine sand	Offshore waters
	Abra prismatica, *Bathyporeia elegans* and polychaetes in circalittoral fine sand	Offshore waters
	Maldanid polychaetes and *Eudorellopsis deformis* in offshore circalittoral sand or muddy sand	Offshore waters
	Owenia fusiformis and *Amphiura filiformis* in offshore circalittoral sand or muddy sand	Offshore waters
[T&D]Seagrass beds	*Zostera noltii* beds in littoral muddy sand	Territorial waters
	Zostera marina/angustifolia beds on lower shore or infralittoral clean or muddy sand	Territorial waters
	Ruppia maritima in reduced salinity infralittoral muddy sand	Territorial waters
Sea loch egg wrack beds	*Ascophyllum nodosum* ecad *mackaii* beds on extremely sheltered mid eulittoral mixed substrata	Territorial waters
Seamount communities	Seamount communities	Offshore waters
Shallow tide-swept coarse sands with burrowing bivalves	*Moerella* spp. with venerid bivalves in infralittoral gravelly sand	Territorial waters
Tide-swept algal communities	Fucoids in tide-swept conditions	Territorial waters
	Halidrys siliquosa and mixed kelps on tide-swept infralittoral rock with	Territorial waters

MPA search feature	Component habitats / species	Scottish marine area
	coarse sediment	
	Kelp and seaweed communities in tide-swept sheltered conditions	Territorial waters
	Laminaria hyperborea on tide-swept infralittoral mixed substrata	Territorial waters

Table 2. Low or limited mobility species being used to underpin the selection of Nature Conservation MPAs.

MPA search feature	Species name	Taxon group	Scottish marine area
Burrowing sea anemone aggregations	*Arachnanthus sarsi*	Sea anemones, sea fans and seapens	Territorial waters
Northern feather star aggregations on mixed substrata	*Leptometra celtica*	Starfish and feather stars	Both
Fan mussel aggregations	*Atrina pectinata*	Snails, clams, mussels and oysters	Both
Heart cockle aggregations	*Glossus humanus*	Snails, clams, mussels and oysters	Territorial waters
[T&D]Ocean quahog aggregations	*Arctica islandica*	Snails, clams, mussels and oysters	Both

Table 3. Mobile species being used to underpin the selection of Nature Conservation MPAs.

MPA search feature	Species name	Taxon group	Scottish marine area
European spiny lobster#	*Palinurus elephas*	Lobsters and sand hoppers	Territorial waters
Blue ling#	*Molva dypterygia*	Bony fish	Offshore waters
T&D Orange roughy	*Hoplostethus atlanticus*	Bony fish	Offshore waters
Sandeels#	*Ammodytes marinus* & *A. tobianus*	Bony fish	Both (*A. marinus* only offshore)
T&D Basking shark	*Cetorhinus maximus*	Sharks, skates and rays	Territorial waters
T&D Common skate	*Dipturus batis* complex	Sharks, skates and rays	Territorial waters
Minke whale	*Balaenoptera acutorostrata*	Whales, dolphins and porpoises	Territorial waters
Risso's dolphin	*Grampus griseus*	Whales, dolphins and porpoises	Territorial waters
White-beaked dolphin	*Lagenorhynchus albirostris*	Whales, dolphins and porpoises	Territorial waters
Black guillemot	*Cepphus grylle*	Birds	Territorial waters

These species are commercially fished in the seas around Scotland and Marine Scotland is the lead organisation responsible for their wider management. However, these species are also of conservation importance and could benefit from the protection afforded by a MPA (it is recognised that spatial measures other than MPA designation may also be effective). Nature Conservation MPAs are not intended to be used for fisheries management purposes. So, for example, MPAs could be used to protect sandeel populations in locations where sandeels play a key functional role in supporting top predators such as seabirds and cetaceans but would not be used for the purpose of managing a sandeel fishery.

Appendix 2. Summary of the analysis logs

Summary of Firth of Forth banks complex video analysis log

Station_Name	Clip_No.	Start_Latitude	Start_Longitude	End_Latitude	End_Longitude	Biotope	Biotope_Description	Sediment_Description	MPA Search Feature	Reef Presence
HG001_Stn067_1	1	56.34405	-1.6682	56.34411667	-1.668433333	SS.SMx.CMx.OphMx	*Ophiothrix fragilis* and/or *Op*	gmS	Offshore sands and gravels	Absent
HG001_Stn067_2	2	56.34411667	-1.668433333	56.34406667	-1.66855	SS.SMx.CMx	Circalittoral mixed sediment	gmS	Offshore sands and gravels	Absent
HG001_Stn067_3	3	56.34406667	-1.66855	56.34415	-1.66775	SS.SMx.CMx.(OphMx)	(closest match) *Ophiothrix fr*	gmS	Offshore sands and gravels	Absent
HG001_Stn067_4	4	56.34415	-1.66775	56.3442	-1.6674	SS.SMx.CMx.OphMx	*Ophiothrix fragilis* and/or *Op*	gmS	Offshore sands and gravels	Absent
HG001_Stn067_5	5	56.3442	-1.6674	56.34421667	-1.667	SS.SMx.CMx.(OphMx)	(closest match) *Ophiothrix fr*	gmS	Horse mussel beds	Absent
HG001_Stn067_6	6	56.34421667	-1.667	56.34423333	-1.666416667	SS.SMx.CMx.OphMx	*Ophiothrix fragilis* and/or *Op*	gmS	Offshore sands and gravels	Absent
HG001_Stn067_7	7	56.34423333	-1.666416667	56.34428333	-1.66585	SS.SMx.CMx.(OphMx)	(closest match) *Ophiothrix fr*	gmS	Offshore sands and gravels	Absent
HG001_Stn067_8	8	56.34428333	-1.66585	56.3443	-1.665466667	SS.SMx.CMx.(FluHyd)	(closest match) *Flustra foliac*	(g)mS	Offshore sands and gravels	Absent
HG003_Stn062_1	1	56.41103333	-1.960033333	56.41093333	-1.95755	SS.SMx.CMx	Circalittoral mixed sediment	gmS Sh	Offshore sands and gravels	Absent
HG003_Stn062_2	2	56.41093333	-1.95755	56.41093333	-1.955983333	SS.SSA.CMuSa	Circalittoral muddy sand	mS Sh	Offshore sands and gravels	Absent
HG005_Stn080_1	1	56.6643	-1.512916667	56.66386667	-1.5123	SS.SMx.CMx.(FluHyd)	(closest match) *Flustra foliac*	gmS	Offshore sands and gravels	Absent
HG005_Stn080_2	2	56.66386667	-1.5123	56.6635	-1.5118	SS.SSA.CMuSa	Circalittoral muddy sand	mS Sh	Offshore sands and gravels	Possible Reef
HG005_Stn080_3	3	56.6635	-1.5118	56.66288333	-1.510933333	SS.SCS.CCS.PomB	*Pomatoceros triqueter* with b	G R Sh	Offshore sands and gravels	Possible Reef
HG007_Stn085_1	1	56.5593	-2.073633333	56.55833333	-2.076366667	CR.HCR.XFa.FluCoAs.X	*Flustra foliacea* and colonial	gmS	Absent	Reef
HG013_Stn066_1	1	56.26943333	-1.552433333	56.26983333	-1.549283333	SS.SMu.CSaMu	Circalittoral sandy mud	sM	Offshore deep sea muds	Absent
HG026_Stn068_1	1	56.38041667	-1.71385	56.38046667	-1.711033333	CR.HCR.XFa.FluCoAs.X	*Flustra foliacea* and colonial	gmS	Absent	Absent
HG026_Stn068_2	2	56.38046667	-1.711033333	56.38048333	-1.710466667	CR.HCR.XFa.(FluCoAs.X)	*(closest match) Flustra foliac*	gmS	Absent	Absent
HG026_Stn068_3	3	56.38048333	-1.710466667	56.38046667	-1.7101	SS.SMx.CMx.(OphMx)	(closest match) *Ophiothrix fr*	gmS	Offshore sands and gravels	Absent
HG027_Stn061_1	1	56.44268333	-1.584316667	56.4435	-1.580866667	SS.SSA.CMuSa	Circalittoral muddy sand	mS Sh	Offshore sands and gravels	Absent
HG029_Stn069_1	1	56.44906667	-1.760666667	56.4487	-1.7571	SS.SSA.CMuSa	Circalittoral muddy sand	mS Sh	Offshore sands and gravels	Absent
HG031_Stn071_1	1	56.57181667	-1.536766667	56.57108333	-1.53405	SS.SMx.CMx.(FluHyd)	(closest match) *Flustra foliac*	gmS Sh	Offshore sands and gravels	Absent
HG031_Stn071_2	2	56.57108333	-1.53405	56.57101667	-1.53375	SS.SSA.CMuSa	Circalittoral muddy sand	mS Sh	Offshore sands and gravels	Absent
HG034_Stn055_1	1	56.71235	-1.308533333	56.71381667	-1.305416667	SS.SSA.CMuSa	Circalittoral muddy sand	mS	Offshore sands and gravels	Absent
HG036_Stn045_1	1	56.20883333	-1.26595	56.20938333	-1.271133333	SS.SMx.CMx.(FluHyd)	(closest match) *Flustra foliac*	gmS	Offshore sands and gravels	Absent
HG038_Stn053_1	1	56.72876667	-1.257533333	56.73001667	-1.2541	SS.SSA.CMuSa	Circalittoral muddy sand	S (Sh)	Offshore sands and gravels	Absent
HG039_Stn054_1	1	56.79138333	-1.28035	56.79161667	-1.284416667	SS.SSA.CMuSa	Circalittoral muddy sand	S (Sh)	Offshore sands and gravels	Absent
HG040_Stn057_1	1	56.49185	-1.330766667	56.49268333	-1.327683333	SS.SSA.CMuSa	Circalittoral muddy sand	S (Sh)	Offshore sands and gravels	Absent
HG043_Stn052_1	1	56.7094	-1.213933333	56.71033333	-1.209766667	SS.SSA.CMuSa	Circalittoral muddy sand	S (Sh)	Offshore sands and gravels	Absent
HG045_Stn077_1	1	56.62726667	-1.1364	56.62608333	-1.1338	SS.SSA.CMuSa	Circalittoral muddy sand	(g) S Sh	Offshore sands and gravels	Absent
HG048_Stn051_1	1	56.54373333	-1.157966667	56.54458333	-1.15345	SS.SSA.CMuSa	Circalittoral muddy sand	mS	Offshore sands and gravels	Absent
HG050_Stn065_1	1	56.18311667	-1.582733333	56.1834	-1.579483333	SS.SMx.CMx.(FluHyd)	(closest match) *Flustra foliac*	gmS	Offshore sands and gravels	Absent
HG052_Stn047_1	1	56.2663	-1.392566667	56.2664	-1.3936	SS.SMx.CMx	Circalittoral mixed sediment	gmS Sh	Offshore sands and gravels	Absent
HG052_Stn047_2	2	56.2664	-1.3936	56.2666	-1.397966667	CR.MCR.EcCr.FaAlCr.Adig	Alcyonium digitatum, Pomat	gmS Sh	Absent	Absent
HG052_Stn047_3	3	56.2666	-1.397966667	56.26686667	-1.398033333	SS.SMx.CMx	Circalittoral mixed sediment	gmS Sh	Offshore sands and gravels	Absent
HG053_Stn076_1	1	56.77778333	-1.333283333	56.77673333	-1.330616667	SS.SSA.CMuSa	Circalittoral muddy sand	mS (Sh)	Offshore sands and gravels	Absent
HG054_Stn079_1	1	56.71876667	-1.39065	56.7172	-1.388533333	SS.SSA.CMuSa	Circalittoral muddy sand	mS Sh	Offshore sands and gravels	Absent
HG056_Stn070_1	1	56.51533333	-1.79805	56.51526667	-1.7976	SS.SMx.CMx	Circalittoral mixed sediment	gmS Sh	Offshore sands and gravels	Absent
HG056_Stn070_2	2	56.51526667	-1.7976	56.5148	-1.794683333	CR.HCR.XFa.FluCoAs.X	*Flustra foliacea* and colonial	sG	Absent	Potential Reef
HG058_Stn075_1	1	56.81375	-1.340666667	56.81283333	-1.3378	SS.SSA.CMuSa	Circalittoral muddy sand	S (Sh)	Offshore sands and gravels	Absent
HG060_Stn064_1	1	56.30766667	-1.735266667	56.30763333	-1.731066667	CR.HCR.XFa.FluCoAs.X	*Flustra foliacea* and colonial	gmS	Absent	Reef
HG062_Stn056_1	1	56.63445	-1.361283333	56.635	-1.358216667	SS.SSA.CMuSa	Circalittoral muddy sand	S (Sh)	Offshore sands and gravels	Absent
HG066_Stn063_1	1	56.35655	-2.022466667	56.35771667	-2.0189	SS.SMu.CSaMu	Circalittoral sandy mud	sM	Offshore deep sea muds	Absent
HG069_Stn078_1	1	56.66898333	-1.3108	56.66775	-1.308033333	CR.MCR.EcCr.FaAlCr.Adig	*Flustra foliacea* on slightly s	S R	Absent	Potential Reef
HG070_Stn081_1	1	56.58278333	-1.655866667	56.58195	-1.652633333	SS.SCS.CCS.PomB	*Pomatoceros triqueter* with b	G Sh	Offshore sands and gravels	Potential Reef
HG071_Stn082_1	1	56.5983	-1.78255	56.5977	-1.778566667	CR.HCR.XFa.FluCoAs.X	*Flustra foliacea* and colonial	sG Sh	Absent	Reef
HG072_Stn084_1	1	56.59218333	-1.99565	56.59225	-2.00125	SS.SSA.CMuSa	Circalittoral muddy sand	(g) S	Offshore sands and gravels	Absent
HG072_Stn084_2	2	56.59225	-2.00125	56.59228333	-2.002733333	SS.SMx.CMx.(FluHyd)	(closest match) *Flustra foliac*	gmS	Offshore sands and gravels	Absent
HG072_Stn084_3	3	56.59228333	-2.002733333	56.59228333	-2.002933333	SS.SSA.CMuSa	Circalittoral muddy sand	(g) S	Offshore sands and gravels	Absent
HG073_Stn083_1	1	56.66568333	-1.994266667	56.66566667	-1.990183333	SS.SSA.CMuSa	Circalittoral muddy sand	(g) S	Offshore sands and gravels	Absent

Summary of the IBTS Q4 video analysis log

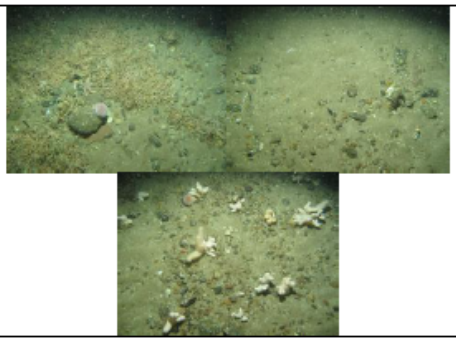
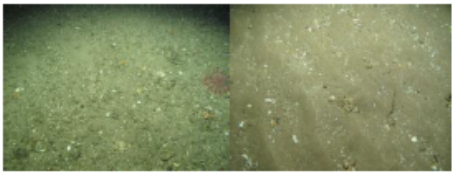
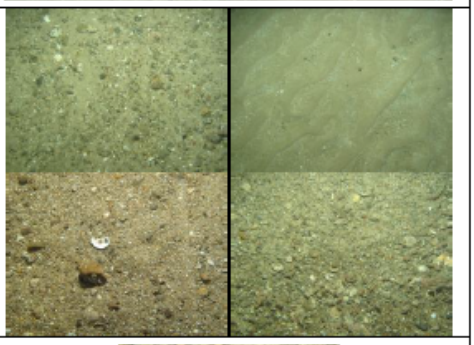
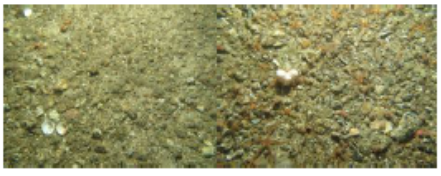
Line Name	Clip Number	SOL Latitu	SOL Longit	EOL Latitu	EOL Longi	Biotope Name	Biotope Description	Sediment Des	Bedforms	MPA Search Feature	Reef Presence
1a	1	59.54028	-4.45505	59.53508	-4.45497	SS.CSC.OCS	Offshore circalittoral coarse sediment	s G sh	gravel on shelly sand	Offshore subtidal sands and gravels	Absent
1a	2	59.53508	-4.45497	59.53993	-4.4549	SS.SSA.OSa	Offshore circalitteral sand	S sh	sand with some shells	Offshore subtidal sands and gravels	Absent
1a	3	59.53993	-4.4549	59.53727	-4.45353	SS.CSC.OCS	Offshore circalittoral coarse sediment	s G sh	gravel on shelly sand	Offshore subtidal sands and gravels	Absent
1a	4	59.53727	-4.45353	59.53378	-4.45205	SS.CSC.OCS.(Dar)	Offshore circalittoral coarse sands with Ditrupa arietina (proposed)	s G sh	gravel on shelly sand	Offshore subtidal sands and gravels	Absent
2a	1	59.3373	-5.45098	59.33741	-5.44479	SS.CSC.OCS.(Dar)	Offshore circalittoral coarse sands with Ditrupa arietina (proposed)	S G	sand and gravel	Offshore subtidal sands and gravels	Absent
2a	2	59.33741	-5.44479	59.33688	-5.4432	SS.SMX.OMx	Offshore circalittoral mixed sediment	g S sh	sand with gravel and shells, ripples presen	Offshore subtidal sands and gravels	Absent
2a	3	59.33688	-5.4432	59.33685	-5.44035	Highly sediment drap	Bioherms Upper slope Lophelia pertusa reefs Highly sediment draped scattere	g S R	sand with boulders and cobbles which hol	Cold-water coral reef	Reef
2a	4	59.33685	-5.44035	59.33682	-5.43975	SS.CSC.OCS.(Dar)	Offshore circalittoral coarse sands with Ditrupa arietina (proposed)	S G	sand and gravel	Offshore subtidal sands and gravels	Absent
2a	5	59.33682	-5.43975	59.33686	-5.43756	Highly sediment drap	Bioherms Upper slope Lophelia pertusa reefs Highly sediment draped scattere	g S R	sand with boulders and cobbles which hol	Cold-water coral reef	Reef
2a	6	59.33686	-5.43756	59.33613	-5.43401	SS.CSC.OCS.(Dar)	Offshore circalittoral coarse sands with Ditrupa arietina (proposed)	S	sand with waves	Offshore subtidal sands and gravels	Absent
2b	1	55.33232	-5.4677	59.3315	-5.45996	SS.CSC.OCS.(Dar)	Offshore circalittoral coarse sands with Ditrupa arietina (proposed)	S R	sand with some cobbles and rocks ripple	Offshore subtidal sands and gravels	Absent
2b	2	59.3315	-5.45996	59.3121	-5.45483	SS.SMX.OMx	Offshore circalittoral mixed sediment	g S R	gravel sand with cobbles ripples	Offshore subtidal sands and gravels	Absent
2b	3	59.3121	-5.45483	59.33095	-5.44975	Highly sediment drap	Bioherms Upper slope Lophelia pertusa reefs Highly sediment draped scattere	g S R	sand with boulders and cobbles which hol	Cold-water coral reef	Reef
4a	1	57.22608	-9.28537	57.23308	-9.2949	SS.CSC.OCS.(Dar)	Offshore circalittoral coarse sands with Ditrupa arietina (proposed)	g S sh	sand and gravel ripples	Offshore subtidal sands and gravels	Absent
5a	1	58.00174	-9.15973	58.01172	-9.15762	Caryophyllia smithii &	Caryophyllia smithii & Actinauge richardi on sand/gravelly sand	(g) m S	muddy sand with gravel	Offshore subtidal sands and gravels	Absent
5b	1	58.02486	-9.1278	58.03048	-9.13656	Caryophyllia smithii &	Caryophyllia smithii & Actinauge richardi on sand/gravelly sand	(g) m S	muddy sand with pebbles	Offshore subtidal sands and gravels	Absent
5b	2	58.03048	-9.13656	58.03217	-9.13888	Atlantic upper slope sa	Atlantic upper slope sand	(g) m S	muddy sand with pebbles	Offshore subtidal sands and gravels	Absent
6a	1	57.74115	-9.38203	57.75138	-9.38993	SS.CSC.OCS.(Dar)	Offshore circalittoral coarse sands with Ditrupa arietina (proposed)	g S sh	sand and gravel with large amount Ditrupia	Offshore subtidal sands and gravels	Absent

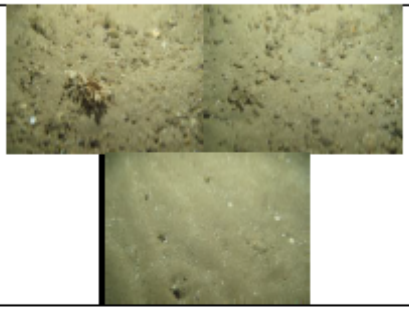
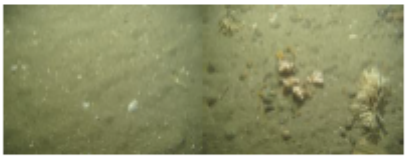
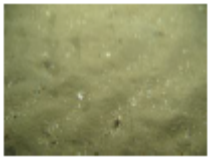
Summary of the video analysis from the selection of sites from the MSS survey

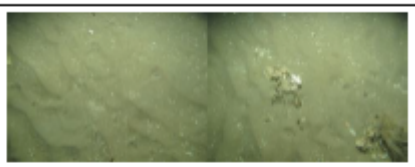
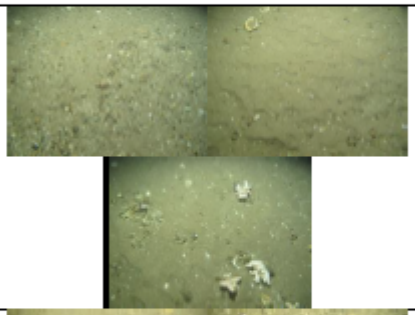
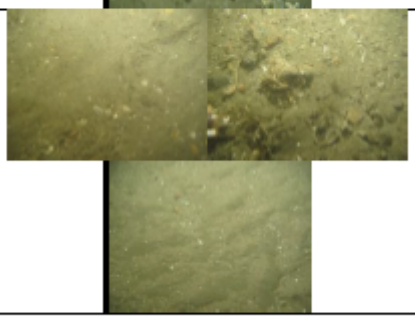
Line_Name	Clip_Number	SOL_Latitude	SOL_Longitude	EOL_Latitude	EOL_Longitude	Biotope_Name	Biotope_description
RKB07-70	1	57.224190	-13.360900	57.226800	-13.369900	Atlantic Upper bathyal Sand	Muddy sand with Distichoptilum gracile and other seapens
DC0925	1	56.947950	-13.688233	56.944883	-13.694083	Atlantic Upper slope Sand	Muddy sand with Funiculina quadrangularis and other seapens
DW0902	1	58.306783	-9.269767	58.304967	-9.265467	Atlantic Upper slope Mud	Sandy mud without characterising fauna but with evidence of bioturbation
ROSE07401	1					Atlantic: Upper slope Hard substrata	Gravel, cobbles and small boulders with anemones, sponges and decapods
ROSE07401	2			59.234023	-10.351608	Atlantic: Upper slope Coarse sediment	Sandy gravel with little visible fauna apart from Cidaris cidaris.
ROSE07401	3	59.233568	-10.351608	59.234188	-10.351708	Atlantic: Upper slope Hard substrata	Gravel, cobbles and small boulders with anemones, sponges and decapods
ROSE07401	4	59.234188	-10.351708	59.234508	-10.351855	Atlantic: Upper slope Coarse sediment	Sandy gravel with little visible fauna apart from Cidaris cidaris.
ROSE07401	5	59.234508	-10.351855	59.234830	-10.352005	Atlantic: Upper slope Hard substrata	Gravel, cobbles and small boulders with anemones, sponges and decapods
ROSE07401	6	59.234830	-10.352005	59.235297	-10.352078	Atlantic: Upper slope Coarse sediment	Sandy gravel with little visible fauna apart from Cidaris cidaris.
ROSE07403	1	59.187673	-10.392298	59.187797	-10.391773	Atlantic: Upper slope Hard substrata	Coarse sandy gravel with cobbles and small boulders
ROSE07403	2	59.187797	-10.391773	59.188050	-10.391200	Atlantic: Upper slope Hard substrata	Bedrock with cobbles, boulders surrounded by sandy gravel
ROSE07403	3	59.188050	-10.407867	59.188537	-10.388302	Atlantic: Upper slope Hard substrata	Coarse sandy gravel with cobbles and small boulders
ROSE07403	4	59.188537	-10.388302	59.188562	-10.388098	Atlantic: Upper slope Hard substrata	Bedrock with cobbles, boulders surrounded by sandy gravel
ROSE07403	5	59.188562	-10.388098	59.188847	-10.387720	Atlantic: Upper slope Hard substrata	Coarse sandy gravel with cobbles and small boulders
ROSE07404	1	59.170115	-10.519855	59.167763	-10.533225	Atlantic Upper slope Mixed	Gravelly sand with some silt. Fauna characterised by Amphiuridae spp.

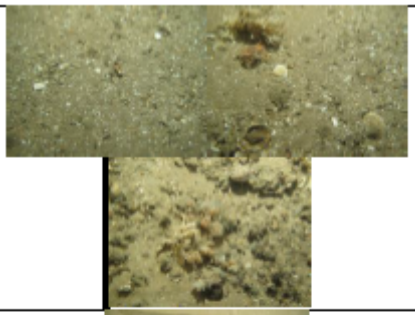
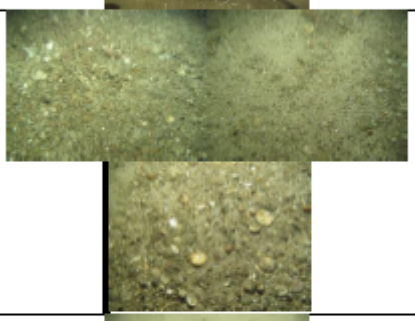
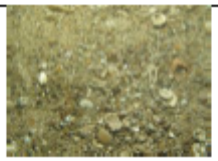
Line_Name	Clip_Number	Sediment_des	MPA_Search_Feature	Reef_Presence
RKB07-70	1	m S sh	Burrowed mud	Absent
DC0925	1	(g) m S sh	Burrowed mud	Absent
DW0902	1	(g) s M sh	Offshore deep sea mud	Absent
ROSE07401	1	s G R	Absent	Reef
ROSE07401	2	s G	Offshore sands and gravel	Absent
ROSE07401	3	s G R	Absent	Reef
ROSE07401	4	s G	Offshore sands and gravel	Absent
ROSE07401	5	s G R	Absent	Reef
ROSE07401	6	s G	Offshore sands and gravel	Absent
ROSE07403	1	s G	Absent	Reef
ROSE07403	2	s G R	Absent	Reef
ROSE07403	3	s G	Absent	Reef
ROSE07403	4	s G R	Absent	Reef
ROSE07403	5	s G	Absent	Reef
ROSE07404	1	g m S	Offshore sands and gravel	Absent

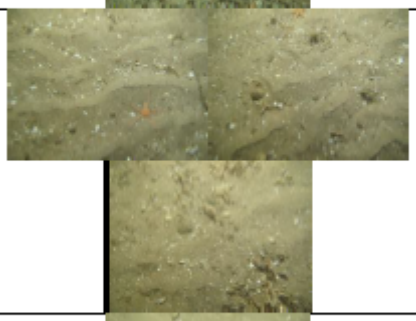
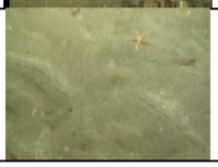
Appendix 3. Summary of the habitats in the Firth of Forth Banks Complex survey area (with photographic examples)

Line	Habitat/faunal summary	Biotope(s)	Still images
HG001_ stn067	Slightly muddy, gravelly sand with occasional cobbles with *Ophiothrix fragilis and Ophiocomina nigra* or *Modiolus modiolus* Gravelly, muddy sand Sandy rock	SS.SMx.CMx.OphMx SS.SBR.SMus.ModMx SS.SMx.CMx.(OphMx) SS.SSa.CMuSa CR.MCR.EcCr.FaAlCr.Adig	
HG003_ stn062	Muddy, sandy gravel. Muddy sand with shell material.	SS.SMx.CMx SS.SSa.CMuSa	
HG005_ stn080	Gravelly sand with shell material Gravelly sand Sand with shell material, *Flustra foliacea* and ascidians	SS.SSa.CMuSa SS.SMx.CMx SS.SCS.CCS CR.HCR.XFa.FluCoAs.X	
HG007_ stn085	Muddy, sandy gravel with *Flustra foliacea* and ascidians	CR.HCR.XFa.FluCoAs.X	
HG013_ stn066	Sandy mud	SS.SMu.CSaMu	
HG026_ stn068	Muddy, sandy gravel with *Flustra foliacea* and ascidians Muddy, sandy gravel with *Ophiocomina nigra*	CR.HCR.XFa.FluCoAs.X SS.SMx.CMx.OphMx	
HG027_ stn061	Muddy sand with shell material	SS.SSa.CMuSa	

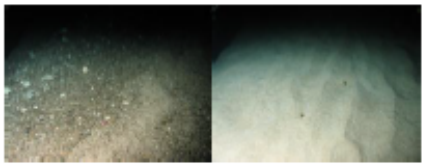
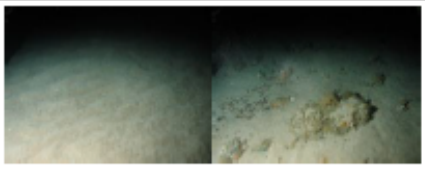
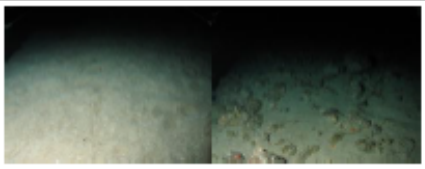
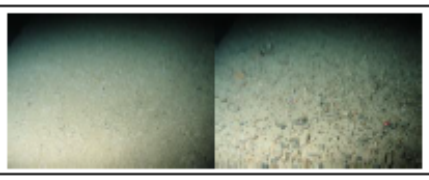
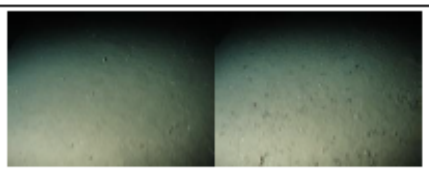
Line	Habitat/faunal summary	Biotope(s)	Still images
HG029_ stn069	Sand with shell material	SS.SSa.CMuSa	
HG031_ stn071	Gravelly, muddy sand Gravelly, muddy sand with shell material and *Flustra foliacea* Muddy sand with shell material	SS.SMx.CMx SS.SMx.CMx.(FluHyd) SS.SSa.CMuSa	
HG034_ stn055	Muddy sand	SS.SSa.CMuSa	
HG036_ stn045	Muddy sand Gravelly, muddy sand with *Flustra foliacea* and *Alcyonium digitatum*	SS.SSa.CMuSa SS.SMx.CMx.(FluHyd)	
HG038_ stn053	Muddy sand	SS.SSa.CMuSa	
HG039_ stn054	Muddy sand with shell material	SS.SSa.CMuSa	
HG040_ stn057	Muddy sand with shell material	SS.SSa.CMuSa	

Line	Habitat/faunal summary	Biotope(s)	Still images
HG043_ stn052	Muddy sand	SS.SSa.CMuSa	
HG045_ stn077	Muddy sand with shell fragments Slightly gravelly muddy sand with shell fragments, *Flustra foliacea* and *Alcyonium digitatum*	SS.SSa.CMuSa SS.SMx.CMx(FluHyd)	
HG048_ stn051	Muddy sand	SS.SSa.CMuSa	
HG050_ stn065	Gravelly, muddy sand Slightly gravelly, muddy sand Gravelly, muddy sand with *Flustra foliacea* and *Alcyonium digitatum*	SS.SMx.CMx SS.SSa.CMuSa SS.SMx.CMx.(FluHyd)	
HG052_ stn047	Gravelly, muddy sand Gravelly, muddy sand with occasional cobbles, *Flustra foliacea* and *Alcyonium digitatum* Muddy sand with shell material	SS.SMx.CMx SS.SMx.CMx.(FluHyd) SS.SSa.CMuSa	
HG053_ stn076	Muddy sand with shell material	SS.SSa.CMuSa	
HG054_ stn079	Slightly muddy sand with shell material	SS.SSa.CMuSa	

Line	Habitat/faunal summary	Biotope(s)	Still images
HG056_ stn070	Gravelly sand with shell material Gravelly sand with shell material, *Flustra foliacea* and Ascidians	SS.SMx.CMx CR.HCR.XFa.(FluCoAs.X) CR.HCR.XFa.FluCoAs.X	
HG058_ stn075	Muddy sand with shell material	SS.SSa.CMuSa	
HG060_ stn064	Sandy gravel will shell material, *Flustra foliacea* and Ascidians Sandy gravel will shell material	CR.HCR.XFa.FluCoAs.X CR.HCR.XFa.(FluCoAs.X) SS.SMx.CMx	
HG062_ stn056	Muddy sand	SS.SSa.CMuSa	
HG066_ stn063	Sandy mud Sandy mud with the Phosphorescent sea pen *Pennatula phosphorea*	SS.SMu.CSaMu SS.SMu.CFiMu.SpnMeg	
HG069_ stn078	Muddy sand with shell material Muddy sand and boulders with *Flustra foliacea* and *Alcyonium digitatum*	SS.SSa.CMuSa CR.HCR.XFa.FluCoAs.X	
HG070_ stn081	Gravel with shell material and *Pomatoceros* sp. Transition between SS.SCS.CCS.PomB and CR.HCR.XFa. FluCoAs.X	SS.SCS.CCS.PomB	

Line	Habitat/faunal summary	Biotope(s)	Still images
HG071_ stn082	Sandy gravel will shell material, *Flustra foliacea* and Acsidians	CR.HCR.XFa.FluCoAs.X CR.HCR.XFa.(FluCoAs.X)	
HG072_ stn084	Muddy sand with shell material Gravelly, muddy sand Gravelly, muddy sand with occasional cobbles, *Flustra foliacea* and *Alcyonium digitatum*	SS.SSa.CMuSa SS.SMx.CMx SS.SMx.CMx.(FluHyd)	
HG073_ stn083	Slightly muddy sand	SS.SSa.CMuSa	

Appendix 4. Summary of the habitats in the IBTS Q4 survey area (with photographic examples)

Line	Habitat/faunal summary	Biotope(s)	Still images
1a	Sandy gravel with shell material. Coarse sand with abundant *Ditrupa arietina*.	SS.SCS.OCS SS.SCS.OCS.(Dar) SS.SSA.OSa	
2a	Coarse sand with abundant *Ditrupa arietina*. Gravelly coarse sand and rock (cobbles / bedrock) with small colonies of hard corals (believed to be *Madrepora oculata* and *Lophelia pertusa*).	SS.SCS.OCS.(Dar) SS.SMx.OMx Highly sediment draped scattered coral framework	
2b	Coarse sand with abundant *Ditrupa arietina*. Gravelly coarse sand (veneer) and rock (cobbles / bedrock) with small colonies of hard corals (believed to be *Madrepora oculata* and *Lophelia pertusa*) surrounded by sand.	SS.SCS.OCS.(Dar) SS.SMx.OMx Highly sediment draped scattered coral framework	
4a	Sandy gravel with shell material. Coarse sand with abundant *Ditrupa arietina*.	SS.SCS.OCS SS.SCS.OCS.(Dar)	
5a	Slightly gravelly muddy sand, sometimes with higher percentage gravel, with *Caryophyllia smithii* and *Actinauge richardi* anemones. Some areas also with *Pennatula phosphorea*.	*Caryophyllia smithii* & *Actinauge richardi* on sand/gravelly sand	
5b	Slightly gravelly muddy sand, sometimes with higher percentage gravel, with *Caryophyllia smithii* and *Actinauge richardi* anemones.	SS.SCS.OCS Atlantic Upper slope Sand *Caryophyllia smithii* & *Actinauge richardi* on sand/gravelly sand	
6a	Gravelly sand, sometimes with cobbles, with sparse *Ditrupa arietina*. Gravelly coarse sand with abundant *Ditrupa arietina*.	SS.SCS.OCS SS.SCS.OCS.(Dar)	

Appendix 5. Photographic video grab images from the selected MSS deep-water datasets.

Rockall Bank surveys

Figure A. Video imagery frame grabs from the drop-down video camera footage captured in 2007 with Distichoptilum gracile on medium to coarse sand.

Figure B. Video imagery frame grabs from the drop-down video camera footage captured in 2007 with Distichoptilum gracile on medium to coarse sand.

Figure C. Video imagery frame grabs from the drop-down video camera footage captured in 2009 with Funiculina quadrangularis on medium to coarse sand.

Figure D. Video imagery frame grabs from the drop-down video camera footage captured in 2009 with Pachycerianthus multiplicatus on medium to coarse sand.